STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

EARL WARREN, Governor

C. H. PURCELL, Director of Public Works

EDWARD HYATT, State Engineer

REPORT ON

WATERMASTER SERVICE

IN

SHASTA RIVER WATERMASTER SERVICE AREA
Siskiyou County, California

1946 SEASON

By

P. E. Stephenson
Associate Hydraulic Engineer

Sacramento, California

EDWARD HYATT, STATE ENGINEER
CHIEF OF DIVISION

EARL WARREN
GOVERNOR OF CALIFORNIA

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STATE OF CALIFORNIA

Department of Public Works

SACRAMENTO 5

DIVISION OF WATER RESOURCES
401 PUBLIC WORKS BUILDING

March 6, 1947

Mr. Gordon Zander,
Principal Hydraulic Engineer,
Sacramento, California.

Attention: Mr. Harrison Smitherum, Supervising Hydraulic Engineer.

Dear Sir:

Herewith is submitted the annual report covering watermaster service within the Shasta River Watermaster District, Siskiyou County, California, during the 1946 season.

The report presents a general description of the work and a discussion of the results obtained. Records of precipitation, run-off and other pertinent data are included.

Respectfully submitted,

P. E. Stephenson
Associate Hydraulic Engineer

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REPORT ON

WATERMASTER SERVICE

ON

SHASTA RIVER AND ITS TRIBUTARIES

SISKIYOU COUNTY, CALIFORNIA

1946 SEASON

INTRODUCTION

The Shasta River Watermaster Service Area was created by order of the Division of Water Resources under date of March 1, 1933, to embrace the water rights on Shasta River and its tributaries in Siskiyou County, California, excepting certain tributaries and springs named in said order, as established by Decree of the Superior Court, Siskiyou County, California, in the Shasta River Proceeding No. 7035, entered on December 30, 1932. Subsequent to creation of the district, the boundaries were changed to exclude the water rights on Willow Creek and its tributaries by order of the Division of Water Resources under date of December 30, 1935.

Watermaster service in the Shasta River Watermaster Service Area was carried on throughout the 1946 season in accordance with the "Distribution of Water" procedure contained in Sections 4000 to 4360, inclusive, of the Water Code. Such service extended over the period from April 1 to September 30. P. E. Stephenson, Watermaster, Shasta River Watermaster Service Area, administered the distribution of water from the streams within the district during the entire period.

WATER SUPPLY

Precipitation

Data on precipitation as compiled from records taken at Division of Water Resources Station at Edgewood, are presented in Table 1. This station was inactive during November, December and March of the 1945-46 season. The precipitation for the above months has been estimated by comparison with precipitation records at Montague and Mount Shasta. Snow Survey data taken at stations within and directly adjacent to the Shasta River water shed are presented in Table 2.

Based upon the data set forth in Table 1, the precipitation during the period October 1 to April 1 was about 95 per cent of the eleven year normal at this station. The precipitation for the remainder of the season was about 81 percent of normal. A large portion of the precipitation during the latter period fell during the last half of July.

Snow Surveys

A record of the water content of the snow at Parks Creek, Sweetwater, North Fork of Sacramento and Mount Shasta snow survey courses as measured on or about April 1 of each year is presented in Table 2. The Parks Creek and Sweetwater courses are within the Parks Creek watershed at elevations 6500 feet and 5500 feet, respectively. The North Fork of Sacramento course lies on the south slope of Eddy Mountain just outside the Shasta River watershed at 6800 feet elevation. The Mount Shasta course is on the south slope of Mount Shasta at 8000 feet elevation. The average water content of the snow at the four stations is considered representative of the snow pack on the Shasta River Watershed. The average water content for the 1946 season was 33.9 inches or about 103 per cent

of the mean for the 10 year period of record. The precipitation at Edgewood for the period October 1 to April 1 was about 95 per cent of the mean of record.

A curve has been developed for forecasting the run-off ~~cut~~ incidental to the melting snow of Shasta River, above the Edson-Foulke Yreka Ditch. The data shown in Table 2 has been used in the development of the curve along with the measured run-off at this station for the years shown in the table. The average period during which this run-off occurs varies with the water content of the April 1st snow pack as shown in the following tabulation:

Water-Content of Snow Inches	Period during which Run-off Occurs
Over 50	April 1 to July 31
30 to 40	April 1 to June 30
16 to 26	April 1 to May 31

There is insufficient data available at the present time to accurately determine these periods, however, in the future it may be possible to forecast not only the amount of run-off but also the approximate date of dissipation of the snow run-off.

Accurate forecasts of snow run-off made on April 1 are important in the operation of Lake Dwinnell Reservoir, which must be held at or below a specified water surface elevation during the run-off season as a safety measure in the protection of Lake Dwinnell Dam. Accurate forecasts of the date of dissipation of snow run-off will be important to the ranches diverting water for irrigation purposes from this portion of Shasta River.

A comparison of the measured run-off of Shasta River above the head of the Edson-Foulke Yreka Ditch with the estimated run-off obtained by applying the average water content of the snow on April 1 to the above memtioned curve is shown in the following tabulation:

Year	Average Water-Content of Snow Inches on April 1	Run-Off in Acre-Feet Measured	Run-Off in Acre-Feet Estimated from Curve
1937	32.3	12,100 **	11,900
1938	55.0	30,200 ***	30,200
1939	17.1	3,000 *	3,300
1940	33.1	12,600 **	12,500
1941	56.8	32,000 ***	31,800
1942	30.2	13,800 **	10,500
1943	25.7	7,100 *	7,600
1944	16.8	3,600 *	3,200
1945	26.7	9,000 **	8,700
1946	33.9	11,600 **	13,000

* April - May
** April - May - June
*** April - May - June - July

Stream Flow

Stream flow measuring stations equipped with water-stage recorders were maintained during the period of watermaster service from about April 1 to September 30 on Shasta River above the Edson-Foulke Yreka Ditch, at Edgewood Bridge and near Montague; on Parks Creek above Edson-Foulke Yreka Ditch and at the 8-foot weir above the Robertson Ranch, and on Little Shasta River above the Harp Ditch. The station on Shasta River at Edgewood Bridge was maintained by the Montague Water Conservation District during the winter

months. Records of discharge at the above stations are presented at the end of this report in Table 3 to 8, inclusive.

Intermittant measurements were taken on Carrick Spring and Cleland Springs, records of which are submitted in Tables 10 and 11, respectively.

Intermittant measurements were taken at Big Springs to determine the water available for the Big Springs Irrigation District.

A summary comparing the seasonal run-off of various streams and springs in Shasta Valley for the 1946 season with that of previous seasons is presented in Table 19 at the end of this report.

Distribution of Water

Distribution for the 1946 season followed the practices initiated during the past seasons with little modification. As a necessary adjunct to distribution twelve water-stage recorders were installed and operated throughout the season at critical points on streams and diversion conduits. These recorders were in addition to those mentioned heretofore and were located as follows:

Beaughan Creek below Long-Bell Mill Pond (2' Parshall Flume)

M.W.C.D. Parks Creek Canal at Head

Lake Dwinell Reservoir in Outlet Tower

Soule Ditch at Head (4' weir)

Dennis Ditch at Head (3' weir)

Jones #1 and #2 Take-outs from M.W.C.D. Shasta River Canal (4' weir)

M.W.C.D. Shasta River Canal

M.W.C.D. Shasta River Canal at Big Springs - Little Shasta Road

Carrick Creek at Head of Upper Jackson Ditch

Carrick Ditch at Head (2' Parshall Flume)

Big Springs Lake at B.S.I.D. Pumping Station

The resulting distribution in each of the several sections into which the stream system naturally divides from the standpoint of water supply follows:

Shasta River above Confluence of Boles Creek

The water supply available to this area is the summation of the flow of Shasta River above the Edson-Foulke Yreka Ditch, as set forth in Table 3, plus the combined discharge of the Dow Eddy Creek Ditch and the Hammond Scott Ditch diverting from Eddy Creek. During the 1946 season this

supply was sufficient to meet all irrigation demands until about June 30. Subsequent to that date there was insufficient water to meet the demands of the Edson-Foulke Yreka Ditch and those ditches diverting from Eddy Creek. A summary of the distribution for the 1946 season is set forth in the following tabulation:

	Average Available Water Supply Cu. Ft. Per. Sec.	Distribution in Per Cent of Priority Allotments		
		Hammond-Scott	Foulke, et al.	Dow
April	77	100	100	100
May	85	100	100	100
June	56	100	100	100
July	24	43	67	0
Aug.	11	33	28	0
Sept.	8	33	16	0

Shasta River Below Junction of Boles Creek and Boles Creek

During the 1946 season one hundred per cent allotments were available for all priorities including storage rights of Montague Water Conservation District until about June 26. Subsequent to this date the water was distributed on an equal and correlative basis among water right owners down to and including the Mills Ranch. Under this arrangement an average of 100 per cent allotments was delivered prior to August 1. During the period August 1 to September 15, an average of about 60 per cent of allotments was delivered to all ditches except the Alexander Ditch which received stock water only. Subsequent to September 15 and until the end of the irrigation season 100 per cent of allotments was available.

Shasta River below Lake Dwinnell Reservoir

Watermaster service on this section of the stream system involves

the operation of the Montague Water Conservation District's Lake Dwinell Reservoir during the irrigation season. The watermaster, in cooperation with the District, exercises control over deliveries from the reservoir both to the District and to the water right owners below the reservoir, who receives water from the reservoir in lieu of their natural flow rights.

Deliveries to the water right owners below the reservoir are made in accordance with the respective agreements between the District and the several water right owners. In general each agreement sets forth the total acre-feet to which the water right owner is entitled and provides that delivery from the reservoir shall be made upon demand of the water users. The watermaster receives and attends to all requests for such service and regulates the discharge from the reservoir and the various diversion ditches accordingly. Regulation of deliveries to the District is also handled by the watermaster; firstly, to avoid draining the reservoir through excessive delivery to the District before the "in lieu rights" are satisfied; and, secondly, to eliminate the confusion that would result under dual regulation.

Deliveries to the District commenced on April 2 and continued until about September 26. All demands of "in lieu rights" were satisfied and about 5400 acre-feet remained in storage on October 1.

Summaries of the operation of the reservoir during the 1946 season are set forth in the following tabulations:

Operation of Lake Dwinnell Reservoir During 1946 Season

Date	Storage: On Hand Acre-Ft.	Storage: Draft Acre Ft.	Inflow to Reservoir Acre Ft.	Total Draft Acre Ft.	Measured Release Acre-Ft.	Seepage and Evaporation Loss from Reservoir Acre-Feet
April 1	24,400					
May 1	24,400	0	4,500	4,500	1,970	2,530
June 1	24,000	400	5,300	5,700	1,680	4,020
July 1	18,600	5,400	1,800	7,200	2,680	4,520
Aug. 1	12,600	6,000	0	6,000	3,190	2,810
Sept. 1	8,000	4,600	0	4,600	2,890	1,710
Oct. 1	5,400	2,600	0	2,600	1,490	1,110
TOTALS		19,000	11,600	30,600	13,900	16,600

Deliveries to Prior Right Owners Below Reservoir-During 1946

Name of Water Right Owner	Allotment as per Agreement Acre-Feet	Amount Delivered From Lake Dwinnell Reservoir for 1946 Season: Acre-Feet	Per Cent of Allot
J. L. Jones	198	198	100
John Soule	692	484 *	70
Fred Dennis; K. K. Wter and Emily S. Waters	696	486 *	70
McKee Company	1200	1094	91
R. E. Richman, Fred Rebling and Orrin Brown	596	0	0

* Leakage from reservoir provided additional water sufficient to supply full irrigation demands.

Summaries of Deliveries from Lake Dwinnell Reservoir for 1946 Season

Month	Measured Release Acre-Feet	Deliveries in Acre-Feet: Prior Rights	M.W.C.D.	Wastage
April	1,970	184	1,786	
May	1,680	448	1,232	
June	2,680	463	2,217	
July	3,190	434	2,756	
August	2,890	338	2,552	
September	1,490	395	1,095	
TOTALS	13,900	2,262	11,638	

Additional data pertaining to Lake Dwinnell Reservoir are contained in Tables 11, 12, 13, 14, and 15.

Beaughan Creek

One measurement was made during the 1945 season at the 8.0 foot rectangular weir (Long-Bell Upper Weir) located at the head of Beaughan Creek. This water flowing over the weir was checked at intermittant intervals during the 1946 season. These measurements indicated that there had been no change in the flow of the spring since the measurement made in 1945. The results of the 1945 measurement are given below.

Date	Gage Height in Feet	Discharge in c.f.s.
7-15-45	0.37	5.92

This amount of water was sufficient to supply approximately 71 per cent of the total second priority allotments of 8.28 cubic feet per second. Distribution was made in accordance there with during the 1946 season. The Long-Bell Lumber Company diverts practically the entire flow of Beaughan Creek, including the downstream users' share of the available water, for use at its sawmill. After such use, the downstream users' share of the water, which is 65 per cent of the measured flow at Long-Bell Upper Weir, must be returned to Beaughan Creek above

the 2 foot Parshall Flume below the Long-Bell Mill Pond. Based upon the above measurement, the amount of water required at said Parshall Flume was 3.85 cubic feet per second. The daily discharge during the 1946 season was in excess of this amount at all times.

Carrick Creek

There was sufficient water available in Carrick Creek during the 1946 season to satisfy all irrigation requirements.

The results of intermittant measurements of Carrick Spring are set forth in Table 9.

Parks Creek

Distribution on Parks Creek for the 1946 season was in accordance with the practices followed during the past seasons. A summary of the distribution made during the 1946 season is set forth in the following tabulation:

	Measured Water Supply c.f.s.	Distribution in Per Cent of Priority Allotments			
		Duke 1	Caledonia 2	Foulke, et.al. 3	Robertson 4,6,11,15
April	57.5	100	100	100	100
May	70.5	100	100	100	100
June	27.5	100	100	100	63
July	9.8	100	100	26	29
August	4.8	80	8	0	12
Sept.	4.0	67	0	0	9

Records of the flow available for the above distribution are set forth in Tables 4 and 5.

The 21st and 24th priority rights of Frank H. Solus on the extreme lower end of Parks Creek received 100 per cent allotments throughout the season.

Big Springs

The water supply of Big Springs averaged about 35 cubic feet per second during April. The supply increased during the season and an average of about 44 cubic feet per second was available during July, August and September.

The Big Springs Irrigation District was supplied with irrigation water through its pumping plant during the entire 1946 season.

Fred Litchens operated his pumping plant nearly continuously from April 1 to September 30 during the 1946 season. The pump was operated at its full capacity of 7.5 cubic feet per second.

Ellis Louie received his full allotment of 10 cubic feet per second throughout the season.

Lower Shasta River

The water supply for this section of the stream was in excess of requirements at all times during the 1946 season. All ditches and pumping plants were operated with a minimum of regulation during the season.

A record of the flow available to the water users below the Montague Bridge is presented in Table 7. Records of diversion by the Grenada Irrigation District and the Shasta River water association are submitted in Tables 17 and 18, respectively. A summary of these data is set forth in the following tabulation.

Month	Average Diversion Grenada Irrigation District c.f.s.	Average Diversion Shasta River Water Association c.f.s.	Average Available Water Supply Fioch et.al. c.f.s.
April	29.5	30.2	113.8
May	28.6	31.8	47.5
June	20.6	23.8	54.1
July	20.1	31.9	31.3
Aug.	19.7	30.4	31.0
Sept.	23.7	31.8	58.4

Little Shasta River

Regulation was necessary on this stream beginning about June 1 when the available water supply was only sufficient to satsify the full requirements of the first five priority classes. Water was available for the higher priority classes during April and May.

The flow from Cleland Spring supplied enough supplementary flow to the natural flow of Little Shasta River to provide 100 per cent allotments throughout the season to the first four priority classes.

A summary of the distribution during the 1946 season is set forth in the following tabulation:

Month	Available Water Supply: Cubic Feet Per Second	Available Water Supply: Per Cent of Total Allotments	Distribution in Per Cent of Priority Allotments: 1	2	3	4	5	6	7
April	56.7	72	100	100	100	100	100	100	0
May	48.6	62	100	100	100	100	100	25	0
June	25.1	32	100	100	100	100	50	0	0
July	16.0	20	100	100	100	100	30	0	0
Aug.	13.3	17	100	100	100	100	20	0	0
Sept.	12.4	16	100	100	100	100	10	0	0

Intermittent measurements of the discharge of Cleland Spring are recorded in Table 10. The following tabulation was compiled from measurements made during the period 1935 to 1946, inclusive.

CLELAND SPRING

Year	Discharge - Cubic Feet Per Second		
	Beginning of Season	End of Season	Seasonal Mean
1935	6.81	6.62	6.65
1936	6.50	6.72	6.60
1937	6.50	6.78	6.65
1938	7.10	10.0	7.70
1939	8.77	8.25	8.44
1940	7.84	9.56	8.48
1941	8.39	9.04	8.60
1942	8.20	9.20	8.70
1943	10.50	11.10	10.80
1944	10.20	11.40	10.60
1945	8.8	8.9	9.1
1946	9.0	9.4	9.1

OWNERSHIP OF LANDS AND WATER RIGHTS WITHIN SHASTA RIVER WATERMASTER SERVICE AREA

Changes in Ownership

The changes in ownership of lands and water rights which have occurred subsequent to filing "Statement for Shasta River Watermaster Service Area, County of Siskiyou, State of California for 1946" and which shall be included in the statement for said watermaster service area for 1947 are listed in the following tabulation:

Tract No.	Name of Water Right Owner Appearing in 1946 Statement	Name of Water Right Owner to Appear in 1947 Statement	Amount of water c.f.s
5-78	Albee, Estate of Abbie C.	Albee, Ralph	2.269
5-84	Caldwell, Callie; Hoy, Nora, and Rucker, Leverne	Rucker, Leverne	3.62
5-63	Carrigan, Louis R.; Carrigan, Grace M.; and Van Norman, Maude	Robinson, Roscoe E. and Robinson, Katherine	4.80
5-60	Dennis, J. W. and Dennis, Mary L.	Waters, Kenneth King and Waters, Emily S.	2.16
5-35	Flock, Henry	Flock, Estate of Henry	4.99
5-59	Graves, Hubert	Dennis, Fred	0.64
5-14, 5-28, 5-47	Hart, Kate C.	Hart, Estate of Kate C.	14.79
5-86	Nickum, Dan and Nickum, Teresa	Lively, H. T. and Lively, Vera	2.50
5-112	Peabody, R. E. and Peabody, Anna E.	Buranek, Joseph and Buranek, Ida	5.75
5-54	Edward Stallcup and Sons Co., a corporation	Litchens, Fred and Litchens, Effie	7.50
5-65	Scott, J. Robert	Scott, J. Robert	0.95
5-65	Scott, J. Robert	Sasso, Michael and Sasso, Myrtle	4.05

TABLE 1

PRECIPITATION AT EDGEWOOD - ELEVATION 3952

Monthly, Seasonal, and Average Amounts in Inches

1934 - 1946

Season	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Seasonal
1934-35	1.30	3.53	1.08	1.65	1.15	2.62	2.58	0.43	0.57	0.38	0.06	0.21	15.56
1935-36	.81	.82	1.51	3.15	1.65	1.22	1.08	1.04	.45	.15	.00	.13	12.01
1936-37	.00	.00	.41	1.90	1.28	3.53	.86	1.06	1.27	.00	.00	.33	10.64
1937-38	1.52	3.49	4.24	3.47	5.45	5.16	.96	.89	.35	.08	.00	.60	26.21
1938-39	1.31	1.79	.44	1.17	.53	1.79	.56	.37	.51	.55	.37	1.27	10.62
1939-40	1.27	.38	5.77	2.45	5.37	3.12	.92	.91	.68	.01	T	2.61	23.49
1940-41	2.61	.64	9.30	2.25	7.86	6.36	4.51	1.55	1.42	.29	.78	.07	37.64
1941-42	1.87	1.42	4.69	3.83	3.01	.58	3.09	2.53	.61	.00	.90	.00	22.53
1942-43	.70	3.17	2.29	3.92	1.74	1.78	1.71	0.20	1.02	.09	.00	.03	16.65
1943-44	2.31	1.25	.85	.61	.66	.00	1.79	1.37	.91	.85	.33	.00	10.93
1944-45	.97	2.91	.81	.94	3.60	E 1.60	E .80	2.51	.34	.00	.00	.00	14.48
1945-46	2.43	2.90 E	4.50 E	1.26	.54	1.30 E	.09	.37	.98	1.82	.00	.34	16.53
Totals	17.10	22.26	35.89	26.60	32.84	29.06	18.94	13.23	9.11	4.22	2.44	5.59	217.29
12 Year Mean	1.42	1.86	2.99	2.22	2.74	2.42	1.58	1.10	.76	.35	.20	.47	18.16

TABLE 2

Snow Survey Data

Year	Water Content of Snow as of April 1 - Inches				
	Parks Creek Elevation-6,500	Sweetwater Elevation-5,500	Mt. Shasta Elevation-8,000	N. Fk. Sacramento Elevation-6,800	Average
1936	36.8	16.5	39.4	21.6	
1937	31.8	18.4	43.4	35.5	32.3
1938	33.3	27.0	120.4	39.1	55.0
1939	24.8	10.5	23.3	9.9	17.1
1940	36.3	6.3	67.4	22.2	33.1
1941	54.6	18.8	108.6	45.3	56.8
1942	33.1	12.7	52.7	22.5	30.2
1943	34.2	11.8	41.5	15.4	25.7
1944	18.2	7.7	28.6	12.6	16.8
1945	29.3	10.9	46.7	19.9	26.7
1946	42.8	14.2	53.4	25.4	33.9
10 Year Mean	33.8	13.8	58.6	24.8	32.8

TABLE 3

Daily Discharge in Cubic Feet per Second

SHASTA RIVER ABOVE EDSON-FOULKE YREKA DITCH

April 1 to September 30, 1946

Day	Apr.	May	June	July	Aug.	Sept.
1	52	78	61	29	15	5
2	52	82	67	30	14	5
3	52	90	70	26	14	5
4	52	95	68	26	13	5
5	52	92	62	25	11	5
6	52	89	58	24	11	5
7	51	89	54	22	11	5
8	51	84	51	22	10	5
9	46	84	48	21	10	5
10	43	84	46	20	8	5
11	43	84	45	20	8	5
12	44	82	44	19	8	5
13	51	80	44	19	8	5
14	52	75	44	18	8	5
15	63	73	51	17	8	5
16	80	74	54	17	8	5
17	95	78	44	16	7	5
18	97	84	44	15	6	4
19	91	84	44	15	6	4
20	82	82	46	14	6	4
21	75	82	47	14	6	4
22	72	73	48	14	6	4
23	72	66	49	15	5	4
24	84	58	44	16	5	4
25	97	61	40	20	5	4
26	97	66	35	27	5	4
27	87	62	29	20	5	4
28	83	60	29	15	5	4
29	83	57	29	16	5	4
30	78	56	29	17	5	4
31		60		16	5	
Tot. Sec. Ft. Days	2029	2364	1424	605	247	137
Mean Sec. Feet	67.6	76.4	47.5	19.5	8.0	4.7
Total Acre Feet	4030	4690	2820	1200	490	270

Total Acre Feet for 183 day period - 13500.

TABLE 4
Daily Discharge in Cubic Feet per Second
PARKS CREEK ABOVE DUKE NORTH DITCH
April 1 to September 30, 1946

Day	Apr.	May	June	July	August	Sept.
1	31	80	49	13	7	4
2	29	84	52	12	7	4
3	27	94	49	12	7	4
4	25	94	45	12	6	4
5	26	88	43	11	6	4
6	27	83	38	11	6	4
7	28	83	34	11	6	4
8	27	80	31	10	6	4
9	26	80	30	10	5	4
10	26	83	25	10	5	4
11	27	79	24	10	5	4
12	33	78	23	10	5	4
13	40	73	22	10	5	4
14	43	66	22	10	5	4
15	58	66	25	10	5	4
16	79	68	41	10	4	4
17	98	75	29	10	4	4
18	98	78	21	9	4	4
19	93	73	21	9	4	4
20	84	73	21	9	4	4
21	74	73	21	9	4	4
22	69	69	20	9	4	4
23	78	66	20	9	4	4
24	93	62	20	9	4	4
25	111	59	19	9	4	4
26	104	57	18	9	4	4
27	90	52	17	8	4	4
28	90	43	16	8	4	4
29	88	42	15	8	4	4
30	78	41	14	8	4	4
31		44		8	4	
Tot. Sec. Ft. Days	1726	2186	825	303	150	120
Mean Sec. Feet	57.5	70.5	27.5	9.8	4.8	4.0
Total Acre Feet	3420	4340	1640	600	300	240

Total Acre-Feet for 183 day period - 10,540

TABLE 5

Daily Discharge in Cubic Feet per Second

PARKS CREEK AT ROBERTSON WEIR

June 1 to September 30, 1946

Day	Apr.	May	June	July	August	Sept.
1			16.0	5.3	4.4	0.5
2			16.0	4.9	3.4	0.5
3			16.0	4.4	3.3	0.5
4			16.0	4.1	3.3	1.6
5			12.6	3.7	2.6	1.6
6			11.4	3.9	3.1	1.9
7			10.3	7.1	3.1	1.9
8			9.2	5.9	2.7	1.9
9			8.4	5.9	3.3	2.4
10			7.9	5.2	2.4	.9
11			7.9	4.1	1.7	.9
12			10.8	3.7	1.6	.9
13			9.7	3.5	1.6	1.6
14			7.1	3.3	1.6	1.6
15	Surplus	Surplus	7.1	3.1	1.3	1.7
16			16.0	3.9	1.3	1.9
17			13.5	3.7	1.3	1.9
18			12.0	3.7	1.6	1.6
19			8.6	2.7	1.9	1.6
20			7.6	2.6	1.9	1.4
21			7.1	2.4	1.6	1.4
22			8.6	2.4	1.6	1.4
23			10.0	2.4	1.6	1.4
24			12.0	3.5	1.4	1.3
25			8.9	3.3	1.3	1.1
26			7.9	9.1	1.3	1.1
27			7.3	8.6	1.3	1.1
28			6.6	5.9	1.3	1.1
29			6.1	6.6	0.9	1.1
30			5.9	6.6	0.5	1.1
31				6.1	0.5	
Tot. Sec. Ft. Days			304.5	141.6	60.7	40.9
Mean Sec. Feet			10.1	4.6	2.0	1.4
Total Acre Feet			604	281	120	81

Total Acre-Feet 122 day period - 1,086

TABLE 6

Daily Discharge in Cubic Feet Per Second
SHASTA RIVER AT EDGEWOOD BRIDGE
October 1, 1945 to September 30, 1946

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7	65	92	23	50	65	66	88	54	11	10	7
2	6	80	105	168	50	60	66	94	55	11	8	7
3	6	80	115	134	48	57	66	111	60	11	7	7
4	10	52	180	168	48	54	68	125	60	11	6	11
5	12	42	134	119	46	55	66	111	52	11	4	10
6	14	40	115	91	44	55	66	105	48	11	4	11
7	15	40	101	80	47	57	66	105	42	10	4	11
8	15	40	74	74	45	57	66	101	35	10	4	10
9	16	40	60	67	45	62	65	95	32	10	4	10
10	16	44	59	67	44	66	58	98	31	10	5	10
11	16	35	52	67	43	65	54	95	25	10	6	9
12	15	37	45	62	39	72	55	94	23	10	7	8
13	15	28	42	60	39	78	61	91	20	10	8	8
14	16	45	40	57	42	67	68	82	18	10	8	7
15	16	86	40	56	42	60	68	82	23	11	7	7
16	16	65	40	55	48	56	67	83	46	12	7	10
17	16	55	37	54	51	57	80	88	26	10	7	11
18	16	55	33	52	52	60	92	98	25	10	7	10
19	16	119	32	54	55	60	78	95	23	8	7	11
20	16	77	37	54	51	61	66	95	23	7	7	11
21	16	57	269	52	80	60	58	111	22	6	6	10
22	16	52	465	53	56	60	54	87	24	4	5	10
23	16	62	255	57	53	54	67	81	24	10	6	10
24	16	62	180	80	61	53	119	66	25	10	6	11
25	16	61	145	70	60	48	147	62	22	10	6	11
26	16	68	156	50	55	51	119	74	18	20	6	10
27	16	80	310	50	91	62	101	72	14	13	5	10
28	16	80	465	50	72	108	101	62	13	10	5	10
29	16	80	365	50		100	87	52	12	10	5	10
30	60	80	168	50		80	87	48	11	10	6	10
31	60		119	50		74		50		10	6	
Total	539	1807	4530	2244	1462	1974	2282	2701	906	317	189	288
Mean	17.4	60.0	139.5	72.5	52.2	63.6	76.1	87.1	30.2	10.2	6.1	9.6
Ac. Feet	1070	3580	8590	4450	2900	3920	4530	5360	1800	630	370	570

Total Acre-Feet 37,770

TABLE 7

Daily Discharge in Cubic Feet per Second

Shasta River Near Montague

April 1 to September 30, 1946

Day	Apr.	May	June	July	Aug.	Sept.
1	150	56	75	39	64	20
2	146	56	75	33	69	30
3	144	55	80	33	69	32
4	150	52	62	38	53	32
5	154	50	69	36	47	32
6	162	44	98	34	44	32
7	150	44	94	40	38	32
8	126	38	62	47	28	32
9	126	39	56	50	25	32
10	126	33	55	29	23	31
11	126	31	38	26	21	31
12	126	28	34	26	21	46
13	124	32	32	26	18	61
14	120	37	32	26	21	56
15	144	37	42	26	25	55
16	150	34	82	25	29	56
17	146	37	89	23	21	56
18	150	36	69	20	16	58
19	150	37	46	19	18	59
20	136	43	38	18	20	65
21	120	69	32	19	21	59
22	100	65	47	28	26	59
23	75	72	28	24	30	59
24	75	53	32	24	24	93
25	67	49	34	29	25	117
26	59	47	39	32	26	117
27	59	56	47	31	28	107
28	59	56	53	23	30	103
29	59	53	44	20	26	96
30	59	56	39	64	30	93
31		75		64	25	
Tot. Sec. Ft. Days	3414	1470	1623	972	961	1751
Mean Sec. Feet	113.8	47.5	54.1	31.3	21.0	58.4
Total Acre Feet	6770	2920	3220	1930	1910	3470

Total Acre Feet for 183 day period - 20,220.

TABLE 8

Daily Discharge in Cubic Feet per Second

LITTLE SHASTA RIVER ABOVE HARP DITCH

April 1 to September 30, 1946

Day	April	May	June	July	Aug.	September
1	20	52	26	10	5	3
2	22	62	24	10	5	3
3	24	51	24	10	5	3
4	25	50	23	9	5	3
5	26	48	22	9	5	3
6	28	47	22	9	5	3
7	30	46	21	9	5	3
8	34	46	13	8	5	3
9	37	45	13	7	4	3
10	29	42	18	7	4	3
11	33	42	18	7	4	3
12	40	42	18	7	4	3
13	43	42	17	7	4	3
14	46	42	17	7	4	3
15	58	42	16	7	4	3
16	66	40	16	7	4	3
17	72	38	15	6	4	3
18	76	38	14	6	4	3
19	77	37	13	6	4	3
20	65	33	13	6	4	3
21	58	33	13	6	4	3
22	58	33	13	6	4	3
23	58	33	12	6	3	3
24	66	33	13	6	3	3
25	66	33	12	6	3	3
26	66	33	12	6	3	3
27	59	33	11	6	3	3
28	58	31	11	5	3	3
29	50	29	11	5	3	3
30	42	27	10	5	3	3
31		26		5	3	
Tot. Sec. Ft. Days	1432	1229	481	216	123	90
Mean Sec. Feet	47.7	39.6	16.0	7.0	4.0	3.0
Tot. Acre Feet	2840	2440	950	430	240	180

Total Acre-Feet for 183 day period - 7,080

TABLE 9

Discharge in Cubic Feet Per Second

CARRICK SPRING

April 1 to September 30, 1946

Day	April	May	June	July	August	Sept.
1						
2						
3		6.9			7.0	
4	7.3					
5						
6				6.9		6.9
7						
8			7.0			
9						
10						
11						
12						
13						
14		7.0				
15	6.9					
16						
17						
18						
19						
20					7.0	
21						
22						
23				7.0		
24			7.0			
25						
26						
27	6.9					6.9
28						
29		6.9				
30						
31						
Mean Sec. Feet	7.0	6.9	7.0	7.0	7.0	6.9
Total Acre Ft.	420	420	420	430	430	410

Total Acre-Feet 183 day period - 2,530

TABLE 10

Discharge in Cubic Feet Per Second

CLELAND SPRING

April 1 to September 30, 1946

Day	April	May	June	July	August	Sept.
1				8.7		
2						
3		9.0				
4						
5						9.3
6			9.1			
7						
8						
9						
10						
11						
12						
13						
14						
15					9.4	
16						
17	9.0					
18						
19						
20					9.2	
21						
22						
23						
24						
25			9.1			
26						
27		9.0				9.4
28						
29				9.3		
30						
31						
Mean Sec. Feet	9.0	9.0	9.1	9.0	9.3	9.4
Tot. Acre Feet	530	550	540	550	570	560

Total Acre-Feet for 183 day period - 3,300

TABLE 11

Daily Discharge in Cubic Feet Per Second

M.W.C.D. PARKS CREEK CANAL AT HEAD

April 23 to June 11, 1946

Day	April	May	June
1		25	8
2		25	5
3		35	5
4		45	5
5		35	5
6		35	5
7		35	3
8		30	1
9		25	1
10		25	1
11		25	1
12		25	
13		25	
14		25	
15		20	
16		20	
17		30	
18		30	
19		25	
20		25	
21		25	
22		25	
23	17	25	
24	50	25	
25	70	25	
26	40	25	
27	30	25	
28	30	15	
29	25	10	
30	25	10	
31		8	
Total Sec.Ft. Days	317	783	40
Mean Sec.Ft.	39.6	25.3	3.6
Total Acre Feet	630	1550	80

Total Acre-Feet for 50 day period - 2,260

TABLE 12

Daily Storage on Hand in Acre-Feet

LAKE DWINNELL RESERVOIR

April 1 to September 30, 1946

Day	April	May	June	July	August	September
1	24,400	24,400	24,000	18,600	12,600	8,000
2	24,400	24,400	23,800	18,400	12,400	7,700
3	24,400	24,400	23,600	18,200	12,200	7,500
4	24,400	24,500	23,400	18,000	12,100	7,400
5	24,400	24,500	23,200	17,800	12,000	7,300
6	24,400	24,500	22,900	17,500	11,900	7,200
7	24,400	24,500	22,600	17,200	11,700	7,100
8	24,400	24,600	22,400	16,900	11,500	7,000
9	24,400	24,600	22,200	16,800	11,400	6,900
10	24,400	24,600	22,000	16,600	11,300	6,800
11	24,400	24,600	21,900	16,500	11,200	6,700
12	24,400	24,700	21,800	16,500	11,200	6,600
13	24,400	24,700	21,700	16,200	11,000	6,500
14	24,400	24,800	21,600	15,900	10,900	6,500
15	24,400	24,800	21,500	15,600	10,700	6,400
16	24,400	24,900	21,300	15,400	10,500	6,300
17	24,400	24,900	21,200	15,200	10,200	6,200
18	24,400	25,000	20,900	15,000	10,100	6,200
19	24,400	25,000	20,700	14,800	10,000	6,100
20	24,400	25,100	20,500	14,600	9,900	6,000
21	24,400	25,000	20,300	14,300	9,700	5,900
22	24,400	24,900	20,200	14,100	9,400	5,800
23	24,300	24,900	20,000	14,000	9,300	5,700
24	24,200	24,800	19,900	13,900	9,100	5,600
25	24,200	24,800	19,700	13,800	9,000	5,600
26	24,200	24,700	19,500	13,700	8,800	5,600
27	24,300	24,600	19,400	13,500	8,700	5,600
28	24,300	24,500	19,200	13,400	8,500	5,500
29	24,300	24,400	19,000	13,200	8,300	5,500
30	24,300	24,300	18,800	13,000	8,200	5,400
31		24,200		12,800		

TABLE 13

Daily Release in Cubic Feet per Second

LAKE DWINNELL RESERVOIR

April 2, 1945 to September 30, 1946

Day	April	May	June	July	Aug.	Sept.
1		50	54	50	40	51
2	13	50	54	50	40	46
3	26	52	54	50	44	41
4	26	55	54	50	44	33
5	26	35	54	52	47	26
6	26	2	54	54	50	26
7	26	2	54	54	50	26
8	26	5	54	57	50	26
9	26	7	54	59	25	26
10	26	7	56	59	0	26
11	26	7	40	59	0	26
12	26	7	18	59	23	26
13	26	8	59	59	46	26
14	26	8	54	59	46	26
15	26	8	50	58	50	26
16	26	8	50	58	55	26
17	26	8	38	57	57	26
18	26	8	27	57	60	28
19	33	8	30	56	62	30
20	40	11	33	56	64	30
21	40	27	33	55	64	30
22	40	40	33	50	61	30
23	40	40	33	45	55	30
24	47	45	37	45	53	30
25	55	50	40	48	53	25
26	55	50	40	50	53	10
27	55	50	45	50	53	0
28	55	50	50	50	53	4
29	52	50	50	50	52	4
30	50	50	50	50	52	4
31		52		47	52	
Total Sec. Ft. Days	991	850	135.2	160.5	145.4	76.4
Total Ac.Ft.	1970	1680	2680	3190	2890	1490

Total Acre-Feet for 182 day period - 13,900

TABLE 14

Summary of Deliveries to Prior Right Owners From
LAKE DWINNELL RESERVOIR
1929 to 1946

Year	Deliveries in Acre-Feet						Deliveries in per cent of Allotment
	Jones	Soule	Dennis	McKee	Terwilliger *	Total	
1929							
1930	190	485	465	923		2060	61
1931	198	473	473	909		2050	61
1932							
1933	198	692	687	1130	101	2210	83
1934	159	692	461	922	159	2390	71
1935	198	609	600	1075	234	2720	80
1936	198	637	527	1195	202	2759	82
1937	198	633	489	1200	120	2690	80
1938	198			1073		1271	38
1939	198	692	687	1138	308	3023	90
1940	198	471	562	1105	0	2336	69
1941	198	561	631	1200	51	2641	76
1942	198	344	618	1200	0	2360	70
1943	198	509	443	1200	0	2350	70
1944	198	692	460	1200	0	2550	76
1945	198	591	387	1050	0	2220	65
1946	198	484	486	1094	0	2262	67

1929 - Record of deliveries missing.
1930---1931 Record of deliveries to Terwilliger missing.
1932 Records missing.
1938 Soule, Dennis and Terwilliger had sufficient water from reservoir seepage to supply irrigation demands.
1940--1941)
1942--1943) Reservoir seepage supplied additional water for
1944--1945--1946) Soule, Dennis and Terwilliger.

*Accretions to the flow of Shasta River through the Dennis Ranch provide additional water, which is available for diversion by E.S. Terwilliger, in amounts more than sufficient to make up the shortage in the amounts of water deliveried from the reservoir.

TABLE 15

RECORD OF OPERATION OF LAKE DWINNELL RESERVOIR - 1929 to 1946

Year	Reservoir Storage On April 1 Ac. Ft.	Inflow Apr.1 to Sept.30 Ac. Ft.	Total Available Water Supply Ac.Ft.	Maximum Storage in Reservoir Ac. Ft.	Maximum Storage in Reservoir Date	Delivery from Reservoir: M.W.C.D. Ac. Ft.	M.W.C.D. Period	Prior Rights Ac. Ft.	Prior Rights Period	Total Ac.Ft.	Storage In Res. When Delivery to MWCD Ceased Ac. Ft.	Seepage and Evaporation Loss Ac. Ft.
1929				4,500		No Rcrd		No Rcrd				
1930				10,500	Mar. 14	5,000	5/5/30-7/4/30	2,060	4/23/30-9/5/30	7,060	2,800	
1931				4,250	Apr. 4	0		2,050	4/1/31-7/25/31	2,050	2,800	
1932	5,500			5,500	Mar. 20	2,000	5/15/32-6/15/32	No Rcrd		2,000	2,000	
1933	5,200			6,500	May 3	4,750	4/21/33-7/16/33	2,810	4/10/33-9/3/33	7,560	2,200	
1934	4,850			5,000	April 5	1,500	4/10/34-4/23/34	2,390	4/5/34-7/22/34	3,890	2,800	
1935	5,000	4,620	9,620	5,700	May 10	2,700	5/10/34-6/2/35	2,720	4/9/35-8/11/35	5,420	3,000	4,200
1936	5,460	4,720	10,180	6,020	March 3	1,560	4/14/36-5/20/36	2,760	4/14/36-8/11/36	4,320	3,250	5,860
1937	5,940	14,040	19,980	9,800	May 6	7,360	5/5/37-9/15/37	2,690	4/26/37-9/9/37	10,050	0	9,930
1938	31,600	28,440	60,040	32,100	May 3	23,910b	5/1/38-9/30/38	1,270	5/1/38-9/30/38	25,180	2,850	32,010
1939	7,350	1,210	8,560	7,350	April 1	2,350	4/9/39-5/5/39	3,020	4/4/39-8/10/39	5,370	3,525	3,190
1940	27,350	18,000	45,350	28,000	April 6	18,570c	4/22/40-9/18/40	2,340	4/17/40-9/30/40	20,900	2,540	22,040
1941	31,680	48,060	79,740	34,400	April 4	36,490d	4/1/41-9/30/41	2,640	5/1/41-9/30/41	39,130	13,600	27,010
1942	25,700	20,600	46,300	29,100	June 6	12,940e	4/13/42-9/30/42	2,360	4/13/42-9/30/42	15,300	10,000	21,000
1943	33,100	12,880	45,980	33,400	April 5	19,770f	4/13/43-9/30/43	2,350	4/15/43-9/30/43	22,120	4,900	18,960
1944	14,200	5,370	19,570	14,200	April 1	9,030	4/17/44-9/30/44	2,550	4/17/44-9/30/44	11,580	90	7,900
1945	17,550	12,450	30,000	18,600	June 11	9,840	4/13/45-9/30/45	2,220	4/13/45-9/30/45	12,060	2,500	15,400
1946	24,400	11,600	36,000	25,100	May 20	11,640	4/2/46-9/30/46	2,260	4/19/46-9/30/46	13,900	5,400	16,600

TABLE 15 (Cont'd.

RECORD OF OPERATION OF LAKE DWINNELL RESERVOIR -- 1929 to 1946

(a) In 1929 the District used water only for puddling its canal.

(b) Includes 831 acre-feet wasted through outlet to prevent increase in reservoir level and 9980 acre-feet delivered by District to Stallcup and Big Springs Irrigation District.

(c) Includes 2710 acre-feet wasted in April to maintain reservoir level and deliveries through the entire season to Big Springs Irrigation District.

(d) Includes 21,600 acre-feet wasted in April and May through outlet to prevent increase in reservoir level and 5,970 acre-feet delivered to Big Springs Irrigation District.

(e) Includes 3,390 acre-feet delivered to Big Springs Irrigation District.

(f) Includes 10,000 acre-feet wasted in April through outlet to maintain safe water-surface elevation in reservoir.

TABLE 16

Daily Discharge in Cubic Feet per Second
BIG SPRINGS IRRIGATION DISTRICT
April 1 to September 30, 1946

Day	April	May	June	July	Aug.	Sept.
1		17	23	25	25	25
2		19	23	25	25	25
3		19	23	25	25	25
4		19	23	25	25	25
5		19	23	25	25	25
6		19	23	25	25	25
7	12	19	23	25	25	25
8	17	19	23	25	25	25
9	17	19	24	25	25	25
10	17	19	24	25	25	25
11	17	19	24	25	25	25
12	17	19	24	25	25	25
13	17	19	24	25	25	25
14	17	19	24	25	25	25
15	17	20	24	25	25	25
16	17	20	24	25	25	25
17	17	20	24	25	25	25
18	17	20	24	25	25	25
19	17	20	24	25	25	25
20	17	20	24	25	25	25
21	17	20	24	25	25	25
22	17	20	24	25	25	25
23	17	20	24	25	25	25
24	17	22	24	25	25	25
25	17	22	25	25	25	25
26	17	23	25	25	25	25
27	17	23	25	25	25	25
28	17	23	25	25	25	25
29	17	23	25	25	25	25
30	17	23	25	25	25	25
31		23		25	25	
Total Sec. Ft. Days	403	626	718	775	775	750
Mean Sec. Ft.	17.0	20.2	23.9	25.0	25.0	25.0
Tot. Acre Feet	800	1,240	1,420	1,540	1,540	1,490

Total Acre-Feet 177 day period - 8,030

TABLE 17
Discharge in Cubic Feet per Second
GRENDA IRRIGATION DISTRICT PUMPING PLANT
April 17 to September 12, 1946

Day	April	May	June	July	Aug.	Sept.	October
1		32	0	22	0	34	
2		32	0	22	0	34	
3		32	0	18	0	27	
4		33	0	0	0	24	
5		33	0	0	0	29	
6		33	0	0	0	22	
7		33	0	0	0	22	
8		33	0	11	32	22	
9		33	0	25	34	22	
10		33	11	34	34	22	
11		32	28	34	34	20	
12		32	33	34	34	6	
13		32	33	34	34	0	
14		32	32	34	34		
15		32	33	18	34		
16		32	33	34	34		
17	11	32	33	34	34		
18	17	31	33	34	34		
19	28	32	32	34	28		
20	32	32	33	18	22		
21	32	32	33	22	17		
22	32	33	32	17	17		
23	32	33	32	22	17		
24	33	33	33	18	17		
25	33	27	33	0	17		
26	32	22	33	0	17		
27	32	22	21	17	17		
28	33	19	22	22	17		
29	33	13	22	22	17		
30	33	5	22	20	17		
31		0		23	21		
Tot. Sec. Ft. Days	413	885	618	623	613	284	
Mean Sec. Ft.	29.5	28.6	20.6	20.1	19.7	23.7	
Tot. Acre-Ft.	820	1,760	1,220	1,240	1,220	560	

Total acre-feet 149 day period - 6,820

TABLE 18
Daily Discharge in Cubic Feet Per Second
SHASTA RIVER WATER ASSOCIATION PUMPING PLANT
March 27 to September 24, 1946

Day	March	April	May	June	July	August	September
1		31	32	27	32	32	32
2		31	32	20	32	26	32
3		31	32	20	32	20	32
4		31	32	20	32	20	32
5		31	32	14	32	29	32
6		31	32	0	32	32	32
7		31	32	0	32	32	32
8		31	32	13	32	32	32
9		31	32	32	32	32	32
10		31	32	32	32	32	32
11		31	32	32	32	32	32
12		31	32	32	32	32	32
13		31	32	32	32	32	32
14		31	32	32	32	32	32
15		13	32	20	32	32	32
16		10	32	0	32	32	32
17		32	32	0	32	32	32
18		32	32	24	32	32	32
19		32	32	32	32	32	32
20		32	32	32	32	32	32
21		32	24	22	32	32	32
22		32	32	22	32	32	32
23		32	32	32	32	32	32
24		32	32	32	32	32	29
25		32	32	32	27	27	
26		32	32	32	22	22	
27	3	32	32	32	32	32	
28	31	32	32	32	32	32	
29	31	32	32	32	32	32	
30	31	32	32	32	32	32	
31	31		32		32	32	
Tot. Sec. Ft. Days	127	905	984	714	987	944	765
Mean Sec. Feet	25.4	30.2	31.8	23.8	31.9	30.4	31.8
Total Acre Feet	250	1,800	1,950	1,420	1,960	1,870	1,520

Total acre-feet for 181 day period 10,770

TABLE 19

Summary of Run-off in Acre-Feet
of Streams in Shasta Valley
For the Period April 1 to October 1, 1946

Name of Stream	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946
Shasta River Above Yreka Ditch	4,420	8,510	7,440	13,600	* 19,100	4,090	14,800	33,300	* 13,800	*** 10,900	6,500	11,000	13,500
Parks Creek Above Duke North Ditch	2,550	6,100	6,560	11,000	* 14,400	4,490	16,000	18,100	* 9,880	*** 8,800	5,670	9,720	10,540
Little Shasta River above Harp Ditch	850	5,630	6,520	5,680	** 6,060	3,270	4,160	4,480	* 5,570	*** 10,500	2,840	6,100	7,080
Beaughan Spring	2,020	1,960	1,860	1,820	1,950	1,810	1,810	2,200	2,140	2,100	2,150	2,450	2,450
Big Spring	12,400	12,200	12,100	12,100	----	12,100	----	----	** ** 15,600	14,800	14,500	14,400	14,600
Carrick Spring	2,090	2,090	2,050	2,020	2,110	2,000	2,070	2,700	2,700	2,530	2,450	2,540	2,530
Cleland Spring	2,400	2,420	2,400	2,410	2,790	3,060	3,070	3,170	3,160	3,820	3,840	3,290	3,300

* Does not include April Run-off ** May 14 to September 30, inclusive *** April Partly estimated
**** Estimated from measurements made during July, August and September