



The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

November 28, 1988

Enron Oil Canada Ltd.
1300 - 700 - 9th Avenue S.W.
Calgary, Alberta
T2P 3V4

Attention: Mr. H. Dale Logie
Chief Reservoir Engineer

Dear Sir:

Re: Waskada Lower Amaranth A Pool
Pressure Maintenance Expansion

Your letter of November 15, 1988 regarding the effect of conversion to water injection of Enron et al Waskada 4-9-2-25 (WPM) on project performance is acknowledged. Based on the results of your further study, we concur that conversion of this well is not warranted at this time.

We request, however, that you continue to monitor the performance of the project and, should such performance warrant, that you reconsider conversion of the well to water injection.

Yours respectfully,

~~Original Signed by H. C. Moster~~

H. Clare Moster
Deputy Chairman

cc: C. S. Kang
Chairman

bc: Petroleum Branch
Wm. McDonald, Member

LRD/HCM/sml



Date: NOVEMBER 25, 1988

Action / Route Slip

To: L.R. Dubreuil

From: H. Clare Moster

Telephone: 1111

- | | | | | |
|---|---|--|---|--|
| <input type="checkbox"/> Take Action | <input type="checkbox"/> Per Your Request | <input type="checkbox"/> Circulate, Initial and Return | <input type="checkbox"/> For Approval and Signature | <input type="checkbox"/> Make _____ Copies |
| <input type="checkbox"/> May We Discuss | <input type="checkbox"/> For Your Information | <input type="checkbox"/> Return With Comments or Revisions | <input checked="" type="checkbox"/> Draft Reply for Signature of C.S. Kang (Chairman) | <input type="checkbox"/> Please File |

Comments:

RE: WASKADA UNIT 16 - ENRON:

Please review and draft appropriate reply, along with covering memo for Board.

Att.

HCM:p

Manitoba

Sent to LRD on:-
Nov 25/88



Date: November 23, 1988

To: Clare Moster, ADM
Energy Division

Action / Route Slip

From: Office of the Deputy Minister
Manitoba Energy and Mines
Room 309
Legislative Building
Winnipeg, Manitoba
R3C 0V8

- | | | | | |
|---|---|--|---|--|
| <input type="checkbox"/> Take Action | <input type="checkbox"/> Per Your Request | <input type="checkbox"/> Circulate, Initial and Return | <input type="checkbox"/> For Approval and Signature | <input type="checkbox"/> Make _____ Copies |
| <input type="checkbox"/> May We Discuss | <input type="checkbox"/> For Your Information | <input type="checkbox"/> Return With Comments or Revisions | <input checked="" type="checkbox"/> Draft Reply for Signature | <input type="checkbox"/> Please File |

Chairman-if necessary

Comments:

DEPARTMENT OF ENERGY
AND MINES

Thanks

NOV 24 1988

Rose

cc: ADM Pending
L.R. Dubreuil ✓

ENERGY ECONOMICS BRANCH

15 November 1988

The Oil and Gas Conservation Board
#555, 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3

Attention: Charles S. Kang,
Chairman

Dear Sir:

Re: Waskada Lower Amaranth Unit No. 16
Pressure Maintenance Expansion

As requested in your letter of August 4, 1988, Enron Oil Canada Ltd. has rerun the reservoir simulation model with the 4-9 well included as a water injector. A comparison of the forecast daily and cumulative oil production rates for a seven-spot pattern with the 4-9 well producing or injecting is illustrated in Table 1. With a voidage replacement ratio of 1.0, the loss in oil productivity due to the conversion of well 4-9 to injection is not regained in the first ten years and the cumulative oil production loss is only recouped after twenty years of waterflood operation.

Enron still has no plans to convert well 4-9 to water injection at this time. Should the oil productivity of well 4-9 drop below an economic rate, Enron will reassess the conversion of this well at that time.

Yours very truly,
ENRON OIL CANADA LTD.

H. Dale Logie

H.D. Logie,
Chief Reservoir Engineer

HDL:pdc
attach



TABLE 1

**WASKADA LOWER AMARANTH ENRON STUDY AREA
SEVEN-SPOT WATERFLOOD OIL PRODUCTION FORECASTS**

Date	Daily Oil (m ³ /d)		Cumulative Oil (10 ³ m ³)	
	Producer 4-9	Injector 4-9	Producer 4-9	Injector 4-9
April 1988	121.5	—	55.4	55.4
April 1990	101.7	(2 90)	130.9	128.7
April 1992	95.9	(1 80)	202.9	199.0
April 1994	89.6	(1 30)	270.3	265.3
April 1996	84.2	(0 60)	333.5	327.8
April 1998	78.5	—	392.6	387.0
April 2000	71.9	1.1	447.3	442.1
April 2002	66.2	0.9	497.4	493.2
April 2004	61.3	0.9	543.7	540.3
April 2006	56.9	0.8	586.6	583.9
April 2008	53.0	0.7	626.6	624.6

△



The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

November 28, 1988

Enron Oil Canada Ltd.
1300, 700 - 9th Avenue S.W.
Calgary, Alberta
T2P 3V4

Attention: Mr. T. McKay
Production Engineer

Dear Sir:

Re: Waskada Unit No. 16
Expanded Pressure Maintenance Operations

This letter is in response to your recent questions to the Petroleum Branch regarding interpretation of The Oil and Natural Gas Conservation Board Order No. PM 57 in light of the recent expansion of pressure maintenance operations in the subject enlarged unit.

Pressure Maintenance Rule No. 3(1) of Board Order No. PM 57 required a pressure survey in a minimum of four wells in the Unit Area prior to commencement of injection. This was intended to provide one pressure measurement in each injection pattern in the original Unit Area. With enlargement of the Unit, five new injection patterns are being implemented. We are requesting, therefore, that a pre-injection pressure survey involving five wells in the enlargement area be conducted. Results of this survey should be submitted to the Petroleum Branch.

Pressure Maintenance Rule No. 3(2) requires subsequent annual pressure surveys on a minimum of four wells in the Unit Area. Again, this was intended to provide for at least one annual pressure survey per injection pattern. With enlargement of the pressure maintenance project, there are now nine injection patterns. Consequently, you are requested to conduct annual surveys on a minimum of nine wells in the enlarged Unit Area.

All other provisions of Board Order No. PM 57 remain unchanged. Upon further expansion of the pressure maintenance project, a new Board Order, better reflecting pressure survey requirements, will be issued.

Board Order No. 76A provides conditional exemption from maximum permissible production rate restrictions of the Petroleum Drilling and Production Regulation. The provisions of this order apply without change to the enlarged Unit Area.

Yours respectfully,

~~Original~~ Signed by H. C. Moster

H. Clare Moster
Deputy Chairman

bc: Petroleum Branch
C. S. Kang, Chairman
Wm. McDonald, Member

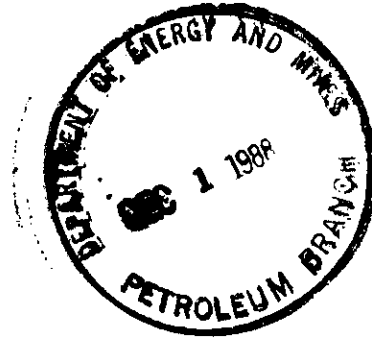
LRD/HCM/sml

ENRON
Oil Canada Ltd.

(403) 298-2600

25 November 1988

Manitoba Energy and Mines
Petroleum Department
#555, 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3



Attention: Mr. L.R. Dubreuil,
Chief Petroleum Engineer

Dear Sir:

Re: 1988 Pressure Surveys
Waskada Unit No. 16

Please find attached a copy of the proposed fall off test procedure for the original Waskada Unit No. 16 area.

Enron Oil Canada Ltd. hopes to start conducting the tests on the morning of December 5, 1988, while at the same time continuing to inject in the expanded Unit area. The continued injection into 1-9, 5-10, 6-9, 10-9 and 16-9 is not expected to affect the integrity of the tests.

Enron will be forwarding the surveys just completed on the new injectors and the fall off tests as soon as the results become available.

Yours very truly,

ENRON OIL CANADA LTD.

A handwritten signature in dark ink, appearing to read "T. McKay".

T. McKay,
Production Engineer

TM:pdc
attach

WASKADA UNIT NO. 16
FALL OFF TEST PROGRAM

1. Record surface pressures of all four injectors (5-4, 11-4, 15-4, 16-5) on the morning of December 5, 1988.
2. Shut in injectors and record surface pressure and time of shut in.
3. Continue to record surface pressures every one to two hours for the first day of shut (minimum of five times).
4. For the next five days record pressures twice daily.
5. During the next six to fourteen days record pressures once a day or until well goes on vacuum.
6. During these fall off tests data sheets should be sent to the Calgary office twice a week (Monday and Friday).

NOTE: It is imperative that accurate gauges be used and checked with a dead weight tester prior to and during these tests.

cc: C. Turnbull
D. Logie
D. Stoodley
I. Verstraete
I. Fenwick

~~Donna~~ / DAN

19 October 1988

Manitoba Energy and Mines
Petroleum Department
#555, 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3



Attention: Mr. L.R. Dubreuil,
Chief Petroleum Engineer

Dear Sir:

Re: Applications to Convert Wells to
Water Injection - Waskada Unit No. 16

Please find enclosed applications to convert the following wells
to water injection:

Enron et al Waskada	1-9-2-25 WPM
Enron et al Waskada	6-9-2-25 WPM
Enron et al Waskada	10-9-2-25 WPM
Enron et al Waskada	16-9-2-25 WPM
Enron et al Waskada	5-10-2-25 WPM

Should you have any questions or require further
information, please contact the undersigned at your convenience.

Yours very truly,

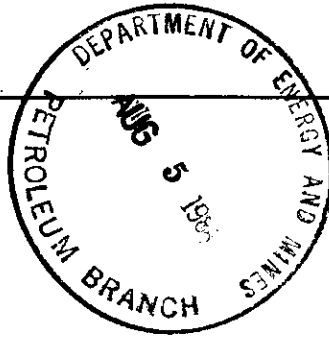
ENRON OIL CANADA LTD.

T. McKay,
Production Engineer

A handwritten signature in cursive script, appearing to read "T. McKay".

TM:pdc
attach

cc: Waskada Field Office



Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

AUG - 4 1988

Enron Oil Canada Ltd.
1300 - 700 - 9th Avenue S.W.
CALGARY, Alberta
T2P 3V4

Attention: Mr. H. Dale Logie,
Chief Reservoir Engineer

Re: Waskada Lower Amaranth A Pool
Pressure Maintenance Expansion
Enron et al Waskada 1-9-2-25 (WPM)
Enron et al Waskada 6-9-2-25 (WPM)
Enron et al Waskada 10-9-2-25 (WPM)
Enron Waskada 16-9-2-25 (WPM)
Enron et al Waskada Prov. 5-10-2-25 (WPM)

Dear Sir:

Your application to expand pressure maintenance operations in Waskada Unit No. 16 by conversion of the subject wells to water injection is hereby approved. Pressure maintenance operations in the Unit will continue to be governed by the provisions of Board Order No. PM 57.

Please note that commencement of injection is not authorized prior to approval by the Board of the required expansion to Waskada Unit No. 16.

As pointed out in our letter of June 10, 1988 the Board is concerned that injection in the well Enron et al Waskada 4-9-2-25 (WPM) may be required to optimize production performance even if the injection is not completely confined to the Lower Amaranth. However, Enron has excluded conversion of this well from its reservoir studies and its proposal. To better assess the effect of this you are requested, as a condition of approval, to rerun your reservoir simulation with the 4-9 well included as

an injector (with appropriate assumptions made for loss of water to the Mississippian). You are further requested to submit, prior to January 1, 1989 a summary of this analysis as compared to the appropriate performance predictions contained in your application.

Yours sincerely,

**ORIGINAL SIGNED BY
CHARLES S. KANG**

Charles S. Kang
Chairman

LRD/sml

Manitoba



Memorandum

Date August 2, 1988

To The Oil and Natural Gas
Conservation Board

From L. R. Dubreuil
Chief Petroleum Engineer
Petroleum Division

Subject Charles S. Kang - Chairman
Wm. McDonald - Deputy Chairman
R. Bruce Ball - Member

Telephone

Re: **Waskada Lower Amaranth A Pool**
Waskada Unit No. 16 - Pressure Maintenance Expansion

Enron Oil Canada Ltd. has made application to expand its pressure maintenance operations in the subject Pool. Notice of the application was published in the Manitoba Gazette (June 25, 1988) and The Deloraine Times and Star (June 22, 1988). In addition, copies of the notice were sent to all working interest owners offsetting the proposed project. No objections to or interventions in the application have been received.

Recommendations:

It is recommended that the application be approved and that the attached letter of approval be forwarded to Enron.

Discussion:

Upon receipt of Enron's application, a deficiency letter was sent to Enron requesting additional comment and information as required by The Petroleum Drilling and Production Regulation. One area of concern resulted from Enron's unwillingness to convert the well Enron et al Waskada 4-9-2-25 (WPM) to water injection. This well is an injection location in the injection pattern being employed by Enron. Enron is unwilling to convert this well to injection because of evidence that suggests communication between the Lower Amaranth and the Mississippian in this and nearby wells. Enron contends that in the presence of such communication, the effectiveness of injection would be reduced due to loss of injected water into the Mississippian. In its letter the Board indicated its concern that lack of injection in the area could negatively effect performance of the project. In its response, Enron noted previous efforts made to eliminate communication which were not completely successful. Enron concludes that containment of water within the Lower Amaranth would not be effective.

First | Fold

The positions of Enron and the Board can be summarized as follows:

- 1) Enron's primary objective appears to be maximizing effectiveness of available injection water.
- 2) The Board's primary concern is maximizing recovery from the area and implies that partial pressure support at 4-9 may benefit the overall performance of the project.

In as much as pressure maintenance is clearly required to maximize recovery it is proposed that Enron's application be approved and that additional performance analysis be made to better define the effect of injection at the 4-9 location. The proposed condition on approval is outlined in the attached letter.

All other issues raised in the Board's deficiency letter have been adequately resolved.

Board Order No. PM 57 which governs pressure maintenance operations in Waskada Unit No. 16 authorizes the Board to approve conversion of additional wells within the Unit to injection. Enron has confirmed its plans to expand Unit No. 16 as opposed to forming a new Unit. Consequently the attached letter of approval is all that is required.

L. R. Dubreuil

Original Signed by
L. R. DUBREUIL

Recommended for Approval: _____
for H. Clare Moster

Attachment

Is
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NOTICE WASKADA OIL FIELD

Enron Oil Canada Ltd. has made application under The Mines Act to expand its waterflood operations in the Waskada Lower Amaranth A Pool. Enron proposes to convert the following wells to water injection.

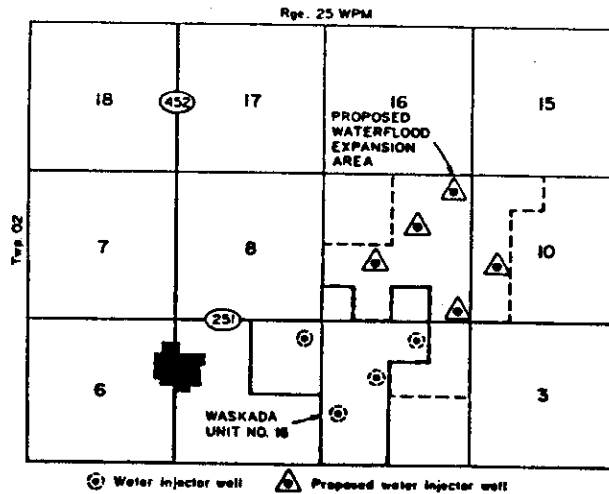
Enron et al Waskada 1-9-2-25 (WPM)

Enron et al Waskada 6-9-2-25 (WPM)

Enron et al Waskada 10-9-2-25 (WPM)

Enron et al Waskada 16-9-2-25 (WPM)

Enron et al Waskada 5-10-2-25 (WPM)



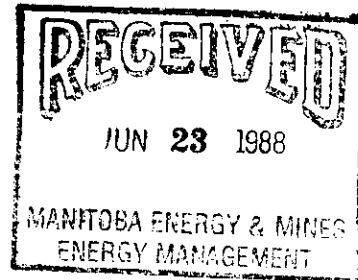
If no objection or intervention in writing is received by the Board at Room 309, Legislative Buildings, Winnipeg, Manitoba, R3C 0V8 within 14 days of the publication of this notice, the Board may approve the application.

Dated at Winnipeg this 10 day of June, 1988.

WM. McDonald
Deputy Chairman

Deloraine Times & Star

June 22/88



21 June 1988

The Oil and Gas Conservation Board
#555, 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3

Attention: Mr. W. McDonald,
Deputy Chairman

Dear Sir:

Re: Waskada Lower Amaranth "A" Pool
Proposed Waterflood Expansion

In reply to your letter dated June 10, 1988, the following information is provided in response to the four questions you have posed:

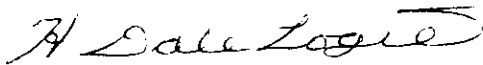
1. Attached please find copies of the consent of surface owners for conversion of the five proposed water injection wells.
2. Enron et al Waskada 4-9-2-25 WPM was cement squeezed September 7, 1984 in an attempt to eliminate communication between the Lower Amaranth and Mississippian formations. This cement squeeze reduced but did not eliminate the Mississippian communication problem with a coincident negative reduction of wellbore permeability in the Lower Amaranth zone. Mississippian communication problems also exist in offset wells 13-4 and 5-9 (an unsuccessful cement squeeze was also conducted on well 5-9). For these reasons, it is felt that containment of water injection within the Lower Amaranth zone in this area of the pool would not be effective. Additionally, offset wells Enron 5-9 (0.8 m³/d) and Omega 8-8 (0.9 m³/d) are poor oil producers. Injection into well 6-9 will hopefully curtail the decline of oil productivity from well 3-9. The waterflood study did not include water injection at well 4-9.
3. Wells in the southwest quarter of Section 15 will not be included in this round of unit negotiations and thus well 4-15 will not be converted to water injection at this time. Enron has plans to drill wells at 3-15 and 11-10 in the summer of 1988. Dependent upon drilling results and after at least three months of continuous production, an additional unit expansion may be required.

4. Enron Oil Canada Ltd.'s intention is to strive for the enlargement of Unit No. 16. Unit negotiations will however determine whether enlargement or formation of a new unit will be necessary.

We hope that this addresses your concerns and we look forward to a favourable response to our application.

Yours very truly,

ENRON OIL CANADA LTD.



H. Dale Logie,
Chief Reservoir Engineer

HDL:pdc
attach

CONSENT OF LESSOR

WE, TEMPLE LAND LTD., Lessor of a Surface Lease dated the 14th day of February, A.D. 1986 do hereby grant consent to ENRON OIL CANADA LTD., Lessee, to convert an oilwell located in Legal Subdivision Six (6) of Section Nine (9), Township Two (2), Range Twenty-Five (25), West of the Principal Meridian to a water injection well as required by Lessee's pressure maintenance program. This consent is provided pursuant to Clause 2 of the Surface Lease Agreement.

DATED this 8th day of June, A.D. 1988.

TEMPLE LAND LTD.

Per Lerald D. Temple

Sec. Lorna J. Temple

Files: 3692,
3699 and 3335

CONSENT OF LESSOR

I, GERALD DEAN TEMPLE, Lessor of the following Surface Leases:

Surface Lease dated February, 14, 1986 - Enron et al Waskada 1-9-2-25-WPM

Surface Lease dated February, 13, 1986 - Enron et al Waskada 10-9-2-25-WPM

Surface Lease dated February, 20, 1985 - Enron Waskada 16-9-2-25-WPM

do hereby grant consent to ENRON OIL CANADA LTD., Lessee, to convert the said three (3) oilwells to water injection wells as required by Lessee's pressure maintenance program. This consent is provided pursuant to Clause 2 of the Surface Lease Agreements.

DATED this 8th day of June, A.D. 1988.

(Witness)

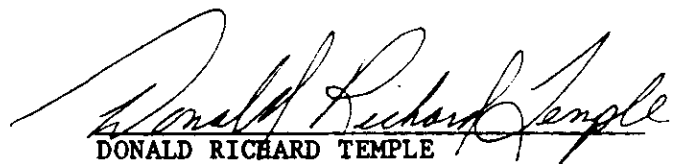

GERALD DEAN TEMPLE

CONSENT OF LESSOR

I, DONALD RICHARD TEMPLE, Lessor of a Surface Lease dated the 14th day of February, A.D. 1986 do hereby grant consent to ENRON OIL CANADA LTD., Lessee, to install an oilwell satellite battery to be located at Legal Subdivision Thirteen (13) of Section Ten (10), Township Two (2), Range Twenty-Five (25), West of the Principal Meridian. This consent is provided pursuant to Clause 2 of the Surface Lease Agreement.

DATED this 8th day of June, A.D. 1988.


(Witness)


DONALD RICHARD TEMPLE

CONSENT OF LESSOR

I, DONALD RICHARD TEMPLE, Lessor of a Surface Lease dated the 2nd day of March, A.D. 1988 do hereby grant consent to ENRON OIL CANADA LTD., Lessee, to convert an oilwell located in Legal Subdivision Five (5) of Section Ten (10), Township Two (2), Range Twenty-Five (25), West of the Principal Meridian to a water injection well as required by Lessee's pressure maintenance program. This consent is provided pursuant to Clause 2 of the Surface Lease Agreement.

DATED this 8th day of June, A.D. 1988.


(Witness)


DONALD RICHARD TEMPLE



The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

June 10, 1988

Enron Oil Canada Ltd.
1300 - 700 - 9th Avenue S.W.
CALGARY, Alberta
T2P 3V4

Attention: Mr. H. Dale Logie,
Chief Reservoir Engineer

Re: Waskada Lower Amaranth A Pool
Proposed Waterflood Expansion

Dear Sir:

Your application, dated May 30, 1988, to expand your waterflood operations in the subject Pool is acknowledged. To assist in our processing of the application, we request that you provide the information, clarification or comments requested below:

1. To complete the application, we request that you provide, at this time, evidence that surface owners have been notified of your plans.
2. We are concerned that exclusion of the well Enron et al Waskada 4-9-2-25 (WPM) from conversion in the expanded waterflood scheme may adversely affect ultimate recovery. Figure No. 1 shows the percentage change in operating day oil rate between August 1987 (before production response commenced) and April 1988. We note that all but one of the wells in the unit showing a positive change in rate are offset by two injectors. On the other hand, four out of seven wells showing a negative change in rate are offset by only one injector. If the 4-9 well is not converted to injection, three wells (2 Enron operated and 1 Omega operated) would be offset by only one injection well. Further, it has been indicated by Omega that success in eliminating Lower Amaranth/Mississippian communication has recently been achieved in injection wells by cement squeezing. Your further comments and consideration of conversion of this well to injection are requested.
3. The reservoir simulation study included conversion of the well Enron et al Waskada A4-15-2-25 (WPM) to water injection. However, your application does not include this conversion. Please clarify your plans with respect to this well.

4. As you are aware, prior to commencement of injection in accordance with your plans, unitization will be necessary. To assist in preparing the necessary pressure maintenance approvals, we request that you provide, as soon as possible, an indication of whether you intend to enlarge Unit No. 16 or form a new unit.

Initial processing of your application (including publication of a notice) will be proceeded with at this time. Upon receipt of your response to this letter, and the expiry of the notice period, processing will be completed.

Yours respectfully,

ORIGINAL SIGNED BY
WM. M. McDONALD P. ENG

Wm. McDonald
Deputy Chairman

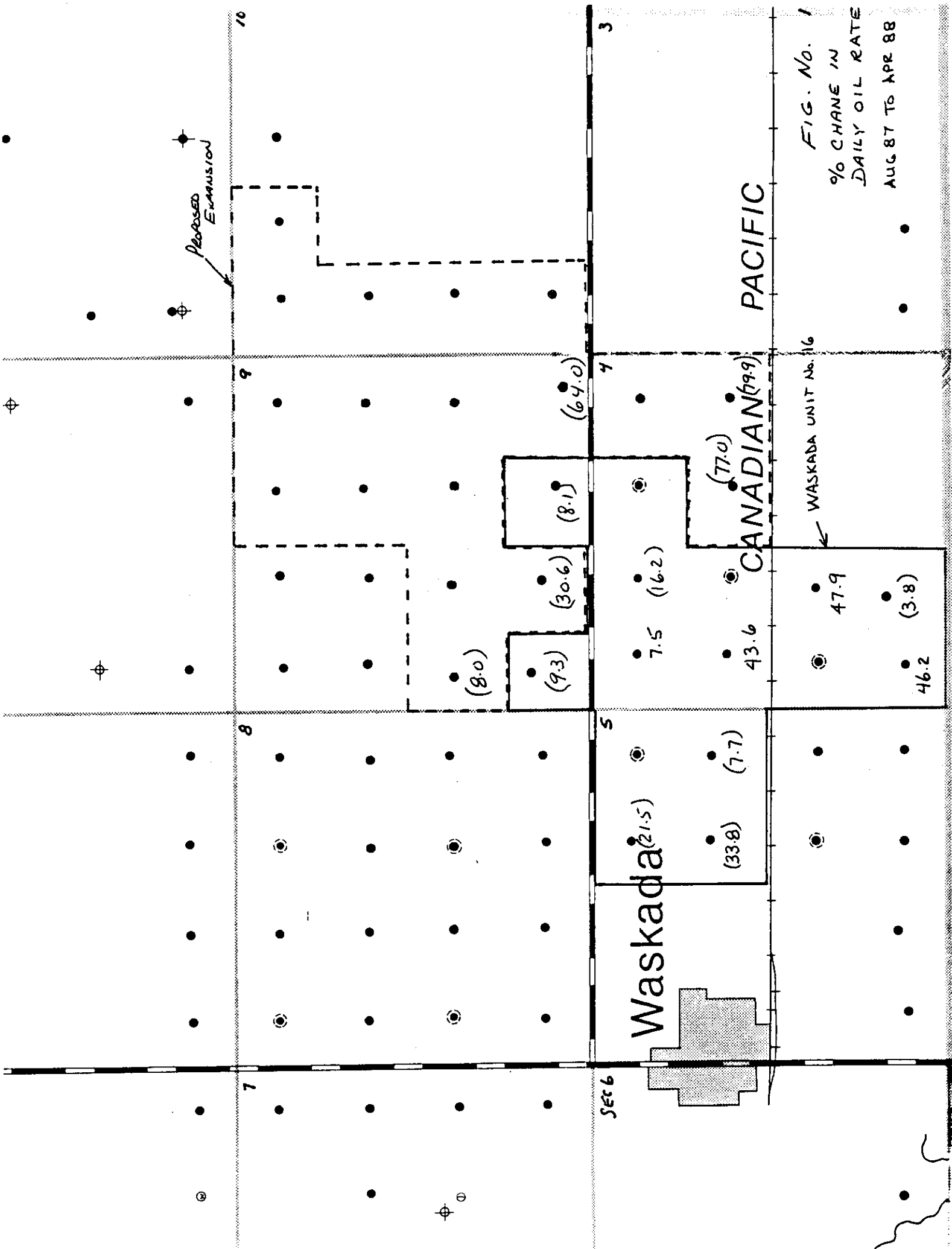


FIG. No. 1
% CHANGE IN
DAILY OIL RATE
AUG 87 TO APR 88

WASKADA UNIT No. 116

PACIFIC

CANADIAN

Waskada

PROPOSED
EXAMINATION

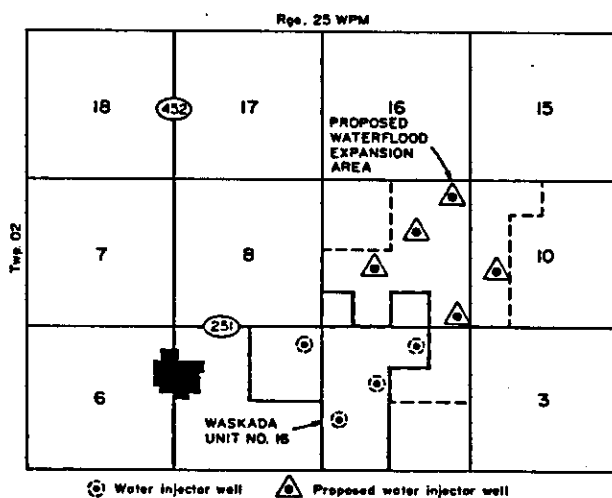


NOTICE

WASKADA OIL FIELD

Enron Oil Canada Ltd. has made application under The Mines Act to expand its waterflood operations in the Waskada Lower Amaranth A Pool. Enron proposes to convert the following wells to water injection.

Enron et al Waskada 1-9-2-25 (WPM)
Enron et al Waskada 6-9-2-25 (WPM)
Enron et al Waskada 10-9-2-25 (WPM)
Enron Waskada 16-9-2-25 (WPM)
Enron et al Waskada 5-10-2-25 (WPM)



If no objection or intervention in writing is received by the Board at Room 309, Legislative Building, Winnipeg, Manitoba, R3C 0V8 within 14 days of the publication of this notice, the Board may approve the application.

Dated at Winnipeg this

10 day of June, 1988

Wm. McDonald
Deputy Chairman



Memorandum

Date June 4, 1988

To The Oil and Natural Gas Conservation Board

From L. R. Dubreuil
Chief Petroleum Engineer
Petroleum Division

Charles S. Kang - Chairman
Wm. McDonald - Deputy Chairman
R. Bruce Ball - Member

Subject Telephone

Re: Waskada Lower Amaranth A Pool
Waterflood Expansion - Enron

Enron Oil Canada Ltd. has made application to expand its pressure maintenance operations in the Waskada Lower Amaranth A Pool. Enron proposes to convert the following wells to water injection:

Enron et al Waskada 1-9-2-25 (WPM)
Enron et al Waskada 6-9-2-25 (WPM)
Enron et al Waskada 10-9-2-25 (WPM)
Enron Waskada 16-9-2-25 (WPM)
Enron et al Waskada Prov. 5-10-2-25 (WPM)

Recommendation

It is recommended that notice of the application be published in the Manitoba Gazette and the Deloraine Times and Star. A copy of the proposed notice is attached.

It is also recommended that the attached letter acknowledging receipt of the application and requesting clarification and further comment be sent to Enron.

Discussion

Enron is the operator of Waskada Unit No. 16. A waterflood project was initiated in this Unit in June 1987. Enron has successfully continued its development drilling in the area and now wishes to expand its waterflood operations (see Fig. No. 1.)

Waterflooding operations in Unit No. 16 have resulted in an increase in production rate of more than 40% since August 1988. (see Fig. No. 2.) Figure No. 3 shows the net change in daily production rate for each well in the Unit and proposed expansion area. It is noted that the most significant

response has taken place in the south and central part of the Unit. By comparison, wells in the proposed expansion area have experienced severe production declines clearly demonstrating the need for pressure maintenance.

Enron is proposing an incomplete inverted seven spot injection pattern as shown on Fig. No. 4. This pattern is a continuation of the pattern established in Unit No. 16. In support of its recommendation, Enron has submitted a reservoir simulation study. The reservoir model was history matched to observed reservoir pressure by adjusting input permeability values. Once history matched, five simulation predictions were made as follows:

- Case 1 - Primary production in study area.
- Case 2 - Existing waterflood in Unit 16, primary outside Unit.
- Case 3 - Inverted seven spot injection pattern - recommended.
- Case 4 - Inverted nine spot in expansion area. (Note: Enron has incorrectly referred to this as a five spot pattern.)
- Case 5 - Slightly modified inverted seven spot.

Table No. 1 shows a comparison of calculated recoveries (% of original oil in place) for all five cases. This comparison clearly demonstrates the need for waterflooding and indicates the relative insensitivity of recovery to injection pattern used. The slightly lower recovery achieved with continuation of the inverted nine spot pattern used elsewhere in the Pool is probably attributable to poorly swept areas at the boundary between the Unit 16 pattern and the assumed nine spot pattern.

Enron is proposing to leave the well Enron et al Waskada 4-9-2-25 (WPM) as a producer because of suspected communication with the Mississippian at this location. However, review of Figure No. 3 shows that all but one of the wells showing a positive rate change (between Aug. 87 and April 88) are offset by two injection wells. Further, all but one of the wells showing a negative rate change over the same period are offset by only one injection well. In view of this, even if there may be some pressure support in the area from the Mississippian, every effort should be made to eliminate interzone communication at this location and convert the well to injection.

The reservoir simulation study (Case 3) also included conversion of the well Enron et al Waskada A4-15-2-25 (WPM) to water injection. The application, however does not include this conversion. Enron should be questioned as to reasons for exclusion of this well.

Enron has not provided evidence that surface owners in the proposed expansion areas have been notified of its plans. This should be provided as soon as possible to facilitate processing.

Enron has provided all other information required with respect to surface facilities, wellbore completions etc., and all is satisfactory.

Because working interest, royalty and surface owners in the area may be affected by the prospect, advertisement for objections is required. Advertisement in the Deloraine Times and Star (distributed in the Waskada area) as well as in the Manitoba Gazette is recommended. A copy of the notice should also be sent to all offsetting working interest owners (listed on Table No. 2). A proposed notice is attached.

Also attached is a proposed letter requesting additional information and clarification as noted above.

Enclosed for review
by Mr. Dubreuil

L. R. Dubreuil

LRD/sml

Recommended for Approval:

Signature of H. C. Moster

H. Clare Moster

Attachment

TABLE NO. 1

PREDICTED RECOVERY

Recovery (% of 001P)

<u>CASE NO.</u>	<u>10 YEARS</u>	<u>20 YEARS</u>	<u>40 YEARS</u>
1	7.3	9.3	-
2	8.9	12.3	-
3	12.4	19.8	29.1
4	11.8	19.5	-
5	12.6	20.2	-

TABLE NO. 2

WORKING INTEREST OWNERS OFFSETTING
PROPOSED WATERFLOOD EXPANSION

<u>AREA</u>	<u>WORKING INTEREST OWNER</u>
SE 1/4-4-2-25 (WPM)	
SW 1/4-3-2-25 (WPM)	
SE 1/4-16-2-25 (WPM)	Omega Hydrocarbons Ltd.
NW 1/4-9-2-25 (WPM)	
A11 8-2-25 (WPM)	
E 1/2-10-2-25 (WPM)	
S 1/2-15-2-25 (WPM)	Wildmount Resources Ltd.
W 1/2-16-2-25 (WPM)	c/o Trilogy Resources Corporation

All other offsetting working interest owners also have an interest in the proposed expansion area.

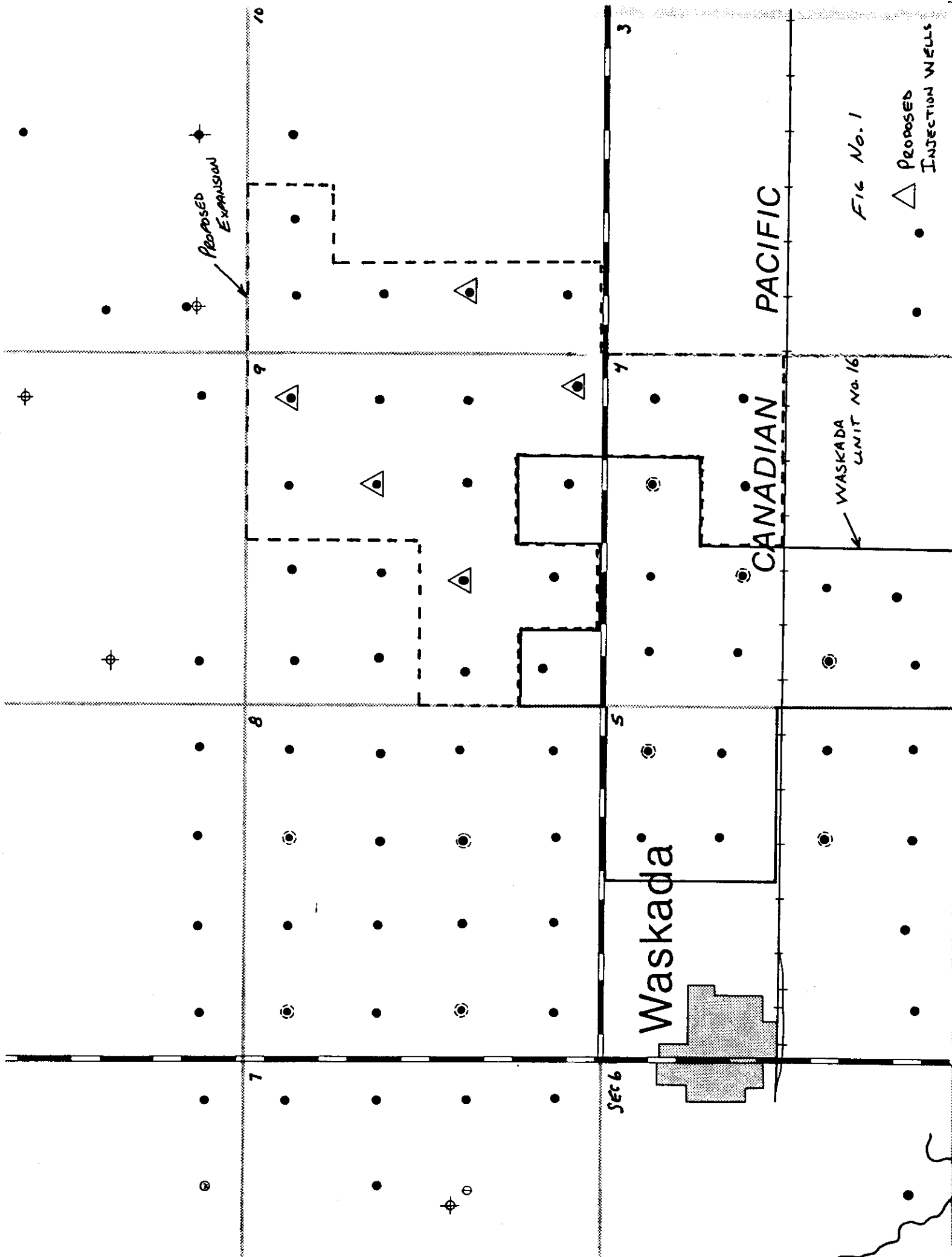


Fig No. 1

△ PROPOSED
INJECTION WELLS

WASKADA
UNIT No. 16

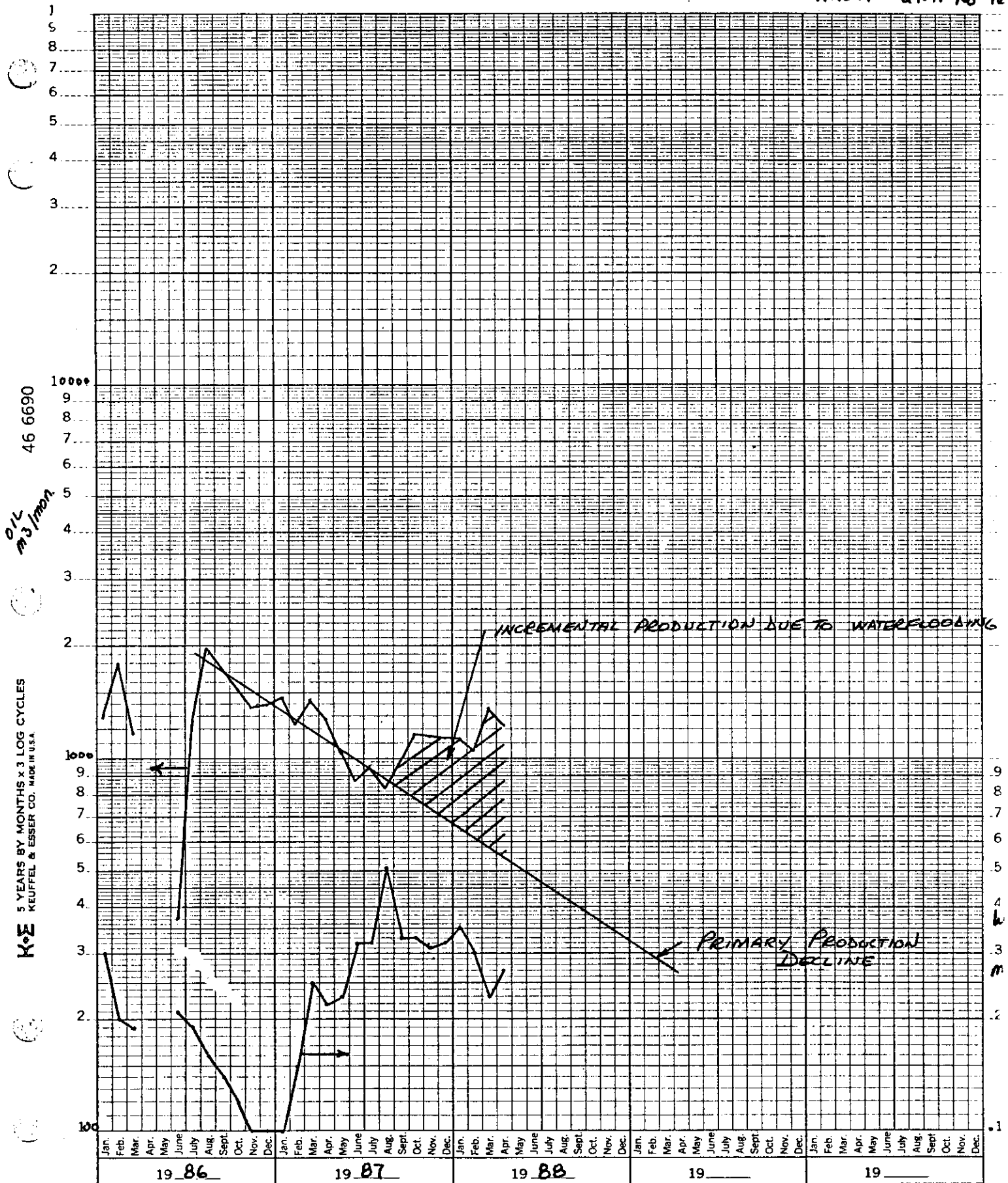


FIG. No. 2

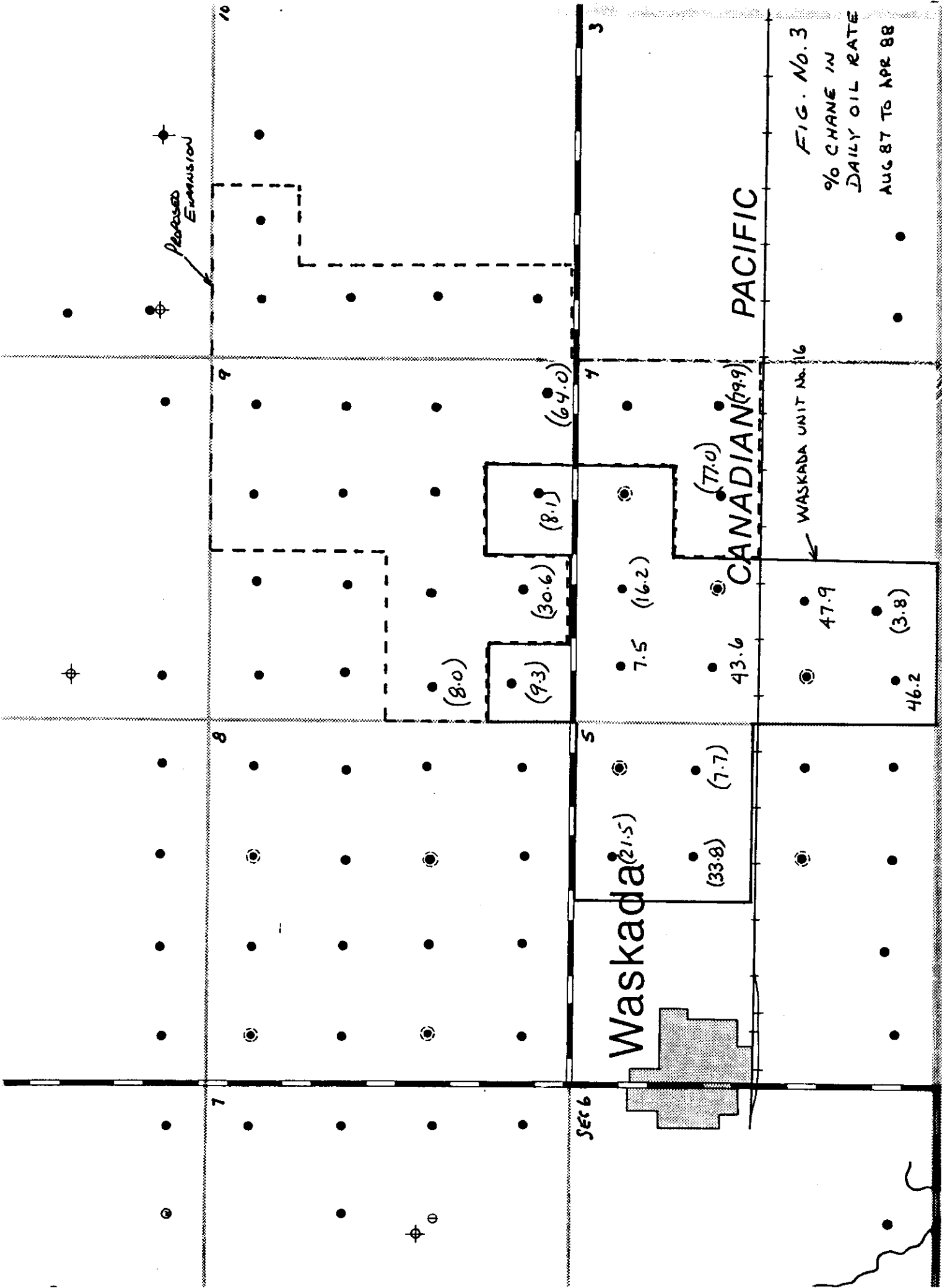
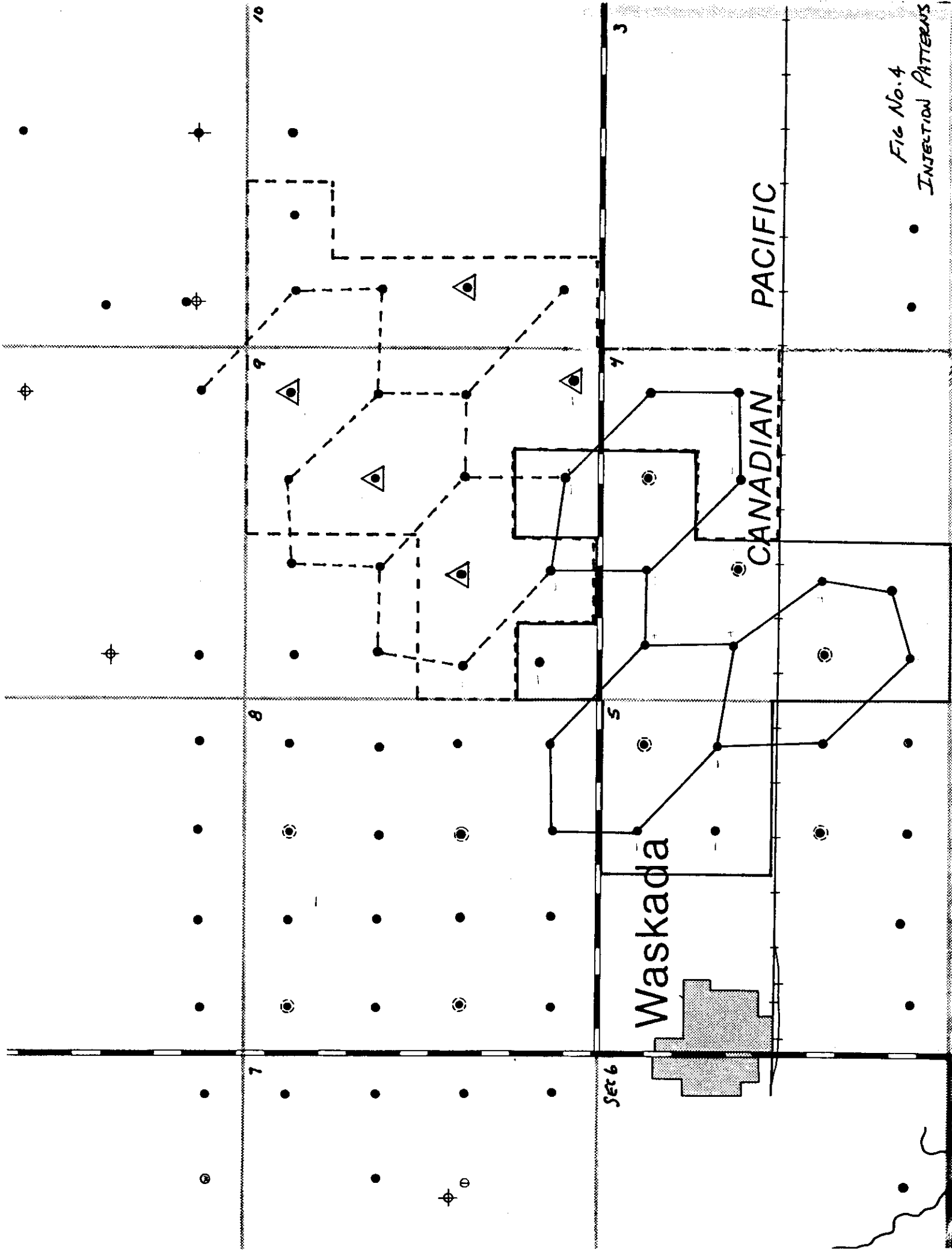
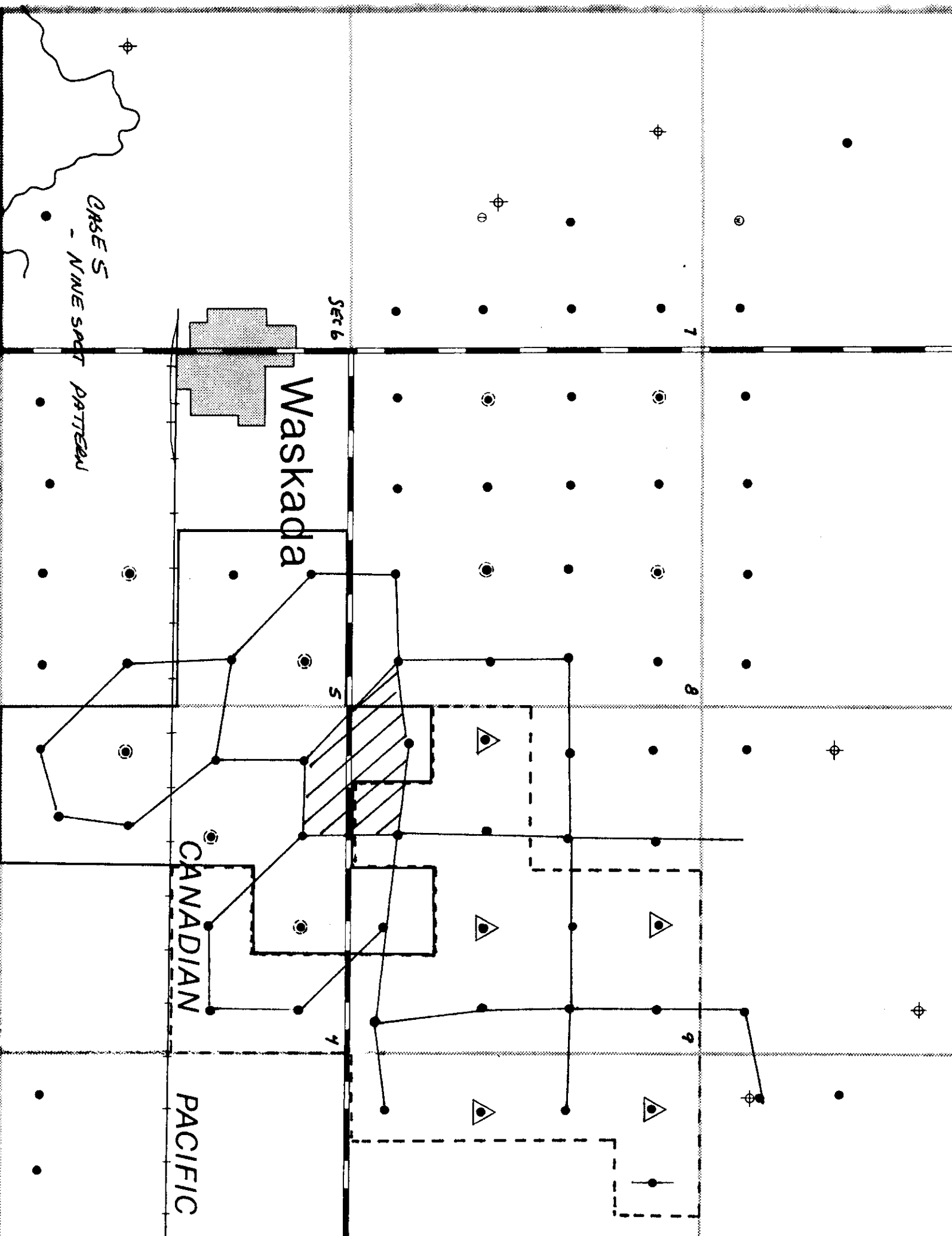


FIG. No. 3
% CHANGE IN
DAILY OIL RATE
AUG 87 TO APR 88

FIG No.4
INJECTION PATTERNS





<u>Well</u>	<u>April 88</u>	<u>Aug 87</u>	<u>% change</u>
3-4	0.79	0.82	(3.8)
4-4	5.35	3.66	46.2
6-4	9.36	6.33	47.9
12-4	3.03	2.11	43.6
13-4	1.43	1.33	7.5
14-4	2.23	2.66	(16.2)
9-5	12.40	13.44	(7.7)
10-5	0.53	0.80	(33.8)
15-5	0.79	0.96	(21.5)
2-9	2.73	3.01	(9.3)
4-9	2.15	2.34	(8.1)
9-4	1.45	7.20	(79.9)
10-4	2.92	12.70	(77.0)
16-4	2.48	—	
1-9	1.09	3.03	(64.0)
3-9	7.88	11.35	(30.6)
5-9	0.46	0.50	(8.0)

30 May 1988

The Oil and Gas Conservation Board
#555, 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3

Attention: Mr. Charles S. Kang,
Chairman

Dear Sir:

Re: Waskada Lower Amaranth "A" Pool
Pressure Maintenance Application

Enron Oil Canada Ltd. presently operates a pressure maintenance scheme in Waskada Unit No. 16 which commenced water injection in June 1987 (Map No. 1). Application is hereby made to expand the existing waterflood project or create a new waterflood project in the adjacent Enron operated area as shown on Map No. 2. Unitization of this expanded area will commence immediately.

Permission is requested to create a seven-spot waterflood pattern (Map No. 3) by injecting water into wells Enron et al Waskada 1-9-2-25, Enron et al Waskada 6-9-2-25, Enron et al Waskada 10-9-2-25, Enron Waskada 16-9-2-25 and Enron et al Waskada 5-10-2-25 coincident with the effective date of the new or expanded Unit.

The enclosed Waskada Lower Amaranth Waterflood Computer Simulation Study provides the necessary detailed information in support of this application. The following items are included for additional application support:

- 1) A map showing the surface owners, lessors and lessees in and adjoining the area of application (Map No. 4).
- 2) Maps of the surface facilities, oil lines and water injection lines (Map Nos 5 and 6).
- 3) Schematic diagrams of injection well completions.
- 4) Schematic of the Waskada water distribution system.

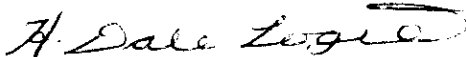
Copies of notification to surface owners will be submitted at a later date when all approvals have been received.

The chosen seven-spot waterflood pattern supplements present Waskada Unit No. 16 water injector locations and conforms nicely with the way the reservoir was geologically layed down in the subject area as evidence by individual well oil productivity (Table 1). The seven-spot pattern generally results in the conversion of wells with lower oil productivity to water injection. This results in accelerated oil recovery and a better distribution of water injection between layers with an associated reduction of potential water channelling. The seven-spot pattern decreases the producer to injector ratio over the conventional nine-spot pattern which should result in an increased sweep efficiency. Well 4-9 would probably not be converted to water injection due to its highly damaged condition and associated Mississippian communication problem.

If you have any questions concerning this application, please contact the undersigned at (403)298-2656.

Yours very truly,

ENRON OIL CANADA LTD.



H. Dale Logie,
Chief Reservoir Engineer

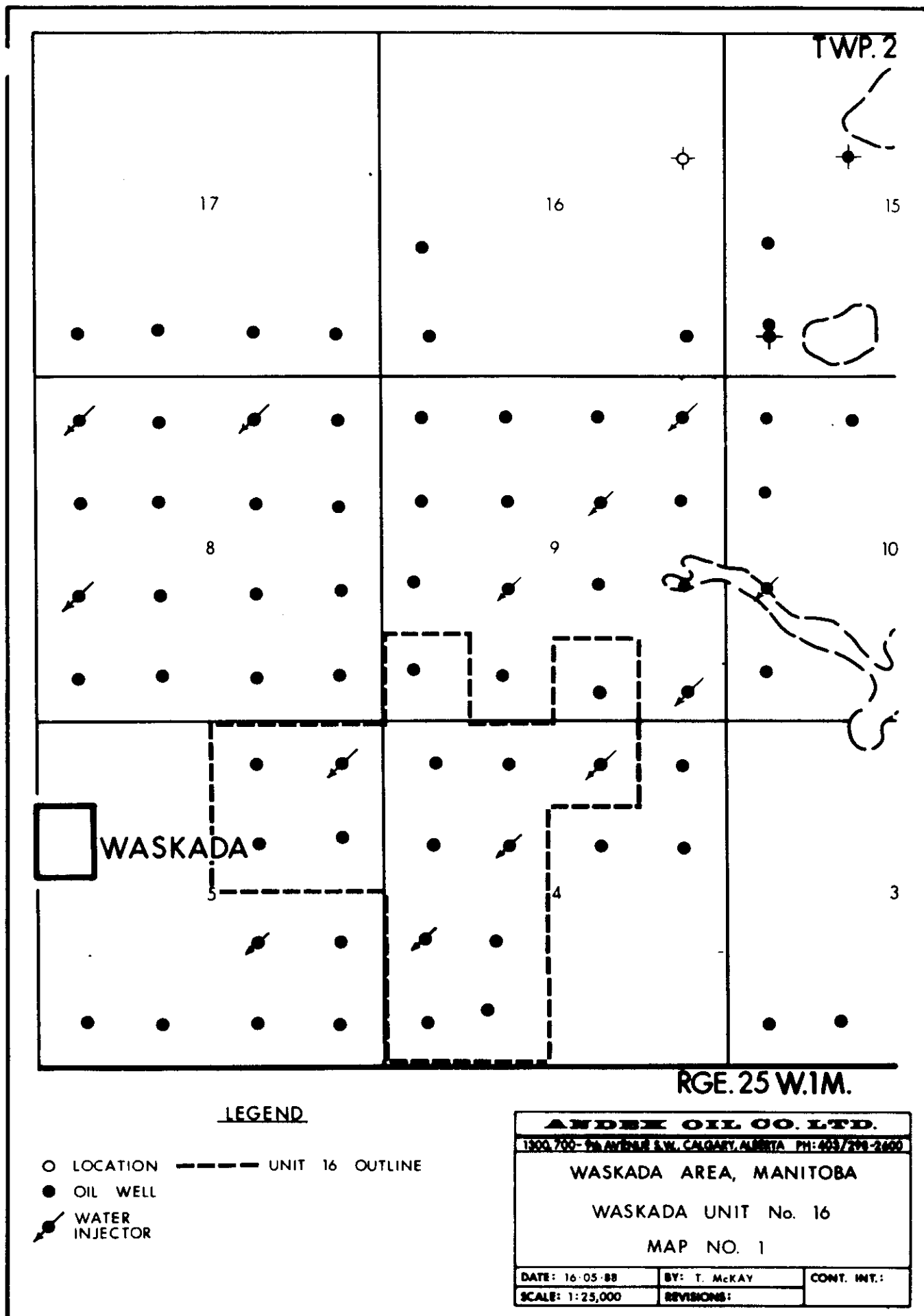
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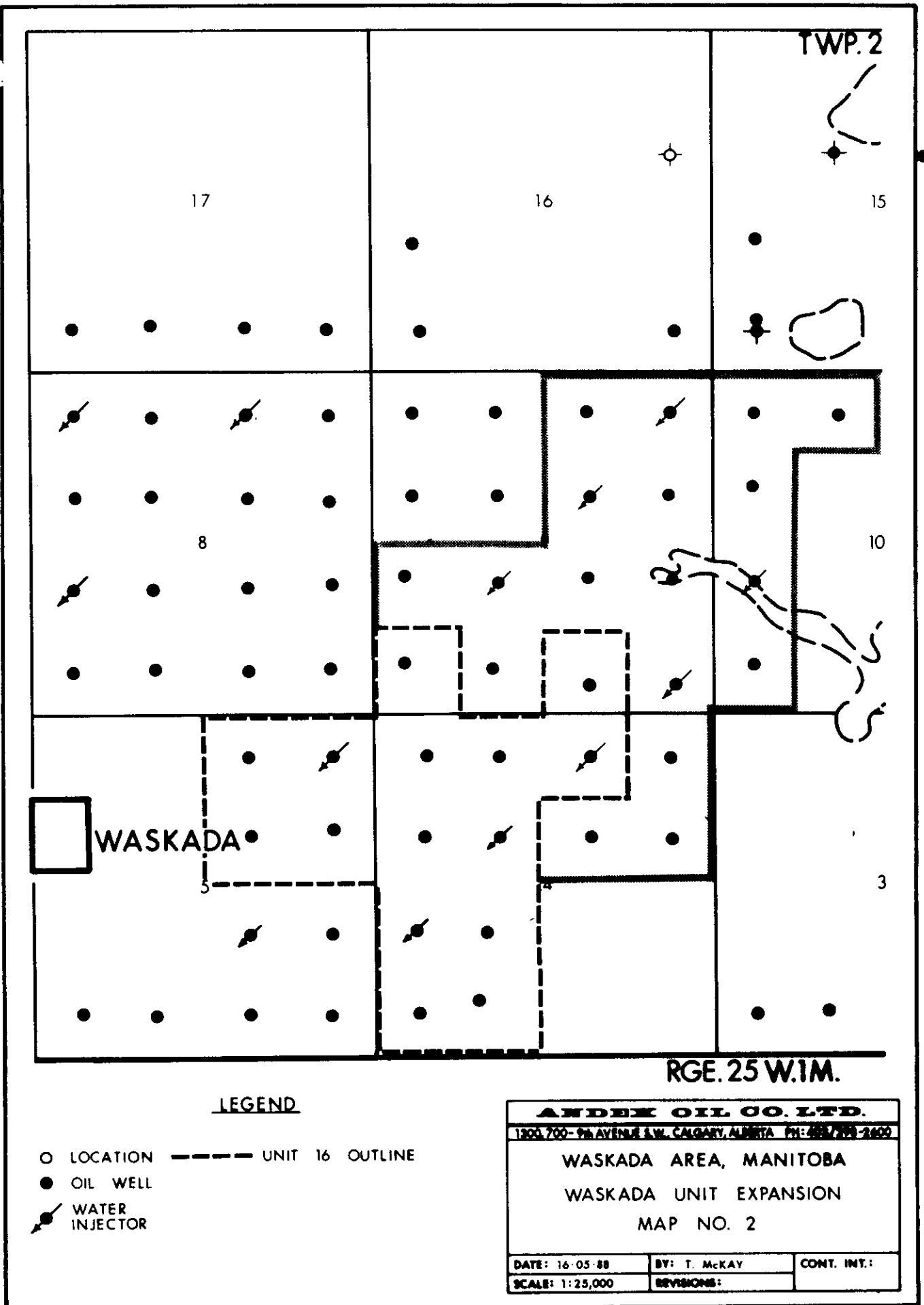
TABLE 1

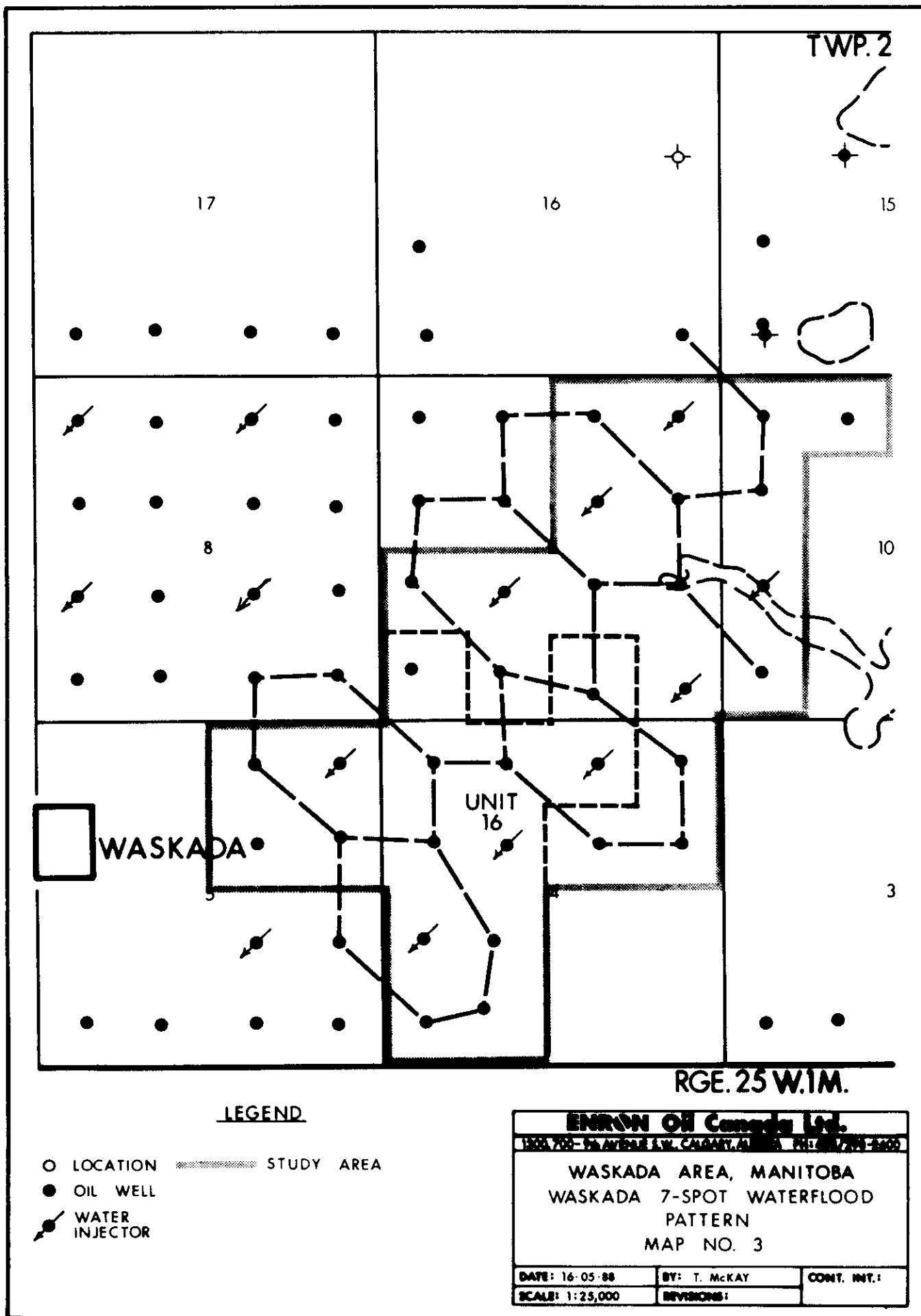
WASKADA LOWER AMARANTH
AVERAGE 1988 DAILY OIL PRODUCTIVITY
(m³/producing day)

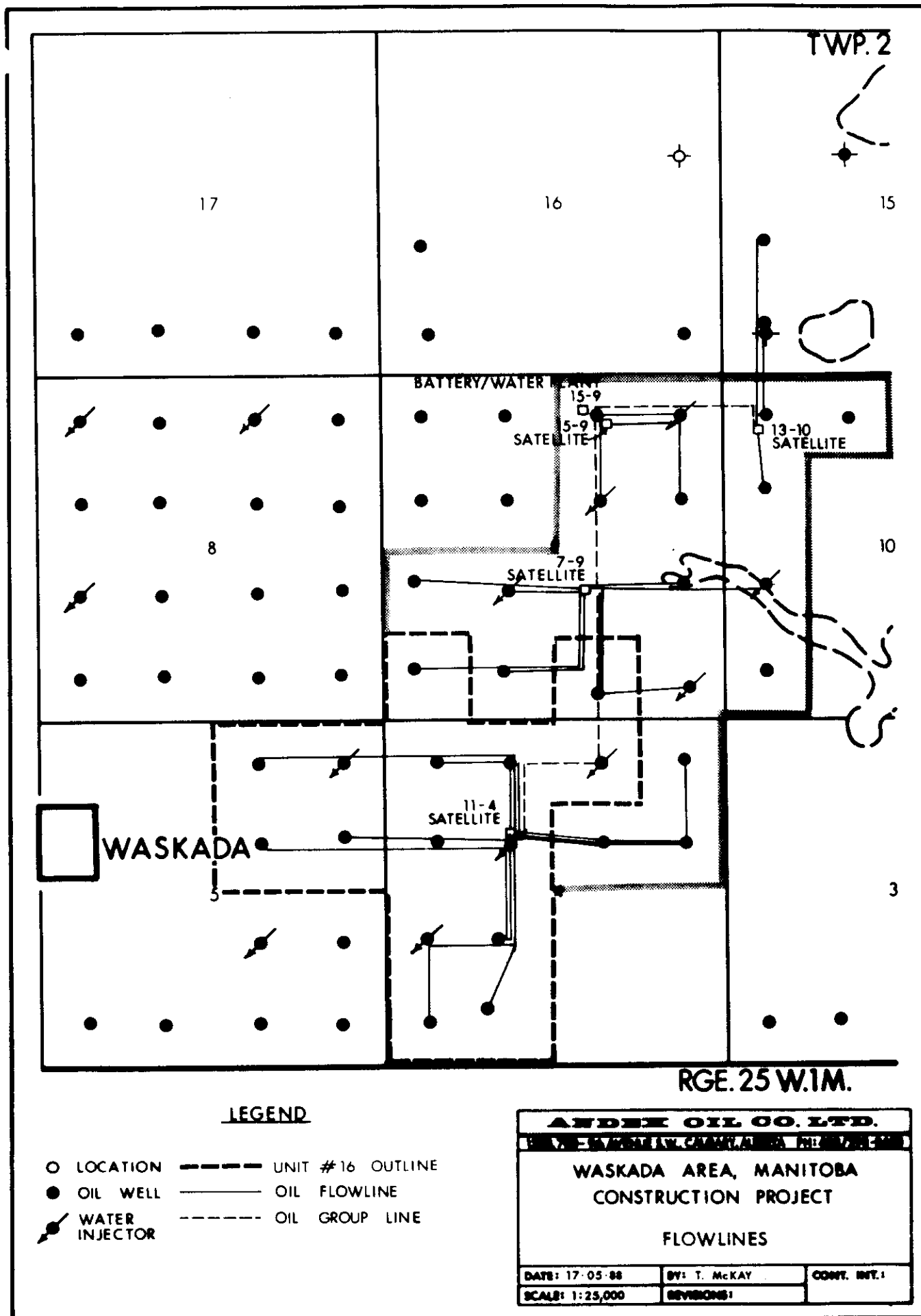
<u>Location</u>	<u>Daily Oil Production (m³/d)</u>
3-4-2-25	0.8
4-4	5.8
6-4	11.1
9-4	1.6
10-4	3.2
12-4	3.2
13-4	1.4
14-4	2.3
16-4	2.9
9-5	14.0
10-5	0.6
15-5	1.0
1-9	* 1.0
2-9	2.9
3-9	7.9
4-9	2.1
5-9	0.8
6-9	* 2.9
7-9	7.8
8-9	5.9
9-9	12.6
10-9	* 1.2
15-9	1.1
16-9	* 2.7
4-10	1.2
5-10	* 3.0
12-10	11.0
13-10	10.7
14-10	0.8
4-15	2.2
5-15	6.1

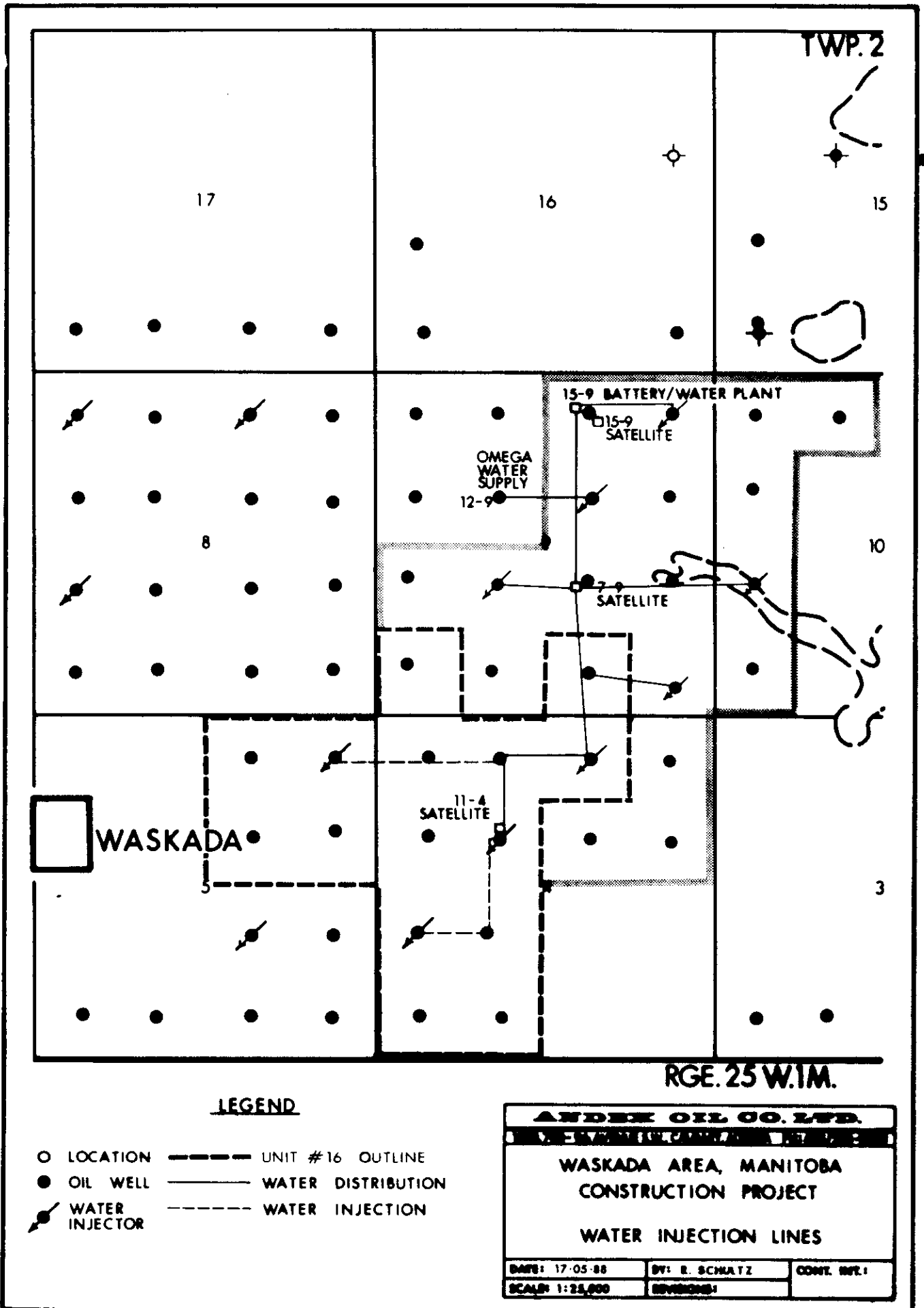
* Recommended injector locations to supplement injection wells 5-4, 11-4, 15-4 and 16-5.



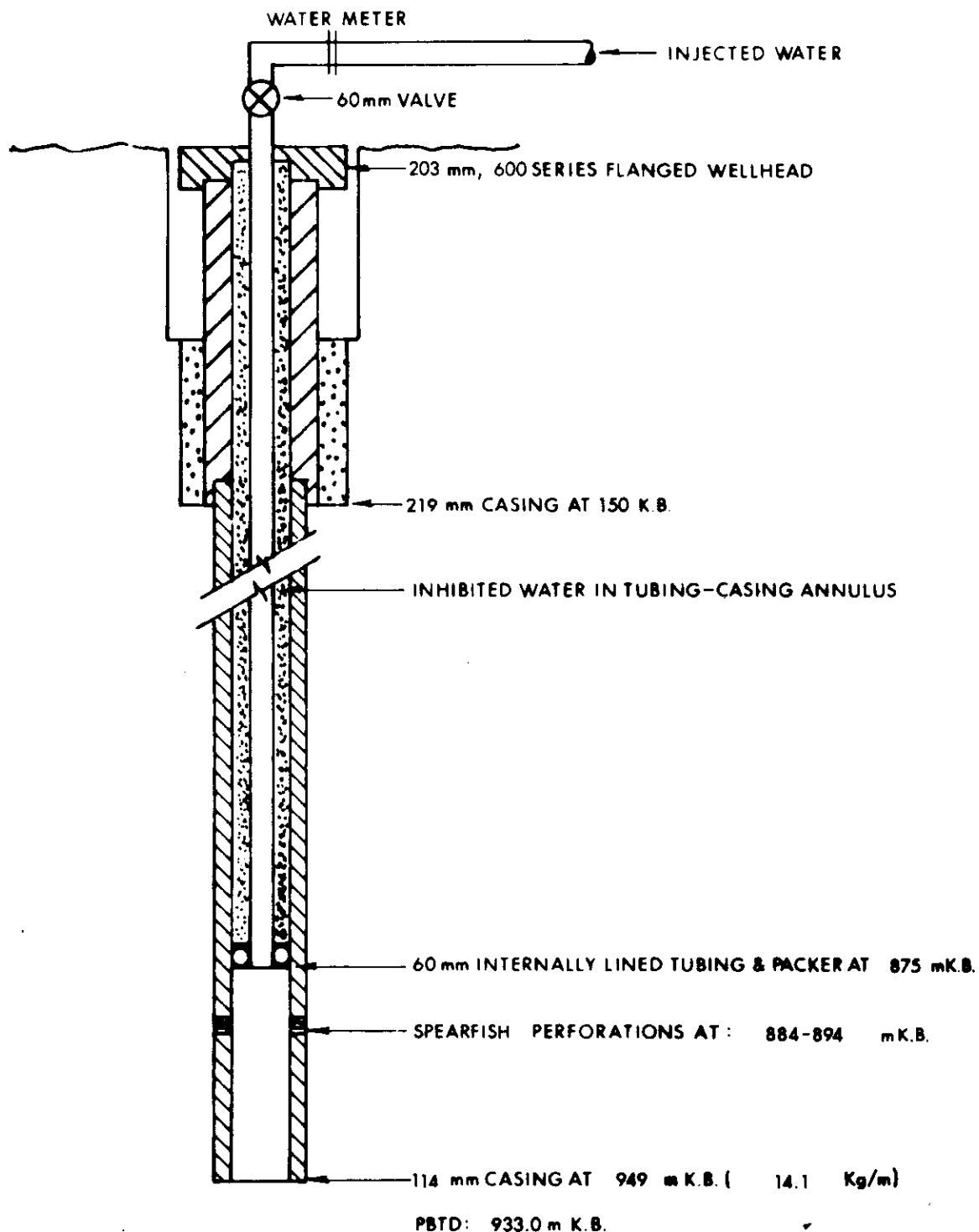






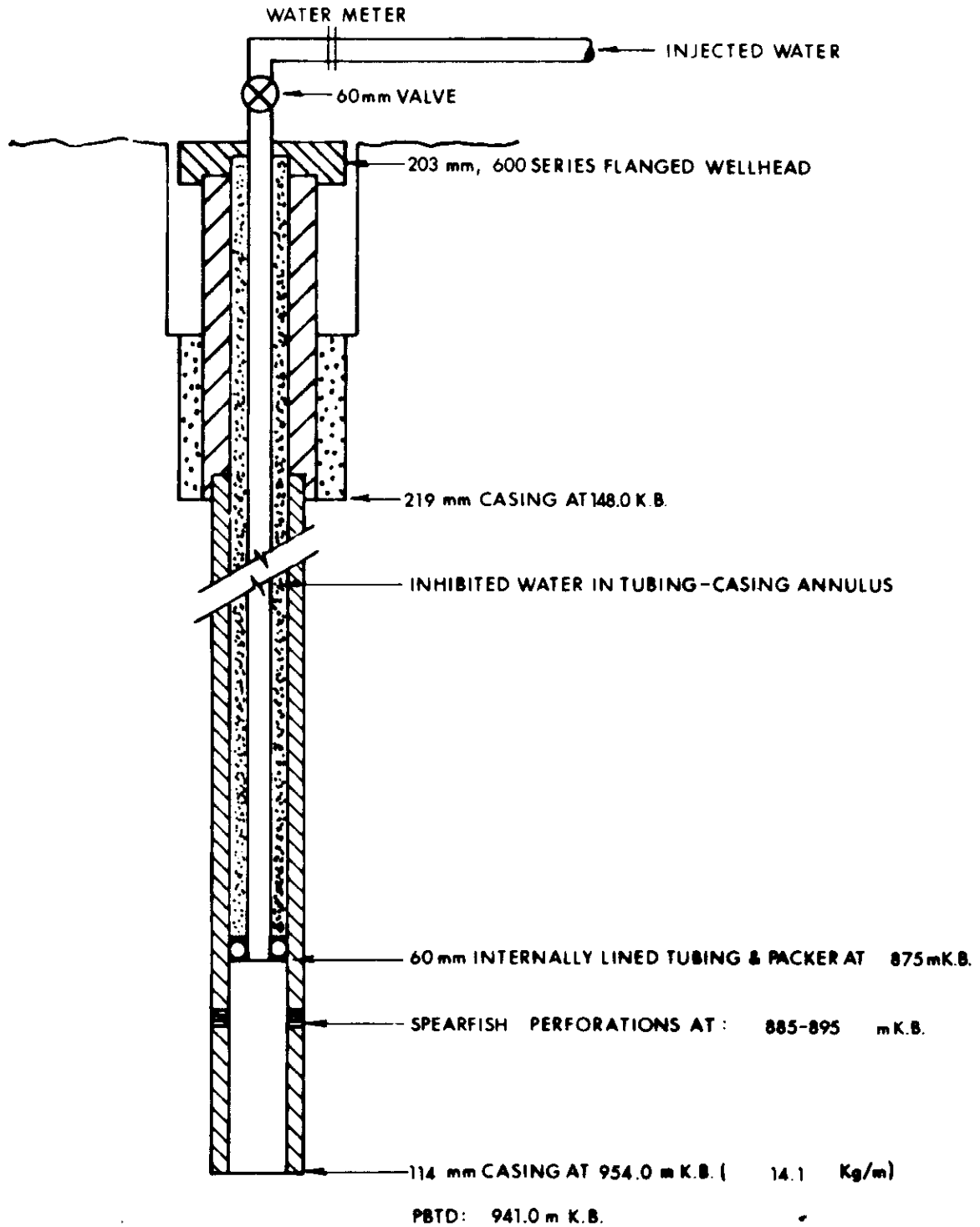


PROPOSED INJECTION WELL SUBSURFACE EQUIPMENT



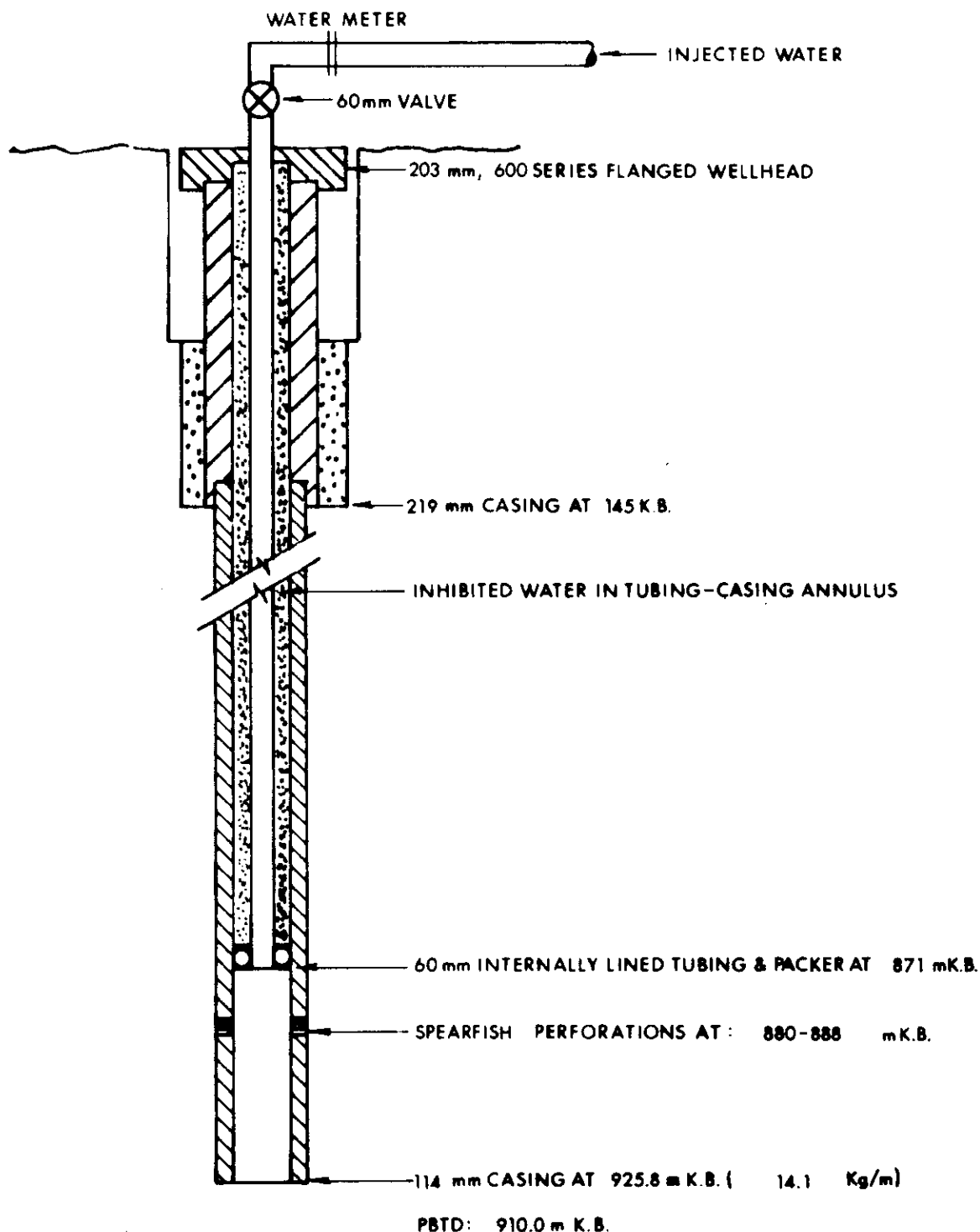
ANDEX OIL CO. LTD.		
1501, 300 - 4th AVENUE S.W., CALGARY, ALBERTA PH: 403/261-2040		
SCHEMATIC DIAGRAM ANDEX ET AL WASKADA 1-9-2-25WPM		
DATE: 17-05-88	BY: T. McKay	FILE NO:
SCALE: NTS	REVISIONS:	

PROPOSED INJECTION WELL SUBSURFACE EQUIPMENT



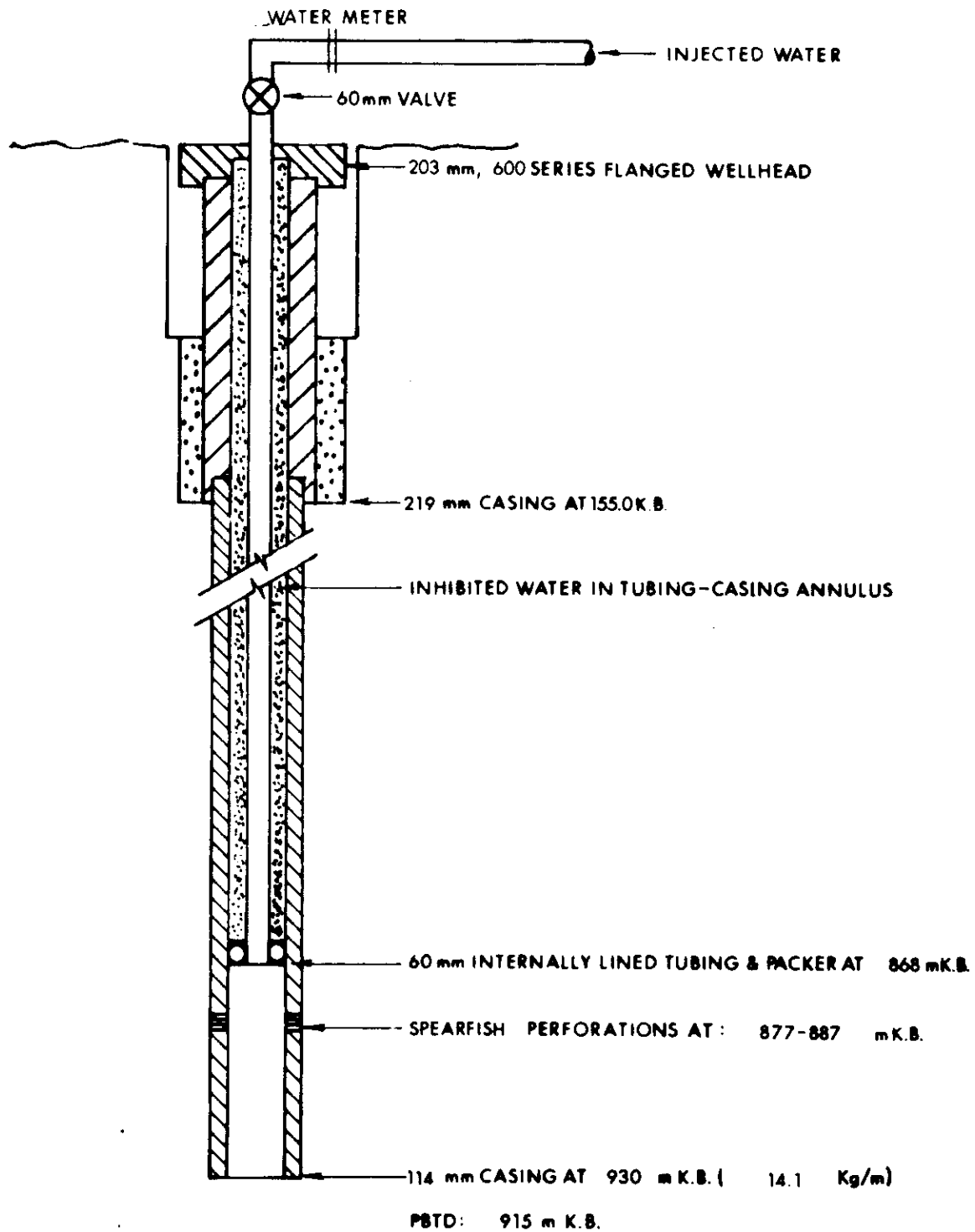
ANDEX OIL CO. LTD.		
1501, 900 - 4th AVENUE S.W., CALGARY, ALBERTA PH: 809/361-2040		
SCHEMATIC DIAGRAM ANDEX ET AL WASKADA 6-9-2-25WPM		
DATE: 17-05-88	BY: T. McKAY	FILE NO:
SCALE: NTS	REVISIONS:	

PROPOSED INJECTION WELL SUBSURFACE EQUIPMENT



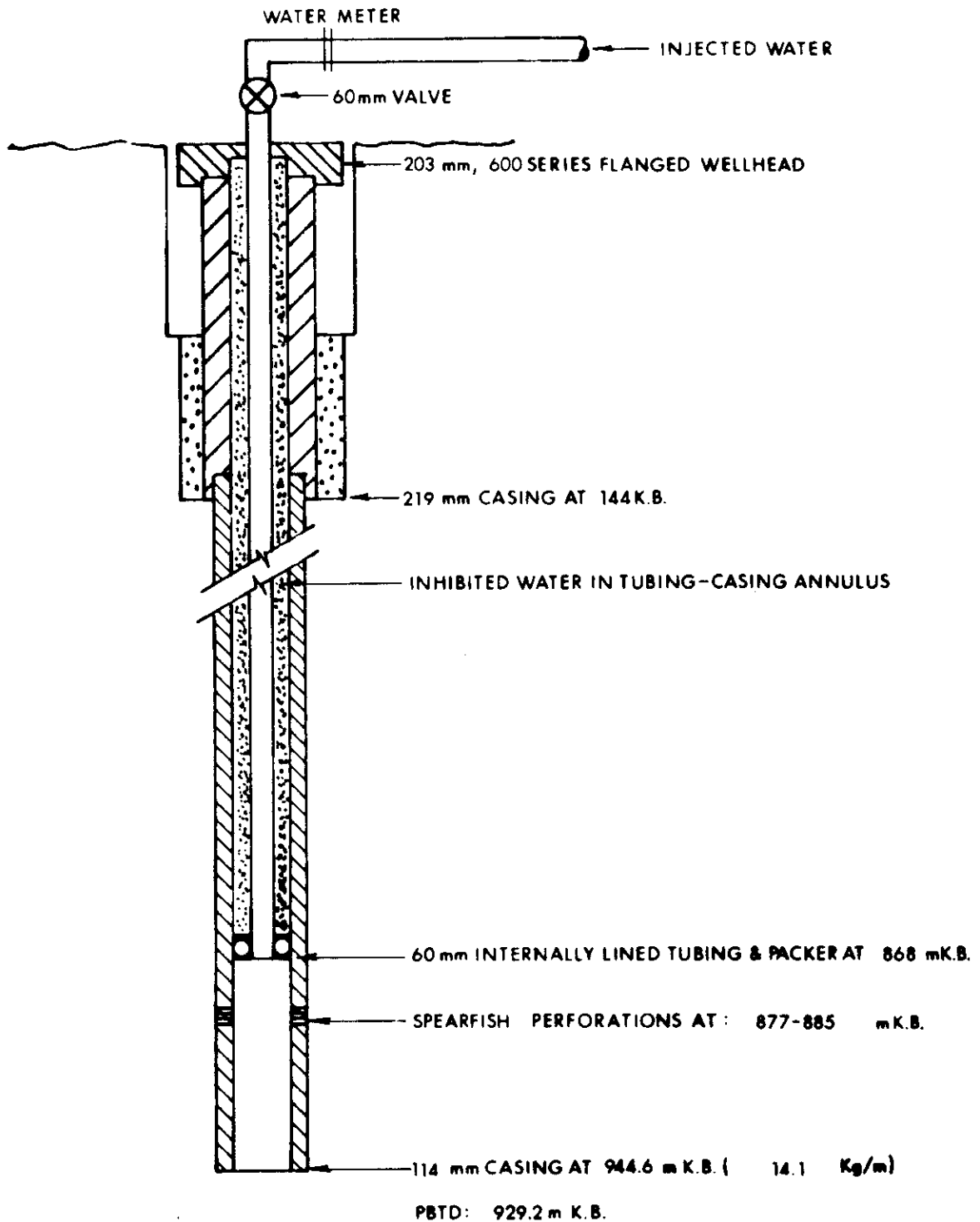
ANDEX OIL CO. LTD.		
1501, 900 - 4th AVENUE S.W., CALGARY, ALBERTA PH: 403/261-2040		
SCHEMATIC DIAGRAM ANDEX ET AL WASKADA 10-9-2-25WPM		
DATE: 17-05-88	BY: T. MCKAY	FILE NO:
SCALE: NTS	REVISIONS:	

PROPOSED INJECTION WELL SUBSURFACE EQUIPMENT



ANDEX OIL CO. LTD.		
1501, 500 - 4th AVENUE S.W., CALGARY, ALBERTA PH: 483/261-2040		
SCHEMATIC DIAGRAM ANDEX ET AL WASKADA 16-9-2-25 WPM		
DATE: 17-05-88	BY: T. McKAY	FILE NO:
SCALE: NTS	REVISIONS:	

PROPOSED INJECTION WELL SUBSURFACE EQUIPMENT



ANDEX OIL CO. LTD.		
1501, 300 - 4th AVENUE S.W., CALGARY, ALBERTA PH: 403/261-2040		
SCHEMATIC DIAGRAM ANDEX ET AL WASKADA 5-10-2-25 WPM		
DATE: 17-05-88	BY: T. MCKAY	FILE NO:
SCALE: NTS	REVISIONS:	

ANDEX OIL CO. LTD. WASKADA WATER DISTRIBUTION SYSTEM

