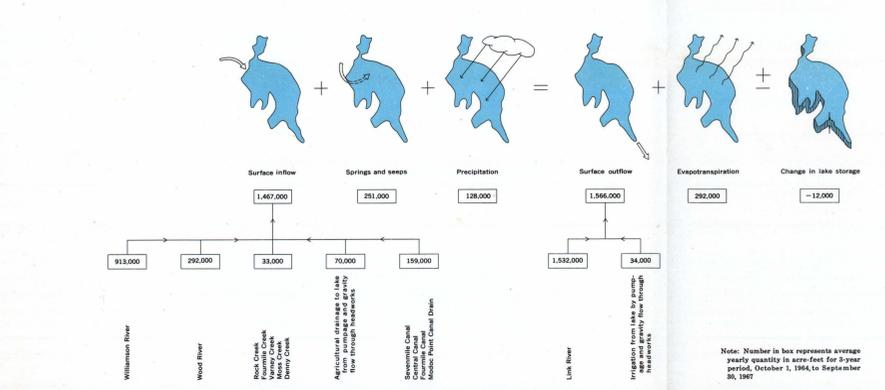


INTRODUCTION
This atlas presents a quantitative water budget for Upper Klamath Lake. It includes an inventory of water entering and leaving the lake and changes in lake storage for the 3-year period October 1, 1964, to September 30, 1967. The basic premise of the budget is that the total inflow equals the total outflow plus or minus the change in lake contents, as shown in the water-budget-equation illustration. The lake bottom, shoreline, and water surface form the boundaries of the budget system.

The basic data in this report were originally compiled by the U.S. Geological Survey as monthly quantitative water budgets. These compilations were furnished monthly to the Federal Water Pollution Control Administration to provide data for determining the sources of nutrients that contribute to the growth of benthic algae in the lake during the summer (Miller and Tash, 1967). These monthly figures, with some minor updating, are shown in the table of inflow, outflow, and changes in lake storage. This report summarizes the results of the original U.S. Geological Survey study and should be useful in research studies or in water management of Upper Klamath Lake.

GENERAL DESCRIPTION
Upper Klamath Lake, just east of the Cascade Range and about 17 miles north of the California State line, has a drainage area of 3,810 square miles and is the largest lake in Oregon. It is about 22 miles long, with about 165 miles of shoreline and a mean depth of about 8 feet. Depths reach 40 to 50 feet in a narrow strip of the lake between Eagle Ridge and Bare Island. During the study period the lake-surface area ranged from 104 to 143 square miles, of which 0 to 39 square miles was submerged marsh area. Some of the original lake-bed has been reclaimed for agricultural use by diking. For the purpose of this report, Agency Lake, connected by a narrow channel at the north end of Upper Klamath Lake, is considered to be a part of Upper Klamath Lake. (See map showing location of hydrologic-data sites.)

The lake lies on a plateau formed by lava and unconsolidated volcanic materials. Parts of the east and west sides of the lake are precipitous fault scarps which may extend beneath the lake in places.

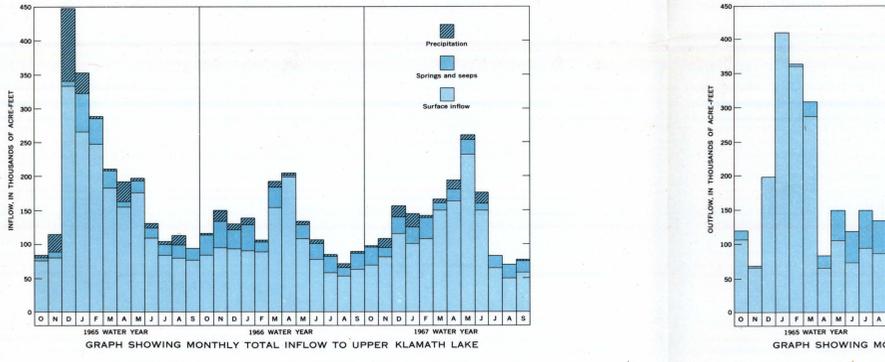


WATER-BUDGET EQUATION
The magnitude of surface inflow by individual streams and canals is shown by the graphs adjacent to the map showing the location of hydrologic-data sites.

Data furnished by the Federal Water Pollution Control Administration indicated that agricultural drainage contributed 4 percent of the total inflow. This part of the inflow included (1) waste water that ponded on the land and was pumped into the lake, and (2) waste water that drained into the lake by gravity flow through drainage structures.

Inflow from springs and seeps.—On the eastern slopes of the Cascade Range, infiltration of water into permeable volcanic rocks in the upper parts of the drainage basins provides water for many springs and seeps in the lower parts of the basins (California Dept. Water Resources, 1964). Springs are the major sources of flows in the Wood and Williamson Rivers. For the purpose of this report, only those springs and seeps that occur at the edge or below the surface of the lake (within the boundaries of the budget system) are considered as springs and seeps in the budget. Inflow from springs and seeps amounted to 14 percent of the total.

Inflow from precipitation.—Precipitation falling directly on the lake provided 7 percent of the total inflow.



TABULATION OF MONTHLY INFLOW, OUTFLOW, AND CHANGE IN LAKE STORAGE IN ACRE-FEET FOR UPPER KLAMATH LAKE, OREGON, FOR THE PERIOD OCTOBER 1, 1964, TO SEPTEMBER 30, 1967

	1965 WATER YEAR												Water year total	1966 WATER YEAR												Water year total	1967 WATER YEAR												Water year total			
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept				
Williamson River near Chiloquin ¹	38,000	38,970	228,400	189,000	174,700	110,800	108,900	124,400	64,250	44,140	38,140	36,740	1,150,000	41,290	51,600	29,500	48,500	45,410	90,100	134,900	134,300	67,760	42,250	35,430	25,260	22,050	670,000	35,250	43,800	70,200	54,200	44,200	68,220	98,200	183,200	107,900	39,900	30,080	30,770	876,000		
Wood River at mouth near Fort Klamath (Combined flow of Wood River near Fort Klamath)	21,850	25,300	31,190	29,900	27,700	30,540	29,710	23,700	25,200	20,900	24,100	27,000	318,900	29,200	30,270	29,900	29,300	26,200	31,200	30,900	18,300	19,700	14,240	12,470	12,470	25,640	292,800	24,900	25,640	27,770	26,200	22,900	27,190	25,430	23,000	18,300	14,830	12,090	15,430	269,000		
Denny Creek near Rocky Point ²	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Moss Creek near Rocky Point ²	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Varnes Creek near Rocky Point ²	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Fossil Creek near Rocky Point ²	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Central Canal near Fort Klamath ³	1,000	1,000	29,800	14,740	14,820	5,450	6,200	1,840	2,400	1,100	912	83,440	1,220	1,470	1,740	2,170	1,600	3,700	7,180	1,270	1,810	2,180	847	954	25,340	899	1,940	4,630	3,920	3,620	4,670	4,140	5,160	3,910	1,200	2,140	1,780	38,200				
Sevensville Canal near Fort Klamath ³	6,840	10,280	16,900	11,130	8,920	7,700	7,220	6,640	5,000	4,400	4,700	5,100	6,840	6,020	7,560	6,900	7,370	5,900	12,400	7,200	2,660	4,140	4,960	86,100	1,110	7,840	7,890	6,870	6,210	8,960	10,610	4,790	2,280	2,060	3,250	72,600						
Modoc Point Canal drain ³	607	1,300	6,340	3,200	1,850	1,000	971	2,970	3,200	3,940	3,950	1,260	29,970	922	1,450	422	62	292	3,900	1,800	1,100	1,400	1,400	1,400	1,400	1,400	220	350	1,110	1,100	1,000	1,400	2,800	1,670	900	2,510	1,700	1,120	1,120	1,120	1,120	1,120
Agricultural drainage between lake and inflow gaging stations ⁴	8,000	2,000	700	1,000	8,610	24,450	9,550	6,200	7,850	7,820	6,640	4,400	80,220	3,280	2,140	676	1,100	8,830	12,800	11,420	6,380	6,500	4,550	3,380	2,380	63,420	861	1,840	4,460	8,420	5,220	8,110	11,420	8,240	5,770	5,470	2,380	2,380	64,970			
Precipitation inflow ⁵	2,280	29,200	107,100	30,150	2,740	950	19,080	2,900	3,900	3,900	14,240	17,100	240,100	415	521	68	547	421	719	985	290	220	212	228	5,660	275	368	434	411	494	591	538	295	193	219	245	215	4,270				
Springs and seeps ⁶	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Surface inflow ⁷	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Evapotranspiration ⁸	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Change in lake storage ⁹	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Total inflow	82,700	114,100	447,200	352,200	288,200	210,500	192,400	197,400	129,900	103,200	113,200	94,200	2,282,000	114,900	150,000	130,200	139,400	105,700	193,200	205,900	152,900	106,800	85,400	71,900	89,700	1,226,000	97,900	109,200	156,900	145,100	145,400	166,800	195,100	262,200	176,900	84,200	70,900	77,900	1,687,000			
Total outflow	105,500	62,500	196,600	409,300	301,900	286,200	261,800	210,500	192,400	147,500	135,400	167,200	1,561,000	157,600	216,200	143,100	125,000	60,650	40,620	139,200	139,200	89,500	93,200	110,540	85,250	1,223,000	94,720	74,300	126,700	130,400	120,200	120,200	116,400	44,200	49,800	69,600	57,220	33,100	290,600			
Change in lake storage	-22,800	+48,500	+250,700	-27,000	-72,700	-96,100	+111,000	+49,700	+12,700	-44,000	-22,900	-72,900	+74,100	-42,700	-65,900	-12,900	0	+54,800	+139,900	+37,700	-900	-26,200	-73,200	-90,800	-29,300	-137,800	-17,500	+27,000	+26,200	+10,800	+18,900	+113,700	+84,800	+17,200	-2,700	-94,100	-98,000	-58,000	+27,600			

¹ Gaging station records published by U.S. Geological Survey.
² Unpublished gaging station records not published.
³ Records estimated on basis of U.S. Weather Bureau records at Klamath Falls, Chiloquin, and Fort Klamath, Oregon.
⁴ Records estimated on basis of discharge measurements and correlation with nearby gaging stations.
⁵ Records furnished by Federal Water Pollution Control Administration.
⁶ Lake evaporation estimated on basis of Pacific Power & Light Co. findings for Upper Klamath Lake and U.S. Weather Bureau class A pan pan at Klamath Falls. Transpiration for marsh area computed using Hargreaves method (Cruick and Thompson, 1967).