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Irrigation Costs of Pumping in the San Joaquin Valley

The distance a pump must lift underground water to the surface is the most important single factor in the per acre-foot cost of irrigation pumping. Other physical factors in the cost complex—pump and well life, maintenance and repairs, changes in the water table and the total amount of water pumped per year—are influenced by the pump lift.

Practically every grower of irrigated crops in the San Joaquin Valley between the Merced River and the Tehachapi Mountains relies, at least in part, on pumps and underground water supplies. The pumping plants range from those with five horsepower motors, lifting less than 100 gallons of water per minute, to 300 horsepower units discharging in excess of 2,000 gallons per minute. An analysis of a sample of 11,000 pump tests conducted over a five-year period by power companies serving the area showed no constant relationship between total lift and horsepower, horsepower and discharge in gallons per minute, or either lift or horsepower and kilowatt hours per acre-foot.

It was evident from the analysis that geography and ground water conditions, as well as pumping lift, affect remaining well characteristics.

The area of the San Joaquin Valley studied was divided into 16 subareas with boundaries drawn on township lines for convenience but oriented to hydrographic areas.

To prepare estimates of irrigation pumping costs, logbook records from drillers of 800 wells put down within the past five years were tabulated by hydrographic areas. The tabulated material supplied the physical characteristics of

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Investment in Wells and Pumping Plants and Costs of Pumping Water by Hydrographic Area, San Joaquin Valley

Area	Well cost	Est. well life	Pump cost	Est. pump life	Total annual depreciation[1]	Insurance interest and tax	Cost due to lower water table[2]	Repair and maintenance	Service (demand) charge	Total cost except energy	Energy charge	Acre feet pumped[3]	Total cost per acre foot
	$	yrs.	$	yrs.	$	$	$	$	$	$	$		$
A	2,301	20	2,790	20	242.85	204.89	0	55.80	134.60	638.14	439.40	449.7	2.40
B	1,406	20	1,860	20	140.89	138.80	74.40	37.20	74.60	465.89	135.65	218.1	2.76
C	2,600	20	2,598	20	217.55	220.92	103.92	51.96	168.25	762.60	495.50	358.2	3.51
D	7,044	15	2,598	20	583.15	409.78	103.92	51.96	168.25	1,317.06	547.82	361.5	5.16
E	8,122	20	3,545	20	483.38	495.85	0	70.90	201.90	1,252.03	625.02	495.6	3.79
F	2,002	20	2,580	20	197.38	194.74	0	51.60	134.60	578.32	393.48	265.5	3.66
G	2,002	20	2,580	20	197.38	194.74	0	51.60	134.60	578.32	384.66	252.6	3.81
H	2,002	20	2,887	20	212.73	207.78	0	57.74	134.60	612.85	437.38	217.8	4.82
I	1,177	20	2,160	20	146.73	141.82	0	43.20	174.60	506.35	130.25	82.2	7.74
J	2,836	20	2,891	20	246.29	243.40	0	57.82	134.60	682.11	387.51	160.5	6.66
K	12,980	20	4,422	20	721.55	737.58	309.54	132.66	201.90	2,103.23	686.32	213.0	13.10
L	9,766	15	4,769	20	864.22	617.74	333.83	143.07	299.50	2,258.36	962.14	306.0	10.52
M	2,836	20	3,179	20	260.69	255.64	0	95.37	134.60	746.30	377.84	80.4	13.98
N[4]	....	..	....	..	.....	.....	.....	.....	.....	....	.....	...	....
O	15,007	15	16,206	20	1,731.77	1,326.55	1,134.42	486.18	789.00	5,467.92	3,016.78	475.8	17.83
P	14,000	15	17,700	15	2,013.33	1,347.25	1,239.00	531.00	789.00	5,919.58	3,288.32	406.8	22.63

[1] Salvage value of 40% of motor cost was credited to pump unit.
[2] 4% of new pump cost for areas B, C, and D; 7% for areas K, L, O, and P.
[3] Thirty-six acre inches per acre of summer crops. This will understate the amount pumped in areas where winter crops are irrigated and will cause the cost per acre foot to be overstated for these same areas.
[4] Insufficient information.

AIR FREIGHT

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areas and competitive areas can switch more easily to other transportation.

The air freight rates applicable to California cut flowers are intended to correct the directional imbalance of in-and-out movement of easterly and northerly traffic. With the introduction of jet air cargo carriers—around 1962—the imbalance may reappear and directional rates will need readjustment. Lower jet carrier rates might divert freight from other transportation so the new freight capacity could be utilized fully in both directions. In such a case, any future freight reduction is apt to be general rather than based on directional imbalance. California producers might benefit by a straight percentage reduction, but the differentials probably would be too small to influence the competitive position significantly. For example, a 10% reduction on the Los Angeles-New York rate of $19.65 would amount to $1.96, and the Miami-New York rate of $13.80 would be reduced by $1.38.

It is doubtful that the demand for cut flowers or the competitive position of California growers would be improved solely by reduced air freight rates. Factors leading to the present supply-demand situation probably started when the high profits just after World War II attracted new areas into flower production and expanded the production of existing growers. Improved methods—such as low cost cooling-heating systems in greenhouses—increased production, but also reduced the cost and climatic advantages of California growers.

The California cut flower industry must examine packaging and other cost components to discover the most efficient marketing methods, because lower air freight rates alone will not provide an answer to the competitive problems in out-of-state markets.

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PUMPING COSTS

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the wells—including casing diameter and thickness, depth of well, depth of casing, extent of gravel packing and casing perforation—which were priced at the rates currently charged by well drillers.

Investments in pumps and accessories were determined from current list prices supplied by manufacturers. Costs of pumping plant equipment have risen rapidly in the past few years. Therefore, the prices used in this study overstate the cost of pumping plants installed at earlier dates. The amount of such overstatement is reflected by the wholesale price index for electrical machinery and equipment, which has increased from 96.1 in 1947 to 154.5 in 1959 on the base period of 1947–49 as 100%.

Pump discharge, plant efficiency and electric energy—in kilowatt hours—per acre-foot were adjusted for the seasonal drawdown of the pumping level in the wells. The total energy bill was determined by assuming one-fourth of the water was pumped in the spring when the water table was high, one-half from a lift midway between the seasonal high and seasonal low, and one-fourth in the late summer and early fall when the water table was low.

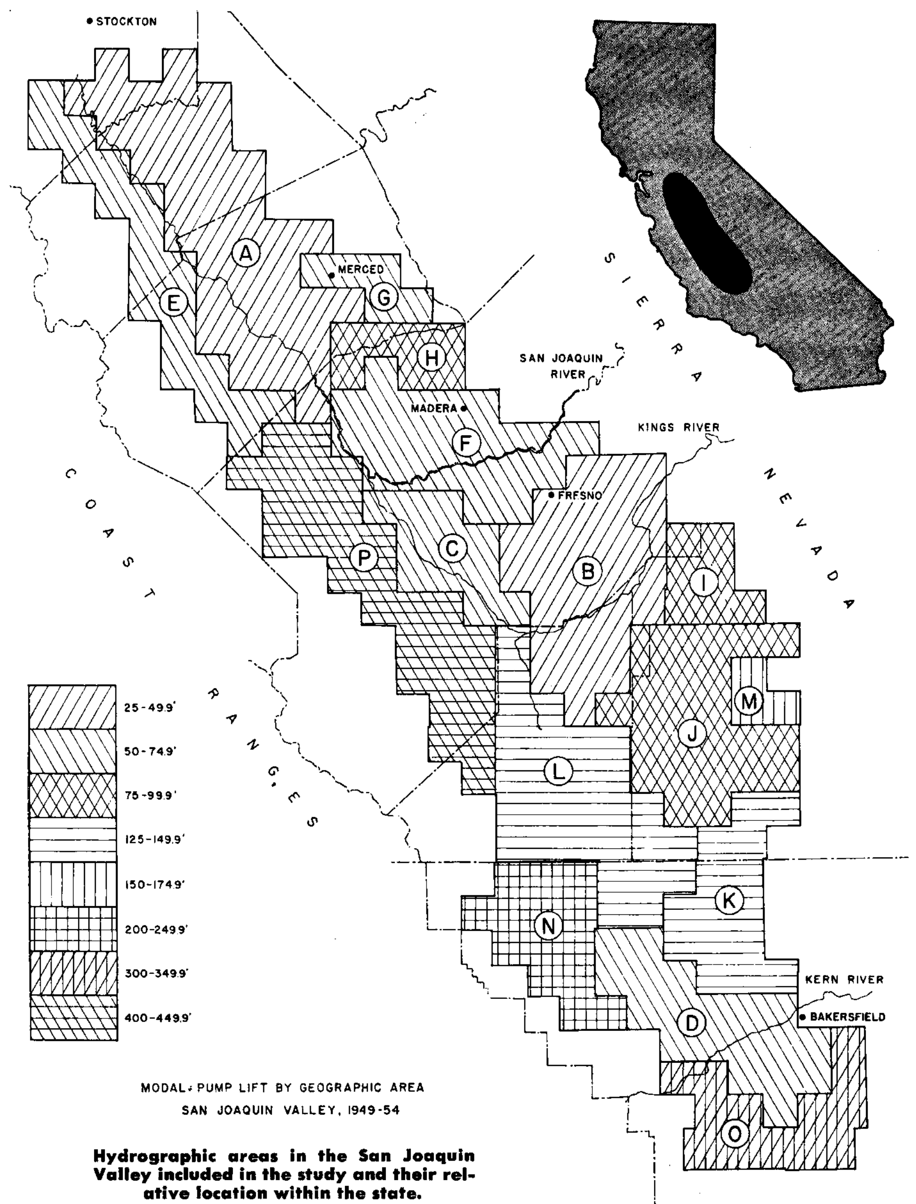
The investment and annual per acre-foot costs of pumping water in the 16 hydrographic areas ranged from a low of $2.40 per acre-foot in area *A* at the northern end of the valley to a high of $22.63 per acre-foot in area *P*, the west side of Fresno and Kings counties.

How costs were determined is illustrated by area *D*, where the total pump lift is 62.7′ with a discharge of 1,084 gallons per minute at the midpoint during the pumping season. The seasonal drawdown is 20′; in the spring the total lift is 52.7′ and late in the season the lift is 72.7′. That change in head gave a spring discharge of 1,284 gallons per minute and a fall discharge of 885 gallons per minute. To determine the number of acre-feet pumped it was assumed that the pump had a service area equal to one acre for each nine gallons per minute of discharge at midseason and the area irrigated with 31 acre-inches of water under a farm irrigation efficiency of 86% or 36 acre-inches of water per acre pumped. The assumption was for the irrigation of summer crops only.

In areas such as the Westside—Fresno and Kings counties—where a large share of the land is in winter barley, the total acre-feet pumped would be as much as one-third greater. The greater volume would have a marked effect upon the unit cost of pumping water by spreading the heavy fixed charges over more units. For example, if the acre-feet pumped on the west side were increased by one-third, the cost per acre-foot would drop to $18.38 compared to the $22.63 shown in the table. Area *D* experiences ground water overdraft at the rate of about 3′ per year. Therefore, an additional average annual cost equal to 4% of the new pump cost was charged to cover lowering of bowls and other capital improvements associated with the lower water table.

For area *D*, the well life was estimated at 15 years and the pump life at 20 years. Total annual depreciation was calculated by summing the two initial costs, less salvage value of the motor, and dividing by the estimated life. Interest was calculated at 6% of mid-value and insurance and taxes at 2.5% of mid-value. Repair costs were estimated at 2% of new pump costs for areas with a pump lift of less than 100′ and 3% for areas with lifts of more than 100′.

The wide differences in ground water conditions among the subareas in the valley cause sharp variations in the cost per acre-foot of water pumped. Low water cost areas have a definite economic advantage when other factors, such as yields, climate, and land values, are held constant. The effect of the seasonal supply and cost of surface water will be explored in detail in further studies.



MODAL PUMP LIFT BY GEOGRAPHIC AREA
SAN JOAQUIN VALLEY, 1949-54

Hydrographic areas in the San Joaquin Valley included in the study and their relative location within the state.

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