



GREENHILL PETROLEUM CORPORATION

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Incorporated in Delaware
July 30, 1991

Oil Conservation Division
Energy, Minerals and Natural Resources Department
State of New Mexico
P.O. Box 2088
Santa Fe, New Mexico 87504-1088

Attention: David Catanach

Re: West Lovington Unit
Step Rate Test/Water Injection Wells
OCD Administrative Order No. 59-9/10/90
Lea County, N. M.

In compliance with the referenced administrative order and discussions with local (Hobbs, N. Mexico) OCD representatives, Greenhill Petroleum Corporation has run step rate tests on certain wells covered by this order. These tests were run up to the limiting pressure of the West Lovington Field injection facilities. This will be the future maximum water injection pressure of 2200 PSIG. None of the wells tested to date showed any evidence of matrix rock fracturing or the opening of existing fractures (should they exist.) No effort was made to determine the actual fracturing pressures of the reservoir (San Andres Dolomite) in these wells.

Therefore, we respectfully request approval of the maximum routine injection pressure of 2200 PSIG for these wells. Copies of the step rate test for these wells are enclosed for your use.

As the reservoir pressure increases and additional wells become injection-limited by pressure, additional more costly step rate tests will be required. We note that this is a historic water flood with original injection beginning in 1962 with Texaco as Operator. During the interim period, injection pressures have been as high as +/-3500 PSIG. Water floods of this period were what is referred to as "dirty water" floods. Plugging of the matrix by solids carried in the water required much higher pressures to inject the necessary water volumes. Examination of the records from this period of time fails to show any evidence of fracturing in any of the injection wells. The field is currently being redeveloped on closer spacing in the same (San Andres) formation with "clean" water now being injected. Based on the available waterflood injection data, we find no reason to believe that a field injection pressure of 2200 PSIG would cause the formation to fracture. Therefore, we recommend an injection pressure of 2200 PSIG be approved for recently completed and future injection wells in the West Lovington Field Unit.

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Additional information on this subject was obtained in recently drilled (2/91) WLU #68. when the well was fracture treated for completion in the San Andres Formation. The first interval (5080'-5156') in the lower part of the reservoir was fracture treated with gelled 20% HCL containing 25% CO2. The surface fracture initiation pressure was 4941 PSIG and the fracture extension pressure was 4883 PSIG at 10.4 B/M. An attempt to fracture the Middle San Andres Formation in the same well reached a maximum pressure of 3883 PSIG and a maximum rate of 4.9 B/M down casing using the same frac fluid as described above, but was not successful in creating a fracture. All evidence suggest that the existing fracture gradient is well above the mechanical limitations of the West Lovington Field permanently installed equipment.

Your consideration of a field-wide operating pressure limitation on all newly converted or future water injection wells of 2200 PSIG is requested.

Please contact me in the event you need additional information.

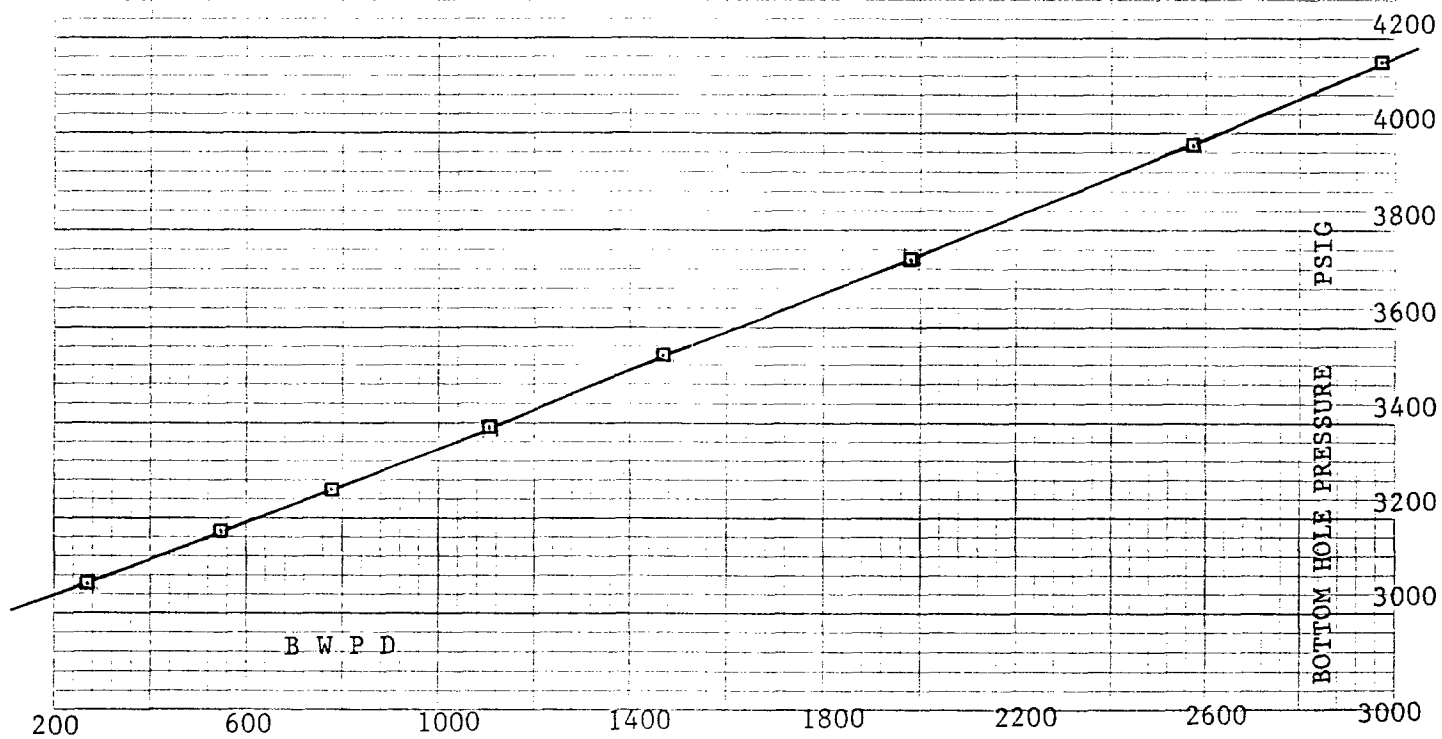
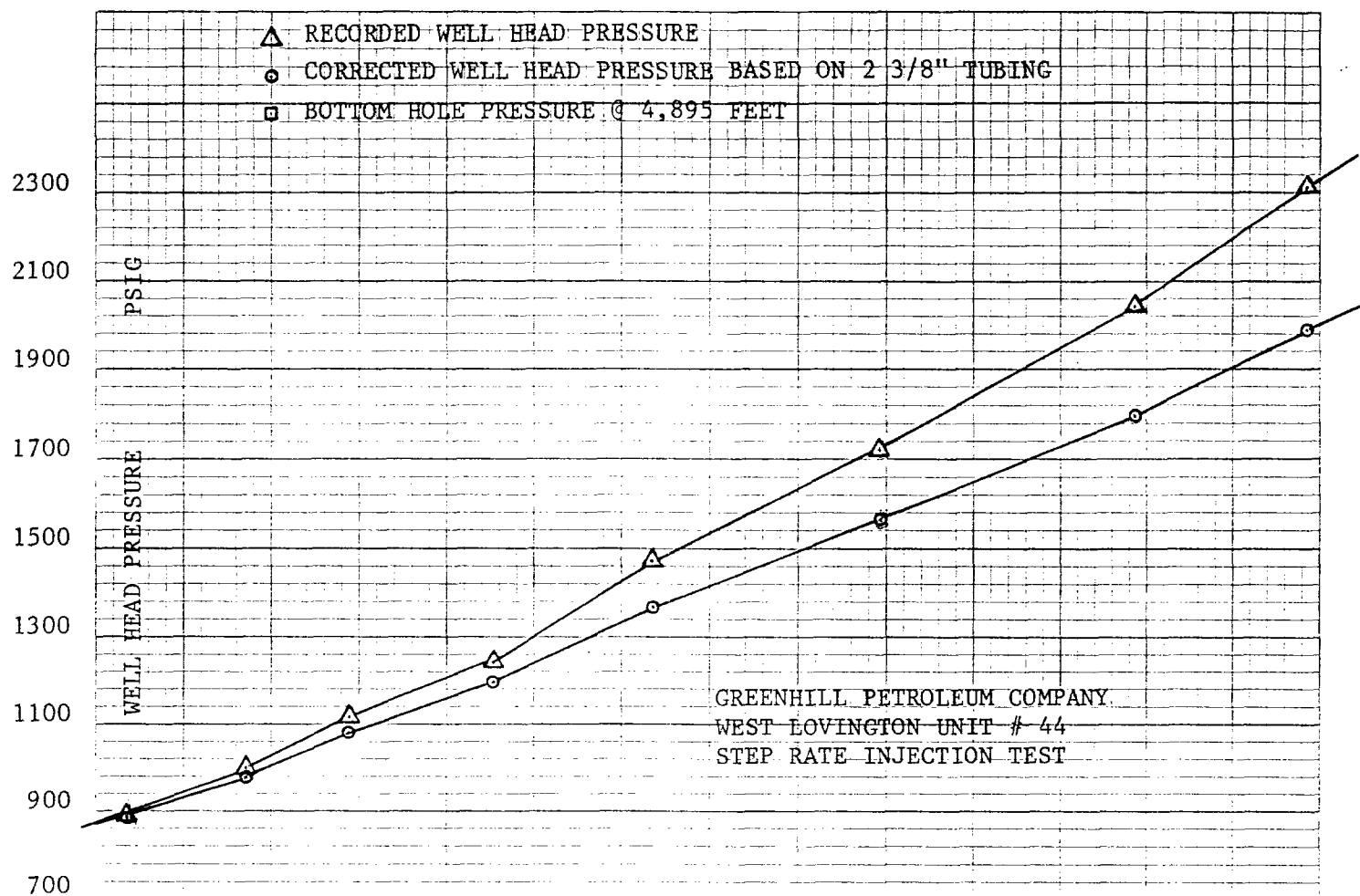
Sincerely,



Michael J. Newport
Land Manager, Permian Basin

Enclosures

MJN:sjs



JOHN WEST ENGINEERING CO.
Step Rate Injection Test

Well Name GREENHILL PETROLEUM COMPANY
CO. Name WEST LOVINGTON UNIT # 44

Date 7-15-91

PAGE 1

Remarks	Time	Tbg. Press.	Rate BWP.	Total	B.H.P.	Tbg. Press.	Rate GPM	Head Loss
TD 5160 FEET	Csg Shoe	4730 FEET	PKR	4633				
Set @ 4895								
	11:55	797		0	2973			
	12:00	874	288.00	1.0	3035			
	12:05	898.0	259.20	1.9	3052			
1	12:10	891	288.00	2.9	3062	887.0	8.12	3.965
			278.40					
	12:15	954.2	547.20	4.8	3128			
	12:20	990.0	547.20	6.7	3150			
2	12:25	993.00	576.00	8.7	3166	978.7	16.24	14.294
			556.80					
	12:30	1076	777.60	11.4	3223			
	12:35	1073	777.60	14.1	3244			
3	12:40	1108	777.60	16.8	3261	1081.5	22.69	26.541
			778.00					
	12:45	1202	1,944.0	20.6	3337			
	12:50	1244	1152.00	24.6	3371			
4	12:55	1247	1094.40	28.4	3392	1195.5	32.48	51.528
			1113.60					
	1:00	1390	1497.60	33.60	3480			
	1:05	1435	1468.80	38.70	3515			
5	1:10	1464	1468.80	43.80	3542	1377.0	43.12	87.039
			1478.40					
	1:15	1631	1987.20	50.7	3656			
	1:20	1695	2016.00	57.7	3706			
6	1:25	1719	1958.40	64.5	3739	1568.6	57.96	150.433
			1987.20					
	1:30	1957.4	2592.00	73.5	3872			
	1:35	2002.0	2563.20	82.4	3925			
7	1:40	2039.0	2563.20	91.3	3966	1796.4	75.04	242.576
			2572.80					
	1:45	2213	2995.20	101.7	4068			
	1:50	2271	2966.40	112.0	4117			
8	1:55	2303	2966.40	122.30	4154	1985.5	86.80	317.555
			2976.80					
NO BREAK								

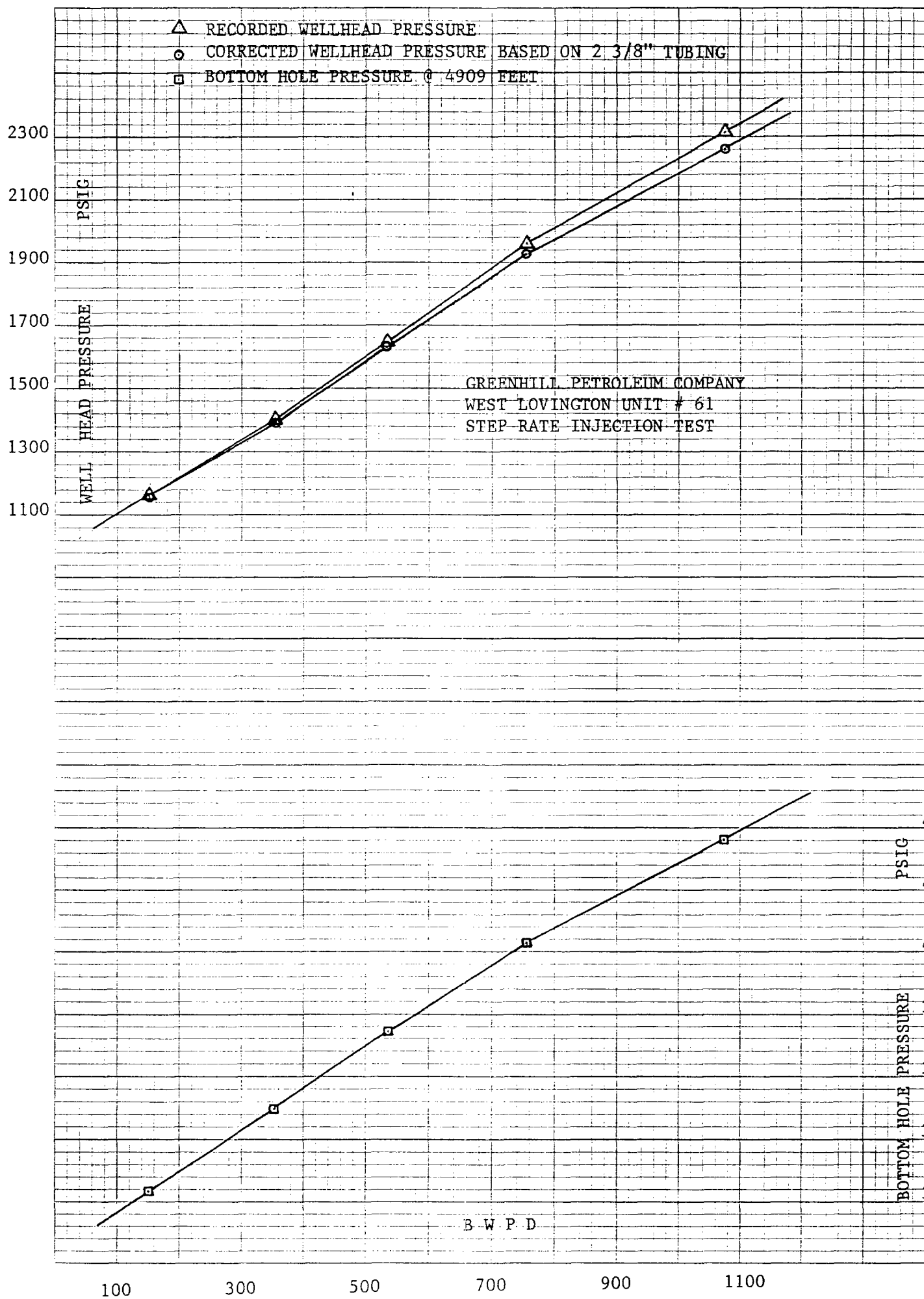
JOHN WEST ENGINEERING CO.
Step Rate Injection Test

Well Name WEST LOVINGTON UNIT # 44
CO. Name GREENHILL PETROLEUM COMPANY

Date 7-15-91

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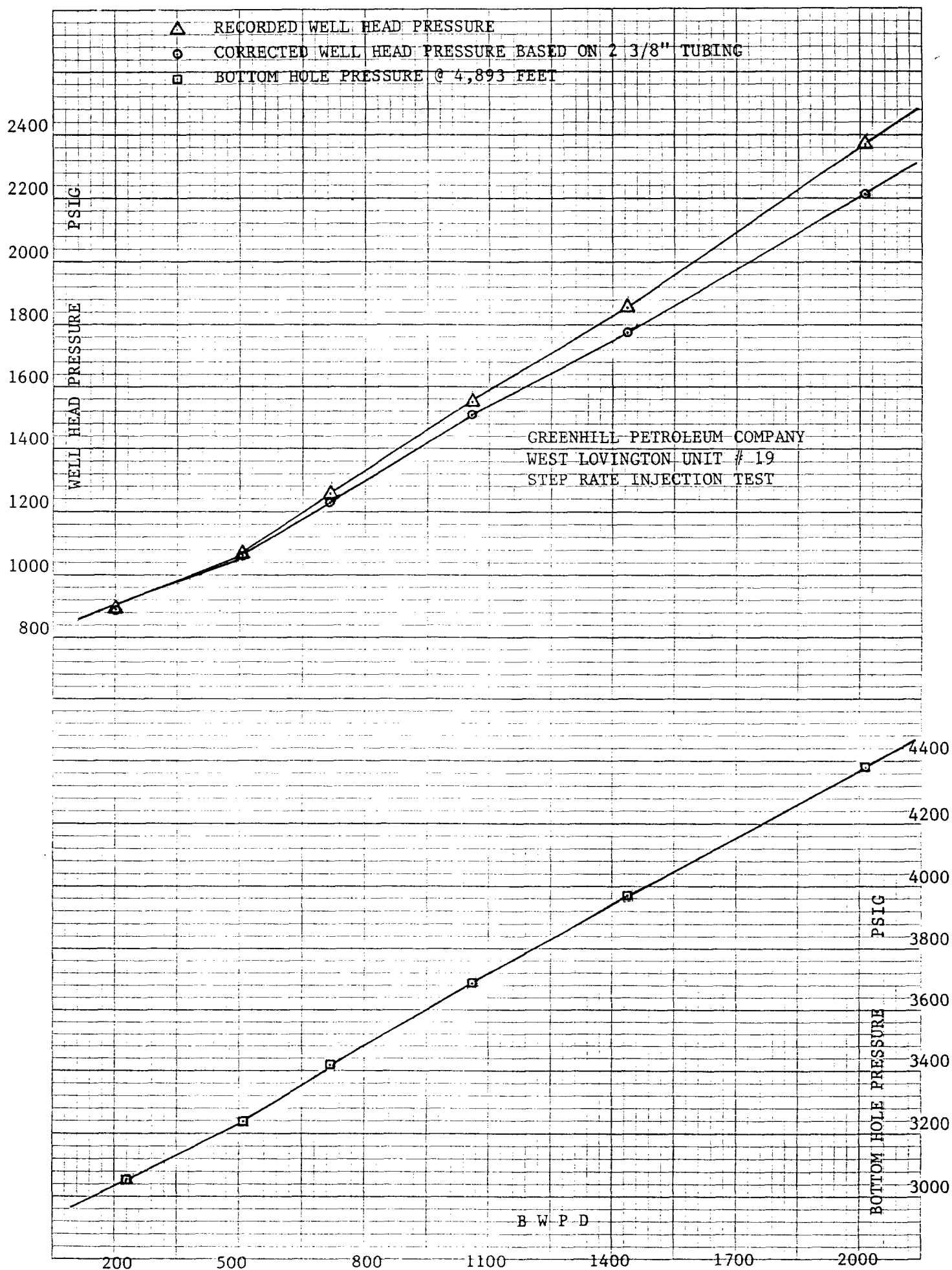
JOHN WEST ENGINEERING CO.
Step Rate Injection Test

Well Name WEST LOVINGTON UNIT # 61
CO. Name GREENHILL PETROLEUM COMPANY

Date 7-15-91

PAGE 1

Remarks	Time	Tbg. Press.	Rate BHPD.	Total	B.H.P.	Tbg. Press.	Rate GPM	Head Loss
TD 5064	CSG SHOE	4753 FEET						
SET @ 4909	FEET							
	8:53	964			3148			
	8:55	969		0	3153			
	9:00	1100.5	172.80	.6	3280			
	9:05	1133.5	172.80	1.2	3317			
1	9:10	1156.0	115.20	1.6	3338	1154.7	4.48	1.323
			153.60					
	9:15	1284	374.40	2.9	3480			
	9:20	1353	316.80	4.0	3533			
2	9:25	1396	374.40	5.3	3595	1389.8	10.36	6.240
			355.20					
	9:30	1548.6	547.20	7.2	3734			
	9:35	1619.0	547.20	9.1	3796			
3	9:40	1653	518.40	10.9	3834	1639.6	15.68	13.433
			537.60					
	9:45	1828.80	748.80	13.5	3994.0			
	9:50	1901.60	777.60	16.2	4071.00			
4	9:55	1956.50	748.80	18.8	4124.00	1931.1	22.12	25.389
			758.40					
	10:00	2171.70	1065.60	22.5	4313			
	10:05	2256.20	1094.40	26.3	4402			
5	10:10	2308	1065.60	30.0	4460	2259.6	31.36	48.428
			1075.20					
FALL OFF								
	10:11	2086			4284			
	10:12	1993			4188			
	10:13	1918			4111			
	10:14	1860			4053			
	10:15	1809			4002			
5 MINUTE	10:20	1640			3831			
5 MINUTE	10:25	1532.5			3723			
NO BREAK								



JOHN WEST ENGINEERING CO.
Step Rate Injection Test

Well Name WEST LOVINGTON UNIT # 19

Date 7-16-91

CO. Name GREENHILL PETROLEUM COMPANY

PAGE 1

Remarks	Time	Tbg. Press.	Rate B/PD.	Total	B.H.P.	Tbg. Press.	Rate GPM	Head Loss
TD 5045'	CSG SHOE	4740'						
PKR 4638'	SET @ 4893'							
	10:30	741		0	2914			
	10:35	864	230.40	.8	2999			
	10:40	889	230.40	1.6	3031			
1	10:45	892	230.40	2.4	3054	889.2	6.72	2.850
			230.40					
	10:50	1016	547.20	4.3	3168			
	10:55	1032	489.60	6.0	3210			
2	11:00	1070	489.60	7.7	3239	1057.9	14.84	12.093
			508.80					
	11:05	1200	748.80	10.3	3398			
	11:10	1226	720.00	12.8	3386			
3	11:15	1260	691.20	15.2	3417	1237.0	21.00	22.987
			720.00					
TRASH IN METER	11:20	1425	748.8	17.8	3562			
METER STOPPED								
APPROX ONE MIN.								
	11:25	1515	1065.6	21/5	3636			
4	11:30	1556	1065.6	25.2	3684	1508.5	31.08	47.476
			1065.6					
	11:35	1763	1468.80	30.3	3844			
	11:40	1837	1440.00	35.3	3915			
5	11:45	1852	1411.20	40.2	3965	1769.1	42.00	82.869
			1440.00					
	11:50	2189	2016	47.20	4200			
	11:55	2289	2016	54.20	4304			
6	12:00	2364	2016	61.20	4379	2209.6	58.80	154.429
NO BREAK			2016					
FALL OFF								
	12:01	1978			4152			
	12:02	1840			4023			
	12:03	1752			3937			
	12:04	1689			3877			
	12:05	1635			3818			
5 MINUTES	12:10	1457			3638			
5 MINUTES	12:15	1352			3532			

- △ RECORDED WELL HEAD PRESSURE
○ CORRECTED WELL HEAD PRESSURE BASED ON 2 3/8" TUBING
□ BOTTOM HOLE PRESSURE @ 4,820 FEET

WELL HEAD PRESSURE PSIG

GREENHILL PETROLEUM COMPANY
WEST LOVINGTON UNIT # 42
STEP-RATE INJECTION TEST

100 300 500 700 900 1100

BWPD

PSIG
BOTTOM HOLE PRESSURE

JOHN WEST ENGINEERING CO.

Step Rate Injection Test

Well Name WEST LOVINGTON UNIT WELL NO. 42
CO. Name GREENHILL PETROLEUM COMPANY

Date 6-28-91

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JOHN WEST ENGINEERING CO.
Step Rate Injection Test

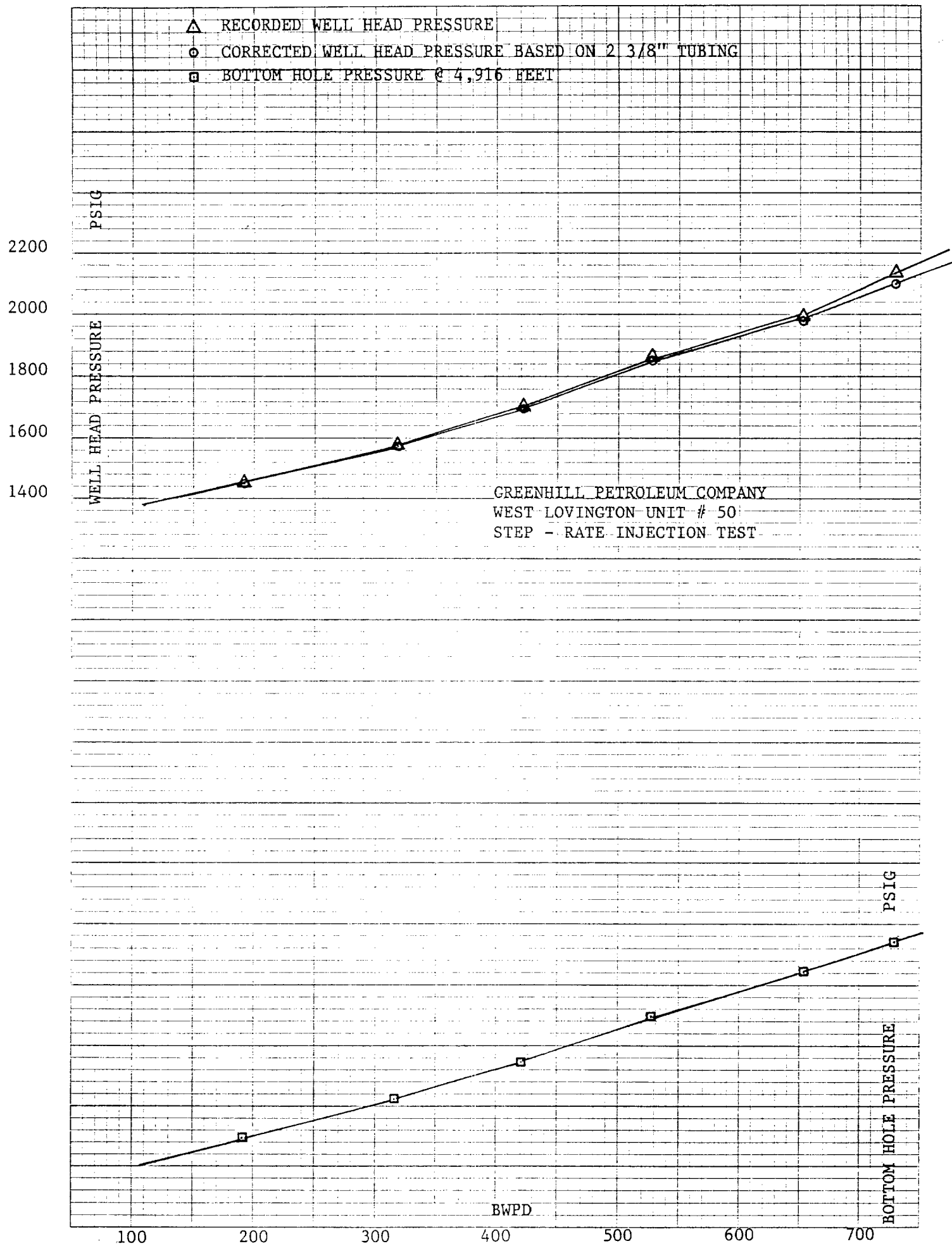
Well Name WEST LOVINGTON UNIT WELL # 42

Date 6-28-91

CO. Name GREENHILL PETROLEUM COMPANY

PAGE 2

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JOHN WEST ENGINEERING CO.
Step Rate Injection Test

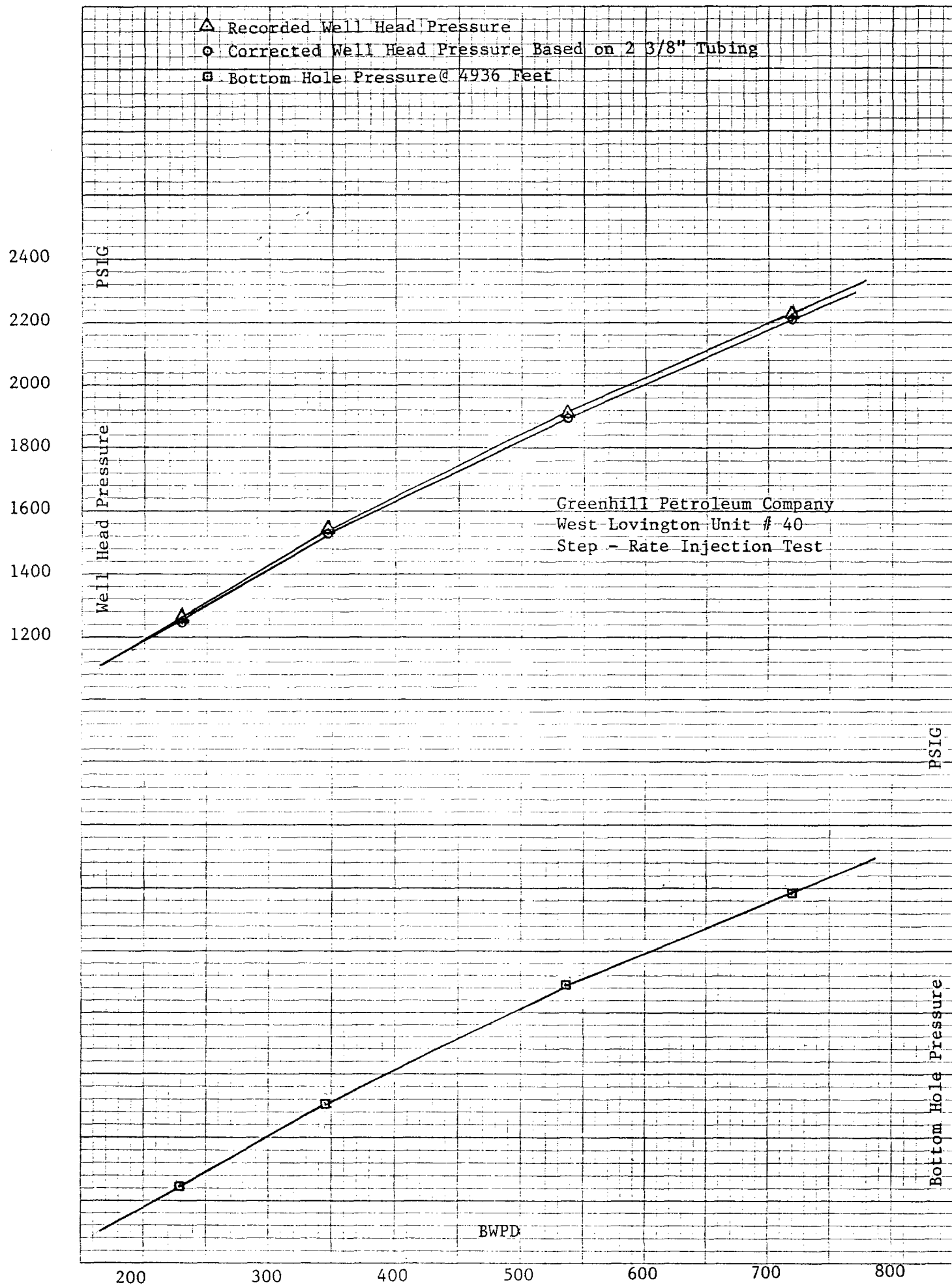
Well Name WEST LOVINGTON UNIT # 50

Date 6-28-91

CO. Name GREENHILL PETROLEUM COMPANY

PAGE 1

Remarks	Time	Tbg. Press.	Rate BWP.	Total	D.H.P.	Tbg. Press.	Rate GPM	Head Loss
				TD 5094 CSG SHOE	4738 PKR	4636 FEET		
				SET @ 4916 FEET				
	8:30	1300			3458			
BEGIN TEST	8:35	1302		0	3467			
	8:40	1371	201.60	.7	3537			
	8:45	1409	201.60	1.4	3571.7			
1	8:50	1444	172.80	20	3595	1442.0	5.60	2.003
			192.00					
	8:55	1497.5	316.8	3.1	3654.5			
	9:00	1534.3	316.8	4.2	3688.2			
2	9:05	1580.3	316.8	5.3	3726.00	1575.2	9.24	5.057
			316.8					
	9:10	1638	432.00	6.8	3781.0			
	9:15	1675	403.20	8.2	3818			
3	9:20	1701.3	432.00	9.7	3852	1692.7	12.32	8.611
			422.4					
	9:25	1792	547.20	11.6	3915.5			
	9:30	1833.30	518.40	13.4	3954.50			
4	9:35	1861.40	518.40	15.2	3986.00	1848.4	15.40	13.012
			528.00					
	9:40	1926.6	662.40	17.5	4049.5			
	9:45	1964.9	633.60	19.7	4089.10			
5	9:50	1998.10	662.40	22.0	4121.40	1978.8	19.04	19.266
			652.80					
	9:55	2062.10	748.80	24.6	4175.50			
	10:00	2098.00	720.00	27.1	4210.70			
6	10:05	2125.00	720.00	29.6	424.00	2101.3	21.28	23.668
			729.60					
FALL-OFF								
	10:06	2054			4187.50			
	10:07	2016.9			4155.00			
	10:08	1994.00			4132.00			
	10:09	1975.0			4112.00			
	10:10	1958.00			4095.00			
	10:15	1900.10			4034.00			
	10:20	1858.00			3992.00			



JOHN WEST ENGINEERING CO.
Step Rate Injection Test

Well Name West Lovington Unit # 40
CO. Name Greenhill Petroleum Company

Date 6-27-91

Page 1

Remarks	Time	Tbg. Press.	Rate BWPD	Total	B.H.P.	Tbg. Press.	Rate GPM	Head Loss
				Casing Shoe 4712	Feet TD	5160 PKR	4626	Feet
				Set @ 4936 Feet				
	8:52	909			2994			
	9:00	907		0	3003			
	9:05	10579	230.40	.8	3151			
	9:10	1145.0	230.40	1.6	3243			
1	9:15	1226.70	230.40	2.4	3322	1223.9	6.72	2.817
			230.40					
	9:20	1356	345.60	3.6	3449			
	9:25	1459.4	374.40	4.9	3544			
2	9:30	1548	316.80	6.0	3617	1542.0	10.08	5.965
			345.60					
	9:35	1704	547.20	7.9	3771			
	9:40	1819	518.40	9.7	3885			
3	9:45	1918.50	547.20	11.6	3983	1905.0	15.68	13.507
			537.60					
	9:50	2069.50	720.00	14.10	4132.50			
	9:55	2132.2	720.00	16.60	4235.0			
4	10:00	2233.4	720.00	19.10	4294.10	2210.2	21.00	23.189
			720.00					
FALL-OFF	10:01	2112			4244			
	10:02	2068			4206			
	10:03	2040			4178			
	10:04	2016.6			4153.20			
	10:05	1996.10			4132.20			
	10:06	1977			4114.00			
	10:07	1963			4097.00			
	10:08	1947			4083.00			
	10:09	1936			4070			
	10:10	1924			4059			
	10:11	1914.0			4047.0			
	10:12	1902.40			4036.40			
	10:13	1892.10			4027.00			
	10:14	1883.10			4016.10			
	10:15	1874.10			4007.20			