

# CHEVRON STANDARD LIMITED

400 FIFTH AVENUE S.W., CALGARY, ALBERTA

December 6, 1968

Mr. W. W. Mair, Chairman  
Oil and Natural Gas Conservation Board  
901 Norquay Building  
401 York Avenue  
Winnipeg 1, Manitoba

Dear Sir:

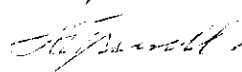
Pursuant to your request, Chevron Standard has calculated a balance, by pattern, for the North Virden-Sealion Unit No. 1 waterflood area. Only the North Virden-Sealion Unit has been reviewed in detail to date.

In addition, a review was made of the ultimate recovery in a segment of the waterflood area in which the producing well has experienced producing rates in excess of 100 BOPD for the past four years and rates of approximately 200 BOPD for the past two years.

The results and conclusions from the above are presented in the attached technical report. It is felt that the conclusions from the study of this area are equally applicable to the Virden-Roselea Units.

We are available for informal discussion of these data at your convenience.

Yours very truly,



J. G. TROWELL  
Division Superintendent  
Producing Department  
Calgary Division

PP:mg  
Attach.

RECEIVED  
OIL AND NATURAL GAS  
CONSERVATION BOARD  
WINNIPEG  
DEC 9 1968

## VOIDAGE BALANCE AND ULTIMATE RECOVERY STUDY

### NORTH VIRDEN-SCALLION UNIT NO. 1

December, 1968

#### A. Review of Voidage Balance by Pattern

At the request of the Oil and Natural Gas Conservation Board, a detailed study was conducted on the balance between reservoir fluid withdrawals and fluid injection into the reservoir. This study was conducted on an individual pattern basis.

##### Procedure:

The Unit area was divided into 41 individual segments or patterns such that each pattern had one injection well and several producing wells. (See Figure 1). For the purposes of this study, it was assumed that the reservoir voidage created by any producer located on adjacent pattern boundaries, is distributed equally amongst those patterns on whose boundaries it is situated.

A voidage balance was calculated for the month of July, 1968 to represent current conditions. In addition, a cumulative voidage balance from the inception of waterflooding to July 31, 1968 was calculated.

##### Results:

Table 1 and Figures 2 and 3 present the results of the study. Reasonable balance between injection and withdrawals exists at most patterns. There are instances of over and under injection on a current and cumulative basis.

Some interpretation of the injection profile survey results (See Progress Report No. 3 - 1964) was necessary to make a realistic appraisal of voidage balance. The "Remarks" column on Table 1 indicates some views that are applicable. All injection figures in Table 1 represent total injection. Losses indicated by injection profiles were not deducted.

Observations and Conclusions:

The conclusions from the study are listed and discussed below:

1. The erratic nature of the reservoir creates difficulties in calculating a voidage balance by pattern. Pay thicknesses vary by as much as 45 feet between adjacent spacing units and much interpretive reasoning has been used to determine pay thickness values. Accuracies of porosity and permeability values are also variable since in portions of the Unit area, only extremely poor data were available for the determination of these reservoir parameters.
2. The erratic nature of the reservoir is equally problematical with computer simulation. Chevron is currently updating a computer study for the surveillance of a central area of the Unit. From the results obtained to date it is concluded that, because of the variable nature of the reservoir, the results can only be treated as semi-quantitative.
3. The results from an injection profile survey conducted during 1964 were used interpretively in this review. In several instances, the survey indicated that injected water was escaping below the

bottom of the completed interval. In other instances large volumes were indicated as entering the reservoir at the bottom of the completed interval. In all cases, where there is an indication or suspicion of water entering the reservoir below the completed interval, the possibility should not be excluded that this "lost water" does, somewhere in the reservoir, replace some voidage that has been created by reservoir withdrawals. Most injection profile surveys lose contact with injected water when it moves 3 to 5 feet beyond the wellbore.

4. By combining two or more patterns in certain areas, a better voidage balance is indicated. It is reasonable to do this since it is not possible to accurately establish what reservoir voidage should be balanced with what injection, particularly when dealing with those producing wells that are equidistant from two or more injection wells.
5. The voidage balance from fluid production and injection records for the entire unit is favorable. It is reasonable to conclude that the balance within the reservoir is also favorable. Currently, the total injection within the unit area exceeds the total reservoir withdrawals by approximately 30%. Total cumulative injection has exceeded reservoir withdrawals since the inception of waterflooding by approximately 30%. Pre-unit production has resulted in cumulative reservoir withdrawals currently exceeding cumulative fluid injection by approximately 12 million reservoir barrels.

6. Because of the variable nature of the reservoir, the most realistic basis on which to review voidages is for the entire area. It is reasonable to assume that essentially all the water injected into the reservoir is replacing voidage created by withdrawals from the reservoir. As stated above, it is not possible to determine, with any accuracy, what reservoir withdrawals are being affected by what injection.
7. It is reasonable to assume that if there has been no waterflood response at first line producing wells, then there is little likelihood that oil is being flushed into areas from whence it cannot be recovered.

If there has been, or is, response, the possibility of losing Unit reserves beyond the reach of future Unit production exists if production is restricted beyond the bounds of good engineering practice. One has no assurance that waterflood response oil that is permitted to move beyond the first line producing wells, will be available for production at the next line of producing wells. This is particularly the case in a reservoir such as this, where combinations of variations in thickness, porosity, and permeability could very easily permit oil to be trapped and lost.

It is, therefore, concluded, that to restrict production or injection by other than good engineering practice is to risk adversely affecting the ultimate recovery of oil from the total unit area.

B. Review of Ultimate Recovery in the Vicinity of 9-14-11-26 WPM

An attempt was made to establish whether unrestricted production rates permitted in the North Virden-Scallion Unit No. 1 could adversely affect the ultimate recovery of oil.

The area surrounding 9-14-11-26 WPM was chosen as a test area for two main reasons:

- (a) The well on LSD 9-14 has experienced production rates in excess of 100 BOPD for the past four years and rates of approximately 200 BOPD for the past two years.
- (b) The well on LSD 9-14 is on the common boundary of three injection patterns. Of these three patterns, one is in good voidage balance; one is over-injected and one is under-injected, on a current and cumulative basis.

Assumptions:

For this study, it was assumed that the producer on 9-14 was responsible for recovering the oil from its 40 acre tract as well as the remaining recoverable oil from one-quarter of each of LSD 8-14; LSD 10-14 and LSD 12-13, which are the directly offsetting injection wells.

It was assumed that one-quarter of the oil production from the three injection wells, prior to conversion, was from the additional area assigned to LSD 9-14, as outlined above.

The calculation of original oil-in-place was based on the reservoir study conducted prior to unitization.

Results, Observations and Conclusions:

1. The original oil-in-place, production, and recovery data are presented on Table 2. The recovery to July 31, 1968 represents a recovery factor of 21.1%. It is anticipated that an additional 300,000 STB will be produced from 9-14 before it becomes non-economic to produce. This would then represent an ultimate recovery for the area of 39% of the original oil-in-place. At the time of the waterflood study for unitization, the calculated recovery factor for the entire area was 28.4% of the original oil-in-place.
2. It is concluded that unrestricted oil producing rates have not adversely affected, nor will they adversely effect the ultimate recovery of oil in this area.
3. It is reasonable to conclude that, with the same injection history in the area, had the production been restricted, the resultant ultimate recovery at 9-14 would in all likelihood, have been adversely affected. Under restricted producing conditions, it is likely that oil would be flushed by 9-14 and perhaps into areas beyond the reach of future Unit production.

TABLE I

## MCCLELLAN-MCCALLISTER WELL NO. 1

Review of Reservoir Voidage and Withdrawals by Pattern  
(See attached Figures 1 and 2)

Pattern	Injection Well	July 1968 Injection (Bbls./Month)	July 1968 Withdrawals (Bbls./Month)	July 1968 Net Voidage Res. Bbls./Month	Cum. Inject. to 7/31/68 Res. Bbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbls.	Net Voidage Res. Bbls.
1	12-4-12-26	6,450	7,370	1,420	394,200	289,200	(105,000) From 1964 injection profile, no water lost out bottom of well.
2	10-4-12-26	6,440	7,260	790	256,000	241,500	35,500 Although fair void, the balance is indicated, injection profile indicates 54% of water going below completed interval, but may still be entering the oil reservoir.
3	4-4-12-26	3,230	4,920	1,690	252,800	243,300	( 9,500) Consider combining Pattern Nos. 3, 4 and 6.
4	2-4-12-26	3,100	3,900	600	177,300	140,700	( 36,600) Injection profile indicates loss of 35% of water, but could still be effective water. See remarks for "3" above.
5	4-3-12-26	4,610	6,920	2,310	125,600	225,500	99,900 No injection profile available. Consider combining Pattern Nos. 5 and 7.
6	14-33-11-26	8,180	5,910	( 2,270)	374,500	270,400	(104,100) Good injection profile. See remarks under Pattern No. 3.
7	16-33-11-26	3,490	3,730	( 4,760)	444,500	153,600	(290,900) Good injection profile. See remarks under Pattern No. 5.
8	6-33-11-26	12,840	9,410	( 3,430)	549,100	335,500	(213,600) Good injection profile. Expected additional response should balance voidage.



Pattern No.	Injection Well	July 1968 Injection (bbls./month)	July 1968 Production (bbls./month)	July 1968 Net Voidage (bbls./month)	Cost, Inject. to 7/31/68 (\$)	Cost, Rec. to 7/31/68 (\$)	Net Voidage (bbls.)	
9	6-34-11-26	4,060	3,250	( 810)	125,800	142,100	16,300	Withdrawal area may be being affected by water, plus floating barrel balance.
10	14-28-11-26	20,800	9,740	(11,140)	332,400	469,160	(133,900)	From injection profile, could be losing 40% of the injected water.
11	15-28-11-26	9,740	7,620	( 2,120)	132,800	252,100	(120,700)	Could be losing 30% of the water.
12	14-27-11-26	10,350	9,630	( 720)	535,800	347,800	(188,000)	Reasonable balance.
13	6-28-11-26	9,630	9,650	0	306,600	371,700	( 65,100)	Good balance indicated, however could be losing as much as 30% at bottom of hole.
14	8-23-11-26	10,740	11,480	740	510,400	422,900	( 87,500)	Good balance indicated.
15	8-27-11-26	6,220	9,120	2,900	190,500	323,900	133,400	Good injection profile. Consider combining with Pattern No. 16.
16	8-27-11-26	15,200	9,520	( 5,680)	730,000	376,900	(353,100)	Good injection profile. Consider combining with Pattern No. 15.
17	6-26-11-26	7,950	9,080	1,130	319,700	292,700	( 27,000)	Reasonable injection profile. Consider combining with Pattern No. 23.
18	8-26-11-26	10,030	7,810	( 2,220)	411,100	252,800	(158,300)	Good injection profile.
19	10-21-11-26	15,610	21,650	6,040	772,400	1,093,600	321,200	Injection profile indicates 50% of water lost. Large area attributed to this pattern. Consider combining Pattern Nos. 19, 20, and 26.
20	12-22-11-26	28,360	22,000	( 6,360)	1,556,500	997,000	(559,500)	Good injection profile. Consider combining Pattern Nos. 19, 20 and 26.
21	19-22-11-26	13,370	15,400	2,030	732,600	663,200	( 69,400)	Good injection profile. Consider combining Pattern Nos. 21 and 22.

Pattern Number	Injection Well	July, 1968 Injection (Bbbls./Month)	July 1968 Withdrawals (Bbbls./Month)	July 1968 Net Voidage Res. Bbbls./Month	Cum. Inject. to 7/31/68 Res. Bbbls.	Cum. Withdrawals Since Incept. to 7/31/68		Remarks
						Res. Bbbls.	Net Voidage Res. Bbbls.	
22	12-23-11-26	11,740	8,910	( 2,830)	506,000	349,700	( 156,300)	Satisfactory injection profile. Consider combining Pattern Nos. 21 & 22.
23	14-23-11-26	9,290	5,460	( 3,830)	365,700	207,500	( 158,200)	Satisfactory injection profile. Additional flood response expected. Consider combining Pattern Nos. 17 & 23.
24	16-23-11-26	9,140	4,750	( 4,390)	463,000	215,700	( 247,300)	Poor balance; however expected additional response could balance voidage.
25	12-24-11-26	13,980	1,200	(12,780)	507,500	87,300	( 419,700)	Poor injection profile indicates loss of 75% of the water. Anticipated additional withdrawals in area could balance voidage.
26	4-22-11-26	8,400	31,140	22,740	536,900	1,775,200	1,238,300	Good injection profile. Consider combining Pattern Nos. 19, 20 & 26.
27	6-24-11-26	9,470	2,410	( 7,060)	435,900	101,900	( 334,000)	Injection profile indicates some loss of water. Additional anticipated response could balance voidage.
28	10-15-11-26	14,090	12,140	( 1,950)	690,400	801,300	110,900	Injection profile indicates that 65% of the water is going below the open hole interval.
29	12-14-11-26	13,780	12,890	( 890)	482,600	377,500	( 105,100)	Reasonable balance; however injection profiles indicate that 60% of the water may be lost.
30	10-14-11-26	14,190	17,640	3,450	753,500	690,400	( 163,100)	Good injection profile. Consider combining Pattern Nos. 30, 31 & 34.
31	12-13-11-26	11,740	11,660	( 80)	506,000	508,400	2,400	Good balance and good injection profile. Could be combined with Pattern Nos. 30 & 34.
32	14-13-11-26	3,570	3,490	( 80)	252,800	147,800	( 105,000)	Good injection profile, good balance indicated.

Well No.	Injection Dates	July 1968			Cum. Inject.		Cum. Inject.		Remarks
		Injection (bbls)	Water (bbls)	Net Collage (bbls)	to 7/31/68	to 8/31/68	to 11/31/68	to 1/31/69	
33	2-43-41-26	16,430	16,330	( 1,630)	956,900	1,125,800	168,400		Good injection profile. 40% of water being lost.
34	8-44-41-26	16,430	6,340	( 10,090)	426,100	278,600	( 217,900)		Good profile. Good loss of water with pattern loss, 20 and 41.
35	6-43-41-26	8,690	1,030	( 7,360)	418,200	76,400	( 341,800)		Good injection profile. Fair plate 5-spot.
36	10-40-41-26	13,750	610	( 13,170)	396,200	43,700	( 347,500)		Good injection profile. Fair plate 5-spot.
37	12-40-41-26	8,700	9,600	900	455,500	537,400	81,900		Poor injection profile. 31% of water going below T.O. (possibly still into oil reservoir).
38	10-40-41-26	18,670	4,380	( 14,260)	838,300	326,900	( 511,400)		Good injection profile. 39% of water going below T.O. (possibly still into oil reservoir).
39	2-40-41-26	11,660	1,660	( 10,000)	381,900	113,200	( 268,700)		Good injection profile. Fair plate 5-spot.
40	4-41-41-26	10,470	2,550	( 7,920)	538,300	159,300	( 379,000)		Poor injection profile.
41	2-41-41-26	13,880	2,260	( 11,620)	689,200	106,100	( 583,100)		Fair injection profile.
TOTAL		462,010	351,770	(110,240)	21,141,500	16,056,100	(5,085,400)		

TABLE 2

## REVIEW OF ULTIMATE RECOVERY IN THE VICINITY OF 9-14-11-26 WPM

<u>Tract</u>	<u>Original Oil in Place-STB</u>	<u>Cum. Oil Prod. to 7/31/68-STB</u>	<u>Recovery Factor to 7/31/68</u>	<u>Est. Remaining Prod.-STB</u>	<u>Est. Ult. Recovery</u>	<u>Est. Ult. Recovery Factor</u>
8-14 (total)		41,900				
( $\frac{1}{2}$ of 8-14)	233,000	<u>10,500</u>	4.5%	-	10,500	4.5%
9-14 (total)	962,000	<u>320,400</u>	33.3%	300,000	620,400	64.5%
10-14 (total)		27,000				
( $\frac{1}{2}$ of 10-14)	135,000	<u>7,000</u>	5.2%	-	7,000	5.2%
12-13 (total)		70,200				
( $\frac{1}{2}$ of 12-13)	353,000	<u>17,600</u>	5.0%	-	17,600	5.0%
	<u>1,683,000</u>	<u>355,500</u>	<u>21.1%</u>	<u>300,000</u>	<u>655,500</u>	<u>39.0%</u>

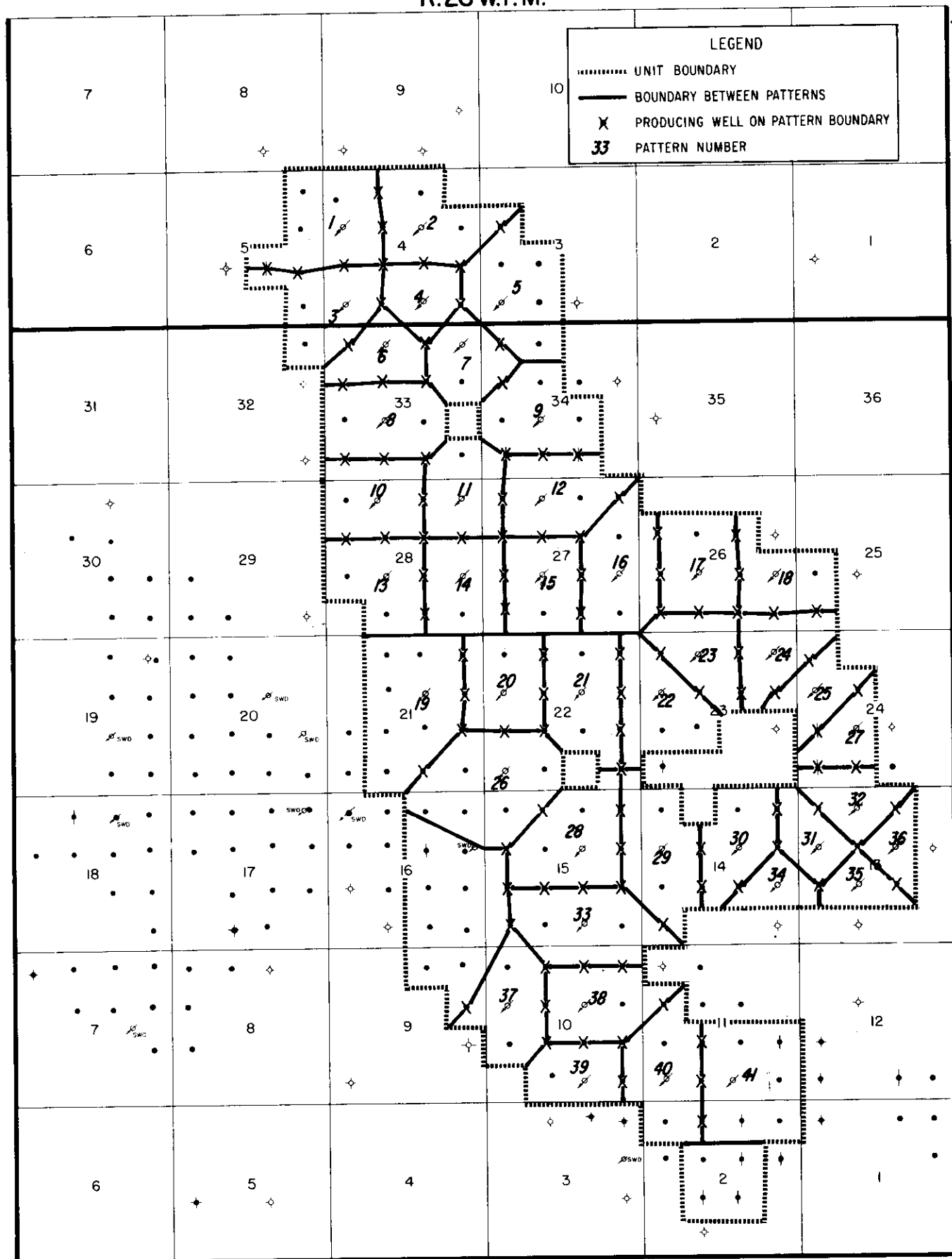


FIGURE 1  
NORTH VIRDEN SCALLION UNIT No. 1  
PATTERN BOUNDARIES FOR VOIDAGE BALANCE



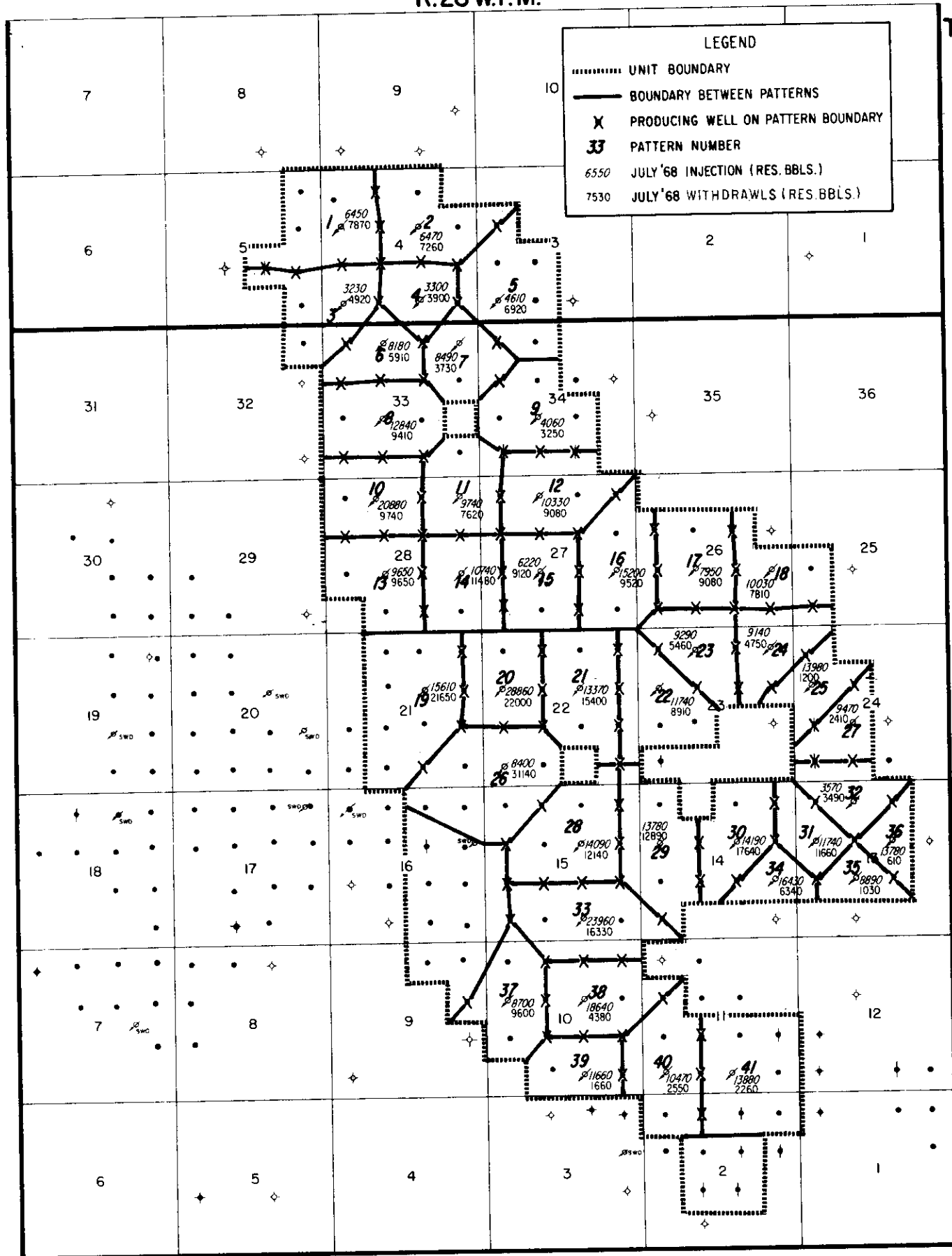
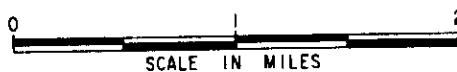


FIGURE 2  
NORTH VIRDEN SCALLION UNIT No.1  
JULY, 1968 VOIDAGE BALANCE BY PATTERN



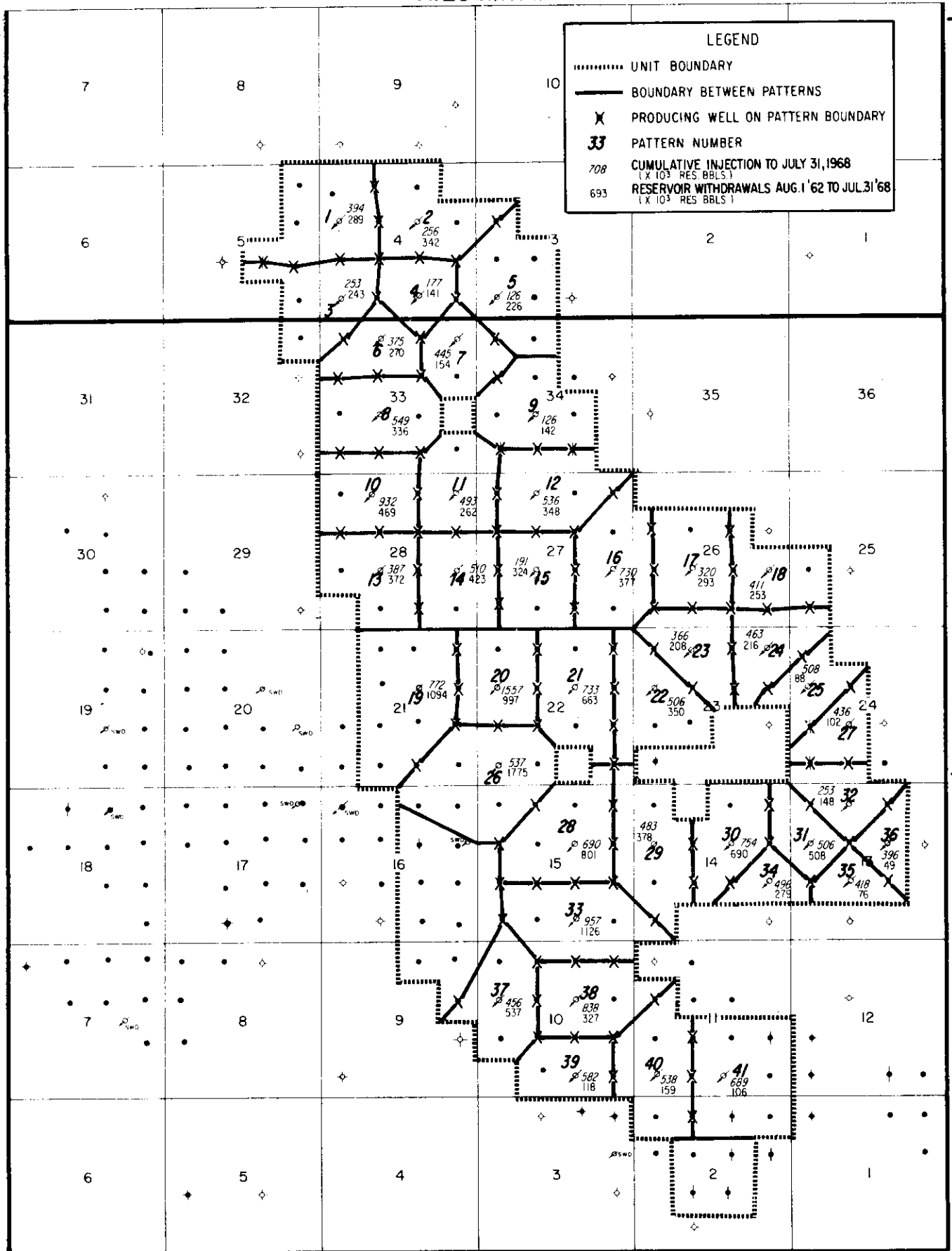


FIGURE 3  
NORTH VIRDEN SCALLION UNIT No.1  
VOIDAGE BALANCE TO JULY 31, 1968 BY PATTERN





**Chevron Standard Limited**

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

September 30, 1975

North Virden Scallion Unit No. 1  
Voidage Balance Requirements  
Order PML, Section 2, Clause 6

Oil and Natural Gas Conservation Board  
310 Legislative Building  
Winnipeg, Manitoba  
R3C 0V8

Attention: Mr. J. T. Cawley, P.Eng., Chairman

Gentlemen:

Enclosed are Figures 1 to 9 adherent to our submission of September 22, 1975. Please accept our apology for any inconvenience.

Yours very truly,

A handwritten signature in dark ink, appearing to read "G. W. Cruickshank", written over a horizontal line.

G. W. CRUICKSHANK, Chairman  
North Virden Scallion Unit No. 1  
Operating Committee

KFard/lw  
Enclosures



R. 26 W.P.M.

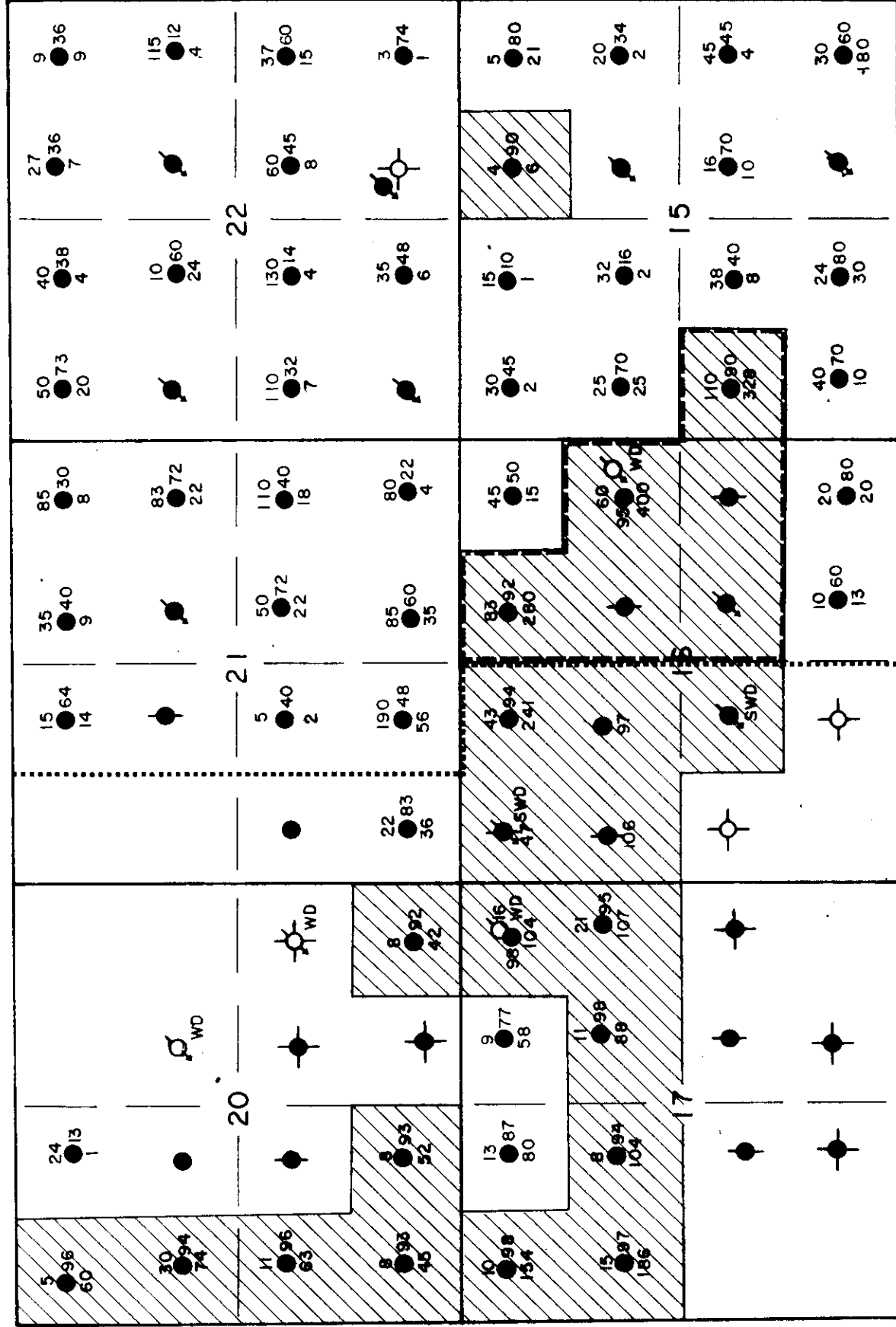


FIGURE 1  
NORTH VIRDEN SCALLION UNIT No. 1

PRODUCTION PERFORMANCE  
IN AND AROUND SUBMISSION AREA

AS OF DEC. 1974

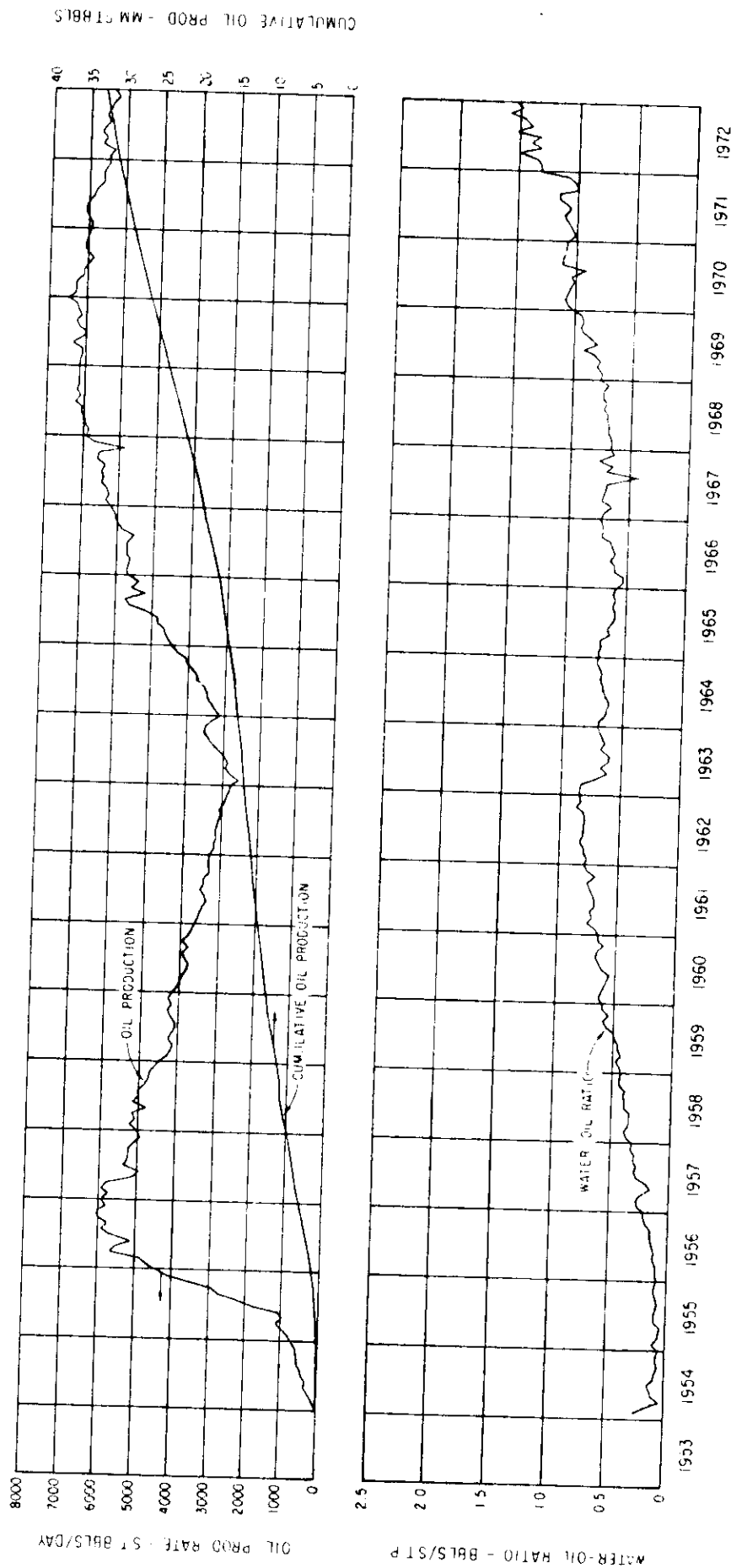


FIGURE 2  
NORTH VIRDEN SCALLION UNIT No. 1  
RESERVOIR PERFORMANCE

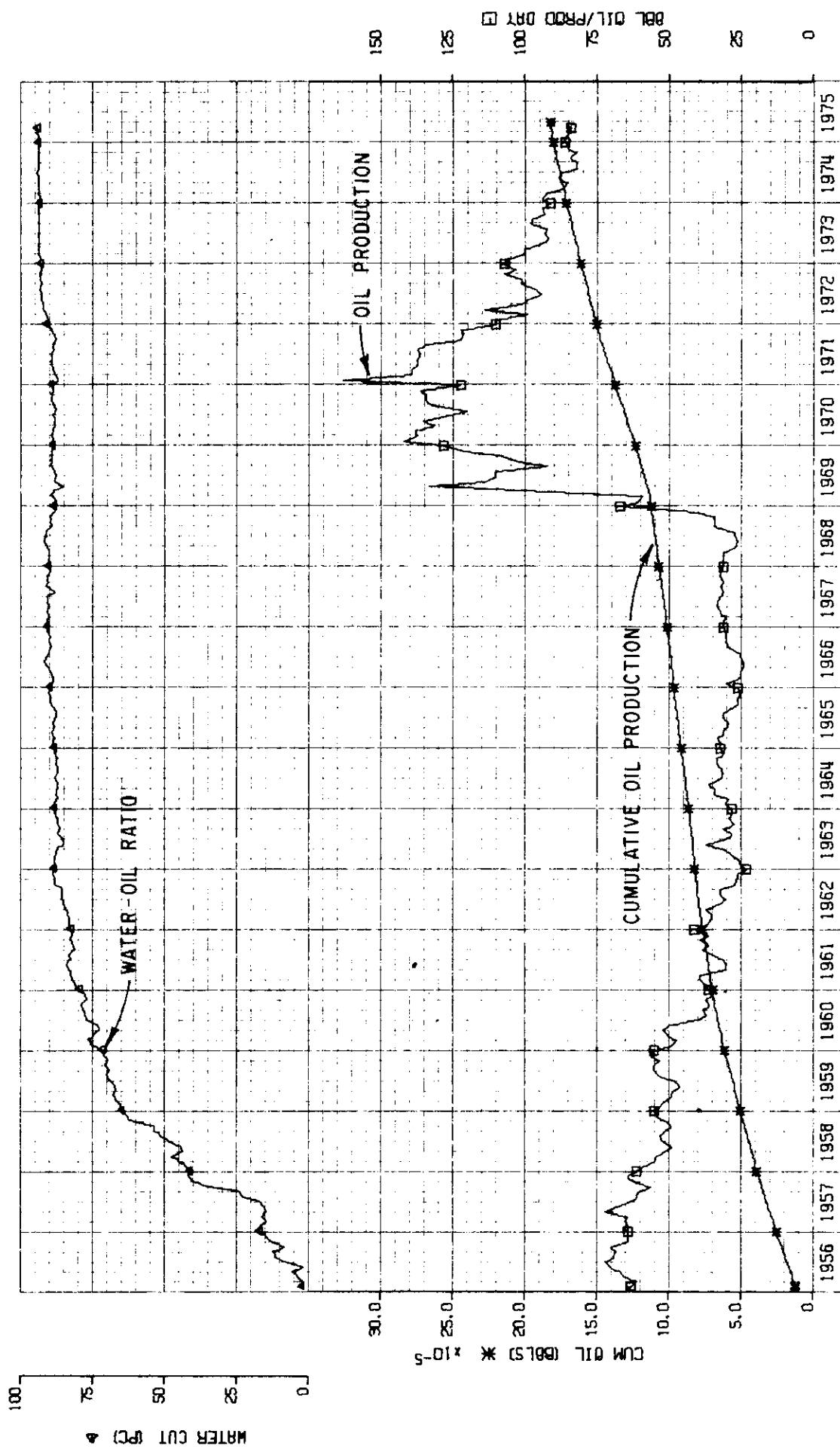
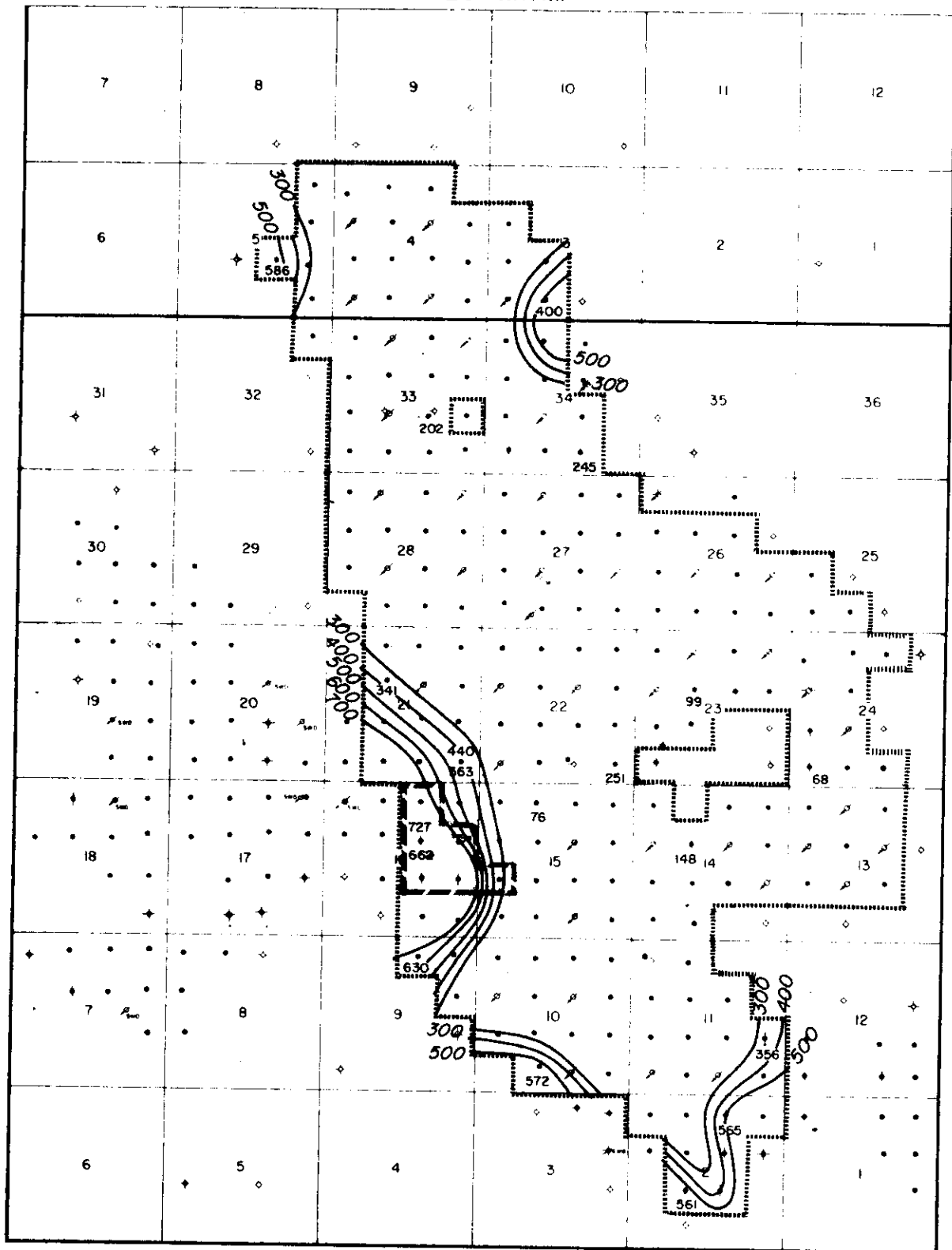


FIGURE 3  
SUBMISSION AREA  
RESERVOIR PERFORMANCE

LEGEND

- ..... UNIT BOUNDARY
- INJECTION WELL
- ◆ SUSPENDED WELL
- ◆ ABANDONED WELL
- SUBMISSION AREA

FIGURE 4

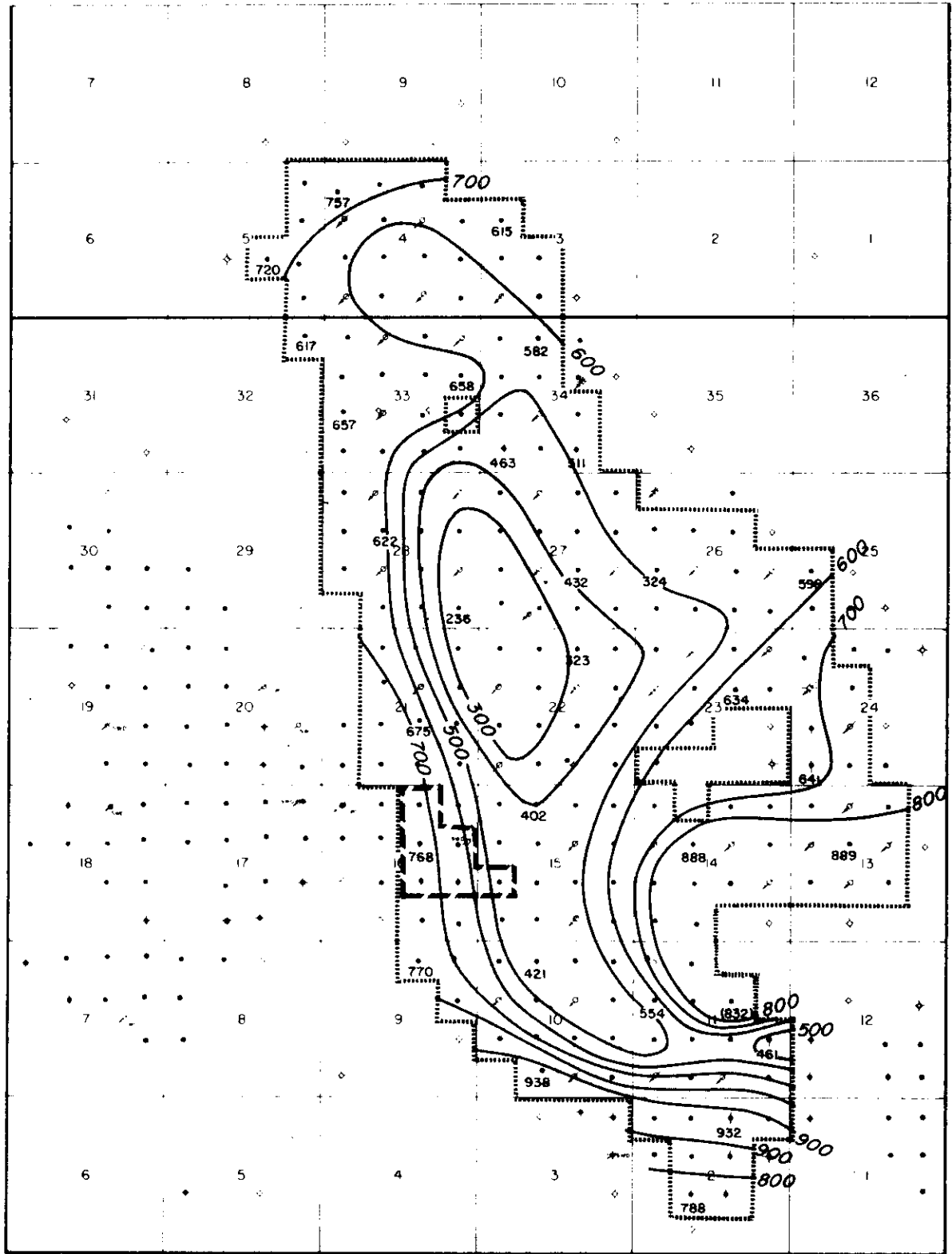
NORTH VIRDEN SCALLION UNIT No.1

ISOBARIC MAP

BASED ON 1962 BHP SURVEY

SCALE IN MILLS



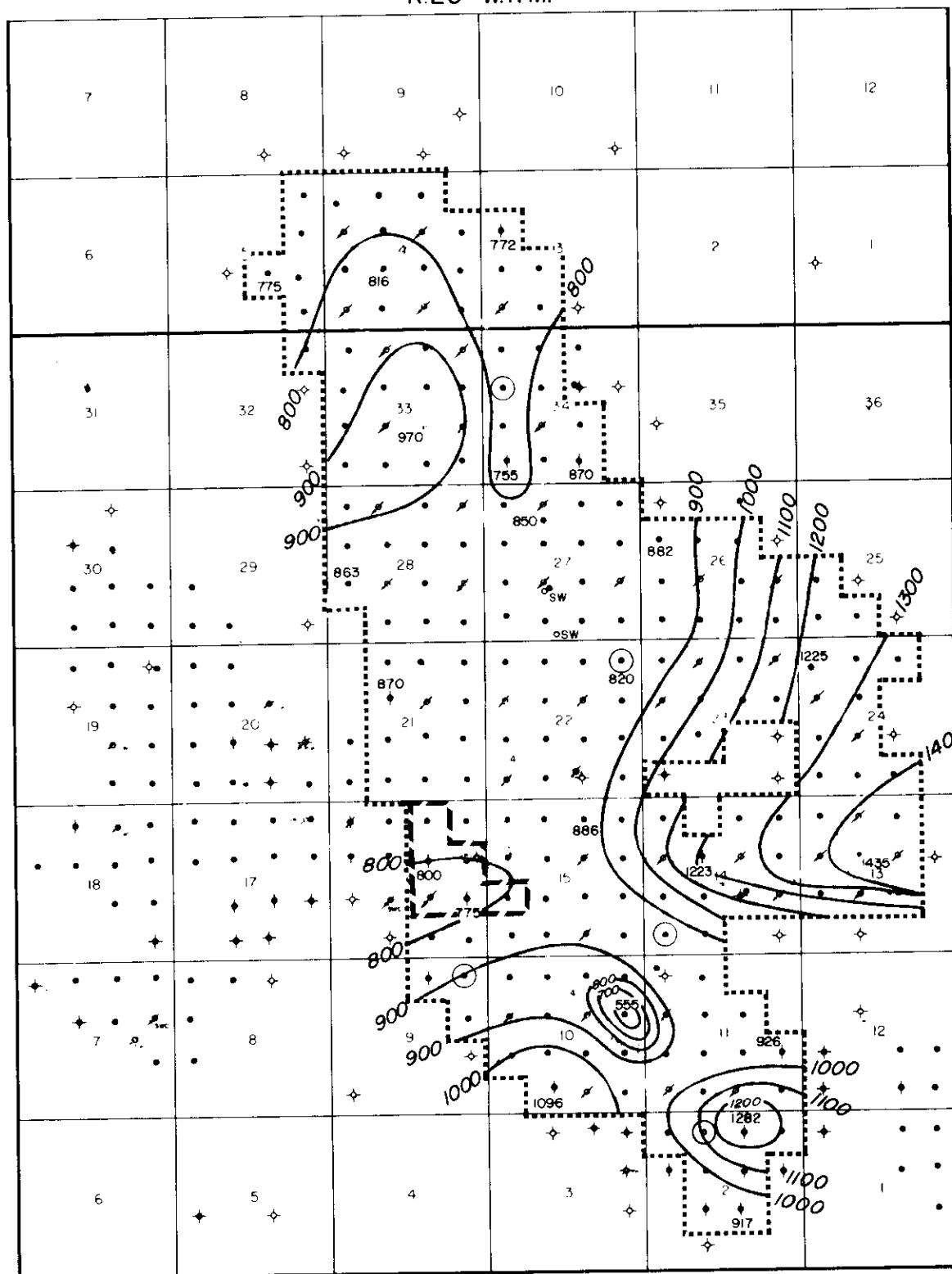
LEGEND

- UNIT BOUNDARY
- ♦ INJECTION WELL
- ♦ SUSPENDED WELL
- ♦ ABANDONED WELL
- SUBMISSION AREA

FIGURE 5  
 NORTH VIRDEN SCALLION UNIT No.1  
 ISOBARIC MAP  
 BASED ON 1966 BHP SURVEY

SCALE IN MILES

T.12



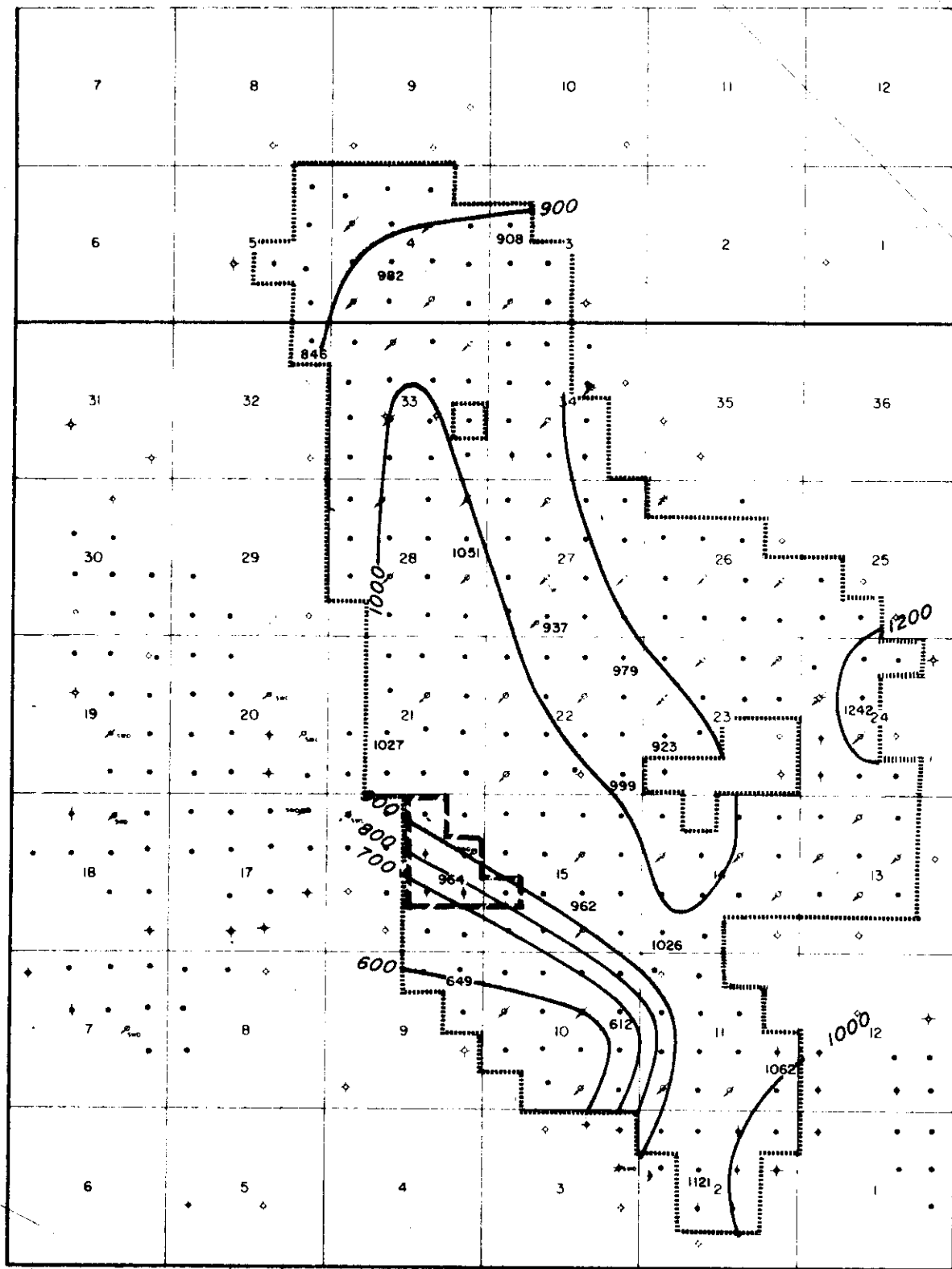
T.11

## FIGURE 6

..... UNIT BOUNDARY  
 ⚡ INJECTION WELL  
 † SUSPENDED WELL  
 ✦ ABANDONED WELL  
 — — — SUBMISSION AREA

NORTH VIRDEN SCALLION UNIT No. 1  
ISOBARIC MAP  
BASED ON 1971 BHP SURVEY

S. A. E. IN M. F. S.

LEGEND

- ..... UNIT BOUNDARY
- INJECTION WELL
- ◇ SUSPENDED WELL
- ✕ ABANDONED WELL
- SUBMISSION AREA

FIGURE 7

NORTH VIRDEN SCALLION UNIT No.1

ISOBARIC MAP

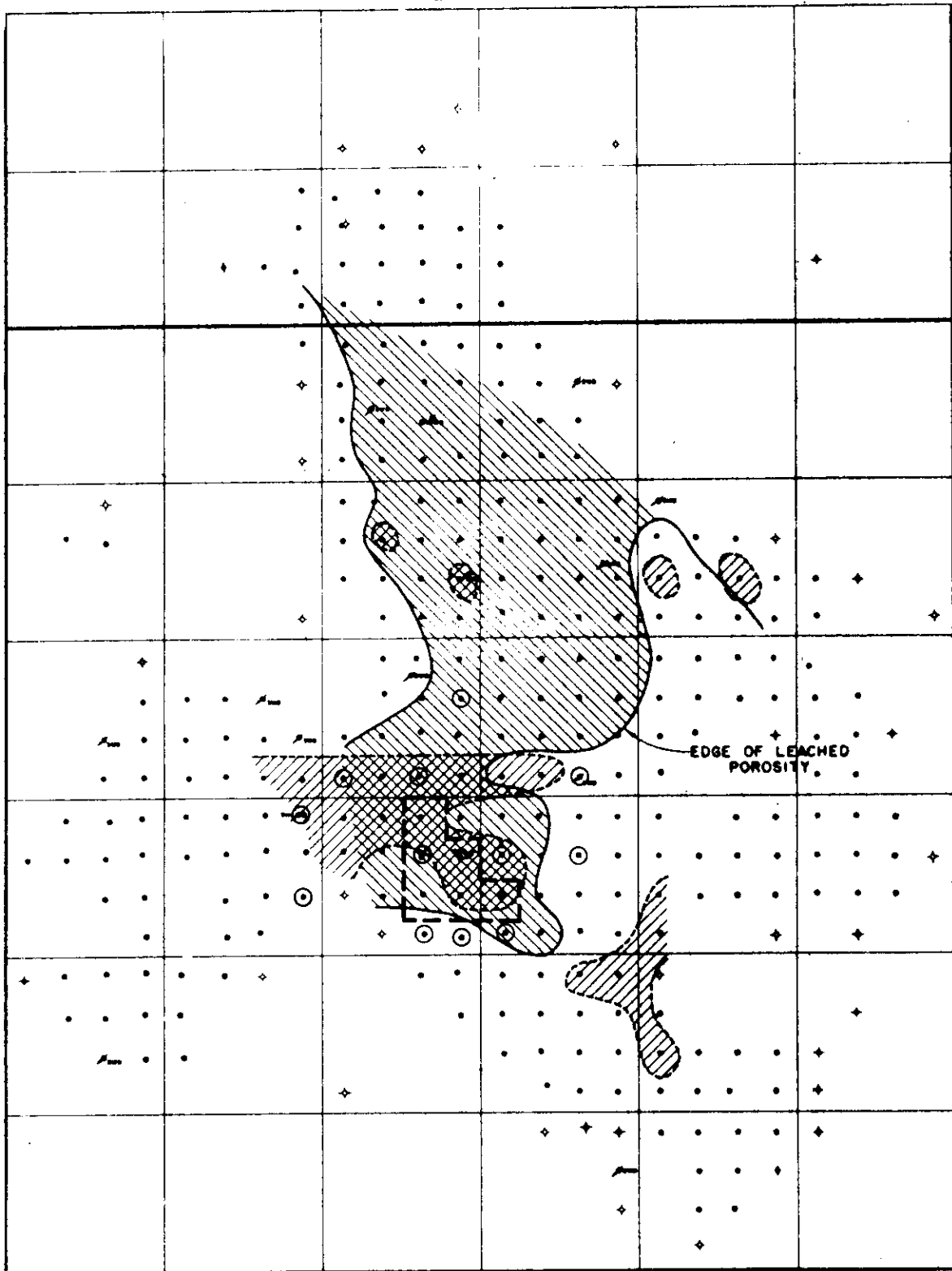
BASED ON 1974 BHP SURVEY

SCALE IN MILES



R.26 W.P.M.

T.12



T.11

FIGURE 8

**NORTH VIRDEN SCALLION FIELD**  
**CHERTY ZONE**  
 SHOWING AREAS OF OPEN FRACTURING  
 AND LEACHED POROSITY

--- SUBMISSION AREA

-LEGEND-

OPEN FRACTURES

LEACHING

WELLS WITH CORE CONTROL

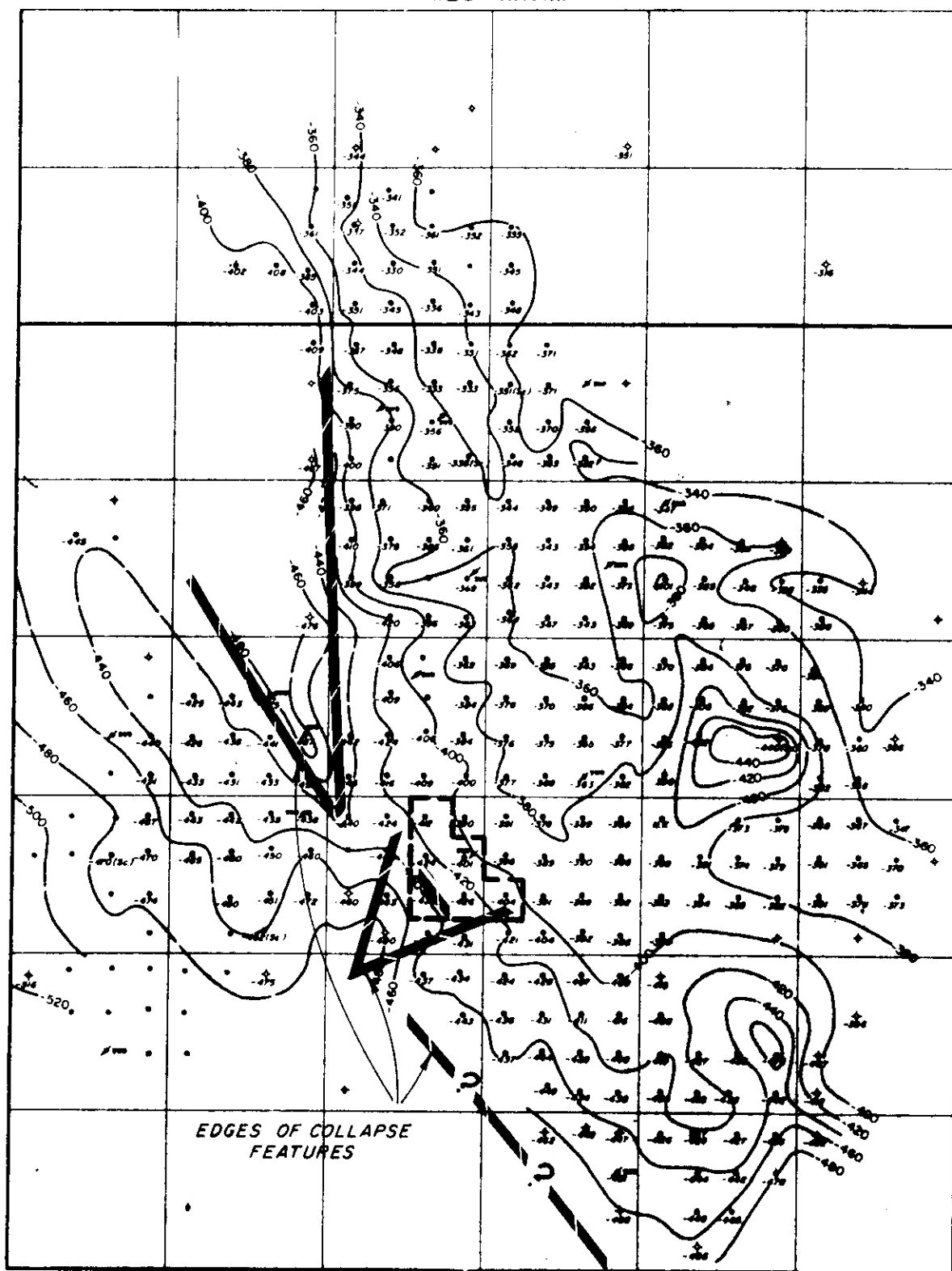
MAY 1961  
 REVISED 1975

SCALE IN MILES  
 0 1 2



R.26 W.P.M.

T.12



T.11

FIGURE 9

**NORTH VIRDEN SCALLION FIELD**  
**STRUCTURE CONTOURS**  
**ON TOP OF**  
**MISSISSIPPIAN**

--- SUBMISSION AREA

MAY 1961  
 REVISED 1973



C. 1. = 20 FT.



## **Chevron Standard Limited**

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

September 22, 1975

North Virden Scallion Unit No. 1  
Voidage Balance Requirements  
Order PM1, Section 2, Clause 6

Oil and Natural Gas Conservation Board  
310 Legislative Building  
Winnipeg, Manitoba  
R3C 0V8

Attention: Mr. J. T. Cawley, P.Eng.  
Chairman

Gentlemen:

In accordance with the Oil and Natural Gas Conservation Board, Order No. PM1, Pressure Maintenance Rule No. 2, Clause 6, Chevron Standard Limited as Unit Operator of North Virden Scallion Unit No. 1, hereby submits that a voidage balance is being naturally maintained by an active water drive, and that artificial maintenance of voidage balance by injection of water is not required in the Submission Area as shown on attached Figure 1 and listed as follows:

Lsd. 5-15-11-26 WPM  
Lsd. 7-16-11-26 WPM  
Lsd. 8-16-11-26 WPM  
Lsd. 9-16-11-26 WPM  
Lsd. 10-16-11-26 WPM  
Lsd. 15-16-11-26 WPM

The following information is offered in support of this submission:

### I. GENERAL

In 1963 North Virden Scallion Unit No. 1 initially had two sources of water for injection. Mississippian produced water was gathered from the unit batteries and after filtration was injected from a plant in Lsd. 9-16-11-26. Devonian water was produced from two Devonian supply well at 3-27 and 6-27 and injected from a plant in Lsd. 6-27-11-26. These two waters are not compatible and the systems must remain separated.

During 1973, the increase of the unit Mississippian water production enabled the Unit Operator to convert thirteen wells on the east water injection line supplied by the 6-27 plant from Devonian to Mississippian water injection, and a Mississippian water injection plant was constructed at 6-27. The water supply well at 3-27 was suspended, and was subsequently recompleted as a Mississippian oil well, presently producing at 59 BOPD and 16 BWPD.

The casing in the present unit water supply well at 6-27 was found to be corroded, and during 1973 a liner was run and cement squeezed. The well is presently operating satisfactorily, but with the past problems, the future of the well could be in some doubt. Therefore, Chevron anticipates ultimately replacing the Devonian water supply system with a Mississippian supply system.

## II. BOTTOM HOLE PRESSURE HISTORY

The first accurate pressure taken in the field was 906 psig which was measured at 9-16-11-26 well in April 1955; for the purpose of this study the original discovery pressure was assumed to be 906 psig.

The result of bottom hole pressure surveys taken in 1962, 1966, 1972 and 1974 are shown in Figures 4 to 7 inclusive. The isobaric maps indicate that the reservoir pressure in the Submission Area has remained near the original discovery pressure. Withdrawals from the Submission Area since production inception to August 1, 1974, the approximate time of 1974 pressure survey, amounted to 12,100,000 reservoir barrels, whereas injection during the same period amounted to 2,370,000 reservoir barrels. Therefore, a net voidage in the Submission Area of about 9,830,000 reservoir barrels has not resulted in a corresponding significant reduction of reservoir pressure.

## III. GEOLOGICAL

Oil is produced from seven zones in the Virden Scallion field. Zones of higher porosity and permeability are generally separated by dense impermeable zones, and therefore, fluid communication between zones would not be anticipated. However, fluid communication is likely in areas containing vertical fractures as observed in cores.

With reference to the report "Reservoir study North Virden Scallion field, Manitoba, August 1961," Figure 4, contained with that study has been modified and presented as Figure 8 in this report. This figure outlines areas of recognized fracturing in the cores and samples of wells drilled in portions of Sections 15, 16, 17, 20, 21 and 22 with the largest concentration of fracturing being in Section 16.

Quoting from the report "... the field is partially controlled by structure. This is in the form of true structure nosing reflected somewhat by the Lodgepole erosional surface (see Figure 7). Wells in which the Lodgepole formation is structurally high generally showing anhydrite infilling."

It is known that the structural lows bounding the Virden Scallion field are the result of post-Mississippian collapse, and fracturing of overlying competent beds such as the Lodgepole is common. A salt solution feature is inferred in Section 16, (based on structure contour map top of Mississippian as shown in Figure 9). This collapse is postulated as the cause of the extensive fracturing.

#### IV. RESERVOIR PERFORMANCE AND WATER INFLUX CALCULATIONS

The wells in the Submission Area that are on production have a producing capability in excess of 1,150 barrels of fluid per day per well with an average water to oil ratio of 15 as compared to a WOR of 1.5 for the whole unit as exhibited in Figures 2 and 3.

A simple material balance calculation, which is shown in Table 1, yields a net aquifer influx of 14,967,720 barrels in the pool since the production inception. Furthermore, a net efflux of 1,703,760 barrels was indicated for the period of January 1963 to July 1972 followed by an influx of 911,880 barrels for the following two years.

#### V. SUMMARY AND CONCLUSIONS

Chevron Standard Limited hereby submits that fluid withdrawals from the Submission Area are being replaced by an active water drive from the neighboring aquifer and, therefore, reservoir voidage need not be replaced by injection of water in this area. The evidence supporting this submission is summarized as follows:

1. The reservoir pressure in the Submission Area is presently near original discovery pressure, even though reservoir voidage in the Submission Area exceeded 9.8 million reservoir barrels.
2. All wells in the Submission Area are in good communication with the aquifer because of the extensive fracturing of the Mississippian rocks which is due to a collapse feature inferred to be present in this area. All producing wells in the Submission Area exhibit high water cuts.
3. The producing capability of most wells in the Submission Area is in excess of 300 barrels of fluid per day with some wells capable of producing as much as 1,700 barrels of fluid per day.

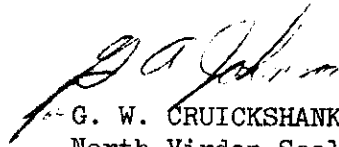
With the concurrence of the Board, Chevron Standard Limited, as operator of North Virden Scallion Unit No. 1, proposes to report in the annual progress report, the voidage balance of fluids in the unit area exclusive of the Submission Area. Water and oil production from the Submission Area will not be considered as voidage withdrawals and any water injected will not be credited as voidage replacement. The water injected in the well 7-16-11-26 WPM in the Submission Area will be limited to excess water that cannot be injected into other injection wells in the unit due to pumping equipment limitations and wellhead injection pressure limitations.

A comparison of the present and proposed methods for calculating reservoir voidage for the calendar year 1974, is shown on Table II and III attached.

As shown on Figure 1, it is evident that sufficient water for injection requirements is available from the Submission Area. Wells in the Submission Area are capable of producing 4,000 barrels of fluid per day at high water cuts. The net voidage in North Virden Scallion Unit No. 1 averaged at 1,418 reservoir barrels per day during 1974.

If additional information is required regarding this submission, please contact Mr. G. W. Cruickshank at Box 100, Virden, Alberta, ROM 2C0. Additional copies of this submission may be obtained from the Information Centre in our Calgary office.

Yours very truly,

 P. Eng. (APEGGA)  
G. W. CRUICKSHANK, Chairman  
North Virden Scallion Unit No. 1  
Operating Committee

KF/hb  
Attach.

Table I

Material Balance Calculations

	Pool*	Np**	Gp**	Wp**	Wi		We
	Pressure	Cum. Oil	Cum. Gas	Cum. Water	Cum. Water		Net Water
Date	(psi)	Production	Production	Production	Injection	Bo	Influx
		(bbls.)	(MCF)	(bbls.)	(bbls.)	(RB/STB)	(STB)
Initial pressure 906 psig							
1/1/63	350	12,010,560	840,740	5,033,160	21,720	1.0493	15,759,600
1/7/66	662	17,455,290	1,221,870	8,567,170	10,290,890	1.0468	15,724,920
1/7/72	926	32,353,020	2,263,710	22,042,210	41,847,660	1.0446	14,055,840
1/7/74	941	36,806,800	2,611,930	29,222,210	52,865,530	1.0445	14,967,720

\* Arithmetic average reservoir pressure used.

\*\* Cumulative production includes the pre-flood production.

Table II

North Virden Scallion Unit No. 1

Reservoir Voidage Rates 1974

	<u>First</u> <u>Quarter</u>	<u>Second</u> <u>Quarter</u>	<u>Third</u> <u>Quarter</u>	<u>Fourth</u> <u>Quarter</u>	<u>Total for</u> <u>Period</u>
Oil Produced (Bbls.)	529,140	528,250	520,653	531,634	2,109,677
Gas Produced (MSCF)	37,040	36,977	36,446	37,214	147,677
Water Produced (Bbls.)	850,521	880,712	874,137	941,720	3,547,090
Average Solution GOR	70	70	70	70	70
Formation Volume Factor	1.05	1.05	1.05	1.05	1.05
Voidage Oil (Res. Bbls.)	555,597	554,662	546,685	558,215	2,215,159
Voidage Water (Res. Bbls.)	850,521	880,712	874,137	941,720	3,547,090
Total Voidage (Res. Bbls.)	1,406,118	1,435,374	1,420,822	1,499,935	5,762,249
Water Inj. (Res. Bbls.)	1,199,231	1,238,155	1,344,328	1,463,074	5,244,788
Net Voidage (Res. Bbls.)	206,887	197,219	76,494	36,861	517,461
Net Voidage Rate (Res. B/D)	2,299	2,167	831	401	1,418
Cum. Net Voidage (Res. Bbls.)	-2,074,001	-1,876,782	-1,800,288	-1,763,427	-

Gas Produced = Solution Gas

Cumulative Pre-Unit Voidage:

Oil	-	12,447,263	Bbls.
Water	-	5,042,098	"
Total	-	17,489,361	"

Table III

North Virden Scallion Unit No. 1

Reservoir Voidage Rates 1974\*

	<u>First Quarter</u>	<u>Second Quarter</u>	<u>Third Quarter</u>	<u>Fourth Quarter</u>	<u>Total for Period</u>
Oil Produced (Bbls.)	506,020	505,477	498,611	508,438	2,018,546
Gas Produced (MSCF)	35,426	35,388	34,894	35,596	141,304
Water Produced (Bbls.)	545,898	547,391	552,683	603,646	2,249,618
Average Solution GOR	70	70	70	70	70
Formation Volume Factor	1.05	1.05	1.05	1.05	1.05
Voidage Oil (Res. Bbls.)	531,321	530,750	523,541	533,860	2,119,472
Voidage Water (Res. Bbls.)	545,898	547,391	552,683	603,646	2,249,618
Total Voidage	1,077,219	1,078,141	1,076,224	1,137,506	4,369,090
Water Inj.	1,163,883	1,202,110	1,302,071	1,440,031	5,108,095
Net Voidage (Res. Bbls.)	-86,664	-123,969	-225,847	-302,525	-739,005
Net Voidage (Res. B/D)	-1,007	-1,362	-2,482	-3,325	-2,025
Cum. Net Voidage (Res. Bbls.)	-2,367,552	-2,491,521	-2,717,368	-3,019,893	-

\* Excluding oil, gas and water produced from and injected to the following well in the Submission Area:

Lsd. 5-15-11-27 WPM  
 Lsd. 7-16-11-26 WPM  
 Lsd. 8-16-11-26 WPM  
 Lsd. 9-16-11-26 WPM  
 Lsd. 15-16-11-26 WPM



DEPARTMENT OF MINES AND NATURAL RESOURCES  
ROUTE SLIP

TO Mr. F.S. Gamey

FROM J.S. Richards

TO

FROM

- |  |  |  |
|--|--|--|
| <input type="checkbox"/> For your approval or revision                       | <input type="checkbox"/> Reply direct with copy to me                | <input type="checkbox"/> Please sign   |
| <input type="checkbox"/> For your information                                | <input type="checkbox"/> Please supply data for my reply             | <input type="checkbox"/> Please return |
| <input type="checkbox"/> Please take action                                  | <input type="checkbox"/> Return with comments and/or recommendations | <input type="checkbox"/> Please see me |
| <input type="checkbox"/> Extracts of minutes for your information and action | <input type="checkbox"/> Investigate and report                      | <input type="checkbox"/> Please phone  |
| <input type="checkbox"/> Please draft reply for signature of                 |  |  |

Date Dec. 12/68

Subject

Message For your information.

MNR-A-94

Use reverse side if necessary

December 10, 1963

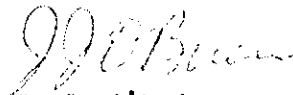
Mr. J. G. Trowell,  
Division Superintendent,  
Producing Department,  
Calgary Division,  
Chevron Standard Limited,  
400 - 5th Avenue S. W.,  
Calgary, Alberta.

Dear Mr. Trowell:

Re: North Virden - Scallion  
Unit No. 1

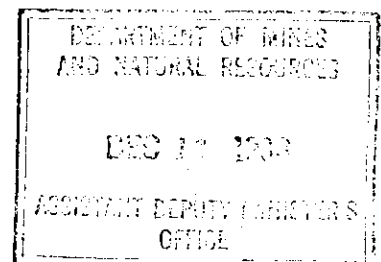
On behalf of the Chairman of the Oil and Natural Gas  
Conservation Board I wish to acknowledge with thanks receipt of your  
letter of December 6th with attachments.

Yours sincerely,



J. J. O'Brien,  
Executive Assistant to  
the Deputy Minister.

cc. Mr. J. S. Richards ✓  
Mr. M. J. Gobert.





# CHEVRON STANDARD LIMITED

400 FIFTH AVENUE S.W., CALGARY, ALBERTA

December 6, 1968

Mr. W. W. Mair, Chairman  
Oil and Natural Gas Conservation Board  
901 Norquay Building  
401 York Avenue  
Winnipeg 1, Manitoba

Dear Sir:

Pursuant to your request, Chevron Standard has calculated a balance, by pattern, for the North Virden-Scallion Unit No. 1 waterflood area. Only the North Virden-Scallion Unit has been reviewed in detail to date.

In addition, a review was made of the ultimate recovery in a segment of the waterflood area in which the producing well has experienced producing rates in excess of 100 BOPD for the past four years and rates of approximately 200 BOPD for the past two years.

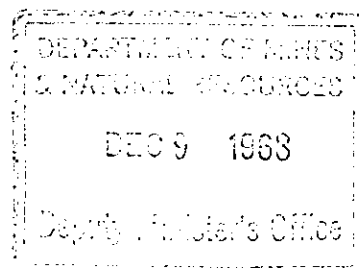
The results and conclusions from the above are presented in the attached technical report. It is felt that the conclusions from the study of this area are equally applicable to the Virden-Roselea Units.

We are available for informal discussion of these data at your convenience.

Yours very truly,

J. G. TROWELL  
Division Superintendent  
Producing Department  
Calgary Division

PP:mg  
Attach.



## VOIDAGE BALANCE AND ULTIMATE RECOVERY STUDY

### NORTH VIRDEN-SCALLION UNIT NO. 1

December, 1968

#### A. Review of Voidage Balance by Pattern

At the request of the Oil and Natural Gas Conservation Board, a detailed study was conducted on the balance between reservoir fluid withdrawals and fluid injection into the reservoir. This study was conducted on an individual pattern basis.

##### Procedure:

The Unit area was divided into 41 individual segments or patterns such that each pattern had one injection well and several producing wells. (See Figure 1). For the purposes of this study, it was assumed that the reservoir voidage created by any producer located on adjacent pattern boundaries, is distributed equally amongst those patterns on whose boundaries it is situated.

A voidage balance was calculated for the month of July, 1968 to represent current conditions. In addition, a cumulative voidage balance from the inception of waterflooding to July 31, 1968 was calculated.

##### Results:

Table 1 and Figures 2 and 3 present the results of the study. Reasonable balance between injection and withdrawals exists at most patterns. There are instances of over and under injection on a current and cumulative basis.

Some interpretation of the injection profile survey results (See Progress Report No. 3 - 1964) was necessary to make a realistic appraisal of voidage balance. The "Remarks" column on Table 1 indicates some views that are applicable. All injection figures in Table 1 represent total injection. Losses indicated by injection profiles were not deducted.

Observations and Conclusions:

The conclusions from the study are listed and discussed below:

1. The erratic nature of the reservoir creates difficulties in calculating a voidage balance by pattern. Pay thicknesses vary by as much as 45 feet between adjacent spacing units and much interpretive reasoning has been used to determine pay thickness values. Accuracies of porosity and permeability values are also variable since in portions of the Unit area, only extremely poor data were available for the determination of these reservoir parameters.
2. The erratic nature of the reservoir is equally problematical with computer simulation. Chevron is currently updating a computer study for the surveillance of a central area of the Unit. From the results obtained to date it is concluded that, because of the variable nature of the reservoir, the results can only be treated as semi-quantitative.
3. The results from an injection profile survey conducted during 1964 were used interpretively in this review. In several instances, the survey indicated that injected water was escaping below the

bottom of the completed interval. In other instances large volumes were indicated as entering the reservoir at the bottom of the completed interval. In all cases, where there is an indication or suspicion of water entering the reservoir below the completed interval, the possibility should not be excluded that this "lost water" does, somewhere in the reservoir, replace some voidage that has been created by reservoir withdrawals. Most injection profile surveys lose contact with injected water when it moves 3 to 5 feet beyond the wellbore.

4. By combining two or more patterns in certain areas, a better voidage balance is indicated. It is reasonable to do this since it is not possible to accurately establish what reservoir voidage should be balanced with what injection, particularly when dealing with those producing wells that are equidistant from two or more injection wells.
5. The voidage balance from fluid production and injection records for the entire unit is favorable. It is reasonable to conclude that the balance within the reservoir is also favorable. Currently, the total injection within the unit area exceeds the total reservoir withdrawals by approximately 30%. Total cumulative injection has exceeded reservoir withdrawals since the inception of waterflooding by approximately 30%. Pre-unit production has resulted in cumulative reservoir withdrawals currently exceeding cumulative fluid injection by approximately 12 million reservoir barrels.

6. Because of the variable nature of the reservoir, the most realistic basis on which to review voidages is for the entire area. It is reasonable to assume that essentially all the water injected into the reservoir is replacing voidage created by withdrawals from the reservoir. As stated above, it is not possible to determine, with any accuracy, what reservoir withdrawals are being affected by what injection.
7. It is reasonable to assume that if there has been no waterflood response at first line producing wells, then there is little likelihood that oil is being flushed into areas from whence it cannot be recovered.

If there has been, or is, response, the possibility of losing Unit reserves beyond the reach of future Unit production exists if production is restricted beyond the bounds of good engineering practice. One has no assurance that waterflood response oil that is permitted to move beyond the first line producing wells, will be available for production at the next line of producing wells. This is particularly the case in a reservoir such as this, where combinations of variations in thickness, porosity, and permeability could very easily permit oil to be trapped and lost.

It is, therefore, concluded, that to restrict production or injection by other than good engineering practice is to risk adversely affecting the ultimate recovery of oil from the total unit area.

B. Review of Ultimate Recovery in the Vicinity of 9-14-11-26 WPM

An attempt was made to establish whether unrestricted production rates permitted in the North Virden-Scallion Unit No. 1 could adversely affect the ultimate recovery of oil.

The area surrounding 9-14-11-26 WPM was chosen as a test area for two main reasons:

- (a) The well on LSD 9-14 has experienced production rates in excess of 100 BOPD for the past four years and rates of approximately 200 BOPD for the past two years.
- (b) The well on LSD 9-14 is on the common boundary of three injection patterns. Of these three patterns, one is in good voidage balance; one is over-injected and one is under-injected, on a current and cumulative basis.

Assumptions:

For this study, it was assumed that the producer on 9-14 was responsible for recovering the oil from its 40 acre tract as well as the remaining recoverable oil from one-quarter of each of LSD 8-14; LSD 10-14 and LSD 12-13, which are the directly offsetting injection wells.

It was assumed that one-quarter of the oil production from the three injection wells, prior to conversion, was from the additional area assigned to LSD 9-14, as outlined above.

The calculation of original oil-in-place was based on the reservoir study conducted prior to unitization.



Results, Observations and Conclusions:

1. The original oil-in-place, production, and recovery data are presented on Table 2. The recovery to July 31, 1968 represents a recovery factor of 21.1%. It is anticipated that an additional 300,000 STB will be produced from 9-14 before it becomes non-economic to produce. This would then represent an ultimate recovery for the area of 39% of the original oil-in-place. At the time of the waterflood study for unitization, the calculated recovery factor for the entire area was 28.4% of the original oil-in-place.
2. It is concluded that unrestricted oil producing rates have not adversely affected, nor will they adversely effect the ultimate recovery of oil in this area.
3. It is reasonable to conclude that, with the same injection history in the area, had the production been restricted, the resultant ultimate recovery at 9-14 would in all likelihood, have been adversely affected. Under restricted producing conditions, it is likely that oil would be flushed by 9-14 and perhaps into areas beyond the reach of future Unit production.

TABLE I

## NORTH VIRDAN-SCALLION UNIT NO. 1

Review of Reservoir Voidage and Withdrawals by Pattern  
(See attached Figures 1 and 2)

Pattern No.	Injection Well	July 1968 Injection (Bbls./Month)	July 1968 Withdrawals (Bbls./Month)	July 1968 Net Voidage Res. Bbls./Month	Cum. Withdrawals		Remarks
					Cum. Inject. to 7/31/68 Res. Bbls.	Since Incept. to 7/31/68 Res. Bbls.	
						Net Voidage Res. Bbls.	
1	12-4-12-26	6,450	7,370	1,420	394,200	289,200	From 1964 injection profile, no water lost out bottom of well.
2	10-4-12-26	6,470	7,260	790	256,000	341,500	Although fair voidage balance is indicated, injection profile indicates 54% of water going below completed interval, but may still be entering the oil reservoir.
3	4-4-12-26	3,230	4,920	1,690	252,800	243,300	Consider combining Pattern Nos. 3, 4 and 6.
4	2-4-12-26	3,300	3,900	600	177,300	140,700	Injection profile indicates loss of 35% of water, but could still be effective water. See remarks for "3" above.
5	4-3-12-26	4,610	6,920	2,310	125,600	225,500	No injection profile available. Consider combining Pattern Nos. 5 and 6.
6	14-33-11-26	8,180	5,910	( 2,270)	374,500	270,400	Good injection profile. See remarks under Pattern No. 3.
7	16-33-11-26	8,490	3,730	( 4,760)	444,500	153,600	Good injection profile. See remarks under Pattern No. 5.
8	6-33-11-26	12,340	9,410	( 3,430)	549,100	335,500	Good injection profile. Expected additional response should balance voidage.

Pattern No.	Injection Well	July 1968		July 1968		Cum. Inject. to 7/31/68		Cum. Withdrawals Since Incept. to 7/31/68		Net Voidage Res. Bbls.	Remarks
		Injection (Bbls./Month)	Withdrawals (Bbls./Month)	Net Voidage Res. Bbls./Month	Res. Bbls.	Res. Bbls.	Res. Bbls.	Res. Bbls.	Res. Bbls.		
9	6-34-11-26	4,060	3,250	( 810)	125,800	142,100	16,300	Withdrawal area might be considerably smaller, thus yielding better balance.			
10	14-28-11-26	20,880	9,740	(11,140)	932,400	469,100	(463,300)	From injection profile, could be losing 40% of the injected water.			
11	16-28-11-26	9,740	7,620	( 2,120)	422,800	262,100	(230,700)	Could be losing 30% of the water.			
12	14-27-11-26	10,330	9,080	( 1,250)	535,800	347,800	(188,000)	Reasonable balance.			
13	6-28-11-26	9,650	9,650	0	326,600	371,700	( 14,900)	Good balance indicated, however can be losing as much as 30% at bottom of hole.			
14	8-23-11-26	10,740	11,480	740	510,400	422,900	( 87,500)	Good balance indicated.			
15	6-27-11-26	6,220	9,120	2,900	190,500	323,900	133,400	Good injection profile. Consider combining with Pattern No. 16.			
16	3-27-11-26	15,200	9,520	( 5,680)	730,000	376,900	(353,100)	Good injection profile. Consider combining with Pattern No. 15.			
17	6-26-11-26	7,950	9,080	1,130	319,700	292,700	( 27,000)	Reasonable injection profile. Consider combining with Pattern No. 22.			
18	8-26-11-26	10,030	7,810	( 2,220)	411,100	252,800	(158,300)	Good injection profile.			
19	10-21-11-26	15,610	21,650	6,040	772,400	1,093,600	321,200	Injection profile indicates 50% of water lost. Large area attributed this pattern. Consider combining Pattern Nos. 19, 20, and 26.			
20	12-22-11-26	28,860	22,000	( 6,860)	1,556,500	997,000	(559,500)	Good injection profile. Consider combining Pattern Nos. 19, 20 and 26.			
21	10-22-11-26	13,370	15,400	2,030	732,600	663,200	( 69,400)	Good injection profile. Consider combining Pattern Nos. 21 and 22.			

Pattern Number	Injection Well	July, 1968		July 1968		Cum. Inject. to 7/31/68		Cum. Withdrawals Since Incept. to 7/31/68		Net Voidage		Remarks
		Injection (Bbls./Month)	Withdrawals (Bbls./Month)	Net Voidage Res. Bbls./Month	Res. Bbls.	Res. Bbls.	Res. Bbls.	Res. Bbls.	Res. Bbls.	Res. Bbls.	Res. Bbls.	
22	12-23-11-26	11,740	8,910	( 2,830)	506,000	349,700	( 156,300)	Satisfactory injection profile. Consider combining Pattern Nos. 21 & 22.				
23	14-23-11-26	9,290	5,460	( 3,830)	365,700	207,500	( 158,200)	Satisfactory injection profile. Additional flood response expected. Consider combining Pattern Nos. 17 & 23.				
24	16-23-11-26	9,140	4,750	( 4,390)	463,000	215,700	( 247,300)	Poor balance; however expected additional response could balance voidage.				
25	12-24-11-26	13,980	1,200	(12,780)	507,500	87,300	( 419,700)	Poor injection profile indicates loss of 75% of the water. Anticipated additional withdrawals in area could balance voidage.				
26	4-22-11-26	8,400	31,140	22,740	536,900	1,775,200	1,238,300	Good injection profile. Consider combining Pattern Nos. 19, 20 & 26.				
27	6-24-11-26	9,470	2,410	( 7,060)	435,900	101,900	( 334,000)	Injection profile indicates some loss of water. Additional anticipated response could balance voidage.				
28	10-15-11-26	14,090	12,140	( 1,950)	690,400	801,300	110,900	Injection profile indicates that 65% of the water is going below the open hole interval.				
29	12-14-11-26	13,780	12,890	( 890)	482,600	377,500	( 105,100)	Reasonable balance; however injection profiles indicate that 60% of the water may be lost.				
30	10-14-11-26	14,190	17,640	3,450	753,500	690,400	( 163,100)	Good injection profile. Consider combining Pattern Nos. 30, 31 & 34.				
31	12-13-11-26	11,740	11,660	( 80)	506,000	508,400	2,400	Good balance and good injection profile. Could be combined with Pattern Nos. 30 & 34.				
32	14-13-11-26	3,570	3,490	( 80)	252,800	147,800	( 105,000)	Good injection profile, good balance indicated.				

Pattern Number	Injection Well	July 1968 Injection (Bbls./Month)	July 1968 Withdrawals (Bbls./Month)	July 1968		Cum. Inject. to 7/31/68		Cum. Withdrawals to 7/31/68		Net Voltage Res. Ohms.	Remarks
				Net Voltage Res. Ohls./Month	Res. Ohls.	Res. Ohls.	Res. Ohls.				
33	2-15-11-26	23,960	16,330	( 7,630)	956,900	1,125,800	163,900	Poor injection profile; 27% of water being lost.			
34	3-14-11-26	16,430	6,340	( 10,090)	496,100	278,600	( 217,500)	Good profile. Consider combining with Pattern Nos. 30 and 31.			
35	6-13-11-26	8,890	1,030	( 7,860)	418,200	76,400	( 341,800)	Good injection profile. Incomplete 5-spot.			
36	10-12-11-26	13,730	610	( 13,170)	396,200	43,700	( 347,500)	Good injection profile. Incomplete 5-spot.			
37	12-10-11-26	3,700	9,600	900	455,500	537,400	81,900	Poor injection profile. 51% of water going below T.D. (possibly still into oil reservoir).			
38	10-10-11-26	18,640	4,380	( 14,260)	838,300	326,900	( 511,400)	Poor injection profile. 39% of water going below T.D. (possibly still into oil reservoir).			
39	2-10-11-26	11,660	1,660	( 10,000)	581,900	118,200	( 463,700)	Fair injection profile. Incomplete 5-spot.			
40	4-11-11-26	10,470	2,550	( 7,920)	538,300	159,300	( 379,000)	Poor injection profile.			
41	2-11-11-26	13,330	2,260	( 11,620)	669,200	106,100	( 583,100)	Fair injection profile.			
TOTAL		462,010	351,770	(110,240)	21,141,500	16,056,100	(5,085,400)				

TABLE 2

## REVIEW OF ULTIMATE RECOVERY IN THE VICINITY OF 9-14-11-26 WPM

Tract	Original Oil in Place-STB	Cum. Oil Prod. to 7/31/68-STB	Recovery Factor to 7/31/68	Est. Remaining Prod.-STB	Est. Ult. Recovery	Est. Ult. Recovery Factor
8-14 (total)		41,900				
( $\frac{1}{2}$ of 8-14)	233,000	<u>10,500</u>	4.5%	-	10,500	4.5%
9-14 (total)	962,000	<u>320,400</u>	33.3%	300,000	620,400	64.5%
10-14 (total)		27,000				
( $\frac{1}{2}$ of 10-14)	135,000	<u>7,000</u>	5.2%	-	7,000	5.2%
12-13 (total)		70,200				
( $\frac{1}{2}$ of 12-13)	353,000	<u>17,600</u>	5.0%	-	17,600	5.0%
	<u>1,683,000</u>	<u>355,500</u>	<u>21.1%</u>	<u>300,000</u>	<u>655,500</u>	<u>39.0%</u>

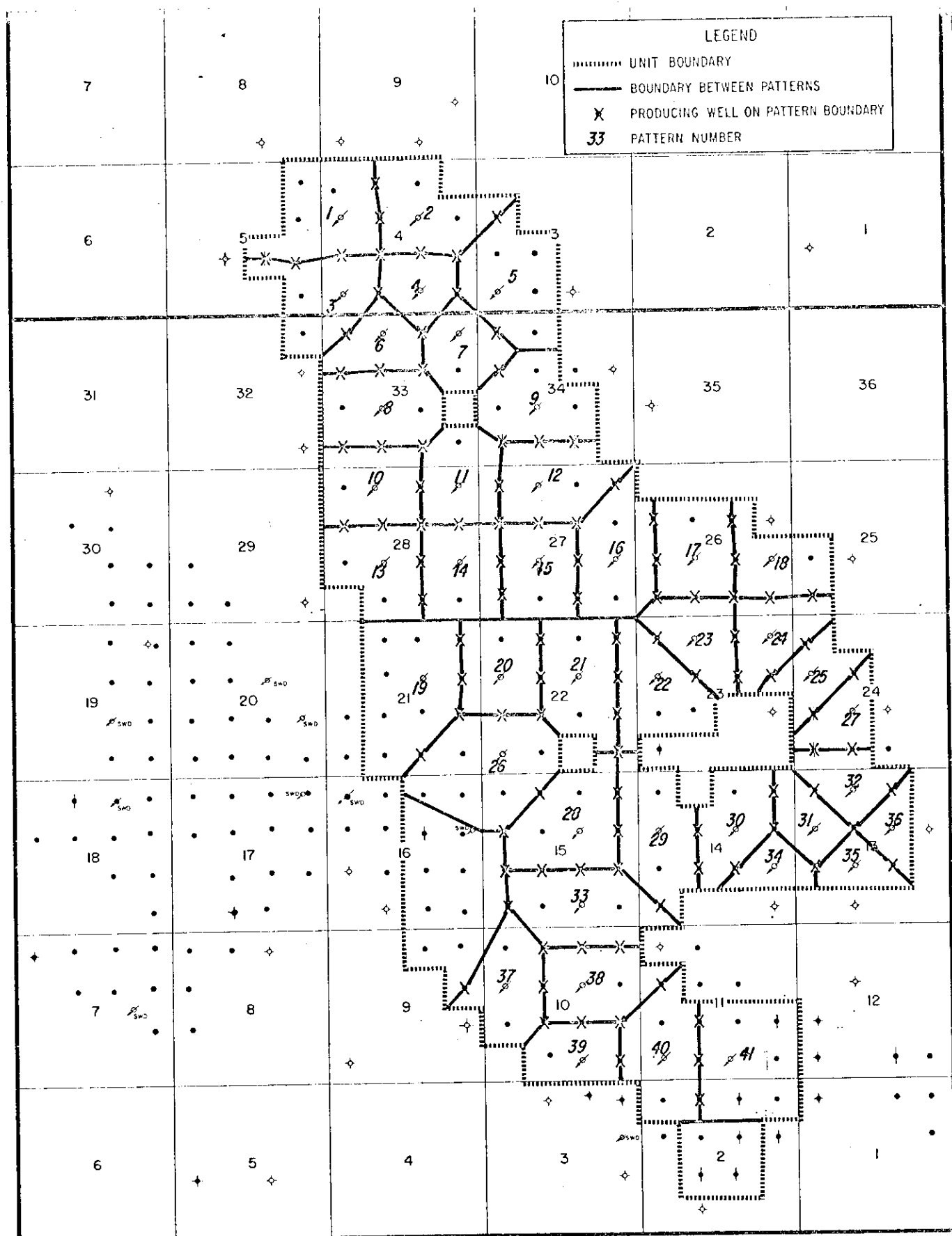


FIGURE 1  
NORTH VIRDEN SCALLION UNIT No. 1  
PATTERN BOUNDARIES FOR VOIDAGE BALANCE



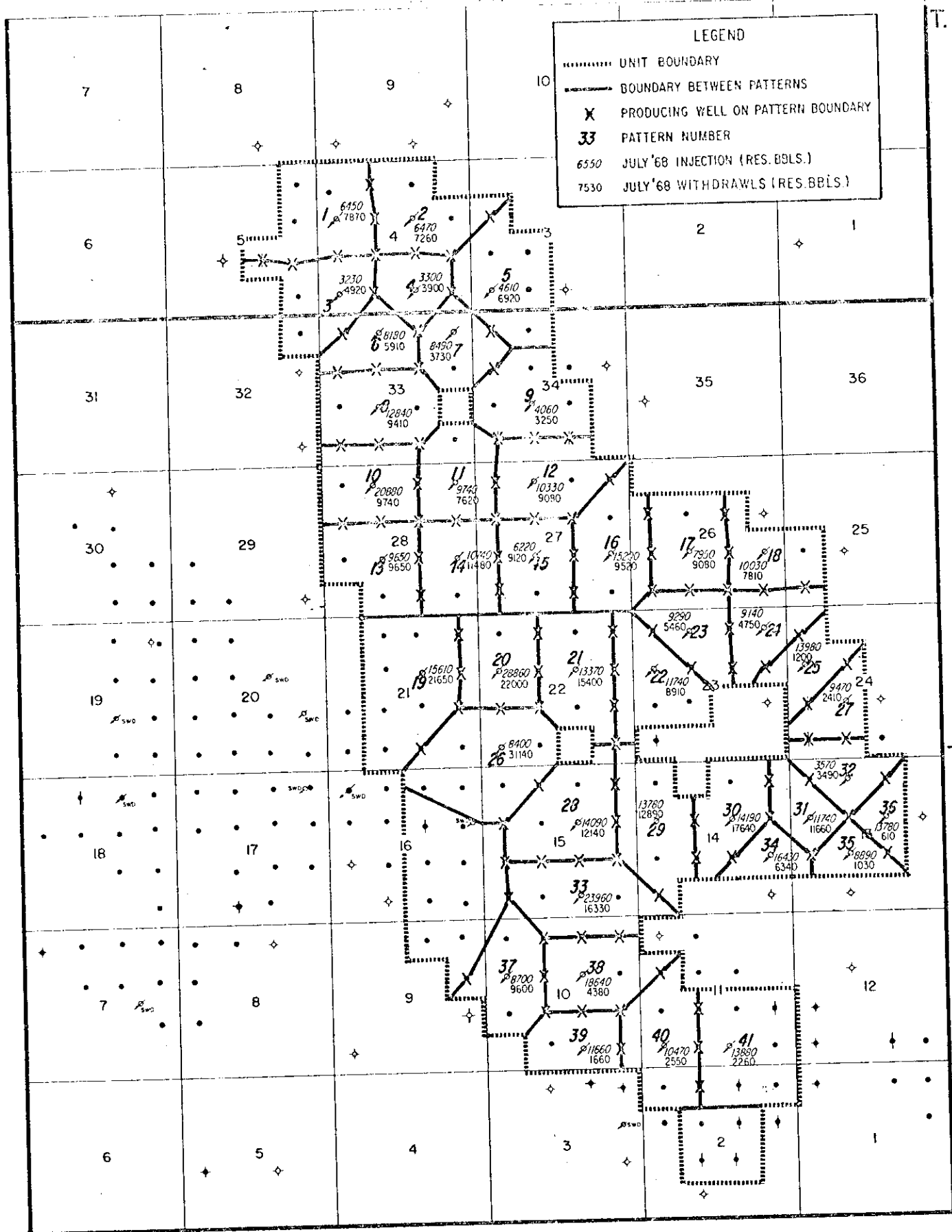


FIGURE 2  
NORTH VIRDEN SCALLION UNIT No.1  
JULY, 1968 VOIDAGE BALANCE BY PATTERN





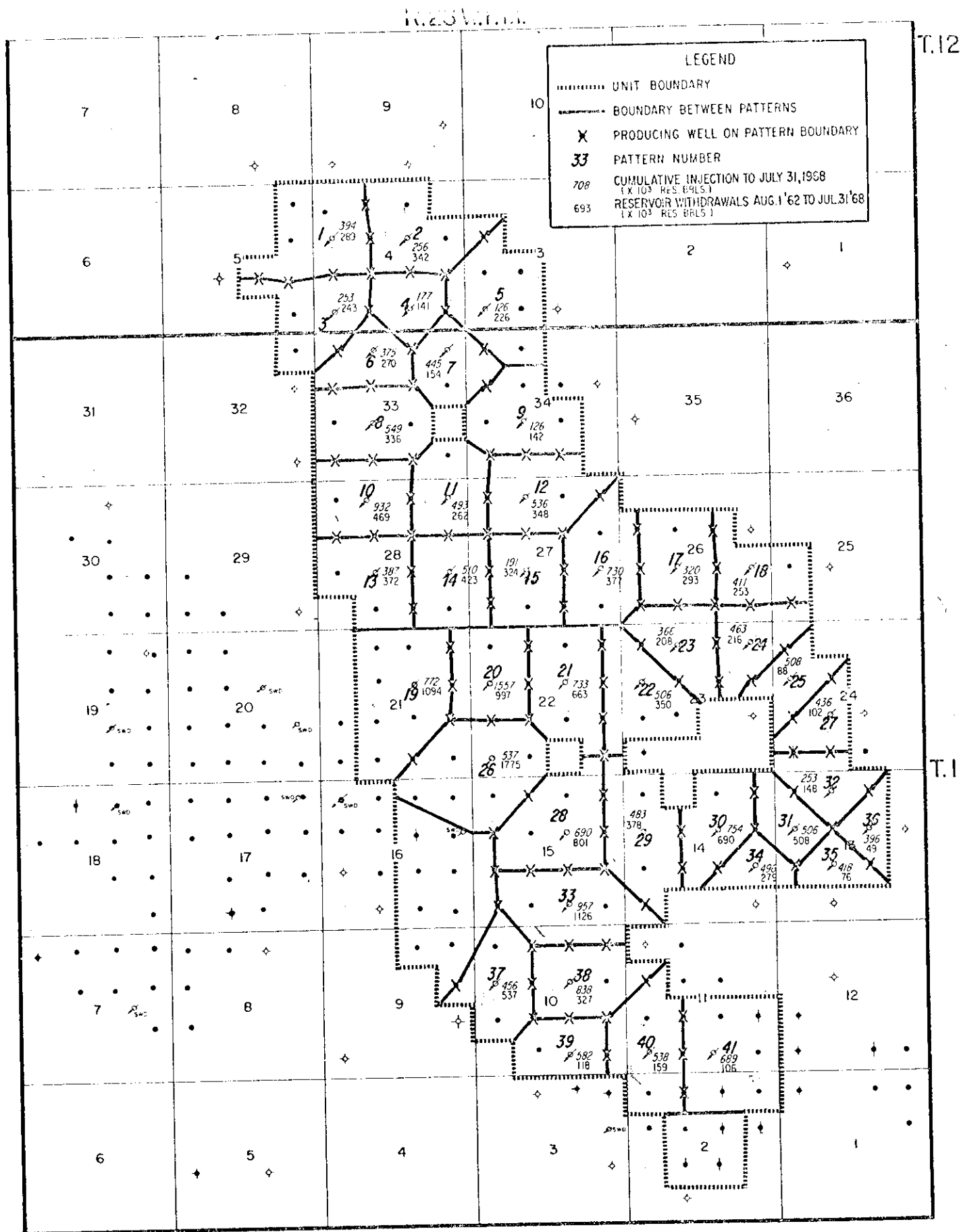


FIGURE 3  
NORTH VIRDEN SCALLION UNIT No.1  
VOIDAGE BALANCE TO JULY 31, 1968 BY PATTERN

b.c.c. - Jas. T. Cawley  
- I. Haugh  
- H. C. Moster

Jas. T. Cawley, P. Eng.  
xxxxxxxxxx

COPY

I. Haugh xxxxxxxx

xxxxxxxxxxxxxxxxxx  
xxxxxxxxxxxxxx

November 27th, 1975.

Chevron Standard Limited,  
Box 100,  
Virden, Manitoba.  
ROM 200

Attention: Mr. G. M. Cruickshank, Chairman,  
North Virden Scallion Unit No. 1,  
Operating Committee.

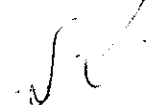
Dear Sir:

Re: North Virden Scallion Unit No. 1  
Voidage Balance Requirements.

Subject to the conditions listed below your application dated September 22nd, 1975 relating to voidage balance determination and annual reporting for North Virden Scallion Unit No. 1 is approved.

1. Voidage balance of fluids in the submission area, namely: Lsd. 5 of Section 15-11-26 WPM and Lsd. 7, 8, 9, 10 and 15 of Section 16-11-26 WPM, will not be required in future annual progress reports unless future pressure surveys indicate otherwise.
2. A minimum of one bottom hole pressure survey shall be run in the submission area annually and the results submitted to the Petroleum Branch.
3. Reporting of voidage balance in the submission area shall be reinstituted if the bottom hole pressure in the submission area declines below 600 psi.
4. Reporting of voidage balance in the submission area may be reinstituted at any time upon the written request of the Oil and Natural Gas Conservation Board.

Yours sincerely,



J. S. Roper,  
Deputy Chairman.

HCM/gls

TABLE I

## NORTH VERDEN-SCALLION UNIT NO. 1

Review of Reservoir Voidage and Withdrawals by Pattern  
(See attached Figures 1 and 2)

Pattern	Injection Well	July 1968 Injection (Bbls./Month)	July 1968 Withdrawals (Bbls./Month)	July 1968 Net Voidage Res. Bbls.	Cum. Inject. to 7/31/68 Res. Bbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbls.	Net Voidage Res. Bbls.	Remarks
1	12-4-12-26	6,450	7,370	1,420	394,200	289,200	(105,000)	From 1964 injection profile, no water lost out bottom of well.
2	10-4-12-26	6,470	7,260	790	256,000	341,500	85,500	Although fair voidage balance is indicated, injection profile indicates 54% of water going below completed interval, but may still be entering the oil reservoir.
3	4-4-12-26	3,230	4,920	1,690	252,800	243,300	( 9,500)	Consider combining Pattern Nos. 3, 4 and 6.
4	2-4-12-26	3,300	3,900	600	177,300	140,700	( 36,600)	Injection profile indicates loss of 35% of water, but could still be effective water. See remarks for "3" above.
5	4-3-12-26	4,610	6,920	2,310	125,600	225,500	99,900	No injection profile available. Consider combining Pattern Nos. 5 and
6	14-33-11-26	8,180	5,910	( 2,270)	374,500	270,400	(104,100)	Good injection profile. See remarks under Pattern No. 3.
7	16-33-11-26	3,490	3,730	( 4,760)	444,500	153,600	(290,900)	Good injection profile. See remarks under Pattern No. 5.
8	6-33-11-26	12,840	9,410	( 3,430)	549,100	335,500	(213,600)	Good injection profile. Expected additional response should balance void

Pattern No.	Injection Well	July 1968		July 1968		Cum. Inject. to 7/31/68		Cum. Withdrawals Since Incept. to 7/31/68		Net Voidage Res. Bbls.	Remarks
		Injection (Bbls./Month)	Withdrawals (Bbls./Month)	Net Voidage Res. Bbls./Month		Res. Bbls.		Res. Bbls.			
9	6-34-11-26	4,060	3,250	( 810)		125,800		142,100	16,300		Withdrawal area might be considerably smaller, thus yielding better balance.
10	14-28-11-26	20,880	9,740	(11,140)		932,400		469,100	(463,300)		From injection profile, could be losing 40% of the injected water.
11	16-28-11-26	9,740	7,620	( 2,120)		492,800		262,100	(230,700)		Could be losing 30% of the water.
12	14-27-11-26	10,330	9,680	( 1,250)		535,800		347,800	(128,000)		Reasonable balance.
13	6-28-11-26	9,650	9,650	0		326,600		371,700	( 14,900)		Good balance indicated, however could be losing as much as 30% at bottom of hole.
14	8-23-11-26	10,740	11,480	740		510,400		422,900	( 87,500)		Good balance indicated.
15	6-27-11-26	6,220	9,120	2,900		190,500		323,900	133,400		Good injection profile. Consider combining with Pattern No. 16.
16	3-27-11-26	15,200	9,520	( 5,680)		730,000		376,900	(353,100)		Good injection profile. Consider combining with Pattern No. 15.
17	6-26-11-26	7,950	9,080	1,130		319,700		292,700	( 27,000)		Reasonable injection profile. Consider combining with Pattern No. 20.
18	8-26-11-26	10,030	7,810	( 2,220)		411,100		252,800	(158,300)		Good injection profile.
19	10-21-11-26	15,610	21,650	6,040		772,400		1,093,600	321,200		Injection profile indicates 50% of water lost. Large area attributed this pattern. Consider combining Pattern Nos. 19, 20, and 26.
20	12-22-11-26	28,360	22,000	( 6,860)		1,556,500		997,000	(559,500)		Good injection profile. Consider combining Pattern Nos. 19, 20 and 26.
21	10-22-11-26	13,370	15,400	2,030		732,600		663,200	( 69,400)		Good injection profile. Consider combining Pattern Nos. 21 and 22.

Pattern Number	Injection Well	July, 1968 Injection (Bbls./Month)	July 1968 Withdrawals (Bbls./Month)	July 1968 Net Voidage Res. Bbls./Month	Cum. Inject. to 7/31/68 Res. Bbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbls.	Net Voidage Res. Bbls.	Remarks
22	12-23-11-26	11,740	8,910	( 2,830)	506,000	349,700	( 156,300)	Satisfactory injection profile. Consider combining Pattern Nos. 21 & 22.
23	14-23-11-26	9,290	5,460	( 3,830)	365,700	207,500	( 158,200)	Satisfactory injection profile. Additional flood response expected. Consider combining Pattern Nos. 17 & 23.
24	16-23-11-26	9,140	4,750	( 4,390)	463,000	215,700	( 247,300)	Poor balance; however expected additional response could balance voidage.
25	12-24-11-26	13,980	1,200	(12,780)	507,500	87,300	( 419,700)	Poor injection profile indicates loss of 75% of the water. Anticipated additional withdrawals in area could balance voidage.
26	4-22-11-26	8,400	31,140	22,740	536,900	1,775,200	1,238,300	Good injection profile. Consider combining Pattern Nos. 19, 20 & 26.
27	6-24-11-26	9,470	2,410	( 7,060)	435,900	101,900	( 334,000)	Injection profile indicates some loss of water. Additional anticipated response could balance voidage.
28	10-15-11-26	14,090	12,140	( 1,950)	690,400	801,300	110,900	Injection profile indicates that 65% of the water is going below the open hole interval.
29	12-14-11-26	13,780	12,890	( 890)	482,600	377,500	( 105,100)	Reasonable balance; however injection profiles indicate that 60% of the water may be lost.
30	10-14-11-26	14,190	17,640	3,450	753,500	690,400	( 163,100)	Good injection profile. Consider combining Pattern Nos. 30, 31 & 34.
31	12-13-11-26	11,740	11,660	( 80)	506,000	508,400	2,400	Good balance and good injection profile. Could be combined with Pattern Nos. 30 & 34.
32	14-13-11-26	3,570	3,490	( 80)	252,800	147,800	( 105,000)	Good injection profile, good balance indicated.

Pattern Number	Injection Well	July 1968 Injection (Bbls./Month)	July 1968 Withdrawals (Bbls./Month)	July 1968 Net Voidage Res. Bbls./Month	Cum. Inject. to 7/31/68 Res. Bbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbls.	Net Voidage Res. Bbls.	Remarks
33	2-15-11-26	23,960	16,330	( 7,630)	936,900	1,125,800	168,900	Poor injection profile; 27% of water being lost.
34	9-14-11-26	16,430	6,340	( 10,090)	496,100	278,600	( 217,500)	Good profile. Consider combining with Pattern Nos. 30 and 31.
35	6-13-11-26	8,890	1,030	( 7,860)	418,200	76,400	( 341,800)	Good injection profile. Incomplete 5-spot.
36	10-10-11-26	13,700	610	( 13,170)	396,200	43,700	( 347,500)	Good injection profile. Incomplete 5-spot.
37	12-10-11-26	8,700	9,600	990	455,500	537,400	81,900	Poor injection profile. 51% of water going below T.D. (possibly still into oil reservoir).
38	10-10-11-26	18,640	4,380	( 14,260)	838,300	326,900	( 511,400)	Poor injection profile. 30% of water going below T.D. (possibly still into oil reservoir).
39	2-10-11-26	11,660	1,660	( 10,000)	581,900	118,200	( 463,700)	Fair injection profile. Incomplete 5-spot.
40	4-11-11-26	10,470	2,550	( 7,920)	538,300	159,300	( 379,000)	Poor injection profile.
41	2-11-11-26	13,880	2,260	( 11,620)	689,200	106,100	( 583,100)	Fair injection profile.
TOTAL		462,010	351,770	(110,240)	21,141,500	16,056,100	(5,085,400)	

The Oil & Natural Gas Conservation

Board:

Jas. T. Conley, P. Eng., Chairman

J. S. Roper, Deputy Chairman

I. Haugh, Member

November 20, 1975

H. J. Mosier

Director

Petroleum Branch

XXXXXX

Subject:

Norfolk Virden Scallion Unit No. 1

Voidage Balance Requirements

Chevron Standard Limited

Background:

The Norfolk Virden Scallion field was discovered in December 1953 and the initial Norfolk Virden Scallion Unit No. 1 was formed on August 1, 1962. Pressure maintenance by water flooding was commenced in the Unit on December 2, 1962 using five injection wells. The Unit presently contains 12 oil wells (23 are suspended), plus 17 water injection wells and has produced over 12 million barrels of oil, with an expected ultimate recovery of approximately 33 million barrels of 1,200,000 barrels original oil-in-place (29% recovery factor).

Discussion:

Article 10 under Pressure Maintenance Subclause 1.1 of The Oil and Natural Gas Conservation Board Order No. 11-1 states:

"The Unit Operator shall inject water in each well referred to in clause 1.1 in a manner such that, within five years of the effective date of the order, a voidage balance is achieved and maintained between water injected to, and fluids withdrawn from, the Unitized Strata."

Chevron Standard Limited in an application dated September 22, 1975 has requested it be permitted to report, in the annual progress report, the voidage balance of fluids in the Unit area exclusive of the submission area. The attached figure shows the field, Unit and submission area.

The submission area consists of 6 forty-acre spacing units containing 3 producing oil wells, 2 suspended oil wells and 1 water injection well (7-16-11-26).

Fluid (oil and water) withdrawal from the submission area since production inception to July 1975 amounted to 12,994,160 barrels. Water injection through the 7-16 well started in December 1969 and the cumulative injection volume to July 1975 was 2,468,410 barrels. This amounts to a net theoretical voidage in the submission area of 10,525,750 barrels. A plot of total fluid withdrawal against monthly injection in the submission area

shows that a drop of injection rate from 60,000 barrels/month to an average of 10,000 barrels/month in 1973 did not have an apparent effect on the fluid withdrawal rate in the area.

The original reservoir pressure for the reservoir was approximately 540 psi. The lowest pressure recorded in the submission area was 662 psi (8-16-11-26) in 1962, seven years after direct injection into the submission area. The last pressure recorded in the submission area was 764 psi in the 8-16-11-26 abandoned well. Based on 1970 well hole pressure survey results, the average reservoir pressure in the submission area is considered to be 764 psi, which would give the 1962 pressure a decline from the original reservoir pressure.

[illegible]

A. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 84

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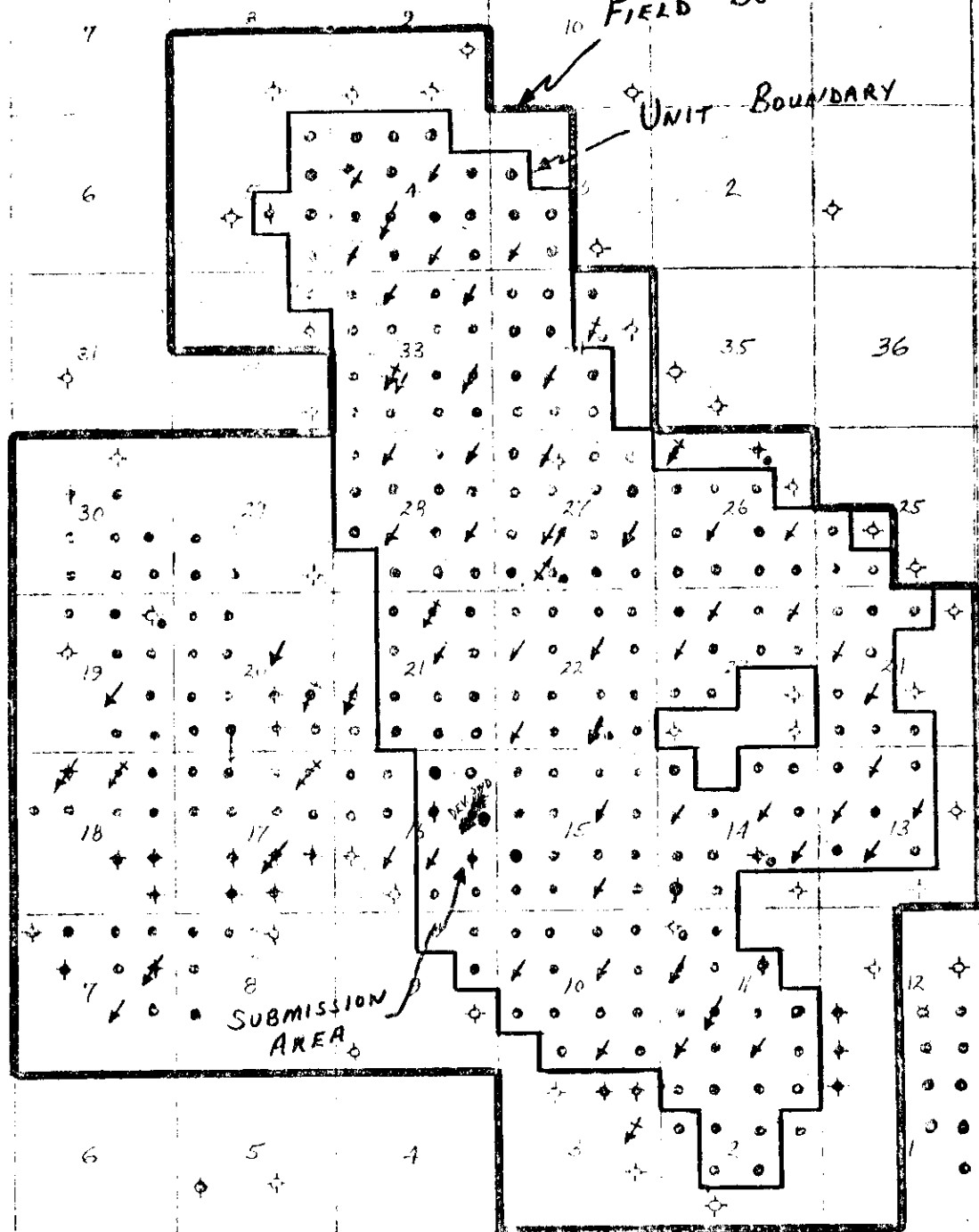


RGE. 26

NORTH VIRDEN SCALLION

12

FIELD BOUNDARY  
UNIT BOUNDARY



TWR. 12

VIRDEE  
ROSELE

## Subject:

North Virden Scallion Unit No 1  
Voidage Balance Requirements -  
Chevron Standard Limited.

## Background:

The North Virden Scallion field lies on the North-East flank of the Williston Basin, directly north of the town of Virden. The field is basically a stratigraphic trap in the Mississippian formation, the limits being partially controlled by a ~~st~~ structural rising.

The reservoir rocks are part of the lodgepole formation of lower Mississippian age. They are mainly elastic limestones, subdivided by thin ~~beds~~ interbeds of argillaceous limestone.

In August 1st, 1962 North Virden Scallion Unit No. 1 was formed under Unitization order No. 1. Pressure Maintenance by water flooding within the unit area commenced Dec 20, 1962 by using five injection wells.

## Discussion

Chevron Standard Limited in letter dated September 22, 1975 has made an application to exclude <sup>from</sup> Voidage Calculations the portion of North Vaden Scallion Unit No. 1 that is under active water drive. This portion of the Unit consists of the following areas:

LSD.	5-15-11-26	WPM
LSD.	7-16-11-26	WPM
LSD.	8-16-11-26	WPM
LSD.	9-16-11-26	WPM
LSD.	10-16-11-26	WPM
LSD.	15-16-11-26	WPM

### Performance of Submission Area:-

The Submission Area is located on the western side of N.V.S. Unit No. 1. At present there are three (3) oil producing wells in Submission Area, ~~namely~~ namely, 5-15-11-26, 9-16-11-26 and 15-16-11-26 ; & two (2) suspended wells, namely, 8-16-11-26 and 10-16-11-26 ; and one injection well, 7-16-11-26.

- Injection through the well 7-16-11-26 started in December 1969.

Cumulative injection in barrels from <sup>Dec.</sup> 1969 to July 1975 is 2, 468, 410.

- Fluid withdrawn from the submission area since production inception to July 1975 amounted to 12,994,160 bbls.

- Based on 1975 bottom hole pressure survey, the average Reservoir Pressure in Submission area is considered to be 750 psi. Taking the original reservoir pressure to be 900 psi:-

- A net Voidage in the submission area of 10,525,750 ~~total~~ reservoir barrels has resulted in a drop of about 150 psi in reservoir pressure, which would indicate the presence of ~~an~~ a partial active water drive in submission area.

Chevron Standard Limited had made a similar application dated March 6, 1973 for a portion of Virden-Roselea Unit No. 3 (including 2-10, 5-10, 6-10, 7-10, 10-10, 11-10, 12-10 and 9-15 all of Township 10 and Range 26 West of First meridian). Approval had been granted in May 11, 1973 to exclude this ~~area~~ portion from Voidage Calculation.

### Recommendations

Grant Approval of Chevron's application to exclude the submission area from Voidage calculation Subject to the following condition:-

- 1- At least annually, Chevron to run a bottom hole pressure survey in the submission area to determine the reservoir pressure. Results should be forward to the Petroleum Branch with the annual bottom hole pressure survey report for North Virden Scallion Unit No. 1 <sup>reservoir</sup>
- 2- If the <sup>reservoir</sup> pressure in any of the submission area drops belows 500 psi, then the reporting of Voidage ~~to~~ calculations may be re-instituted.

SAN

## Appln NUS #1 Voidage Balance (Chiron)

Prepare memo to O&NC Board w/ appln spelling out:

### Background

Date Unit formed

Date start/stop commenced

Other similar appln's, their handling and results

### Discussion

Describe intent of present appln

Describe performance of submission area (prod, inv, voidage, purchase)

### Recommendations

Whether appln ~~is~~ <sup>recommended</sup> for approval, denial or partial approval  
Specify conditions tied to approval!

No production from Wells 8-16-11-26 & 10-16-11-26

# Injection Versus Withdrawal in Submission area.

Month	Injection Rate bbls	Cum. Injection	Oil production Submission	Total fluid withdrawn
Sept 75	2,277	2,475,673	7129	105878
Aug.	4,986	2,473,396	7253	108267
July	16,048	2,468,410	6605	95937
June	16,086	2,452,362	6924	106430
May	16,440	2,436,276	7357	117154
April	2,274	2,419,836	7324	113775
March	4,956	2,417,562	7664	116206
Feb.	3,696	2,412,606	7049	106455
Jan.	7,548	2,408,910	7708	109883
Dec. 74	13,583	2,401,362	7902	122,148
Nov.	7,175	2,387,779	7623	121,571
Oct.	9,460	2,380,604	7671	117,551
Sept.	20,949	2,371,144	7053	109,928
Aug.	8,853	2,356,195	7631	113,121
July	12,455	2,341,342	7558	120,586
June	13,430	2,328,887	7096	114,308
May	17,005	2,315,457	7462	128,286
April	5,610	2,298,452	7976	115,924
March	5,764	2,292,842	7598	117,213
Feb.	9,559	2,287,078	7096	107,351
Jan.	20,025	2,277,519	7332	125,373
Dec. 73	10,486	2,257,494	8434	124,182
Nov.	25,956	2,247,008	7482	112,308
Oct.	61,953	2,221,052	8543	132,508
Sept.	64,029	2,159,099	8277	129,646
Aug.	58,346	2,095,070	8754	131,283

Month	Injection <del>lbs</del> bbls	Cum. Inj.	Oil Prods, Subm. Area	Total fluid withdrawn
July 73	46,426	2,036,674	7765	120304
June	60,324	1,990,248	8176	125516
May	67,236	1,929,924	8282	129,335
April	53,248	1,862,688	8057	127,888
March	53,973	1,809,390	8310	126,184
Febr.	61,800	1,755,417	7678	116,602
Jan	65,800	1,693,617	8893	122,879
Dec. 72	55,958	1,627,817	9440	132,858
Nov.	46,880	1,571,859	7861	108,455
Oct.	56,507	1,524,979	9647	140,842
Sept.	44,211	1,468,472	8008	113,176
Aug.	62,893	1,424,261	9132	119,920
July	57,850	1,361,368	8997	127,465
June	36,258	1,303,518	7634	102,798
May	62,396	1,267,260	9216	126,490
April	50,668	1,204,864	8782	108,414
March.	47,190	1,154,196	10617	139, <sup>275</sup> <del>658</del>
Feb.	35,511	1,107,006	7555	83520
Jan. 72	35,860	1,071,495	10242	107693
Dec. 71	31,866	1,035,635	9238	101239
Nov.	35,441	1,003,769	8537	76675
Oct.	54,834	968,328	8588	73935
Sept.	45,691	908,489	10577	85361
Aug.	52,061	862,798	12354	108134
July	68,896	810,737	12634	112267

Month	Injection, bbls	Cum. injection	Oil prodn, subm. area	Total fluid withdrawn
June	32,500	741,841	10706	95207
May	38,847	709,341	11428	110620
April	42,243	670,494	11905	109234
March.	36,698	628,251	12831	111240
Feb.	38,180	591,553	11394	95042
Jan. 71	35,362	553,373	11586	89724
Dec.	61,801	518,011	9918	91785
Nov	35,709	456,210	11942	103522
Oct.	39,242	420,501	11562	103633
Sept.	44,181	381,254	11805	107625
Aug.	36,542	337,078	12047	106736
July	34,315	300,486	10665	84470
June	35,695	266,171	10855	95456
May	27,804	230,476	11997	101181
April	33,813	202,672	11013	92523
March.	45,255	168,859	12866	113023
Feb.	42,439	123,604	11504	104532
Jan 70	42,427	81,165	13104	115218
Dec. 69	38,738	38,738	11435	101545
Nov			9851	<del>90710</del>
Oct.			8625	90310
Sept.			9171	78325
Aug.			8358	84387
July			9891	79801
June			7688	83811
				62503



month

Oil Production, Subm.  
area

Total fluid  
withdrawn

may

10113

83000

april

11603

61100

march

8042

69840

Feb.

4632

41890

Jan.

5441

43930

# Subsurface Pressure Measurement

History in Submission Area Psi

Twp 11 - Rge 26

Year	Well	Neighbouring Wells	5-15	7-16	8-16	9-16	10-16	15-16
1975								
74		7-15; 962			764.4			
73					774.8			
72					771.4			
71					774.9			
70								
69								
68								
67		745; 623 4-15; 732					772	
66							768	
65								
64								
63								
62							662	
61								

Production Statistics of  
Submission Area

Statistics		Well	5-15	7-16	8-16	9-16	10-16	15-16
oil BBLs	[	Cum. Prodn. from Aug, 62 to Dec., 74	404,639	Injection Well	14,611	324,785		225,370
		Production, July 75	3,080		Suspended	1,310		2,215
		Cum. Prodn, 1975	22,449			11,535		16,647
Water BBLs	[	Cum. Prodn from Aug 62 to Dec. 74	2,826,178		228,057	3,649,324	Suspended	2,438.12
		<del>B</del> Production July 75	30,091		<del>B</del>	36,805		29,051
		Cum. Prodn, 75	220,384			325,952		219,504
No. days on prodn July 75			31			24		31
BOPD, July 75			99.5			54.6		71.5
BWPD, July 75			995			1500		938
WC %, July 75			91			96.5		93.5
WOR, July 75			<del>10</del> 9.8			27.5		13

North Uden Scallion Unit No. 1  
Total produced water injected at plant #1 & #2

Year	Mississippian water		Devonian Water		Miss. Water Cum.	Dev. Water Cum.
	plant 1	Plant 2	Plant 1	Plant 2		
1974	2,467,333			1,537,078	26,681,636	27,626,459
73	3,083,835	124,714		2,359,456	24,214,253	26,058,681
72	3,194,520			2,826,177	21,130,400	23,729,680
71	2,711,952			2,445,444	17,935,522	20,905,548
70	2,557,461			3,128,864	15,223,570	18,458,104

- Cum. fluid production in submission area from Aug 62 to July 75 is 10,927,560 bbls.
- Cum. water injection to July 1975 in 7-16 is 2,468,410 bbls.
- Net voidage in submission area is 8,459,150 bbls.
- Assuming Original reservoir pressure to be around 900 psi, the Average BHP in submission area is around 800 psi.
- A net voidage of 8,459,150 bbls resulted in 100 psi drop in pressure which would indicate a water drive source from the Aquifer replacing the voidage
- Chevron stated in their letter, section 2 under summary and conclusions, Page 3 "All wells in submission area are in good communication with the aquifer ----". However, based on 1974 isobaric map, the difference in pressure in submission area would appear to be about 250 psi (2).

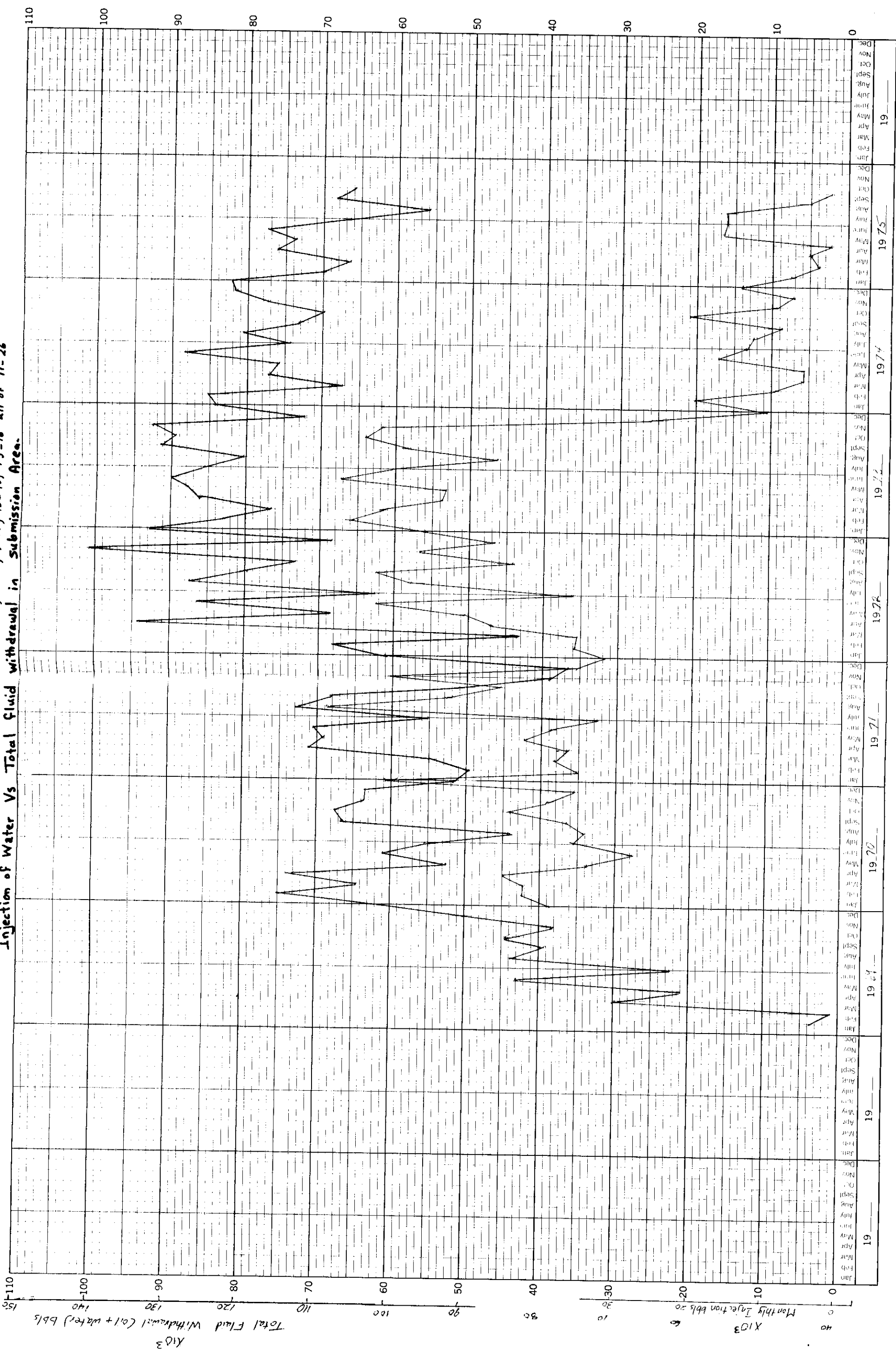
Note that total depth of wells in the area is more or less the same  
~~5-15, 2040'; 7-16, 2075';~~

Well	Total depth
5-15	2040'
7-16	2075'
8-16	2060'
9-16	2050'
10-16	2081'
15-16	2071'

#### Recommendation :

- Approval of their proposal provided that :
  - 1- Chevron measures the reservoir pressure in the submission area at least annually.
  - 2- They notify the branch if the pressure drops less than 500 psi.

Voidage Balance for Submission Area 5-15, 7-16, 8-16, 9-16, 10-16, 11-16 all of 11-26  
Injection of Water Vs Total Fluid Withdrawal in Submission Area.





## **Chevron Standard Limited**

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

September 22, 1975

North Virden Scallion Unit No. 1  
Voidage Balance Requirements  
Order PML, Section 2, Clause 6

Oil and Natural Gas Conservation Board  
310 Legislative Building  
Winnipeg, Manitoba  
R3C 0V8

Attention: Mr. J. T. Cawley, P.Eng.  
Chairman

Gentlemen:

In accordance with the Oil and Natural Gas Conservation Board, Order No. PML, Pressure Maintenance Rule No. 2, Clause 6, Chevron Standard Limited as Unit Operator of North Virden Scallion Unit No. 1, hereby submits that a voidage balance is being naturally maintained by an active water drive, and that artificial maintenance of voidage balance by injection of water is not required in the Submission Area as shown on attached Figure 1 and listed as follows:

Lsd. 5-15-11-26 WPM  
Lsd. 7-16-11-26 WPM  
Lsd. 8-16-11-26 WPM -  
Lsd. 9-16-11-26 WPM  
Lsd. 10-16-11-26 WPM -  
Lsd. 15-16-11-26 WPM

The following information is offered in support of this submission:

### I. GENERAL

In 1963 North Virden Scallion Unit No. 1 initially had two sources of water for injection. Mississippian produced water was gathered from the unit batteries and after filtration was injected from a plant in Lsd. 9-16-11-26. Devonian water was produced from two Devonian supply well at 3-27 and 6-27 and injected from a plant in Lsd. 6-27-11-26. These two waters are not compatible and the systems must remain separated.

During 1973, the increase of the unit Mississippian water production enabled the Unit Operator to convert thirteen wells on the east water injection line supplied by the 6-27 plant from Devonian to Mississippian water injection, and a Mississippian water injection plant was constructed at 6-27. The water supply well at 3-27 was suspended, and was subsequently recompleted as a Mississippian oil well, presently producing at 59 BOPD and 16 BWPD.

The casing in the present unit water supply well at 6-27 was found to be corroded, and during 1973 a liner was run and cement squeezed. The well is presently operating satisfactorily, but with the past problems, the future of the well could be in some doubt. Therefore, Chevron anticipates ultimately replacing the Devonian water supply system with a Mississippian supply system.

## II. BOTTOM HOLE PRESSURE HISTORY

The first accurate pressure taken in the field was 906 psig which was measured at 9-16-11-26 well in April 1955; for the purpose of this study the original discovery pressure was assumed to be 906 psig.

The result of bottom hole pressure surveys taken in 1962, 1966, 1972 and 1974 are shown in Figures 4 to 7 inclusive. The isobaric maps indicate that the reservoir pressure in the Submission Area has remained near the original discovery pressure. Withdrawals from the Submission Area since production inception to August 1, 1974, the approximate time of 1974 pressure survey, amounted to 12,100,000 reservoir barrels, whereas injection during the same period amounted to 2,370,000 reservoir barrels. Therefore, a net voidage in the Submission Area of about 9,830,000 reservoir barrels has not resulted in a corresponding significant reduction of reservoir pressure.

## III. GEOLOGICAL

Oil is produced from seven zones in the Virden Scallion field. Zones of higher porosity and permeability are generally separated by dense impermeable zones, and therefore, fluid communication between zones would not be anticipated. However, fluid communication is likely in areas containing vertical fractures as observed in cores.

With reference to the report "Reservoir study North Virden Scallion field, Manitoba, August 1961," Figure 4, contained with that study has been modified and presented as Figure 8 in this report. This figure outlines areas of recognized fracturing in the cores and samples of wells drilled in portions of Sections 15, 16, 17, 20, 21 and 22 with the largest concentration of fracturing being in Section 16.

Quoting from the report "... the field is partially controlled by structure. This is in the form of true structure nosing reflected somewhat by the Lodgepole erosional surface (see Figure 7). Wells in which the Lodgepole formation is structurally high generally showing anhydrite infilling."

It is known that the structural lows bounding the Virden Scallion field are the result of post-Mississippian collapse, and fracturing of overlying competent beds such as the Lodgepole is common. A salt solution feature is inferred in Section 16, (based on structure contour map top of Mississippian as shown in Figure 9). This collapse is postulated as the cause of the extensive fracturing.



#### IV. RESERVOIR PERFORMANCE AND WATER INFLUX CALCULATIONS

The wells in the Submission Area that are on production have a producing capability in excess of 1,150 barrels of fluid per day per well with an average water to oil ratio of 15 as compared to a WOR of 1.5 for the whole unit as exhibited in Figures 2 and 3.

A simple material balance calculation, which is shown in Table 1, yields a net aquifer influx of 14,967,720 barrels in the pool since the production inception. Furthermore, a net efflux of 1,703,760 barrels was indicated for the period of January 1963 to July 1972 followed by an influx of 911,880 barrels for the following two years.

#### V. SUMMARY AND CONCLUSIONS

Chevron Standard Limited hereby submits that fluid withdrawals from the Submission Area are being replaced by an active water drive from the neighboring aquifer and, therefore, reservoir voidage need not be replaced by injection of water in this area. The evidence supporting this submission is summarized as follows:

1. The reservoir pressure in the Submission Area is presently near original discovery pressure, even though reservoir voidage in the Submission Area exceeded 9.8 million reservoir barrels.
2. All wells in the Submission Area are in good communication with the aquifer because of the extensive fracturing of the Mississippian rocks which is due to a collapse feature inferred to be present in this area. All producing wells in the Submission Area exhibit high water cuts.
3. The producing capability of most wells in the Submission Area is in excess of 300 barrels of fluid per day with some wells capable of producing as much as 1,700 barrels of fluid per day.

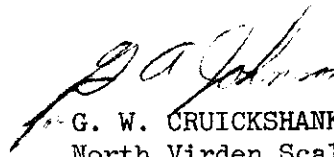
With the concurrence of the Board, Chevron Standard Limited, as operator of North Virden Scallion Unit No. 1, proposes to report in the annual progress report, the voidage balance of fluids in the unit area exclusive of the Submission Area. Water and oil production from the Submission Area will not be considered as voidage withdrawals and any water injected will not be credited as voidage replacement. The water injected in the well 7-16-11-26 WPM in the Submission Area will be limited to excess water that cannot be injected into other injection wells in the unit due to pumping equipment limitations and wellhead injection pressure limitations.

A comparison of the present and proposed methods for calculating reservoir voidage for the calendar year 1974, is shown on Table II and III attached.

As shown on Figure 1, it is evident that sufficient water for injection requirements is available from the Submission Area. Wells in the Submission Area are capable of producing 4,000 barrels of fluid per day at high water cuts. The net voidage in North Virden Scallion Unit No. 1 averaged at 1,418 reservoir barrels per day during 1974.

If additional information is required regarding this submission, please contact Mr. G. W. Cruickshank at Box 100, Virden, Alberta, ROM 2C0. Additional copies of this submission may be obtained from the Information Centre in our Calgary office.

Yours very truly,

 P. Eng. (APEGGA)  
G. W. CRUICKSHANK, Chairman  
North Virden Scallion Unit No. 1  
Operating Committee

KF/hb  
Attach.

Table I

Material Balance Calculations

<u>Date</u>	<u>Pool*</u> <u>Pressure</u> <u>(psi)</u>	<u>Np**</u> <u>Cum. Oil</u> <u>Production</u> <u>(bbls.)</u>	<u>Gp**</u> <u>Cum. Gas</u> <u>Production</u> <u>(MCF)</u>	<u>Wp**</u> <u>Cum. Water</u> <u>Production</u> <u>(bbls.)</u>	<u>Wi</u> <u>Cum. Water</u> <u>Injection</u> <u>(bbls.)</u>	<u>Bo</u> <u>(RB/STB)</u>	<u>We</u> <u>Net Water</u> <u>Influx</u> <u>(STB)</u>
Initial pressure 906 psig							
1/1/63	350	12,010,560	840,740	5,033,160	21,720	1.0493	15,759,600
1/7/66	662	17,455,290	1,221,870	8,567,170	10,290,890	1.0468	15,724,920
1/7/72	926	32,353,020	2,263,710	22,042,210	41,847,660	1.0446	14,055,840
1/7/74	941	36,806,800	2,611,930	29,222,210	52,865,530	1.0445	14,967,720

\* Arithmetic average reservoir pressure used.

\*\* Cumulative production includes the pre-flood production.

Table II

North Virden Scallion Unit No. 1

Reservoir Voidage Rates 1974

	<u>First</u> <u>Quarter</u>	<u>Second</u> <u>Quarter</u>	<u>Third</u> <u>Quarter</u>	<u>Fourth</u> <u>Quarter</u>	<u>Total for</u> <u>Period</u>
Oil Produced (Bbls.)	529,140	528,250	520,653	531,634	2,109,677
Gas Produced (MSCF)	37,040	36,977	36,446	37,214	147,677
Water Produced (Bbls.)	850,521	880,712	874,137	941,720	3,547,090
Average Solution GOR	70	70	70	70	70
Formation Volume Factor	1.05	1.05	1.05	1.05	1.05
Voidage Oil (Res. Bbls.)	555,597	554,662	546,685	558,215	2,215,159
Voidage Water (Res. Bbls.)	850,521	880,712	874,137	941,720	3,547,090
Total Voidage (Res. Bbls.)	1,406,118	1,435,374	1,420,822	1,499,935	5,762,249
Water Inj. (Res. Bbls.)	1,199,231	1,238,155	1,344,328	1,463,074	5,244,788
Net Voidage (Res. Bbls.)	206,887	197,219	76,494	36,861	517,461
Net Voidage Rate (Res. B/D)	2,299	2,167	831	401	1,418
Cum. Net Voidage (Res. Bbls.)	-2,074,001	-1,876,782	-1,800,288	-1,763,427	-

Gas Produced = Solution Gas

Cumulative Pre-Unit Voidage:

Oil	-	12,447,263	Bbls.
Water	-	5,042,098	"
Total	-	17,489,361	"

Table III

North Virden Scallion Unit No. 1

Reservoir Voidage Rates 1974\*

	<u>First Quarter</u>	<u>Second Quarter</u>	<u>Third Quarter</u>	<u>Fourth Quarter</u>	<u>Total for Period</u>
Oil Produced (Bbls.)	506,020	505,477	498,611	508,438	2,018,546
Gas Produced (MSCF)	35,426	35,388	34,894	35,596	141,304
Water Produced (Bbls.)	545,898	547,391	552,683	603,646	2,249,618
Average Solution GOR	70	70	70	70	70
Formation Volume Factor	1.05	1.05	1.05	1.05	1.05
Voidage Oil (Res. Bbls.)	531,321	530,750	523,541	533,860	2,119,472
Voidage Water (Res. Bbls.)	545,898	547,391	552,683	603,646	2,249,618
Total Voidage	1,077,219	1,078,141	1,076,224	1,137,506	4,369,090
Water Inj.	1,163,883	1,202,110	1,302,071	1,440,031	5,108,095
Net Voidage (Res. Bbls.)	-86,664	-123,969	-225,847	-302,525	-739,005
Net Voidage (Res. B/D)	-1,007	-1,362	-2,482	-3,325	-2,025
Cum. Net Voidage (Res. Bbls.)	-2,367,552	-2,491,521	-2,717,368	-3,019,893	-

\* Excluding oil, gas and water produced from and injected to the following well in the Submission Area:

Lsd. 5-15-11-27 WPM  
Lsd. 7-16-11-26 WPM  
Lsd. 8-16-11-26 WPM  
Lsd. 9-16-11-26 WPM  
Lsd. 15-16-11-26 WPM



**Chevron Standard Limited**

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

September 30, 1975

North Virden Scallion Unit No. 1  
Voidage Balance Requirements  
Order PML, Section 2, Clause 6

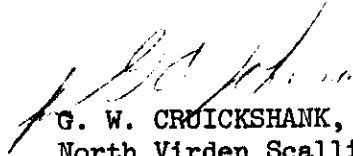
Oil and Natural Gas Conservation Board  
310 Legislative Building  
Winnipeg, Manitoba  
R3C 0V8

Attention: Mr. J. T. Cawley, P.Eng., Chairman

Gentlemen:

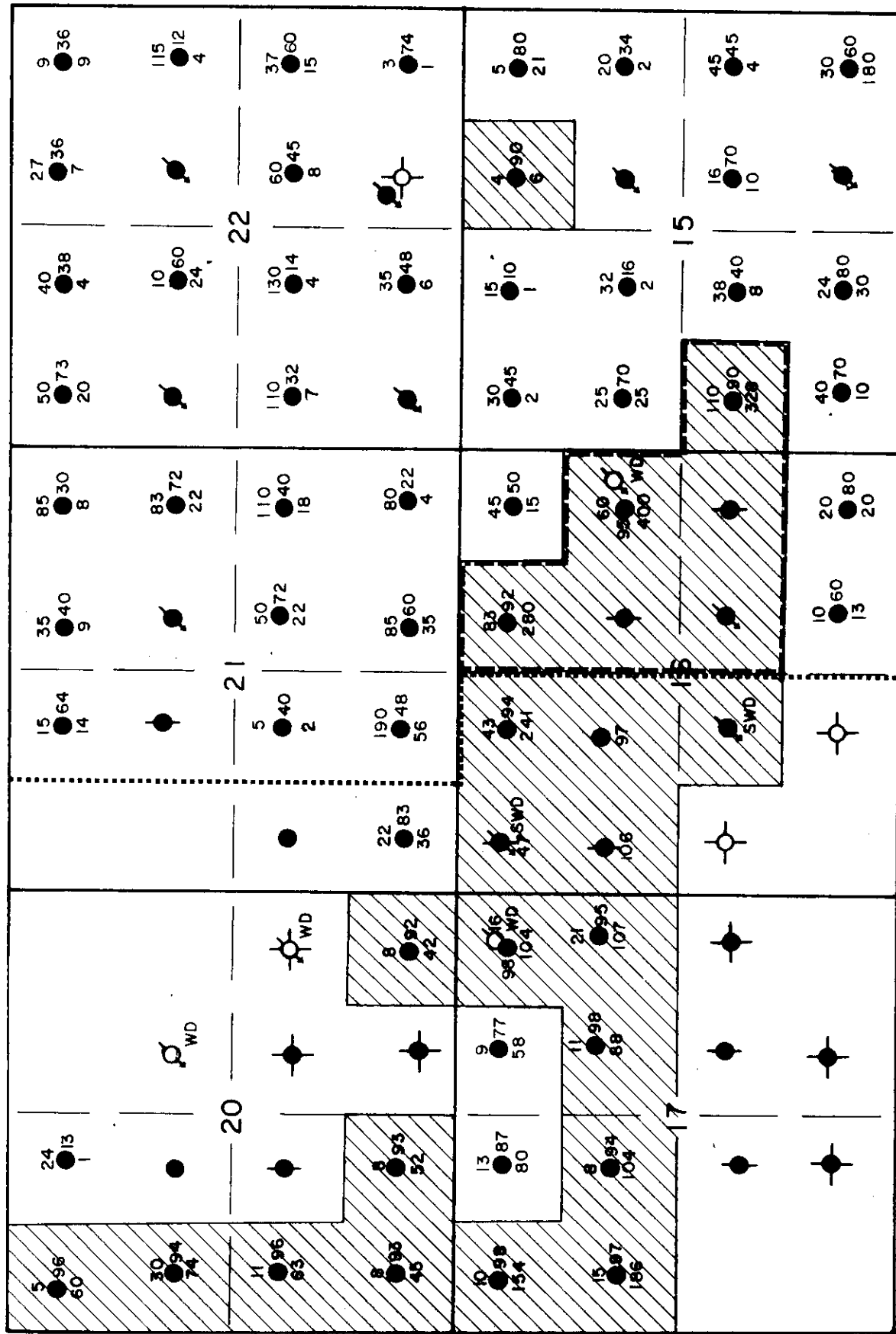
Enclosed are Figures 1 to 9 adherent to our submission of September 22, 1975. Please accept our apology for any inconvenience.

Yours very truly,

  
G. W. CROICKSHANK, Chairman  
North Virden Scallion Unit No. 1  
Operating Committee

KFard/lw  
Enclosures

R. 26 W.P.M.



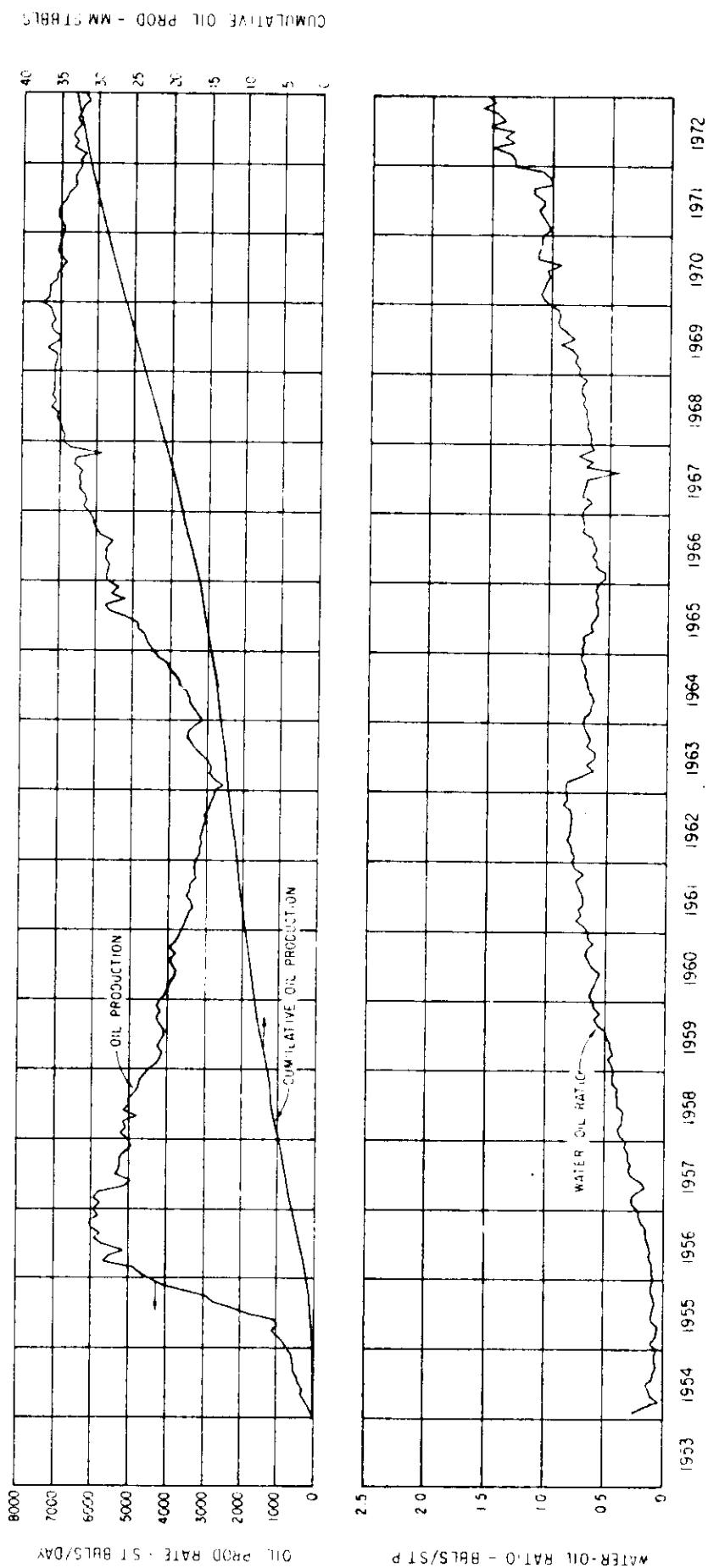


FIGURE 2  
NORTH VIRDEN SCALLION UNIT No.1  
RESERVOIR PERFORMANCE



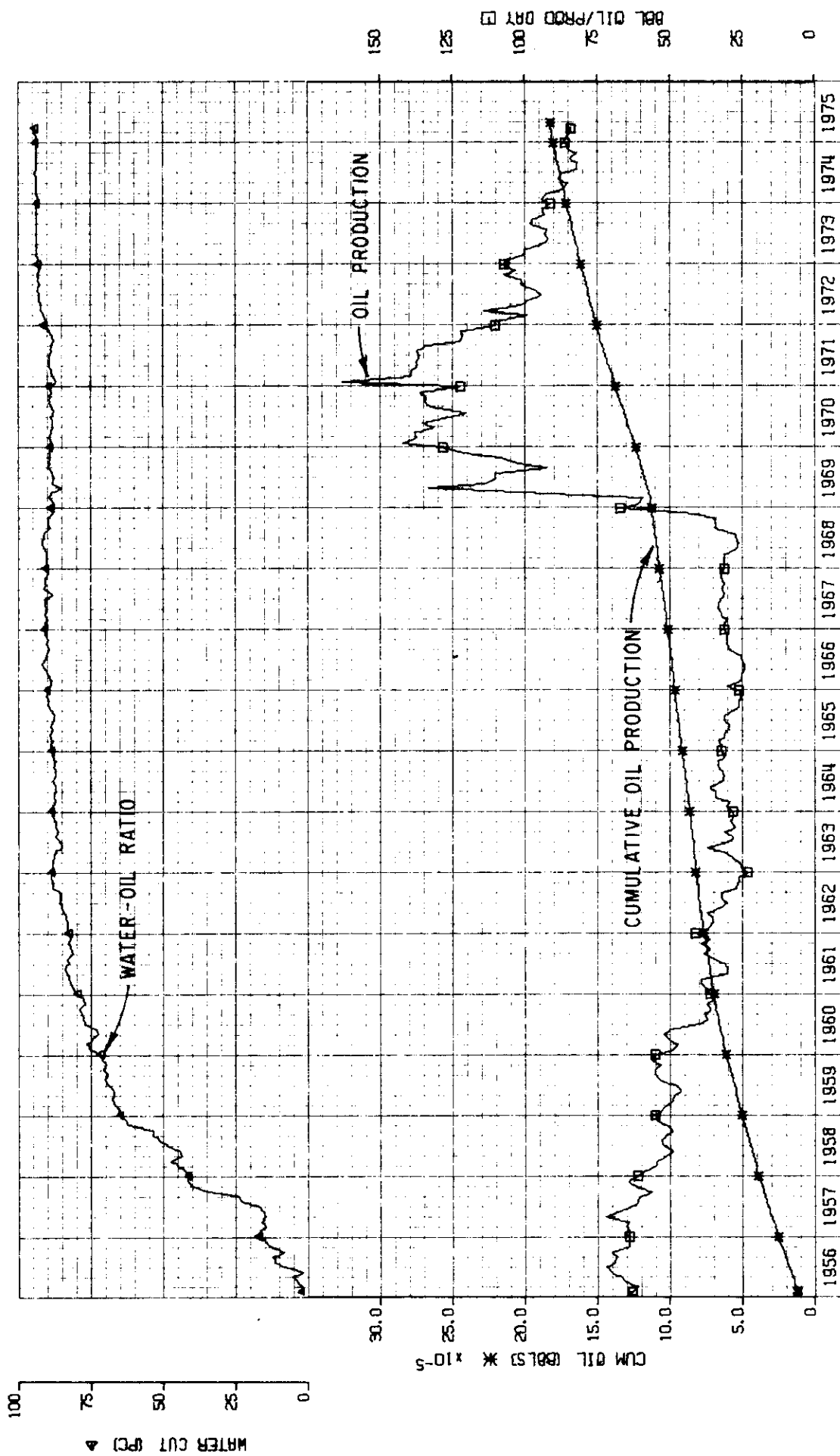
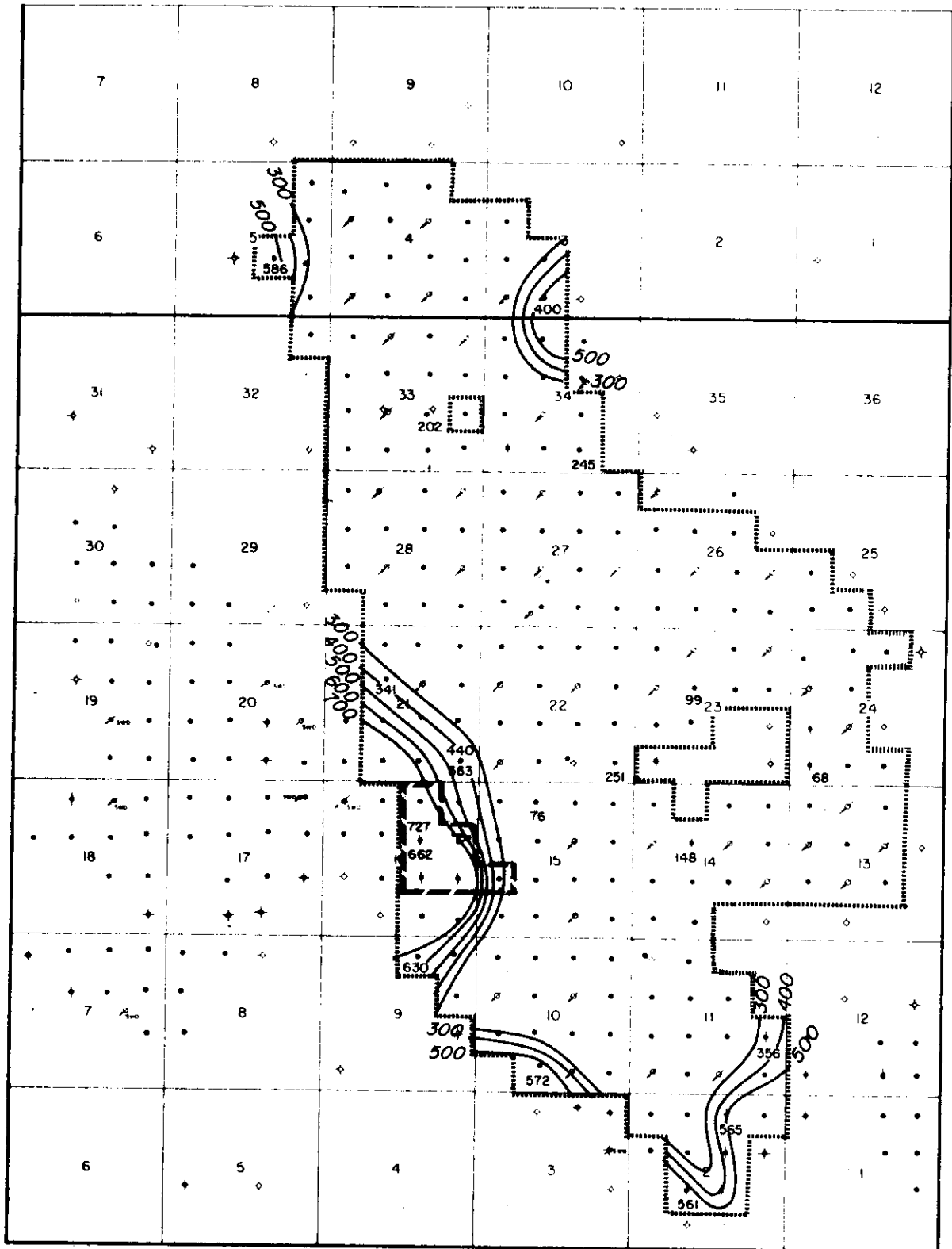


FIGURE 3  
SUBMISSION AREA  
RESERVOIR PERFORMANCE

R.26 W.P.M.

T.12



T.11

# LEGEND

- ..... UNIT BOUNDARY
- INJECTION WELL
- ♦ SUSPENDED WELL
- ★ ABANDONED WELL
- SUBMISSION AREA

FIGURE 4

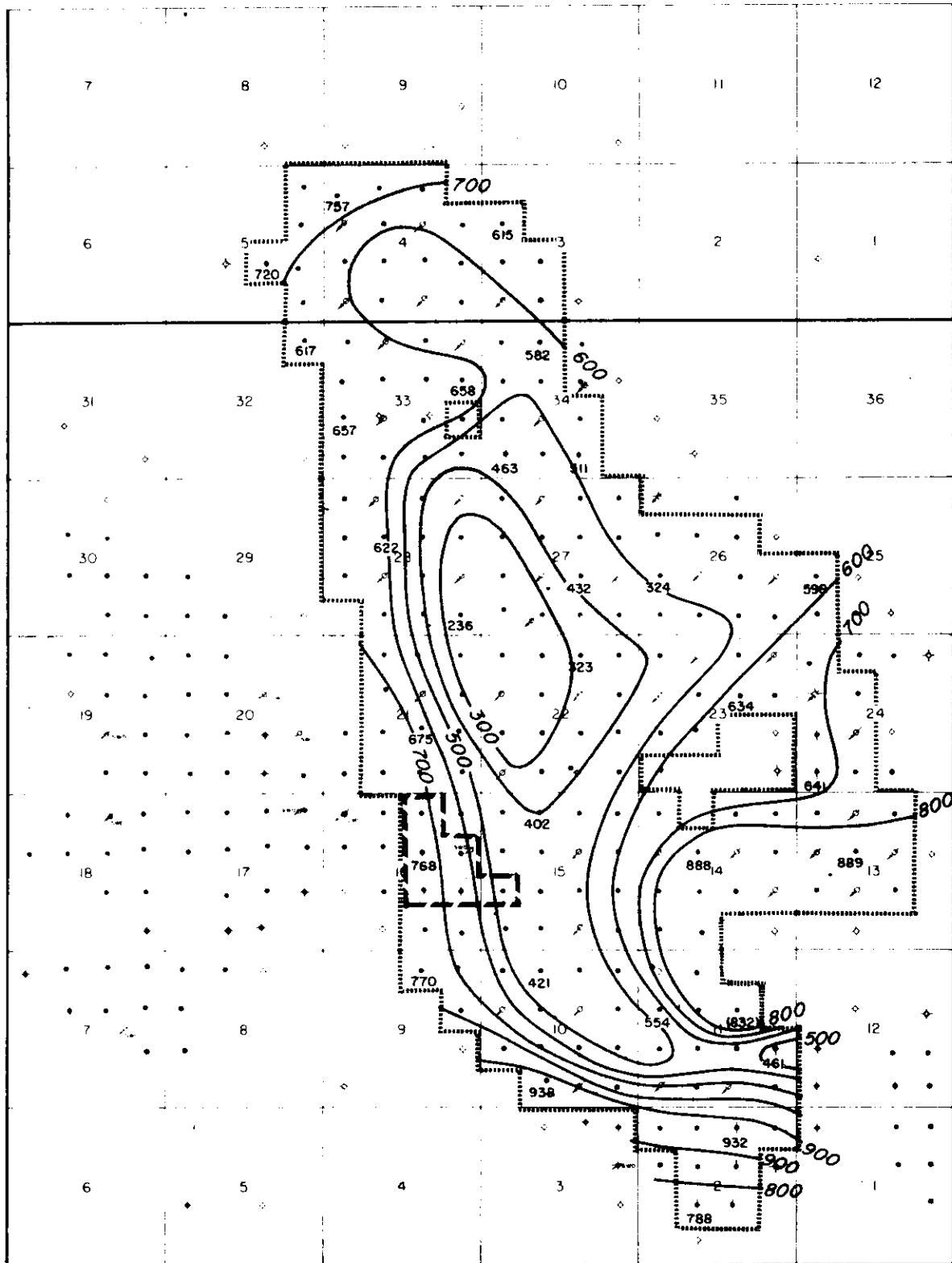
NORTH VIRDEN SCALLION UNIT No.1

ISOBARIC MAP

BASED ON 1962 BHP SURVEY

SCALE IN MILES



**LEGEND**

- ..... UNIT BOUNDARY
- INJECTION WELL
- ♦ SUSPENDED WELL
- ✦ ABANDONED WELL
- SUBMISSION AREA

FIGURE 5

NORTH VIRDEN SCALLION UNIT No.1

ISOBARIC MAP

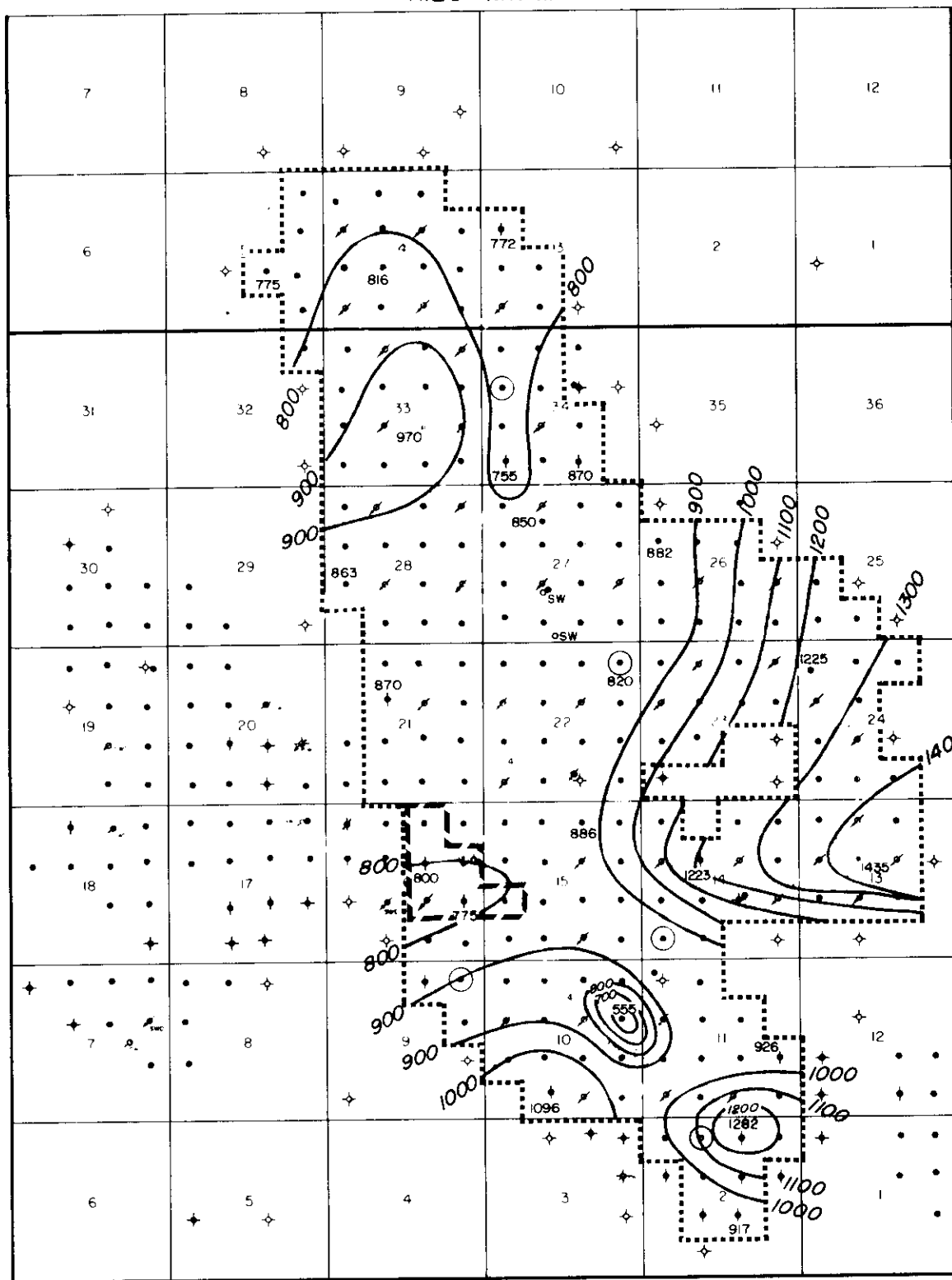
BASED ON 1966 BHP SURVEY

SCALE IN MILES



R.26 W.P.M.

T.12



T.11

# LEGEND

- ..... UNIT BOUNDARY
- INJECTION WELL
- ♦ SUSPENDED WELL
- ✦ ABANDONED WELL
- SUBMISSION AREA

FIGURE 6

NORTH VIRDEN SCALLION UNIT No.1

ISOBARIC MAP

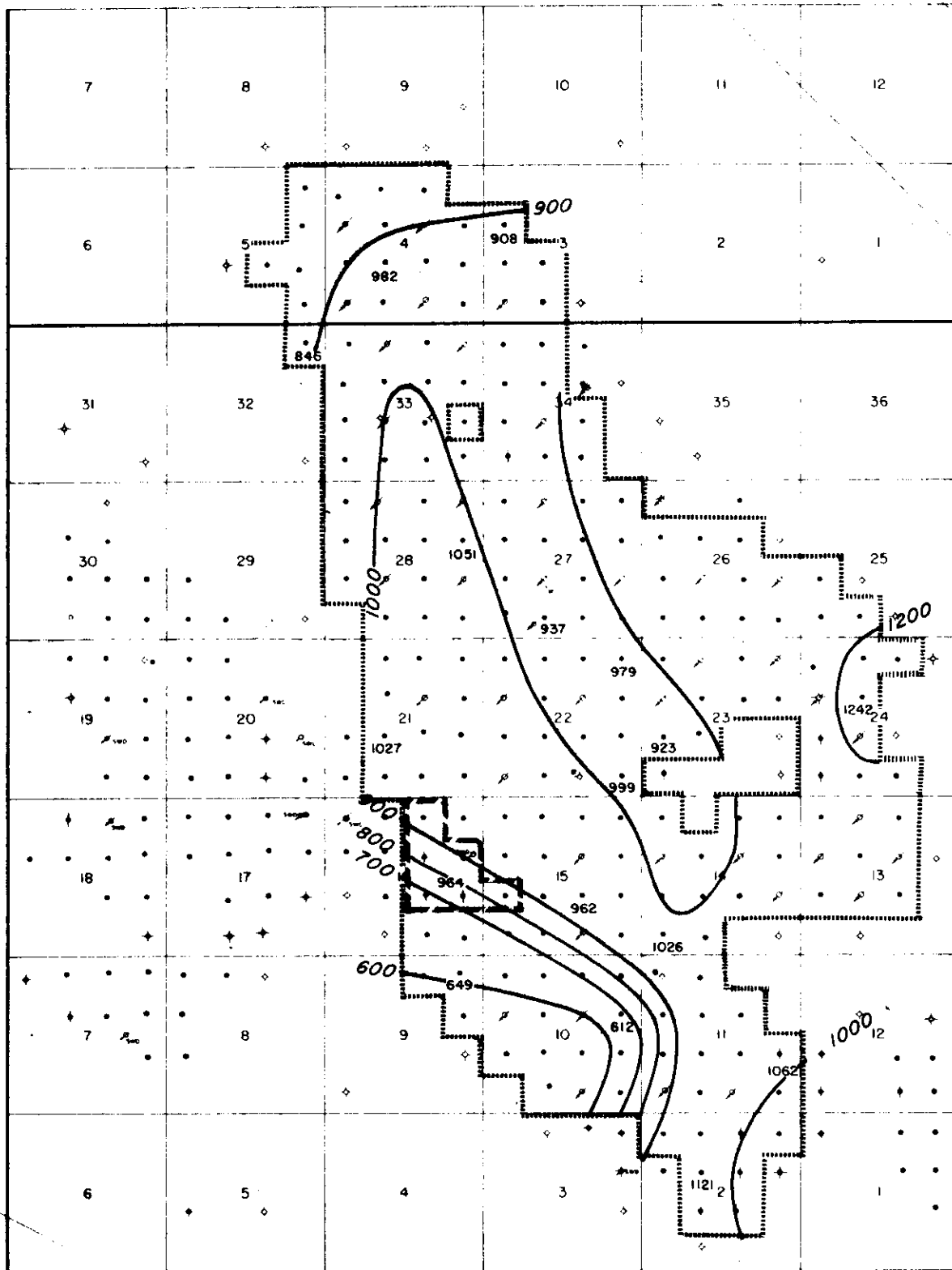
BASED ON 1971 BHP SURVEY

SCALE IN MILES



R.26 W.P.M.

T.12



T.11

# LEGEND

- UNIT BOUNDARY
- INJECTION WELL
- ⊕ SUSPENDED WELL
- ⊕ ABANDONED WELL
- SUBMISSION AREA

FIGURE 7

NORTH VIRDEN SCALLION UNIT No.1

ISOBARIC MAP

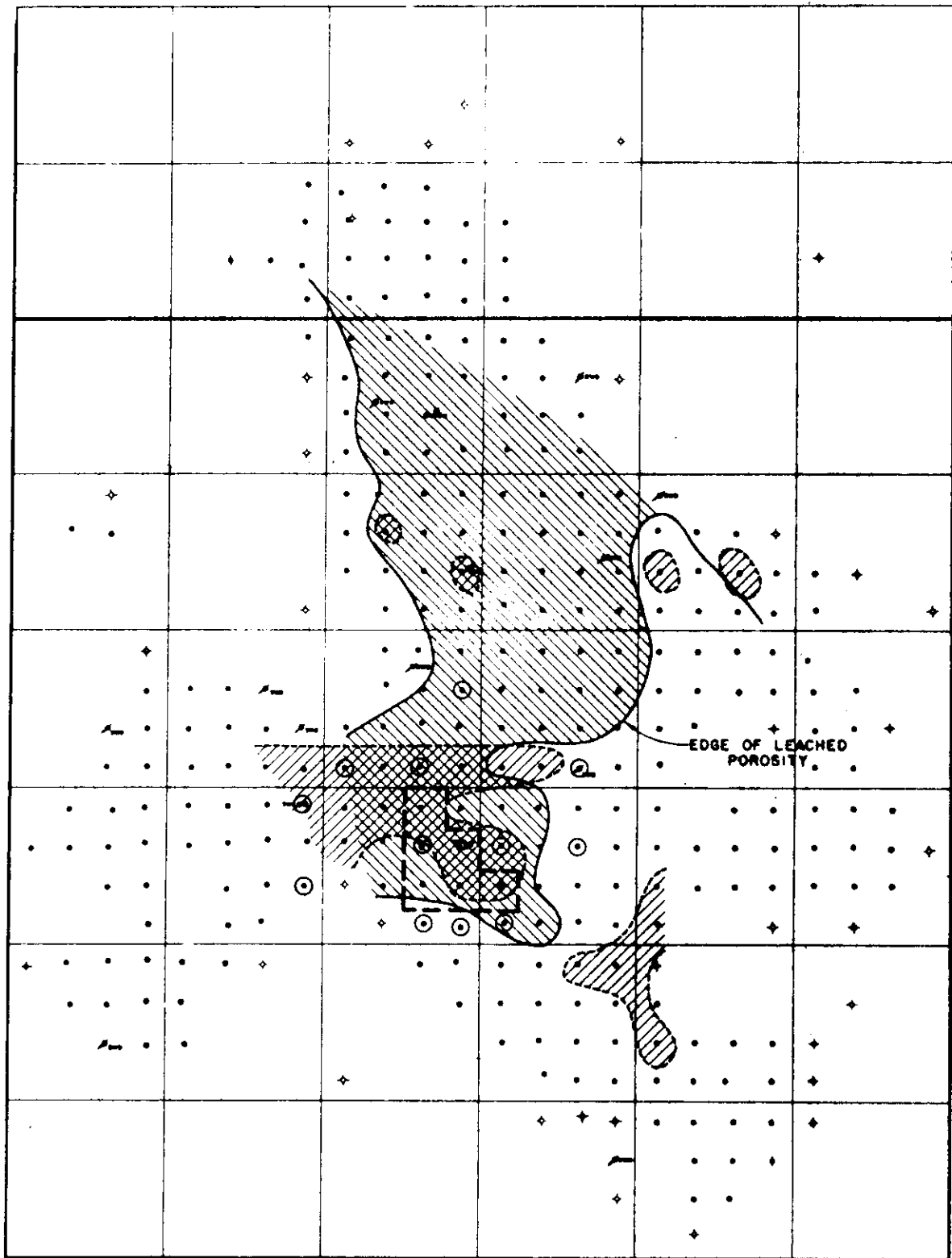
BASED ON 1974 BHP SURVEY

SCALE IN MILES



R.26 W.P.M.

T.12



T.11

FIGURE 8

**NORTH VIRDEN SCALLION FIELD**  
**CHERTY ZONE**  
**SHOWING AREAS OF OPEN FRACTURING**  
**AND LEACHED POROSITY**

— — — SUBMISSION AREA

-LEGEND-

OPEN FRACTURES

LEACHING

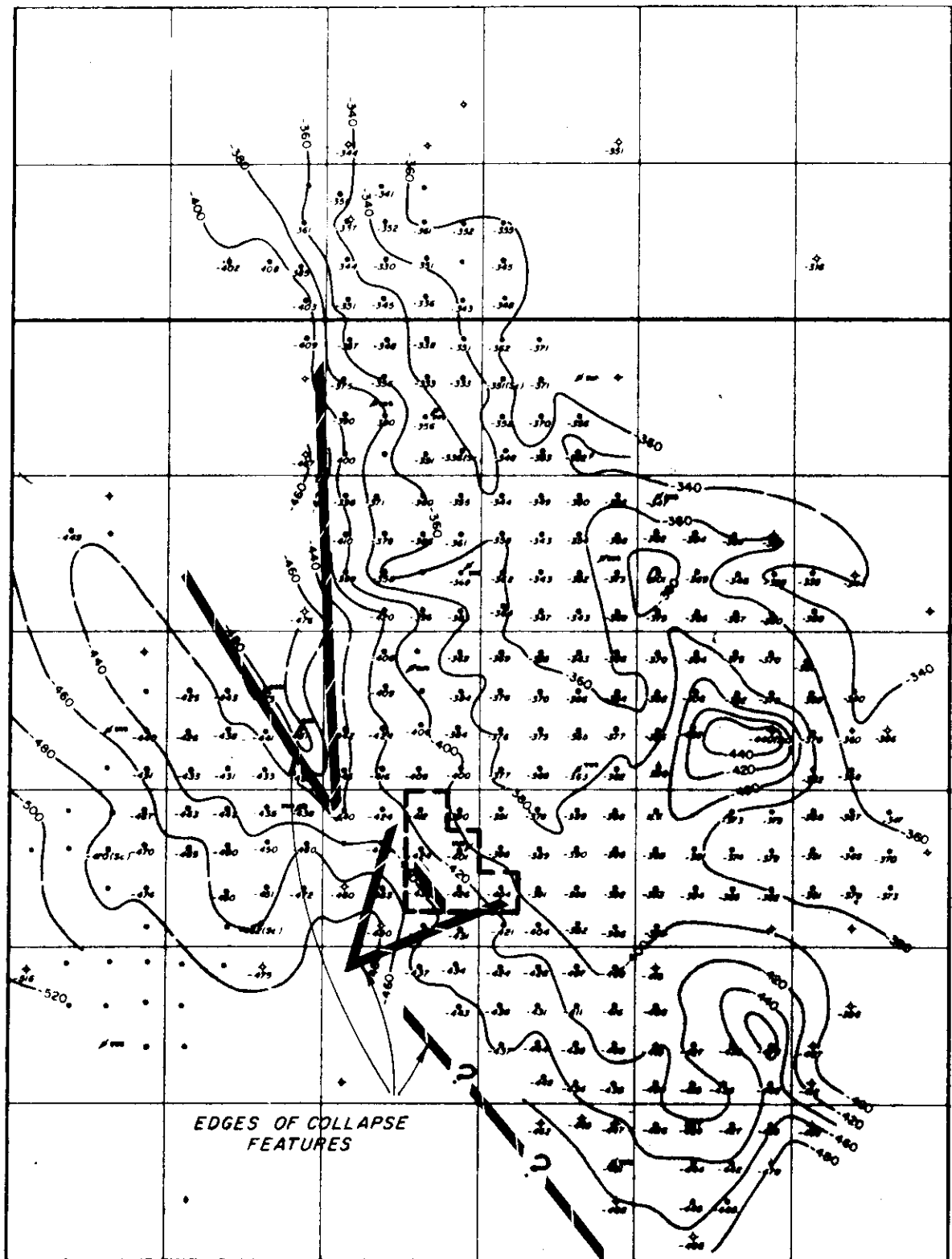
WELLS WITH CORE CONTROL

MAY 1961  
 REVISED 1975

SCALE IN MILES  
 0 1 2

R.26 W.P.M.

T.12



T.11

FIGURE 9

**NORTH VIRDEN SCALLION FIELD**  
**STRUCTURE CONTOURS**  
**ON TOP OF**  
**MISSISSIPPIAN**

--- SUBMISSION AREA

MAY 1961  
 REVISED 1975

0 SCALE IN MILES 2

C. I. = 20 FT.

October 1975

$$x_1, \dots, x_n \in \mathbb{R}^n, \quad x_i = (x_{i1}, \dots, x_{in})^T, \quad i = 1, \dots, n, \quad x_{ij} = x_{ij}^1, \dots, x_{ij}^n, \quad i = 1, \dots, n, \quad j = 1, \dots, n.$$

1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 26

John G. Thompson, Chairman  
North Virginia School Unit No. 114  
The Corbett

Figure 1. Schematic representation of the experimental design. The subjects were divided into two groups: the control group (CG) and the experimental group (EG). The CG was divided into two subgroups: the control group (CG) and the control group (CG). The EG was divided into two subgroups: the experimental group (EG) and the experimental group (EG). The CG was divided into two subgroups: the control group (CG) and the control group (CG). The EG was divided into two subgroups: the experimental group (EG) and the experimental group (EG).

[illegible][illegible]

2. Our understanding that some of the above supporting material initially intended to accompany this Application, and since we will not take of it. Upon receipt of the above supporting material, receipt of your application will be enhanced. We shall advise you if any additional information is required.

Yours Sincerely,

Original Signed by H. C. ...

W. S. Foster, P. M.,  
Inspector, Petroleum Branch.

MEM/t  
c.c. Jas. T. Gawley, D. H.,  
J. T. Gayer



## VOIDAGE BALANCE AND ULTIMATE RECOVERY STUDY

### NORTH VIRDEN-SCALLION UNIT NO. 1

December, 1968

#### A. Review of Voidage Balance by Pattern

At the request of the Oil and Natural Gas Conservation Board, a detailed study was conducted on the balance between reservoir fluid withdrawals and fluid injection into the reservoir. This study was conducted on an individual pattern basis.

##### Procedure:

The Unit area was divided into 41 individual segments or patterns such that each pattern had one injection well and several producing wells. (See Figure 1). For the purposes of this study, it was assumed that the reservoir voidage created by any producer located on adjacent pattern boundaries, is distributed equally amongst those patterns on whose boundaries it is situated.

A voidage balance was calculated for the month of July, 1968 to represent current conditions. In addition, a cumulative voidage balance from the inception of waterflooding to July 31, 1968 was calculated.

##### Results:

Table 1 and Figures 2 and 3 present the results of the study. Reasonable balance between injection and withdrawals exists at most patterns. There are instances of over and under injection on a current and cumulative basis.

Some interpretation of the injection profile survey results (See Progress Report No. 3 - 1964) was necessary to make a realistic appraisal of voidage balance. The "Remarks" column on Table 1 indicates some views that are applicable. All injection figures in Table 1 represent total injection. Losses indicated by injection profiles were not deducted.

Observations and Conclusions:

The conclusions from the study are listed and discussed below:

1. The erratic nature of the reservoir creates difficulties in calculating a voidage balance by pattern. Pay thicknesses vary by as much as 45 feet between adjacent spacing units and much interpretive reasoning has been used to determine pay thickness values. Accuracies of porosity and permeability values are also variable since in portions of the Unit area, only extremely poor data were available for the determination of these reservoir parameters.
2. The erratic nature of the reservoir is equally problematical with computer simulation. Chevron is currently updating a computer study for the surveillance of a central area of the Unit. From the results obtained to date it is concluded that, because of the variable nature of the reservoir, the results can only be treated as semi-quantitative.
3. The results from an injection profile survey conducted during 1964 were used interpretively in this review. In several instances, the survey indicated that injected water was escaping below the

bottom of the completed interval. In other instances large volumes were indicated as entering the reservoir at the bottom of the completed interval. In all cases, where there is an indication or suspicion of water entering the reservoir below the completed interval, the possibility should not be excluded that this "lost water" does, somewhere in the reservoir, replace some voidage that has been created by reservoir withdrawals. Most injection profile surveys lose contact with injected water when it moves 3 to 5 feet beyond the wellbore.

4. By combining two or more patterns in certain areas, a better voidage balance is indicated. It is reasonable to do this since it is not possible to accurately establish what reservoir voidage should be balanced with what injection, particularly when dealing with those producing wells that are equidistant from two or more injection wells.
5. The voidage balance from fluid production and injection records for the entire unit is favorable. It is reasonable to conclude that the balance within the reservoir is also favorable. Currently, the total injection within the unit area exceeds the total reservoir withdrawals by approximately 30%. Total cumulative injection has exceeded reservoir withdrawals since the inception of waterflooding by approximately 30%. Pre-unit production has resulted in cumulative reservoir withdrawals currently exceeding cumulative fluid injection by approximately 12 million reservoir barrels.

6. Because of the variable nature of the reservoir, the most realistic basis on which to review voidages is for the entire area. It is reasonable to assume that essentially all the water injected into the reservoir is replacing voidage created by withdrawals from the reservoir. As stated above, it is not possible to determine, with any accuracy, what reservoir withdrawals are being affected by what injection.
7. It is reasonable to assume that if there has been no waterflood response at first line producing wells, then there is little likelihood that oil is being flushed into areas from whence it cannot be recovered.

If there has been, or is, response, the possibility of losing Unit reserves beyond the reach of future Unit production exists if production is restricted beyond the bounds of good engineering practice. One has no assurance that waterflood response oil that is permitted to move beyond the first line producing wells, will be available for production at the next line of producing wells. This is particularly the case in a reservoir such as this, where combinations of variations in thickness, porosity, and permeability could very easily permit oil to be trapped and lost.

It is, therefore, concluded, that to restrict production or injection by other than good engineering practice is to risk adversely affecting the ultimate recovery of oil from the total unit area.

B. Review of Ultimate Recovery in the Vicinity of 9-14-11-26 WPM

An attempt was made to establish whether unrestricted production rates permitted in the North Virden-Scallion Unit No. 1 could adversely affect the ultimate recovery of oil.

The area surrounding 9-14-11-26 WPM was chosen as a test area for two main reasons:

- (a) The well on LSD 9-14 has experienced production rates in excess of 100 BOPD for the past four years and rates of approximately 200 BOPD for the past two years.
- (b) The well on LSD 9-14 is on the common boundary of three injection patterns. Of these three patterns, one is in good voidage balance; one is over-injected and one is under-injected, on a current and cumulative basis.

Assumptions:

For this study, it was assumed that the producer on 9-14 was responsible for recovering the oil from its 40 acre tract as well as the remaining recoverable oil from one-quarter of each of LSD 8-14; LSD 10-14 and LSD 12-13, which are the directly offsetting injection wells.

It was assumed that one-quarter of the oil production from the three injection wells, prior to conversion, was from the additional area assigned to LSD 9-14, as outlined above.

The calculation of original oil-in-place was based on the reservoir study conducted prior to unitization.

Results, Observations and Conclusions:

1. The original oil-in-place, production, and recovery data are presented on Table 2. The recovery to July 31, 1968 represents a recovery factor of 21.1%. It is anticipated that an additional 300,000 STB will be produced from 9-14 before it becomes non-economic to produce. This would then represent an ultimate recovery for the area of 39% of the original oil-in-place. At the time of the waterflood study for unitization, the calculated recovery factor for the entire area was 28.4% of the original oil-in-place.
2. It is concluded that unrestricted oil producing rates have not adversely affected, nor will they adversely effect the ultimate recovery of oil in this area.
3. It is reasonable to conclude that, with the same injection history in the area, had the production been restricted, the resultant ultimate recovery at 9-14 would in all likelihood, have been adversely affected. Under restricted producing conditions, it is likely that oil would be flushed by 9-14 and perhaps into areas beyond the reach of future Unit production.

TABLE I

NET VOLTAGE AND WITHDRAWALS BY PATTERN

TABLE I  
Pattern of Response to Voltage and Withdrawals by Pattern  
(See attached Figures 1 and 2)

Pattern Number	Injection Date	July 1968 Injection (815-11-11)	July 1968 Withdrawals (815-11-11)	July 1968 Net Voltage (815-11-11)	Cum. Inject. to 7/31/68	Cum. Withdrawals to 7/31/68	Net Voltage Res. 8/12/68	Remarks
1	12-4-12-26	6,450	7,070	1,420	394,200	269,200	(105,000)	From 1964 injection profile, no water lost out bottom of hole.
2	10-4-12-26	6,470	7,160	790	235,000	341,500	35,500	Although fair voidage balance is indicated, injection profile indicates 54% of water going below completed interval, but may still be entering the oil reservoir.
3	4-4-12-26	3,230	4,110	1,690	252,000	243,300	( 9,500)	Consider combining Pattern Nos. 3, 4 and 6.
4	2-4-12-26	3,300	3,900	600	177,300	140,700	( 36,600)	Injection profile indicates loss of 35% of water, but could still be effective water. See remarks for "3" above.
5	4-3-12-26	4,610	6,920	2,310	125,600	225,500	99,900	No injection profile available. Consider combining Pattern Nos. 5 and 7.
6	14-33-11-26	8,180	5,910	( 2,270)	374,500	270,400	(104,100)	Good injection profile. See remarks under Pattern No. 3.
7	16-33-11-26	8,490	3,730	( 4,760)	444,500	153,600	(290,900)	Good injection profile. See remarks under Pattern No. 5.
8	6-33-11-26	12,840	9,410	( 3,430)	549,100	335,500	(213,600)	Good injection profile. Expected additional response should balance voidage.

Pattern Number	Injection Interval	July 1968		July 1968		July 1968		July 1968		July 1968		Remarks
		Injection Cobbls./ft.	Water Cobbls./ft.	Water Cobbls./ft.	Water Cobbls./ft.	Water Cobbls./ft.	Water Cobbls./ft.	Water Cobbls./ft.	Water Cobbls./ft.	Water Cobbls./ft.	Water Cobbls./ft.	
9	6-34-11-26	4,060	3,230	( 810)		125,300	142,100	16,300				Middle of cone might be considered ably better, thus yielding better balance.
10	14-28-11-26	20,830	9,710	(11,140)		932,100	469,100	(463,300)				From injection profile, could be losing 40% of the injection water.
11	16-23-11-26	9,710	7,620	( 2,090)		492,800	262,100	(230,700)				Could be losing 30% of the injection water.
12	17-27-11-26	10,330	9,030	( 1,300)		535,300	347,600	(187,900)				Reasonable balance.
13	6-23-11-26	9,630	9,630	0		325,600	371,700	( 46,100)				Good balance indicated, however could be losing as much as 20% at bottom of hole.
14	8-23-11-26	10,740	11,480	740		510,400	422,900	( 87,500)				Good balance indicated.
15	6-27-11-26	6,220	9,120	2,900		190,500	123,900	133,400				Good injection profile. Consider combining with Pattern No. 16.
16	3-27-11-26	15,300	9,320	( 5,660)		730,000	376,900	(353,100)				Good injection profile. Consider com- bining with Pattern No. 15.
17	6-26-11-26	7,950	9,080	1,130		319,700	292,700	( 27,000)				Reasonable injection profile. Con- sider combining with Pattern No. 23.
18	8-26-11-26	10,030	7,810	( 2,220)		411,100	252,800	(158,300)				Good injection profile.
19	10-21-11-26	15,610	21,650	6,040		772,400	1,093,600	321,200				Injection profile indicates 50% of water lost. Large area attributed to this pattern. Consider combining pattern Nos. 19, 20, and 26.
20	12-22-11-26	28,860	22,000	( 6,860)		1,556,500	997,000	(559,500)				Good injection profile. Consider com- bining Pattern Nos. 19, 20 and 26.
21	10-22-11-26	13,370	15,400	2,030		732,600	663,200	( 69,400)				Good injection profile. Consider com- bining Pattern Nos. 21 and 22.



Pattern Number	Injection Well	July, 1968 Injection (Bbls./Month)	July 1968 Withdrawals (Bbls./Month)	July 1968 Net Voidage Res. Bbls./Month	Cum. Inject. to 7/31/68 Res. Bbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbls.	Net Voidage Res. Bbls.	Remarks
22	12-23-11-26	11,740	8,910	( 2,830)	506,000	349,700	( 156,300)	Satisfactory injection profile. Consider combining Pattern Nos. 21 & 22.
23	14-23-11-26	9,290	5,460	( 3,830)	365,700	207,500	( 158,200)	Satisfactory injection profile. Additional flood response expected. Consider combining Pattern Nos. 17 & 23.
24	16-23-11-26	9,140	4,750	( 4,390)	463,000	215,700	( 247,300)	Poor balance; however expected additional response could balance voidage.
25	12-24-11-26	13,980	1,200	(12,780)	507,500	87,300	( 419,700)	Poor injection profile indicates loss of 75% of the water. Anticipated additional withdrawals in area could balance voidage.
26	4-22-11-26	8,400	31,140	22,740	536,900	1,775,200	1,238,300	Good injection profile. Consider combining Pattern Nos. 19, 20 & 26.
27	6-24-11-26	9,470	2,410	( 7,060)	435,900	101,900	( 334,000)	Injection profile indicates some loss of water. Additional anticipated response could balance voidage.
28	10-15-11-26	14,090	12,140	( 1,950)	690,400	801,300	110,900	Injection profile indicates that 65% of the water is going below the open hole interval.
29	12-14-11-26	13,780	12,890	( 890)	482,600	377,500	( 105,100)	Reasonable balance; however injection profiles indicate that 60% of the water may be lost.
30	10-14-11-26	14,190	17,640	3,450	753,500	690,400	( 163,100)	Good injection profile. Consider combining Pattern Nos. 30, 31 & 34.
31	12-13-11-26	11,740	11,660	( 80)	506,000	508,400	2,400	Good balance and good injection profile. Could be combined with Pattern Nos. 30 & 34.
32	14-13-11-26	3,570	3,490	( 80)	252,800	147,800	( 105,000)	Good injection profile, good balance indicated.

Well No.	Injection Interval	July 1968 Injection (bbls, cu ft)	July 1968 Withdrawals (Bbls, cu ft)	July 1968 Net Voidage Res. bbls, cu ft	Cum. Inject. to 7/31/68 Res. bbls, cu ft	Cum. Withdrawals		
						to 7/31/68 Res. bbls, cu ft	to 7/31/68 Net Voidage Res. bbls, cu ft	
33	2-15-11-26	23,960	16,330	( 7,630)	956,900	1,125,800	163,900	Poor injection profile; 27% of water being lost.
34	8-14-11-26	16,430	6,340	( 10,090)	496,100	278,600	( 217,500)	Good profile. Consider on lining with pattern Nos. 39 and 31.
35	6-13-11-26	8,390	1,030	( 7,360)	413,200	76,400	( 341,800)	Good injection profile. Incomplete 5-spot.
36	10-13-11-26	13,780	610	( 13,170)	326,200	48,700	( 347,900)	Good injection profile. Incomplete 5-spot.
37	12-10-11-26	8,700	9,500	800	355,200	537,400	51,900	Good injection profile. 51% of water going below F.O. (possibly still into oil reservoir).
38	10-10-11-26	18,640	4,330	( 14,310)	538,300	326,900	( 511,400)	Poor injection profile. 36% of water going below F.O. (possibly still into oil reservoir).
39	2-10-11-26	11,560	1,660	( 10,900)	581,900	113,200	( 463,700)	Fair injection profile. Incomplete 5-spot.
40	4-11-11-26	10,470	2,550	( 7,920)	538,300	159,300	( 379,000)	Poor injection profile.
41	2-11-11-26	13,830	2,260	( 11,570)	600,200	106,100	( 583,100)	Fair injection profile.
TOTAL		462,010	351,770	(110,240)	21,141,500	16,056,100	(5,085,400)	

TABLE 2

## REVIEW OF ULTIMATE RECOVERY IN THE VICINITY OF 9-14-11-26 WPM

Tract	Original Oil in Place-STB	Cum. Oil Prod. to 7/31/68-STB	Recovery Factor to 7/31/68	Est. Remaining Prod.-STB	Est. Ult. Recovery	Est. Ult. Recovery Factor
8-14 (total)		41,900				
( $\frac{1}{2}$ of 8-14)	233,000	10,500	4.5%	-	10,500	4.5%
9-14 (total)	962,000	320,400	33.3%	300,000	620,400	64.5%
10-14 (total)		27,000				
( $\frac{1}{2}$ of 10-14)	135,000	7,000	5.2%	-	7,000	5.2%
12-13 (total)		70,200				
( $\frac{1}{2}$ of 12-13)	353,000	17,600	5.0%	-	17,600	5.0%
	1,683,000	355,500	21.1%	300,000	655,500	39.0%

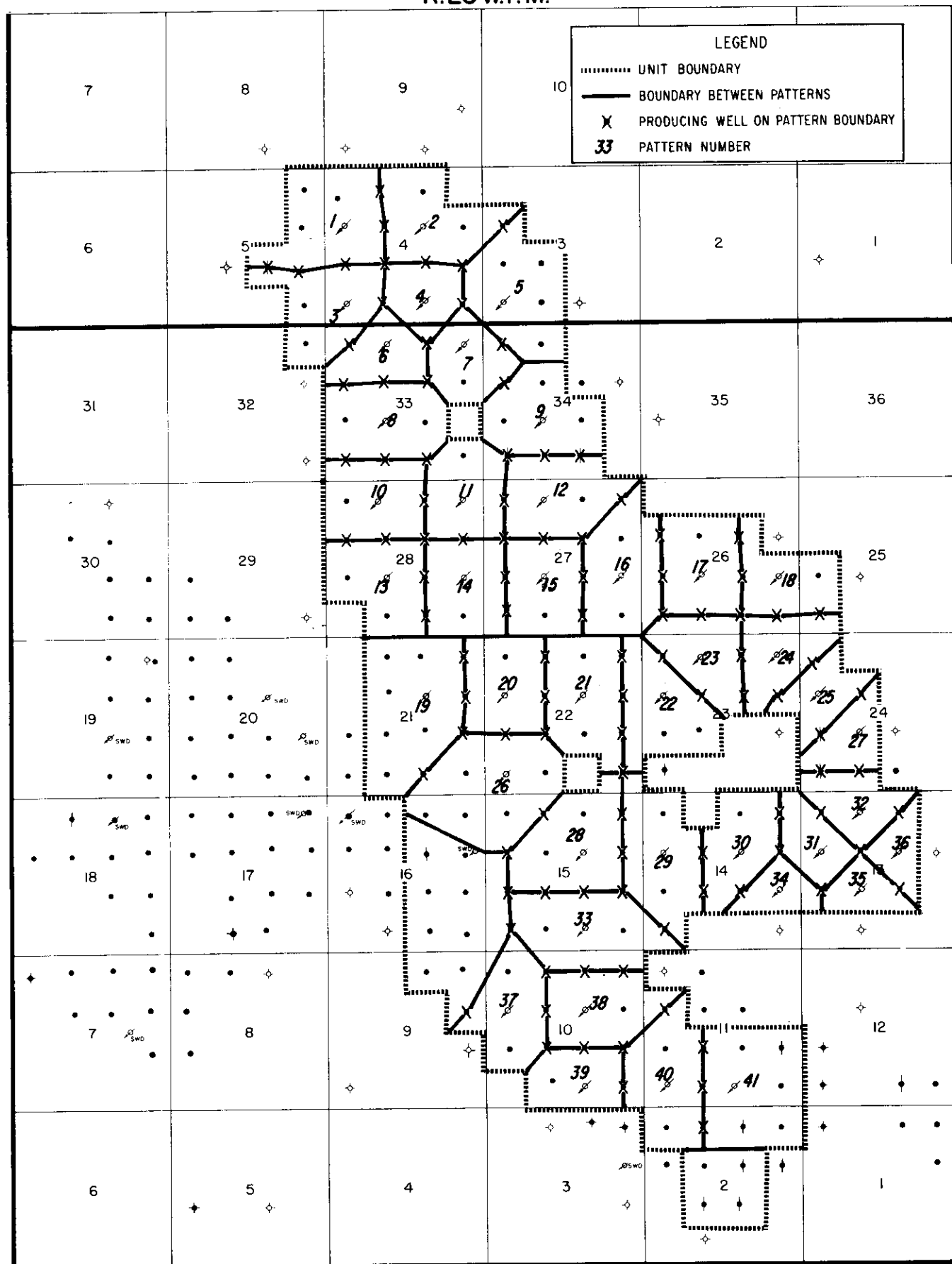
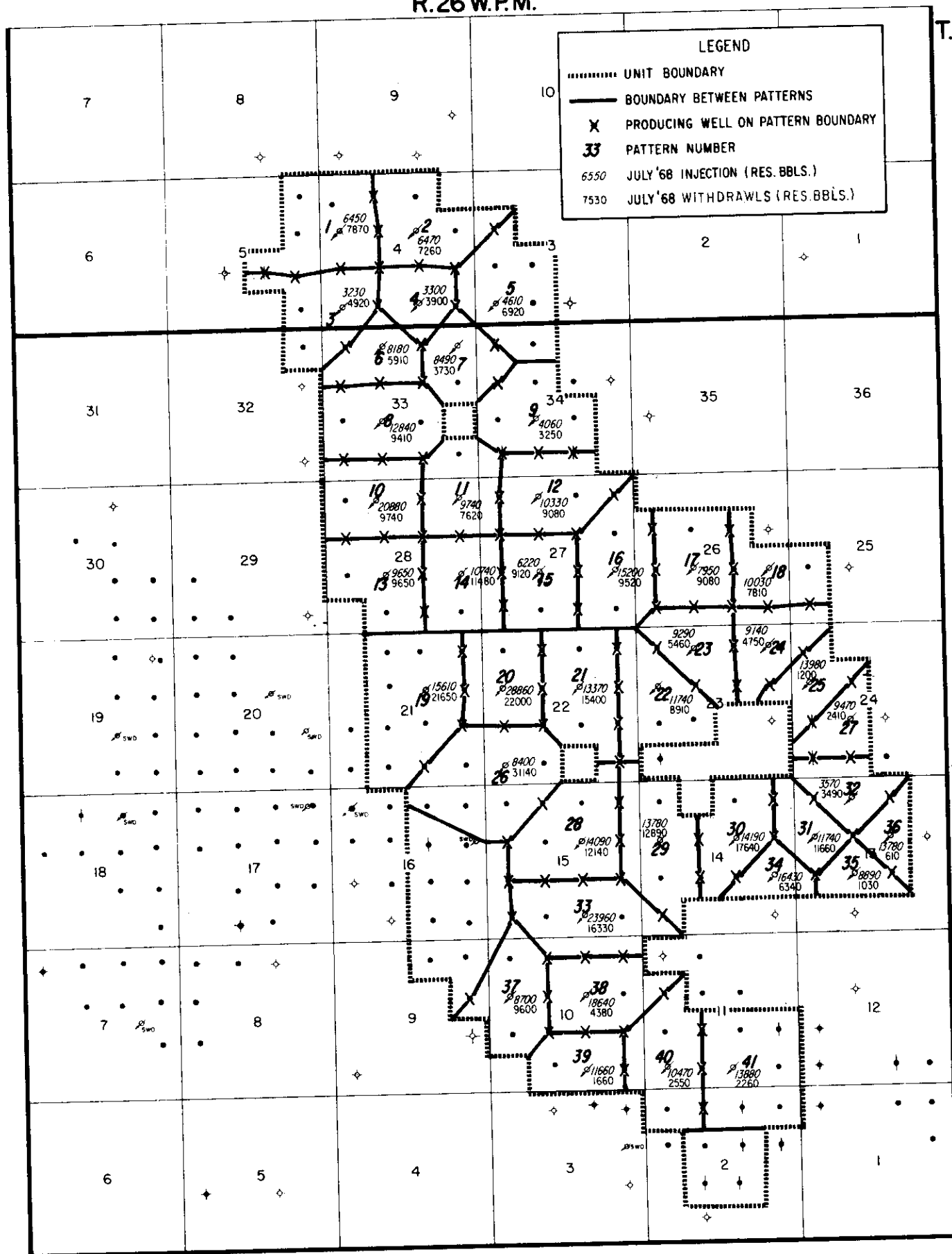


FIGURE 1  
NORTH VIRDEN SCALLION UNIT No. 1  
PATTERN BOUNDARIES FOR VOIDAGE BALANCE



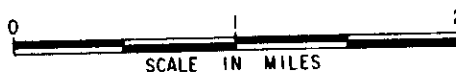
R.26 W.P.M.

T.12



T.11

FIGURE 2  
NORTH VIRDEN SCALLION UNIT No.1  
JULY, 1968 VOIDAGE BALANCE BY PATTERN



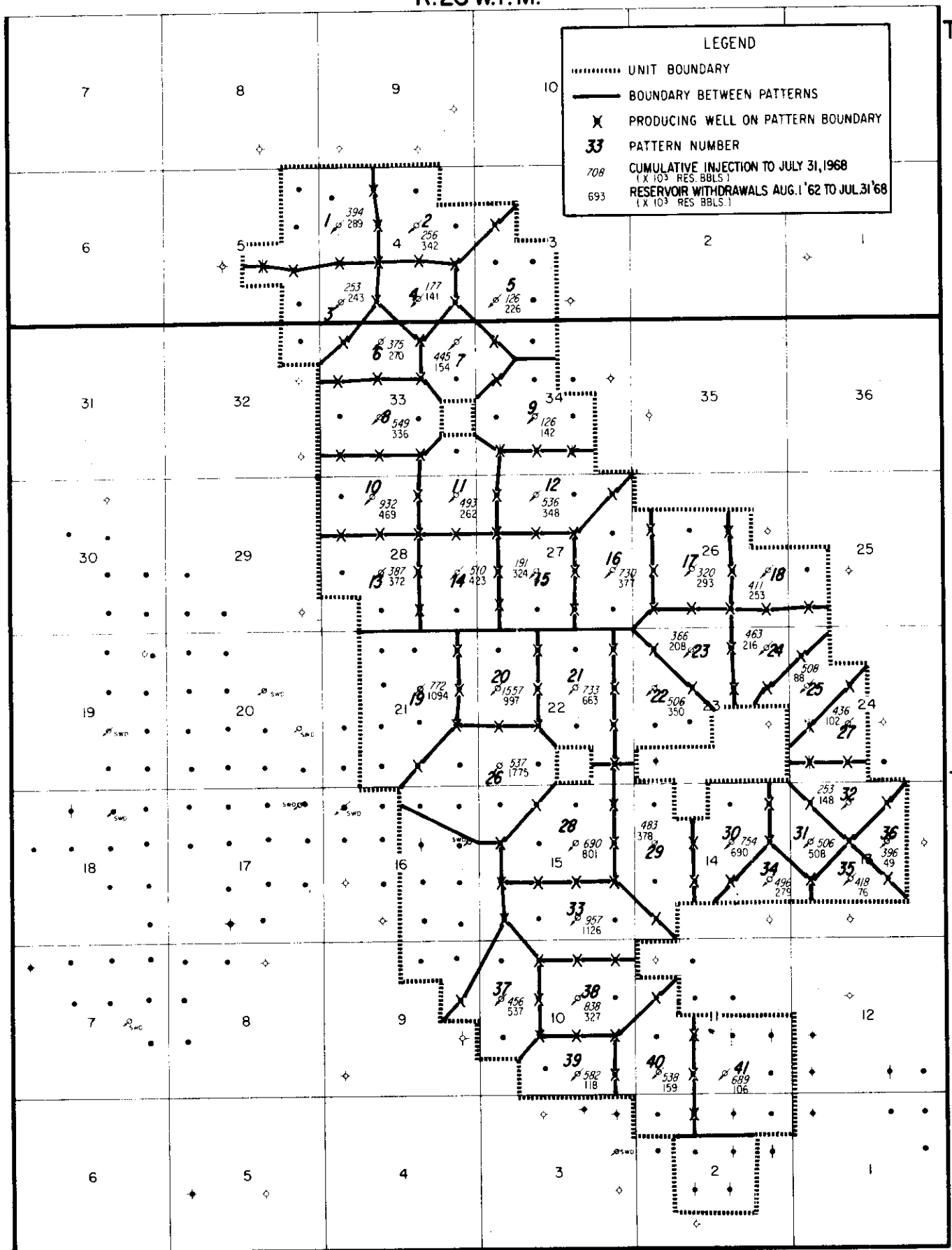


FIGURE 3  
NORTH VIRDEN SCALLION UNIT No.1  
VOIDAGE BALANCE TO JULY 31, 1968 BY PATTERN



## VOIDAGE BALANCE AND ULTIMATE RECOVERY STUDY

### NORTH VIRDEN-SCALLION UNIT NO. 1

December, 1968

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3. The results from an injection profile survey conducted during 1964 were used interpretively in this review. In several instances, the survey indicated that injected water was escaping below the



bottom of the completed interval. In other instances large volumes were indicated as entering the reservoir at the bottom of the completed interval. In all cases, where there is an indication or suspicion of water entering the reservoir below the completed interval, the possibility should not be excluded that this "lost water" does, somewhere in the reservoir, replace some voidage that has been created by reservoir withdrawals. Most injection profile surveys lose contact with injected water when it moves 3 to 5 feet beyond the wellbore.

4. By combining two or more patterns in certain areas, a better voidage balance is indicated. It is reasonable to do this since it is not possible to accurately establish what reservoir voidage should be balanced with what injection, particularly when dealing with those producing wells that are equidistant from two or more injection wells.
5. The voidage balance from fluid production and injection records for the entire unit is favorable. It is reasonable to conclude that the balance within the reservoir is also favorable. Currently, the total injection within the unit area exceeds the total reservoir withdrawals by approximately 30%. Total cumulative injection has exceeded reservoir withdrawals since the inception of waterflooding by approximately 30%. Pre-unit production has resulted in cumulative reservoir withdrawals currently exceeding cumulative fluid injection by approximately 12 million reservoir barrels.

6. Because of the variable nature of the reservoir, the most realistic basis on which to review voidages is for the entire area. It is reasonable to assume that essentially all the water injected into the reservoir is replacing voidage created by withdrawals from the reservoir. As stated above, it is not possible to determine, with any accuracy, what reservoir withdrawals are being affected by what injection.
7. It is reasonable to assume that if there has been no waterflood response at first line producing wells, then there is little likelihood that oil is being flushed into areas from whence it cannot be recovered.

If there has been, or is, response, the possibility of losing Unit reserves beyond the reach of future Unit production exists if production is restricted beyond the bounds of good engineering practice. One has no assurance that waterflood response oil that is permitted to move beyond the first line producing wells, will be available for production at the next line of producing wells. This is particularly the case in a reservoir such as this, where combinations of variations in thickness, porosity, and permeability could very easily permit oil to be trapped and lost.

It is, therefore, concluded, that to restrict production or injection by other than good engineering practice is to risk adversely affecting the ultimate recovery of oil from the total unit area.

B. Review of Ultimate Recovery in the Vicinity of 9-14-11-26 WPM

An attempt was made to establish whether unrestricted production rates permitted in the North Virden-Scallion Unit No. 1 could adversely affect the ultimate recovery of oil.

The area surrounding 9-14-11-26 WPM was chosen as a test area for two main reasons:

- (a) The well on LSD 9-14 has experienced production rates in excess of 100 BOPD for the past four years and rates of approximately 200 BOPD for the past two years.
- (b) The well on LSD 9-14 is on the common boundary of three injection patterns. Of these three patterns, one is in good voidage balance; one is over-injected and one is under-injected, on a current and cumulative basis.

Assumptions:

For this study, it was assumed that the producer on 9-14 was responsible for recovering the oil from its 40 acre tract as well as the remaining recoverable oil from one-quarter of each of LSD 8-14; LSD 10-14 and LSD 12-13, which are the directly offsetting injection wells.

It was assumed that one-quarter of the oil production from the three injection wells, prior to conversion, was from the additional area assigned to LSD 9-14, as outlined above.

The calculation of original oil-in-place was based on the reservoir study conducted prior to unitization.

Results, Observations and Conclusions:

1. The original oil-in-place, production, and recovery data are presented on Table 2. The recovery to July 31, 1968 represents a recovery factor of 21.1%. It is anticipated that an additional 300,000 STB will be produced from 9-14 before it becomes non-economic to produce. This would then represent an ultimate recovery for the area of 39% of the original oil-in-place. At the time of the waterflood study for unitization, the calculated recovery factor for the entire area was 28.4% of the original oil-in-place.
2. It is concluded that unrestricted oil producing rates have not adversely affected, nor will they adversely effect the ultimate recovery of oil in this area.
3. It is reasonable to conclude that, with the same injection history in the area, had the production been restricted, the resultant ultimate recovery at 9-14 would in all likelihood, have been adversely affected. Under restricted producing conditions, it is likely that oil would be flushed by 9-14 and perhaps into areas beyond the reach of future Unit production.

TABLE I

## NORTH VIRDEN-SCALLION UNIT NO. 1

Review of Reservoir Voidage and Withdrawals by Pattern  
(See attached Figures 1 and 2)

Pattern Number	Injection Well	July 1968 Injection (Bbbls./Month)	July 1968 Withdrawals (Bbbls./Month)	July 1968 Net Voidage Res. Bbbls./Month	Cum. Inject. to 7/31/68 Res. Bbbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbbls.	Net Voidage Res. Bbbls.	Remarks
1	12-4-12-26	6,450	7,870	1,420	394,200	289,200	(105,000)	From 1964 injection profile, no water lost out bottom of hole.
2	10-4-12-26	6,470	7,260	790	256,000	341,500	85,500	Although fair voidage balance is indicated, injection profile indicates 54% of water going below completed interval, but may still be entering the oil reservoir.
3	4-4-12-26	3,230	4,920	1,690	252,800	243,300	( 9,500)	Consider combining Pattern Nos. 3, 4 and 6.
4	2-4-12-26	3,300	3,900	600	177,300	140,700	( 36,600)	Injection profile indicates loss of 35% of water, but could still be effective water. See remarks for "3" above.
5	4-3-12-26	4,610	6,920	2,310	125,600	225,500	99,900	No injection profile available. Consider combining Pattern Nos. 5 and 7.
6	14-33-11-26	8,180	5,910	( 2,270)	374,500	270,400	(104,100)	Good injection profile. See remarks under Pattern No. 3.
7	16-33-11-26	8,490	3,730	( 4,760)	444,500	153,600	(290,900)	Good injection profile. See remarks under Pattern No. 5.
8	6-33-11-26	12,840	9,410	( 3,430)	549,100	335,500	(213,600)	Good injection profile. Expected additional response should balance voidage.

Pattern Number	Injection Well	July 1968 Injection (Bbls./Month)	July 1968 Withdrawals (Bbls./Month)	July 1968 Net Voidage Res. Bbls./Month	Cum. Inject. to 7/31/68 Res. Bbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbls.	Net Voidage Res. Bbls.	Remarks
9	6-34-11-26	4,060	3,250	( 810)	125,800	142,100	16,300	Withdrawal area might be considerably smaller, thus yielding better balance.
10	14-28-11-26	20,880	9,740	(11,140)	932,400	469,100	(463,300)	From injection profile, could be losing 40% of the injected water.
11	16-28-11-26	9,740	7,620	( 2,120)	492,800	262,100	(230,700)	Could be losing 30% of the water.
12	14-27-11-26	10,330	9,080	( 1,250)	535,800	347,800	(188,000)	Reasonable balance.
13	6-28-11-26	9,650	9,650	0	386,600	371,700	( 14,900)	Good balance indicated, however could be losing as much as 30% at bottom of hole.
14	8-28-11-26	10,740	11,480	740	510,400	422,900	( 87,500)	Good balance indicated.
15	6-27-11-26	6,220	9,120	2,900	190,500	323,900	133,400	Good injection profile. Consider combining with Pattern No. 16.
16	8-27-11-26	15,200	9,520	( 5,680)	730,000	376,900	(353,100)	Good injection profile. Consider combining with Pattern No. 15.
17	6-26-11-26	7,950	9,080	1,130	319,700	292,700	( 27,000)	Reasonable injection profile. Consider combining with Pattern No. 23.
18	8-26-11-26	10,030	7,810	( 2,220)	411,100	252,800	(158,300)	Good injection profile.
19	10-21-11-26	15,610	21,650	6,040	772,400	1,093,600	321,200	Injection profile indicates 50% of water lost. Large area attributed to this pattern. Consider combining Pattern Nos. 19, 20, and 26.
20	12-22-11-26	28,860	22,000	( 6,860)	1,556,500	997,000	(559,500)	Good injection profile. Consider combining Pattern Nos. 19, 20 and 26.
21	10-22-11-26	13,370	15,400	2,030	732,600	663,200	( 69,400)	Good injection profile. Consider combining Pattern Nos. 21 and 22.

Pattern Number	Injection Well	July 1968		July 1968		Cum. Inject. to 7/31/68		Cum. Withdrawals Since Incept. to 7/31/68		Net Voidage		Remarks
		Injection (Bbls./Month)	Withdrawals (Bbls./Month)	July 1968 Net Voidage Res. Bbls./Month	July 1968 Net Voidage Res. Bbls./Month	Cum. Inject. to 7/31/68 Res. Bbls.	Cum. Inject. to 7/31/68 Res. Bbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbls.	Cum. Withdrawals Since Incept. to 7/31/68 Res. Bbls.	Net Voidage Res. Bbls.	Net Voidage Res. Bbls.	
22	12-23-11-26	11,740	8,910	( 2,830)	( 2,830)	506,000	506,000	349,700	349,700	( 156,300)	( 156,300)	Satisfactory injection profile. Consider combining Pattern Nos. 21 & 22.
23	14-23-11-26	9,290	5,460	( 3,830)	( 3,830)	365,700	365,700	207,500	207,500	( 158,200)	( 158,200)	Satisfactory injection profile. Additional flood response expected. Consider combining Pattern Nos. 17 & 23.
24	16-23-11-26	9,140	4,750	( 4,390)	( 4,390)	463,000	463,000	215,700	215,700	( 247,300)	( 247,300)	Poor balance; however expected additional response could balance voidage.
25	12-24-11-26	13,980	1,200	(12,780)	(12,780)	507,500	507,500	87,300	87,300	( 419,700)	( 419,700)	Poor injection profile indicates loss of 75% of the water. Anticipated additional withdrawals in area could balance voidage.
26	4-22-11-26	8,400	31,140	22,740	22,740	536,900	536,900	1,775,200	1,775,200	1,238,300	1,238,300	Good injection profile. Consider combining Pattern Nos. 19, 20 & 26.
27	6-24-11-26	9,470	2,410	( 7,060)	( 7,060)	435,900	435,900	101,900	101,900	( 334,000)	( 334,000)	Injection profile indicates some loss of water. Additional anticipated response could balance voidage.
28	10-15-11-26	14,090	12,140	( 1,950)	( 1,950)	690,400	690,400	801,300	801,300	110,900	110,900	Injection profile indicates that 65% of the water is going below the open hole interval.
29	12-14-11-26	13,780	12,890	( 890)	( 890)	482,600	482,600	377,500	377,500	( 105,100)	( 105,100)	Reasonable balance; however injection profiles indicate that 60% of the water may be lost.
30	10-14-11-26	14,190	17,640	3,450	3,450	753,500	753,500	690,400	690,400	( 163,100)	( 163,100)	Good injection profile. Consider combining Pattern Nos. 30, 31 & 34.
31	12-13-11-26	11,740	11,660	( 80)	( 80)	506,000	506,000	508,400	508,400	2,400	2,400	Good balance and good injection profile. Could be combined with Pattern Nos. 30 & 34.
32	14-13-11-26	3,570	3,490	( 80)	( 80)	252,800	252,800	147,800	147,800	( 105,000)	( 105,000)	Good injection profile, good balance indicated.

Pattern Number	Injection Well	July 1968 Injection (Bbbls./Month)	July 1968 Withdrawals (Bbbls./Month)	July 1968 Net Voidage Res. Bbbls./Month	Cum. Inject. to 7/31/68 Res. Bbbls.	Cum. Withdrawals		Remarks
						Since Incept. to 7/31/68 Res. Bbbls.	Net Voidage Res. Bbbls.	
33	2-15-11-26	23,960	16,330	( 7,630)	956,900	1,125,800	168,900	Poor injection profile; 27% of water being lost.
34	8-14-11-26	16,430	6,340	( 10,090)	496,100	278,600	( 217,500)	Good profile. Consider combining with Pattern Nos. 30 and 31.
35	6-13-11-26	8,890	1,030	( 7,860)	418,200	76,400	( 341,800)	Good injection profile. Incomplete 5-spot.
36	10-13-11-26	13,780	610	( 13,170)	396,200	48,700	( 347,500)	Good injection profile. Incomplete 5-spot.
37	12-10-11-26	8,700	9,600	900	455,500	537,400	81,900	Poor injection profile. 51% of water going below T.D. (possibly still into oil reservoir).
38	10-10-11-26	18,640	4,380	( 14,260)	838,300	326,900	( 511,400)	Poor injection profile. 30% of water going below T.D. (possibly still into oil reservoir).
39	2-10-11-26	11,660	1,660	( 10,000)	581,900	118,200	( 463,700)	Fair injection profile. Incomplete 5-spot.
40	4-11-11-26	10,470	2,550	( 7,920)	538,300	159,300	( 379,000)	Poor injection profile.
41	2-11-11-26	13,880	2,260	( 11,620)	689,200	106,100	( 583,100)	Fair injection profile.
TOTAL					21,141,500	16,056,100	(5,085,400)	



TABLE 2

## REVIEW OF ULTIMATE RECOVERY IN THE VICINITY OF 9-14-11-26 WPM

<u>Tract</u>	<u>Original Oil in Place-STB</u>	<u>Cum. Oil Prod. to 7/31/68-STB</u>	<u>Recovery Factor to 7/31/68</u>	<u>Est. Remaining Prod.-STB</u>	<u>Est. Ult. Recovery</u>	<u>Est. Ult. Recovery Factor</u>
8-14 (total)		41,900				
( $\frac{1}{2}$ of 8-14)	233,000	<u>10,500</u>	4.5%	-	10,500	4.5%
9-14 (total)	962,000	<u>320,400</u>	33.3%	300,000	620,400	64.5%
10-14 (total)		27,000				
( $\frac{1}{2}$ of 10-14)	135,000	<u>7,000</u>	5.2%	-	7,000	5.2%
12-13 (total)		70,200				
( $\frac{1}{2}$ of 12-13)	353,000	<u>17,600</u>	5.0%	-	17,600	5.0%
	<u>1,683,000</u>	<u>355,500</u>	<u>21.1%</u>	<u>300,000</u>	<u>655,500</u>	<u>39.0%</u>

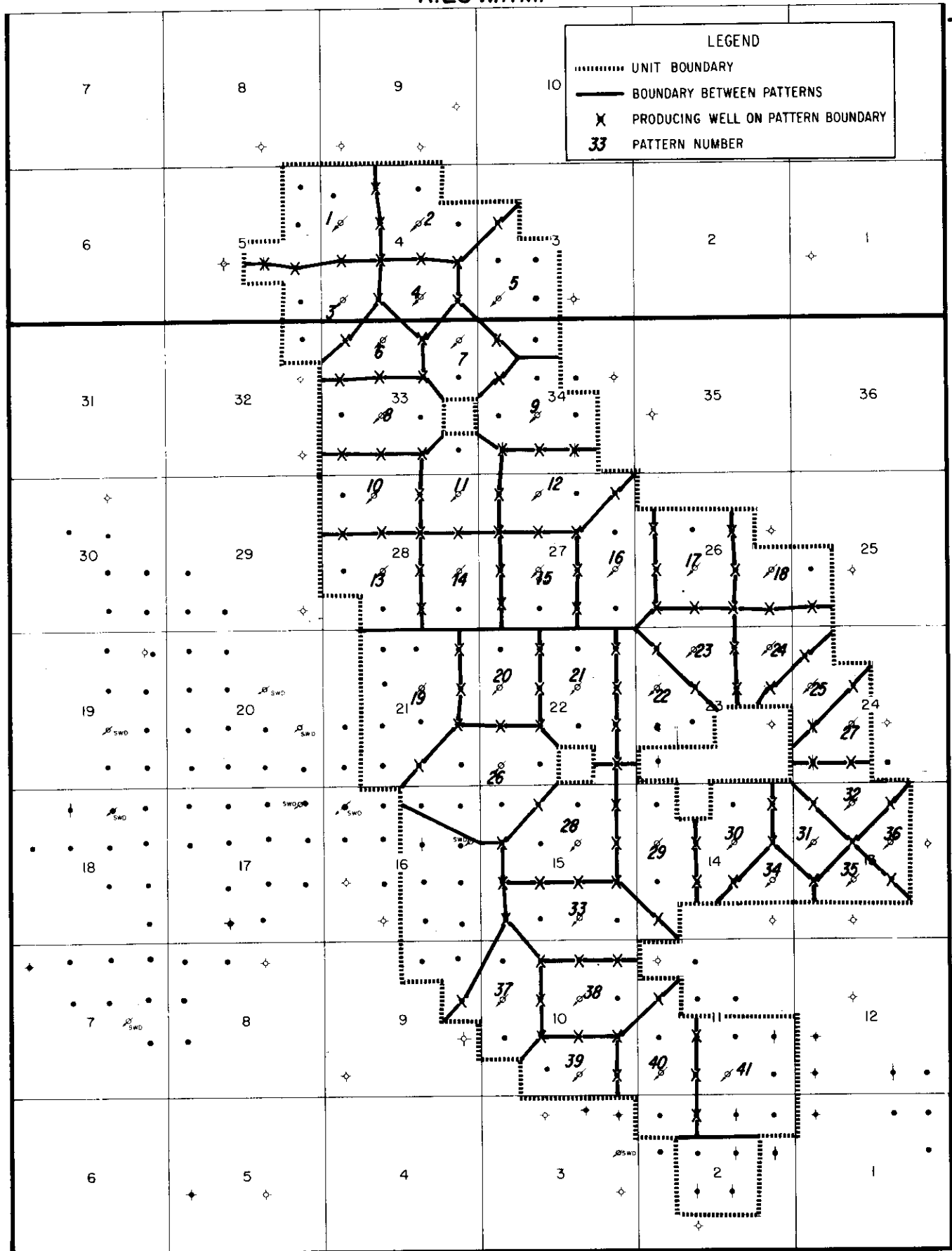
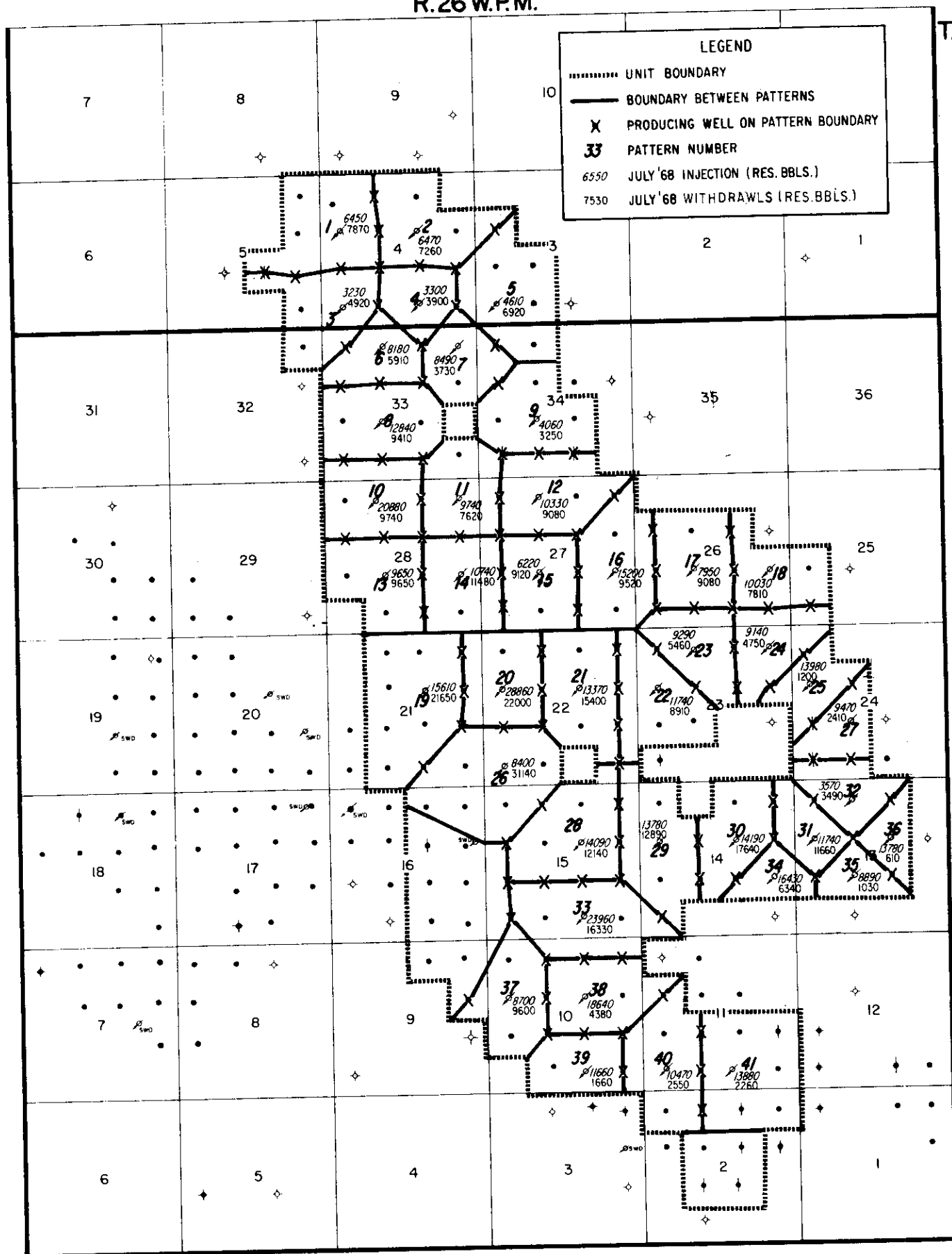


FIGURE 1  
NORTH VIRDEN SCALLION UNIT No. 1  
PATTERN BOUNDARIES FOR VOIDAGE BALANCE



R.26 W.P.M.

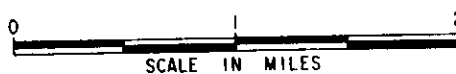
T.12



T.11

FIGURE 2

NORTH VIRDEN SCALLION UNIT No.1  
JULY, 1968 VOIDAGE BALANCE BY PATTERN



R.26W.P.M.

T.12

T.11

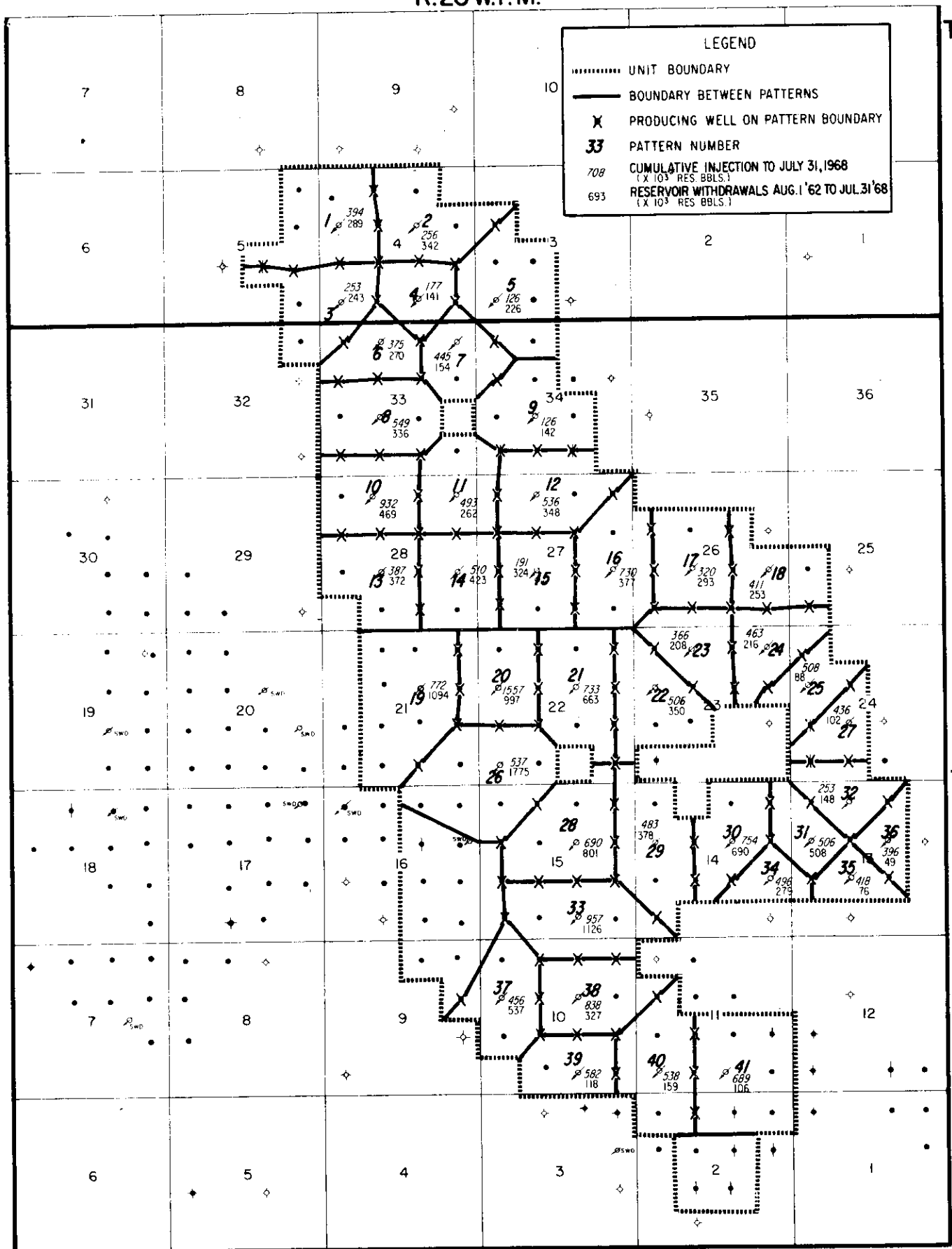


FIGURE 3  
NORTH VIRDEN SCALLION UNIT No.1  
VOIDAGE BALANCE TO JULY 31, 1968 BY PATTERN

0 1 2  
SCALE IN MILES