

## West Butler Water Injection

In March 1983, at our request, Chevron applied for approval to abandon 3 inactive water injection wells in the West Butler Field. These wells were outside the Unit and were on Crown land (mineral rights) to which Chevron's leases had expired.

In approving these applications, we requested that Chevron review and submit its plans for the remaining inactive wells (2 wiw and wsw)

These wells had been shut in since 1980 when it became apparent that pressure maintenance operations in the area were unsuccessful.

In view of the long inactivity... of these wells and the lack of success in attempts at pressure maintenance, abandonment of these wells is recommended.

It is noted that Chevron will swab test the 8-31 well to evaluate its potential as a producer. The other wells are considered to be uneconomic. Below is an average oil rate and WOR over the last six months for each of these wells

7-31 -	1.89 m <sup>3</sup> /d	WOR=12.5	Produced only 42 days
1-31	0.19 m <sup>3</sup> /d	64.09	5 months in 1973

16-30

8-31

0.03 m<sup>3</sup>/d

1.53 m<sup>3</sup>/d

20.4 4 months in 1972

0 6 months in 1972

March 23, 1983

Chevron Canada Resources Limited  
Box 100  
Virden, Man.  
R0M 2C0

Attention: Mr. C. G. Folden

Dear Cal:

Re: Chevron Butler Prov. WIW 12-29-9-29  
Chevron Butler Prov. WIW 14-29-9-29  
Chevron Butler Prov. WIW 4-32-9-29

Enclosed are approved applications for abandonment of the subject wells. Please note the minor changes required in the abandonment procedures.

I would also like to reiterate our request (originally stated in our letter of July 8, 1982, copy attached), concerning your plans for the remaining suspended wells in the West Butler Field. Please forward your plans as soon as possible but not later than the suspension expiry date of August 1, 1983.

Yours sincerely,

Original Signed by  
L. R. Dubreuil

L. R. Dubreuil  
Chief Petroleum Engineer  
Petroleum Branch

LRD/sb  
Encls.

Chevron has applied for approval to abandon three West Butler ~~wells~~ water injection wells not included in the West Butler Unit No. 1.

There are currently 2 active producing wells in the West Butler Lodgepole A pool. Also there are 5 inactive water injectors and one inactive water supply well.

Water injection in the West Butler Lodgepole A pool was initiated in late 1972 and terminated in late 1974. The initial injection period was relatively ineffective because of inadequate water supply and lack of an enclosed pattern (only 2 injectors, 16-30 and 8-31 were utilized).

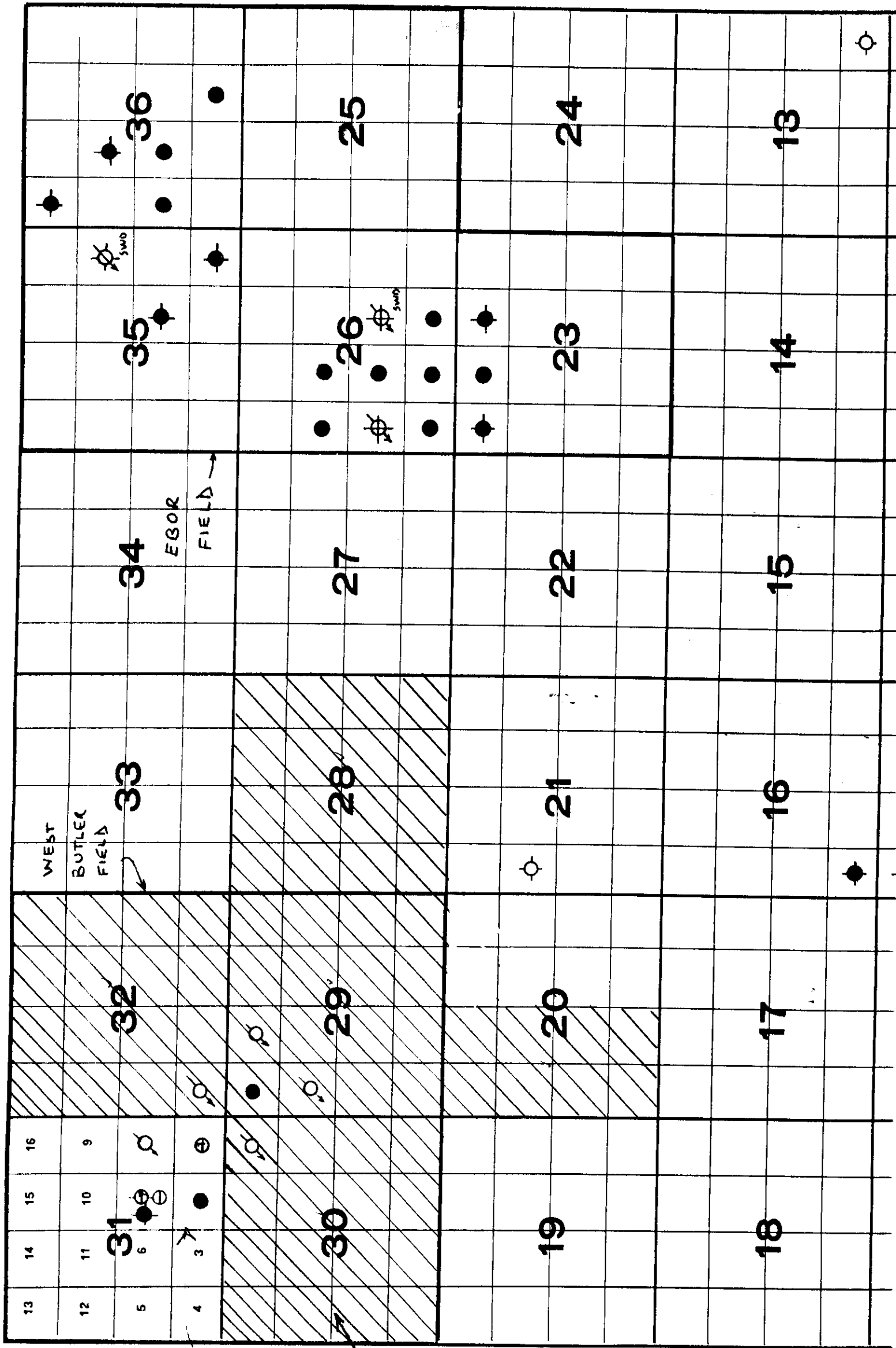
In late 1978, injection resumed, utilizing 5 water injectors, a confined pattern and adequate water supply from a Devonian water supply well (1-31). Injection was terminated in October 1980 after the Board questioned the wisdom of Chevron's request to extend the pilot period, having regard to the lack of response.

Subsequent to this, Chevron has ~~also~~ considered additional options, including development drilling and infill injection but have elected not to pursue further field development.

The 3 injection wells are on a Crown ~~less~~ minerals with leases that expired December 31, 1982.

As the wells appear to have no immediate use, and as Chevron no longer

has mineral rights, the Branch had requested that Chevron abandon the three injection wells.



July 8, 1982

Chevron Standard Limited  
Box 100  
Virden, Manitoba  
R0M 2C0

Attention: Mr. Cal Folden

Dear Cal:

Re: West Butler Field - Suspended Wells

The applications to continue suspensions on five water injection wells and two water supply wells have been approved, subject to an expiry date of August 1, 1983.

We request that prior to the expiry date of these approvals, you submit your definitive plans to either reactivate or abandon these wells. An application to extend further the period of suspension of a well will be considered only in the event that a future development plan is filed incorporating the well.

Please note, further, that all wells are to be pressure tested on an annual basis as required by the Department's District Office.

Yours sincerely,

Original Signed by H. C. Moster

H. Clare Moster, P. Eng.,  
Director  
Petroleum Branch

HCM/sb

cc: Virden Office

## West Butler

Chevron has made application to suspend for an extended period of time 5 water injection wells and two water supply wells in the West Butler area. The reasons given are the lack of water flood response and the possible field development in the near future.

Chevron has indicated on a number of occasions both verbally and in writing that there are plans to ~~develop~~ do some development drilling in the area. Further, with Crown leases in the area expiring, there is a ~~strong~~ incentive for Chevron to do its drilling in the near future.

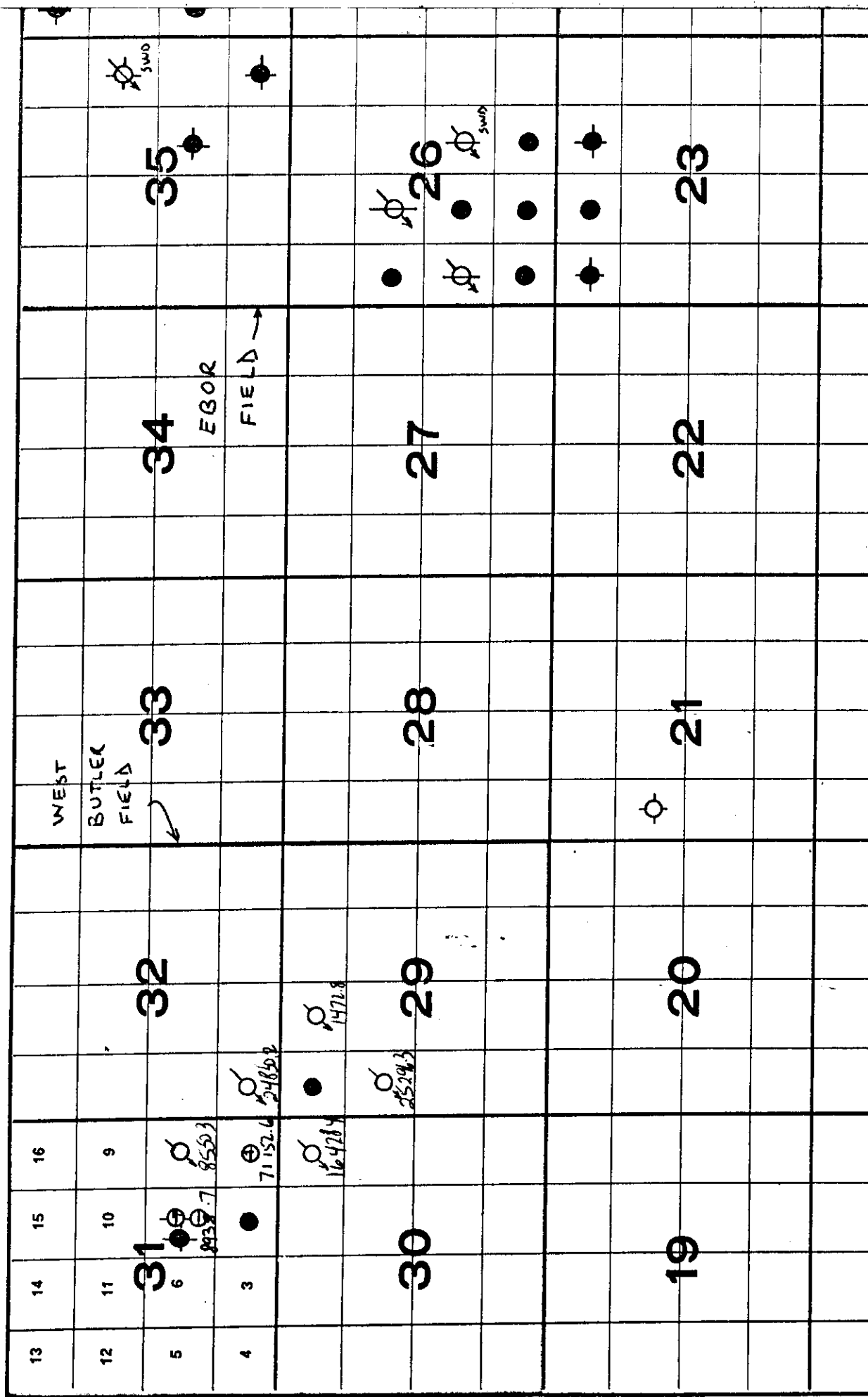
Four of the five water injection wells have been pressure tested this year. 16-30 was tested in 1979 but has since had its packer/tubing pulled. Chevron has requested exemption from testing requirements on this well. However, there is no justification for this request other than the cost of running a packer or bridge plug. It is recommended that pressure testing be required.

Suggest a suspension period of one year only to indicate to Chevron that we are expecting some resolution of their plans.



Cumulative Injection ( $m^3$ )  
Supply ( $m^3$ )

Tp. 9 Rge. 29 P.M.



Date \_\_\_\_\_

To HCM

Re: West Butler

Expiry date for suspension approval was now 1/81.

ON reviewing the more recent production data on the 13-29-9-29 well, we may be seeing an indication of slight response to the water flood. The other producing well (2-31) has not shown any sign of response

LRD  
12/4

THINK POSITIVE

Chevron Standard Limited

Box 100

VIRIDEN Man.

Rom 200

Attention Mr D.A. Zeeuwen, Area Supervisor

Dear Sir:

Chevron West Butler WIW 8-31-9-29 (WPM)

" " " WIW 16-30-9-29 "

" " " WIW 12-29-9-29 "

" " " WIW 14-29-9-29 "

" " " PROV. WIW 4-32-9-29 "

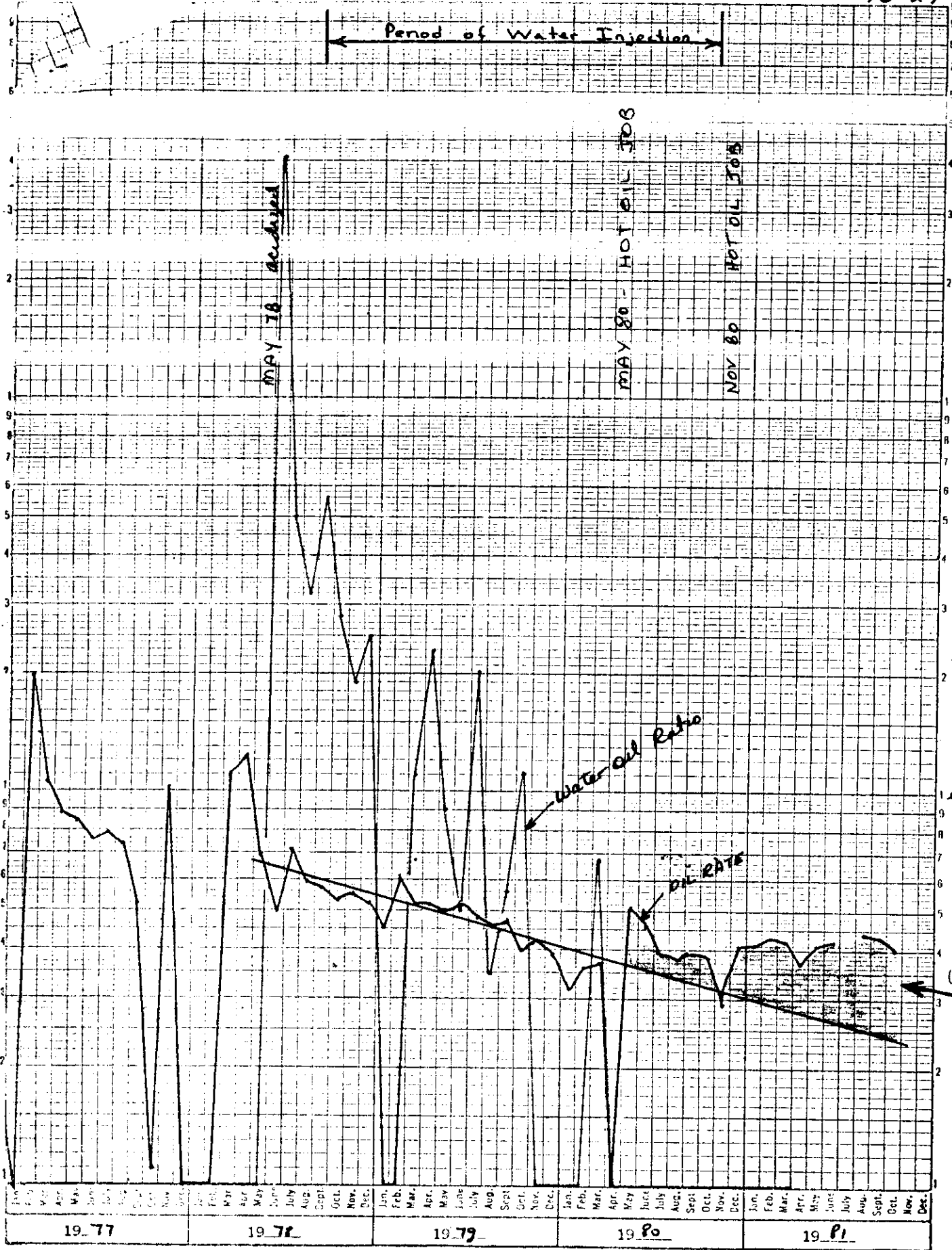
Approval of suspension of the subject West Butler water injection wells expired November 1, 1981.

As indicated in our letter of June 4, 1981, we <sup>feel</sup> ~~would expect~~ that ~~at the~~ by the present time Chevron ~~too~~ has had ample time to evaluate alternative and should be prepared to undertake a specific plan for operation of the field.

Consequently, we request that you submit a summary of your plans, specifically for the five inactive water injection wells and more generally for the field as a whole. We request that these plans be submitted at your earliest convenience but not later than January 15, 1982.

LRD.

13-29-9-29



m³/month/day

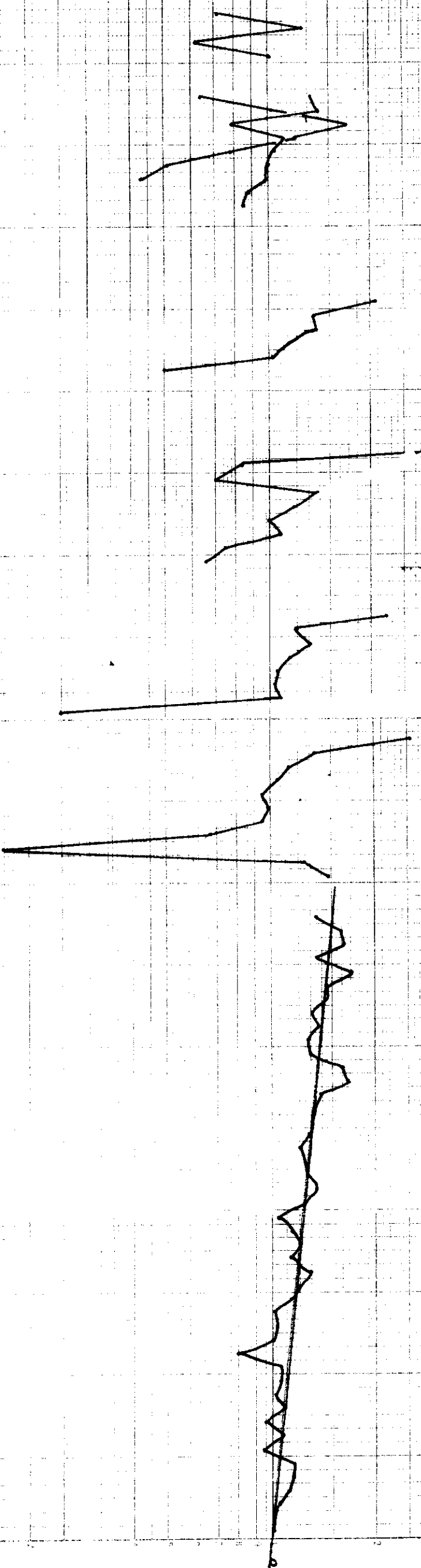
Waterflood Response ?

TABLE 2

Month	Production BOPD	Production (m <sup>3</sup> /mo.)	Crown Royalty (m <sup>3</sup> /mo.)	Producer's Share (m <sup>3</sup> /mo.)	Producer's Revenue @ \$105/m <sup>3</sup> (\$16.75/bbl.)	Producer's Revenue @ \$126/m <sup>3</sup> (\$20.00/bbl.)	Producer's Netback @ \$105/m <sup>3</sup>	Producer's Netback @ \$126/m <sup>3</sup>	Cumulative Netback @ \$105/m <sup>3</sup>	Cumulative Netback @ \$126/m <sup>3</sup>
1	40	191	26	165	17,325	20,790	16,575	20,040	16,575	20,040
2	30	143	18	125	13,125	15,750	12,375	15,000	28,950	35,040
3	25	119	14	105	11,025	13,230	10,275	12,480	39,225	47,520
4	22	105	12	93	9,765	11,718	9,015	10,968	48,240	58,488
5	20	95	10	85	8,925	10,710	8,175	9,960	56,415	68,448
6	17.5	83	8	75	7,875	9,450	7,125	8,700	63,540	77,148
7	15	72	7	65	6,825	8,190	6,075	7,440	69,615	84,588
8	14	67	6	61	6,405	7,686	5,655	6,936	75,270	91,524
9	13	62	5	57	5,985	7,182	5,235	6,432	80,505	97,956
10	12.5	60	5	55	5,775	6,930	5,025	6,180	85,530	104,136
11	12	57	4	53	5,565	6,678	4,815	5,928	90,345	110,064
12	11.5	55	4	51	5,355	6,426	4,605	5,676	94,950	115,740
13	11	52	4	48	5,040	6,048	4,290	5,298	99,240	121,038
14	11	52	4	48	5,040	6,048	4,290	5,298	103,530	126,336
15	10.5	50	3	47	4,935	5,922	4,185	5,172	107,715	131,508
16	10.5	50	3	47	4,935	5,922	4,185	5,172	111,900	136,680
17	10.5	50	3	47	4,935	5,922	4,185	5,172	116,085	141,852
18	10	48	3	45	4,725	5,670	3,975	4,920	120,060	146,772
19	10	48	3	45	4,725	5,670	3,975	4,920	124,035	151,692
20	10	48	5	43	4,515	5,418	3,765	4,668	127,800	Payout = 19 mos.
21	9.5	45	4	41	4,305	5,166	3,555	4,416	131,355	
22	9.5	45	4	41	4,305	5,166	3,555	4,416	134,910	
23	9.5	45	4	41	4,305	5,166	3,555	4,416	138,465	
24	9	43	4	39	4,095	4,914	3,345	4,164	141,810	Payout = 27 mos.
25	9	43	4	39	4,095	4,914	3,345	4,164	145,155	
26	9	43	4	39	4,095	4,914	3,345	4,164	148,500	
27	9	43	4	39	4,095	4,914	3,345	4,164	151,845	
28	8.5	41	3	38	3,990	4,788	3,240	4,038	Payout = 27 mos.	
29	8.5	41	3	38	3,990	4,788	3,240	4,038		
30	8.5	41	3	38	3,990	4,788	3,240	4,038		

1 Period of Transition  
12-14-30 18-31

West Butler  
2-31-9-19



June 4, 1981

Chevron Standard Limited  
Box 100  
Virden, Manitoba  
ROM 2C0

Attention: Mr. D. A. Zeeuwen, P. Eng.  
Area Supervisor

Dear Sir:

Re: West Butler Field  
Pilot Waterflood and Field Development

Correspondence during October 1980 between Chevron and this office which led to termination of water injection in the subject Field also indicated that Chevron was reviewing available options for development of the Field. It was indicated that both infill drilling in the pilot pattern area and development drilling outside the Unit were under consideration. At this time, we would appreciate an update on any studies which have been undertaken and your comments regarding the most likely plan of development.

The five water injection wells in the field are currently suspended subject to an expiry date of November 1, 1981. We would expect that by this date, Chevron would have had sufficient time to evaluate the alternatives and would be prepared to recommend a specific plan for production of the field.

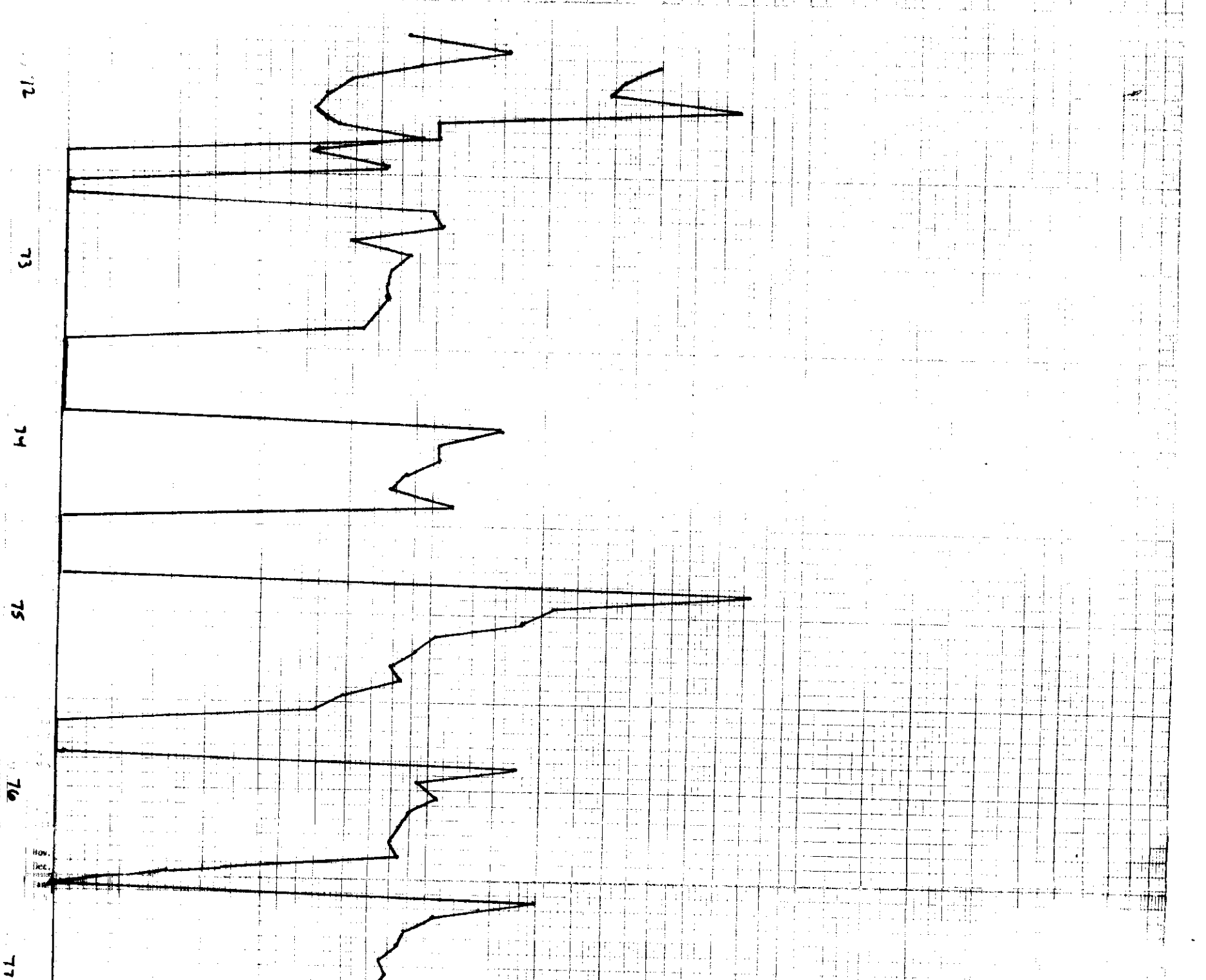
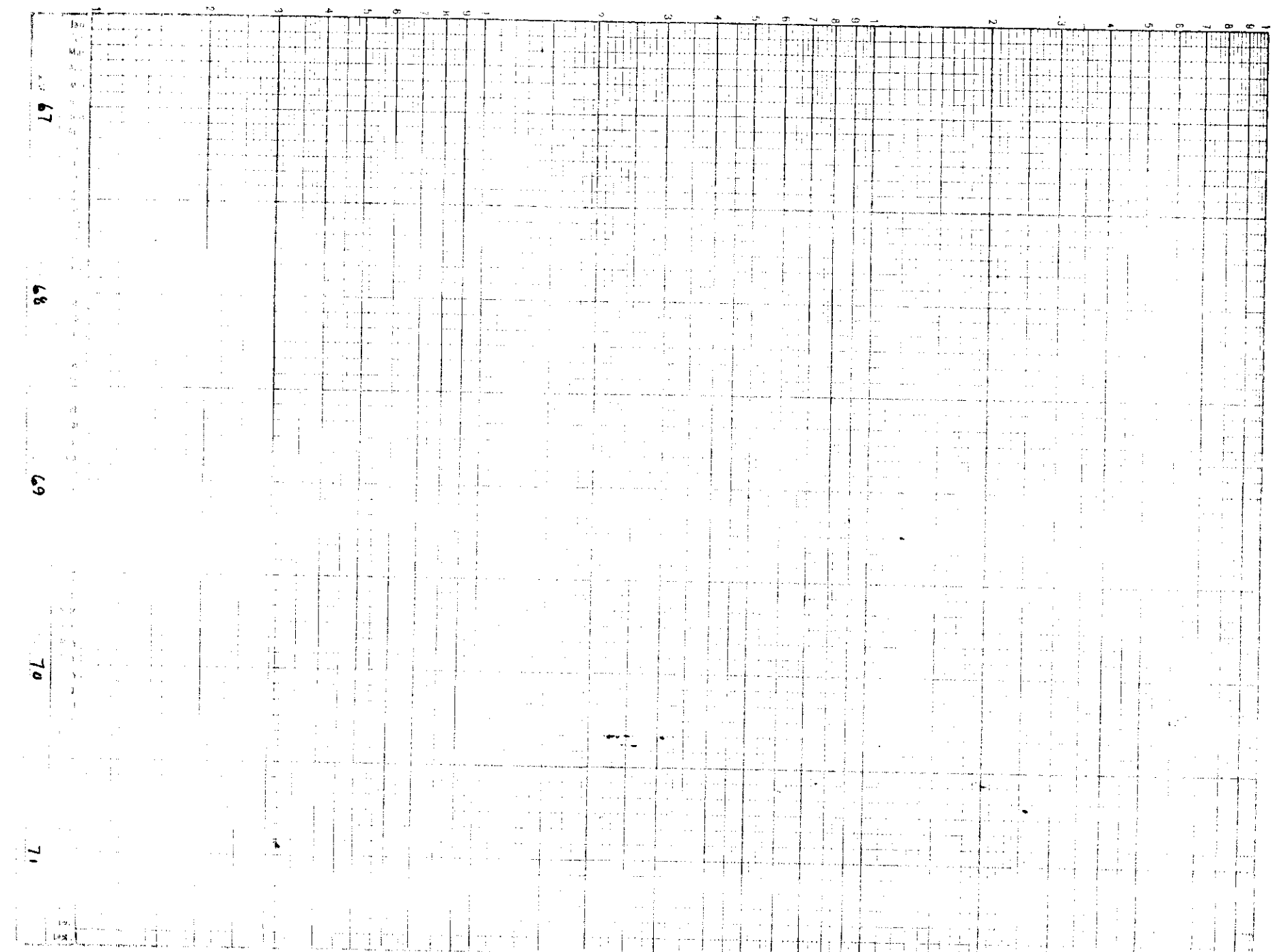
Yours sincerely,



L. R. Dubreuil  
Chief Petroleum Engineer

LRD/lk

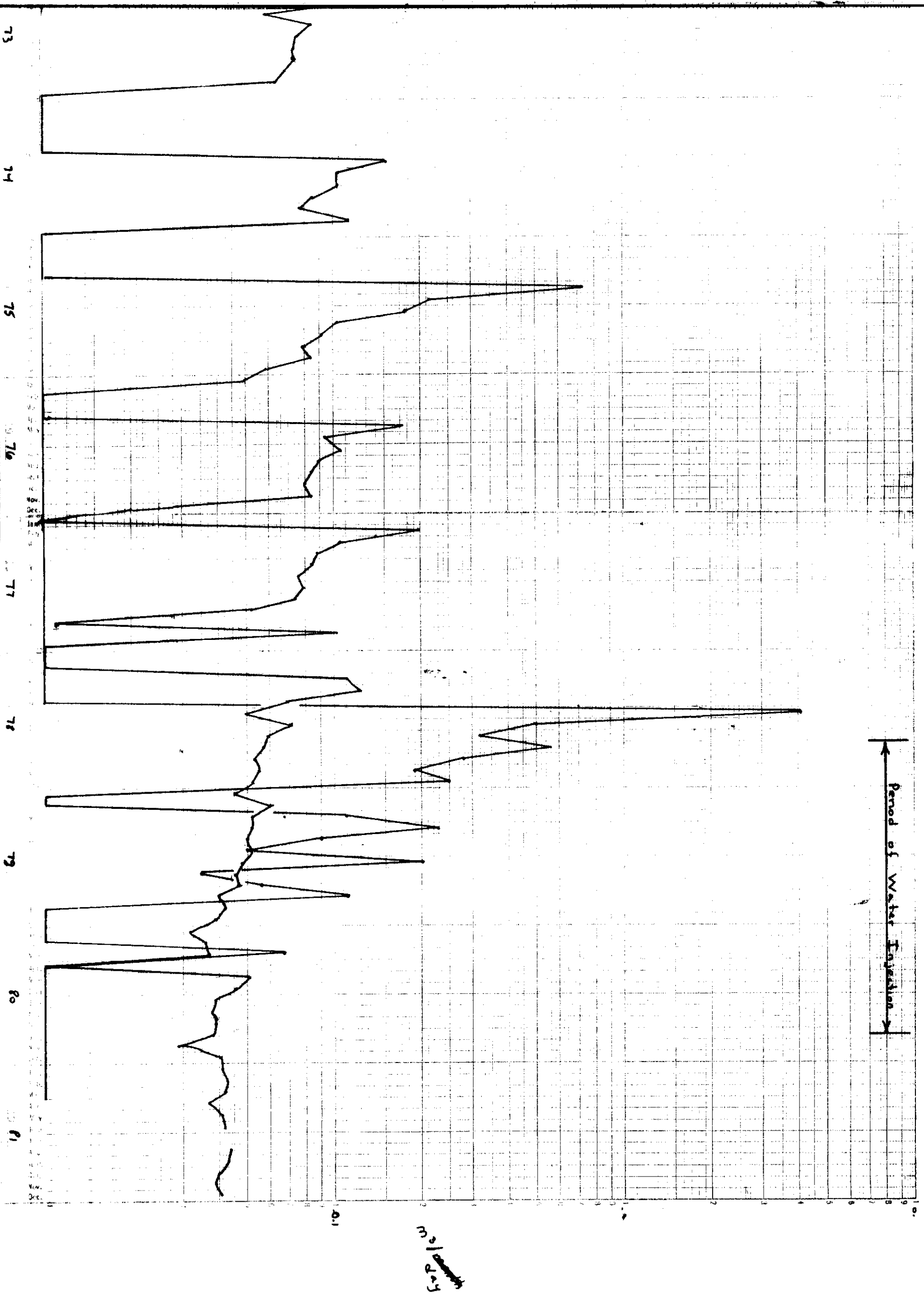
b.c. I. Haugh





West Butler  
13-29-9-29

Period of Water Injection



June 4, 1981

Chevron Standard Limited  
Box 100  
Virden, Manitoba  
R0M 2C0

Attention: Mr. D. A. Zeeuwen, P. Eng.  
Area Supervisor

Dear Sir:

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Yours sincerely,



L. R. Dubreuil  
Chief Petroleum Engineer

LRD/lk

b.c. I. Haugh

## APPENDIX A

### WEST BUTLER POOL DEVELOPMENT

#### Introduction

The West Butler pool was discovered in 1955 in the Lodgepole formation by the drilling and testing of the well Chevron West Butler 1-31-9-29. Within four months of discovery of the pool, five additional wells were drilled on 40 acre spacing directly or diagonally offsetting the discovery well. Further development of the pool was curtailed when the rapid decline in production became apparent. The field was unitized and waterflooding commenced in 1972. Water injection was suspended in 1974. The lack of production response was primarily due to insufficient water supply and subsequent insufficient water injection.

#### Geology

The West Butler field produces from limestone and dolomites in the Upper Lodgepole beds of Mississippian age. The top of the Mississippian is an erosional surface (post Mississippian unconformity). Dolomitization below the Mississippian erosional surface has occurred in all wells. Completions have been made in both the dolomite and limestone with no marked difference in the productivity of the wells. The best porosity and permeability appears to occur about 38 to 45 feet below the top of the reservoir, regardless of whether the lithology is dolomite or limestone. The oil-water interface has been estimated at -992 feet based upon drillstem test results and E-log interpretation. The gross pay interval between the top of the Mississippian and the estimated oil-water interface averages 100 to 115 feet over the developed portion of the reservoir.

The limits of the West Butler Pool are still undefined. The seismic map for a horizon near the Bakken formation appears to support a structural interpretation with a domal feature in the field area. The seismic data suggests a productive area of about three or four sections and possibly larger. The drilling of wells for primary production cannot be economically justified and therefore, the pool boundaries have not been delineated.

#### Reservoir Properties

Using a one millidarcy cutoff the average net pay for the West Butler pool is 48.8 feet, the average porosity is 10.8 percent and the average permeability is 11.8 millidarcies. However, for the purposes of evaluating a waterflood project, an additional restriction was imposed upon the net pay. The net pay includes only intervals of 1.5 feet of continuous section having permeabilities greater than one millidarcy. This was done to eliminate isolated thin stringers of permeability which would contribute little to a waterflood project. Using this additional cutoff, the average net pay is 24.7 feet, the average porosity is 10.6 percent and the average permeability is 8.2 millidarcies. Using established reservoir parameters (1), the original oil in place per 40 acre spacing unit is 500,000 STB. Reserve parameters are summarized in Table 1.

### Performance Review

The rapid decline in production rates during primary production is attributed to low reservoir permeability and lack of an effective reservoir drive mechanism. The pool was approaching the end of its productive life on primary production when waterflooding was commenced in 1972. Waterflooding to increase production rates and ultimate recovery offered the only alternative to abandonment of the pool at that time.

The major contributing factor to the lack of success of the waterflood is deemed to be the lack of an adequate water supply for injection purposes. Approximately one third of the reservoir voidage created by preunit and unit production has been replaced by water injection. It is considered unlikely that any response will be evident until at least half of the reservoir voidage is replaced. The second factor contributing to the lack of success of the waterflood is the absence of an injection pattern configuration, i.e., a confined 5-spot injection pattern. The injection of water is largely uncontrolled unless an injection pattern configuration is established. Thus, the success or failure of a waterflood project is difficult to evaluate unless a pattern configuration is developed.

In view of the potential for the West Butler area and the need for adequate testing of production response, the following recommendations are made:

1. An adequate water supply must be developed to provide sufficient water for a waterflood.
2. A pilot 5-spot injection pattern should be developed as shown on Figure 1 to realistically evaluate production response. If production response is adequate, then expansion of the waterflood can be justified.

The above recommendations are the basis for the two following proposals:

#### Proposal No. 1

It is proposed that a pilot waterflood be initiated as illustrated on Figure 1. A water supply well would be drilled to the Devonian zone at an estimated depth of 4230 feet. The Devonian formation has been found to be an excellent source of water supply in the Virden area. Sustained rates of water production of 4000 BWPD have been obtained from the Devonian zone. The water has been found suitable for injection in the Mississippian zones in the Virden Scallion and Virden Roselea pools with little or no water treatment required. Three additional water injection wells would be drilled offsetting the present producer 13-29-9-29 WPM. The existing injector 16-30-9-29 WPM and injection facilities would be used for the pilot waterflood.

The investment required to initiate the pilot waterflood is estimated to be \$619,000. Details of the investment and economics are shown on Table 2. The pilot waterflood economics are substandard even if the pilot

is successful and the central producing well responds at 25 EOPD. In view of the large investment and the risk involved, Chevron Standard Limited would not normally participate in a project of this nature. Therefore, it is proposed, that if the pilot waterflood fails, the full investment should be credited to Chevron Standard out of royalty payments on other Manitoba properties. An evaluation of the pilot waterflood would be required to determine if further development is warranted.

#### Proposal No. 2

If the results of the pilot waterflood indicate that expansion of the waterflood is warranted, drilling and enlarging of the waterflood project would commence. It is postulated that a four section project could develop as illustrated on Figure 2. The Devonian water supply well drilled for the pilot waterflood will be adequate to supply the water requirements for a project of this size. It is estimated that additional investment of \$8,917,000 will be required to complete the four section project. Details of investment and economics are shown on Table 3. Chevron Standard Limited proposes that the royalty be waived until the project fully pays out; i.e., all costs are recovered for the expanded waterflood including the pilot waterflood costs.

#### Summary

The potential of the West Butler Pool warrants further development. It is recognized that a high degree of uncertainty is involved in the waterflooding of the West Butler pool. The main uncertainty is the degree of production response that might be achieved upon waterflooding. Chevron Standard Limited believes that the proposed pilot waterflood project is the best method of evaluating waterflood response. The two proposals offered minimize the investment risks involved to Chevron Standard. The Manitoba Government also benefits through additional royalties if further development of the West Butler pool can be justified.

#### References

- (1) S. N. Borowski, Feasibility of Secondary Recovery - West Butler Field. December 1971. (Part of Application to Waterflood West Butler dated 1972-05-19.)

TABLE 1  
RESERVES PARAMETERS  
WEST BUTLER AREA

Connate Water:	35% (restored state method for 13 cores from well 2-31-9-29 averaged 34.3%)
Reservoir Temperature:	82°F (Drillstem test data)
Original Bottom Hole Pressure:	1050 psig (Drillstem test data)
Saturation Pressure:	220 psig (fluid sample from Daly well 6-32-9-29)
Initial Formation Volume Factor:	1.07 Res. Bbls./STB
Crude Viscosity at 0 psig & 82°F:	5.35 cp
Crude Viscosity at 600 psig & 82°F:	3.48 cp
Gravity of Stock Tank Crude at 60°F:	33 API
Footage Weighted Average Porosity:	1 md cutoff - 10.8% 1 md cutoff and 1.5 feet continuous section - 10.6%
Footage Weighted Average Permeability:	1 md cutoff - 11.4 md 1 md cutoff and 1.5 feet continuous section - 8.2 md
Median Permeability:	4.6 md
Permeability Variation:	0.73
Average Net Pay:	1 md cutoff - 48.8 ft. 1 md cutoff and 1.5 feet continuous section - 24.7 ft.
Original Oil in Place:	= 7756 Ø (1 - Sw)/Boi = 7756 x 0.106 (1 - 0.35)/1.07 = 499 STB/Acre Foot
OOIP per 40 Acre Spacing Unit:	= 499 Ah = 499 x 40 x 25 = 500,000 STB

TABLE 1 Cont'd.

OOIP in Present 200 Acre Project:	2,500,000 STB
OOIP in 4 Section Project:	32,000,000 STB
Primary Recovery Factor:	6.4% (decline curve analysis)
Estimated Primary Recovery:	
40 Acre Spacing Unit	32,000 STB
200 Acre Project	160,000 STB
4 Section Project	2,048,000 STB
<u>Waterflood Recovery Factors</u>	
Mobility Ratio:	0.50
Displacement Efficiency:	Ed - 34% at Terminal WOR = 25:1
Vertical Coverage Efficiency:	Ev - 88% at Terminal WOR = 25:1
Areal Sweep Efficiency:	Ea - 94%
Waterflood Efficiency:	Ed x Ev x Ea = 28.1%
Estimated Waterflood Recovery:	
Present 200 Acre Project	700,000 STB
4 Section Project	8,990,000 STB
Proposed 80 Acre Pilot Project	280,000 STB

(Data summarized from Reference 1)

TABLE 2  
PILOT WATERFLOOD PROJECT  
WEST BUTLER FIELD

Investment

1977 Investment

3 Injection Wells	\$333,300
Water Source Well	130,900
Water Supply Well Pump	20,000
Power Costs	35,000
Injection Lines	6,600
Sub Total	525,800
Dry Hole Risk Investment	92,800
TOTAL	\$618,600

Assumptions

1. The wellhead price of crude will be \$9.485 per barrel.
2. Waterflood response would be evident after six months injection at a rate of 25 BOPD from the central pilot producing well. Production would remain constant until 140,000 Bbls. of oil are produced. Production would then decline at approximately 9.5 percent per year until 236,000 Bbls. oil are produced. The final production rate would be 9 BOPD. The project life would be 34 years.
3. Old royalty rates would apply with the pilot producing well being allocated one half of its production for royalty purposes. The remaining one-half production will be allocated to offsetting injection wells at the same royalty rate.
4. Injection rates would be 100 BWPD per injector initially. Fill up and production response would be evident after six months.
5. Pilot project operating cost would be \$22,000 per year.

Economics

Three economic evaluations were made as follows:

Case 1 - base case with payment of normal royalties.

Case 2 - no royalties.

Case 3 - payment of normal royalties commences after the project is paid out.



TABLE 2 cont'd

	<u>Case 1</u>	<u>Case 2</u>	<u>Case 3</u>
Project Payout Period - Years	9.8	7.1	7.1
Rate of Return - %	6.5	10.4	8.6
Royalty Barrels - M. Bbls.	36	0	26
Working Interest Barrels - M. Bbls.	200	236	210
Value of Royalty Oil - Undiscounted			
M. \$	339	0	245
Discounted at 10%	114	0	52
Present Worth Profit - M\$			
Discounted at 10%	-84	12	-31
Discounted at 20%	-217	-166	-180

TABLE 3  
EXPANDED WATERFLOOD  
WEST BUTLER FIELD

Investment

1977 Investment

Pilot Waterflood (Table 1)	\$ 618,600
----------------------------	------------

1978 Investment

15 Injection Wells	1,666,500
15 Producers	1,996,500
Water Plant and Battery	60,000
Injection Lines	61,000
Flow Lines	77,000
Sub Total	3,861,000
Dry Hole Risk Investment	836,000
1978 TOTAL	\$4,697,000

1979 Investment

12 Injection Wells	1,333,000
15 Producers	2,996,000
Injection Lines	61,000
Flow Lines	72,000
Sub Total	3,467,700
Dry Hole Risk Investment	752,400
1979 TOTAL	\$4,220,100

GRAND TOTAL	\$9,535,700
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Assumptions

1. The wellhead price of crude will be \$9.485 per barrel.
2. Development of the expanded waterflood will follow the pilot waterflood. Production rates of 33 BOPD will be sustained until approximately one half of the reserves are recovered. Production will then decline at approximately 7.5 percent per year until 8.3 million barrels of oil are produced. The final production rate will be 7 BOPD per well. The project life will be 34 years.
3. Old royalty rates would apply to production from present unit wells. Production from new wells would be subject to new royalty rates.
4. Injection rates will be sufficient to meet voidage, approximately 35 BOPD per well throughout the life of the project.
5. Operating costs for the fully developed project would be \$270,000 per year.

TABLE 3 cont'd

Economics

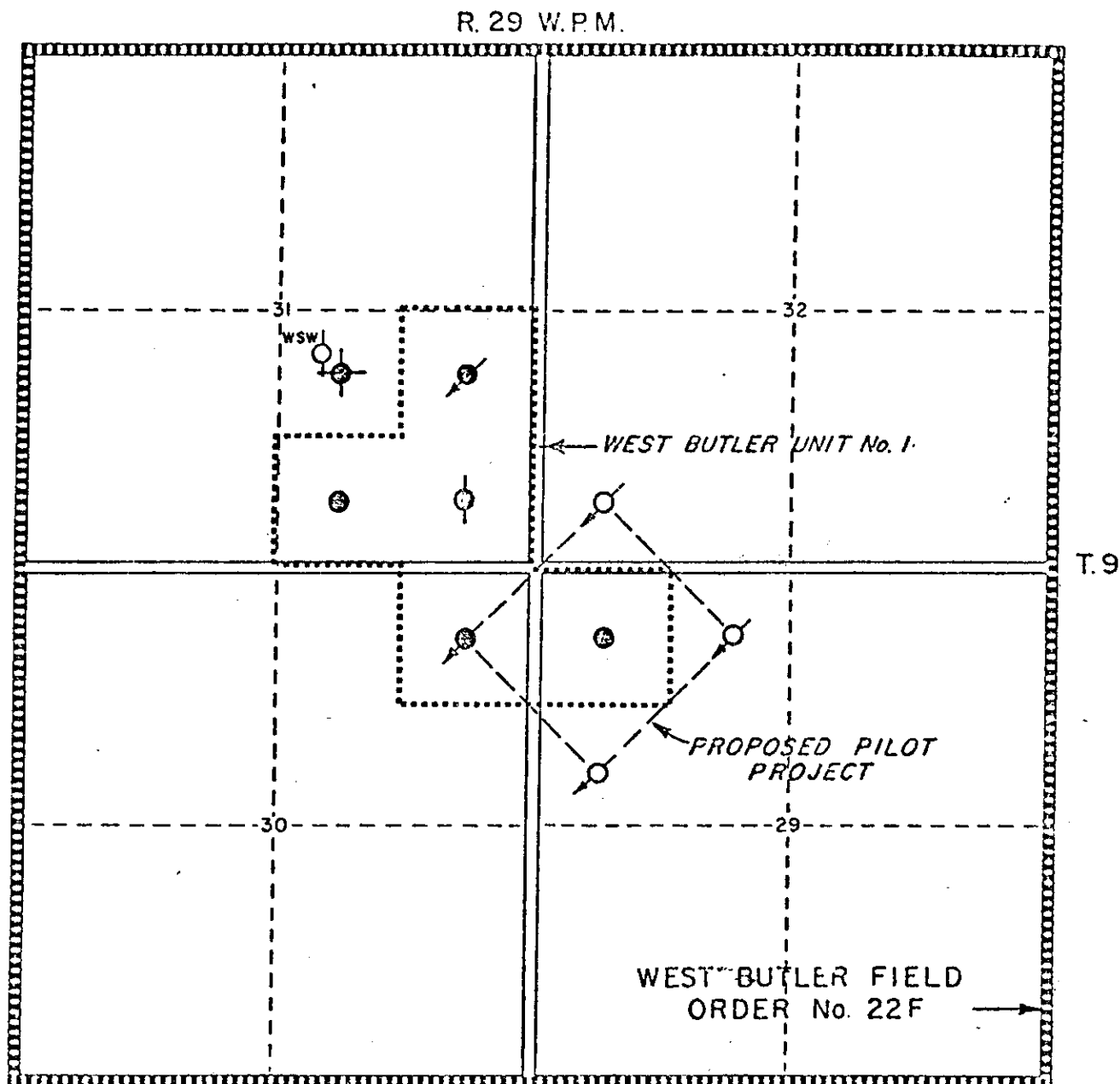
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Case 1 - base case with payment of normal royalties.

Case 2 - no royalties.

Case 3 - payment of normal royalties commences after the project is paid out.

	<u>Case 1</u>	<u>Case 2</u>	<u>Case 3</u>
Project Payout Period - Years	5.0	4.2	4.2
Rate of Return - %	28.3	38.6	34.5
Royalty Barrels - M. Bbls.	1,254	0	1,060
Working Interest Barrels - M. Bbls.	7,015	8,269	7,209
Value of Royalty Oil -			
Undiscounted - M\$	11,885	0	10,045
Discounted at 10%	4,350	0	3,018
Present Worth Profit - M\$			
Discounted at 10%	6,043	9,741	7,175
Discounted at 20%	1,463	3,372	2,312



# LEGEND




-  INJECTION WELL
-  SUSPENDED WELL
-  WSW WATER SOURCE WELL

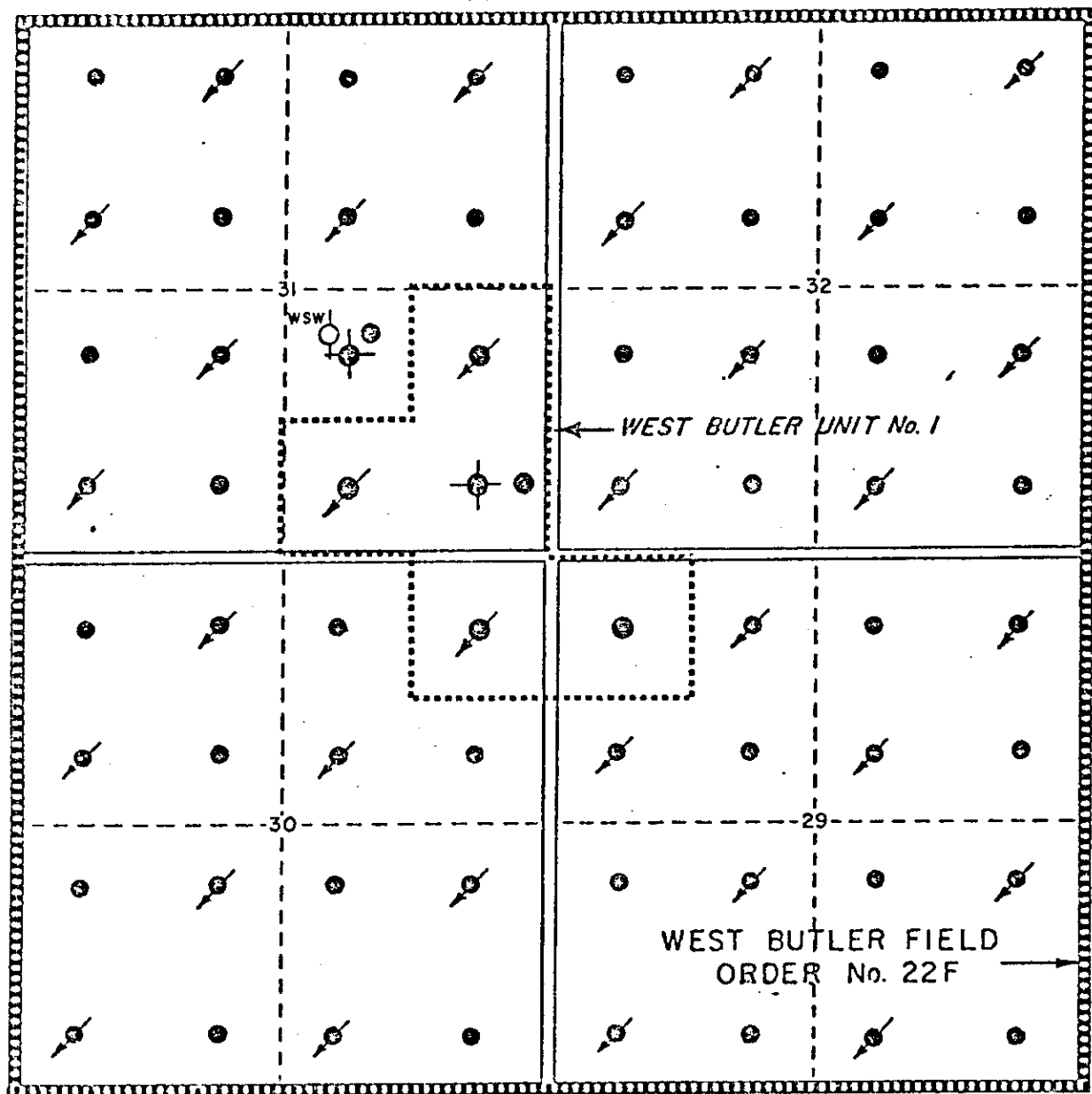
FIGURE 1

DEVELOPMENT OF A PILOT PROJECT

WEST BUTLER FIELD

SCALE: 3" = 1 MILE

R. 29 W.P.M.



T.9

LEGEND




-  INJECTION WELL
-  SUSPENDED WELL
-  WSW WATER SOURCE WELL

FIGURE 2  
DEVELOPMENT OF A FOUR SECTION PROJECT  
WEST BUTLER FIELD

SCALE: 3" = 1 MILE

## APPENDIX B: E-LOGS

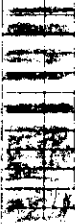
12-29

2600

ZONES OF PERMEABILITY  
INDICATED BY  
ORANGE SHADING

900

2700



SP CURVE

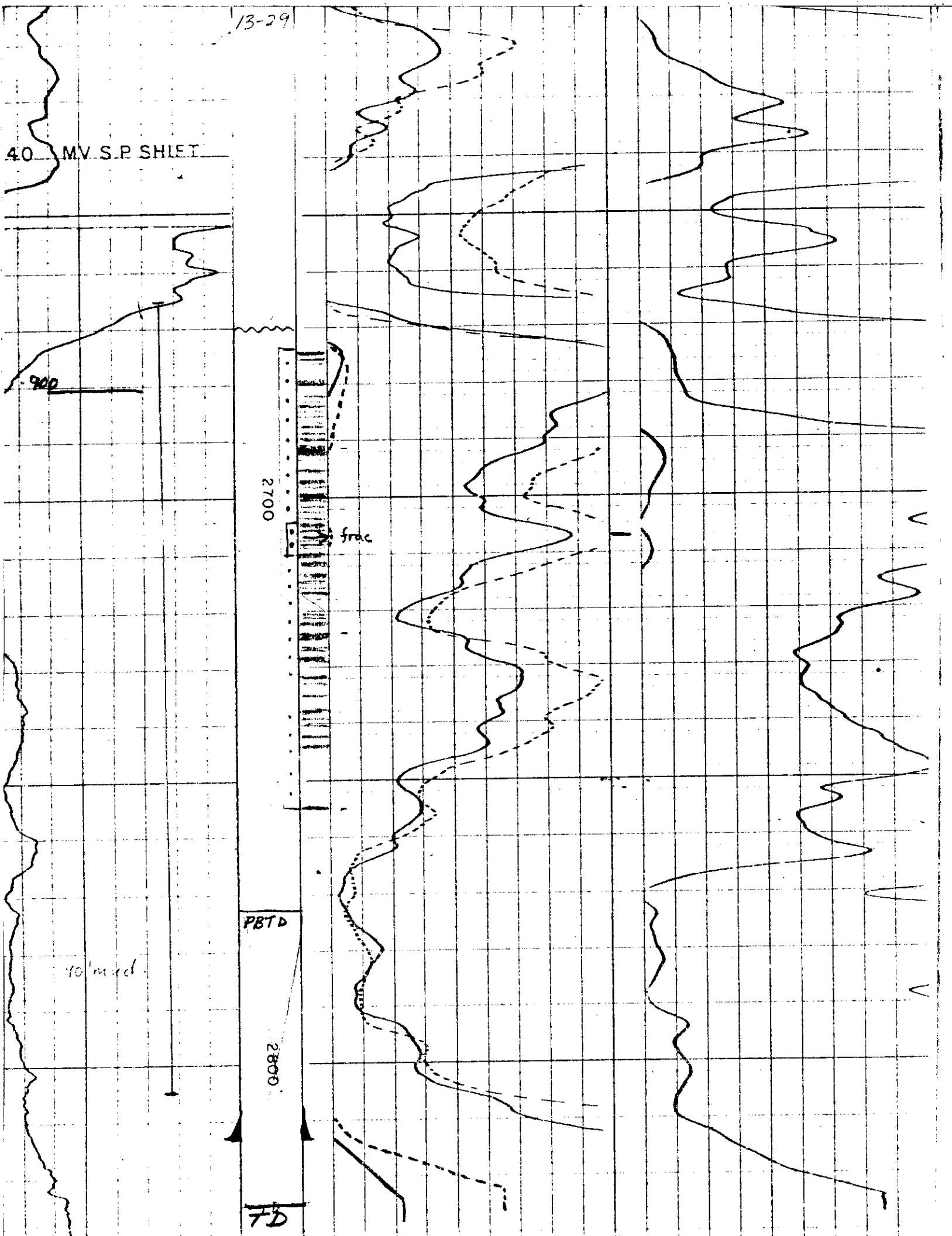
FR

SFL-E

MEDIUM INDUCTION

13-29

40 MV S.P. SHIFT



900

2700

frac

PBTD

2800

7D

med



14-29

2600

-900

2700

SP Curve

MEDIUM INDUCTION  
DEEP INDUCTION

Log SFI -

FR

FR

FR

H-30

E 20 MV S.P.

-920

2700

concrete plug

frac

PBTD

-1000

TD

T.D. SWSC 2795  
T.D. DRLR 2795  
F.R. SWSC 2794

THE CALIFORNIA STANDARD CO.

1-31

(ZONE OF PERMEABILITY  
INDICATED BY  
ORANGE SHADING)

20 MV SP. SHIRT

900

180' on

20' mud

WAB. + 1000 ft  
40  
D.G.M.

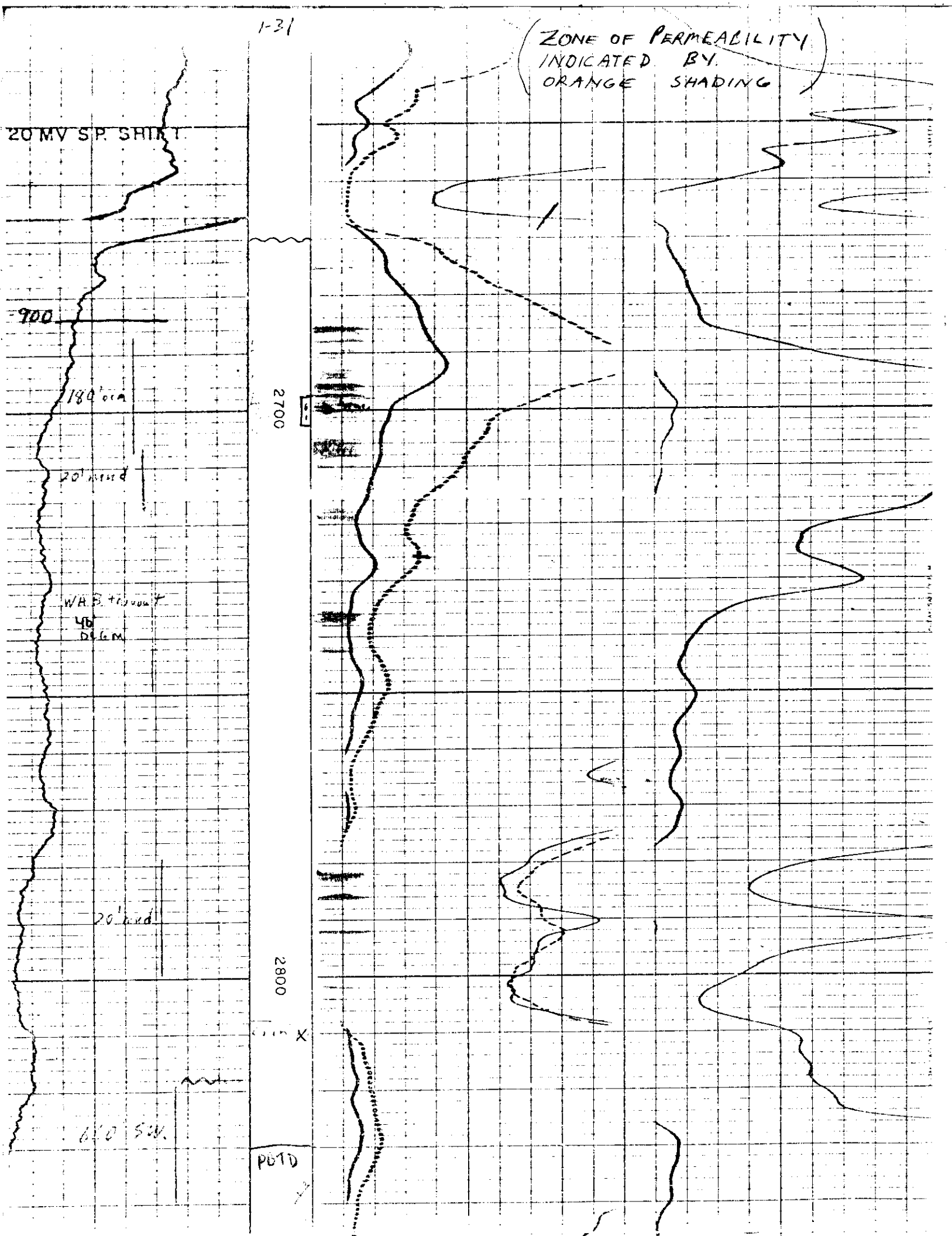
20' mud

6' 0" S.W.

2700

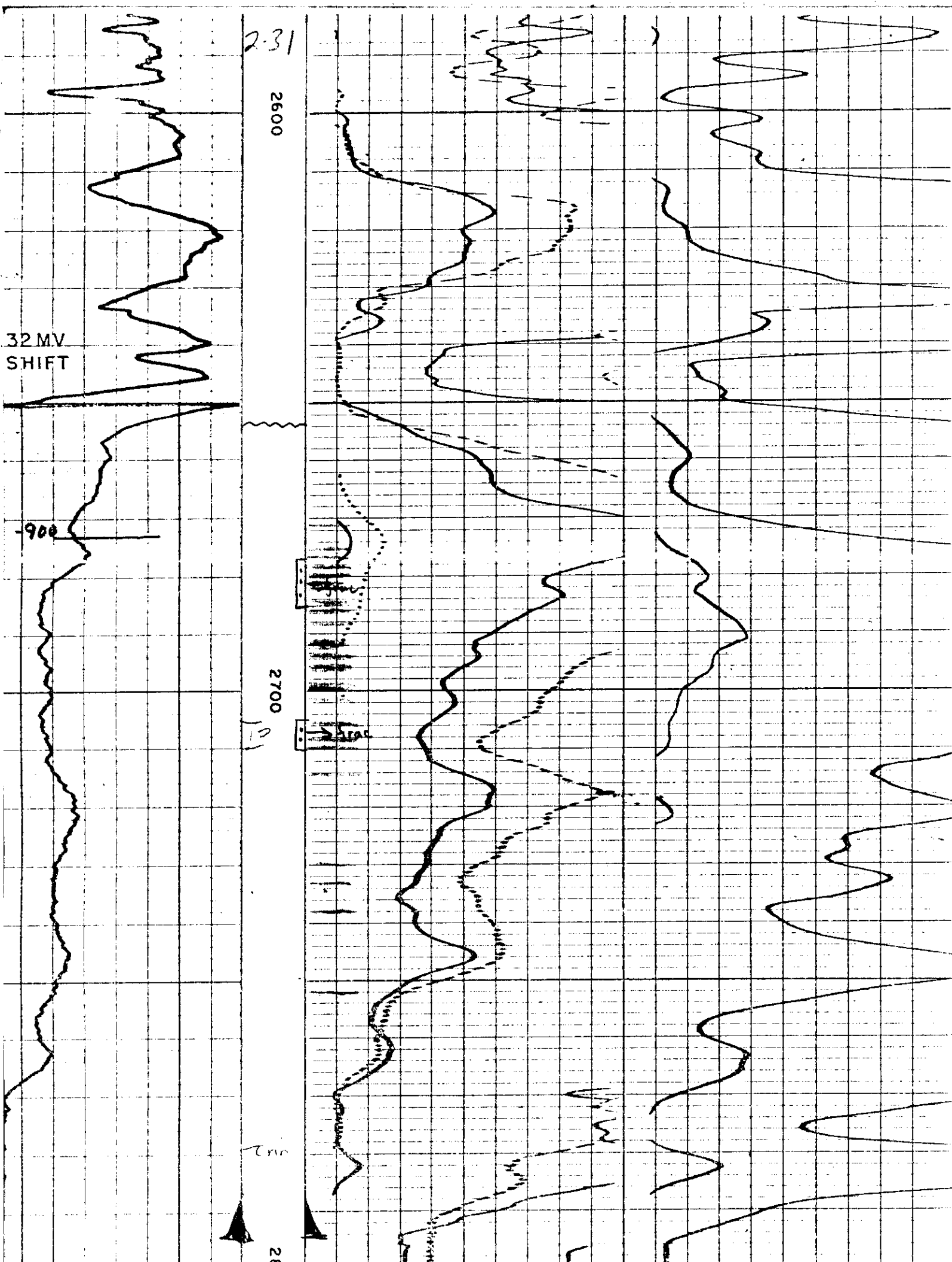
2800

POTD



28

-900



0 200  
0 2000

2600  
7.31

BMV S P SHIFT

900

2700

P870

T.O. SISC 2772

T.O. DNR 2771

40MV S.P. SHIFT

8-31

-900

46' mod

2700

60' mod

PATP

2800

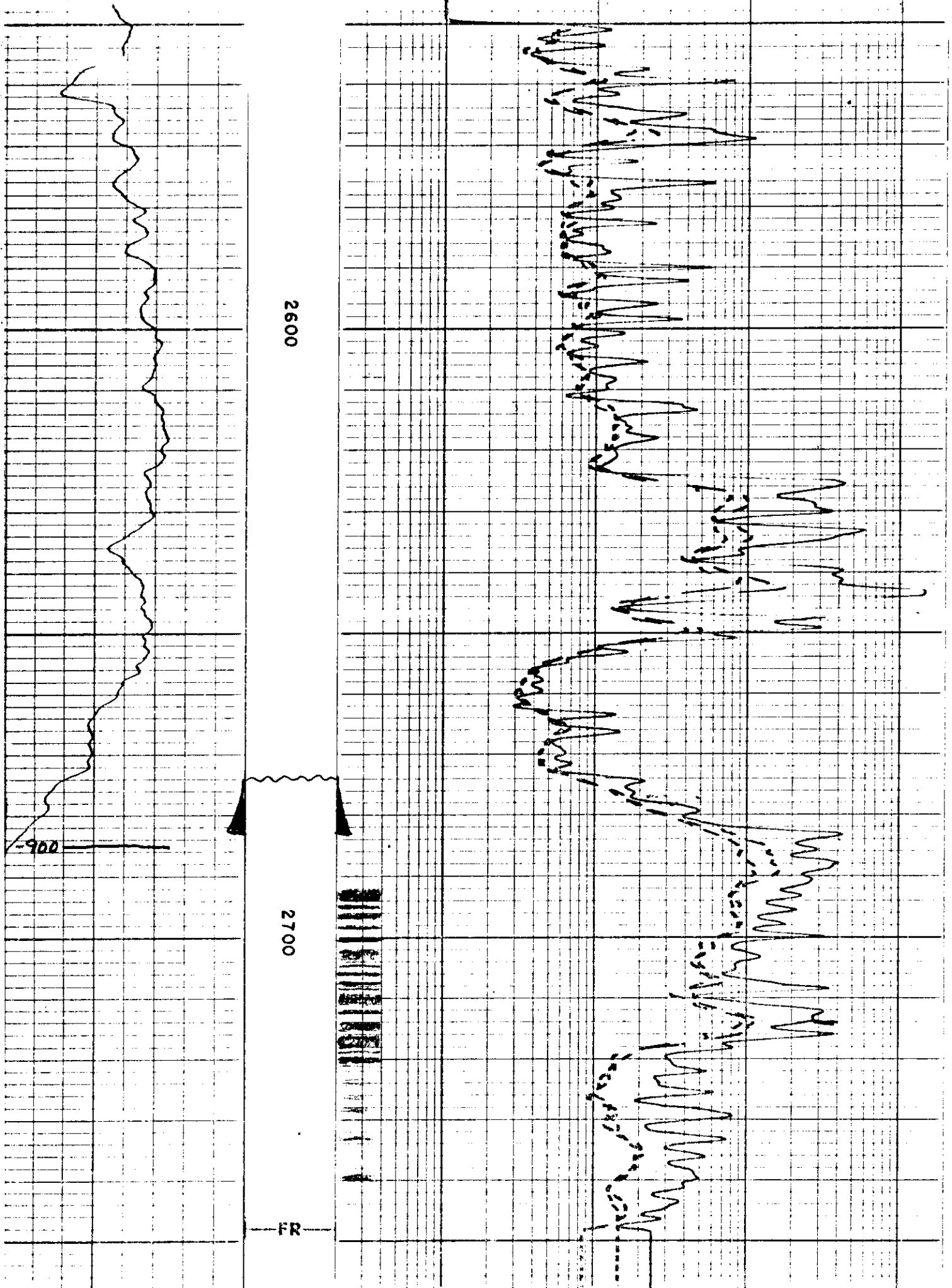
1300' SW

T.D. SWSC 2814  
T.D. DRLR 2814  
F.R. SWSC 2813

THE CALIFORNIA STANDARD CO.

CALIFORNIA STANDARD WEST BUTLER # 8-31

4-32

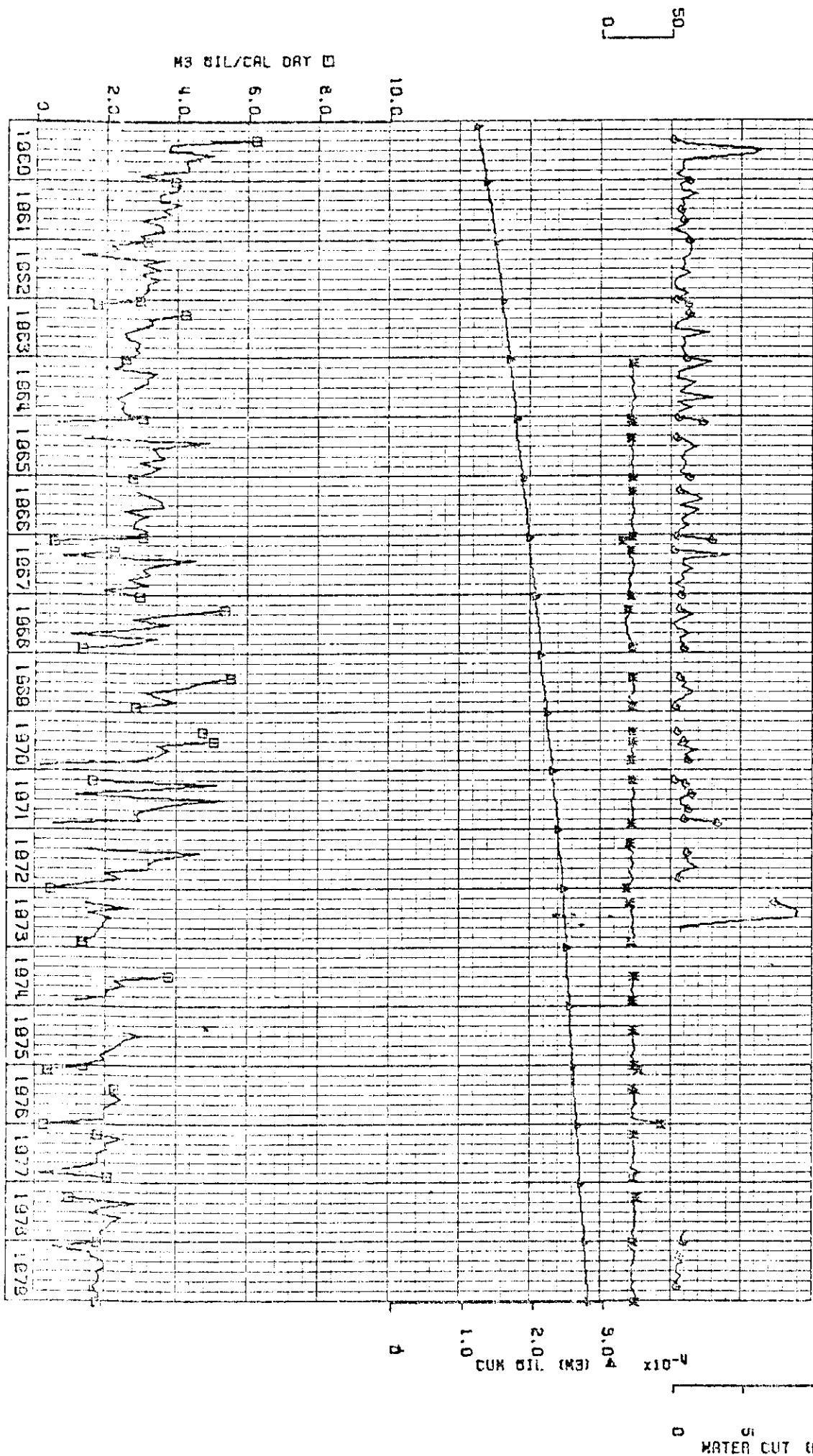


## APPENDIX C : PRODUCTION DATA



# WEST BUTLER PRODUCTION PLOT

## SUMMARY

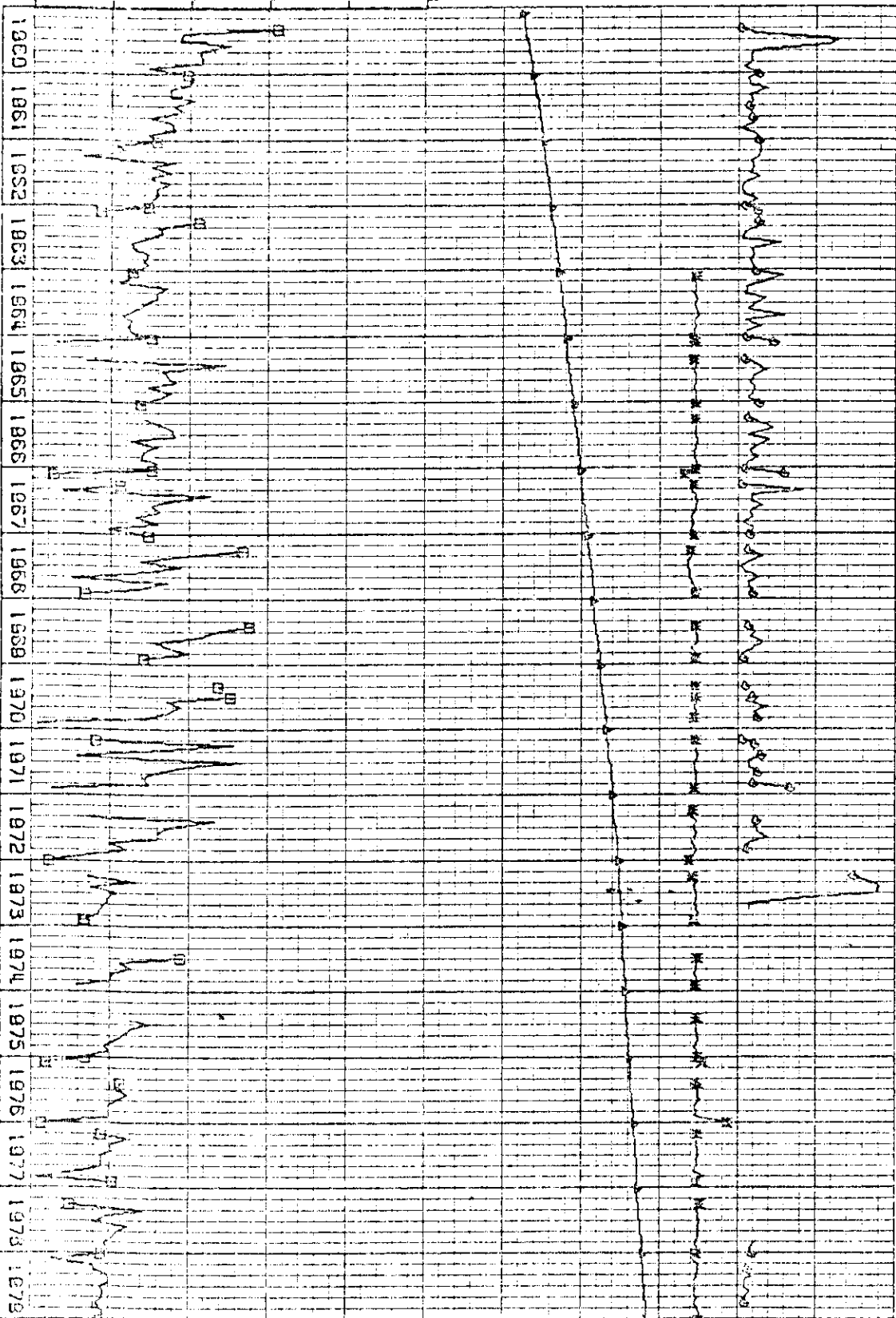


60R (M3/M3)

50  
0

M3 BIL/CAL DAY

10.0  
8.0  
6.0  
4.0  
2.0  
0

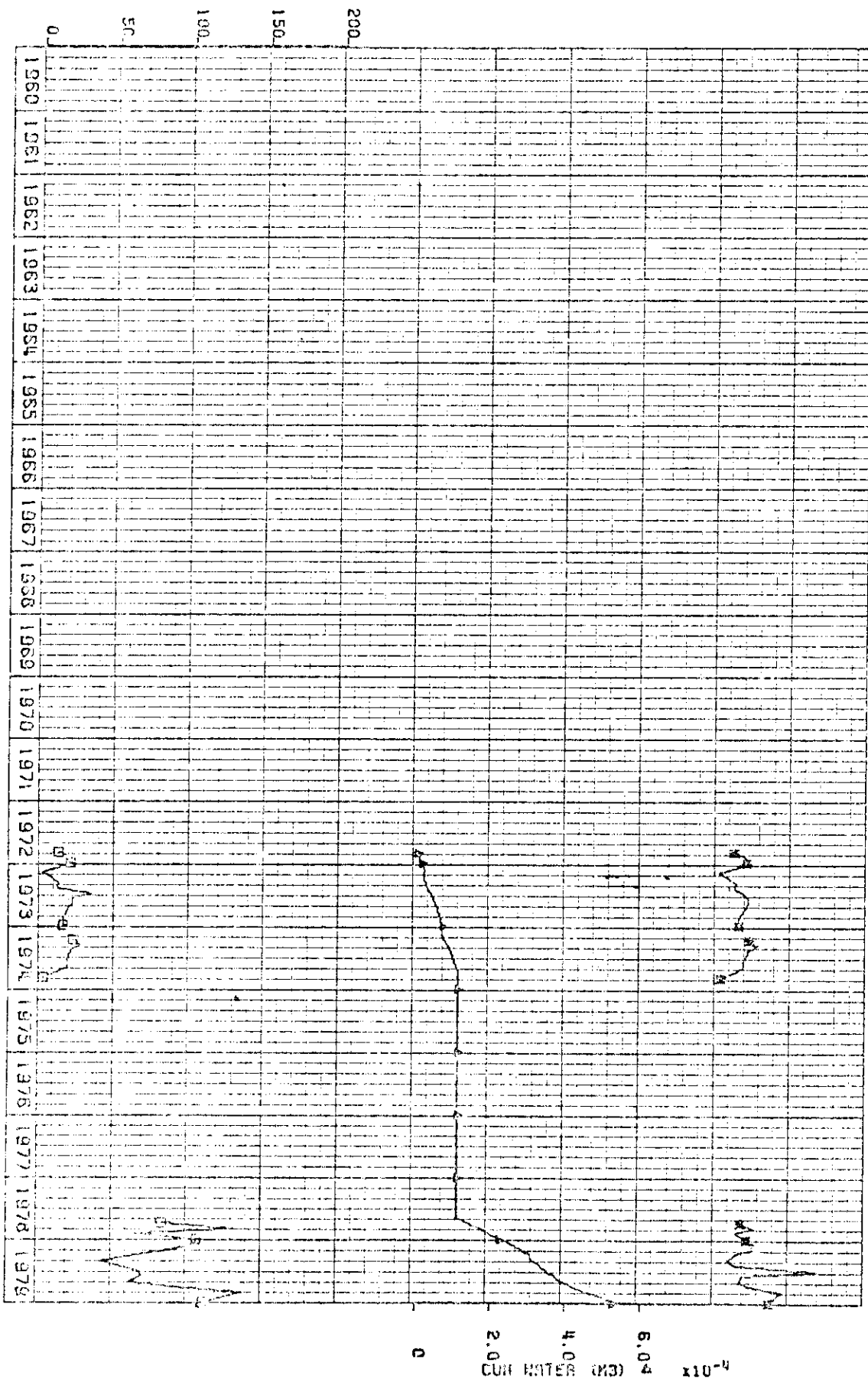


5.0  
4.0  
3.0  
2.0  
1.0  
0

WATER CUT (PC) & X 10<sup>1</sup>

20  
10  
0

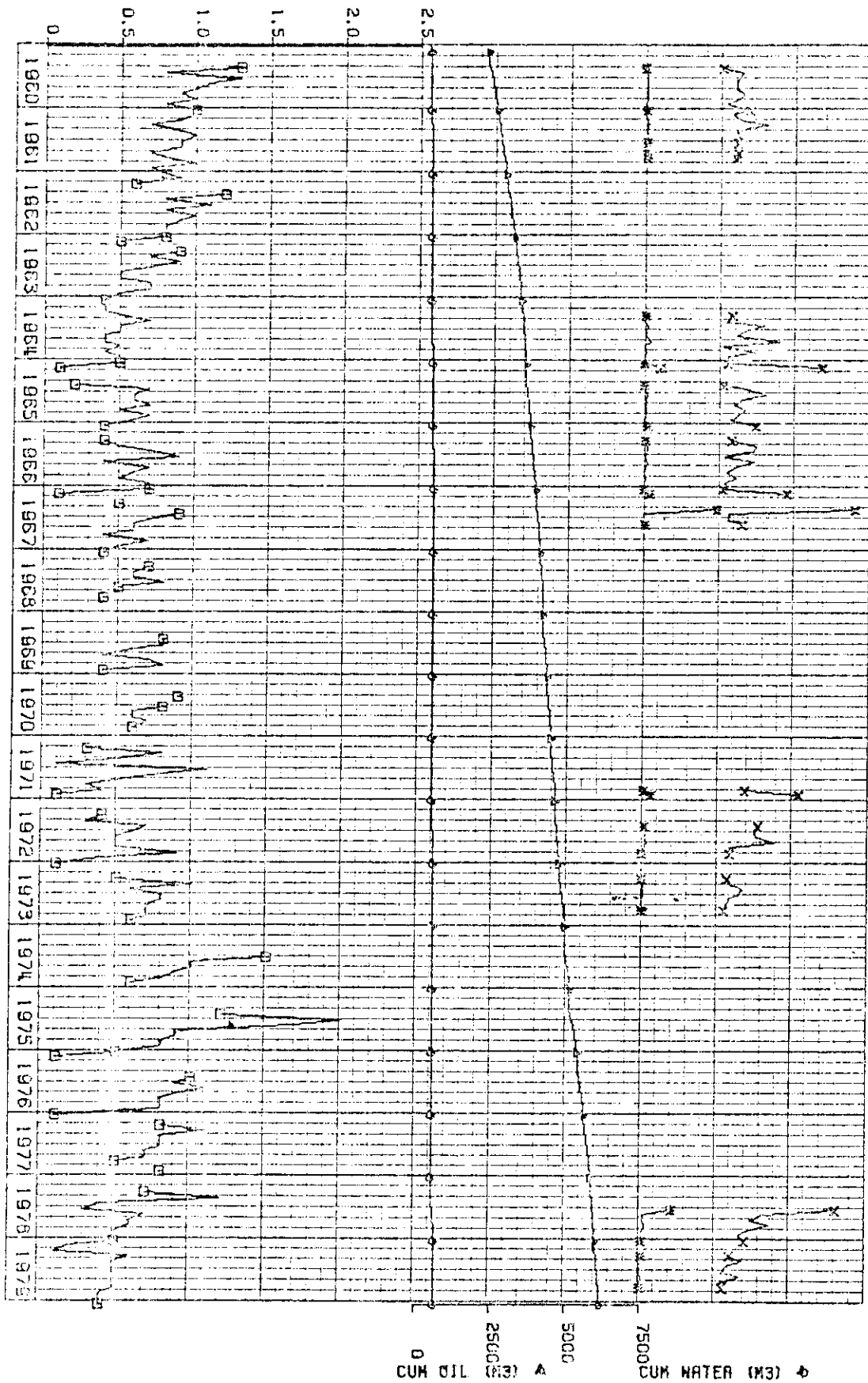
M3 WATER/CAL DRY D



WEST BUTLER  
INJECTION PLOT  
SUMMARY

10  
0

M3 OIL/CRL DRY □



WEST BUTLER  
PRODUCTION PLOT  
13-29-009-29M1

10  
5  
0

WATER CUT (PC) X x 10<sup>1</sup>

# WEST BUTLER PRODUCTION PLOT 02-31-009-29M1

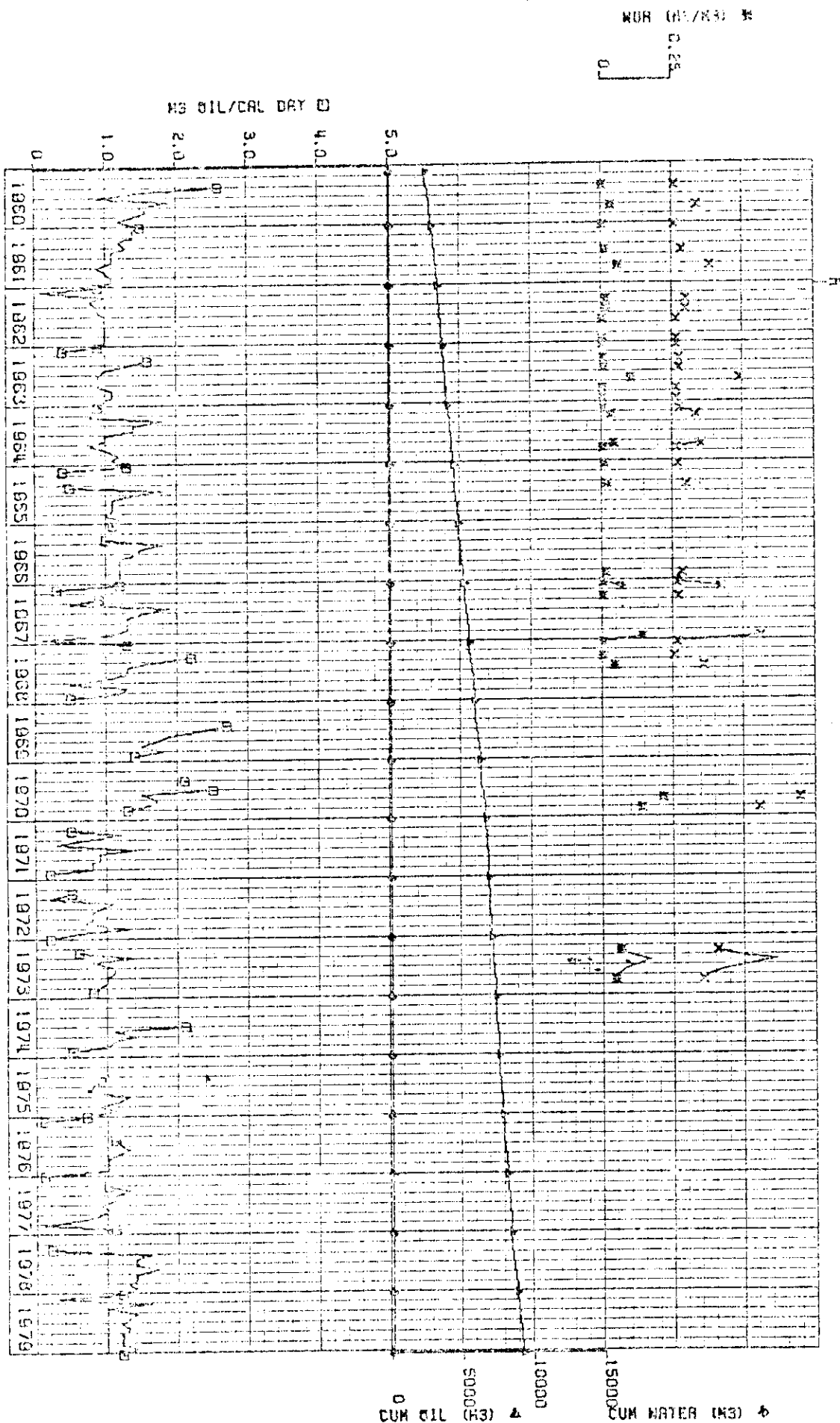


TABLE 2

Month	Production BOPD	Production (m <sup>3</sup> /mo.)	Crown Royalty (m <sup>3</sup> /mo.)	Producer's Share (m <sup>3</sup> /mo.)	Producer's Revenue @ \$105/m <sup>3</sup> (\$16.75/bbl.)	Producer's Revenue @ \$126/m <sup>3</sup> (\$20.00/bbl.)	Producer's Netback @ \$105/m <sup>3</sup>	Producer's Netback @ \$126/m <sup>3</sup>	Cumulative Netback @ \$105/m <sup>3</sup>	Cumulative Netback @ \$126/m <sup>3</sup>
1	40	191	26	165	17,325	20,790	16,575	20,040	16,575	20,040
2	30	143	18	125	13,125	15,750	12,375	15,000	28,950	35,040
3	25	119	14	105	11,025	13,230	10,275	12,480	39,225	47,520
4	22	105	12	93	9,765	11,718	9,015	10,968	48,240	58,488
5	20	95	10	85	8,925	10,710	8,175	9,960	56,415	68,448
6	17.5	83	8	75	7,875	9,450	7,125	8,700	63,540	77,148
7	15	72	7	65	6,825	8,190	6,075	7,440	69,615	84,588
8	14	67	6	61	6,405	7,686	5,655	6,936	75,270	91,524
9	13	62	5	57	5,985	7,182	5,235	6,432	80,505	97,956
10	12.5	60	5	55	5,775	6,930	5,025	6,180	85,530	104,136
11	12	57	4	53	5,565	6,678	4,815	5,928	90,345	110,064
12	11.5	55	4	51	5,355	6,426	4,605	5,676	94,950	115,740
13	11	52	4	48	5,040	6,048	4,290	5,298	99,240	121,038
14	11	52	4	48	5,040	6,048	4,290	5,298	103,530	126,336
15	10.5	50	3	47	4,935	5,922	4,185	5,172	107,715	131,508
16	10.5	50	3	47	4,935	5,922	4,185	5,172	111,900	136,680
17	10.5	50	3	47	4,935	5,922	4,185	5,172	116,085	141,852
18	10	48	3	45	4,725	5,670	3,975	4,920	120,060	146,772
19	10	48	3	45	4,725	5,670	3,975	4,920	124,035	151,692
20	10	48	5	43	4,515	5,418	3,765	4,668	127,800	Payout = 19 mos.
21	9.5	45	4	41	4,305	5,166	3,555	4,416	131,355	
22	9.5	45	4	41	4,305	5,166	3,555	4,416	134,910	
23	9.5	45	4	41	4,305	5,166	3,555	4,416	138,465	
24	9	43	4	39	4,095	4,914	3,345	4,164	141,810	
25	9	43	4	39	4,095	4,914	3,345	4,164	145,155	
26	9	43	4	39	4,095	4,914	3,345	4,164	148,500	
27	9	43	4	39	4,095	4,914	3,345	4,164	151,845	
28	8.5	41	3	38	3,990	4,788	3,240	4,038	Payout = 27 mos.	
29	8.5	41	3	38	3,990	4,788	3,240	4,038		
30	8.5	41	3	38	3,990	4,788	3,240	4,038		

BOPD

40

30

20

10

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	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC												
1956												1957												1958												1959												1960											

WEST BUTLER T9 R 29 WPM

CROSS SECTIONS LOCATIONS

32

31

⊗

A

⊗

C'

⊗

B

B'

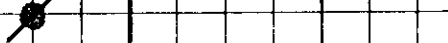
⊗

30

29

A'

C



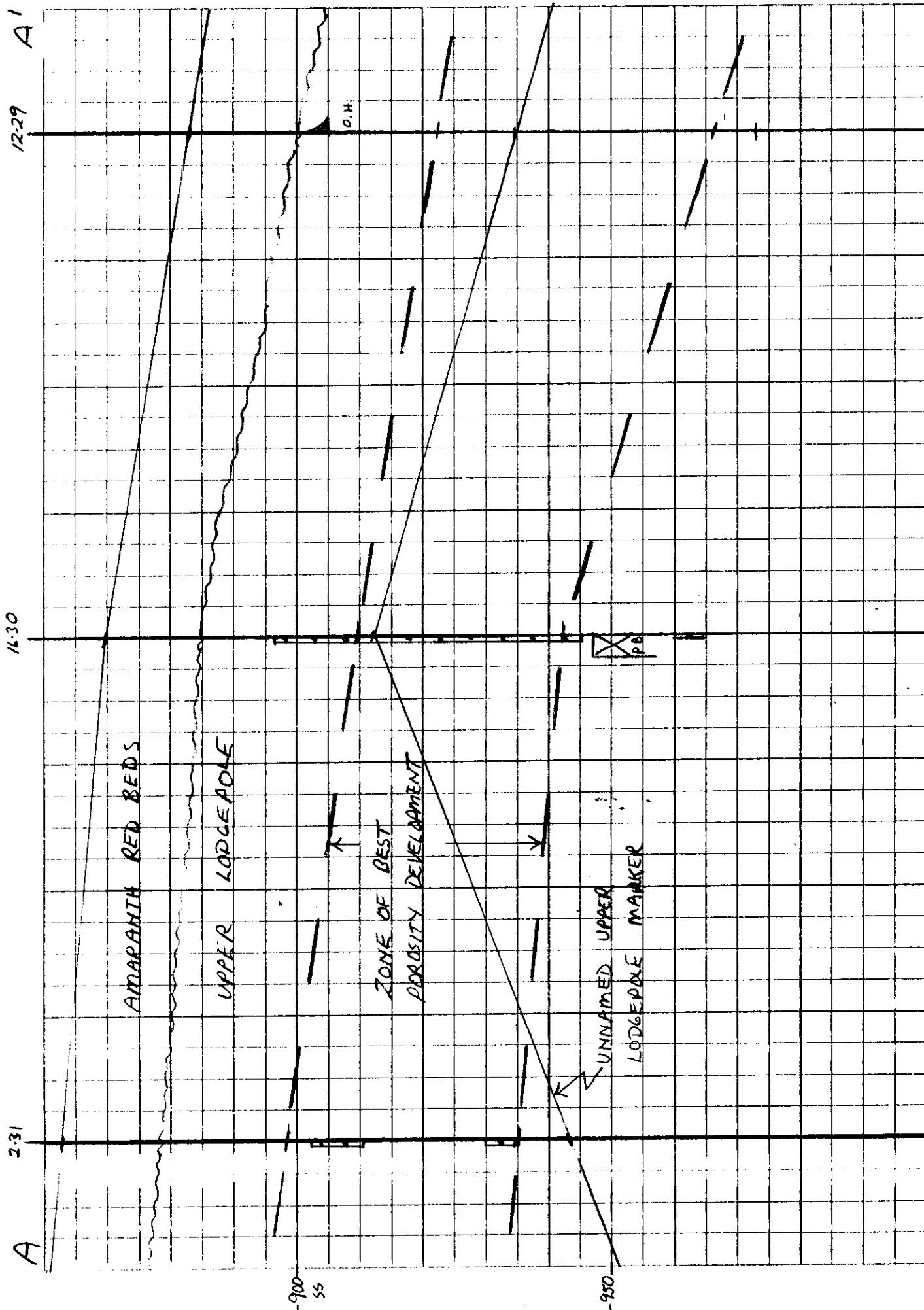


FIG. 3 CROSS-SECTION A-A'





EDUCATIONAL SETTING  
MADE IN U.S.A.

340-4 DIE-CAST GRAPH PAPER  
4 X 4 PER INCH

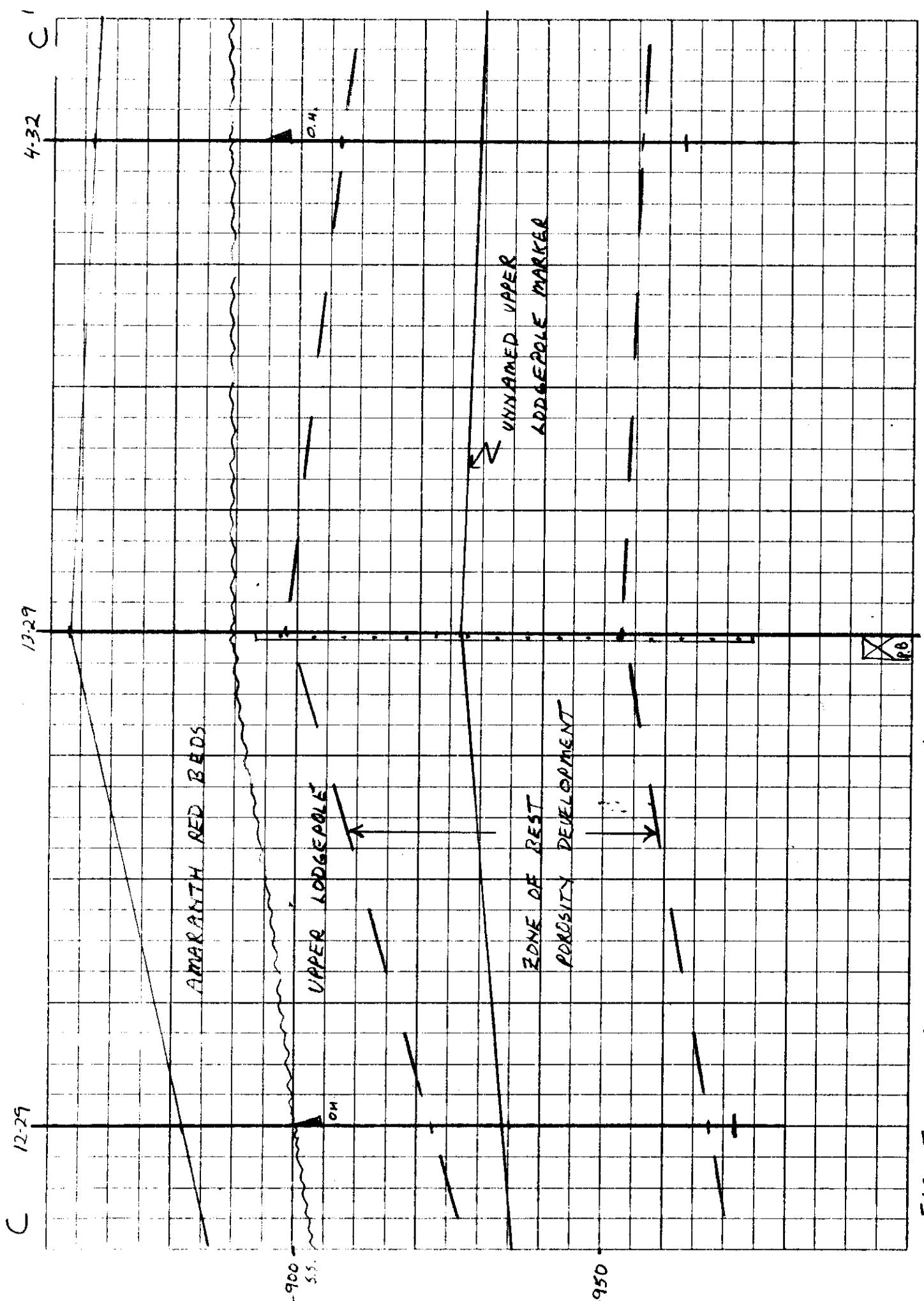


FIG. 5 : CROSS-SECTION, C-C'

WASH. STATE UNIV.

4 X 4 PER INCH

FIG. 6: WEST POTTER T9 R29 W00N

NET PAY 150MACH CI. = 10'

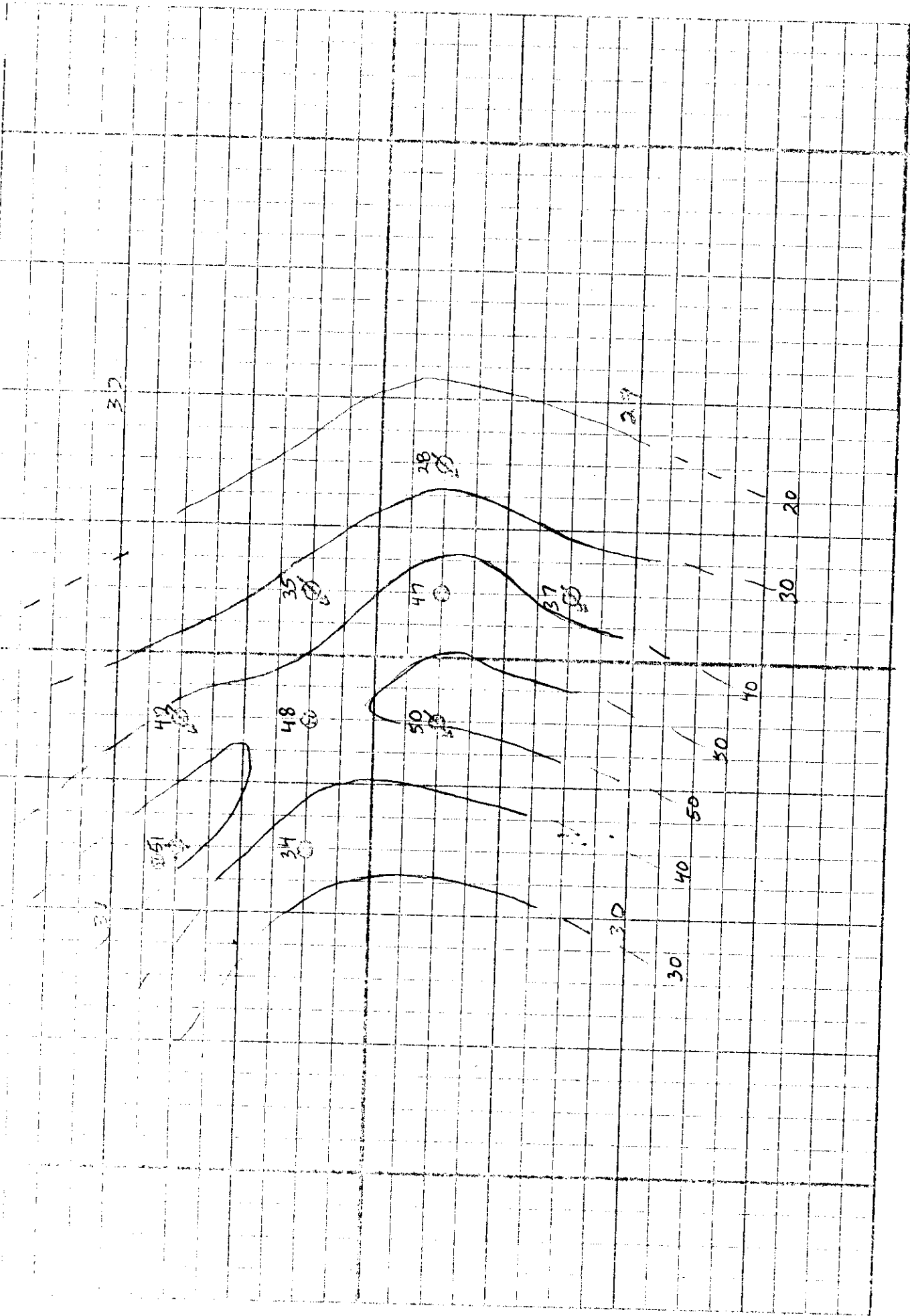


FIG. 7: PRODUCTION - 2-31, 13-29

EUGENE DIETZGEN CO.  
MADE IN U. S. A.

NO. 341-T30 DIETZGEN GRAPH PAPER  
3 YEARS BY MONTHS

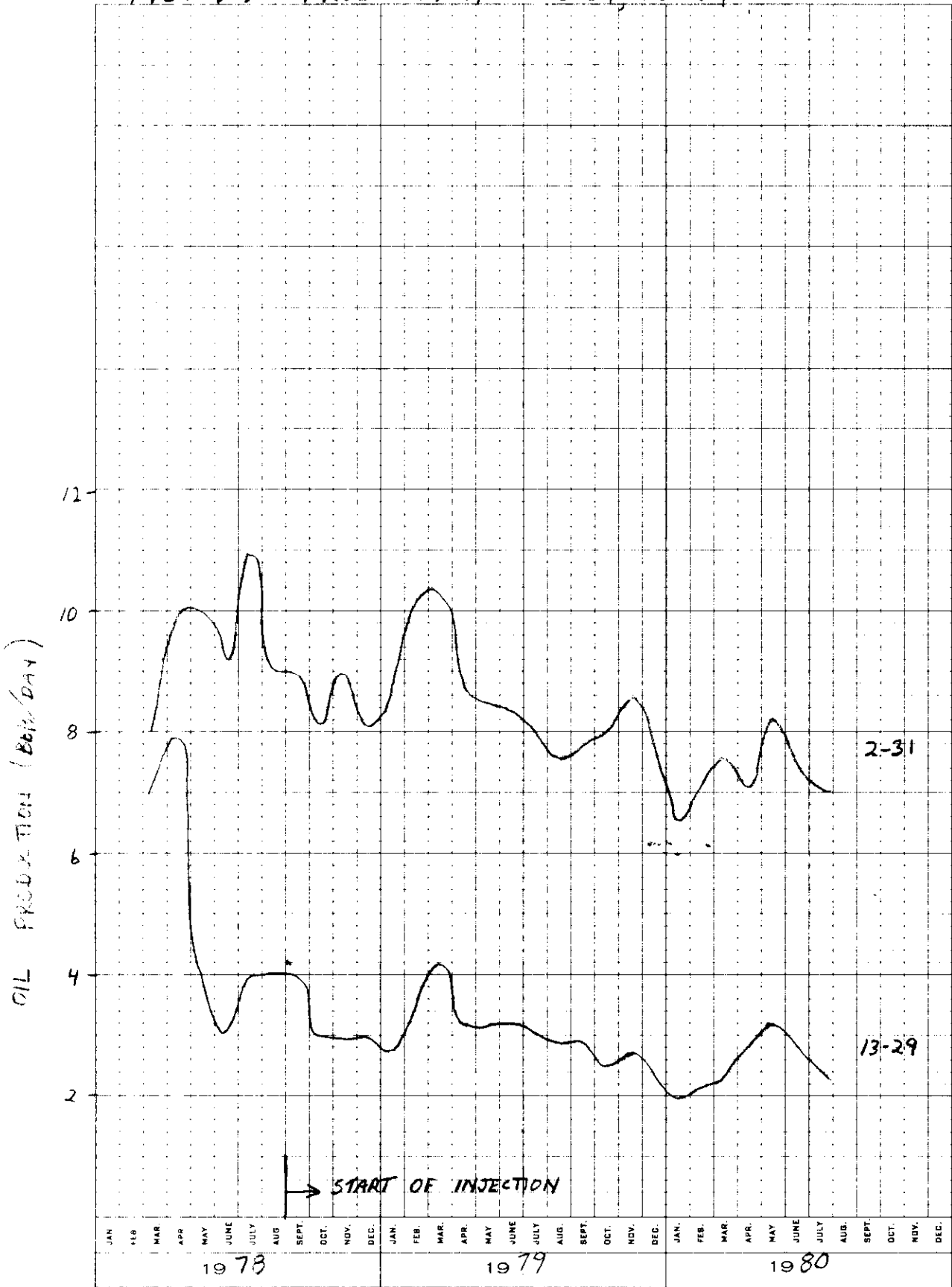


FIG. 8. WEST CUTLER T9 R 24 WITH NET EFFECTIVE PAY SCHEDULE

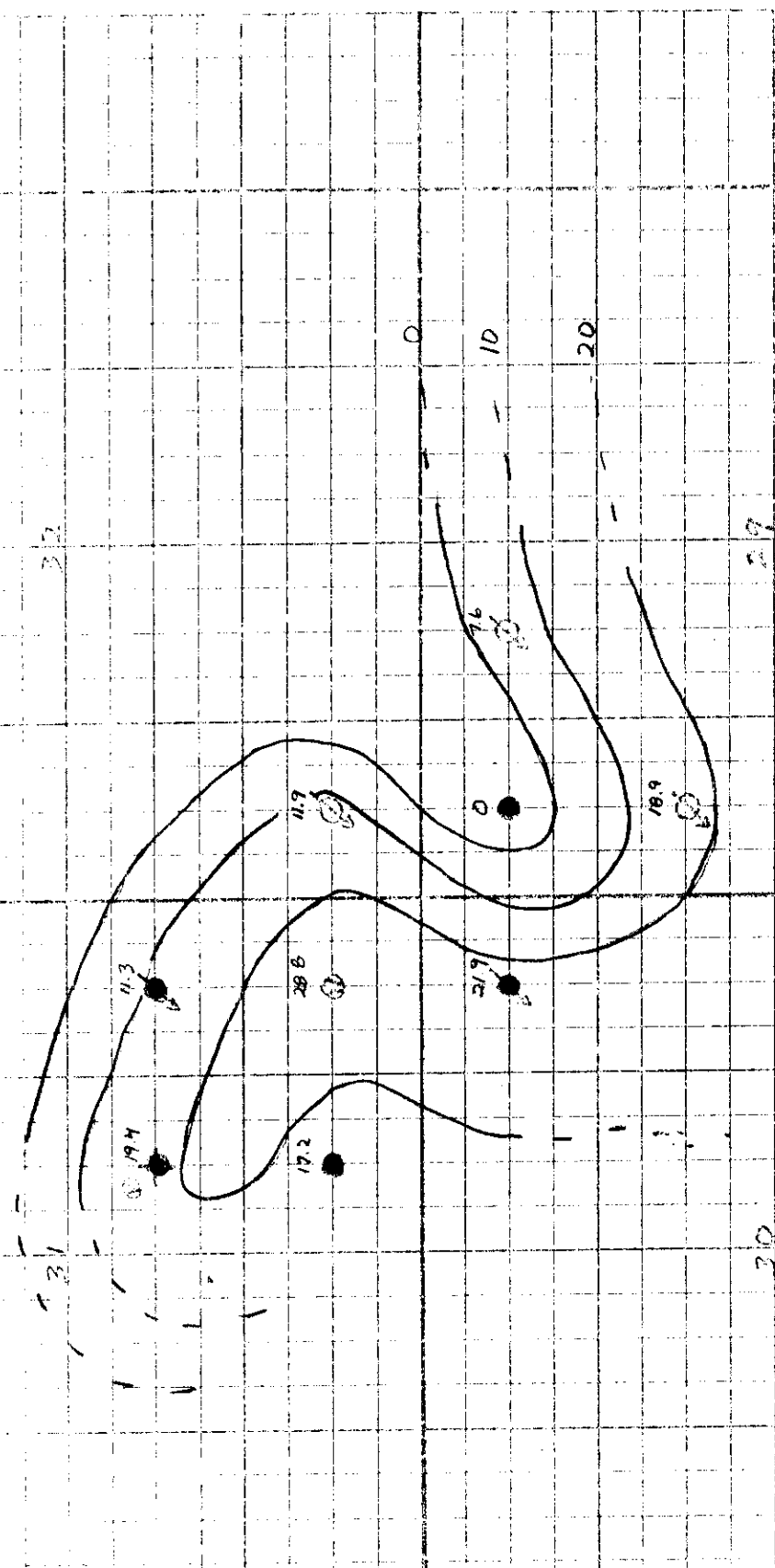
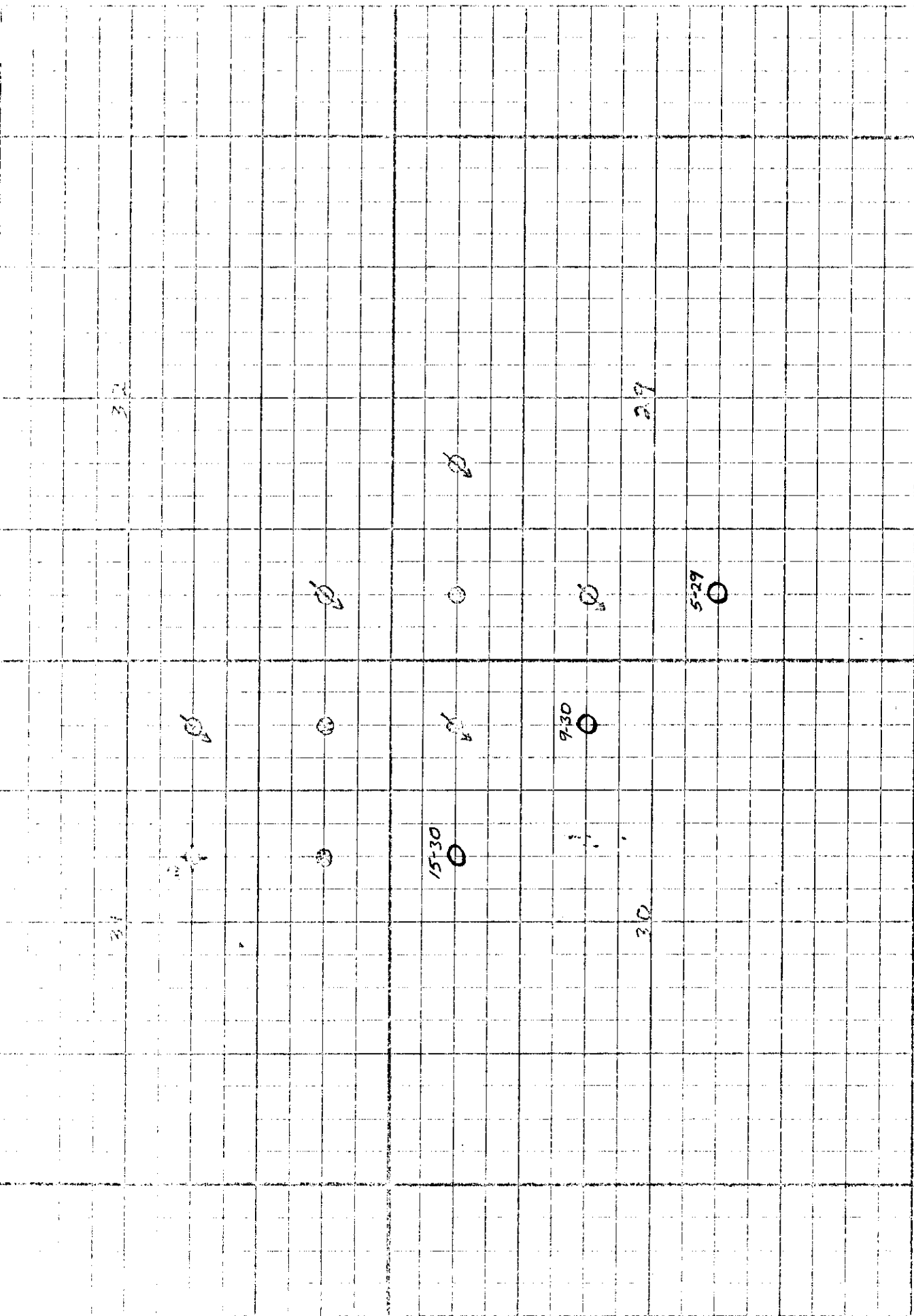
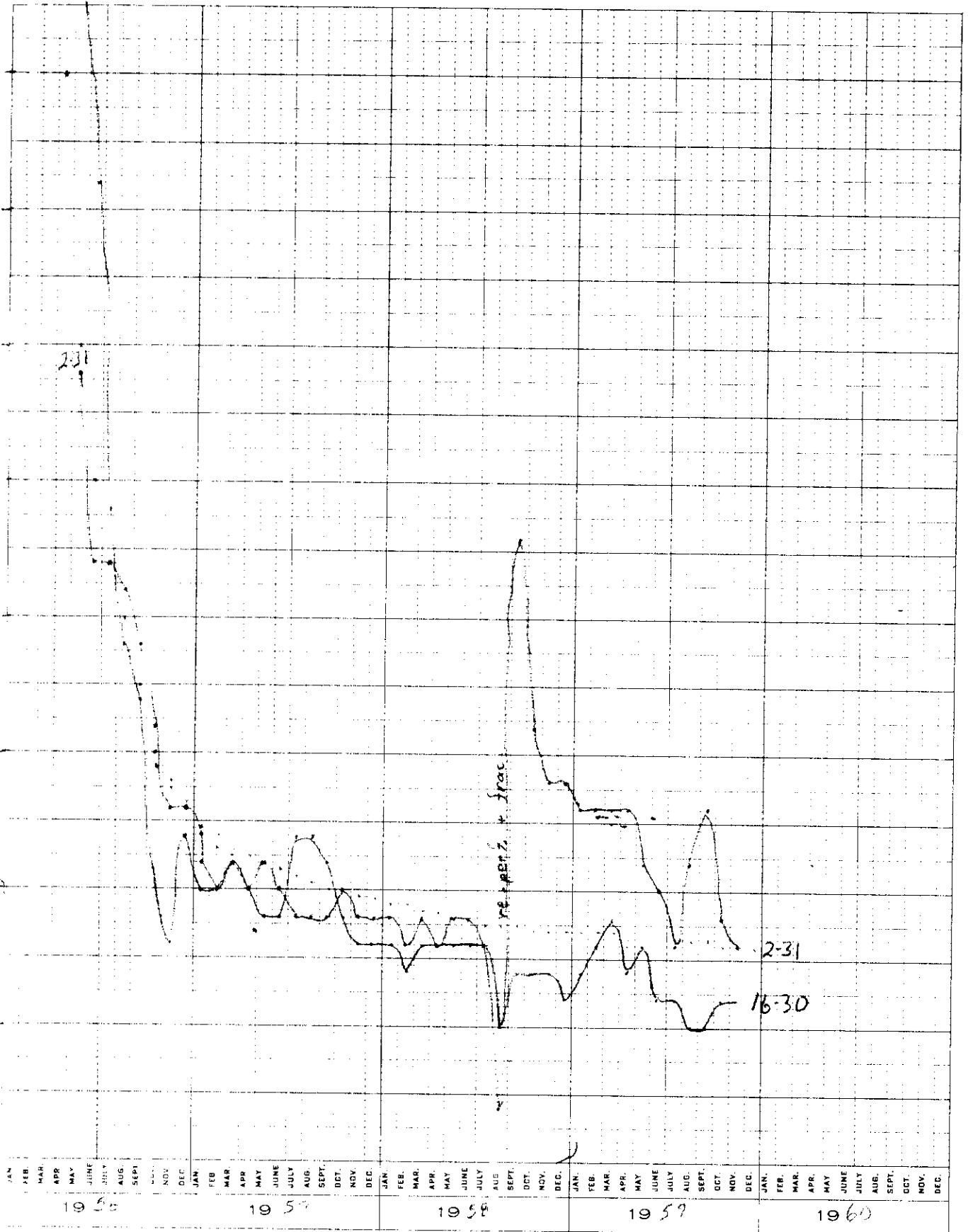


FIG. 9: WEST BUTLER T9 R29:400. 3-WELL DEVELOPMENT PROGRAM



NO. 34Q-T33 DIETZGEN GRAPH PAPER  
5 YEARS BY MONTHS



WEST BUTLER PILOT WATERFLOOD PROJECT

October 1980

Dan Barchyn

Manitoba Petroleum Branch



Metric Note:

The Manitoba Petroleum Branch subscribes to the International System of Units (SI) as set down by the Canadian Petroleum Association. However since the following report involved the compilation of existing data in English Units only, the text of this report shows S.I. Units as well as English Units and a number of the figures appear in English Units only.

## WEST BUTLER PILOT WATERFLOOD PROJECT

### Background

The West Butler Field, located approximately 30 kilometres west of Virden in Twp. 9, Rge. 29, was discovered in 1955 when Chevron West Butler 1-31-5-29 was completed as an oil well in the upper Lodgepole Formation. Five additional wells were drilled on 40 acre spacing but development was curtailed when rapid production declines became apparent.

This rapid production decline coupled with the lack of water encroachment suggested a solution gas drive reservoir with low permeability and low primary recovery. A map of the West Butler Field is presented in Figure 1.

A waterflood was initiated in 1972 by converting the wells in 16-30 and 8-31 to water injection wells. This waterflood was not successful in significantly affecting the production rates due to a lack of adequate water supply and absence of a confined injection pattern. Only about one-third of the pre-unit voidage was replaced by water injection until injection was terminated at the end of 1974. This waterflood project was not considered to have properly evaluated the production response of the West Butler reservoir to waterflooding.

In 1978 a second pilot waterflood project was initiated by drilling three additional water injection wells (12-30, 14-30, 4-32) to offset the producer in 13-29. This in addition to the injector in 16-30 and a Devonian water source at 1-31, provided the adequate water supply and confined 5-spot pattern necessary to evaluate the waterflood potential. A production response of  $3.97 \text{ m}^3/\text{day}$  (25 BOPD) from the central well in 13-29 was expected after six months of injection. As of June 1980, no production response is evident as the well continues to produce in the range of  $0.48 \text{ m}^3/\text{day}$  (3 BOPD). A pressure survey taken in May of 1980 indicated a bottom hole pressure near the original reservoir pressure of 7 239.5 kPa (1 050 psi) in the injector wells and a bottom hole pressure in the range of 344.7 kPa (50 psi) in 13-29. This suggests that despite the volumes of water injected and the confined pattern, the producing well is not responding to the waterflood.

The following discussion will attempt to explain the lack of waterflood response and provide proposals for further evaluating the potential of the West Butler Field.

#### Geology and Reservoir Characteristics

West Butler production is obtained from an upper member of the Lodgepole Formation of Mississippian Age. The lithology is predominately limestone with dolomite, argillaceous limestone, anhydrite and chert. The limestone is generally finely crystalline and granular with fair to good intergranular porosity and bands of vuggy porosity. Oil staining occurs in distinct bands scattered throughout the section. Zones of dolomitic limestone are present especially towards the top of the section. Bands of purplish argillaceous limestone are common as are reddish argillaceous partings occurring irregularly throughout the section. Large, irregular white chert nodules are common. A few bands of silicified coarse crinoidal limestone are also present. Anhydrite occurs both as a fracture filling material and in bands up to several centimeters in thickness. A zone of brecciated argillaceous limestone in a matrix of anhydrite is present near the top of the section. Vertical fractures are common, especially in the cherty zones. Some open fractures are present which contain minor amounts of black bituminous material.

The section as a whole exhibits a banded appearance with bands of distinct lithology seldom exceeding a metre in thickness. Zones of porous, oil stained limestone and dolomitic limestone are interbedded with the purplish argillaceous limestone, bands and nodules of chert and anhydrite.

The top of the Mississippian is an erosional surface showing very little relief. Definitive structural markers in the Upper Lodgepole are not easily recognizable on logs, but a structural interpretation has been attempted. A structural contour map on an unnamed Upper Lodgepole marker is presented in Figure 2. This interpretation suggests a positive domal feature centered at 16-30. Cross-sections across this feature and the pilot waterflood area are presented in Figures 3, 4 and 5.

The limits of reservoir development do not appear to be controlled by structure as the reservoir configuration seems to be related to the Mississippian erosional surface rather than the structural marker. The porosity development is partly secondary in nature having occurred through a leaching process during the post-Mississippian erosional period. Much of this porosity has subsequently been infilled with anhydrite during the deposition of the Amaranth evaporites, but this infilling process seems to have occurred most extensively to a depth of only 12 to 15 metres (40 to 50 feet) below the top of the Amaranth red beds. This formed an effective cap rock above the remaining porosity in the Upper Lodgepole.

The trapping mechanism is therefore stratigraphic in nature with a permeability pinchout occurring in the regional up-dip direction. An oil water contact has been postulated at -302.4 metres (-992 feet) subsea based on the recovery of salt water on a drill stem test at 1-31.

The areal extent of the reservoir has not been delineated by drilling. Given the gross pay interval which exceeds 30 metres (100 feet) in most parts of the developed portion of the reservoir and the low relief of the Mississippian unconformity, it is likely that the reservoir will extend over a considerably larger area than that which has been developed. A net pay isopach map is presented in Figure 6.

Specific reservoir properties are discussed in Appendix A: West Butler Pool Development by Chevron Producing Department. Generally, the reservoir has a thick gross pay section with net pays in the range 12 - 15 metres (40 - 50 feet). Core analysis indicates that pay zones occur in thin stringers of permeability separated by impermeable stringers of anhydritic or argillaceous material which occur throughout the gross pay section. This is consistent with conclusions drawn from the visual examination of the core. Zones of continuous permeability seldom exceed 1 metre (3 feet) in vertical thickness. The occurrence of vertical fracturing suggests the possibility of an effective vertical permeability over the reservoir as a whole, which would not be detected by core analysis.

Electric logs indicating the completion and permeable zones for all wells in the West Butler area are presented in Appendix B.

### Production History

West Butler production and injection data are plotted in Appendix C. The following table summarizes production and injection data for the following three periods:

1. Pre-unit (1955 - August 31, 1972)  
- reservoir is on primary depletion
2. Initial Waterflood (September 1, 1972 - August 31, 1978)  
- limited water injection from September 1, 1972 to 1974
3. Pilot Waterflood (September 1, 1978 to June 30, 1980)  
- adequate water injection and confined pattern

Table 1  
Production and Injection Summary

<u>Period</u>	<u>Oil Produced m<sup>3</sup> (barrels)</u>	<u>Water Produced m<sup>3</sup> (barrels)</u>	<u>Water Injected m<sup>3</sup> (barrels)</u>
1	24 226.8 (152,443)	5 217.3 (32,829)	
2	2 874.8 (18,089)	1 264.1 (7,954)	11 136.4 (70,074)
3	1 048.7 (6,599)	37.2 (234)	61 766.7 (388,656)
Total	28 150.3 (177,131)	6 518.6 (41,017)	72 903.1 (458,730)

During period 1 (pre-unit) production was characterized by high initial rates followed by rapid decline with limited water encroachment. This was attributed to the low permeability of the reservoir and the lack of an efficient drive mechanism. Production from fracture porosity may also be involved. The reservoir appears to be undersaturated and of the solution gas drive type and primary recoveries were estimated at less than 7%. It was felt that the reservoir was reaching the end of its economic life in 1972 when the initial waterflood was introduced.

During period 2 (initial waterflood), adequate sources of water were not available to create an effective waterflood. Only about one-third of the pre-unit voidage was replaced before injection was discontinued in 1974. Production rates were only marginally affected during this time and

continued on the primary depletion trend. The high WOR during this period can be attributed to engineering problems at 1-31 following a frac job and does not represent an increase in water encroachment. The lack of production response was attributed to both the lack of adequate injection and the lack of a confined injection pattern. A pressure survey run in 1976 indicated that the suspended wells and suspended injection wells had bottom hole pressures near the original reservoir pressure of 7 239.5 kPa (1,050 psi) and that the producers in 13-29 and 2-31 had bottom hole pressures of 772.2 kPa (112 psi) and 882.5 kPa (128 psi) respectively after a shut-in period of approximately four months. This confirmed the low permeability of the reservoir and suggested that pressure communication between the producing and injection wells was either very poor or non-existent. The suspended producer at 1-31 had a pressure of 7 494.6 kPa (1,087 psi) suggesting that the influence of water injection at 16-30 and 8-31 may have been felt here. However, the engineering problems at this well mentioned earlier may be the primary cause of this higher than expected pressure.

Since the lack of success of this initial waterflood was attributed to inadequate water supply and the absence of a confined injection pattern, a new pilot waterflood which addressed both problems was proposed. The details of the proposed are presented in Appendix A. The well in 1-31 was deepened and converted to a Devonian water supply well in order to provide the adequate water supply. New water injection wells were drilled in 12-29, 14-29 and 4-32. This provided a confined 5-spot injection pattern around the producer in 13-29 from which production response was expected. Injection commenced in September 1978 which marked the start of period 3 (Pilot Waterflood Project). Pressure surveys in the new injection wells were done before injection commenced and indicated bottom hole pressure slightly below the original reservoir pressure of 7 239.5 kPa (1,050 psi). These wells were placed on injection at pressures in the range of 8 300 kPa (1,200 psi) and by the end of 1979 cumulative injection volumes were as follows:

12-29	12 368.9 m <sup>3</sup>	(77,829 barrels)
14-29	1 070.2 m <sup>3</sup>	(6,734 barrels)
4-32	15 895.9 m <sup>3</sup>	(100,022 barrels)

Problems were encountered in the 16-30 injector shortly after being placed on injection at a pressure of about 6 998.2 kPa (1,015 psi) and a low injection rate. The injection rate suddenly increased to a high rate with no back pressure. A tracer survey indicated that the water was leaving through bottom perforations which had been fracture treated. The problem is most likely due to engineering problems in the completion of the well. Alternatively, the fracture treatment, together with the low stratigraphic position of the perforations may have provided communication with a highly permeable aquifer below in the Crinoidal equivalent zone, perhaps through vertical fractures. Either way, it is safe to assume that the large volumes injected at this well did not significantly contribute to the waterflood.

Average daily oil production for 13-29 and 2-31 during period 3 is plotted in Figure 7. Since the start of injection in the pilot waterflood project, daily production rates of 13-29 have remained in the range of .6 to 1.2 m<sup>3</sup> (2 to 4 BOPD) and the general decline trend of primary production is still evident. A pressure survey taken in May of 1980 indicated a bottom hole pressure of approximately 344.7 kPa (50 psi) in the producer (13-29) and a bottom hole pressure of 7 487.7 kPa (1,086 psi) in the suspended injector of 16-30. The lack of production response together with the low pressure of 13-29 indicate that there has been essentially no response to the waterflood in this well. Data in Table 1 indicates that as of the end of June 1980, voidage replacement has exceeded 200% which is far beyond the 50% level at which some production response would be expected.

#### Reasons for Lack of Response

One of the essential requirements for a successful waterflood is continuity of effective reservoir between injection and producing wells. The West Butler reservoir, although possessing a thick gross pay section and adequate net pay section, should be analysed in terms of effective pay as it relates to waterflooding, i.e. what part of the reservoir is likely to be continuous between wells. This is especially important in reservoirs such as West Butler where permeable zones occur as thin stringers interbedded with dense anhydritic and argillaceous beds.

Figure 8 presents an isopach of what is termed to be net effective pay. It has been assumed that only those zones of continuous permeability which exceed 0.6 metre (2 feet) in thickness will be effective in the waterflood. Implicit in this assumption is that zones of continuous permeability which are less than 0.6 metre (2 feet) in thickness will pinch out between wells and not contribute to effective pay as reservoir continuity is required for a waterflood to be effective. From Figure 8 it can be seen that the producer in 13-29 is outside the zero isopach meaning that there is no continuous effective pay between this well and the adjacent injectors. This would explain the lack of response to the waterflood. The reservoir configuration depicted here would also explain the low injection rate at 14-29, as that well has a low net effective pay value and is close to the zero isopach.

Whether or not a 0.6 metre (2 feet) of continuous permeability cut off as used above is legitimate is open to question. In their analysis (Appendix A), Chevron used a 0.5 metre (1.5 feet) cut off which also suggested a deterioration of reservoir quality in the vicinity of 13-29. For secondary solution porosity and subsequent partial porosity infill, any inference as to continuity of porosity zones is questionable.

Even if reservoir continuity exists between wells, a problem that would be encountered in this type of reservoir would be the tendency of injected water to move out along stringers of higher permeability. This "fingering" tendency would preclude the possibility of the formation of an effective flood front and reduce the effectiveness of the waterflood.

Another factor that may be contributing to the lack of success is the pressure depletion in the vicinity of 13-29. The bottom hole pressure of 344.7 kPa (50 psi) is well below the estimated bubble point pressure of 1 516.9 kPa (220 psi). This would suggest that a free gas phase is present in this part of the reservoir which may be influencing the effectiveness of the waterflood to some extent.

Finally, the presence of vertical fractures, as observed in the core, could create a network of effective vertical permeability over the reservoir as a whole. Given the low horizontal permeability of the reservoir, there would be a tendency for injected water to move along vertical fractures



as they are encountered. An extensive system of this type of fracturing could account for the ability of the reservoir to take large volumes of injected water without a production response in an adjacent well.

In summary, the lack of success of the pilot waterflood project can likely be attributed to the thin interbedding of permeable and non-permeable beds within the West Butler reservoir and the consequent lack of effective communication between permeable zones in the injecting wells and those in 13-29 along with the presence of a vertical fracture system which disperses the injected water in an uncontrolled manner.

#### Future Development Prospects

The waterflood experience to date at West Butler would not justify the expansion of the pilot waterflood project as originally planned. Production responses have shown that the continuous sections of permeability which are necessary to establish the continuity of reservoir between wells are not present throughout the area. Also, there is likely a tendency for injected water to move out through stringers of the best permeability preventing the formation of an effective flood front. The presence of vertical fractures further complicates the situation as much of the injected water may move vertically along a fracture system.

Analysis of reservoir properties (i.e. net effective pay - Figure 7) suggests that the choice of 13-29 as the central producer for a pilot waterflood was a poor one. Improved reservoir quality in the SE $\frac{1}{4}$  31 and NE $\frac{1}{2}$  30 seems to be suggested and the establishment of an injection pattern here may have produced more encouraging results.

Given the thick gross pay section, the large oil in place per acre, and the undefined areal limits of the pool, further development of the West Butler area seems warranted. Since waterflooding has not been successful in this type of reservoir, further development should proceed by drilling for primary production and delineating both the extensive and intensive parameters of the reservoir.

As a start, Figure 9 presents a three well program aimed at evaluating the reservoir along the south-west edge of the developed portion. The net pay and net effective pay isopach maps (Figures 6 and 8) suggest that this is likely the area in which reservoir quality is maintained or, perhaps, improved. These wells should be cored through the pay zone and drill stem tested with a PVT analysis in order to provide maximum information about the reservoir. If these wells are successful, further delineation of the reservoir should continue.

New development wells should be placed on primary production with regular pressure surveys taken to give further information concerning the reservoir.

Only if the reservoir properties prove to be more favourable should a secondary recovery (waterflood) project be considered once primary production has declined to the economic limit. Waterflooding would likely be more successful if specific zones of good horizontal permeability can be identified and correlated from well to well. Injection and production should be confined to these specific zones to minimize the chances of injecting water into ineffective parts of the reservoir or zones of extensive vertical fracturing.

Contrary to what is stated by Chevron, the economics of development wells for primary production alone are not that unattractive. An economic analysis of primary production from a West Butler development well has been carried out using the following assumptions:

- (1) Capital cost of drilling and completing a well is \$150,000
- (2) Operating cost of producing a well is \$750/month
- (3) Production is classified as "new oil" with a royalty incentive period of 19 months. (as calculated under Manitoba Revised Regulation 231/78 for a well with a total depth of 823 metres (2,700 feet).
- (4) Production over the first 3 years of the well life will be as plotted on Figure 10 (estimated on the basis of the actual production performance of 16-30 and 2-31).

The analysis was carried out on a monthly basis and the economic criteria used is the payout time for the initial capital cost. The analysis was done with both the present average oil price \$105.40/m<sup>3</sup> (\$16.75/barrel) and an estimate of the average price over the next two years \$125.85/m<sup>3</sup> (\$20.00/barrel). The analysis is presented in Table 2.

The payout times are 27 months for \$105.40/m<sup>3</sup> (\$16.75/barrel) oil and 19 months for \$126.00/m<sup>3</sup> (\$20.00/barrel) oil. There is of course a dry hole risk factor which has not been considered, but it is assumed to be quite small for the proposed locations given the geological interpretation of the area. There is also the possibility that with properly engineered completion and stimulation programs, actual production may significantly exceed the values assumed in the analysis.

The above analysis would suggest that development drilling in the West Butler pool for primary production is likely to be an economic proposition.

#### Conclusions:

1. The failure of the West Butler Pilot Waterflood Project can be attributed to certain parameters of the reservoir including:
  - (a) thin interbedding of permeable and non-permeable zones which prevents effective communication between producing and injecting wells.
  - (b) presence of a vertical fracture system which may disperse injected water in a vertical direction.
  - (c) pressure depletion at 13-29 which has likely resulted in the presence of a free gas phase in the reservoir.
2. Further development of the reservoir by development drilling for primary production is geologically and economically prospective.
3. Waterflooding, as a secondary recovery technique should only be considered it newly developed areas show an improvement in reservoir quality over the currently developed portion of the reservoir.

TABLE 2

Month	Production BOPD	Production (m <sup>3</sup> /mo.)	Crown Royalty (m <sup>3</sup> /mo.)	Producer's Share (m <sup>3</sup> /mo.)	Producer's Revenue @ \$16.75/bbl. (\$16.75/m <sup>3</sup> )	Producer's Revenue @ \$126/m <sup>3</sup> (\$20.00/bbl.)	Producer's Netback @ \$105/m <sup>3</sup>	Producer's Netback @ \$126/m <sup>3</sup>	Cumulative Netback @ \$105/m <sup>3</sup>	Cumulative Netback @ \$126/m <sup>3</sup>
1	40	191	26	165	17,325	20,790	16,575	20,040	16,575	20,040
2	30	143	18	125	13,125	15,750	12,375	15,000	28,950	35,040
3	25	119	14	105	11,025	13,230	10,275	12,480	39,225	47,520
4	22	105	12	93	9,765	11,718	9,015	10,968	48,240	58,488
5	20	95	10	85	8,925	10,710	8,175	9,960	56,415	68,448
6	17.5	83	8	75	7,875	9,450	7,125	8,700	63,540	77,148
7	15	72	7	65	6,825	8,190	6,075	7,440	69,615	84,588
8	14	67	6	61	6,405	7,686	5,655	6,936	75,270	91,524
9	13	62	5	57	5,985	7,182	5,235	6,432	80,505	97,956
10	12.5	60	5	55	5,775	6,930	5,025	6,180	85,530	104,136
11	12	57	4	53	5,565	6,678	4,815	5,928	90,345	110,064
12	11.5	55	4	51	5,355	6,426	4,605	5,676	94,950	115,740
13	11	52	4	48	5,040	6,048	4,290	5,298	99,240	121,038
14	11	52	4	48	5,040	6,048	4,290	5,298	103,530	126,336
15	10.5	50	3	47	4,935	5,922	4,185	5,172	107,715	131,508
16	10.5	50	3	47	4,935	5,922	4,185	5,172	111,900	136,680
17	10.5	50	3	47	4,935	5,922	4,185	5,172	116,085	141,852
18	10	48	3	45	4,725	5,670	3,975	4,920	120,060	146,772
19	10	48	3	45	4,725	5,670	3,975	4,920	124,035	151,692
20	10	48	5	43	4,515	5,418	3,765	4,668	127,800	Payout = 19 mos.
21	9.5	45	4	41	4,305	5,166	3,555	4,416	131,355	
22	9.5	45	4	41	4,305	5,166	3,555	4,416	134,910	
23	9.5	45	4	41	4,305	5,166	3,555	4,416	138,465	
24	9	43	4	39	4,095	4,914	3,345	4,164	141,810	
25	9	43	4	39	4,095	4,914	3,345	4,164	145,155	
26	9	43	4	39	4,095	4,914	3,345	4,164	148,500	
27	9	43	4	39	4,095	4,914	3,345	4,164	151,845	
28	8.5	41	3	38	3,990	4,788	3,240	4,038	Payout = 27 mos.	
29	8.5	41	3	38	3,990	4,788	3,240	4,038		
30	8.5	41	3	38	3,990	4,788	3,240	4,038		

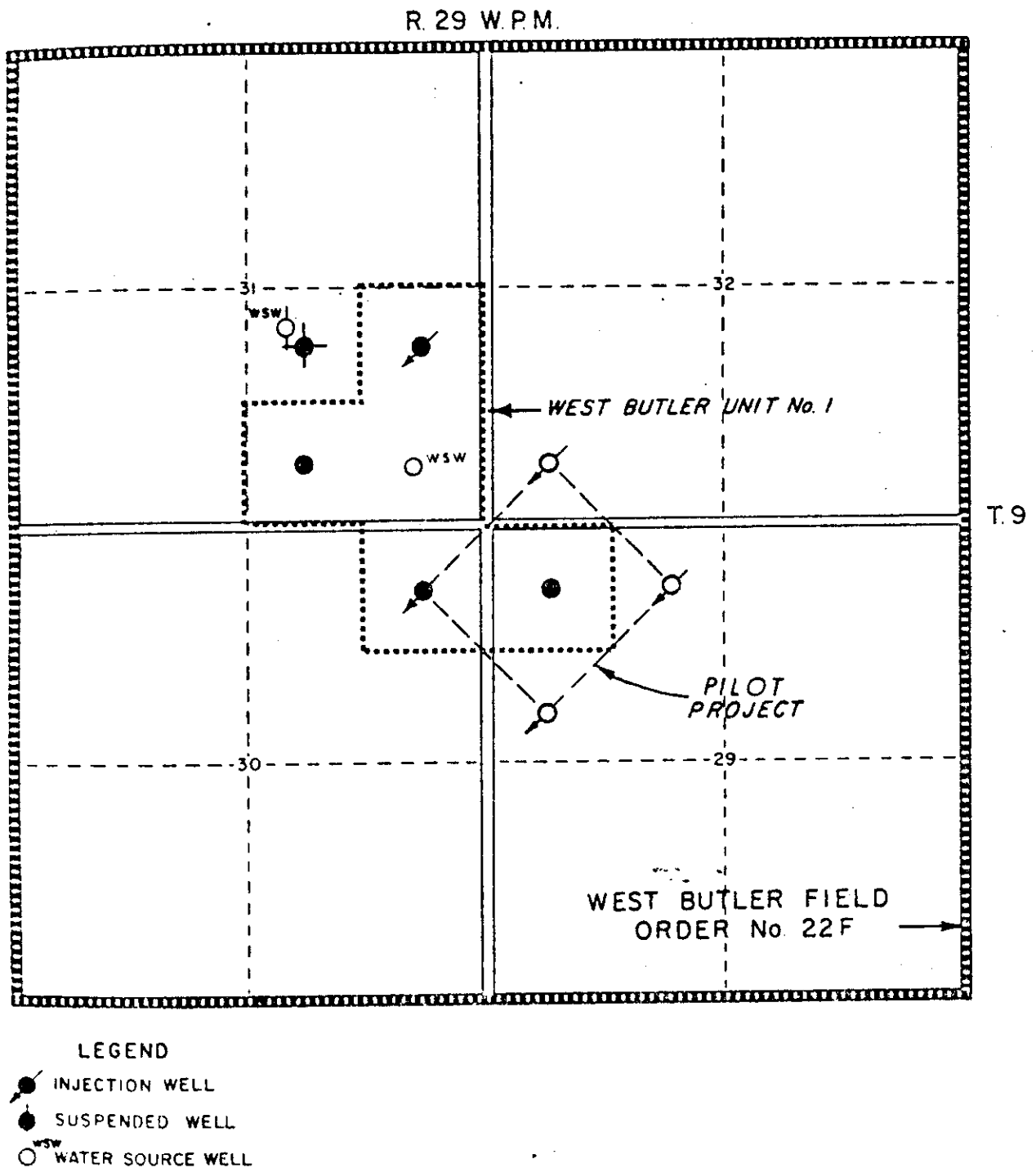
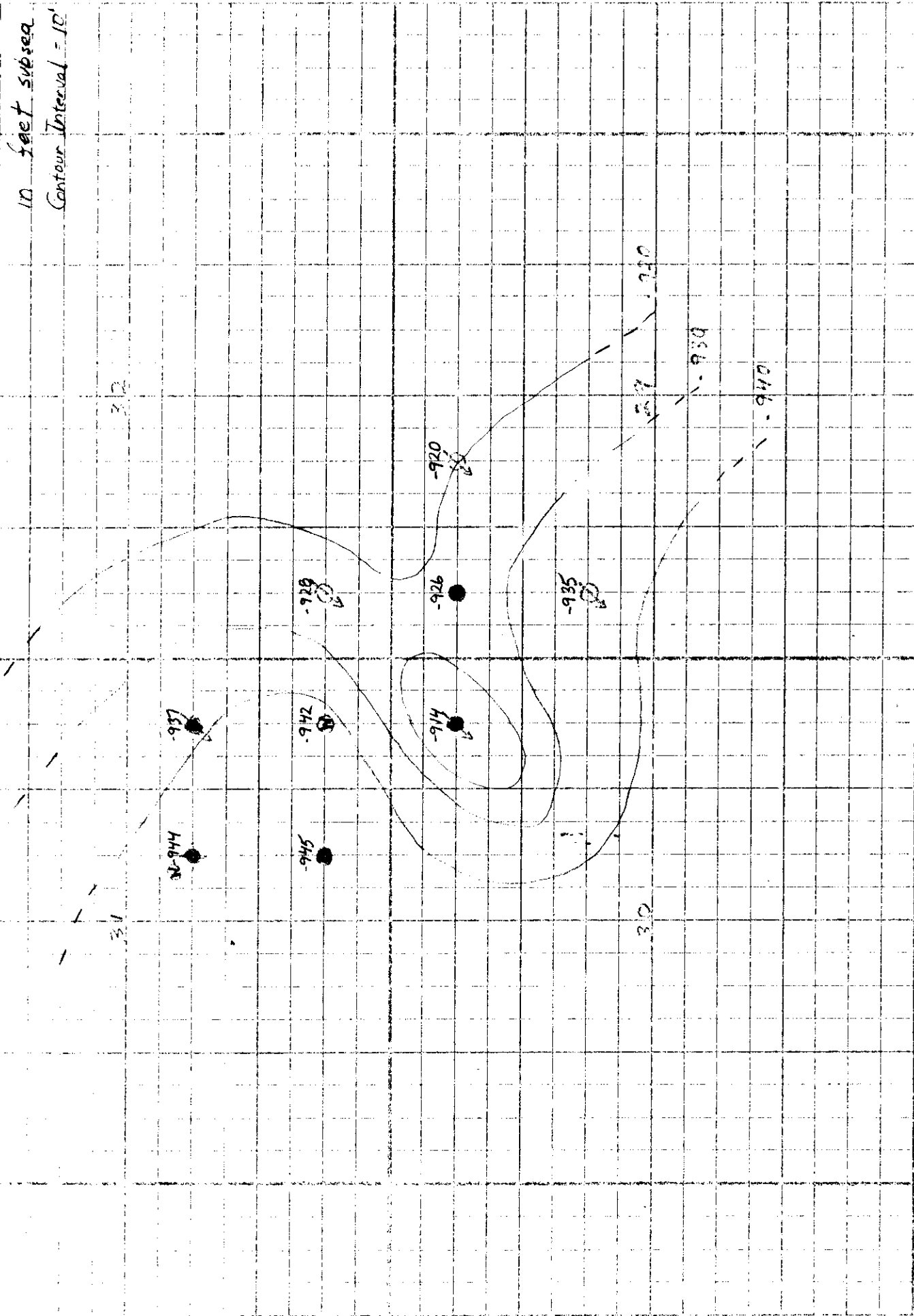


FIG. 1 WEST BUTLER PILOT WATERFLOOD PROJECT  
WEST BUTLER FIELD  
SCALE: 3" = 1 MILE

FIG. 2 : WEST POTTER T9.224 WPM STRUCTURE - UNNAMED L.P. MA"YER

10 feet subsea

Contour Interval = 10'



October 27, 1980

Chevron Standard Limited  
Box 100  
Virden, Manitoba  
ROM 2C0

Attention: Mr. D. A. Zeeuwen, P. Eng.  
Area Supervisor

Dear Sir:

Re: Application for Approval to Extend the  
Termination Date of the West Butler  
Unit No. 1 Pilot Waterflood

---

Receipt of your letter dated 1980-10-22 in which you advised that injection operations were shut down on 1980-10-14 in the West Butler Unit No. 1 Pilot Waterflood is acknowledged.

As discussed in our meeting we would appreciate being kept informed of your plans to develop the field together with results of the information requested in the Deputy Chairman's letter to you dated 1980-10-06.

By copy of this letter the members of The Oil and Natural Gas Conservation Board will be informed of your present plans regarding the pilot waterflood.

Yours sincerely,

Original Signed by H. C. Moster

H. Clare Moster, P. Eng.,  
Director, Petroleum Branch.

HCM/et

c.c. The Oil and Natural Gas  
Conservation Board:

Paul E. Jarvis  
Dr. Ian Haugh  
J. P. Redgwell

b.c. Virden Office



**Chevron Standard Limited**

Box 100  
Virden, MB  
ROM 2C0  
1980-10-22

Dept. of Energy and Mines  
Petroleum Branch  
989 Century Street  
Winnipeg, Manitoba  
R3H 0W4

Attention: Mr. H. C. Moster

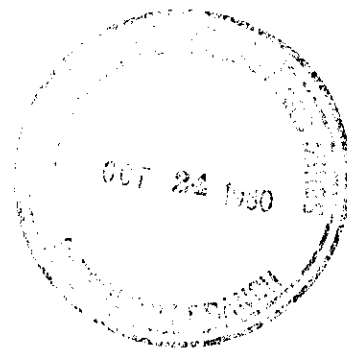
Dear Sir:

Re: Application for Approval to Extend the Termination  
Date of the West Butler Unit No. 1 Pilot Flood

We are in receipt of your letter dated 1980-10-06 requesting alternatives for the development, if any, of the West Butler Field to the pilot flood currently in effect.

Following the meeting between ourselves I think we all agreed that the pilot flood's lack of success does not warrant further injection. Injection operations were subsequently shut down on 1980-10-14. Our Calgary Reservoir Engineering Dept. is currently investigating the economic feasibility of infill drilling within the 80 acre water flood pattern. Should a new well be drilled and pressure communication be established to another well within the pilot, the injection scheme will be reactivated.

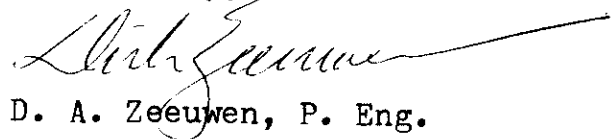
Our present plans to develop the field are contingent upon the outcome of economic studies presently in progress to determine whether wells can be drilled for primary production alone. Based on the current crude oil prices, favourable royalty treatment and production history of wells in the West Butler area initial economic analysis appears favourable. Should our Development Geology Dept. decide that





minimum risk exists outside the existing Unit and if the aforementioned economics are favourable Chevron will probably drill one or more wells in the not too distant future. We trust that the above has adequately explained our position with respect to this Unit.

Yours truly,

A handwritten signature in cursive script, appearing to read 'D. A. Zeeuwen', with a long horizontal flourish extending to the right.

D. A. Zeeuwen, P. Eng.

Area Supervisor

Virden Area

DAZ/ck

→ D.A. ✓  
file

Manitoba Department of Energy and Mines  
THE OIL AND NATURAL GAS CONSERVATION BOARD

156 Legislative Building  
Winnipeg, Manitoba

RSC 078

COPY

October 6, 1980

Chevron Standard Limited,  
Box 100,  
Virden, Manitoba.  
ROM 2CO

Attention: Mr. D. A. Zeeuwen, Chairman,  
West Butler Unit No. 1.

Dear Sir:

Re: Application for Approval to Extend the  
Termination Date of the West Butler  
Unit No. 1 Pilot Waterflood.

Following a review of the data available from the West Butler Pilot Waterflood, the Board concurs with your conclusions that:

1. To date, no response has been indicated at the central producer well 13-29-9-29.
2. Recent pressure fall-off tests and BH pressures indicate no pressure communication between the injection wells and the central producer.

On this basis, the necessity and the wisdom of continued water injection into this reservoir is questioned, since an alternative method of developing this reservoir seems to be warranted.

Before your application can be considered further, the Board will require the following information:

1. Justification for the continuation of water injection in light of the apparent negative response of the reservoir to waterflooding.
2. An outline of the possible future courses of action open to Chevron regarding the Pilot Waterflood Project with comments on the technical and economic feasibility of the various options.
3. Chevron's present plans for the overall development of the West Butler area with reference to the Pilot Waterflood Project results.



Mr. D. A. Zeeuwen

COPY

The Board recognizes the substantial investment that Chevron has made towards the development of the West Butler area and would encourage a meeting between Chevron and Departmental staff to discuss the technical and economic aspects of future development in the West Butler area.

Yours sincerely,

ORIGINAL SIGNED BY  
IAN HAUGH

Ian Haugh,  
Deputy Chairman.

cc: Mr. Paul E. Jarvis,  
Chairman.

Mr. J. F. Redgwell,  
Member.

bc: H. Clare Moster  
Virden Office

HCM/ra

Meeting held on Oct. 6/80  
between:  
D. A. Zeeuwen (Chevron)  
DAN BARCHYN } DEPT.  
H.C. MOSTER }

Discussed:

- Work & reports prepared by both Zeeuwen & Barchyn.
- Prospects for future primary development of area.
- Lease due to terminate on Dec. 31/82
- Chevron's proposal for possible infill well (including between 13-29 and 4-32) & 20 acre spacing
- Barchyn's proposal for primary development of SW area of Field.

*Copy of draft letter  
sent to I.H.  
on Oct. '80.  
following discussion  
held Sept. 30/80.*

DRAFT ONLY -- October 1, 1980

Chevron Standard Limited,  
Box 100,  
Virden, Manitoba.  
ROM 2CO

Attention: Mr. D. A. Zeeuwen, Chairman,  
West Butler Unit No. 1.

Dear Sir:

Re: Application for Approval to Extend the  
Termination Date of the West Butler  
Unit No. 1 Pilot Water Flood

Following a review of the data available from the West Butler Pilot Waterflood, the Board concurs with your conclusions that:

1. To date, no response has been indicated at the central producer well 13-29-9-29 and
2. Recent pressure fall-off tests and BH pressures indicate no pressure communication between the injection wells and the central producer.

On this basis, the necessity and the wisdom of continued water injection into this reservoir is questioned, since an alternative method of developing this reservoir seems to be warranted.

Before your application can be considered further, the Board will require the following information:

1. Justification for the continuation of water injection in light of the apparent negative response of the reservoir to waterflooding.
2. An outline of the possible future courses of action open to Chevron regarding the Pilot Waterflood Project with comments on the technical and economic feasibility of the various options and
3. Chevron's present plans for the overall development of the West Butler area with reference to the Pilot Waterflood Project results.

The Board recognizes the substantial investment that Chevron has made towards the development of the West Butler area and would encourage a meeting between Chevron and Departmental staff to discuss the technical and economic aspects of future development in the West Butler area.

Yours sincerely,  
Dr. Ian Haugh,

DATE September 22, 1980

MANITBA

TO: H. Clare Moster

COMMENTS:

RE: West Butler Unit No. 1.

FROM: Ian Haugh

Please draft reply for my signature.

Dept.:

Branch:

Address:

Telephone:

☐ Take action

☐ Circulate

☐ Per your request

☐ See me re attached

☐ Call me on this matter

☐ For your information

☐ Investigate and report

☐ Supply data for my reply

☐ For your revision  
or approval

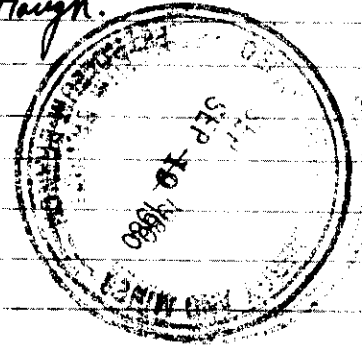
☐ Reply direct  
with copy to me

☐ Return with comments  
or recommendations

☐ Draft reply  
for signature of:



DAN  
draft reply & be prepared to  
discuss pilot test with myself  
and possibly Dr. Haugh.

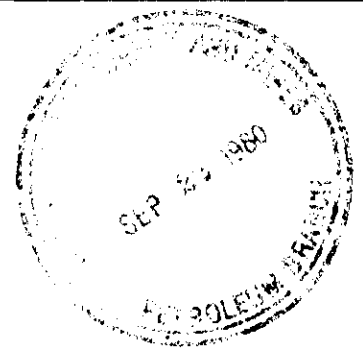




**Chevron Standard Limited**

Box 100 Virden, MB ROM 2C0

1980-09-16

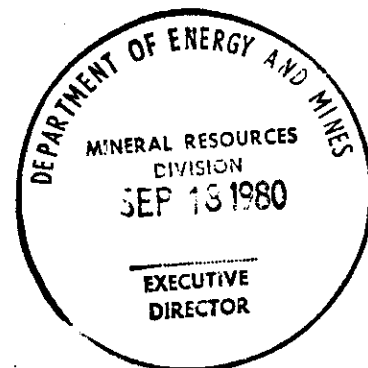


Application For Approval To  
Extend the Termination Date  
of the West Butler Unit No.1  
Pilot Water Flood

---

File No.: 668.3

Department of Energy & Mines  
Mineral Resources Division  
989 Century Street  
Winnipeg, Manitoba  
R3H 0W4



Attention: Dr. I. Haugh, Deputy Chairman

Gentlemen:

Chevron Standard Limited, as operator of the West Butler Unit No.1, hereby applies for approval to extend the termination date of the Pilot Water Flood for one year in accordance with subsection 6 of Board Order No. PM 35. The following is submitted in support of this application:

1. To date, no response has been indicated at the central producer well 13-29-9-29.
2. Recent pressure fall-off tests and BH pressures indicate no pressure communication between the injection wells and the central producer.
3. We are presently in the process of analysing data from the Pilot Water Flood and would like to keep the wells on injection until we are in a position to recommend a future course of action.

If further information is required please contact Mr. S. Dave Fairless at the letterhead address.

x.c. - H. Clare Moster  
September 22, 1980 - ra

Yours truly,

D. A. Zeeuwen, P. Eng.  
Chairman, West Butler Unit No.1

# COPY

June 4, 1981

Chevron Standard Limited  
Box 100  
Virden, Manitoba  
R0M 2C0

Attention: Mr. D. A. Zeeuwen, P. Eng.  
Area Supervisor

Dear Sir:

Re: West Butler Field  
Pilot Waterflood and Field Development

Correspondence during October 1980 between Chevron and this office which led to termination of water injection in the subject Field also indicated that Chevron was reviewing available options for development of the Field. It was indicated that both infill drilling in the pilot pattern area and development drilling outside the Unit were under consideration. At this time, we would appreciate an update on any studies which have been undertaken and your comments regarding the most likely plan of development.

The five water injection wells in the field are currently suspended subject to an expiry date of November 1, 1981. We would expect that by this date, Chevron would have had sufficient time to evaluate the alternatives and would be prepared to recommend a specific plan for production of the field.

Yours sincerely,



L. R. Dubreuil  
Chief Petroleum Engineer

LRD/lk

b.c. I. Haugh

September 19, 1979

Chevron Standard Limited,  
Box 100,  
Virden, Manitoba.  
ROM 2CO

Attention: Mr. G. W. Cruickshank, P. Eng.,  
Chairman, West Butler Unit No. 1.

Dear Sir:

Re: Order No. PM 35,  
West Butler Field.

Receipt of your application dated 1979-09-05 to extend the termination date of the West Butler pilot water flood is acknowledged.

In accordance with Rule 6 of Order No. PM 35, The Oil and Natural Gas Conservation Board hereby extends the termination date of the subject Order for a further period of 365 days commencing on the ninth day of September, 1979.

Yours sincerely,

ORIGINAL SIGNED BY  
IAN HAUGH

Ian Haugh,  
Deputy Chairman.

HCM/IH/ra

cc: Mr. Paul E. Jarvis, Chairman  
Mr. J. F. Redgwell, Member  
Mr. H. C. Moster  
Virden Office





## Chevron Standard Limited

Box 100 Virden, Manitoba ROM 2C0

1979-09-05

Application for Approval to  
Extend the Termination Date  
of the West Butler Unit No.1  
Pilot Waterflood.

Department of Mines, Resources  
& Environmental Management  
The Oil & Gas Conservation Board  
989 Century Street  
Winnipeg, Manitoba  
R3H 0W4

Attention: Dr. I. Haugh, Deputy Chairman

Gentlemen:

Chevron Standard Limited, as Operator of West Butler Unit No. 1, hereby applies for approval to extend the termination date of West Butler Unit No. 1 Pilot Waterflood for one (1) year in accordance with Subsection 6 of Board Order No. PM 35. The following is submitted in support of this application:

1. Water injection commenced 1978-09-09 in the West Butler Unit No. 1 Pilot Waterflood. No production response is evident to date. This could be due to insufficient void-age replacement and not continuous water injection in the four (4) pilot water injection wells. Cumulative net void-age for the pilot waterflood area to 1979-08-31 is -23 412.0 Res. m<sup>3</sup>. (The annual progress report for the West Butler Unit No. 1 will be forwarded in 1979-10.)

2. A problem was encountered with the 16-30 WIW. Injection pressures of 7 000 - 8 000 kPa were obtained at the injection wells 12-29, 14-29, & 4-32 while the injection pressure at 16-30 was 0 kPa. A cement squeeze was carried out on 16-30 WIW in 1979-05. The well was placed back on injection and the maximum injection pressure obtained was 3 170 kPa when the entire water supply was injected into this well for month 1979-06. This would indicate the water is still entering the aquifer and the rework was unsuccessful. A Radioactive Tracer Survey was run on the 16-30 WIW prior to the rework which indicated the fluid was injecting into the formation below the perforated intervals. It is felt that this well cannot be successfully reworked.
3. The injection pump which was used for the 1st year of the pilot waterflood was found to be inadequate. The maximum discharge pressure obtained was 8 000 kPa and at that pressure continuous mechanical problems were encountered. A new triplex pump has been purchased and is presently being installed. This will allow us to increase the injection pressure to the 12-29, 14-29, & 4-32 WIW by 3 000 - 4 000 kPa if required. By increasing the injection pressure, the volume of water injection in the above mentioned wells should also increase allowing us to make up voidage at an increased rate. The water injected in the 16-30 WIW will be restricted by choking it back.
4. It has also been recommended at this time to stimulate the 1-31 WSW to ensure an adequate water supply for the new triplex injection pump.
5. It is felt another year of injection at increased rates and pressure will give us sufficient time to evaluate the pilot-flood project.

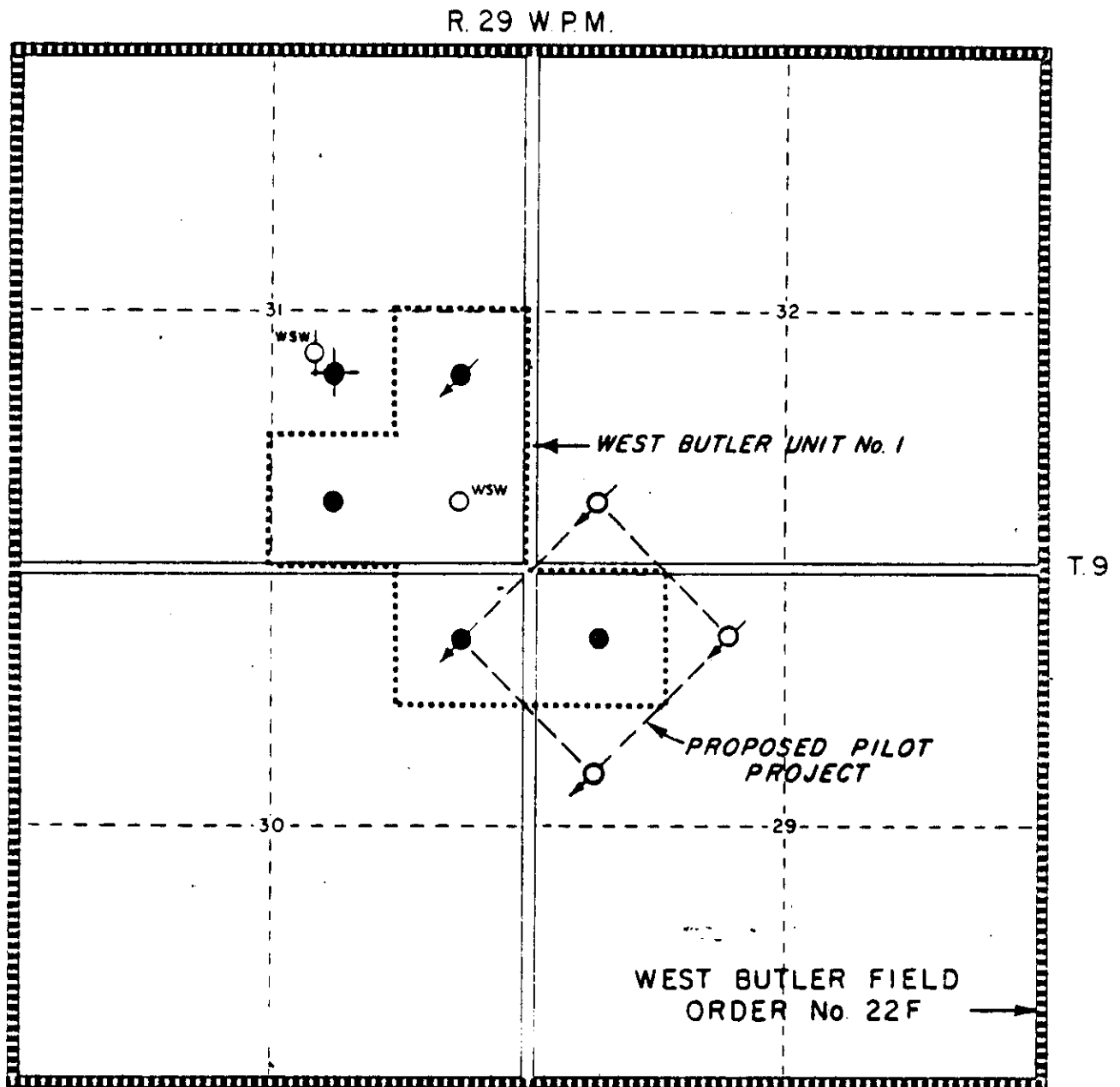
If additional information is required, please contact L. G. Thorhaug at the letterhead address.

Yours very truly,

  
G. W. Cruickshank, P. Eng.

Chairman, West Butler Unit No. 1

FIGURE 1



LEGEND

- INJECTION WELL
- SUSPENDED WELL
- WSW WATER SOURCE WELL

DEVELOPMENT OF A PILOT PROJECT  
WEST BUTLER FIELD

SCALE 3" = 1 MILE

JUNE 1, 1978



MANITOBA

DEPARTMENT OF MINES, RESOURCES  
& ENVIRONMENTAL MANAGEMENT

THE OIL AND NATURAL GAS CONSERVATION BOARD

989 Century Street  
Winnipeg, Manitoba  
R3H 0W4

September 11, 1978

Chevron Standard Limited  
Box 100  
Virden, Manitoba  
ROM 2C0

Attention: Mr. G. W. Cruickshank, P. Eng.  
Chairman, West Butler Unit No. 1

Dear Sir:

Re: West Butler Field

With respect to your application dated 1978-06-27 please be advised that:

1. The temporary suspension of water injection into the wells Chevron West Butler Prov. 16-30-9-29 and Chevron West Butler 8-31-9-29 as authorized by letter dated September 14, 1976 is hereby terminated.
2. The change of water supply source from the Ashville formation to the formation of Devonian age in the well Chevron West Butler WSW 1-31-9-29 is approved for injection wells in West Butler Unit No. 1.
3. Board Order No. PM 35, a copy of which is enclosed, was passed by the Board on August 22nd, 1978 and published in the September 9th, 1978 issue of The Manitoba Gazette.

Yours sincerely,

ORIGINAL SIGNED BY

**J. S. ROPER**

J. S. Roper,  
Chairman,  
The Oil and Natural Gas  
Conservation Board.

HCM/et

Encl.

b.c. I. Haugh  
J. F. Redgwell  
R. C. Moster

# MANIT<sup>BA</sup>

## Inter-Departmental Memo

Date 78 August 09

To The Oil and Natural Gas  
Conservation Board:  
J. S. Roper, Chairman,  
Dr. I. Haugh, Deputy Chairman, *PH*  
J. F. Redgwell, Member.

From H. C. Moster,  
Director,  
Petroleum Branch.

Telephone

Subject West Butler Pilot Waterflood — Order No. PM 35

Further to my memo dated July 21, 1978 and comments provided by J. S. Roper and discussions with Dr. I. Haugh, the attached pressure maintenance order has been prepared.

1. As the proposed Order pertains only to the additional area (and wells) outside the area presently covered by Board Order No. PM 21, no reference to the area (or wells) included in Order No. PM 21 has been made, unless otherwise necessary. This was done to preclude any future complications that might arise due to two separate Orders covering the same area (well).
2. No reference is made to tract participation factors (or formulas) in the Order as it is not felt that such is warranted nor advisable at this time. Reference could be made in the covering letter accompanying the Order that methods to determine or calculate future tract participation factors will be better understood when the results of the pilot waterflood are known and a hearing is held.
3. The Order has been amended to specify the water to be injected and the necessary testing to determine the source (Devonian or Mississippian) of produced water and suitability for injection.

The proposed Order was informally discussed with Mr. Glen Cruickshank, Chairman of the Unit Operating Committee, and he was in agreement with the proposed rules and conditions.

### Recommendation:

1. That the attached Order No. PM 35 be signed by the Board and presented to the Minister pursuant to Section 62(9)(d) of The Mines Act for his approval and signature. As stated in my memo of July 21, 1978, the Minister's attention should be specifically drawn to the intent that his approval is also an indirect consent as Crown mineral owner to:
  - (1) Injection of water through the three (3) new non-unit water injection wells drilled on Crown mineral rights.
  - (2) No allocation of production from the Unit to the three (3) non-unit injection wells (tracts) during the term of the pilot water flood.

*Memo + P.M.O. passed to J.S.R. Aug 14/78*

2. The attached Certificate of Regulation be signed <sup>and dated</sup> by the Chairman.

Please return all signed copies of the Order and Certificate to the Petroleum Branch in order that we may be arrange for filing and publication in the Gazette.

A handwritten signature in dark ink, appearing to read 'H. G. Moster', with a stylized, flowing script.

H. G. Moster

HCM/et  
Attachs.

MANIT<sup>BA</sup>

## Inter-Departmental Memo

Date 78 July 21

To

The Oil and Natural Gas  
Conservation Board:  
J. S. Roper, Chairman,  
Dr. I. Haugh, Deputy Chairman,  
J. F. Redgwell, Member.

From H. C. Moster,  
Director,  
Petroleum Branch.

Telephone

Subject Pilot Waterflood Operation - West Butler Field - Chevron Standard Limited

This is further to our discussions with the Board members on July 11, 1978 regarding Chevron's application to resume water injection in West Butler Unit No. 1, and to conduct pilot waterflood operations in the West Butler Field.

The following is the Branch's comments on three contentious points regarding the application:

1. Running Compatibility Tests:

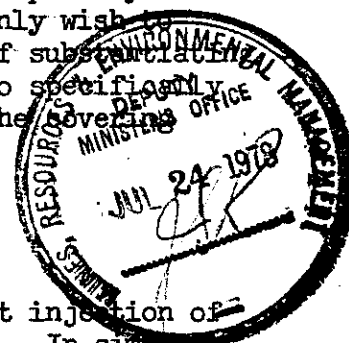
It is felt that conducting compatibility tests by Chevron is not required at present. Chevron's reasons for not running such tests do not entirely justify their request, however the fact is that Chevron will have spent some \$525,000 (1977 dollar value) to drill the additional injection wells and to install the related facilities for the pilot waterflood operations and therefore will be the major loser in the event any uncorrected compatibility problems do develop. This Branch agrees that running these tests has its merits and benefits, however, the additional costs and expenses to the Company for running such tests may not be completely justified. Therefore we would suggest that the Board may only wish to draw Chevron's attention to the Board's concern over lack of sufficient evidence to ensure compatibility but not to order Chevron to specifically carry out such tests at this time. Such could be done in the letter to the pressure maintenance order.

2. Crown Consent to Water Injection:

Referring to the attached map, it can be seen that injection of water will be conducted through wells located on Crown land. In similar previous cases involving freehold land, and as a matter of policy, consents from the mineral owners effected were required.

It was suggested at our meeting that the consent of the Crown, as a mineral owner, to the injection could possibly be obtained by a separate ministerial consent. However, to our knowledge, neither The Mines Act, and Regulations thereunder, nor the Oil and Natural Gas Leases covering this land contain any specific provisions providing for such consent or approval.

Please note that for Crown lands in existing Units, Crown's consents have been obtained through O-I-C's pursuant to subsections 75(1) and 75(2) of The Mines Act. These subsections would not be applicable in this case however, since a part of the pilot is outside the Unit.



3. No Allocation of Production to Non-Unit Crown Injection Wells:

As also discussed at the meeting, Chevron's proposal not to allocate any production over the duration of the Pilot (1 year) to the three Crown injection wells (tracts) located on Crown land outside the existing Unit boundary appears reasonable. It was explained to the Board that a great deal of work is required in order to be able to allocate any production from a well inside a Unit to wells outside a Unit. For instance, consents to such allocation must be obtained from all royalty and working interest owners in the existing Unit. Further, the Unitization Agreement must be amended, hence, a public hearing and subsequent new Unitization Order would be required.

The alternative of including these injection wells in the Unit now and prior to satisfactory demonstration of waterflood success would be premature and may be inequitable to the freehold royalty owners and working interest owners in the existing Unit.

Again in this case, both the Act/Regulation and the Crown lease are silent regarding statutory authority to approve Chevron's proposal.

In order to cover points 2 and 3 above discussed, one may conclude that the Minister when approving the Pressure Maintenance Order pursuant to subsection 62(9) of The Mines Act is in fact also granting approval on behalf of the Crown to Chevron to:

1. Inject water through the three non-unit wells located on Crown land.
2. Not allocate production to the subject three Crown injection wells (tracts) during term of the pilot waterflood project.

If the Board agrees with this conclusion, then it would be our recommendation that the Board bring these two points to the attention of the Minister when his approval of the PM Order is recommended.

1. Please advise of your decisions regarding the points presented in this memo in order that we may proceed accordingly.

Also attached is a draft PM order for your revision or comments relating to Chevron's application.

SE/et  
Attachs.

for: H. C. Moster

Question - Do you have to make any reference to a necessity of approval of T.P.F., enlarging of the unit etc prior to the success or failure of the Pilot Waterflood?

How is the 4th WIN 16-30-9-29 covered? By being the present?

OK. gll.  
See notes for consideration



## Manitoba Regulation /78

Being

## THE OIL AND NATURAL GAS CONSERVATION BOARD

Order No. PM 35

An Order Pertaining to Pressure Maintenance by Water Flooding

## WEST BUTLER FIELD

Made and Passed Pursuant to "The Mines Act", Cap. M160, of the Continuing Consolidation of the Statutes of Manitoba, and Amendments Thereto, by The Oil and Natural Gas Conservation Board of Manitoba

(Filed: )

WHEREAS, subsection (9)(d) of Section 62 of The Mines Act", being Chapter M160 of the Continuing Consolidation of the Statutes of Manitoba, provides as follows:

"62(9) Without restricting the generality of subsection (8) the board, with the approval of the minister, may make orders

(d) requiring the repressuring, recycling, or pressure maintenance, of any pool or portion thereof where it is economical so to do, and for that purpose where necessary requiring the introduction or injection into any pool or portion thereof of gas, air, water, or other substance;"

AND WHEREAS, Chevron Standard Limited, has made application to conduct a pilot water flood in parts of Section 29 and Section 32, Township 9, Range 29 WPM, a part of the West Butler Field;

AND WHEREAS, the Board, upon due consideration of the said application, has found it is ~~reasonably necessary~~ to conduct a pilot water flood in the West Butler Field. *reasonable?*

NOW, THEREFORE, the Board orders that:

1. (a) Chevron Standard Limited, or its successor (hereinafter called "the operator"), shall conduct a pilot water flood by the injection of produced water to the Members of the Lodgepole Formation of the Mississippian Age underlying the application area.
- (b) The waterflood operations shall be in accordance with and subject to the following rules:

## PRESSURE MAINTENANCE RULES

1. (1) Produced water shall be injected to the Lodgepole Formation of the Mississippian Age in the wells:

Chevron Butler Prov. WIW 12-29-9-29

Chevron Butler Prov. WIW 14-29-9-29

Chevron Butler Prov. WIW 4-32-9-29

WIW 16-30-9-29?

*that in the  
interests of recovery  
and conservation  
Question: Should  
the produced water  
be isolated anywhere in  
the Order?*

and, from time to time, in such other wells as the Board may direct, or, upon application of the operator, may approve.

- Question: Do you need to specify a maximum pressure before water injection must take place?*
- (2) After commencement, the operation<sup>or</sup> shall, subject to any remedial work required to be performed on any of the wells, endeavor to maintain continuous injection.
- (3) Notwithstanding the provisions of subclause (2) the Board may, upon application by the operator, approve<sup>or order?</sup> the suspension of water injection.
2. Before any change is made in the source of water being injected, or upon the request of the Board, the operator shall satisfy the Board as to the source, suitability, and method of treatment of the water to be injected.
3. The operator shall immediately report to the Board any channelling or breakthrough of injected water to producing wells, or any indication of other detrimental effects that may be attributable to pressure maintenance operations.
4. The operator shall, not later than the twenty-fifth day of each month, file with the Petroleum Branch of the Department of Mines, Resources and Environmental Management a report of the quantity, sources and maximum pressure at which water was injected during the preceding month, into the wells referred to in Rule 1 hereof.
5. Unless otherwise authorized in writing by the Board, the operator shall within six weeks of the expiration of each yearly period commencing on the first day of September 1978, during the period this order is in effect, file with the Petroleum Branch a report of the pressure maintenance program during the period, setting out graphically such interpretative information necessary to evaluate the progress, performance and efficacy of the water flood.
6. This order shall terminate 365 days after commencement of injection of water into the wells referred to in subclause (1) of Rule 1, notwithstanding the provisions of subclause (3) of Rule 1; but the Board may, upon submission of an application by the operator to that effect, extend the termination date for a further period, or periods, provided that the Board is satisfied upon due consideration of the application that it is reasonably necessary to continue the pilot water flood operations.
- last?*

Oil and Natural Gas Order No. PM 35,  
made and passed this day of  
A.D., 1978 at the City  
of Winnipeg, in the Province of  
Manitoba, by The Oil and Natural  
Gas Conservation Board.

J. S. Roper  
Chairman  
The O. & N. G. C. B.

J. F. Redgewell, Member  
The O. & N. G. C. B.

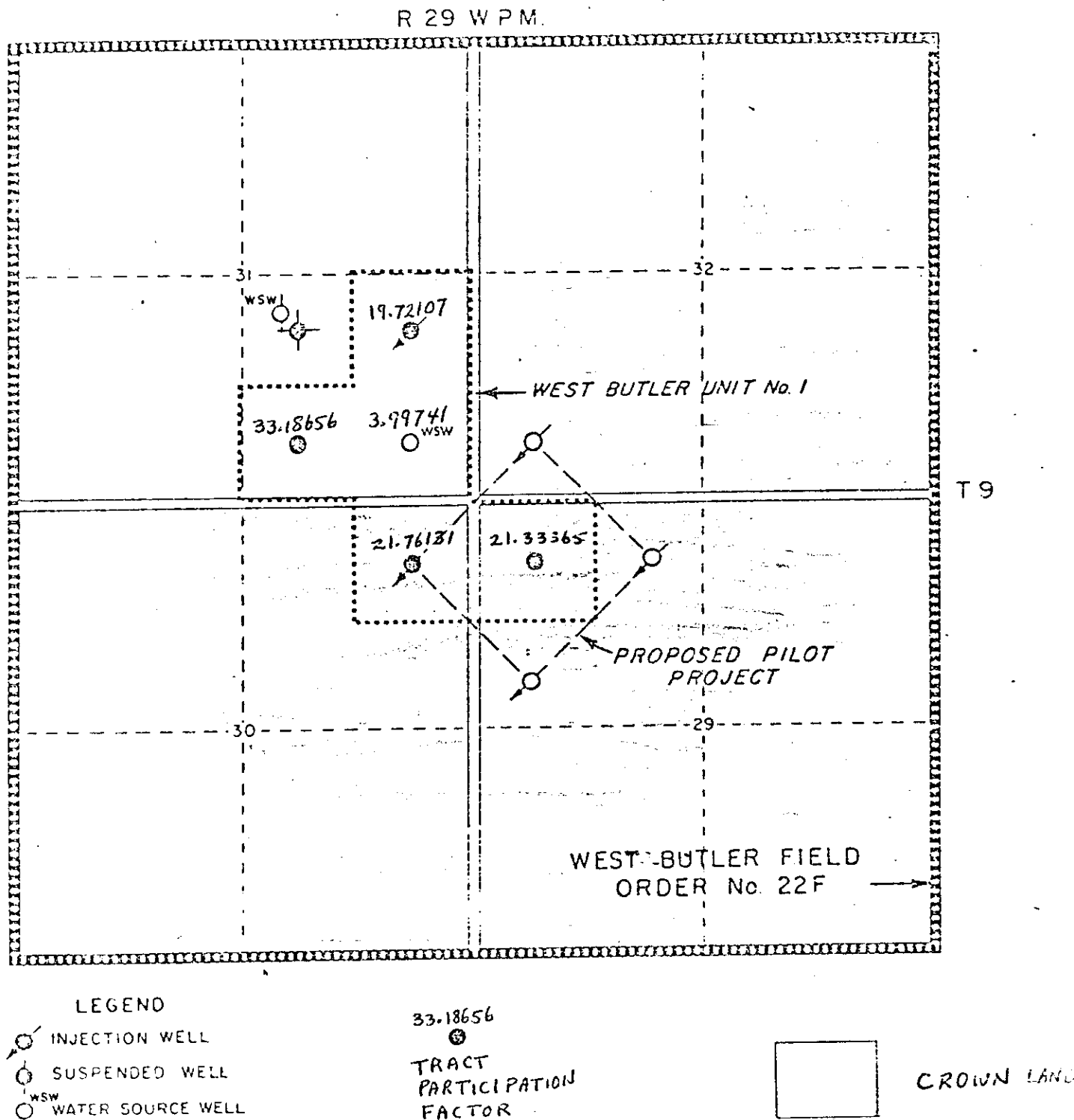
Dr. I. Haugh  
Deputy Chairman  
The O. & N. G. C. B.

Approved:

A. Brian Ransom, Minister

*Is this clear and  
does it say what you want  
it to say?*

FIGURE 1



DEVELOPMENT OF A PILOT PROJECT  
WEST BUTLER FIELD

SCALE 3" = 1 MILE

JUNE 1, 1978



**Chevron Standard Limited**

400 - Fifth Ave. S.W., Calgary, Alberta T2P 0L7

1978-06-27

Department of Mines, Resources  
& Environmental Management  
Mineral Resources Division

800 24 1416

PETROLEUM BRANCH

JUN 29 1978

ASSISTANT DEPUTY MINISTER

Application for Approval to Resume  
Water Injection and to Conduct a  
Pilot Waterflood Operation  
West Butler Unit No. 1

The Oil and Natural Gas Conservation Board  
Department of Mines, Resources and Environmental  
Management  
310 Legislative Building  
Winnipeg, Manitoba  
R3C 0V8

Gentlemen:

1. Chevron Standard Limited, as Operator of West Butler Unit No. 1 hereby applies for approval to change the source of water to be injected into West Butler Unit No. 1 in accordance with Subsection 2(2) of Board Order No. PM 21. In support of this application we submit the following:
  - (a) Termination of the temporary suspension of water injection granted by the Board's letter dated 1976-09-14 is requested. An alternate supply of injection water has been developed as outlined in following sections. Therefore, injection of water may now be resumed in the Unit and the temporary suspension of water injection can be removed.
  - (b) A change of water supply source from Ashville water to Devonian water is requested. An alternate source of injection water has been developed from the formation of Devonian age in the well Chevron West Butler 1-31-9-29 WPM which will replace the present inadequate Ashville water supply. The well 1-31-9-29 WPM was deepened to the Devonian formation and swab tested at a rate of 40 barrels per hour. Therefore, the Devonian water source developed will adequately supply injection water for the Unit injection wells and the proposed pilot waterflood.

J.S. ROPER

XC: I. HAUGH ←

- (c) Based upon the successful history of injection of Devonian water into the Mississippian formation in other Units in Manitoba, specifically North Virden Scallion Unit No. 1, Virden Roselea Unit No. 1 and Virden Roselea Unit No. 3, we submit that the Devonian water source will be suitable for injection purposes in West Butler Unit No. 1. No problems have been encountered in other Units with the injection of Devonian water, nor have any problems been encountered in changing the source of injection water in other Units from Devonian to Mississippian water sources. Therefore, no problems are anticipated with the injection of Devonian water into the Mississippian formation in West Butler Unit No. 1. Based upon the successful use of Devonian water as a source of injection water in other Units, no specific tests for water compatibility were made. Therefore, no information or data is available that would indicate compatibility problems.
2. Chevron further applies for approval of a pilot waterflood operation pursuant to Subsection 62(9)(d) of the Mines Act. In support of this application we submit the following:
- (a) The objective of the proposed pilot waterflood is to test and demonstrate the feasibility of waterflooding in the West Butler pool as outlined in our letter to the Board dated 1977-03-11. If adequate production response is evident from the pilot project, expansion of the waterflood into the undeveloped area of the pool will be undertaken. As the limits of the West Butler pool are still undefined, there exists a potential for the development of additional oil reserves if successful waterflooding can be demonstrated by the pilot waterflood.

The success or failure of a waterflood project is difficult to evaluate unless a pattern configuration is developed in which the injection of water can be controlled. The present configuration of injection and producing wells in West Butler Unit No. 1 does not provide a confined injection pattern. Therefore, continued injection in the present Unit is not considered adequate to evaluate the feasibility of future waterflood operations. As a result, the proposed pilot waterflood as shown on Figure 1 was developed to provide a confined five-spot injection pattern. Two existing Unit Wells will be incorporated in the pattern that was completed by the successful drilling of three injection wells. Utilization of this pattern will result in adequate testing of production response. Because of

the low reservoir permeability, the main uncertainty in waterflooding a reservoir of this nature is the degree of production response that might be achieved by waterflooding. Chevron believes that the proposed pilot waterflood configuration of wells is necessary to provide the required degree of confidence in the information obtained from the pilot to justify expansion of the waterflood.

- (b) Chevron requests that the duration of the pilot be one year, with possible yearly extensions if results are incomplete or inconclusive. If the pilot is successful, application will be made to incorporate the non-Unit injection wells into the Unit by enlargement with corresponding termination of the pilot project.
- (c) Chevron requests that no limit be placed upon surface injection pressure in the pilot project. Some difficulty may be anticipated in injecting a sufficient quantity of water into the West Butler reservoir because of the low reservoir permeability. Therefore, it is likely that high injection pressures may be required to provide balanced injection rates in the four injection wells. Hydraulic fracturing or acidizing may be required in the three new wells to improve injectivity. No difficulty was previously encountered in injecting water in the two Unit injection wells; however, insufficient water was available to adequately test the injectivity of the wells.

Voidage in the pilot waterflood area by previous production is estimated to be 55,000 reservoir barrels. Voidage has been partially replaced by injection in the well 16-30-9-29 WPM of 49,000 barrels water of which 12,000 barrels water is estimated to have entered the pilot waterflood area. Therefore, net voidage in the waterflood area is estimated to be 43,000 reservoir barrels at present. At anticipated injection rates of 100 BWPD per well, fill-up time is estimated to be seven months assuming 50 percent of injected water enters the pilot waterflood pattern.

- (d) The source of injection water for the pilot project will be the same as for the Unit as outlined earlier. No treatment will be required. The existing pumping facilities will be utilized. Additional injection lines from the main battery in Lsd. 1-31-9-29 WPM to the new injection wells will be utilized. The line size will be

3½" OD from 1-31 to 4-32 and from 4-32 to 14-29. The line size will be 2-3/8" OD from 14-29 to 12-29. The lines have been sized to be capable of handling future anticipated flow rates if the waterflood is expanded. Individual water meters will be installed at each injection well.

- (e) Additional oil reserves to be recovered from the pilot area are estimated to be 280,000 STB if the pilot is successful. Details of reserve parameters are shown in our letter to the Board dated 1977-03-11.
- 3. The well 1-31-9-29 WPM was deepened to the Devonian zone in 1977 to develop an injection water supply for the Unit and the pilot waterflood project. The well was incapable of further economic oil production from the Mississippian zone because of high water production. It was suspected that the well has been fractured into the underlying water aquifer. It is planned that a new well will be drilled on this location if the waterflood is expanded.
- 4. Chevron suggests that tract areas may be proposed as the best basis for determining participation factors for new tracts which may enter West Butler Unit No. 1 by enlargement. No production statistics will be available for wells that are immediately placed on injection such as the three new injection wells in the pilot project. Therefore, production statistic methods of calculating tract factors will be inadequate because of the lack of production information. Calculated tract oil-in-place methods require a detailed knowledge of a number of reserve parameters which are subject to interpretation, such as water saturation, net pay and porosity. In the absence of core data, these parameters must be interpreted from log data. It is anticipated that future well completions will be open hole and therefore will not penetrate the oil-water interface. Therefore, interpretative estimates of net pay must be made. Information that is subject to interpretation is not considered a good basis for unitization. Therefore, tract area may be the most reasonable factor in determining future Unit participation in this field.
- 5. Chevron further requests that approval to resume injection and to conduct a pilot waterflood operation be granted simultaneously. Water injection would then commence simultaneously in all the pilot waterflood injection wells and injection volumes will be balanced between injectors. It is anticipated that all facilities will be completed by 1978-07-01 and injection will commence immediately upon approval of these applications.

6. Any enquiries regarding this letter should be directed to Mr. J. D. Scott at the letterhead address.

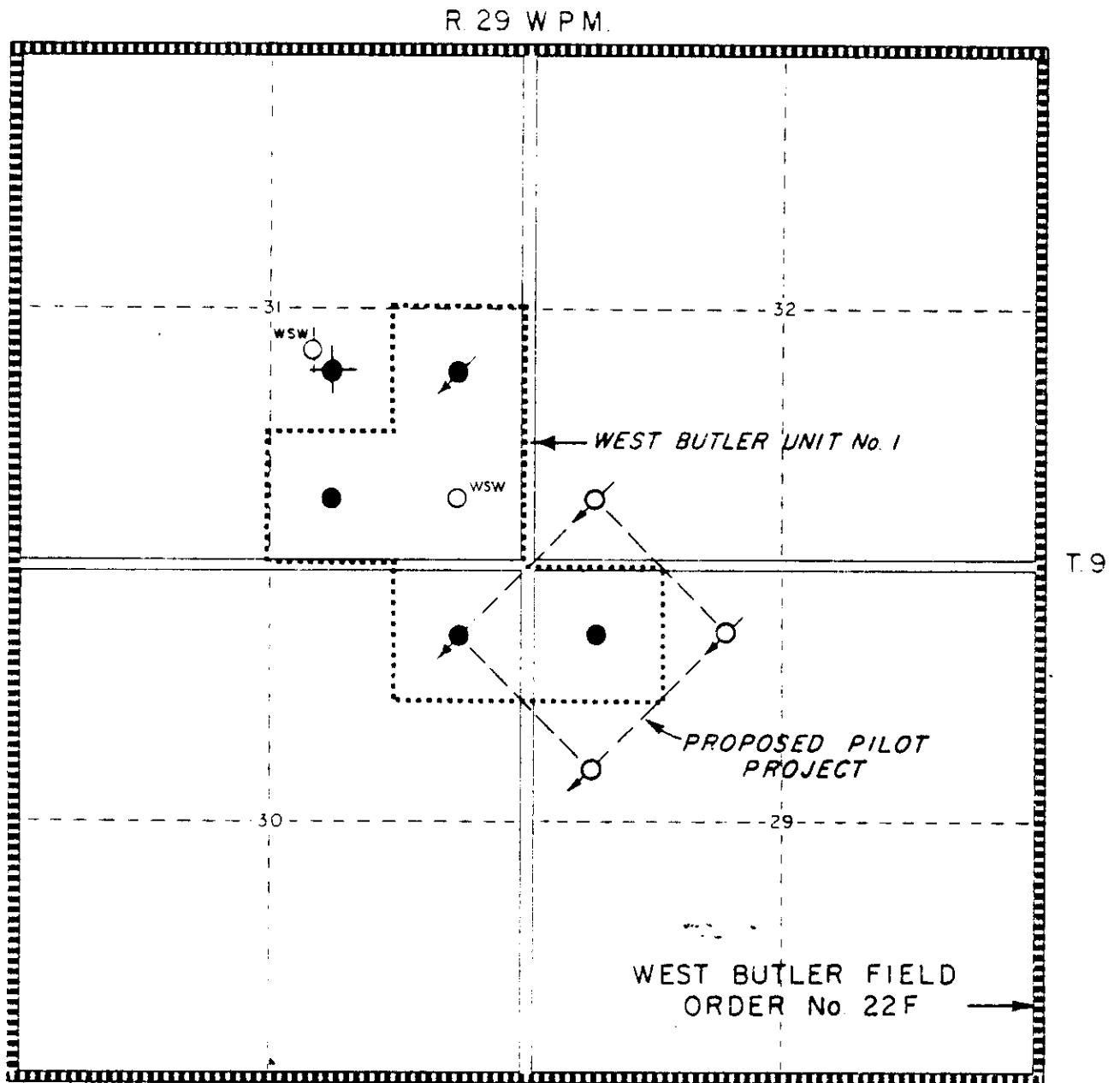
Yours very truly,

*for John D. Scott P. Eng.*  
G. W. CRUICKSHANK, P.Eng.  
Chairman, West Butler Unit No. 1

JDS/hb  
Attachment



FIGURE 1



LEGEND

- INJECTION WELL
- SUSPENDED WELL
- <sup>WSW</sup> WATER SOURCE WELL

DEVELOPMENT OF A PILOT PROJECT  
WEST BUTLER FIELD

SCALE 3" = 1 MILE

JUNE 1, 1978

Department of Energy and Mines  
Ottawa, Ontario

London, March  
Telephone (416) 947-9543  
1100 Lawrence Street  
Windsor, Ontario  
N3A 6G3

October 12, 1977

Chevron Canada Limited  
4400 - 17th Avenue S. W.  
Calgary, Alberta  
T2C 1K7

Attention: Mr. A. Lemberg  
Supervising Engineer, Reservoir

Dear Sir:

Re: Pilot Waterflood Plans  
West Butler Unit No. 1

The following comments and questions pertain to the development plans for a West Butler pilot waterflood outlined in your letter of 77 09 26:

1. An application for approval to change the source of water to be injected in West Butler Unit No. 1 is required in accordance with Subsection 2(2) of Board Order No. IM 21. The application should include:
  - (a) The reasons for and a request to terminate the temporary suspension of water injection granted by the Board's letter dated September 14, 1976;
  - (b) The reasons for and a request to change the water supply source;
  - (c) The suitability of the new water source for injection purposes (i.e. information and data to indicate compatibility problems, if any).
2. Chevron will require approval for a pilot waterflood operation pursuant to Subsection 62(9)(d) of The Mines Act. The application for a pressure maintenance order should be justified by including:
  - (a) General objective and need for pilot;
  - (b) Requested maximum duration for the pilot;
  - (c) Maximum requested surface injection pressure including injectivity calculations, voidage calculations in the pilot area, approximate volumes of water to be injected per well, anticipated fill up time, plus any expected problems and corrective measures due to the tightness of the reservoir (krv = 0.26 m.d. according to S. N. Borowski's study on the Area, Chevron, 1971);

- (1) Test existing methods of determining the amount of water in the reservoir, including piping and purging methods and other methods and related treatment methods;
  - (2) Test other additional oil reserves to be recovered if pilot waterflood is successful, including pertinent reservoir data such as present reservoir pressure, GOR, gas saturation, etc.
3. The team should demonstrate why the 1-31-9-25 well is incapable of controlled oil production, and include a reservoir evaluation and the proposed future plans for the field.
4. The team's reasons for suggesting that tract areas may be proposed as a basis for determining participation factors for new tracts and a description of the use of "tract areas", "calculated tract oil in place", or "production statistics methods".

Yours sincerely,

*Handwritten signature*  
H. C. Moster, P. Eng.,  
Director, Petroleum Branch.

HCE/et

c.c. The Oil and Natural Gas  
Conservation Board.

*Gas & Gravity*  
*D. S. Rogers*  
*Dr. van Haren* ←

Oil and Natural Gas  
Conservation Board:  
Jas. T. Cowley, P. Eng., Chairman,  
J. S. Hoper, Deputy Chairman,  
I. Daugh, Member. ←

Date 77 10 11

From H. C. Hoster,  
Director,  
Petroleum Branch.

Subject:

Chevron's Development Plans, Pilot Waterflood Scheme  
West Butler Field

Background:

The West Butler Field is located approximately twenty miles west of the Town of Virden. The discovery well in the Field was Chevron West Butler 1-31-9-29 which was drilled by California Standard Co. (Chevron) in November 1955. The Field presently contains seven wells including five wells in West Butler Unit No. 1. This Unit was formed in September 1, 1972 with Chevron Standard Limited being the Unit Operator. The Unit presently consists of two oil producing wells, one suspended oil well and two suspended water injection wells (see attached maps).

In 1972, a waterflood scheme was initiated in the Unit using two wells for water injection purposes. The injection was temporarily suspended in November 1974 due to the inavailability of an adequate water source well (water productivity from the existing water source well had been low and volumes of water were insufficient for voidage fill-up and reservoir pressure build-up). On September 14, 1976 the Board approved the temporary suspension of water injection for a maximum period of two years commencing July 1, 1976.

Discussion:

A letter from Chevron outlining its development plans in the West Butler area was received by this Branch (copy attached). Chevron requested that the plan be reviewed and they be advised if their plans meet with the approval of the Department. The development plans call for:

1. Developing an adequate water supply from the Devonian zone underlying the West Butler Field (by deepening and converting the presently suspended well located on Lsd. 1-31-9-29 W1 as a water source well).
2. Re-instituting water injection (from new water source) into the presently suspended injection wells located on Lsds. 16-30-9-29 and 8-31-9-29 W1.
3. Drilling three new injection wells around the well located on Lsd. 13-29-9-29 and commence water injection for a period of up to two years to test the feasibility of waterflood response on a full scale five-spot injection pattern.

4. If the results of the pilot waterflood are favourable, the three new injection tracts would be added to the present Unit by enlargement. Future tracts would be added as conditions warrant due to project expansion.
5. If production response is obtained on 13-29-9-29 as a result of the pilot waterflood, Chevron proposes to continue to allocate all of that well's production to the Unit to be divided proportionately according to presently established tract participation factors for the Unit (this will be done only during the life of the pilot - up to two years). Chevron suggests that the Crown possibly may forego some royalty during the test period that should be credited to the injection well tracts.

This Branch is in general agreement with the principles presented in the above listed five points, however, point number 5 needs further elaboration and clarification due to its unique nature.

Referring to the attached map, it can be seen that the oil producer and one injector (proposed pilot) are already part of an existing Unit, while the other three injectors will be located outside of the Unit. Certain past cases in Manitoba handled this complication by agreements in which 1/8 of the production from the pilot waterflood's producing well was allocated to each of the offsetting injection wells (tracts). Since two wells in the pilot area are already included in the Unit, such an allocation becomes impossible under present circumstances unless the other three injectors are also included in the Unit.

Section 4.01 of the West Butler Unitization Agreement states:

"4.01 All Unitized Substances produced and saved shall be apportioned among and allocated to the several Tracts in accordance with their respective Tract Participations. The amount of Unitized Substances so allocated to each Tract, and only that amount, regardless of whether it be more or less than the amount of the actual production of Unitized Substances from the Well or Wells, if any, on such Tract, shall for all intents, uses and purposes, be deemed to have been produced from such Tract."

Therefore it can be concluded that no production from wells within the Unit can be allocated to wells (tracts) outside the Unit without first amending the Unitization Agreement.

As stated in Chevron's letter, including the three injection tracts (Crown) in the existing Unit before waterflood success can be established, may be unjust to the Freeholder's interests for the remaining life of the project, if the pilot is not successful.

To show the effect of Chevron's proposal on the royalty revenue to the Crown, we have carried out sample calculations comparing the revenues in two cases showing different production response (detailed calculations are presented on attachment):

1. The total production from the 13-29 well is allocated to West Butler Unit No. 1 versus,
2. 1/8 of the total production from 13-29 well is allocated to each of the three injection wells outside the Unit (total of 3/8 of 13-29 production).

The results were as follows (presently, the oil productivity of 13-29 well is approximately 5 barrels per day):

West Butler Unit No. 1 total royalty payment for August 1977 = \$209.97

Case I: if oil production is tripled on 13-29 well  
(15 BOPD, pilot waterflood effect)

	<u>Total Royalty Payable \$</u>
a. If production is allocated to Unit	422.00
b. If 1/8 of the production is allocated to each of the three injection tracts	539.50

Case II: if oil production is 25 BOPD on 13-29 wells and  
15 BOPD on 2-31 well

a. If production is allocated to Unit	934.66
b. If 1/8 of the production is allocated to each of the three injection tracts	1,061.99

For the expected duration of the pilot (2 years maximum), the difference in cumulative royalty to the crown could amount to approximately \$2,300.00 maximum, if production on 13-29 increased by fivefold its present level (25 BOPD) (assumption: response will probably not be evident until approximately 6 months after commencement of water injection).

We should mention that aside from the mentioned inequity to Freeholders, if the three injection tracts are immediately included in the Unit, such inclusion would require tremendous efforts from all parties concerned (i.e. changing the Unitization Agreement, tract participation factors, Unitization Order, ratifications by Working Interest Owners and Royalty Owners, Public Hearing by the Board, various submissions and preparations by Chevron and the Department, etc.).

Recommendation:

This memo is presented to the Board mainly for informational purposes.

It is proposed that unless the Board has any objections to Chevron's proposals, the Branch shall reply to Chevron's letter confirming that their proposals appear reasonable and that an application to the Board for a pilot waterflood pressure maintenance order is still required along with necessary supporting data.

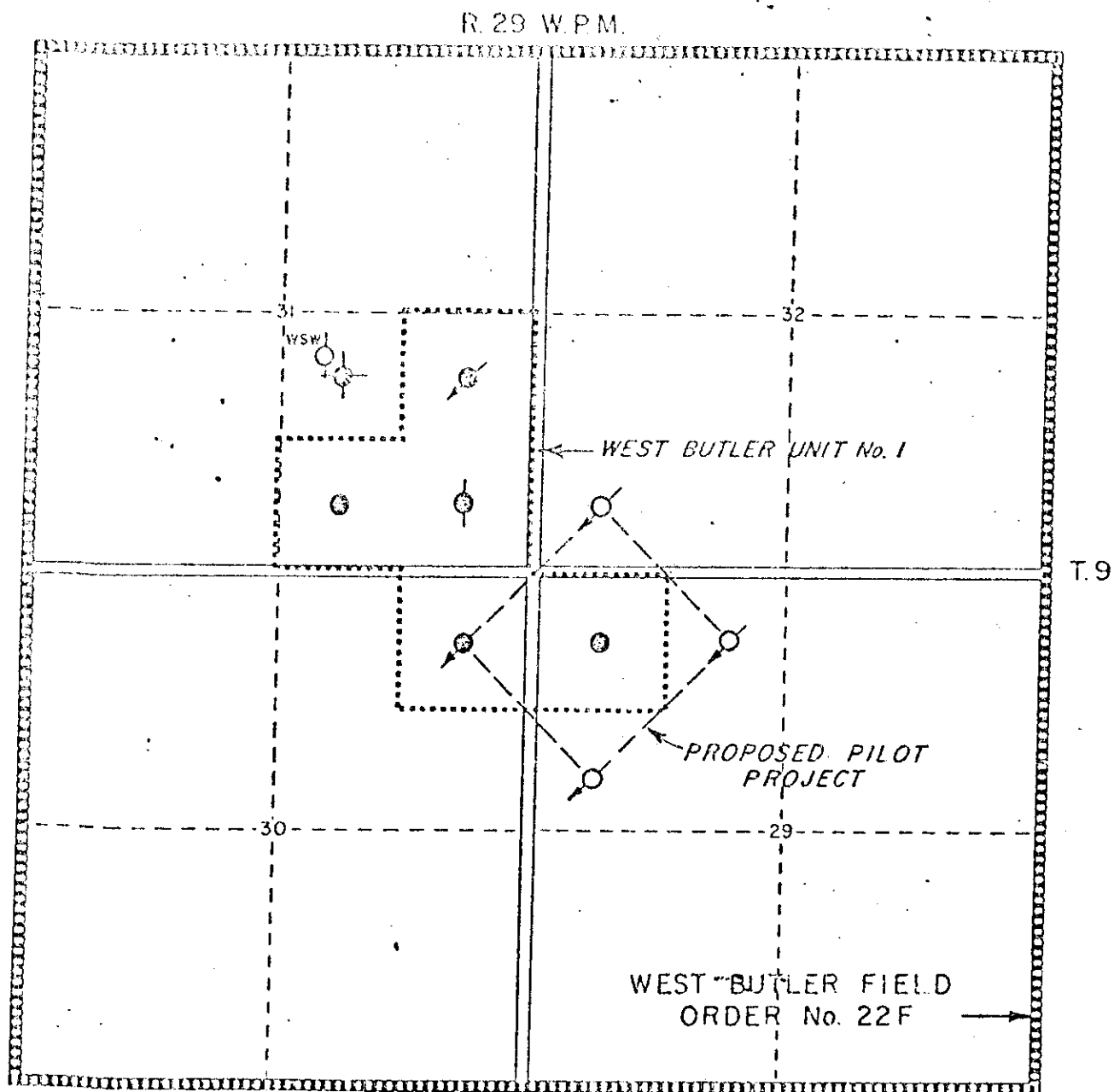
Please advise prior to October 21, 1977 if the above proposal meets, or does not meet, with the Board's approval.

Original Signed by H. C. Moster




H. C. Moster

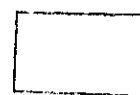
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Attachs.

FIGURE 1

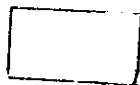


LEGEND

-  INJECTION WELL
-  SUSPENDED WELL
-  WSW WATER SOURCE WELL



CROWN



FREEHOLD

DEVELOPMENT OF A PILOT PROJECT

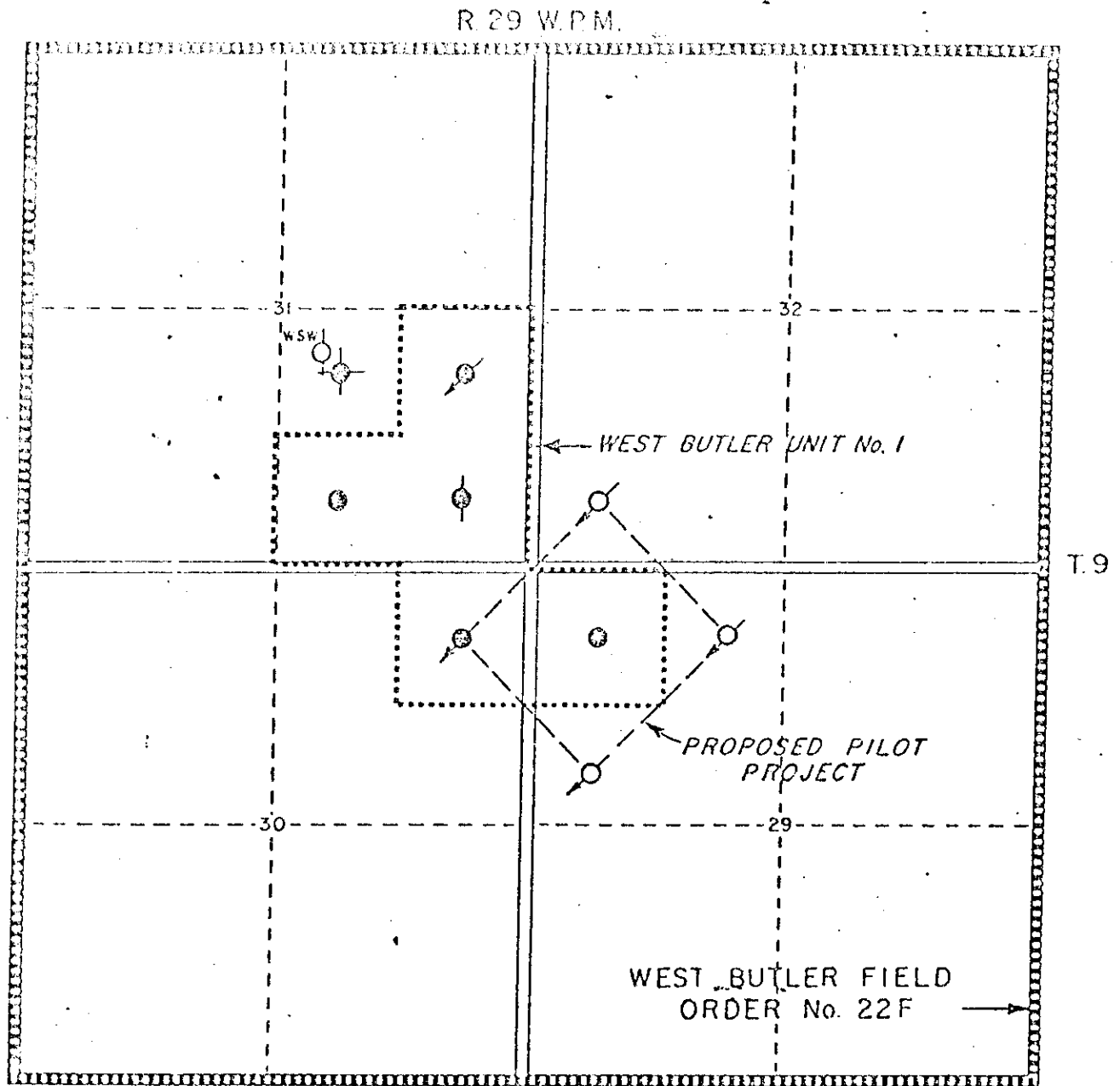
WEST BUTLER FIELD

SCALE 3" = 1 MILE




JULY 11, 1977



FIGURE 1



LEGEND

-  INJECTION WELL
-  SUSPENDED WELL
-  WATER SOURCE WELL

DEVELOPMENT OF A PILOT PROJECT  
WEST BUTLER FIELD

SCALE 3" = 1 MILE

JULY 11, 1977



**Chevron Standard Limited**  
400 - Fifth Ave. S.W., Calgary, Alberta T2P 0L7

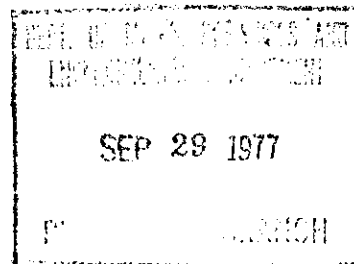
R. I. Bailey  
Chief Engineer

1977-09-26

Pilot Waterflood Plans  
West Butler Unit No. 1

Department of Mines Resources and  
Environmental Management  
Mineral Resource Division  
Province of Manitoba  
933 Century Street  
Winnipeg, Manitoba  
R3H 0W4

Attention: Mr. H. C. Moster, P.Eng.  
Director, Petroleum Branch



Gentlemen:

Chevron Standard Limited is planning to initiate a pilot waterflood in the West Butler Field. Details of the proposed development are listed in the appendix of our letter to Mr. J. S. Roper, Deputy Chairman of The Oil and Natural Gas Conservation Board, dated 1977-03-11. The purpose of this letter is to inform you of our development plans and to ascertain that they meet with the approval of your Department. We will be attempting to commence injection before freeze-up this fall and we wish to minimize the time required for the various approvals required to get the project under way. Any suggestions, changes or recommendations that you might propose to expedite this project will be sincerely appreciated.

Chevron plans to develop an adequate water supply from the Devonian zone underlying the West Butler field. The presently suspended well 1-31-9-29 WPM is incapable of commercial production of hydrocarbons from the Mississippian zone. We plan to abandon the Mississippian zone in this well and deepen it to the Devonian zone. The necessary approvals to abandon the Mississippian zone and deepen the well to the Devonian zone will be obtained by Mr. G. W. Cruickshank in our Virden office. After the well is deepened, it will be tested to determine the adequacy of the Devonian water supply.

Assuming that an adequate water supply is developed, we plan to immediately reinitiate injection into the presently suspended injection wells 16-30-9-29 WPM and 8-31-9-29 WPM. An application will be made requesting permission to change the source of water being injected in accordance with clause 2(2) of Order No. PM 21,

and to rescind the approval of temporary suspension of water injection as outlined in your letter of 1976-09-14. We further plan to drill three additional wells outside of the West Butler Unit No. 1 boundaries as shown on Figure 1. The proposed wells 12-29-9-29 WPM, 14-29-9-29 WPM and 4-32-9-29 WPM will be used as injection wells in the proposed pilot project indicated on Figure 1. Before the completion of these wells, we will make application for the approval of the wells as injectors in a pilot waterflood project. We do not propose that the injection well tracts be included in the Unit until after the success of the pilot waterflood has been adequately demonstrated on the basis of production response at the production well 13-29-9-29 WPM. It is expected that response should be evident in six months, and the pilot waterflood may operate for up to two years, if response is not evident. It is difficult to establish the value of the injection wells to the Unit for equity purposes unless positive production response is demonstrated.

Chevron believes that this approach to unitization offers the greatest protection for the freehold interests in the present Unit. We contend that there is a high degree of uncertainty involved in the degree of production response that might be achieved by the waterflood. Obviously, if there were no response in the pilot waterflood, and the unit were enlarged beforehand to include the three additional injection wells, then freeholders' interests would be diluted. The freeholder interest income would then be reduced for the remaining life of the project. Inasmuch as the three proposed injectors will be located upon Crown leases, the Crown possibly will forego some royalty during the test period that should be credited to the injection well tracts.

If the pilot waterflood is successful, then Chevron would make application to include the three injection well tracts in West Butler Unit No. 1 by enlargement. If further development occurs as anticipated, then additional tracts, as developed, would also be included in the Unit by enlargement.

Historically, in Manitoba units, participation factors were based upon production history during a substantial primary production period. Inasmuch as little or no production history will be available for the injection well tracts and further development well tracts, Chevron would propose that participation factors for tracts included in West Butler Unit No. 1 by enlargement be based upon tract area unless there is reason to believe that area allocation is not equitable. In this case, another participation factor formula would be proposed based upon the most equitable method at the time.

In order to expedite the pilot waterflood as quickly as possible, Chevron requests that you review our development plans as outlined and advise us if the procedure recommended meets the approval of your Department.

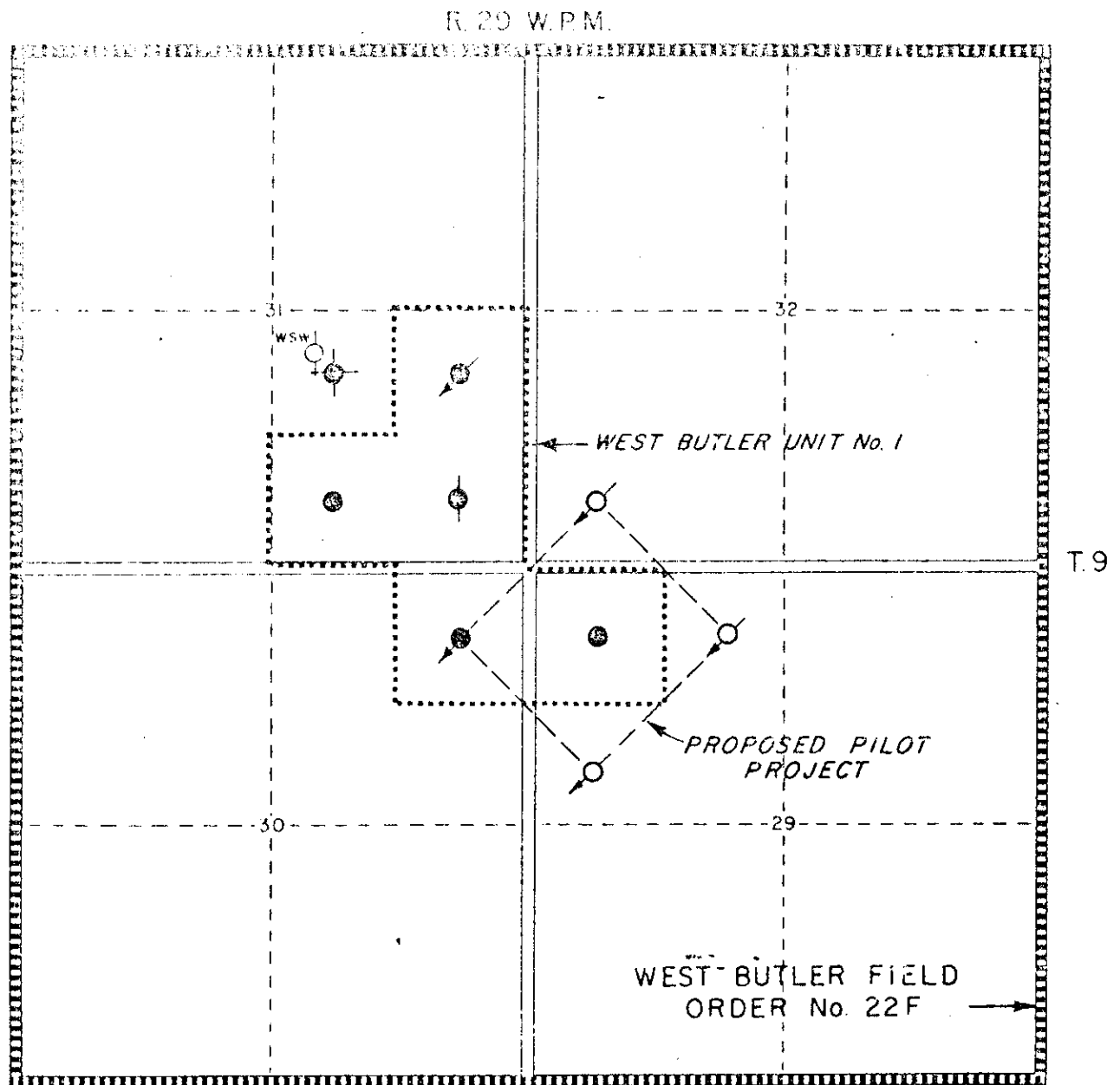
Any enquiries regarding this letter should be directed to Mr. J. D. Scott at the above letterhead.

Yours very truly,

*John D. Scott, P. Eng*  
for *A. HAMBERG*  
Supervising Engineer, Reservoir

JDS/hb  
Attachment

FIGURE 1



LEGEND

- INJECTION WELL
- SUSPENDED WELL
- WATER SOURCE WELL

DEVELOPMENT OF A PILOT PROJECT  
WEST BUTLER FIELD

SCALE 3" = 1 MILE

JULY 11, 1977

## Royalty Calculations on West Butler Pilot Waterflood

### General Assumptions:

1. The price of crude remains at \$10.76/bbl.
2. Transportation charges remain at \$0.31/bbl.
3. Unchanged royalty structure system.

### West Butler Unit No. 1

Tract No.	Tract Participation Factor	August 1977			
		Days on Prod.	Actual Prod.	Alloc. Prod.	BOPD
13-29 (Crown)	21.33365	31	145	70	2.3
16-30 (Crown)	21.76131	31	—	72	2.3
1-31 (Freehold)	3.99741	31	—	13	0.4
2-31 (Freehold)	33.18656	31	185	109	3.5
8-31 (Freehold)	19.72107	31	—	66	2.1

Total royalty paid for August 1977

for 13-29 \$103.51

for 16-30 106.46

Total \$209.97

### Case I:

- A. Assumptions:
1. Production is tripled on 13-29 well (15 BOPD, 30 days/month).
  2. 6 BOPD constant production for 2-31 well
  3. Royalty is paid on "developed well" status
  4. 13-29 total production is allocated to Unit

Total Unit Production =  $(15 \times 30) \times (6 \times 30) = 630$  barrels

Tract No.	Alloc. Prod.	BOPD
13-29	134 bbl.	4.48
16-30	137 bbl.	4.6

### Total Royalty Payable:

13-29 Tract =  $134 (10.76 - 0.31) [0.125 + 1.5 \times 0.015] = \$ 206.54$

16-30 Tract =  $137 (10.76 - 0.31) [0.125 + 1.5 \times 0.015] = \underline{215.46}$

\$ 422.00

- B. Assumptions:
1. Production is tripled on 13-29 wells (15 BOPD, 30 days/month),
  2. 6 BOPD constant production for 2-31 well
  3. Royalty is paid on "developed well" status in Unit and "new well" status for 3 injection wells outside Unit
  4.  $1/8$  of 13-29 production is allocated to each of the three injection wells outside the Unit.

$$\text{Total Unit Production} = (5/8 \times 300) + 180 = 461 \text{ barrels}$$

<u>Tract No.</u>	<u>Alloc. Prod.</u>	<u>BOPD</u>
13-29	98 bbl.	3.2
16-30	100 bbl.	3.3
12-29, } 14-29 & } 4-32 }	56 bbl.	1.88

Total Royalty Payable:

$$\begin{aligned} 13-29 &= 98 \times 10.45 [0.125 + 1.5 \times 0.013] &= \$ 147.98 \\ 16-30 &= 100 \times 10.45 [0.125 + 1.5 \times 0.013] &= 151.00 \\ 12-29; 14-29 \& 4-32 &= (3 \times 56) \times 10.45 [0.125 + 1.5 \times 0.008] &= 240.52 \\ &&= \$ 539.50 \end{aligned}$$

Case II:

- A. Assumptions:
1. Production on 13-29 increases to 25 BOPD (as per Chevron's submission 77 03 11).
  2. Production on 2-31 well increases to 15 BOPD ( $2\frac{1}{2}$  times present level - result of re-institution of water injection).
  3. Royalty is paid on "developed well" status.
  4. 13-29 production is allocated to Unit.

$$\text{Total Unit Production} = (25 \times 30) + (15 \times 30) = 1,200 \text{ bbl.}$$

<u>Tract No.</u>	<u>Alloc. Prod.</u>	<u>BOPD</u>
13-29	256 bbl.	8.5
16-30	261 bbl.	8.70

Total Royalty Payable:

$$\begin{aligned} 13-29 \text{ Tract} &= 256 \times 10.45 [0.125 + 1.5 \times 0.032] &= \$ 462.81 \\ 16-30 \text{ Tract} &= 261 \times 10.45 [0.125 + 1.5 \times 0.032] &= 471.85 \\ &&= \$ 934.66 \end{aligned}$$

- B. Assumptions:
1. Production on 13-29 increases to 25 BOPD (as per Chevron's submission 77 03 11).
  2. Production on 2-31 well increases to 15 BOPD ( $2\frac{1}{2}$  times present level - result of re-institution of water injection).
  3. Royalty is paid on "developed well" status in Unit and "new well" status for 3 injection wells outside Unit.
  4.  $\frac{1}{8}$  of 13-29 production is allocated to each of the three injection wells outside the Unit.

Total Unit Production =  $\frac{5}{8} \times 750 + 450 = 919$  bbl.

<u>Tract No.</u>	<u>Alloc. Prod.</u>	<u>BOPD</u>
13-29	196 bbl.	6.5
16-30	200 bbl.	6.7
12-29, } 14-29 & } 4-32 }	94 bbl.	3.1

Total Royalty Payable:

13-29 = $196 \times 10.45 [0.125 + 1.5 \times 0.022]$	= \$ 323.62
16-30 = $200 \times 10.45 [0.125 + 1.5 \times 0.022]$	= 330.22
12-29, 14-20 & 4-32 = $(3 \times 94) \times 10.45 [0.125 + 1.5 \times 0.009]$	= 408.15
	<hr/> \$1,061.99



POLICY ADVISOR  
**COPY**

77 04 26.

Chevron Standard Limited,  
400 - Fifth Avenue S.W.,  
Calgary, Alberta.  
T2P 0L7

ATTENTION: Mr. J. Zedde.

Dear Mr. Zedde:

Re: West Butler.

Further to your letter of 77 03 11 and the Department's letter of 77 03 15, Chevron's proposals have been reviewed. The Department is prepared to recommend consideration of the proposed pilot waterflood and expansion of the waterflood if warranted on an appropriate sharing of the costs basis, in return for a proportionate working interest.

It is suggested that discussion of the subject take place at a mutually convenient time, date, and place. Please contact the writer at your early convenience regarding arrangements for the meeting.

Yours sincerely,

*(Signature)*

J. S. Roper.

JSR/gw

c.c.: Jas. T. Cavley.  
Ian Hough.  
H. C. Mosier.

*(Signature)*

25 → Man  
100  
40 → Chas  
100  
2 m. → 55 to Chas.

J. S. Roper,  
Policy Advisor  
Dept. of M. R. & L. N.

COPY 77 04 26

H. C. Mosier, Director  
Petroleum Branch  
989 Century Street

RE: WEST BUTLER WATERFLOOD COUNTER PROPOSALS

Further to my memo of 77 04 18 and the possible agreement you described in your memo of 77 04 21, please find attached a descriptive summary of the leasing history of the Crown oil and natural gas rights in the lands in question. As stated, Chevron has expended over \$45,000. in Crown rentals including a 1971 bonus payment.

With respect to your proposal, the following suggestions are made:

1. The Crown (MMR), in return for putting up 100% of the costs of the pilot (\$413,000), would earn a 50% interest in all of Chevron's current interest in the West Butler Field plus in the pilot.
2. If the pilot is successful, the expansion of the waterflood area would be done on a working interest arrangement under which the Crown (MMR) could take up to a 50% working interest.

An improvement to the proposal might require Chevron to put up a portion of the cost of the pilot so as to make the proper management of the pilot of more concern to them plus their having a even greater investment in the area might provide a future incentive to then continue with the extension of the waterflood if the results of the pilot are only marginal.

Original Signed by H. C. Mosier

H. C. Mosier

HCM/ch  
Attach.

→ c.c. I. Haugh

Department of Mines, Resources  
& Environmental Management  
Mineral Resources Division

APR 27 1977  
ASSISTANT DEPUTY MINISTER

History of Crown Leases in West Butler Field  
(Sections 29, 30 and 32-9-29 W)

The first Oil and Natural Gas Leases issued to West Butler Field were:

Lease No.	Company	Location	Acreage	Date Issued	Rental Paid	Remarks
444	Chevron	NW $\frac{1}{4}$ -29-9-29	159	May 1/54	\$1,669.50	In Good Standing
446*	Chevron	NE $\frac{1}{4}$ -30-9-29	160	May 1/54	1,834.00	In Good Standing

Above Leases were selected from Geological Reservation 1 - 9, issued to Chevron in 1947.

\* Lease # 446 was partly surrendered on June 15, 1960  
Original description N $\frac{1}{2}$  Sec. 30-9-29. New description NE $\frac{1}{4}$  Sec. 30-9-29.

Paradise Petroleum Ltd. was successful bidder during the Oil and Natural Gas Lease Sale No. 42, held on March 2, 1965, however these leases were surrendered in 1967, 1968 and 1970 respectively.

Lease No.	Company	Location	Acreage	Date Issued	Bonus Paid	Rental Paid	Surrendered
2165	Paradise	SE 29-9-29	159	5/3/65	\$ 675.75	\$ 238.50	26/11/68
2166	Paradise	SE 30-9-29	160	5/3/65	680.00	240.00	26/11/68
2167	Paradise	NW 30-9-29	157	5/3/65	981.25	706.50	18/3/70
2168	Paradise	SW 32-9-29	161	5/3/65	1,006.25	724.50	18/3/70
2169	Paradise	NE 32-9-29	162	5/3/65	688.50	162.00	11/4/67
			799		\$4,031.75	\$2,071.50	

Chevron Standard was successful bidder during the Oil and Natural Gas Lease Sale No. 69, held September 27, 1971, for the following parcel:

Lease No.	Company	Location	Acreage	Date Issued	Bonus Paid	Rental Paid	Remarks
2389	Chevron	E $\frac{1}{2}$ & SW $\frac{1}{4}$ Sec. 29 S $\frac{1}{2}$ & NW $\frac{1}{4}$ Sec. 30 and All Sec. 32	1,599	27/9/71	\$32,203.86	\$9,594.00	In Good Standing

TOTAL PAYMENTS FOR CROWN ACREAGE IN WEST BUTLER FIELD

Lease No.	Company	Acreage	Bonus	Rental	Total	Price # Per Acre
444	Chevron	159		\$ 1,669.50	\$ 1,669.50	
446	Chevron	160		1,834.00	1,834.00	
2389	Chevron	1,599	\$32,203.86	9,594.00	41,797.86	\$20.14
		1,918	\$32,203.86	\$13,097.50	\$45,301.36	
5 leases						
Total	Paradise	799	4,031.75	2,071.50	6,103.25	5.05
		1,918	\$36,235.61	\$15,169.00	\$51,404.61	

\*Based on "Bonus Payment" only.

## inter-departmental memo

To

J. S. Roper,  
Policy Advisor,  
Dept. of M., R. & E. M.

Date 77 04 18

From H. C. Moster,  
Director,  
Petroleum Branch.

Subject: West Butler Waterflood — Chevron Standard's Proposals

Pursuant to your memo dated 77 03 15, the submission from Chevron Standard has been reviewed and the proposals analysed by the Branch.

Background:

West Butler Unit No. 1 presently contains 5 wells (2 water injectors and 3 oil producers). One of the producing wells has been suspended since July 1974 due to low productivity. The following summarizes each well's last production rate .

<u>Well</u>	<u>Last Prod. Date</u>	<u>Barrels of Oil Produced</u>	<u>Barrels of Water Produced</u>	<u>Days on Prod.</u>	<u>BOPD</u>	<u>WC%</u>
13-29-9-29	February 1977	137	—	11	12	0
1-31-9-29	July 1974	19	—	13	1.5	0
2-31-9-29	February 1977	177	—	11	16	0

The relatively high production rates of the 13-29 and 2-31 wells during February 1977 is attributed to the wells being shut-in for approximately two months (December 1976 - February 1977). Under normal operating conditions, however, both wells are expected to produce 5 - 6 barrels of oil per day each.

Voidage Calculations:

Cumulative Oil Production to end of February 1977 - 165,462 STB  
 Cumulative Water Production to end of February 1977 - 40,472 STB  
 Oil Formation Volume Factor - 1.07 bbl./STB  
 Cum. Voidage Oil - 177,044 reservoir barrels  
 Cum. Voidage Water - 40,472 reservoir barrels  
 Total Voidage - 217,516 reservoir barrels  
 Cum. Water Injected - 70,074 reservoir barrels  
 Cum. Net Voidage - 147,442 reservoir barrels

Discussion:

The technical material presented in the submission is the same as that used in 1972 when the current Unit was formed and original waterflood initiated. This technical material still applies (i.e. - original oil-in-place estimated at 500,000 S.T.B. per 40 acre spacing). The primary recovery factor of 6.4% appears reasonably accurate (estimated primary recoverable reserves = 32,000 STB per 40 acre spacing).

From the above data, it can be seen that the productivity of the wells in the West Butler has come to a critical point where enlarging the Field or re-instituting waterflood is necessary, otherwise, all the wells can be expected to be abandoned in the near future.

A. Proposal No. 1

Chevron would drill a Devonian water supply well (\$130,000) plus 3 new injection wells (\$333,000) and commence a pilot waterflood at a total estimated initial capital expenditure of \$618,600 (including \$92,800 for risk). If this pilot proved unsuccessful, Chevron's proposal is that it would receive a credit for all expenditures incurred in carrying out the pilot from provincial Crown royalties (could also include Chevron mineral tax obligations?) payable by Chevron on its other producing properties in Manitoba.

Chevron currently pays approximately 80% of our annual provincial Crown royalties (\$2.3 million) or \$1.8 million per year or \$150,000 per month.

Chevron currently pays 55% of the annual Freehold mineral tax (\$6.5 million) or \$3.6 million per year or \$300,000 per month.

Therefore, if Chevron's proposal with respect to the pilot was accepted and the pilot was unsuccessful, then the province would either credit Chevron with  $\$618,000 + \$150,000 = 4.1$  months of Crown royalty payments or  $\$618,000 + \$450,000 = 1.4$  months of Crown royalty plus freehold mineral tax payments.

B. Proposal No. 2

If the pilot proves successful, then Chevron would expand the waterflood. Chevron has postulated that this enlargement could cover up to four sections (i.e. - 8.99 million S.T.B. of recoverable oil through waterflooding using an estimated 28.1% recovery factor). The estimate of drilling an additional 57 wells plus related production and injection facilities including risk is \$8.917 million. Chevron's second proposal is that it would be exempt from paying all provincial Crown royalties on production from the waterflood until it has paid out all costs.

Based on Chevron's submission, this payout period would result in no royalty or mineral tax payments by it to the province for an estimated 4.2 years.

NOTE: We requested and have received the computerized economic print-out sheets from Chevron. A detailed check of these print-outs has not yet been completed and may require some taxation expertise.

Conclusions:

1. The primary recoverable reserves of the current West Butler wells have now been nearly produced and unless a successful waterflood can be achieved no further reserves will be produced.
2. Drilling of additional wells in the future in this Field are unlikely under current economics unless waterflooding can be reasonably assured.
3. Indications are that additional reserves do exist in the undrilled spacing units in the Field (based on seismic structural high anomaly).
4. A scheme that is satisfactory to both the province and Chevron is very desirable in order to:
  - conserve additional reserves that might otherwise not be produced in the West Butler Field.
  - determine that other similar "tight" reservoirs in Manitoba can also be successfully exploited under waterflood (eg.: inter-Daly area)

Recommendations:

That the Board meet with or ask Chevron to clarify or comment on the following items:

1. What would Chevron consider to be the minimum response in the pilot and still warrant expansion of the waterflood project?
2. In allocating production from the pilot producer to its offsetting injection locations, how would Chevron propose handling same?

Problem: Proposed producing well and one injection well are located in current Unit but three new injectors would be outside Unit. Current agreement would require production be allocated to current unit wells only, thus subject to developed oil royalty rates. The picture will be more complicated if the well located on Lsd. 1-31-9-29<sup>also</sup> shows response to the waterflood (this well will be offset by 2 injectors).

Solutions: 1. Enlarge unit<sup>to</sup> cover new pilot injection wells.

2. Special agreement between all parties for special allocation contrary to Unit Agreement.

3. When referring to "royalty" in study, does this only mean provincial Crown royalty or also freehold mineral tax (company's share)?
4. What makes the enlarged waterflood project unattractive to Chevron when it would have a 28.3% rate of return and a 5 year payout period under existing new oil royalty rates (Chevron's No.'s - Table 3 cont'd.).

Counter Proposals:

1. Government - Chevron joint participation agreement.

Pros: Both parties share risk and potential success.  
Less initial capital outlay required by Chevron.  
More palatable to province (share risk, do not lose taxes)

Cons: Does not change unattractive economic returns for Chevron.  
Requires province to put up risk capital.

2. Exempt production from scheme from incremental royalty and incremental mineral tax payments till after payout of project.

Pros: More palatable to province than Chevron's proposals.  
Province receives basic royalties & taxes from continuing production.  
Better than existing taxation for Chevron.  
Excludes province from risk if project fails.

Cons: Less attractive to Chevron than Chevron's proposal.  
(eg. - longer payout period,  $\approx$  6 months)  
Loss of incremental taxes and royalties during payout period.

3. Partial exemption of Chevron from royalty and mineral tax obligations to make project economically feasible for Chevron.

Eg.: 50 - 75% tax and royalty exemption till payout

Pros & Cons: similar to 2

4. Implementing Pilot Waterflood using only one existing injector:

This proposal would involve the drilling of a Devonian water supply well and using only one existing well for injection (16-30-9-29). The total estimated initial capital expenditure would be approximately \$227,000 (including 18% for risk).

Pros: Would reduce the loss for Crown royalty and tax revenue should the project fail (Chevron would be credited with \$227,000 Crown royalties instead of \$618,600).

Cons: Technically speaking, implementing the 5-spot injection network is more desirable to accurately evaluate the success of the project. More time is required, using only one injector, before response to waterflood is evident. This partial injection pattern would still not fully evaluate the expected performance of a complete 5-spot pattern.

Due to the uncertainties of the results of the pilot and changing economic conditions, a commitment on the enlarged project phase of the program at this time would be undesirable from a provincial standpoint other than under Counter Proposal No. 1.

COPY

Mr. J. Zedde,  
Vice-President,  
Producing Department,  
Chevron Standard Limited,  
400 - Fifth Avenue S.W.,  
Calgary, Alberta.  
T2P 0L7

Dear Mr. Zedde:

Re: West Butler Unit No. 1.

Your letter of 1977 03 11 submitting two proposals for resuming water injection in the subject Unit is acknowledged.

The Petroleum Branch will be asked to review the proposals and to direct any enquiries to Mr. J. D. Scott.

The Board or the Branch will contact you regarding your invitation to discuss the proposals at a mutually satisfactory time and place following the review.


Yours sincerely,

  
J. S. Roper,  
Deputy Chairman.

JSR/dv

c.c.: Jas. T. Cawley.  
I. Haugh.  
H. C. Moster.

Department of Mines, Research  
& Environmental Management  
Mining & Resources Division

 MAY 23 1977  
ASSISTANT DEPUTY MINISTER



MAR 15 1977

H. C. Moster,  
Director, Petroleum Branch,  
Mineral Resources Division,  
993 Century Street.

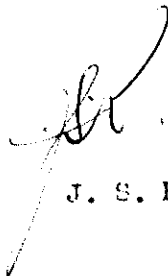
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J. S. Roper,  
Policy Advisor,  
302 Legislative Building.

WEST BUTLER UNIT NO. 1.

Attached is a copy of Mr. J. Zedde's letter of 77 03 11 plus  
attachments regarding two proposals for resuming water injection.

1. Please review and analyze the proposals for the Board;
2. Prepare possible counter proposals for the Board;
3. Arrange for discussion of (1) and (2) with the Board on  
or before April 18th.



J. S. Roper.

JSR/dw

Attachments.

c.c.: Jas. T. Cawley.  
I. Haugh.

Department of Mineral Resources  
302 Legislative Building  
Mineral Resources Division



RECEIVED BY THE MINISTRY



**Chevron Standard Limited**  
400 - Fifth Ave. S.W., Calgary, Alberta T2P 0L7

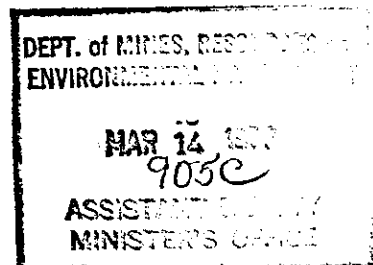
1977-03-11

J. ZEDDE  
Vice-President  
Producing Department

West Butler Unit No. 1

The Oil and Natural Gas Conservation Board  
Department of Mines, Resources and  
Environmental Management  
993 Century Street  
Winnipeg, Manitoba  
R3H 0W4

Attention: Mr. J. S. Roper  
Deputy Chairman



Gentlemen:

In response to Condition <sup>4</sup>3 of your letter of 1976-09-14, Chevron Standard Limited hereby submits to the Petroleum Branch for discussion two proposals for resuming water injection. The proposals are as follows:

Proposal 1:

It is proposed that a pilot waterflood be initiated in the West Butler pool as illustrated on Figure 1 attached. The purpose of the proposed pilot is to test and demonstrate the feasibility of waterflooding in the West Butler pool. It is proposed that all costs of the pilot waterflood be paid by Chevron Standard Limited. If the pilot waterflood fails, it is proposed that Chevron Standard Limited be credited the full cost of the pilot project out of its royalty obligations in other Manitoba pools.

Proposal 2:

If the pilot waterflood is successful, further development would proceed on 40 acre spacing as shown on Figure 2 attached. Chevron Standard proposes that the Manitoba Government waive royalties for the West Butler pool until the project investment including the pilot waterflood investment has been paid out.

The technical information for the above proposals is attached as Appendix 1. Any enquiries regarding the technical details should be directed to Mr. J. D. Scott at the letterhead address.

We would like to discuss these proposals with you at your convenience after you have had an opportunity to review them.

Yours very truly,

J. ZEDDE

JDS/njs  
Attach.

## APPENDIX

### WEST BUTLER POOL DEVELOPMENT

#### Introduction

The West Butler pool was discovered in 1955 in the Lodgepole formation by the drilling and testing of the well Chevron West Butler 1-31-9-29. Within four months of discovery of the pool, five additional wells were drilled on 40 acre spacing directly or diagonally offsetting the discovery well. Further development of the pool was curtailed when the rapid decline in production became apparent. The field was unitized and waterflooding commenced in 1972. Water injection was suspended in 1974. The lack of production response was primarily due to insufficient water supply and subsequent insufficient water injection.

#### Geology

The West Butler field produces from limestone and dolomites in the Upper Lodgepole beds of Mississippian age. The top of the Mississippian is an erosional surface (post Mississippian unconformity). Dolomitization below the Mississippian erosional surface has occurred in all wells. Completions have been made in both the dolomite and limestone with no marked difference in the productivity of the wells. The best porosity and permeability appears to occur about 38 to 45 feet below the top of the reservoir, regardless of whether the lithology is dolomite or limestone. The oil-water interface has been estimated at -992 feet based upon drillstem test results and E-log interpretation. The gross pay interval between the top of the Mississippian and the estimated oil-water interface averages 100 to 115 feet over the developed portion of the reservoir.

The limits of the West Butler Pool are still undefined. The seismic map for a horizon near the Bakken formation appears to support a structural interpretation with a domal feature in the field area. The seismic data suggests a productive area of about three or four sections and possibly larger. The drilling of wells for primary production cannot be economically justified and therefore, the pool boundaries have not been delineated.

#### Reservoir Properties

Using a one millidarcy cutoff the average net pay for the West Butler pool is 48.8 feet, the average porosity is 10.8 percent and the average permeability is 11.8 millidarcies. However, for the purposes of evaluating a waterflood project, an additional restriction was imposed upon the net pay. The net pay includes only intervals of 1.5 feet of continuous section having permeabilities greater than one millidarcy. This was done to eliminate isolated thin stringers of permeability which would contribute little to a waterflood project. Using this additional cutoff, the average net pay is 24.7 feet, the average porosity is 10.6 percent and the average permeability is 8.2 millidarcies. Using established reservoir parameters (1), the original oil in place per 40 acre spacing unit is 500,000 STB. Reserve parameters are summarized in Table 1.

### Performance Review

The rapid decline in production rates during primary production is attributed to low reservoir permeability and lack of an effective reservoir drive mechanism. The pool was approaching the end of its productive life on primary production when waterflooding was commenced in 1972. Waterflooding to increase production rates and ultimate recovery offered the only alternative to abandonment of the pool at that time.

The major contributing factor to the lack of success of the waterflood is deemed to be the lack of an adequate water supply for injection purposes. Approximately one third of the reservoir voidage created by preunit and unit production has been replaced by water injection. It is considered unlikely that any response will be evident until at least half of the reservoir voidage is replaced. The second factor contributing to the lack of success of the waterflood is the absence of an injection pattern configuration, i.e., a confined 5-spot injection pattern. The injection of water is largely uncontrolled unless an injection pattern configuration is established. Thus, the success or failure of a waterflood project is difficult to evaluate unless a pattern configuration is developed.

In view of the potential for the West Butler area and the need for adequate testing of production response, the following recommendations are made:

1. An adequate water supply must be developed to provide sufficient water for a waterflood.
2. A pilot 5-spot injection pattern should be developed as shown on Figure 1 to realistically evaluate production response. If production response is adequate, then expansion of the waterflood can be justified.

The above recommendations are the basis for the two following proposals:

#### Proposal No. 1

It is proposed that a pilot waterflood be initiated as illustrated on Figure 1. A water supply well would be drilled to the Devonian zone at an estimated depth of 4230 feet. The Devonian formation has been found to be an excellent source of water supply in the Virden area. Sustained rates of water production of 4000 BWPD have been obtained from the Devonian zone. The water has been found suitable for injection in the Mississippian zones in the Virden Scallion and Virden Roselea pools with little or no water treatment required. Three additional water injection wells would be drilled offsetting the present producer 13-29-9-29 WPM. The existing injector I6-30-9-29 WPM and injection facilities would be used for the pilot waterflood.

The investment required to initiate the pilot waterflood is estimated to be \$619,000. Details of the investment and economics are shown on Table 2. The pilot waterflood economics are substandard even if the pilot

is successful and the central producing well responds at 25 BOPD. In view of the large investment and the risk involved, Chevron Standard Limited would not normally participate in a project of this nature. Therefore, it is proposed, that if the pilot waterflood fails, the full investment should be credited to Chevron Standard out of royalty payments on other Manitoba properties. An evaluation of the pilot waterflood would be required to determine if further development is warranted.

#### Proposal No. 2

If the results of the pilot waterflood indicate that expansion of the waterflood is warranted, drilling and enlarging of the waterflood project would commence. It is postulated that a four section project could develop as illustrated on Figure 2. The Devonian water supply well drilled for the pilot waterflood will be adequate to supply the water requirements for a project of this size. It is estimated that additional investment of \$8,917,000 will be required to complete the four section project. Details of investment and economics are shown on Table 3. Chevron Standard Limited proposes that the royalty be waived until the project fully pays out, i.e., all costs are recovered for the expanded waterflood including the pilot waterflood costs.

#### Summary

The potential of the West Butler Pool warrants further development. It is recognized that a high degree of uncertainty is involved in the waterflooding of the West Butler pool. The main uncertainty is the degree of production response that might be achieved upon waterflooding. Chevron Standard Limited believes that the proposed pilot waterflood project is the best method of evaluating waterflood response. The two proposals offered minimize the investment risks involved to Chevron Standard. The Manitoba Government also benefits through additional royalties if further development of the West Butler pool can be justified.

#### References

- (1) S. N. Borowski, Feasibility of Secondary Recovery - West Butler Field. December 1971. (Part of Application to Waterflood West Butler dated 1972-05-19.)

TABLE 1  
RESERVES PARAMETERS  
WEST BUTLER AREA

Connate Water:	35% (restored state method for 13 cores from well 2-31-9-29 averaged 34.3%)
Reservoir Temperature:	82°F (Drillstem test data)
Original Bottom Hole Pressure:	1050 psig (Drillstem test data)
Saturation Pressure:	220 psig (fluid sample from Daly well 6-32-9-29)
Initial Formation Volume Factor:	1.07 Res. Bbls./STB
Crude Viscosity at 0 psig & 82°F:	5.35 cp
Crude Viscosity at 600 psig & 82°F:	3.48 cp
Gravity of Stock Tank Crude at 60°F:	33 API
Footage Weighted Average Porosity:	1 md cutoff - 10.8% 1 md cutoff and 1.5 feet continuous section - 10.6%
Footage Weighted Average Permeability:	1 md cutoff - 11.4 md 1 md cutoff and 1.5 feet continuous section - 8.2 md
Median Permeability:	4.6 md
Permeability Variation:	0.73
Average Net Pay:	1 md cutoff - 48.8 ft. 1 md cutoff and 1.5 feet continuous section - 24.7 ft.
Original Oil in Place:	= 7756 $\emptyset$ (1 - Sw)/Boi = 7756 x 0.106 (1 - 0.35)/1.07 = 499 STB/Acre Foot
OOIP per 40 Acre Spacing Unit:	= 499 Ah = 499 x 40 x 25 = 500,000 STB

TABLE 1 Cont'd.

OOIP in Present 200 Acre Project:	2,500,000 STB
OOIP in 4 Section Project:	32,000,000 STB
Primary Recovery Factor:	6.4% (decline curve analysis)
Estimated Primary Recovery:	
40 Acre Spacing Unit	32,000 STB
200 Acre Project	160,000 STB
4 Section Project	2,048,000 STB

Waterflood Recovery Factors

Mobility Ratio:	0.50
Displacement Efficiency:	Ed - 34% at Terminal WOR = 25:1
Vertical Coverage Efficiency:	Ev - 88% at Terminal WOR = 25:1
Areal Sweep Efficiency:	Ea - 94%
Waterflood Efficiency:	Ed x Ev x Ea = 28.1%
Estimated Waterflood Recovery:	
Present 200 Acre Project	700,000 STB
4 Section Project	8,990,000 STB
Proposed 80 Acre Pilot Project	280,000 STB

(Data summarized from Reference 1)

TABLE 2  
PILOT WATERFLOOD PROJECT  
WEST BUTLER FIELD

Investment

1977 Investment

3 Injection Wells	\$333,300
Water Source Well	130,900
Water Supply Well Pump	20,000
Power Costs	35,000
Injection Lines	6,600
Sub Total	525,800
Dry Hole Risk Investment	92,800
TOTAL	\$618,600

Assumptions

1. The wellhead price of crude will be \$9.485 per barrel.
2. Waterflood response would be evident after six months injection at a rate of 25 BOPD from the central pilot producing well. Production would remain constant until 140,000 Bbls. of oil are produced. Production would then decline at approximately 9.5 percent per year until 236,000 Bbls. oil are produced. The final production rate would be 9 BOPD. The project life would be 34 years.
3. Old royalty rates would apply with the pilot producing well being allocated one half of its production for royalty purposes. The remaining one-half production will be allocated to offsetting injection wells at the same royalty rate.
4. Injection rates would be 100 BOPD per injector initially. Fill up and production response would be evident after six months.
5. Pilot project operating cost would be \$22,000 per year.

Economics

Three economic evaluations were made as follows:

- Case 1 - base case with payment of normal royalties.
- Case 2 - no royalties.
- Case 3 - payment of normal royalties commences after the project is paid out.



TABLE 2 cont'd

	<u>Case 1</u>	<u>Case 2</u>	<u>Case 3</u>
Project Payout Period - Years	9.8	7.1	7.1
Rate of Return - %	6.5	10.4	8.6
Royalty Barrels - M. Bbls.	36	0	26
Working Interest Barrels - M. Bbls.	200	236	210
Value of Royalty Oil - Undiscounted			
M. \$	339	0	245
Discounted at 10%	114	0	52
Present Worth Profit - M\$			
Discounted at 10%	-84	12	-31
Discounted at 20%	-217	-166	-180

TABLE 3  
EXPANDED WATERFLOOD  
WEST BUTLER FIELD

Investment

1977 Investment

Pilot Waterflood (Table 1)	\$ 618,600
----------------------------	------------

1978 Investment

15 Injection Wells	1,666,500
15 Producers	1,996,500
Water Plant and Battery	60,000
Injection Lines	61,000
Flow Lines	77,000
Sub Total	3,861,000
Dry Hole Risk Investment	836,000
1978 TOTAL	\$4,697,000

1979 Investment

12 Injection Wells	1,333,000
15 Producers	2,996,000
Injection Lines	61,000
Flow Lines	72,000
Sub Total	3,467,700
Dry Hole Risk Investment	752,400
1979 TOTAL	\$4,220,100

GRAND TOTAL	\$9,535,700
-------------	-------------

Assumptions

1. The wellhead price of crude will be \$9.485 per barrel.
2. Development of the expanded waterflood will follow the pilot waterflood. Production rates of 33 BOPD will be sustained until approximately one half of the reserves are recovered. Production will then decline at approximately 7.5 percent per year until 8.3 million barrels of oil are produced. The final production rate will be 7 BOPD per well. The project life will be 34 years.
3. Old royalty rates would apply to production from present unit wells. Production from new wells would be subject to new royalty rates.
4. Injection rates will be sufficient to meet voidage, approximately 35 BOPD per well throughout the life of the project.
5. Operating costs for the fully developed project would be \$270,000 per year.

TABLE 3 cont'd

Economics

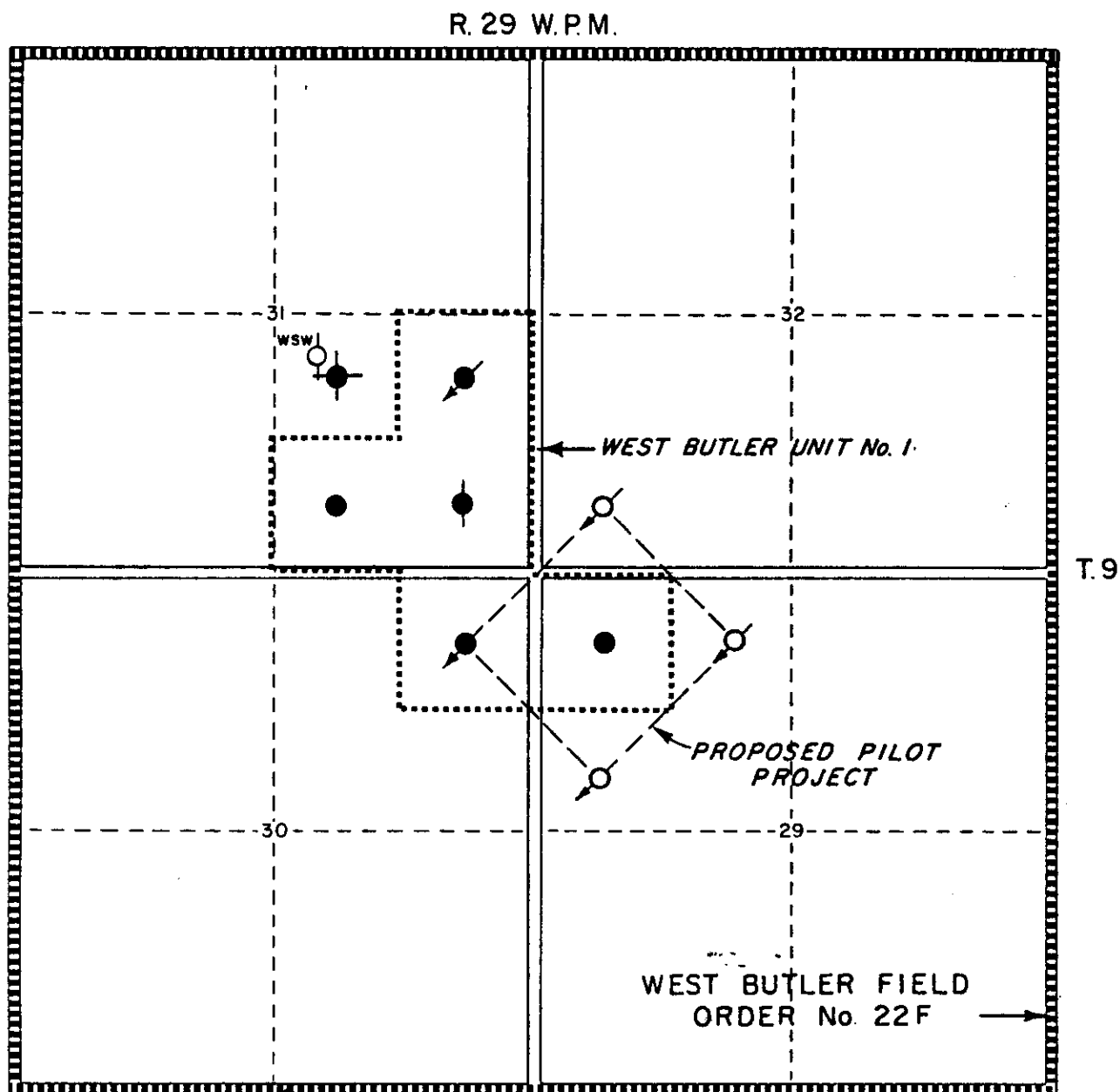
Three economic evaluations were made as follows:

Case 1 - base case with payment of normal royalties.

Case 2 - no royalties.

Case 3 - payment of normal royalties commences after the project is paid out.

	<u>Case 1</u>	<u>Case 2</u>	<u>Case 3</u>
Project Payout Period - Years	5.0	4.2	4.2
Rate of Return - %	28.3	38.6	34.5
Royalty Barrels - M. Bbls.	1,254	0	1,060
Working Interest Barrels - M. Bbls.	7,015	8,269	7,209
Value of Royalty Oil -			
Undiscounted - M\$	11,885	0	10,045
Discounted at 10%	4,350	0	3,018
Present Worth Profit - M\$			
Discounted at 10%	6,043	9,741	7,175
Discounted at 20%	1,463	3,372	2,312



**LEGEND**

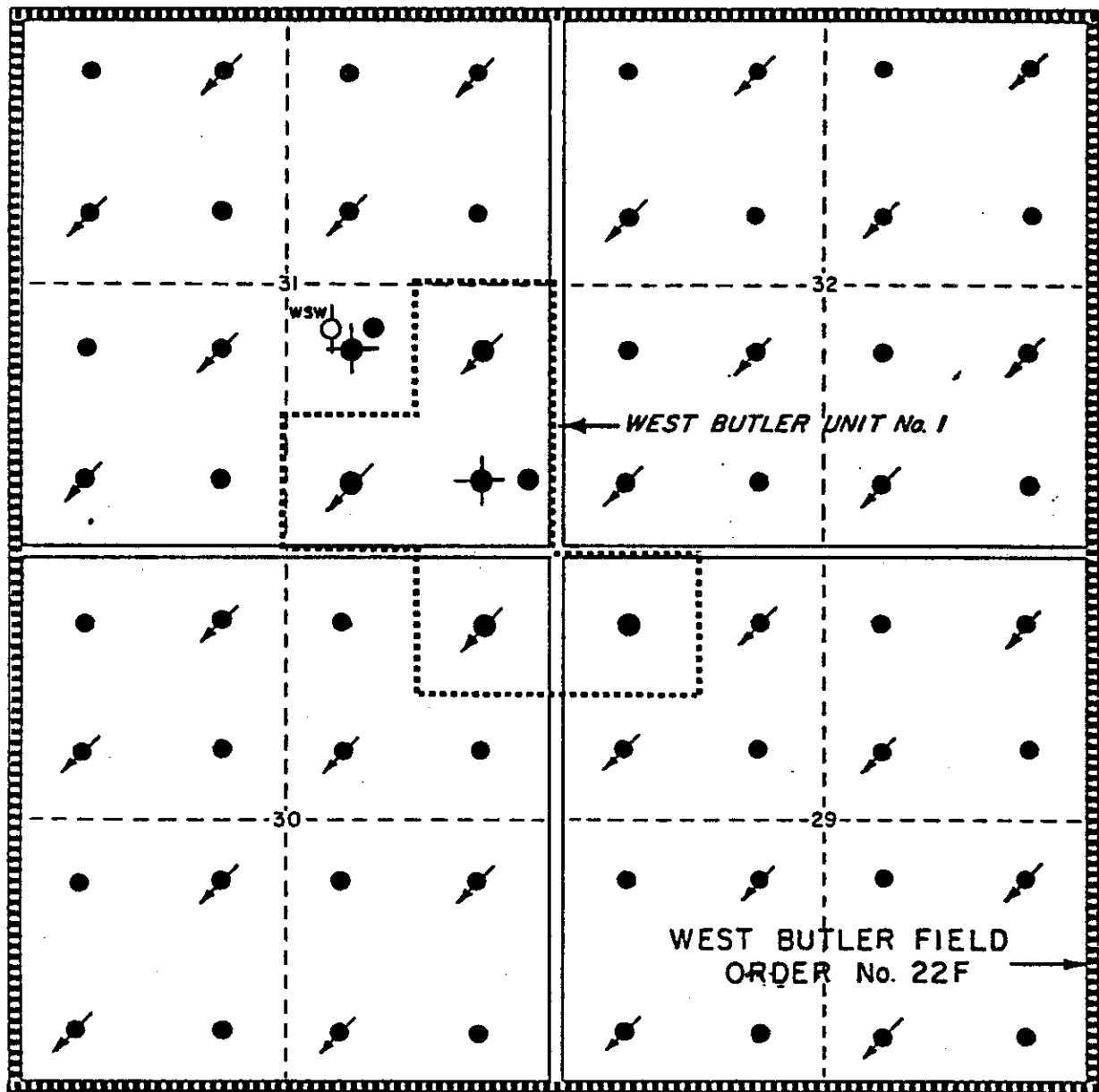
- INJECTION WELL
- SUSPENDED WELL
- <sup>WSW</sup> WATER SOURCE WELL

FIGURE 1

**DEVELOPMENT OF A PILOT PROJECT  
WEST BUTLER FIELD**

SCALE: 3" = 1 MILE

R. 29 W.P.M.



T.9

LEGEND

- INJECTION WELL
- SUSPENDED WELL
- <sup>WSW</sup> WATER SOURCE WELL

FIGURE 2  
DEVELOPMENT OF A FOUR SECTION PROJECT  
WEST BUTLER FIELD

SCALE: 3" = 1 MILE

FEB 23 1977

Chevron Standard Limited,  
400 - Fifth Avenue S. W.,  
Calgary, Alberta  
T2P 0L7

ATTENTION: Mr. J. Zedde

Dear Mr. Zedde:

Re: West Butler Area  
Proposed Pilot Water Flood

We acknowledge your letter dated January 8, 1977 which was received on February 10, 1977 and which is in reply to my letter to you dated February 3, 1977.

In reply to the questions posed in your original letter of January 21, 1977 please note that the present definition of "new well" excludes any well drilled and completed prior to April 1, 1974. I would advise, however, that a comprehensive study is being initiated in the Department in order to review the royalty and mineral taxation aspects pertaining to secondary recovery. In this regard it would be most helpful if Mr. Mester (Director of Petroleum Branch) might again call on you and your staff for advice and assistance in carrying out the study.

As an initial request perhaps you could provide additional data in support of your statement regarding the well in 13-29-12-29 WPM that "The well is producing at an uneconomic rate and . . .".

Yours truly,

Original signed by  
JAS. T. CRAWLEY

Jas. T. Crawley, P. Eng.,  
Deputy Minister

cc: H. C. Mester

HCM/et/df

bc: J. S. Roper  
I. Haugh

# COPY

FEB 03 1977

Chevron Standard Limited,  
400 - Fifth Avenue S.W.,  
Calgary, Alberta.  
T2P 0L7

ATTENTION: Mr. J. Zedde.

Dear Mr. Zedde:

Re: West Butler Area  
Proposed Pilot Water Flood.

Your letter of 77 01 21 is acknowledged.

The attached plat of your proposed pilot water flood referred to in paragraph 3 of your letter was not received. Thus, the meaning of your statement "the proposed pilot project our Company is contemplating in the W. Butler area (see attached plat) should come under a "new well" status and any incremental oil recovered, should receive new oil treatment" is not clear.

Upon receipt of the plat and your explanation of the above, your request will receive further investigation. If other business requires that you travel to Winnipeg, it is suggested that arrangements be made to discuss this matter.

Yours sincerely,


Original Signed By  
JAS. T. CAWLEY

Jas. T. Cawley, P. Eng.,  
Deputy Minister.

JSR/dw

b.c.: J. S. Roper.  
I. Haugh. ✓  
H. C. Moster.

Department of Mines, Geology and  
& Environmental Affairs  
Minister's Reception Section

 FEB 3 1977

ASSISTANT DEPUTY MINISTER



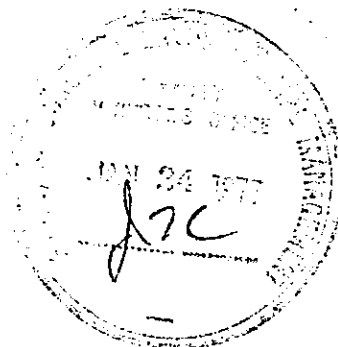
**Chevron Standard Limited**  
400 - Fifth Ave. S.W., Calgary, Alberta T2P 0L7

J. ZEDDE  
Vice-President  
Production Department

January 21, 1977

W. Butler Area  
Proposed Pilot Water Flood

Mr. J. T. Cawley, P. Eng.  
Deputy Minister  
Department of Mines, Resources  
and Environmental Management  
Government of Manitoba  
Legislature Building  
Winnipeg, Manitoba  
R3C 0V8



Dear Mr. Cawley:

Further to our previous discussions and related correspondence on the above subject, we have now had an opportunity to further consider pertinent Sections of the Mineral Taxation Act.

(1)  
We would refer you to Section 2(f.1)(ii)(A) and (B) dealing with the definition of "new well," wherein the Minister is given a discretion to designate what well(s) qualifies as a "new well."

It is our opinion that the proposed pilot project our Company is contemplating in the W. Butler area (see attached plat) should come under a "new well" status and any incremental oil recovered, should receive new oil treatment under the Act. In the event the pilot project is extended then the expanded portion should receive the same consideration.

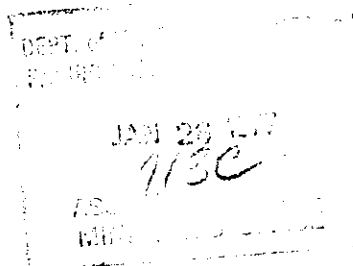
We would appreciate your considering this request and, if favourable, we would suggest that we defer making a submission for legislative change of the Act regarding the definition of "old" and "new" oil until some later date.

We would be pleased to meet with you for further discussion if you so desire.

Yours very truly,

J. ZEDDE

Attachment







**Chevron Standard Limited**  
400 - Fifth Ave. S.W., Calgary, Alberta T2P 0L7

RF 425  
425

J. ZEDDE  
Vice-President  
Producing Department

January 8, 1977

**W. Butler Area**  
**Proposed Pilot Water Flood**

Mr. J. T. Cawley, P. Eng.  
Deputy Minister  
Department of Mines, Resources  
and Environmental Management  
Government of Manitoba  
Legislative Building  
Winnipeg, Manitoba  
R3C 0V8

Department of Mines, Resources  
& Environmental Management  
Mineral Resources Division

*[Signature]* FEB 11 1977  
ASSISTANT DEPUTY MINISTER

Dear Mr. Cawley:

Please accept my apology for failing to enclose the plat referred to in my letter to you dated January 21, 1977. A copy of the plat is attached hereto.

By way of further explanation, I am enclosing the production history on the 13-29 well. The well is producing at an uneconomic rate and would probably be suspended entirely if the installation of a pilot water flood were not anticipated. Therefore, if the pilot flood is implemented, we are suggesting that any incremental oil, which would not otherwise be recovered, from this well and any enlarged area be treated as "new oil".

If you feel further discussion in the matter would be helpful, I would be pleased to meet with you at your convenience.

Yours very truly,

*[Signature]*  
J. ZEDDE

Attachment

cc: Dr. Haugh ✓  
C. Moster  
/ie 77 Feb. 10



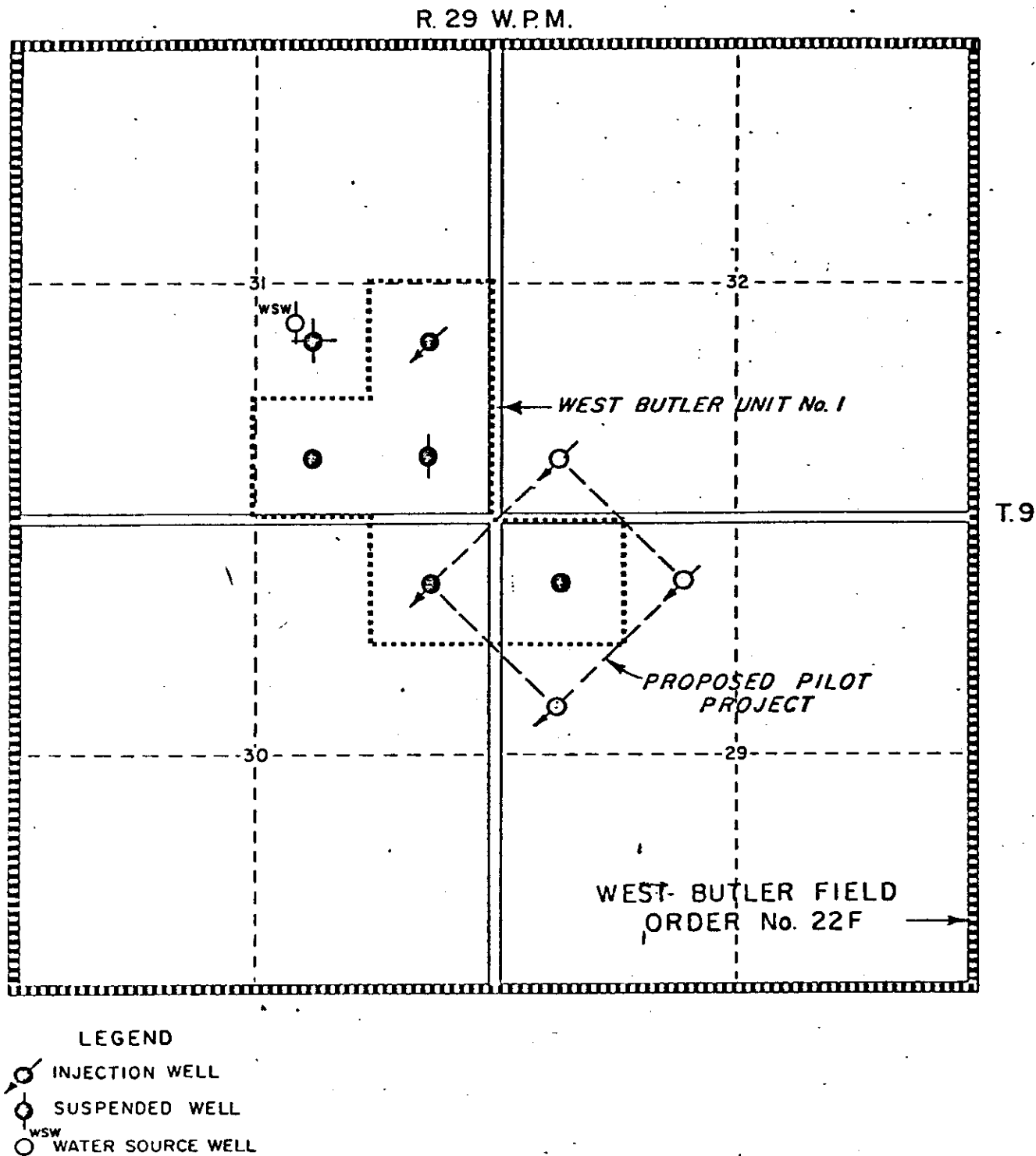


FIGURE 2  
DEVELOPMENT OF A PILOT PROJECT  
WEST BUTLER FIELD  
SCALE: 3" = 1 MILE

WEST BUTLER  
PRODUCTION PLOT  
13-29-009-29W1

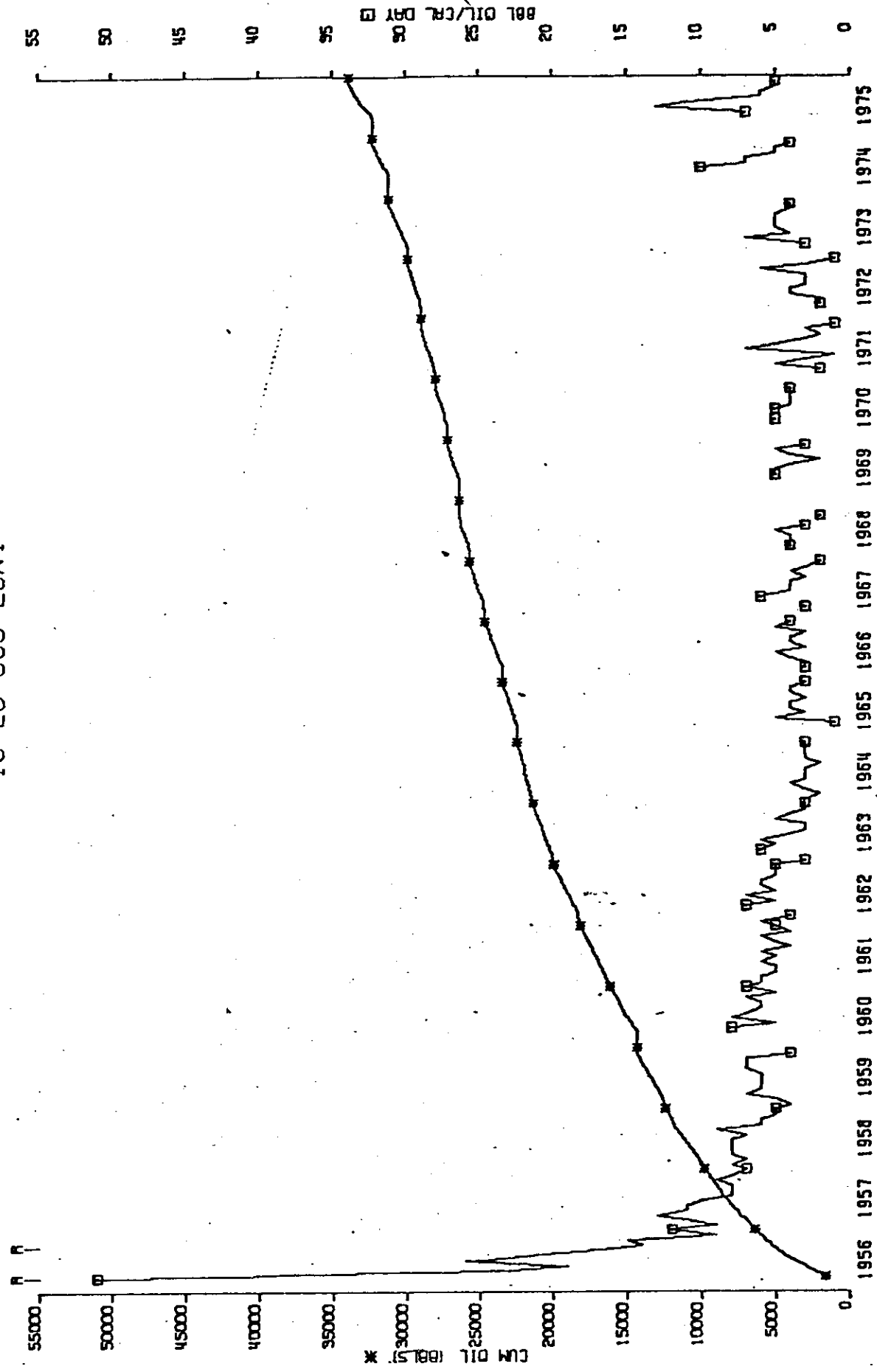


FIGURE 4  
PRODUCTION HISTORY  
13-29-9-29 WPM

<u>Year</u>	<u>Well</u> <u>13 - 29</u>
1955	
1956	6,386
1957	3,391
1958	2,587
1959	1,946
1960	1,783
1961	1,975
1962	1,845
1963	1,393
1964	1,100
1965	961
1966	1,184
1967	1,038
1968	674
1969	864
1970	806
1971	972
1972	927
1973	1,244
1974	1,121
1975	1,722
1976	1,249
Total Oil Produced	35,168
Total Water Produced	3,563

# COPY

SEP 14 1976

Chevron Standard Limited,  
400 - Fifth Avenue S.W.,  
Calgary, Alberta.  
T2P 0L7

ATTENTION: Mr. A. Hamberg.

Dear Mr. Hamberg:

Re: West Butler Unit No. 1.

In response to your request of July 12, 1976, the Board approves the temporary suspension of water injection into the wells Chevron West Butler Prov. 16-30-9-29 and Chevron West Butler 8-31-9-29 for a maximum period of two years from July 1, 1976, subject to the following conditions:

1. Unit operations are continued according to good engineering practices.
2. Annual subsurface pressure measurements are carried out during the suspension period.
3. The required Unit monthly and annual progress reports are submitted.
4. Prior to March 15, 1977, the Unit operator shall submit to the Petroleum Branch for discussion two proposals for resuming water injection. Such proposals should include data on injected water supply source, capacity, suitability, method of treatment, fill up time, costs, economic projections, and other relevant information.

This temporary suspension is issued subject to the Act and regulations in force from time to time whether made before or after this date.

Yours sincerely,

  
J. S. Roper,  
Deputy Chairman.

Department of Mines, Resources  
& Environmental Management  
Mineral Resources Division

JSR/dv

c.c.: Mr. J. Zedde.

b.c.: Jas. T. Cawley.  
I. Haugh. ✓  
H. C. Mosier.

 SEP 15 1976

ASSISTANT DEPUTY MINISTER

COPY

SEP 10 1976

Mr. J. Zedde,  
Vice-President,  
Producing Department,  
Chevron Standard Limited,  
400 - Fifth Avenue S.W.,  
Calgary, Alberta.  
T2P 0L7

Department of Mines, Resources  
& Environmental Management  
Mineral Resources Division

*JTC* SEP 10 1976

ASSISTANT DEPUTY MINISTER

Dear Mr. Zedde:

Your letter of 76 08 31 has been received and the following points noted:

1. Chevron Standard plans to drill five infill wells in the North Virdee Sealion Unit No. 1 in 1977 subject to Working Interest approval.
2. Chevron Standard requests that its application for temporary suspension of water injection in West Butler Unit No. 1 be processed.
3. Chevron Standard and the Canadian Petroleum Association will make a joint submission pertaining to the definition of "old" oil and "new" oil.
4. Chevron Standard is currently considering the subject of deep rights and will advise the department of its position in the near future.

The department appreciates the exchange of information on matters of mutual interest and will look forward to your Company's submissions on matters of concern.

Yours sincerely,

Original Signed by  
JAS. T. CAWLEY

Jas. T. Cawley, P. Eng.,  
Deputy Minister.

JBR/dw

c.c.: J. L. Lebel.

b.c.: J. S. Roper,  
I. Haugh.✓



## Chevron Standard Limited

400 - Fifth Ave. S.W., Calgary, Alberta T2P 0L7

J. ZEDDE  
Vice-President  
Producing Department

August 31, 1976

Mr. J. T. Cawley, P. Eng.  
Deputy Minister  
Department of Mines, Resources  
and Environmental Management  
Government of Manitoba  
Legislative Building  
Winnipeg, Manitoba  
R3C 0V8

Dear Mr. Cawley:

Further to our discussions held in your office on August 23, 1976, this letter will confirm Chevron Standard's plan to drill five infill wells in the North Virden Scallion Unit No. 1 in 1977. This program will cost approximately \$400,000 and is, of course, subject to Working Interest approval. These wells are necessary to recover the corridor oil between two rows of producers as shown on the attached map as the flood front passes through these wells.

During our discussions on West Butler, Mr. Roper expressed some concern regarding our application for temporary suspension of water injection for reasons stated in the application. We did not foresee any difficulty arising since this is considered to be a normal procedure in Alberta as evidenced by the attached copies of correspondence with the Alberta Energy Resources Conservation Board. We trust the matter has been clarified and that our application will be processed in due course.

In regard to other matters discussed, we wish to advise that a joint submission will be made by the CPA regarding the definition of "old" and "new" oil. With respect to the subject of deep rights, the matter is currently under consideration and we will be advising you of our position in the near future.



Attachments

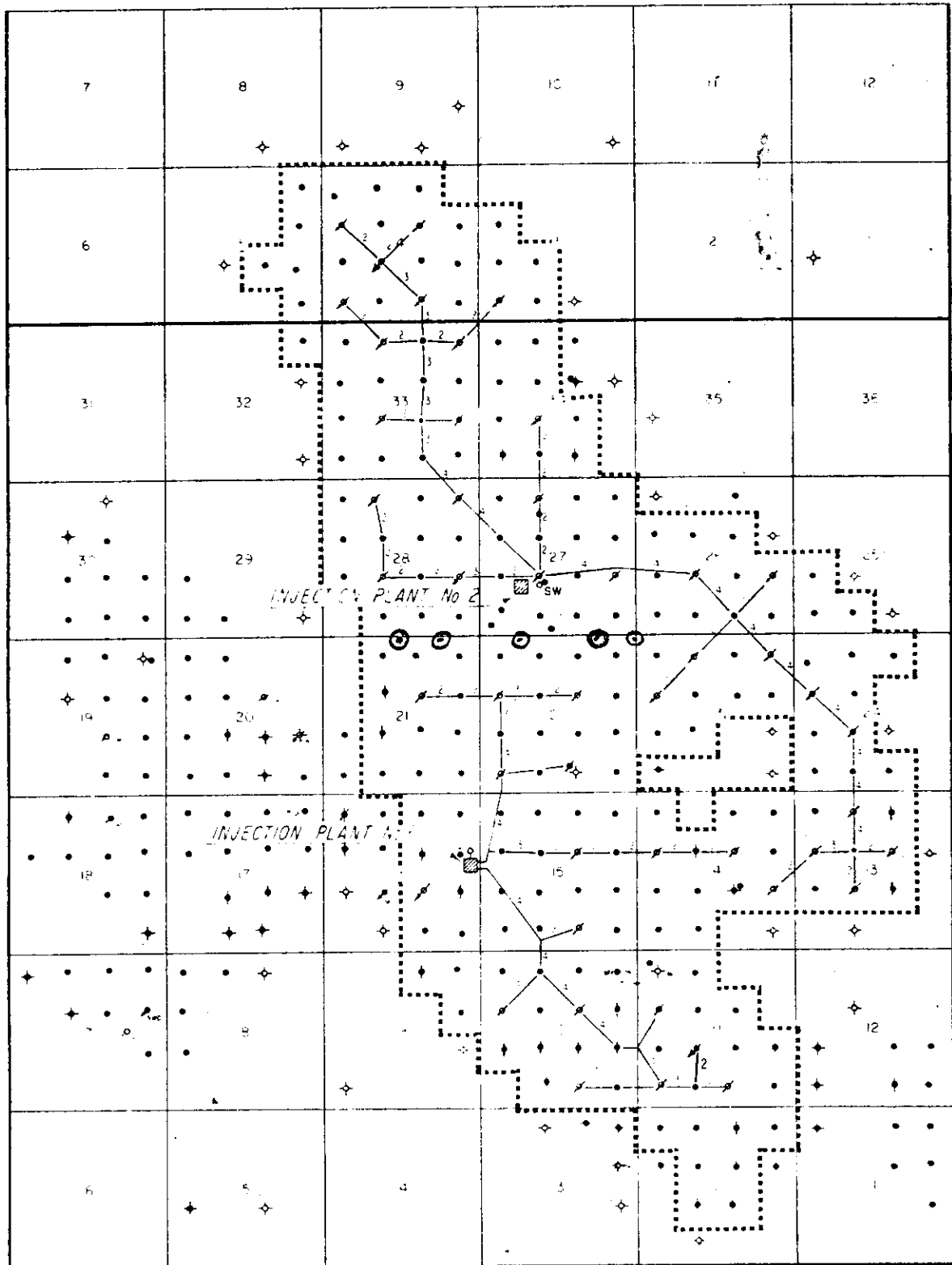
Yours very truly,

J. ZEDDE

cc: J. S. Roper  
/ie 76 09 02

R.26 W.P.M.

T.12



T.11

# © PROPOSED DRILLING PROGRAM - 1977

## LEGEND

- ..... UNIT BOUNDARY
- INJECTION WELL
- ◆ SUSPENDED WELL
- ◆ ABANDONED WELL
- INJECTION LINE
- <sub>SW</sub> DEVONIAN WATER SUPPLY WELL

FIG. RE.1

NORTH VIRDEN SCALLION UNIT No. 1  
AS OF DECEMBER 31, 1975

SCALE IN MILES





THE PROVINCE OF ALBERTA  
THE OIL AND GAS CONSERVATION ACT  
ENERGY RESOURCES CONSERVATION BOARD

IN THE MATTER of a scheme  
of Chevron Standard Limited  
for enhanced recovery of  
oil by water injection  
into the Zama Keg River  
G Pool

AMENDMENT OF APPROVAL NO. 1297A

(Amending Approval No. 1297)

The Energy Resources Conservation Board, pursuant to The Oil and Gas Conservation Act, being chapter 267 of the Revised Statutes of Alberta, 1970, hereby orders as follows:

1. Board Approval No. 1297 is amended.

2. The following clause is added after clause 9:

10. This approval shall have no force or effect for a two-year period commencing July 1, 1976.

MADE at the City of Calgary, in the Province of Alberta, this 25th day of June, 1976.

ENERGY RESOURCES CONSERVATION BOARD

D. R. Craig  
Vice Chairman

RECEIVED

JUL 7 1976

I. I. S.

# ENERGY RESOURCES CONSERVATION BOARD

603 SIXTH AVENUE S.W.

CALGARY, ALBERTA, CANADA

T2P 0L7

R. CRAIG, VICE CHAIRMAN

V. MILLARD, VICE CHAIRMAN

N. BERKOWITZ, BOARD MEMBER

G. J. DESORCY, BOARD MEMBER

TELEPHONE (403) 261-8311

TELEX 03-821717

June 18, 1976

Chevron Standard Limited  
400 5 Avenue S.W.  
Calgary, Alberta  
T2P 0L7

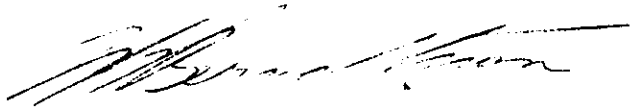
Dear Mr. Johnson:

APPLICATION NO. 9311  
ZAMA KEG RIVER G POOL  
APPROVAL NO. 1297

The Board has considered your application dated April 30, 1976 requesting permission to suspend the terms of Approval No. 1297 for a period of two years. Your application has been granted and Amendment of Approval No. 1297A for this purpose is enclosed.

The Board understands that Chevron plans to recomplete the well at a higher interval in an attempt to alleviate the water oil ratio problem. If successful, cyclic water injection may then be re-initiated. Chevron is requested to submit to the Board the results and analysis of any attempts to recomplete the well and shut off water production and subsequent plans for future pressure maintenance. A reply to this matter by March 15, 1977 would be appreciated.

Yours truly

  
N. G. Berndtsson, P. Eng.  
Assistant Manager  
Projects

PMS/GD/jg

Enclosure

April 30, 1976

Zama Keg River G Pool - Project No. 1  
Approval No. 1297.

Energy Resources Conservation Board  
603 Sixth Avenue S.W.  
Calgary, Alberta  
T2P 0T4

Attention: Mr. N. G. Berndtson

Gentlemen:

Chevron Standard Limited, as operator of the Zama Keg River G pool, requests that waterflood approval No. 1297 be suspended for a two-year period.

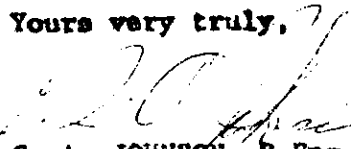
This single-well cyclic injection scheme has not operated as predicted due to excessive production of injected water following the two injection cycles. It was the operator's intention to recomplate the well to allow continuous injection and production. This was delayed through the unavailability of the proper downhole equipment. The water cut has risen from ten percent to fifty percent during the past year, although no water has been injected since 1972. The base of the producing perforations is approximately 55 feet above the original oil-water interface.

Chevron does not feel it prudent to continue with water injection into the aquifer until it is demonstrated that an effective water shut-off can be realized and the well successfully recompleted within the Keg River. At that time, a further attempt will be undertaken to cyclically waterflood this pool. It is estimated that two years will be required to assess the results of the recompletion and formulate plans for additional water injection.

Recovery to date amounts to 20 percent of the original oil-in-place. The gas-oil ratio has remained constant at the solution level. The bottom-hole pressure has also remained relatively static over the past two years, indicating natural water influx.

Enquiries concerning this correspondence can be directed to the undersigned.

Yours very truly,

  
G. A. JOHNSON, P.Eng.  
Assistant Chief Engineer

GAJ/rjc

cc: Amoco Canada Petroleum Company Ltd.  
Hamilton Brothers Canadian Gas Company Ltd.  
bcc: Mr. L. D. Brown, Edmonton



Province of Manitoba

**Department of Mines, Resources and Environmental Management**  
**Mineral Resources Division**

Petroleum Branch  
993 Century Street  
Winnipeg, Manitoba  
R3H 0W4

June 7, 1976

Chevron Standard Company,  
400 - Fifth Avenue S. W.,  
Calgary, Alberta.  
T2P 0L7

Attention: Mr. J. D. Scott, P. Eng.  
Senior Petroleum Engineer

Department of Mines, Resources  
& Environmental Management  
Mineral Resources Division

*[Signature]* JUN 8 1976  
ASSISTANT DEPUTY MINISTER

Dear sir:

Re: West Butler Unit No. 1

Further to your letter of May 28, 1976 applying for temporary suspension of water injection in the waterflood scheme of West Butler Unit No. 1, we advise that additional information is required and certain steps must be taken before proceeding further with your application.

Your May 28th letter does not indicate how long the temporary suspension is applied for, nor does it mention any specific plans Chevron intends to follow in the future to insure continuous water injection. Please submit to this office prior to July 15, 1976 a formalized statement indicating:

1. The length of the temporary suspension period applied for.
2. The future plans for this Unit after the expiration of the temporary suspension period.
3. Original and current reservoir pressure.
4. Whether Chevron intends to continue producing from the two wells located on Lsd. 13-29-9-29 and 2-31-9-29 during the suspension period, and the effect of such production on reservoir pressure and on depleting the reservoir to a stage that re-applying water injection will not be successful in the future (i.e. presence of large free gas saturation).
5. Reasons for lack of response to water injection in the subject Unit. It is our understanding that the lack of response was due to insufficient volumes of water injected into the reservoir.
6. Operating costs for the Unit.

A review of our files on West Butler Unit No. 1 indicates that we have received no subsurface pressure data with respect to this Unit since Order No. PM 21 was issued by The Oil and Natural Gas Conservation Board in 1972.

Section 5 of Order No. PM 21 states as follows:

"At least annually, unless otherwise directed by the Board, the Unit Operator shall determine the reservoir pressure in the producing wells in the Unit to the satisfaction of the Board."

This is to advise you of the Petroleum Branch's policy concerning future annual subsurface pressure measurement surveys for the subject Unit.

In future you are requested to submit the details of your proposed subsurface pressure survey program to this office for approval prior to commencing the program. Such submissions should include the wells to be surveyed, the measurement technique to be used and the intended shut-in periods for each well to be surveyed.

After having the program approved and carried out a report must be submitted to the Branch including:

1. The pressure data obtained from the program.
2. An isobaric map of the reservoir based on the data obtained.
3. A discussion of the survey results and pressure distribution in the reservoir.

You are hereby requested to submit to this office prior to July 1st, 1976 your proposed subsurface pressure survey program for 1976 for West Butler Unit No. 1 in accordance with the Regulation and the Branch policy outlined herein.

Yours sincerely,

H. C. Moster, P. Eng.,  
Director, Petroleum Branch

SE/jr

c. c. The Oil and Natural Gas -  
Conservation Board  
G. W. Cruickshank  
Virden Office

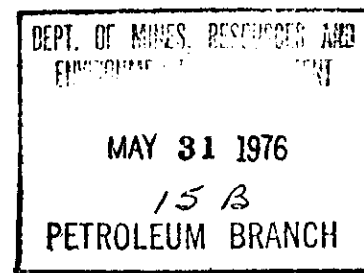
*James L. Bentley*  
*P. B. Ross*  
*David H. Hargreaves*



# Chevron Standard Limited

400 - Fifth Ave. S.W., Calgary, Alberta T2P 0L7

May 28, 1976\*



Department of Mines, Resources, and  
Environmental Management  
Mineral Resources Division  
Province of Manitoba  
993 Century Street  
Winnipeg, Manitoba  
R3H 0W4

Attention: Mr. H. C. Moster, P.Eng.  
Director, Petroleum Branch

Gentlemen:

In response to your letter of May 11, 1976 to our Mr. L. C. Zerr, Chevron Standard Limited hereby requests that a temporary suspension of water injection into the wells Chevron West Butler Prov. 16-30-9-29 and Chevron West Butler 8-31-9-29 be approved in accordance with Subclause 3 of Clause 1 under Pressure Maintenance Rules of Order No. PM 21 pertaining to West Butler Unit No. 1.

Injection of water into the subject wells commenced in September 1972. An unsuccessful attempt was made to develop a water supply well in the Ashville zone by redrilling the abandoned well 7-31-9-29. A water source was finally developed by drilling a new well 7A-31-9-29 to the Ashville zone at a depth of 1750 to 1800 feet KB. The water source well has performed unsatisfactorily with sand problems and low productivity in the order of 100 BWPD or less. The injection system was suspended in October 1974 because of high operating costs. At that time the supply well had declined to 80 BWPD which was insufficient to permit continuous injection into both injection wells.

A summary of injection and production is shown on Table 1 attached. A total of 70,074 barrels of water were injected since inception of the waterflood. During the same period of time, production has resulted in total reservoir voidage of 18,238 barrels for a cumulative net voidage of -51,836 reservoir barrels. Therefore, water injection during the life of the project exceeded voidage by a factor of 2.8 as of December 31, 1975. The effect on production rates is at best insignificant and inconclusive.

Incremental operating costs of \$17,000 were incurred by the operation of the water supply system in 1974. Further operation of the present water supply system cannot be economically justified because of its inadequacy and because no response is evident in the project. The cost of an alternate water supply well drilled to the Devonian formation is estimated to be \$167,000.

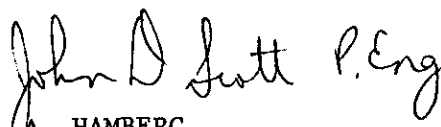
Performance of the project to the time of suspension of injection has not been sufficiently encouraging to justify expansion to a full-fledged 5-spot pilot with a Devonian water supply. Furthermore, the high cost of development of a multiwell waterflood project is submarginal, based upon presently available information. It is possible that, through availability of a cheaper water supply, future crude price increases, new technology, or other occurrence, additional encouragement could be provided to justify further action on our part.

We are, therefore, requesting that temporary suspension of injection be permitted and that the project not be cancelled, in the hope that further action can be initiated within a reasonable time frame.

We submit that temporary suspension of water injection will not decrease recovery nor affect possible future action or recovery inasmuch as an increase in recovery has not been demonstrated by past performance.

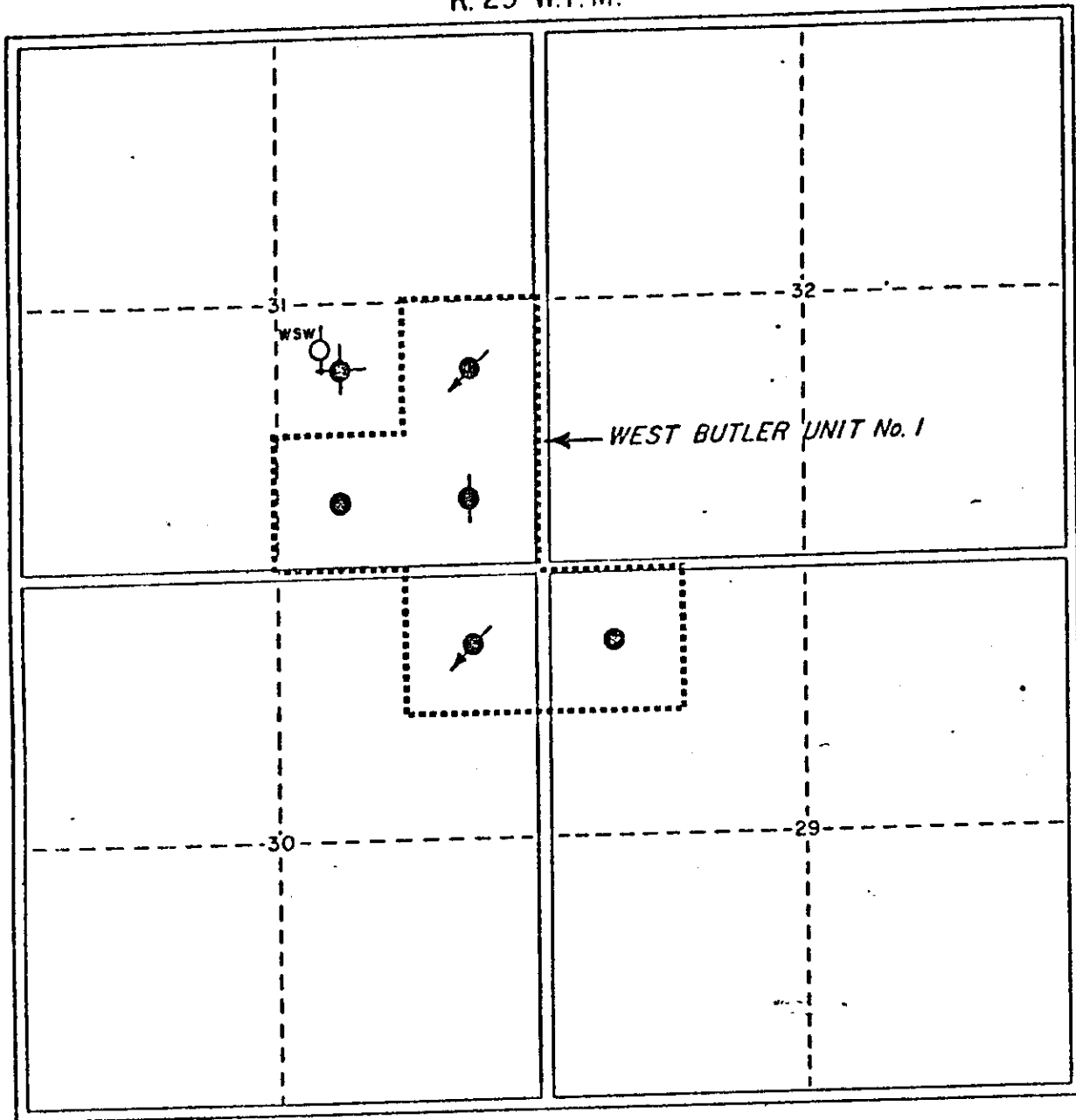
Any enquiries regarding this application should be directed to the attention of Mr. J. D. Scott, P.Eng. at the Company's Calgary address.

Yours very truly,

*for*  P.Eng.  
A. HAMBERG,  
Supervising Engineer  
Reservoir

Attachment

R. 29 W.P.M.



T. 9

LEGEND




-  INJECTION WELL
-  SUSPENDED WELL
-  WSW WATER SOURCE WELL

FIGURE 1  
WEST BUTLER UNIT No. 1  
AS OF DECEMBER 31, 1975  
SCALE: 3" = 1 MILE



TABLE 3

## WEST BUTLER PRE-UNIT AND POST-UNIT PRODUCTION

Year	Production		Operating Period Months	Average Production Per Calendar Day		Average Production Per Well Operating Day		Water Injection Bbls.		Total Reservoir Voidage Res. Bbls.		Net Reservoir Voidage Res. Bbls.		Cumulative Net Unit Voidage Res. Bbls.
	Oil STB	Water Bbls.		Calendar Days	Day	Days	Day		Bbls.	Res. Bbls.	Res. Bbls.		Res. Bbls.	
1967	5,291	482	11	337	15.7	1,077	4.9							
1968	5,165	349	9	275	18.8	693	7.5							
1969	5,239	375	7	214	24.5	737	7.1							
1970	4,409	448	7	213	20.7	605	7.3							
1971	5,446	425	10	303	18.0	831	6.6							
1972 - First 8 Months	3,363	356	6	184	18.3	530	6.3 (2 wells converted to injection)							
1972 - Last 4 Months	1,155	40	4	122	9.5	244	4.7	9,389	1,275	(8,114)				(8,114)
1973	3,015	7,603	9	275	11.0	610	4.9	34,551	10,829	(23,722)				(31,836)
1974	2,530	0	6	183	13.8	360	7.0	26,134	2,707	(23,427)				(55,263)
1975	3,203	0	8	245	13.1	432	7.4	0	3,427	3,427				(51,836)

May 11, 1976+

Chevron Standard Limited  
400 - 5th. Ave., S. W.  
Calgary, Alberta  
T2P 0L7

Attention: Mr. L. C. Zerr, P. Eng.,  
Supervising Engineer  
Populations and Environment.

Dear Sir:

Re: West Butler Unit No.1

Pursuant to your letter of December 8, 1975 in which you indicated that a review would be completed by the first quarter of 1976 as to Chevron's intentions with respect to the suspension of waterflood operations in West Butler Unit No. 1, we advise that to-date this Branch has received no further information in that regard.

A review of our files indicates that no water has been injected through the two wells 8-31-9-29 and 16-30-9-29 since October, 1974.

Subclauses (2) and (3) of clause 1 under Pressure Maintenance Rules of Order No. FM 21 pertaining to the above Unit state as follows:

" 1. (2) After the commencement, the Unit Operator shall, subject to any remedial work required to be performed on the well or wells referred to in this clause, endeavour to maintain continuous injection;

1. (3) Notwithstanding the provisions of subclause (2), the Board may, upon application by the Unit Operator, approve the suspension of water injection, provided the Board is satisfied that the pressure maintenance operation in the Unit Area will not be adversely affected."

In view of the above, please submit to this office prior to June 1, 1976, a formalized application stating Chevron's intentions with

respect to this Unit as outlined in our October 30, 1974 and October 17, 1975 letters.

Yours sincerely,

Original Signed by H. C. Moster

H. C. Moster, P. Eng.,  
Director, Petroleum  
Branch.

HCM/jr

c. c. The Oil and Natural  
Gas Conservation Board  
Virden Office.

b.c.c. S. Elsayed.



# Chevron Standard Limited

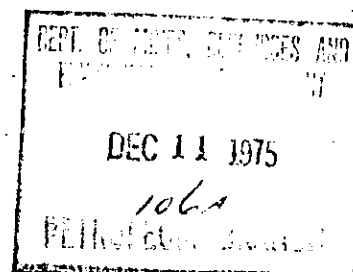
400 - Fifth Avenue S.W., Calgary, Alberta T2P 0L7

*Handwritten notes:*  
A.T. ...  
R.F. - April 1976  
West Butler Unit No. 1

December 8, 1975

## West Butler Unit No. 1 Waterflood

Mr. H. C. Moster, P.Eng.  
Director, Petroleum Branch  
Department of Mines, Resources  
and Environmental Management  
Province of Manitoba  
993 Century Street  
Winnipeg, Manitoba  
R3H 0W4



Dear Sir:

Please refer to our letter of May 29, 1975 and your reply, dated October 17, 1975 on the subject of suspension of waterflood operations in the West Butler Unit No. 1. Because of the mail strike, your letter did not reach me until last week.

We did not write to you sooner on this subject because it was our plan to discuss the matter at an informal meeting with the Department in Virden, Manitoba, on October 29, 1975. I understand that the problem was indeed reviewed at that discussion and that our tentative plans were made known at that time.

For the record, we are currently engaged in a comprehensive review of all factors affecting possible expansion of the waterfloods in both Daly and West Butler and have set a target of the first quarter, 1976 to discuss the results of these two studies with the Manitoba government.

We hope the foregoing satisfactorily explains our current position and we will be in touch in the new year to arrange a meeting.

Yours very truly,

*Handwritten signature: L.C. Zerr*  
L. C. ZERR, P.Eng.  
Supervising Engineer  
Regulations and Environment

LCZ/rjc

October 17, 1975

Chevron Standard Limited  
200 - 5th Avenue S. W.  
Calgary, Alberta  
T2P 0T7

Attention: Mr. J.O. Kerr, P. Eng.,  
Supervising Engineer,  
Regulations and Environment.

Dear Sir:

Re: West Butler Unit No. 1

Further to Chevron's applications to suspend operations on the wells in 7A-31-9-29, 10-31-9-29 and 8-31-9-29 all in West Butler Unit No. 1, we advise that this Branch has received no further information in this regard since your letter of May 29, 1975.

As approximately two months have passed since the Manitoba government's royalty and tax rates were announced, please submit to this office prior to November 15, 1975 a formalized application stating Unit Operator's intentions with regard to the water flood operation in this Unit as requested in our letter of October 30, 1974. Such application should be accompanied by supporting data.

Yours sincerely,

H. C. Foster, P. Eng.,  
Director, Petroleum Branch.

LGL/et  
c.c. The Oil & Natural Gas Conservation Board.  
b.c.c. S. Hasey  
Virden Office

June 2, 1975

H. C. Moster,  
Director of Petroleum Branch,  
Mineral Resources Division.

The Oil & Natural Gas Conservation Bd.  
Jas. T. Cowley, P. Eng., Chairman,  
J. S. Roper, Deputy Chairman.

WEST WATER UNIT NO. 1 — WELLS SUSPENSIONS

The following is presented for the information of the Board.

The last production from the oil wells in this Unit was in November 1974. These oil wells have been winter suspended since that time due to the "problems associated with operating the gas engines in cold weather." The water injection wells have been suspended since October 1974 due to lack of water supply. Chevron applied for suspensions of the two water injection wells and one water supply well on October 23, 1974.

A letter dated October 30, 1974 (copy attached) was sent out by this Branch. A recent request to Chevron has prompted the reply from Mr. L. C. Zerr dated May 29, 1975 (copy attached).

H. C. Moster ✓

KCH/evh  
Attachments

c.c. I. Haugh

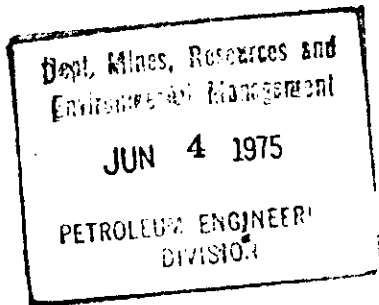
*Reviewed Mon. Royalty application  
in Mon. Royalty on Aug. 23/75.*

*Alerted Chevron on matter if  
no reply received prior to  
November 1, 1975. (Oct. 15)*

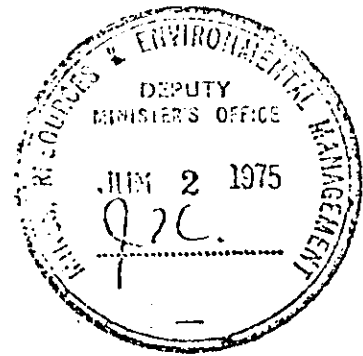


**Chavron Standard Limited**  
400 - Fifth Ave. S.W., Calgary, Alberta T2P 0L7

J. ZEDDE  
Vice-President  
Producing Department

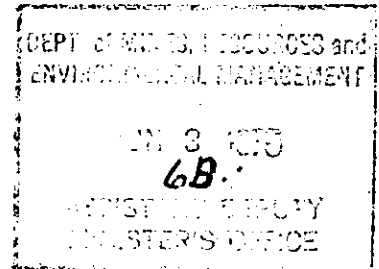


May 29, 1975



Daly Field Development Program

Mr. J. T. Cawley, P.Eng.,  
Deputy Minister,  
Mines, Resources & Environmental Management,  
Legislative Building,  
Winnipeg, Manitoba.  
R3C 0V8



Dear Mr. Cawley:

During your visit to our Calgary office on May 1, 1975, you raised certain questions regarding the status of a step-out development program near the Daly Field. Reference to this program had been made in Mr. Lebel's letter to the Honourable Mr. Edward Schreyer, dated April 26, 1974. That letter outlined the history and results of Chevron's efforts in Manitoba, and proposed that Chevron and other producers retain a major portion of the then recently announced \$2.70/bbl. crude price increase.

The history and status of the Daly Field step-out program are as follows:

In November 1973 our Development Geology Group completed a "Geological and Exploration Study of the Daly Oil Field, Manitoba". The study recommended land acquisition adjacent to the existing developed limits of the Daly Field. At about the same time the high pressure waterflood being conducted by Rundle Petroleum in Daly Unit #1 was showing some promising results. Accordingly, consideration was given to a 320 acre step-out development program, incorporating a high pressure waterflood, and estimated to cost \$800,000. If successful, and if capable of expansion to 6,400 acres the total cost would be as much as \$16,000,000. The economics of the program were based on then current 1973 crude prices and tax considerations.

Land acquisition south and east of Daly was started in March 1974. In April 1974 the \$2.70/bbl. increase in crude price appeared to further improve the economics of the pilot project.

In August 1974 the program was re-examined for possible inclusion in our 1975 budget. The estimated cost of a pilot flood (360 acres rather than 320 acres) had escalated to \$1,200,000. Economics were run based on those costs, incremental mineral tax for new oil, and crude prices of \$7.10/bbl. in 1974 and \$7.85/bbl. from 1976 on. Even with no application of Turner

Mr. J. T. Cawley, P.Eng.,  
Deputy Minister,  
Mines, Resources & Environmental Management.

May 29, 1975

budget tax considerations, the program fell below our economic standards and hence was not included in our 1975 budget. With application of Turner budget tax considerations (non-deductibility of mineral tax) the economics were, of course, even poorer.

When all details of Manitoba's recently announced tax changes are known, the economics of this Daly Field step-out program will be reanalyzed.

Yours very truly,



J. ZEDDE

JGT/ps

cc: Mr. J. S. Roper ✓  
Dr. I. Haugh -

/ie June 2, 1975



October 24, 1974

General Administration  
Department of the Interior  
Washington, D.C. 20540

Re: Application of M. L. H. Smith

Dear Sir:

RE: M. L. H. SMITH

Enclosed for your review are applications for operations on the  
collected well in the Miller Unit No. 1:

- Chevron West Butler WLB 7A-21-1-1
- Chevron West Butler Prov. WLB 7A-21-1-29
- Chevron West Butler WLB 7A-21-1-30

These wells form part of the water flood program maintained in the  
unit. For Order No. 7-17. The pressure maintenance unit is  
operating and the Unit Operator must enforce the unit's  
injection and that the Board may approve any additional water injection  
provided the Board is satisfied that the pressure maintenance operation in  
the Unit area will not be adversely affected.

It is therefore recommended that before approval of these applications  
in accordance with, that is, the Standard License, the Unit Operator, submit to  
this office a formal application stating its intentions with regard to the  
water flood operation with accompanying supporting data.

2 . . . . .

If the intent is to temporarily suspend water flood operations the application should state the proposed period of the suspension, the reasons for the suspension, and evidence showing that the scheme shall not be adversely affected. If on the other hand it is the intention to permanently abandon the water flood operation, the application should request that Order No. PM 17 be repealed and evidence submitted to indicate the progress, performance and efficacy of the flood to date and the reasons why the flood is being terminated.

Yours truly,

*Signed by H. C. Moster*

H. C. Moster, P. Eng., ✓  
Chief Petroleum Engineer

HCM/svh

cc: C. E. Johnson