

GROUNDWATER AVAILABILITY IN THE HAMILTON  
LAKE AREA, ALBERTA

by

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Research Council of Alberta  
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**Alberta**  
RESEARCH COUNCIL



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GROUNDWATER AVAILABILITY IN THE HAMILTON LAKE AREA,  
ALBERTA

Reason for study

Mr. G. W. Rolls, a local farmer, is concerned about the effect of groundwater withdrawal by oil companies on his groundwater supply and asks if recharge will be sufficient to meet withdrawal.

Purpose of report

To consider the effects of additional withdrawal of groundwater supplies for oil field injection purposes into townships 33 and 34, range 9, west of 4th meridian, in the Hamilton Lake area. In this regard the following questions were posed:

(1) Is the "Lower Bearpaw Sandstone" being recharged and, if so, is recharge keeping pace with withdrawals? It is stated in regard to townships 33 and 34, range 9 that the oil companies need a total of 150 million barrels of water  $= 5.25 \times 10^9$  gallons, and that initial demands of 2,000 barrels per day (equal to 48.6 igpm) will be required for the first three years in Lsd. 4, Sec. 20, Tp. 33, R. 9.

(2) Will the oil companies' demands for water affect Mr. Rolls' well over the next 10 to 30 or more years? Mr. Rolls' well is located in Lsd. 16, Sec. 21, Tp. 34, R. 9.

(3) Should the Oil and Gas Conservation Board reverse its policy and refuse permission for oil companies to produce water from the Lower Bearpaw Sandstone?

In connection with the above enquiry it is suggested that the observation well in Lsd. 9, Sec. 18, Tp. 35, R. 9 may assist us in appraising the problem.

### Available information

The major part of the information available is that supplied by the oil companies on their water source wells drilled for injection purposes. The significant aspects of the data commonly report well depth, aquifer depths and thicknesses, water levels, method of well completion, and, during pump tests, the rate of pumping, water levels before and at the end of pump tests and the duration of pumping (from 12 to 48 hours). Some water-well drillers' logs supply much the same details, including one on Mr. G. W. Rolls' water well. Some information is available from water-well inventories listing well depth, and sometimes depth at which water was encountered.

Other more specific and important data include copies of three electric logs supplied by the Oil and Gas Conservation Board; bail and pump tests run by Mr. D. V. Currie, hydrogeologist, Research Council of Alberta, in Lsd. 13, Sec. 1, Tp. 35, R. 10 on the Bulwark Sandstone; a pump test run on the Lower Bearpaw Sandstone by the California Standard Company in Lsd. 7, Sec. 24, Tp. 35, R. 10, and the hydrograph for the observation well in Lsd. 9, Sec. 18, Tp. 35, R. 9, but we lack data on pumping rates and duration of pumping for nearby water source wells.

The water level measurements submitted to us on water source wells occasionally include static and pumping water levels, but pumping rates are seldom included. From only one well can we draw any inference on what may be happening to water levels in the area. Measurements on the pumping water level for this well in Lsd. 6, Sec. 18, Tp. 35, R. 9 noted in October or November for the years 1964 to 1968, inclusive, are consistently recorded as 250 feet. In relation to whatever are the rates and production periods at this site the data does

not indicate a decline in the water level. Similarly, in response to groundwater withdrawal in the vicinity of the forementioned observation well, the water level dropped from 48' to 56 feet in 18 months beginning in 1959 and has never fallen to 44.80' by APRIL 30, 1969. ~~below 60 feet since then.~~

### Geology

The bedrock formation of interest in this study is the Bearpaw Formation, a marine shale with three sandstone zones as shown by the available electric log data. The lower Bearpaw Sandstone ranges over an interval of 100 feet, from 180 to 280 feet above the base of the Bearpaw Formation. The main sandstone bed, occurring in the middle of this interval is about 30 feet thick and is an aquifer used by one farmer for domestic and livestock requirements, location Lsd. 16, Sec. 21, Tp. 34, R. 9, and by oil companies at points 5 and 10 miles to the northwest. One hundred feet above this aquifer is the middle Bearpaw Sandstone, about 20 feet thick, another aquifer from which oil companies take some water. The upper Bearpaw Sandstone, commonly called the Bulwark Sandstone, ranges from 15 to 50 feet thick. The Bulwark Sandstone is an important source of water supply for domestic and livestock requirements and locally for water source purposes for oil companies.

From a study of well data for the concentration of water source wells five miles northwest of Mr. Rolls' water well, the bedrock strata locally are shown to be horizontal. This is illustrated by northeast to southwest and northwest to southeast cross sections. This contrasts to the regional dip to the southwest of 10 feet per mile for the Base of the Fish Scale Zone (O.G.C.B. map).

The sandstone beds are commonly described as fine-grained or very fine-grained and bentonitic, rarely as clean or medium-grained. This description may be

taken to imply low permeability values, slow groundwater movement and low aquifer yields.

Sandstone zones	Bearpaw Formation	
	Elevation range (in feet above sea level)	Aquifer thickness (in feet)
Bulwark (Upper)	2390-2440	15-50
Middle	2315-2335	20
Lower	2165-2265	25-30

#### Groundwater hydrology

Theoretical studies of groundwater movement by Hubbert (1940), Tóth (1962, 1963) and Freeze (1966) show that topography exerts the controlling influence and geology the modifying influence on groundwater movement. In the study area there is no regional slope and only minor variations in local relief. According to Tóth (1963, p. 4808), whose analysis is made for a homogeneous medium "under extended flat areas groundwater movement is retarded; neither regional nor local systems can develop... water in those areas will have high concentrations of total solids."

The topographic gradient immediately northeast of Hamilton Lake is very slight, 20 feet per mile, or 0.0038 feet per foot. This very shallow gradient will create conditions of slow groundwater movement, limit active flow to shallow depths and tend to result in water high in total dissolved solids. The geologic picture showing layers of sandstones and shales is not a homogeneous medium. Though the geology may only modify the flow systems, its effect will be to concentrate the larger quantities of groundwater flow within the more porous medium, the sandstone beds, with the quantity of flow decreasing with depth.

In order to assess the possible effects of water withdrawal for injection purposes on neighboring farm wells some theoretical calculations have been made. The tabulated figures show drawdown values at distances from 1 to 10,000 feet from the pumping well. The drawdown is calculated for pumping rates of 5 igpm (imperial gallons per minute), comparable to farm wells, and at 50 igpm, close to the oil companies' initial requirements. The value for the storage coefficient,  $S = 1.0 \times 10^{-4}$ , the only value available for sediments in the area, is taken from the Research Council of Alberta pump test referred to on page 2. The value for hydraulic conductivity,  $K = 10 \text{ gpd/ft}^2$ , is taken from a table by Todd (p. 53).

The analysis follows the nonequilibrium method as presented by Theis and later developed further by Wenzel, and is based on the following assumptions:

- (1) the aquifer is homogeneous and isotropic,
- (2) the aquifer is of infinite areal extent and constant thickness,
- (3) the discharge well has an infinitesimal diameter and completely penetrates the thickness of the aquifer,
- (4) water taken from storage in the aquifer is discharged instantaneously with the decline in head.

In an idealized aquifer fulfilling the above assumptions, the general equations which define the flow toward a pumped well penetrating the entire thickness of the aquifer are as follows:

$$s = \frac{114.6 Q}{T} W(u)$$

and 
$$u = \frac{1.56 r^2 S}{T t} .$$

### Theoretical drawdown calculations at points beyond the pumping well

The following values were used:

K	(hydraulic conductivity)	= 10 gpd/ft <sup>2</sup>
d	(aquifer thickness, average thickness of Lower Bearpaw Sandstone)	= 25 feet
T	(transmissivity)	= 250 gpd/ft
t	(time)	= 1 day, 1 year, 10 years, 100 years
r	(radius, in feet)	= 1, 10, 100, 1,000, 10,000
Q	(volume rate of discharge)	= 5 igpm, 50 igpm
S	(storage coefficient)	= $1.0 \times 10^{-4}$

### Theoretical drawdown calculations

$$\begin{aligned}
 s_5 &= \frac{114.6 Q W(u)}{T} \\
 &= \frac{1.146 \times 10^2 \times 5 W(u)}{2.5 \times 10^2} \\
 &= 2.29 W(u) \text{ ft}
 \end{aligned}$$

$s_5$  = drawdown in feet at 5 igpm

$$\begin{aligned}
 s_{50} &= \frac{114.6 Q W(u)}{T} \\
 &= 22.9 W(u) \text{ ft}
 \end{aligned}$$

$s_{50}$  = drawdown in feet at 50 igpm

$$\begin{aligned}
 t &= 1 \text{ day} \\
 u &= \frac{1.56 r^2 S}{T t} \\
 &= \frac{1.56 r^2 \times 1 \times 10^{-4}}{2.5 \times 10^2 \times 1} \\
 u &= 6.25 r^2 \times 10^{-7}
 \end{aligned}$$



$t \approx 1 \text{ day}$ 

$r$	$u \approx 6.25r^2 \times 10^{-7}$	$W(u)$	$\overset{s_5}{2.29 W(u)}$	$\overset{s_{50}}{22.9 W(u)}$
1	$6.25 \times 10^{-7}$	13.71	31	314
10	$6.25 \times 10^{-5}$	9.11	21	208
100	$6.25 \times 10^{-3}$	4.51	10	103
1,000	$6.25 \times 10^{-1}$	0.43	1	10

 $t \approx 1 \text{ year}$  $t \approx 1 \text{ year}$  $u \approx 1.69r^2 \times 10^{-9}$ 

$r$	$u \approx 1.69r^2 \times 10^{-9}$	$W(u)$	$\overset{s_5}{2.29 W(u)}$	$\overset{s_{50}}{22.9 W(u)}$
1	$1.69 \times 10^{-9}$	19.61	45	449
10	$1.69 \times 10^{-7}$	15.01	34	344
100	$1.69 \times 10^{-5}$	10.40	24	239
1,000	$1.69 \times 10^{-3}$	5.80	13	133
10,000	$1.69 \times 10^{-1}$	1.35	3	31

 $t \approx 10 \text{ years}$  $t \approx 10 \text{ years}$  $u \approx 1.69r^2 \times 10^{-10}$ 

$r$	$u \approx 1.69r^2 \times 10^{-10}$	$W(u)$	$\overset{s_5}{2.29 W(u)}$	$\overset{s_{50}}{22.9 W(u)}$
1	$1.69 \times 10^{-10}$	21.91	50	501
10	$1.69 \times 10^{-8}$	17.31	40	396
100	$1.69 \times 10^{-6}$	12.70	29	291
1,000	$1.69 \times 10^{-4}$	8.10	18	185
10,000	$1.69 \times 10^{-2}$	3.51	8	80

t = 100 years

t = 100 years

$$u = 1.69r^2 \times 10^{-11}$$

r	$u = 1.69r^2 \times 10^{-11}$	W(u)	$s_5$ 2.29 W(u)	$s_{50}$ 22.9 W(u)
1	$1.69 \times 10^{-11}$	24.22	55	554
10	$1.69 \times 10^{-9}$	19.61	45	449
100	$1.69 \times 10^{-7}$	15.01	34	344
1,000	$1.69 \times 10^{-5}$	10.40	24	239
10,000	$1.69 \times 10^{-3}$	5.80	13	133
100,000	$1.69 \times 10^{-1}$	1.35	3	31

## Interference between wells, t = 1 year

Approximately  
one well per  
square mile

Q = 15 igpm

Q = 10 igpm

Interfering water wells	r in feet	s in feet	r in feet	s in feet
Well # 1	-	-	-	-
Well # 2	5,000	17	5,000	12
Well # 3	5,000	17	5,000	12
Well # 4	5,000	17	5,000	12
Well # 5	5,000	17	5,000	12
		68		48
Self-caused drawdown		120		80
Total drawdown		188		128

Interference between wells,  $t = 10$  years

Approximately one well per square mile				
		Q = 15 igpm		Q = 10 igpm
Interfering water wells	r in feet	s in feet	r in feet	s in feet
Well #1	-	-	-	-
Well #2	5,000	32	5,000	25
Well #3	5,000	32	5,000	25
Well #4	5,000	32	5,000	25
Well #5	5,000	32	5,000	25
		128		100
Self-caused drawdown	-	125		85
Total drawdown		253		185

Interference between wells,  $t = 20$  years

Approximately one well per square mile						
		Q = 10 igpm		Q = 7 1/2 igpm		Q = 5 igpm
Interfering water wells	r in feet	s in feet	r in feet	s in feet	r in feet	s in feet
Well #1	-	-	-	-	-	-
Well #2	5,000	25	5,000	20	5,000	15
Well #3	5,000	25	5,000	20	5,000	15
Well #4	5,000	25	5,000	20	5,000	15
Well #5	5,000	25	5,000	20	5,000	15
		100		80		60
Self-caused drawdown		90		70		55
Total drawdown		190		150		115

Interference between wells,  $t = 1$  year

Approximately one well per 2 square miles				
		Q = 15 igpm		Q = 10 igpm
Interfering water wells	r in feet	s in feet	r in feet	s in feet
Well #1	-	-	-	-
Well #2	10,000	10	10,000	7
Well #3	10,000	10	10,000	7
Well #4	10,000	10	10,000	7
Well #5	10,000	10	10,000	7
		40		28
Self-caused drawdown		120		80
Total drawdown		160		108

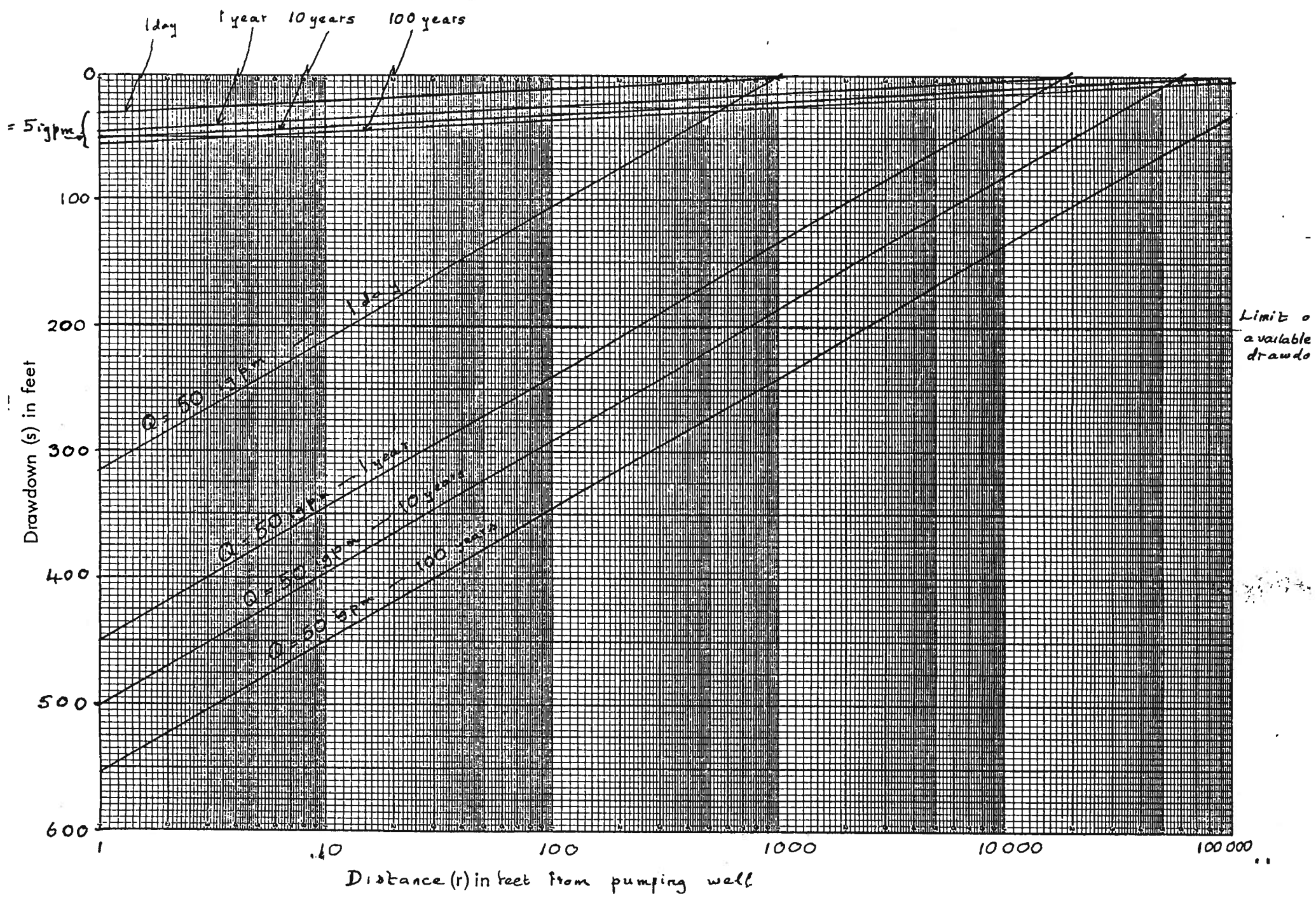
Interference between wells,  $t = 10$  years

Approximately one well per 2 square miles				
		Q = 15 igpm		Q = 10 igpm
Interfering water wells	r in feet	s in feet	r in feet	s in feet
Well #1	-	-	-	-
Well #2	10,000	25	10,000	17
Well #3	10,000	25	10,000	17
Well #4	10,000	25	10,000	17
Well #5	10,000	25	10,000	17
		100		68
Self-caused drawdown		125		85
Total drawdown		225		153

Approximately one well per 2 square miles	Q = 10 igpm		Q = 7 1/2 igpm		Q = 5 igpm	
Interfering water wells	r in feet	s in feet	r in feet	s in feet	r in feet	s in feet
Well #1	-	-	-	-	-	-
Well #2	10,000	18	10,000	13	10,000	8
Well #3	10,000	18	10,000	13	10,000	8
Well #4	10,000	18	10,000	13	10,000	8
Well #5	10,000	18	10,000	13	10,000	8
		72		52		32
Self-caused drawdown		90		70		55
Total drawdown		162		122		87



Assumed aquifer values:  $K = 10 \text{ gpd/ft}^2$ ;  $d = 25 \text{ ft}$ ;  $T = 250 \text{ gpd/ft}$ ;  $S = 1.0 \times 10^{-4}$



Some for the evaluation of drawdown in the field. Be aware that one of the continuous monitoring systems is available.

We may draw the following conclusions from the tabulated figures and accompanying graph:

(1) Allowing one water well per square mile, the maximum possible safe yield per well is 10 igpm for up to 20 years of simultaneous pumping. In these circumstances, and allowing for farm well production of 5 igpm for half a day, water source wells may pump continuously at 7 igpm and should be no closer than 1,000 feet from a farm well producing from the same aquifer.

(2) For well spacings approaching two miles the maximum safe yield will be about 12 igpm for up to 20 years of pumping. In this case a farm well could produce water at 4 igpm for half a day and water source wells may pump water at 10 igpm. Again it is considered that water source wells should be no closer than 1,000 feet from any farm well producing from the same aquifer.

(3) At a pumping rate of 30 igpm, total drawdown within the pumping well occurs after one day and at a rate of 20 igpm total drawdown occurs after only one year.

The above comments are based on calculations of  $K = 10 \text{ gpd/ft}^2$ . However, a value of  $K = 1 \text{ gpd/ft}^2$  may be closer to reality. In this case, the above well yields are reduced to one tenth of those already calculated for the above well spacings. On the other hand, the factors controlling yields (hydraulic conductivity  $K = 10 \text{ gpd/ft}^2$ , storage coefficients  $1 \times 10^{-4}$ , aquifer thickness 25 ft, available drawdown 200 ft) have been estimated as average regional values, and considerable local departures (both positive and negative) from those magnitudes may occur. These uncertainties notwithstanding, the estimates are believed to give a fair representation of the conditions on an areal, or regional basis.

### Theoretical water balance calculations

Considering the demand in an alternative way, the total consumption =  $5.25 \times 10^9$  gallons, number of minutes in one year =  $5.25 \times 10^5$ , then pumping from one well/sq mile over an area of 72 square miles:

<u>igpm</u>	<u>years</u>
139	1
13.9	10
6.95	20
4.6	30
3.5	40

Already classified as an area of groundwater abundance, the area is one where the required quantity of water apparently can be obtained. This is possible over the entire 72 square mile area at one well per square mile over a period of 20 or more years at rates of less than 7 igpm. This does not take account of recharge.

A water balance calculation using the Thomthwaite method shows an adjusted potential evapotranspiration of 21 inches compared to an average of 14.69 inches of precipitation for the weather records collected at Coronation. This analysis shows a water deficit but as no decline in water levels has been reported in the area for at least 10 years of groundwater withdrawal for well injection there must be some recharge. The writer assumes 3 1/2 to 7 per cent of precipitation, about 1/2 inch to 1 inch. This is considered to be a reasonable figure. It is less than the value of 9 per cent recharge calculated by Tóth (1968) for the Three Hills area, where safe groundwater yield of 19 igpm/sq mi. is calculated. So rates of 3 to 7 igpm/sq mi may be realistic in the Hamilton Lake area.

The foregoing analysis is made for the area five miles northwest of Mr. Rolls' location. In applying the computed results to the vicinity of Mr. Rolls'



water well we must consider what is known of the local conditions. With reference to the drillers' log for Mr. Rolls' well, we find the Bulwark Sandstone, the zone producing brown water, to be of very low yield, 1 1/2 igpm for 1 hour with maximum drawdown. The Middle Bearpaw Sandstone is absent and the Lower Bearpaw Sandstone is also a low yield aquifer. In the south of township 33, range 9, the water quality of the Bulwark Sandstone is much inferior to that around Hamilton Lake, total dissolved solids being about 4,300 ppm and 1,800 ppm, respectively. These groundwaters are also predominantly sodium sulfate with some sodium bicarbonate. Water from the Lower Bearpaw Sandstone has a total dissolved solids content of about 1,300 ppm and is mainly sodium chloride with some sodium bicarbonate.

### Conclusions

From the information we have on water levels in the area no serious decline is shown to have occurred subsequent to development of water source wells since 1959 at locations Lsd. 9, Sec. 18, Tp. 35, R. 9 and Lsd. 6, Sec. 18, Tp. 35, R. 9. The hydrograph record for the observation well shows ~~no more than~~ a drop in water level of ~~4~~ <sup>17</sup> feet to ~~60~~ <sup>approximately 65</sup> feet after the initial decline of groundwater from 48 to ~~56~~ <sup>SINCE</sup> feet over ~~1 1/2 years beginning in~~ 1959. This suggests that recharge to groundwater does occur and at a rate sufficient to keep pace with the withdrawals that took place. As there is no basis for assuming an absence of the hydraulic continuity between the Upper and Lower Bearpaw Sandstone beds, the Lower Bearpaw Sandstone will also be recharged.

Safe well yields average 7 igpm at one per square mile, and 12 igpm at one per two square miles for 20 years of pumping calculated on the basis of groundwater mining.

should  
be 9  
(with letter)

HYDRODAT CODED									
6TH 5TH 4TH 3RD		2		1		0		7	
TENS		SF		TENS		SF		TENS	
UNITS		UNITS		UNITS		UNITS		UNITS	
RANGE		SECTION		SECTION		SECTION		SECTION	
DATE: 1963 (?) CO-ORDS: L.S.D. NE(16) SEC. 21 TP. 34 R. 9 W. OF 4 M.									
SITE: DRILLER: Hyolness & McFarlane ADDRESS: CITY/TOWN: Coronation									
ALTITUDE: EST. SURV. DEPTH OF WELL REPT. MEAS. 360' DEPTH TO WATER REPT. MEAS. 90' DIAM. 6 1/4"									
CASING: LENGTH 291' DIAM. 4 1/2" TYPE: FINISH (A) driven (B) openhole									
(C) SCREEN GRAVEL PACK DETAILS: 0.152 to 1.58' WATER AT 298 to 326'									
AQUIFERS: NAME THICKNESS(ES) OTHER									
FLOW: G.P.M. LBS. OF PRESSURE HT. ABOVE G.L. SINCE									
PUMP: TYPE 115 v 18 stage Jacuzzi Submersible set at 230 ft PUMPING RATE 1/2 H.P.									
TEST: Bailed RATE 0 1/2 @ 5 G.P.M. for 0.1 hr. @ 3 hrs.									
DRAWDOWN Pump @ 180 FT. AFTER DAYS 0.20 min @ 1/2 HRS.									
RECOVERY @ - @ 70 FT. IN @ - @ 70 MINS.									
SPEC. CAP. TRANS. STOR. COEFF. POROSITY %									
DISCHARGE CORE PERM. OTHER									
MECH. ANAL. YES NO % SIZE M.M.S. INS. UNIF. COEFF. GR. PACK RATIO									
USE 100 stock WATER SAMPLE DATE OF									
QUAL. OF WATER: TURBIDITY ODOR oil (sic) PRESENCE OF GAS gas (sic) OIL OTHER									
SEISMIC SHOT HOLE (OIL CO.) E-LOGS (OIL CO.)									
SEISMIC DATA (G.W.) RESISTIVITY DATA (G.W.) E-LOGS (G.W.)									
REMARKS: Well - owned by Wm. Ralch of Veteran - satisfactory - bottomed in shale & bedrock 30 ft									
GROUNDWATER REPORTS: REQ. 19-64									
HYDRODAT CODED									

LITHOLOGIC LOGS (R.C.A. ETC.)

0'-2' sandy loam  
 2'-30' boulder clay  
 30'-130' shale (sic)  
 130'-130' hard sandstone (sic)  
 130'-152' sandy shale  
 152'-158' sandstone  
 158'-165' sandy shale  
 165'-280' shale  
 280'-298' sandy shale  
 298'-302' sandstone  
 302'-330' sandy shale & soft  
 sandstone  
 330'-336' sandstone

E-LOGS

PUMP DETAILS

Top water very brown - lower water  
 white with gas present - first water  
 begins rose to 10 ft.

OTHER

The policy of the Oil and Gas Conservation Board regarding use of groundwater supply for water injection purposes may be determined on the basis of the theoretical calculations of drawdown and mutual interference between wells at given pumping rates.

In order to verify the value of  $K = 10 \text{ gpd/ft}^2$  or  $K = 1 \text{ gpd/ft}^2$ , the safe yield of individual wells, and to determine well spacing, a week-long pump test with at least four observation wells located at various distances between 10 and 1,000 feet is recommended. If groundwater withdrawal is permitted, monitoring of the water levels in observation wells equipped with automatic recorders, and sampling of waters in these and in production wells to show changes in water levels and water chemistry should constitute part of a program of groundwater development for well injection purposes.

## References

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Coronation Weather Station: Thornthwaite Water-balance calculation  
 Latitude:  $52^{\circ}06'N$ , Longitude:  $111^{\circ}27'W$  Elev: 2618 ft ASL

	J	F	M	A	M	J	J	A	S	O	N	D	Y
Mean Daily Temp $^{\circ}F$	4.9	8.7	20.0	38.3	50.9	56.7	63.7	60.6	51.1	40.3	24.0	12.5	36.0
" " $^{\circ}C$	-15.0	-13.0	-6.7	3.5	10.5	13.7	17.6	15.9	10.6	4.6	-4.4	-10.8	2.2
Heat Index	0.0	0.0	0.0	0.58	3.08	4.60	6.72	5.76	3.12	0.88	0.0	0.0	21.74
Unadjusted P.E.	—	—	—	2.25	5.98	7.50	9.30	8.58	8.0	2.85	—	—	—
Adjusted P.E. (cms)	—	—	—	2.58	7.96	10.20	12.75	10.72	6.86	2.62	—	—	53.19
" " (ins)	—	—	—	1.02	3.13	4.02	5.02	4.22	2.51	1.03	—	—	—

For Mean Temp of  $2.2^{\circ}C$  the unadjusted PE = 1.48 cms

PE = 53.17 cms or 21 ins.

Estimate of 1" precipitation goes to S.W. recharge = 6.82  
 (If only  $\frac{1}{2}$ " = 3.42%).

G. L. B.  
 April 1968



# CORONATION

Potential Evapotranspiration = 20 in approx

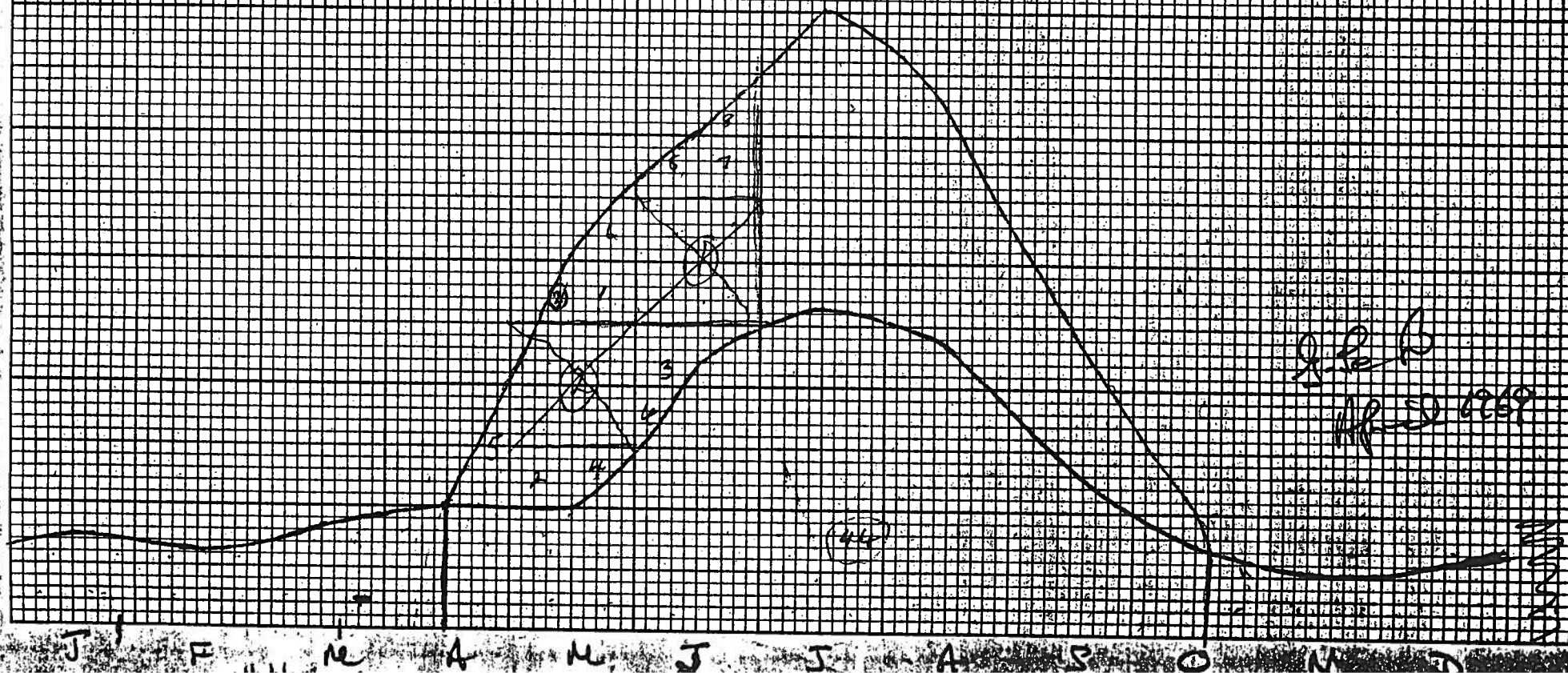
Total Precipitation = 14.69 in

$PE > TP$  by 5.3 in

Precipitation occurring when  $PE$  not applicable is 3.2 approx.

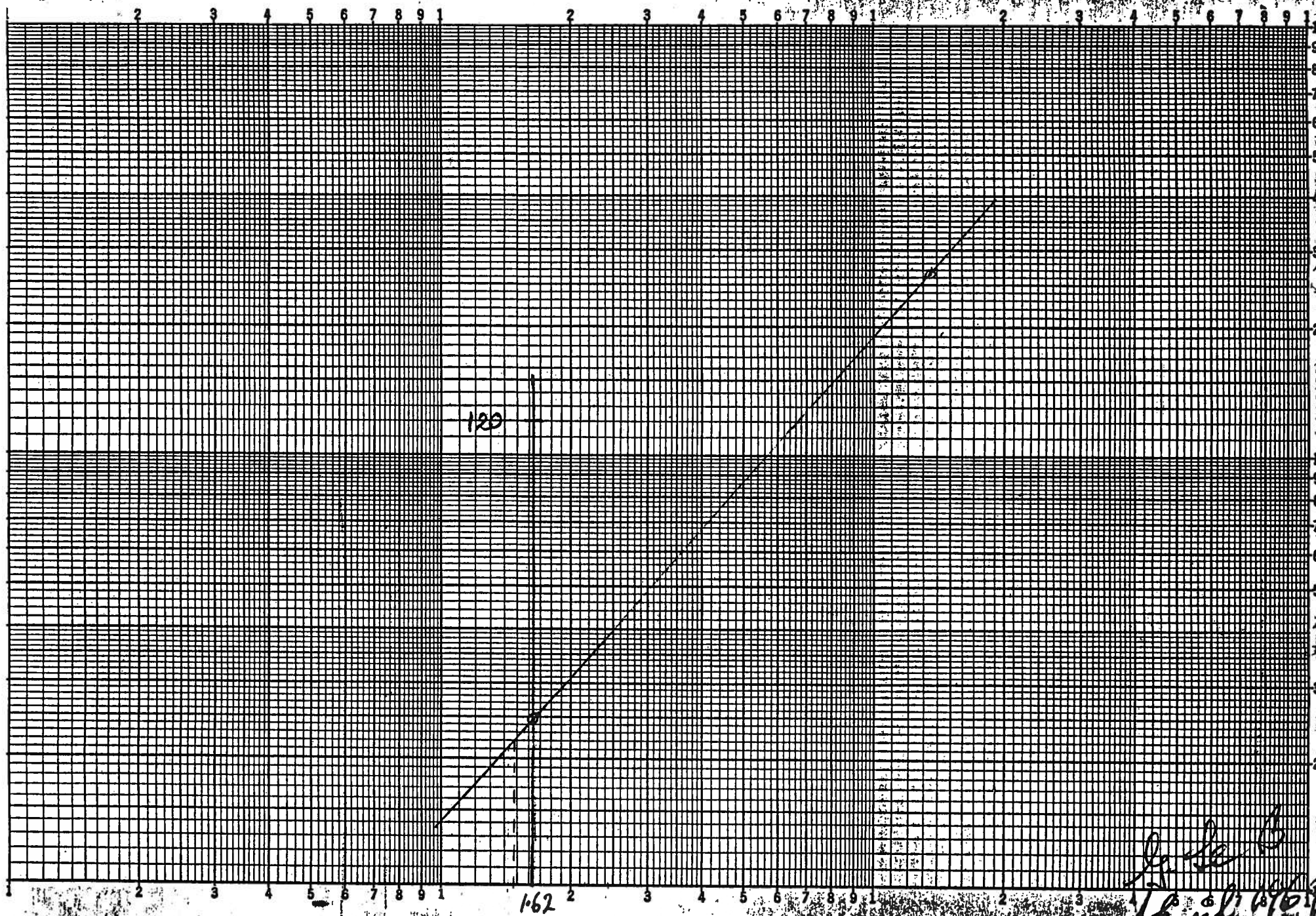
Of this estimate that about 1.1" goes to groundwater recharge

that leaves 6.8% of precip" is available for recharge



calculating AF

ORONATION



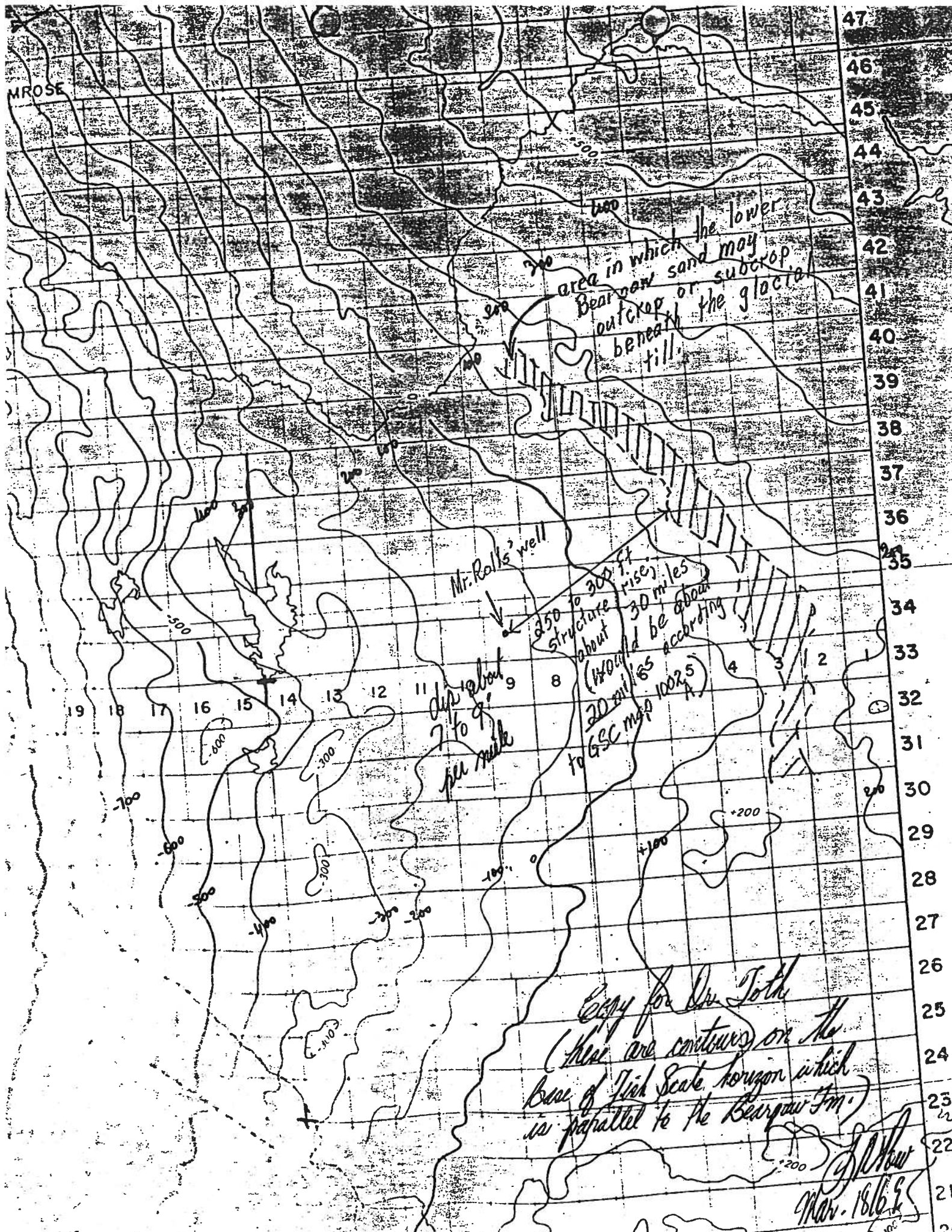
1.62

Potential FT in

April 1969







Copy for Dr. Toth  
(these are contours on the  
base of Fish Scale horizon which  
is parallel to the Bearpaw Fm.)

J. L. How  
Mar. 18, 1965



# SCHLUMBERGER

## INDUCTION ELECTRICAL LOG

SCHLUMBERGER OF CANADA Calgary, Alberta

PROVINCE ALBERTA  
FIELD WILDCAT  
WELL DELTA CPC SUN HAMIL  
10-28-34-9  
COMPANY DELTA GAS & TRANSMISSION LTD.

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WELL DELTA CPC SUN HAMIL

10-28-34-9

FIELD WILDCAT

PROVINCE ALBERTA

LOCATION 10 Sec. 28 Twp. 34 Rge. 9W4

Other Services:  
SGR-C

Permanent Datum GL Elev. 2548.7  
Log Measured From KB 10.3 Ft. Above Perm. Datum

ELEV: KB 2559.0  
GL 2548.7  
CBF

Date 10 SEPT 66

Run No. ONE

First Reading 2990

Last Reading 310

Feet Measured 2680

Depth Reached 2991

Bottom Driller 2990

Csg. SOC 310

Csg. Driller 310

Mud Nature GEL-OIL ADDED

Dens. Visc. 9.4 95

Mud pH 9.0

Water Loss 3.4

Res. 3.79 @ 78 °F

@ BHT 3.28 @ 90 °F

Rmf 2.47 @ 83 °F

Rmc 2.84 @ 84 °F

Bit Size 6 1/4"

Spacing AM 16"

MN 34'-6"

Ind. Type 6FF40

OIL & GAS CONSERVATION BOARD  
GEOLOGICAL DEPARTMENT

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