TEXAS BOARD OF WATER ENGINEERS

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PUMPING COSTS, SELECTED PUMPING PLANTS IN MOORE AND HANSFORD COUNTIES, TEXAS

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PUMPING COSTS, SELECTED PUMPING PLANTS IN MOORE AND HANSFORD COUNTIES, TEXAS

Data relating to the installation and operating costs of 26 deep wells in Moore and Hansford Counties, Texas, were obtained in March 1954. The wells were selected to show the depth, pumping lift, well yield, fuels and types of power units found in the northern Texas Panhandle.

Pumping plants included in the study are scattered throughout the main area of development in the two counties (see map facing page 2 of preceding report).

Pumping plant details are presented in Addendum Table 1 and estimates of cost in Addendum Table 2. It will be noted that development in this area is recent; of the 26 pumping plants 15 were installed in 1953. Only one of the 26 plants was installed before 1950.

One pumping plant, No. H2, is not representative of the general conditions under which plants in this area operate. This plant is in Palo Duro Canyon, a few miles west of Stratford, Texas. The other pumping plants are all on the plains top proper.

Data with respect to pumping lifts and well yields, and several items bearing on operating cost are not firm as those in the preceding report. Pumping lift and most measurements of well yields were made when the pumps were installed. Although several of the wells have been measured since the pumps were installed, it is believed that the seasonal average well yields are somewhat lower than those indicated in Addendum Table 1.

Hours of plant operation which are essential to a determination of quantities of water pumped and unit costs are believed to be reasonably firm. Most engine-powered plants are equipped with hour-meters. Hours of operation for plants not so equipped are based on total consumption of fuel divided by the hourly rate of fuel consumption. Data relative to costs of fuel, oil, energy, and maintenance are firm, as they reflect the actual cash outlays for these purposes.

Pump and power unit repairs are calculated, along with attendance costs.

1953 Pumping Costs

Accounting procedures and assumptions used in this study are similar to those used in the preceding section of this report. Prices used for anticipated expenditures are those in effect during March 1954.

Overhead Costs

As indicated on page 8 of the preceding report, overhead costs---depreciation, interest, risk or insurance, and taxes---approximate 10 percent of the initial investment in electric-powered plants. In engine-powered plants of all types these costs are approximately 12.5 percent of the initial investment. A detailed breakdown of plant component costs could not be obtained. (See Addendum Table 1). Overhead costs herein are calculated at 10 and 12.5 percent of the initial investment in motor and engine-powered plants, respectively.

Annual overhead costs are presented in column 3, Addendum Table 2, and overhead costs per acre-foot pumped during the 1953 season are shown in column 16, Addendum Table 2. Comparison of overhead costs (column 3) with total operating costs (column 13) indicates that annual overhead costs usually amount to more than annual operating costs, particularly on natural gas fueled plants. Comparison of overhead and operating costs per acre-foot pumped (columns 15 and 16, Addendum Table 2) illustrates this even more strikingly.

Like other overhead or "fixed" costs the amount of use or nonuse of the facility involved has a material bearing on unit costs. This is illustrated by the per acre-foot overhead costs on wells No. M4 and M5a. Part of the difference between the per acre-foot costs on wells No. M4 and M5a is due to the greater investment cost of well No. M4. But the greater part can be attributed to the difference in seasonal pumpage---107 acre-feet for well No. M4 compared with 756 acre-feet for well No. M5a. The high per acre-foot overhead costs on well No. M9 reflect the effects of a low-yielding well.

Operating Costs

Operating costs consist of actual expenditures for fuel or energy, lubricants, and maintenance items. Included also is an allowance sufficient to cover time spent in plant attendance and anticipated pump and engine repairs. These costs are shown in Addendum Table 2.

As indicated, fuel or energy, lubricant and maintenance costs are actual expenditures for these items and require no further explanation. Other items of cost are based on estimates.

Although most pumping plants included in this study have been in operation for only one or two seasons, some of them have already had a considerable amount of pump and engine repair. Several reasons suggest that this repair-cost experience does not provide a suitable base for estimating the cost of expected repairs.

Irrigation development is relatively new in this area. It has involved the adaptation of engines and engine sizes not previously or commonly used on irrigation pumping plants and new gas-fueled engines developed primarily for deep-well pumping. Under these conditions, much of the experience to date may be considered more in the nature of a "trial-run" or "shakedown period." Manufacturers and equipment dealers obviously consider it as such, as they have absorbed a large part of the repair costs to date.

In lieu of data on engine repair costs, an allowance of 7.5 cents per hour of operation (excepting Diesel engines) is used for anticipated engine repairs. This 7.5 cents per hour is approximately midway in the range of hourly repair costs estimated by equipment dealers in the general area.

Costs of repairs to pumps are based on the present 1954 cost of rebuilding or replacing pumps plus the cost of removing and resetting a pump twice during its estimated life of 15,000 hours. The cost of rebuilding, as well as the purchase price, depends on size of pump, number of stages, and depth of setting. These

factors also affect the cost of removing and resetting the pump. As a result, each plant has its own anticipated hourly repair cost, depending on how the above factors combine.

Anticipated costs of repairing pumps used herein are devised as follows: (1) (the cost of rebuilding pump) + (the cost of removing and resetting pump, twice) ÷ (15,000 hours of expected life) = (hourly cost of expected pump repairs), (2) (hourly cost of expected pump repairs) x (hours of operation) = (allowance for pump repairs during 1953 pumping season - column 4, Addendum Table 2).

Operating costs for the 1953 season are shown in column 13, whereas operating costs per acre-foot pumped are shown in column 15, Addendum Table 2. Comparison of fuel or energy costs, column 12, with total operating costs, column 13, indicates the importance of cheap fuels and also that even with the more expensive fuels, the cost of fuel seldom amounts to as much as 75 percent of the total operating cost each season. A further comparison of operating costs per acre-foot (column 15) with the total cost per acre-foot (column 17) indicates the extent to which estimates of pumping cost, based on "out-of-pocket" or operating costs may be misleading.

ADDENDUM TABLE I

PUMPING PLANT DETAILS, SELECTED FARM PUMPING PLANTS, MOORE AND HANSFORD COUNTIES, TEXAS

1953 IRRIGATION SEASON

Well No. 1/	Year Drilled	Depth Drilled	Static Water Level	Pump Setting	Pump Size	No. of Stages	Engine Size	Pumping Lift	Well Yield	Plant Costs					
										Pump & Gear Head	Well & Casing	Installation	Gas Line or Fuel Tank	Engine or Motor	Total
Industrial Engines		(feet)	(feet)	(feet)	(inches)		(cu.in.)	(feet)	(gpm)	$	$	$	$	$	$
M 1A	1949	414	185	260	10	4	2,004	230	1,600	6,800	4,140	250	-	6,500	17,690
M 1B	1953	360	162	260	8	4	602	-	1,100	4,950	3,600	-	-	2,950	11,500
M 1C	1953	310	162	260	8	4	602	-	1,100	4,950	3,100	-	-	2,950	11,000
M 2A	1951	576	195	260	10	4	1,800	-	1,290	-	-	-	-	-	18,760
M 2B	1952	507	194	260	10	4	1,965	-	1,590	-	-	-	-	-	21,215
M 2C	1952	501	194	260	10	4	1,965	-	1,530	-	-	-	-	-	21,215
M 3	1953	432	210	290	10	4	1,616	268	1,330	8,052	6,058	-	800	6,630	21,540
M 4	1953	420	235	280	8	4	1,616	275	800	6,799	6,032	504	-	5,838	16,648
M 5A	1951	320	178	240	8	5	89 2/	235	850	-	-	-	-	-	11,500
M 5C	1953	408	190	270	8	4	605	220	1,000	5,140	3,624	-	312	1,700	10,416
M 6A	1953	460	252	350	6	11	605	-	650	4,850	5,300	200	68	1,942	12,360
M 6B	1954	415	265	350	8	7	1,091	-	900	6,009	5,592	200	350	3,900	16,051
M 7	1953	408	170	347	8	7	970	320	750	7,200	3,692	100	392	3,925	15,309
M 8	1953	486	290	370	8	9	850 3/	-	700	7,200	5,974	-	324	2,900	16,398
H 1A	1953	380	177	320	8	6	605	247	1,194	5,000	5,320	200	350	1,800	12,670
H 1B	1953	375	200	345	8	6	605	340	900	5,550	5,320	200	-	2,000	13,070
H 3	1952	400	160	220	8	4	105 2/	200	850	3,220	5,000	250	308	2,500	11,278
H 8	1953	428	220	370	8	8	602	311	1,000	4,300	4,879	50	350	2,975	12,554
H 9A	1951	465	305	370	8	7	605	340	650	5,640	5,491	80	150	1,790	13,151
H 9B	1952	510	315	380	8	8	1,210	345	1,000	6,000	5,450	75	300	3,500	15,325
Automobile Engines															
M 5B	1953	328	178	270	6	4	105 2/	198	600	-	-	-	-	1,100	7,500
M 9	1953	335	286	330	5	8	93 2/	328	230	4,100	3,545	40	-	1,250	8,935
H 6	1953	491	291	350	6	10	105 2/	-	550	-	-	-	-	1,100	10,166
Electric Powered															
H 2	1953	150	90	120	6	2	20 2/	112	450	-	-	-	-	-	3,887
H 5A	1952	426	262	350	10	5	125 2/	292	1,350	-	-	-	-	-	15,200
Diesel Powered															
H 5B	1951	413	260	330	8	8	175 2/	285	950	6,080	3,600	-	320	3,500	13,500
H 10	1952	482	292	350	8	7	190 2/	-	1,000	5,127	6,289	330	495	4,100	16,341

1/ Well No. indicates county, operator, and operator's well number
2/ Horse power
3/ Dual engine setup - 2-425 cu. in. engines

ADDEMDUM TABLE II

OVERHEAD AND OPERATING COSTS PER ACRE-FOOT PUMPED; SELECTED FARM PUMPING PLANTS, MOORE AND HANSFORD COUNTIES, TEXAS

1953 IRRIGATION SEASON

Well Number 1/	Plant Cost	Overhead Costs	Operating Cost - 1953 Season									Total Operating Costs	Acre Feet Pumped	Operating Cost Per Acre Foot	Overhead Cost Per Acre Foot	Total Cost Per Acre Foot
			Repairs		Maintenance	Lubricants 6/		Attendance	Fuel or Energy							
		2/	Pump 3/	Power Unit 4/	5/	Gallons	Cost	7/	Kind	Unit Cost	Total Fuel Cost					
	$	$	$	$	$	No.	$	$			$	$	No.	$	$	$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Industrial Engines																
M1 A	17,690	2211.25	395.02	271.80	12.00	216	170.00	75.50	N. Gas	17.5 M	905.00	1829.32	1072	1.706	2.062	3.77
M1 B	11,500	1437.50	94.94	77.40	10.00	43	33.84	21.50	N. Gas	0 M	0	237.68	210	1.131	6.845	7.98
M1 C	11,000	1375.00	94.94	77.40	10.00	43	33.84	21.50	N. Gas	0 M	0	237.68	210	1.131	6.547	7.68
M2 A	18,760	2345.00	278.06	191.32	102.00	221	154.70	55.00	N. Gas	7.5 M	306.12	1087.20	611	1.779	3.838	5.62
M2 B	21,215	2651.87	278.06	191.32	102.00	221	154.70	55.00	N. Gas	7.5 M	286.99	1068.07	750	1.424	3.535	4.96
M2 C	21,215	2651.87	278.06	191.32	102.00	221	154.70	55.00	N. Gas	7.5 M	286.99	1068.07	723	1.477	3.667	5.14
M3	21,540	2692.50	212.52	138.60	35.00	208	163.90	77.00	N. Gas	6.5 M	192.19	819.21	454	1.804	5.930	7.73
M4	16,648	2081.00	69.12	54.00	15.00	162	127.50	15.00	N. Gas	0 M	0	280.62	107	2.622	19.448	22.07
M5 A	11,500	1437.50	422.40	360.00	30.00	193	125.45	100.00	N. Gas	17.0 M	734.40	1772.25	756	2.344	1.901	4.24
M5 C	10,416	1302.00	178.60	142.50	36.00	70	45.50	79.00	N. Gas	17.0 M	323.00	804.60	351	2.292	3.709	6.00
M6 A	12,360	1545.00	252.00	189.00	20.00	54	41.50	130.00	N. Gas	6.0 M	155.00	787.50	302	2.607	5.115	7.72
M6 B	16,051	2006.37	-	-	-	-	-	-	Butane	8.0 gal.	-	-	-	-	-	-
M7	15,309	1913.62	257.24	177.00	100.00	101	91.00	34.90	N. Gas	0 M	0	660.14	328	2.102	5.834	7.94
M8	16,398	2049.75	424.08	558.00 8/	126.80	110	88.00	55.00	N. Gas	6.0 M	267.84	1519.72	480	3.166	4.270	7.44
H1 A	12,670	1583.75	202.28	145.87	32.50	216	168.48	81.00	N. Gas	0 M	0	630.13	430 9/	1.465	3.683	5.15
H1 B	13,070	1633.75	213.95	145.87	10.50	81	63.18	81.00	N. Gas	0 M	0	514.50	324 9/	1.588	5.042	6.63
H3	11,278	1409.75	169.76	151.57	20.00	41	30.90	34.84	N. Gas	17.0 M	320.45	727.52	318	2.288	4.433	6.72
H8	12,554	1569.25	176.13	115.87	60.12	66	53.00	129.00	Butane	8.0 gal.	1351.60	1885.72	286	6.593	5.486	12.08
H9 A	13,151	1643.87	171.00	112.50	43.00	40	33.28	46.75	Butane	8.0 gal.	690.00	1096.53	180	6.091	9.133	15.22
H9 B	15,325	1915.62	232.00	150.00	129.00	129	80.80	62.50	Butane	8.0 gal.	2080.00	2734.30	370	7.390	5.177	12.57
Automobile Type Engines																
M5 B	7,500	937.50	403.20	360.00	80.00	60	54.00	100.00	N. Gas	17.0 M	575.00	1572.20	532	2.955	1.762	4.72
M9	8,935	1116.87	129.22	100.95	56.00	46	27.00	39.00	N. Gas	6.5 M	65.62	417.79	57	7.329	19.594	26.92
Electric Motors																
H2	3,887	388.70	83.21	0	0	21	16.80	13.75	Elec.	1.5 Kwh	300.00	413.76	128	3.232	3.036	6.26
H5 A	15,200	1520.00	258.83	0	0	41	29.16	40.50	Elec.	1.5 Kwh	3485.00	3813.49	509	7.492	2.986	10.48
Diesel Engines																
H5 B	13,300	1687.50	148.82	154.44	105.00	108	86.40	58.50	Diesel	12.0 gal.	1347.84	1901.00	247	7.696	6.832	14.53
H10	16,341	2042.62	336.60	336.60	88.20	140	101.70	63.50	Diesel	12.0 gal.	2754.00	3680.60	566	6.503	3.608	10.11

1/ Well No. indicates county, operator and operator's well number.
2/ Overhead costs based on 12.5% of investment in engine-powered plants and 10% of initial investment in electric-powered plants.
3/ Pump repairs based on 1953 costs of rebuilding pumps each 15,000 hours of operation plus cost of pump removal reduced to an hourly cost and multiplied by the hours of plant operation, during 1953 season.
4/ Power unit repairs based on a 7.5¢ per hour charge for industrial and automotive type engines; 11¢ per hour for Diesel engine.
5/ Reported expenditures for spark plugs, and filters, air cleaners, points and batteries during 1953 season.
6/ Reported expenditures for oil and grease during 1953 season.
7/ Reported hours of plant attendance at $1.00 per hour.
8/ Two 425 cu. in. engines; repair costs based on 7.5¢ per hour for each engine.
9/ Based on water application of 18" per acre irrigated.