PERFORMANCE REVIEW

DALY BAKKEN 'D' POOL

MANITOBA

(February, 1992)

Prepared by: Shing-Ming Chen

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February 27, 1992

Department of Energy and Mines
Petroleum Branch
555-330 Graham Avenue
Winnipeg, MB
R3C 4A5

Attention: Mr. John Fox

Dear Mr. Fox:

Re: Reservoir Performance Review
Daly Bakken 'D' Pool

As required by the terms of the Oil and Natural Gas Conservation Board Order No. PM67, enclosed please find a copy of the subject report for your review and files.

Should you have any questions, please do not hesitate to contact us.

Sincerely,

S. M. Chen

Shing-Ming Chen,
Senior Reservoir Engineer

SMC/ck

Enclosure

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I. OBJECTIVES

This study was initiated in January 1992 to review the Daly Bakken 'D' reservoir performance. Major objectives of this study were to:

(1) compile and analyse reservoir-related data

(2) estimate original oil-in-place (OOIP)

(3) review and interpret reservoir behaviour

(4) evaluate waterflood performance

(5) determine optimum production/injection strategy

(6) recommend workover candidates

(7) generate production forecast

II. CONCLUSIONS

1. Using the volumetric method, the original oil-in-place (OOIP) of Daly Bakken 'D' pool is calculated to be 344,286 ST.m3.

   At the end of 1991, the field has produced 41,854.8 ST.m3 of oil, or 12.2% of the OOIP. Cumulative water production and injection were 16,535.1 and 11,213.5 m3, respectively.

2. As evidenced from the production performance, the 40-acre spacing development in this field is adequate and should provide an optimum recovery scheme for this pool.

3. There appears to be a directional permeability forming north-south strips in the pool. Formation is tighter in the west and becomes more permeable towards the east.

4. Lack of reservoir energy support from aquifer and solution gas have resulted in a relatively steep production decline in this pool. Immediate production declines in wells 12-13, 13-13, 09-14 & 01-23 may be attributed to 'fines mobilization' problems as warned in the waterflood sensitivity study report (see Ref.3).

5. Favorable responses to waterflood in Unit #1, commenced in well 16-14 in June 1990, were observed. An efficient

piston-like displacement may have been achieved in this Unit, as shown by production increases without water breakthrough in the producers.

The effectiveness of water injection in Unit #2, commenced in well 08-14 in October 1991, needs further evaluation due to insufficient time period up to this point.

6. The overall field performance, as well as individual well performances, was reviewed. Interpretation results and comments were summarized in the report. (see Section 5 - Figures 6.01 to 6.18)

7. Frac and refrac jobs have successfully restored productivity and injectivity in this pool. High water-oil ratios (WORs) observed in southern wells (15-11, 16-11 & 13-12) are perhaps due to formation breakdown created by fracs.

8. Results from the reservoir voidage analysis indicate that differences in regional withdrawals have resulted in large pressure variations within the reservoir. The current water injection rate of 45 m3/d (December 1991) is equivalent to approximately 90% of the field withdrawal rate.

9. Without waterflood implementation, the recovery factor for primary production is estimated at 19% of the OOIP.

   Under the current water injection scheme, an ultimate recovery of 85,363 ST.m3 (or 25% of the OOIP) can be expected.

10. An optimum oil recovery factor of 30% (101,795 ST.m3) or higher may be achieved in this reservoir if:
    (1) water injection can replace the reservoir voidage (i.e. VRR=1), and provide enough driving energy to the reservoir
    (2) permeability deterioration problems can be successfully arrested by formation frac, refrac or deep penetration without damaging the formation

11. The required water injection rate for the 'Waterflood Optimum Case' is estimated at 53 m3/d. An additional injector may be needed unless the current injection capacity can be raised to the desired level utilizing the two existing injectors, 08-14 & 16-14.

III. RECOMMENDATIONS

1. A salinity survey on the following wells should be conducted to identify the sources of the produced water so that an efficient production and injection strategy may be determined:

   15-11, 16-11, 13-12, 12-13, 07-14, 09-14 & 02-23

2. Pressure surveys in wells 04-13 (or 05-13) and 15-11 may be required to evaluate the degree of pressure support in the regions.

3. The injection water should be treated properly to avoid damaging the formation. Water quality from different sources should be carefully examined and selected.

4. Although frac and re-frac jobs have successfully increased the productivity and injectivity in this pool, they must be applied with care, especially in injectors and their nearby producers to avoid risk of formation breakdown which may result in loss of injection water or the channelling of water into the oil bearing formation. A deep perforation technique (using penetrators) may be worth trying (on 12-13 or 01-14) in this respect, to determine its applicability in the pool.

5. The current injection capacity should be tested or evaluated to determine if an additional injector is required.

6. Possibility of utilizing two low oil-productivity wells, 15-11 and 07-14, for other purposes should be examined.

   Note: As mentioned in the individual well performance interpretation section, well 15-11 may be used as an injector if the well is not in communication with upper formation(s).

7. An investigation of the area extension to the east (06-13 & 11-13) is recommended once water breakthrough is observed in wells 04-13 and 05-13.

8. Recommended candidates for 1992 refrac or deep penetration (using penetrator) include wells 12-13, 13-13, 01-14. Other possible candidates are pending results from the above workovers.

Listed below is a brief summary of the recommended 1992 action plan:

<u>SUMMARY - 1992 ACTION PLAN</u>

Activity	Candidates	Objectives/Remarks
- Water salinity survey	15-11, 16-11, 13-12 12-13, 07-14, 09-14 02-23	To determine water sources (& possible communications with other formations)
- Pressure survey	04-13 (or 05-13) & 15-11	To identify pressure support
- Injection water quality examination	All inj. water sources	To avoid (or minimize) injectivity reduction
- Injection capacity evaluation	08-14, 16-14	To determine if an additional well is required
- Re-frac	12-13, 13-13, 01-14	Penetrator may be tried on either 12-13 on 01-14
	Other wells	Pending workover results

Activity	Candidates	Objectives/Remarks
- Area extension study	06-13 or 11-13	Conduct after water breakthrough (or high w-cut) observed in 04-13 or 05-13
- Others		Whenever necessary

IV. DISCUSSIONS

1. Introduction:

The Daly Bakken 'D' pool is located in southwestern Manitoba, approximately 30 kilometers west of Virden, in Township 10 and Range 29 (see Fig.1). The reservoir is rectangular in shape, with a length of 2.4 km and a width of 1.2 km. The pool was discovered in December 1986 with the drilling of well 15-11-10-29WPM, which encountered a thin oil-bearing sandstone in the Bakken 'D' formation. The reservoir is under-saturated with an initial pressure of 8,951 kPa and an estimated bubble point pressure of 2,101 kPa.

Field production commenced in December 1986 after the completion of well 15-11. The pool was developed on a 40-acre spacing and divided into two sections (see Fig.2). Until May 1990, the reservoir was produced under the primary recovery mechanism. In June 1990, well 16-14 was converted to a water injector in an attempt to arrest the reservoir pressure decline and enhance oil recovery in the northern section (called North EBOR Unit #1). In October 1991, as a result of favorable responses observed in Unit #1, another well (08-14) was converted to a water injector in the southern section (North EBOR unit #2).

Table 1 summarizes all the wells drilled in this pool. By the end of 1991, there were 14 producers and two injectors active in the field. As of December 31, 1991, cumulative oil & water production in this field were 41,854.8 ST m3 and 16,535.1 m3, respectively. Cumulative water injection was 11,213.5 m3.

2. Geology/ Lithology

A general stratigraphic column of the Bakken Formation is shown in Figure 3. In general, the Daly Bakken 'D' pool consists of two thin (0-2 m), relatively clean zones (namely Zone A and Zone B) with an average porosity of 15%. Permeability varies within the reservoir, ranging from 5md to 350 md as determined from the DSTs (Drill Stem Tests).

The details of the Bakken 'D' geology and lithology are discussed in Reference 1 and will not be repeated in this report.

3. Field Performance

1) Production & Injection

The overall performance of Daly Bakken 'D' pool is shown in Figure 4. Oil production increased from an initial rate of 2 ST m3/d in December 1986 when only 15-11 was on production to a high of 43.5 ST m3/d in June 1991 when there were 14 producers and two injectors active in the field. Water production is low up to today except for southern wells which are likely producing water from the upper formation(s). The producing gas-oil ratio (GOR) in general is low and is not measurable.

Attachment 1 lists the historical production and injection data including cumulative and monthly figures. The field was produced under natural depletion until June 1990 at which time well 16-14 was converted to a water injector in Unit #1. Well 08-14, the second water injector, was converted in October 1991 for the implementation of waterflood in Unit #2. By December 1991, no water breakthrough was observed, indicating that an effecient water displacement may have been achieved in this pool.

2) Reservoir Pressure

The reservoir pressure declined sharply from an initial pressure of 8,591 kPa (as determined from the 07-14 DST in February 1987) to slightly above 5,000 kPa in mid-1989 as observed from 09-14 & 02-23 DSTs.

Subsequent pressure measurements in the newly drilled wells indicate that there is a wide spread in pressure within the reservoir. Table 2 summarizes all the pressures measured in this field. The historical pressure data is plotted in Figure 5. Well 04-13, south to the field's biggest producer 05-13, was measured at 4,255 kPa in the 1991.02 DST. A month later (1991.03), well 13-12 was measured at 6,130 kPa, a 1875 kPa higher than well 04-13. Prior to water injection in 08-14, a shut-in pressure survey in well 05-13 indicated that the static pressure was down to 1,112 kPa in 1991.10.

Estimating the average reservoir pressure for this pool may be difficult due to insufficient data and large pressure variations observed in the field. In this study, a smoothed curve passing through pressure points in Figure 5 was assumed to be the average reservoir pressure (see Table 5). As it will be discussed in

Section 4.2.2, an attempt to confirm the average reservoir pressure using 'material balance method' was not successful due to uncertainties in PVT data and/or the possibility that Bakken 'D' may be in communication with other formation(s).

4. Original Oil-In-Place (OOIP)

In this chapter, the reservoir rock and fluid properties will be discussed first to assist the evaluation of the Daly Bakken 'D' original oil-in-place:

1) Reservoir Rock/ Fluid Properties

As there are very little data available for Daly Bakken 'D' pool, most of the data used in this study is adopted from the nearby Daly Bakken 'A' pool due to their similarities in reservoir crude and formation lithology. The PVT properties were taken from a Daly Bakken 'A' well (03-28-10-29 WPM) which was sampled at the separator in January 1988.

The oil produced from the Daly Bakken 'D' pool is a light crude oil, with an API gravity of 41 degrees. The oil contains very little gas. In fact, historically the gas rates have been too small to measure. It is evident that the bubble point pressure and shrinkage factor will be extremely low.

Table 3 summarizes the estimated reservoir fluid and rock properties.

2) OOIP evaluation

The following two methods have been used in this study to estimate the OOIP for Bakken 'D' pool:-

(1) Volumetric method:

As there are six dry holes (11-11, 12-12, 03-13, 14-14, 07-23 & 04-24) drilled at the edge of the pool, it is evident that the area of the Bakken 'D' reservoir is well defined. Hence, in this case, the volumetric method can normally be used to estimate the OOIP for this pool with good accuracy.

Equation (1) is the general equation used for volumetric calculations:

$$OOIP = Area * Thickness * Porosity * (1 - S_{wc}) / B_{oi} \quad \ldots \quad (1)$$

Since the field was developed on a 40-acre spacing basis, it is reasonable to assume that:-

(a) data obtained from each well can represent its 40-acre block's properties and,

(b) OOIP for the entire pool can be obtained by adding up each 40-acre block's OOIP.

In this case, Eq.(1) can be re-written as Eq.(2):

OOIP=(40 Acres)* Sum(Thickness*Porosity) *(1-Swc)/Boi *(Conversion factor) ...(2)

Porosity and net pay of each well are summarized in Table 4. The oil formation volume factor at initial pressure is 1.063 m3/ST m3. A 35% conate water saturation is assigned to the entire pool.

The OOIP for each 40-acre block is shown in Table 4. The original oil-in-place for the entire pool is calculated to be 344,286 ST m3 (2.166 MMSTB).

2) Material balance method:

An attempt to calculate the Daly Bakken 'D' OOIP using material balance method was not successful. The material balance equation used for an under-saturated reservoir without aquifer support is: (Ref.2)

OOIP= (Np*Bo -We +Bw*Wp -Wi) /((Bo-Boi)+ (Cf+Cw*Sw)* Delta(p)*Boi/(1-Swc)) ... (3)

Table 5 shows the production, injection, pressure and PVT data used in material balance calculations. The calculated OOIPs for subsequent time intervals failed to converge to a fixed value. This failure could be attributed to one or more of the following reasons:

a) Inaccuracies of the PVT properties - As there is no PVT analysis for this pool, the PVT properties adopted from the Bakken 'A' well (03-28-10-29WPM) may not be representive for the Bakken 'D' pool.

b) Uncertainties in water production sources - As discussed in Section 5.2, the water production in this field may also come from other formations through fractures or wellbore leakages.

c) Pressure influences from other formation(s) - The Bakken 'D' reservoir pressures may be influenced by other information(s) if communication does exist.

5. Performance Review & Interpretation

1) Field performance

Figure 4 illustrates the Bakken 'D' pool performance. An overall increase in oil production was observed after the commencement of the field production. The sharp production increase in early 1988, tripling the oil rate from 6 to 22 m3/d, was attributed to three additional producers (12-13, 09-14 & 15-14) drilled in 1988. Production decline between April 1988 and February 1989 was a result of natural depletion and the permeability reduction possibly caused by fines migration problems. Another sharp increase in the production began in February 1989 and peaked in August with more wells drilled (02-23, 13-13 & 05-13) and a frac job implemented (09-14). Between August 1989 and June 1990, production followed a natural decline again.

In mid-1990, productions in EBOR unit #1 responded favorably to the initiation of water injection in well 16-14. Steady production increases were observed in two wells (09-14 & 15-14) for more than six months. Well 13-13 production stabilized at around 1.8 m3/d after one year of continuous decline. Two successful frac/re-frac jobs (02-23 in 1990.06 & 01-23 in 1991.02) and three additional producers (10-14, 04-13 & 13-12) have brought the field production to its all time high of 43.46 m3/d in June 1991.

Since July 1991, another period of natural decline followed, and the oil rate at the end of 1991 has fallen to 35.71 m3/d.

2) Individual well performance

Figures 6.01 to 6.18 show the individual well production performances. Oil rate, water cut, monthly producing days and water injection are plotted in these figures. Each well's completion history, perforation interval(s), test results, etc. are summarized besides the plot. A field-wide individual well performance plot is presented in Figure 7 to assist visualizing the regional performances.

Listed below is a brief summary of discussions, interpretations and comments on individual well performances:

15-11

- Low productivity well, situated at the south-west corner of the pool.

- Relatively high water-cut, around 40% compared to a field average of 16%
- 89.12.05- 90.01.21 injection test results:
  (a) Total water injection= 489 m3.
  (b) Stabilized injection rate= 16.7 m3/d @ 4482 kPa injection pressure
  (c) Similar oil rate can still be produced after the test, though water-cut jumped from 35% to 80%
- Water-cut remains high even when the well has produced more than three times of what was injected (Wettability changed? or Formation fraced ? :- Check salinity for water source determination)
- Possible future injection candidate if it is not in communication with upper formation(s)

<u>16-11</u>

- Produced from Jurassic until November 1987
- Converted to Bakken producer since November 1989
- Water cut increased sharply in June 1990 due to liner leak.
- Oil rate increased after 1990.10 frac, but dropped sharply at the end of 1991
- Water cut remains high.

(Note: Water source and wellbore integrity need to be checked.)

13-12

- Cored (852-869.5m)
- 1991.03 DST:-

  Reservoir P.= 6130 kPa @ 860.78m

  k= 115 md
- Low oil rate after the initial completion (- pumping problem identified)
- Good oil rate after 1991.08
- High water-cut since production started

  (- Check salinity to determine water source!)

04-13

- 1991.02 DST:

  Reservoir P.= 4255 kPa @ 861.36 m.KB

  k= 312 md
- Possesses high initial production (11.6 m3/d) without frac (Porosity =27%)
- Sharp production decline

  (likely caused by large withdrawal in 05-13 - the largest producer in the area)
- A pressure survey in the region (04-13, 05-13) may be

required (to see if there is enough pressure support)

05-13

- Best producer. This well, together with 04-13 & 13-12, has formed the most productive area in the pool.
- As of 1991.12.31, cumulative production is 7,677 ST m3 or 18.3% of the field production.
- Production cut back in 1990 as per Government request (1988.08 Conservation Board letter).
- Early 1992 production should be analysed to see the response to water injector 08-14.
- A pressure survey may be required to determine if there is enough pressure support in the region.
- Area extension to the east (i.e. 06-13) should be investigated

12-13

- Cored. 1988.03 DST (Poor)
- Good initial rate (8 m3/d) but dropped sharply after the well was put on production
  Oil rate declined to less than one-quarter by 1990.01.
  (Fines migration + insufficient reservoir energy ?)
- Good candidate for re-frac and/or deep penetration (using penetrator)

13-13

- 1989.02 DST:-

  Reservoir P.= 6,719 kPa @ 851.05 m.KB

  k= 5 md
- Relatively low productivity in the east side of the pool
- Sharp initial production decline, but flattened out after first 5-month production period.
- Good response to water injection in 16-14.

  (* Lack of reservoir energy prior to water injection confirmed)

01-14

- South to water injector 08-14
- Steady production decline until 1991.09 (- caused by insufficient reservoir energy support)
- Production flattened out after the commencement of 08-14 water injection (A longer time period may be required to confirm the support from 08-14)
- Similar to 12-13, a deep penetration technique can be tried in this well to evaluate its applicability in the field (especially for injectors or their nearby producers)

07-14

- Cored
- 1987.02 DST:-

  ISIP= 8,024 kPa @ 859.27 m.KB
- Low productivity, situated in tight western flank (porosity= 12%)
- Commingle production from Bakken 'D' and Lodgepole
- Relatively high water-cut
- Possibility of using this well for some other purposes should be evaluated

08-14

- Sharp initial production decline (similar to 09-14, 12-13, 01-23 & 04-13)

  (- Fines mobilization problem suspected)
- 1990.10 re-frac restored only 1/3 of its initial production albeit with little decline
- Converted to injector and commenced water injection in 1991.10
- Monitor 1992 production in nearby producers to evaluate the effectiveness of water injection.

09-14

- Cored. 1988.01 DST:-

  Reservoir P.= 7,763 kPa @ 858.4 m.KB

  k= 64 md
- Sharp inital production decline (similar to 08-14, 12-13, 01-23 & 04-13)
- A successful frac job restored the production to its initial value, though water-cut increased slightly. (Note: Water salinity should be analysed to determine the water source.)
- Good response to water injection in 16-14

  No water breakthrough indicates a good water sweep efficiency may have been achieved

10-14

- 1991.03 DST:-

  Reservoir P.= 5610 kPa @ 858.25 m, k= 63 md
- 1991.03 reservoir pressure of 5610 kPa was much higher than that of 04-13 (4255 kPa from 1991.02 DST)

  * possibly due to significant differences in regional productions
- Water cut decreased from 51% in 1991.04 to 21% in 1991.10. Oil rate stabilized since 1991.10 (supported by injectors 16-14 & 08-14 ?)

15-14

- Cored.
- 1988.02 DST:-

  Reservoir P.=7537 kPa @ 855.63 m

  k= 18.6 md
- High initial rate after the acidization and frac.
- Steady decline from 88.02 to 1989.09
- Good response to 1990.06 water injection in 16-14 (Lack of reservoir energy prior to waterflood confirmed)

16-14

- Cored.
- Reasonable rate after the initial completion (with acidization only)
- Steady decline from 1987.06 to 1989.01
- A frac job in 1989.02 increased the production from 1.2 m3/d to 6.6 m3/d, water cut increased from 6 to 14%.
- Oil rate decreased steadily again from 1989.04 to 1990.06 (Lack of energy support confirmed)
- Converted to water injector in 1990.06
- Injection rate maintained at 21 m3/d for 10 months then decreased sharply afterwards (- Water quality problems suspected.)

- 1991.11 re-frac restored the injection rate back to the initial level

<u>01-23</u>

- Possess high initial rate without frac but dropped down to less than 1/3 in two months
  (* Fines mobilization problem suspected)
- Steady rate between 1988 and 1990
- 1991.02 frac restored production to close to its original level
- Production declined steadily between 1991.03 and 1991.08, but remained constant after 1991.09
  (- Supported by water injection ?)

<u>02-23</u>

- 1989.06 DST:-
  Reservoir P.= 5,353 kPa @ 856.06 m.KB
  k= 13 md
- 1990.06 refrac was effective, raising the production to higher than its initial value
- Production declined steadily between 1990.07 and 1991.07 but maintained at a constant level after 1991.07
  (- Supported by water injection?)

3) Summary

Based on the above discussions and interpretations on Daly Bakken 'D' performances, the following conclusions can be made:

A. Production/Injection

(a) Lack of reservoir energy support from aquifer and solution gas have resulted in a relatively steep production decline in the pool.
Immediate initial production declines in many producers (12-13, 13-13, 09-14 & 01-23) may be attributed to 'fines mobilization' problems, as warned in the waterflood sensitivity study report (Ref.3)

(b) A favorable response to waterflood in Unit #1 was clearly observed. The effectiveness of 08-14 water injection needs to be further investigated due to insufficient time period (3 months only) up to this point.

(c) Frac and re-frac jobs have successfully restored the productivity and injectivity in this pool. High WORs observed in southern wells (16-11, 13-12 & 15-11) are perhaps due to formation breakdown (between Bakken 'D' and Lodgepole) created by fracs.

B. Field Development

(a) The 40-acre spacing development in this field is adequate and should provide an optimum recovery scheme for this pool.
(- as evidenced from the well count and oil recovery relationship)

(b) As the area of the reservoir is well defined, there is little infill potential except in location 06-13 (or 11-13) which requires a further investigation.

C. Others

(a) There appears to be a directional permeability forming north-south strips in the pool. Formation is tighter in the west and becomes more permeable towards the east.

(b) Figures 6.01- 6.18 illustrate individual well performances. Comments on each well are outlined.

D. Recommendations

(a) Although frac or re-frac jobs are efficient in this pool, they should be used with care in injectors and injectors' nearby producers to avoid risk of formation breakdown which may result in loss of injection water or the channelling of water into the oil bearing formation.

A deep perforation technique (using penetrators) may be worth trying in this respect.

(b) A field-wide water salinity survey should be conducted to identify the sources of the produced water so that an optimum production and injection strategy may be determined.

6. Reservoir Voidage Analysis

In this chapter, a reservoir voidage study was conducted to:

(a) compare regional withdrawals within the reservoir

(b) assess the current waterflood scheme

(c) estimate the required water injection rate

1) Regional withdrawals

Three different types of regional withdrawals were analysed:

(1) Individual wells: The current (1991.12) oil rate and cumulative production from each well are listed and compared.

(2) Unit #1- Unit #2: The field is divided into north (Unit #1) and south (Unit #2) in order to compare the total fluid produced from these two sections.

(3) East-Center-West: The field is divided into three strips, namely, eastern, central and western strips. This analysis is performed to compare the total fluid withdrawn from different

strips.

Listed below are wells contained in each region (or section) as defined in the above-mentioned two cases:

Region	Well Names
Unit #1	12-13, 13-13, 09-14, 15-14, 16-14, 01-23, 02-23
Unit #2	15-11, 16-11, 13-12, 04-13, 05-13, 01-14, 07-14, 08-14, 10-14
East	13-12, 04-13, 05-13, 12-13, 13-13
Center	16-11, 01-14, 08-14, 09-14, 16-14, 01-23
West	15-11, 07-14, 10-14, 15-14, 02-23

The total fluid production or withdrawal is calculated by:

Total fluid withdrawal= Oil production*Bo + Water Production ... (4)

where: Bo is the oil formation volume factor

Tables 7 to 9 show the individual well production rates and regional withdrawals for the aforementioned cases. It can be concluded that currently, the eastern wells

(13-12, 04-13, 05-13) in Unit #2 have formed the most productive area in the pool. Northern wells 01-23 & 02-23 and the central well 09-14 appear to be very productive as well.

2) Reservoir voidage replacement

The reservoir voidage replacement ratio (VRR), defined by Equation (5), is normally used as an indicator to show if there is enough pressure support in the reservoir:

$$VRR = (\text{Injection volume})/(\text{Total fluid production}) \qquad \ldots \quad (5)$$

As there was no water injection before June 1990, VRR equals zero prior to the commencement of water injection. Two cases were studied in this project due to the possibility that water productions in southern wells (16-11 & 13-12) may come from Bakken 'D' as well as Lodgepole and/or Jurassic through fractures (or wellbore leaks). Case 1 assumes all the produced water is coming from the Bakken 'D' formation. In Case 2, it is assumed that 80% of the 16-11 & 13-12 produced water is from other formation(s).

Table 10 shows the results of the VRR calculations. The reservoir voidage replacement is approximately 50% prior to the commencement of 08-14 water injection in North EBOR Unit #2. Currently, with two injectors injecting water in the field, the VRR has reached 64% in Case 1 and 89% in Case 2. If we assume Case 2 to be the correct representation and all the water injected into the formation is effective, an additional water injection rate of 10 to 20% may be required in the future for pressure maintenance purposes.

7. Production Forecast

In this field, as the pool is well developed and the reservoir is producing at its full capacity, it is believed that the decline curve analysis technique can be used to predict future production with good accuracy. (Ref.4)

1) Decline Curve Analysis

Figures 8 and 9 show the overall field and individual well production decline. In this study, the field production decline, instead of individual well production decline, will be used due to its simplicity and the chances of avoiding (a) production interference among individual wells, and (b) difficulties in predicting future workovers and their results

Field Production Decline

Figure 8 shows the Bakken 'D' production decline on a semi-log paper. Three periods of natural decline were observed:

(a) 1988.04- 1989.01

(b) 1989.09- 1990.06

(c) After 1991.06

It has been found that all the three declining periods occurred while there were no additional wells contributing to the field production. Three similar straight line slopes were observed in these periods. The exponential decline rate for the 2nd and 3rd period is almost identical, at 31%.

2) Production Forecast

The following three cases were evaluated in this study:

(a) Primary production case: This case assumes that no water injection was implemented and will not be implemented in this pool.

(b) Waterflood Base Case: This case assumes the current waterflood scheme will be continued without major changes. (i.e. Two injectors and possibly insufficient water injection)

(c) Waterflood Optimum Case: This case assumes that the current scheme may be modified in order to meet the optimum production and injection requirements.

(1) Primary Production Case

As discussed in the performance interpretation section, a lack of energy support from aquifer and solution gas has resulted in a sharp production decline everywhere in this pool. It is expected that the field production would continue to decline at around 31% after early 1991, if no waterflood was implemented.

Table 11 shows the production forecast for the primary production case. The ultimate oil recovery for this case is estimated to be 65,434.9 St.m3 or 19% or the OOIP.

(2) Waterflood Base Case

In this case, the ultimate reserve was forecasted by applying one of the most commonly used graphical techniques- a plot of oil rate versus cumulative oil production. As shown in Figure 10, a straight line passing through the most recent data points was extrapolated to the economic limit (say, 3 ST.m3/d) to obtain the ultimate oil reserve.

Table 12 shows the production forecast for the Waterflood Base Case. Oil rate is expected to decline at an exponential decline rate of 26% from the current level. As of 2000.12.31 the cumulative oil production will be 85,363.2 ST.m3, or 25% of the OOIP.

(3) Waterflood Optimum Case

The ultimate recovery factor for reservoirs under waterflood averaged about 33% (Ref.- SPE/AIME publications). For Bakken 'D' pool, with favorable production response and no water breakthrough observed today, it is believed that a similar recovery factor can be achieved if the following requirements can be met:

(a) Reservoir voidage can be replaced (i.e. VRR=1)
(b) Formation damage or breakdown can be minimized

Based on the above assumptions, the ultimate reserve and future productions are forecasted in Table 13. Future production rate versus time and cumulative production are plotted in Figure 10. As of 2000.12.31, cumulative oil production will be 101,794.8 ST. m3 or 30% of the OOIP.

(3) Water injection requirements

As the current Daly Bakken 'D' reservoir pressure is down to about half or less than half of its initial value, it is recommended that the reservoir pressure be maintained at the current level to provide sufficient driving energy for an optimum oil recovery.

Using a reservoir voidage ratio of one with an assumption that future reservoir withdrawal rate will be similar to that of 1991, the required water injection volume is calculated in Table 14. An average of 53 m3/d may be needed for pressure maintenance purposes in the future. As for the injection capacity, an additional injector may be required unless the current rate of 45 m3/d can be raised to the desired level.

V. REFERENCES:-

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VI. NOMENCLATURES

Bo	:	Oil formation volume factor
Boi	:	Oil formation volume factor at initial pressure
Bw	:	Water formation volume factor
Cf,Crock	:	Rock compressibility
Coil,COIL	:	Cumulative oil production
Cw	:	Water compressibility
Cwi	:	Cumulative water injection
Cwp	:	Cumulative water production
Delta(p)	:	Initial pressure - any pressure 'p'
DST	:	Drill-stem test
G.L.	:	Ground level
GOR	:	Gas-oil ratio
H2Om	:	Monthly water production
k	:	Permeability
MN.	:	Month
Np	:	Cumulative oil production
OILm	:	Monthly oil production
OOIP	:	Original oil-in-place
PD,Pd	:	Producing day
Pi	:	Initial pressure
PVT	:	Pressure-volume-temperature
Qoil	:	Oil production rate
Sw	:	Water saturation

Swc	:	Conate water saturation
VRR	:	Voidage replacement ratio
Wcut	:	Water-cut
We	:	Water encroachment
Wi,Winj	:	Water injection
WOR	:	Water-oil ratio
Wp	:	Water production
Yr.	:	Year

TABLE 1: COMPLETION, CORING & DST RECORDS - BAKKEN 'D' WELLS

Well	Completion Date	G.L. (m)	K.B. (m)	Cored (Y/N)	DST (Y/N)	Perf.(m.KB) Top	Bottom
15-11	86-12	524.90	529.00	-	Yes	858.5	863.0
16-11	89-11	524.90	529.40	-	-	861.0	864.5
13-12	91-03	522.90	527.10	Yes	Yes	859.0	863.0
4-13	91-02	520.66	524.86	-	Yes	861.5	863.0
5-13	89-03	520.40	525.25	-	Yes	860.0	864.0
12-13	88-03	523.40	528.00	Yes	Yes	857.0	861.5
13-13	89-02	520.60	524.15	-	Yes	849.5	853.0
1-14	90-09	522.46	526.66	-	Yes	857.0	860.5
7-14	87-02	523.60	527.40	-	Yes	857.0	861.0
8-14	89-03	522.67	526.42	-	-	860.0	864.0
9-14	88-01	522.80	527.40	Yes	Yes	856.5	860.5
10-14	91-03	522.93	527.13	-	Yes	857.5	861.0
15-14	88-02	523.40	528.00	Yes	Yes	855.5	859.0
16-14	87-06	524.20	528.00	Yes	-	855.0	859.0
1-23	87-10	520.40	524.20	Yes	-	853.0	854.0
2-23	89-06	522.35	526.10	-	Yes	855.0	859.0

Note: Six dry holes drilled in the area (11-11, 12-12, 03-13, 14-14, 07-23 & 04-24)

TABLE 2: PRESSURE MEASUREMENTS - DALY BAKKEN 'D' POOL

WELL	DATE	Type of Test	P run D. (kPa)	Run Depth (m.KB)	p datum (kPa)	Remarks
15-11	86.12	DST	8,275	862.16	*	-
07-14	87.02	DST	8,591	857.74		-
09-14	88.01	DST	7,763	858.4		k= 64 md
15-14	88.02	DST	7,537	855.63		k= 19 md
12-13	88.03	DST	-	-		-
13-13	89.02	DST	6,719	851.05		k= 5 md
05-13	89.02	DST	7,426	849.46		k= 57 md
09-14	89.05	F.L.	5,392	-		-
02-23	89.06	DST	5,353	856.06		k= 13 md
01-14	90.09	DST	5,579 (ISIP)	861.82		-
04-13	91.02	DST	4,255	862.89		k=312 md
13-12	91.03	DST	6,130	860.78		k=115 md
10-14	91.03	DST	5,610	858.25		k= 63 md
05-13	91.10	F.L.	1,112	862.00		One week S.I.

Notes: - Datum depth= 330 m.ss
- As all the perforation intervals are close to the datum depth, pressures at run depths are used directly in this study.

TABLE 3 : Reservoir Parameters
- Daly Bakken 'D' Pool

Initial pressure (07-14 DST)	: 8591 kPa @ 857.74 m.KB
Reservoir temperature	: 31 deg.C
Bubble point pressure (*)	: 2101 kPa
Oil API	: 40 - 42 deg. API
Oil formation volume factor (Boi)	: 1.063 res.m3/St.m3
Oil FVF at bubble point pressure	: 1.12 res.m3/ST.m3
Solution GOR	: 27 m3/m3
Porosity	: 12 - 27% (Avg.=15%)
Permeability	: 5 - 350 md
Oil compressibility @ Pi	: 1.15 E-6 (1/kPa)
Water compressibility	: 4.5 E-7 (1/kPa)
Rock compressibility	: 5.8 E-07 (1/kpa)
Conate water saturation (Swc)	: 0.35

Water Salinities- NaCl (Ref.3)

Jurrassic : 13 kppm
Lodgepole : 167 kppm
Bakken 'D': 64 kppm

PVT Table:-

Pressure (kPa)	Bo (rm3/sm3)	GOR (m3/m3)	Oil viscosity (mPa-s)
101	1.013	0	2.020
446	1.106	22.18	1.305
791	1.111	24.00	1.264
1136	1.114	25.13	1.247
1480	1.116	26.06	1.243
2101	1.120	27.29	1.239
Pi	1.063	27.29	-

Note: PVT data is adopted from Bakken 'A' well 03-28 PVT analysis report.

TABLE 4 : OOIP Calculations - Volumetric Method

Well	Zone A		Zone B		OOIP	HCPV m^3/m^2	
Name	Porosity (%)	Net Pay(m)	Porosity (%)	Net Pay(m)	(ST.m3)	TUNDRA	P.B.
15-11	0.140	1.800	0.000	0.000	24655	0.15	.21
16-11	0.000	0.000	0.150	0.800	11740	0.07	.08
13-12	0.130	1.200	0.160	1.000	30916	0.19	.27
4-13	0.000	0.000	0.270	1.200	31699	0.20	.35
5-13	0.130	0.700	0.135	0.800	19469	0.12	.12
12-13	0.130	1.400	0.160	0.800	30329	0.19	.16
13-13	0.130	0.400	0.150	0.800	16828	0.11	.24
1-14	0.130	0.600	0.160	1.200	26416	0.17	.16
7-14	0.120	0.400	0.120	0.200	7044	0.04	.02
8-14	0.140	0.800	0.180	0.900	26807	0.17	.35
9-14	0.130	1.300	0.200	1.200	40015	0.25	.20
10-14	0.000	0.000	0.140	0.800	10958	0.07	.31
15-14	0.120	0.200	0.170	1.000	18980	0.12	.12
16-14	0.130	1.000	0.170	0.900	27688	0.17	.21
1-23	0.000	0.000	0.120	0.700	8218	0.05	.18
2-23	0.000	0.000	0.160	0.800	12523	0.08	.03
				OOIP=	344,286		

Note: - OOIP is calculated based on Swc=0.35, Bo=1.063,
Porosity cut off= 12% and Area= 40 acres for each block

TABLE 5: Material Balance Calculations
(** Un-successful **)

YR. MN.	Cum. oil prod. mstb	Cum. water prod. mbbl	Cum. water inj. mbbl	Reservoir pressure psig	OOIP (MSTB)
1986.12	0.1	0.2	0.0	1247	-
87.06	3.0	2.4	0.0	1161	943.9
.12	10.3	3.6	0.0	1081	1285.6
88.06	27.0	6.6	0.0	994	2051.9
.12	44.6	9.8	0.0	929	2652.0
89.06	72.1	15.6	0.0	849	3429.4
.12	109.6	21.5	0.0	791	4493.9
90.06	141.2	29.5	0.1	729	5159.0
.12	174.8	46.4	22.2	675	5488.7
91.06	219.7	69.9	44.0	624	6245.1
.12	263.3	104.4	70.5	581	7075.6

Parameters used for material balance calculations:-

Boi= 1.063, Bo (@ bubble point)= 1.12, Bw= 1.0
Cw= 3.1 E(-6) (1/psi), Crock= 4.0 E(-6) (1/psi)
Bubble point pressure= 305 psi
Swc= 0.35

Results: OOIPs fail to converge (see Section 4.2.2 for discussions)

TABLE 6 : PRODUCTION WITHDRAWALS
- DALY BAKKEN 'D' WELLS

Well Name (1)	1991.12 Oil rate m3/d (2)	1991.12 Cum. oil prod. m3 (3)	Oil rate /Avg.oil rate (4)	Cum. prod/ Avg.cum. prod. (5)
15-11	0.63	1405.20	0.3	0.5
16-11	0.99	1909.50	0.4	0.7
13-12	5.06	764.10	2.0	0.3
4-13	4.62	1692.50	1.8	0.6
5-13	5.11	7677.00	2.0	2.9
12-13	1.34	3039.90	0.5	1.2
13-13	1.75	2120.10	0.7	0.8
1-14	1.90	1459.80	0.8	0.6
7-14	0.36	854.80	0.1	0.3
8-14	1.73	2082.20	0.7	0.8
9-14	2.74	4670.80	1.1	1.8
10-14	2.30	636.70	0.9	0.2
15-14	1.93	3965.40	0.8	1.5
16-14	2.17	2888.10	0.9	1.1
1-23	4.49	3753.30	1.8	1.4
2-23	2.93	2937.40	1.2	1.1
Avg.=	2.50	2616.05	1.0	1.0

Notes:-

Colume 4= (1991.12 individual well's oil production rate) / (1991.12 individual well's average oil production rate)
i.e. Col.4 = (2)/2.50

Column 5= (1991.12 individual well's cumulative oil production) / (1991.12 individual well's average cumulative oil production)
i.e. Col.5 = (3)/2616.05

(Column (2)-(5) figures are listed in Table 7 for comparison.)

TABLE 7: Porosities, DST Permeabilities and 1991.12 Oil Rates & Cumulative Oil Productions- Bakken 'D' Wells

02-23 Qoil=2.93 (1.2) Coil=2937.4 (1.1) Phi=0.16, k=13	01-23 Qoil=4.49 (1.8) Coil=3753.3 (1.4) Phi=0.12,	
15-14 Qoil=1.93 (0.8) Coil=3965.4 (1.5) Phi=0.17, k=19	16-14 Qoil=2.17 (0.9) Coil=2888.1 (1.1) Phi=0.17,	13-13 Qoil=1.75 (0.7) Coil=2120.1 (0.8) Phi=0.15, k=5
10-14 Qoil=2.30 (0.9) Coil=636.7 (0.2) Phi=0.14, k=63	09-14 Qoil=2.74 (1.1) Coil=4670.8 (1.8) Phi=0.20, k=64	12-13 Qoil=1.34 (0.5) Coil=3039.9 (1.2) Phi=0.16
07-14 Qoil=0.36 (0.1) Coil=854.8 (0.3) Phi=0.12,	08-14 Qoil=1.73 (0.7) Coil=2082.2 (0.8) Phi=0.18,	05-13 Qoil=5.11 (2.0) Coil=7677.0 (2.9) Phi=0.14, k=57
	01-14 Qoil=1.90 (0.8) Coil=1459.8 (0.6) Phi=0.16,	04-13 Qoil=4.62 (1.8) Coil=1692.5 (0.6) Phi=0.27, k=312
15-11 Qoil=0.63 (0.3) Coil=1405.2 (0.5) Phi=0.14,	16-11 Qoil=0.99 (0.4) Coil=1909.5 (0.7) Phi=0.15,	13-12 Qoil=5.06 (2.0) Coil=764.1 (0.3) Phi=0.16, k=115y

where- Qoil: December 1991 oil rate (m3/d)
Coil: 1991.12.31 cumulative oil production
Phi : Maximum prosity of Zone A or B, whichever is higher (fraction)
k : DST permeability (md)

TABLE 8 : Bakken 'D' Regional Withdrawals- Unit #1 vs. Unit #2

YR.MN.		Unit #1 Coil (ST.m3)	Unit #1 Cwp (m3)	Unit #2 Coil (ST.m3)	Unit #2 Cwp (m3)	Production Ratio (Unit #1 / Unit #2)
86	12	0	0	15	37.5	0.000
87	1	0	0	106.7	136.4	0.000
	2	0	0	180.6	215.3	0.000
	3	0	0	280.8	271.3	0.000
	4	0	0	335.2	318.3	0.000
	5	0	0	426.6	347	0.000
	6	4.8	0.0	472.9	377.9	0.006
	7	149.0	0.2	512.3	400.2	0.168
	8	265.6	0.4	548.1	424.0	0.281
	9	385.5	0.4	580.7	444.7	0.386
	10	530.7	4.4	625.1	465.9	0.503
	11	745.4	26.2	693.0	506.9	0.658
	12	890.7	32.8	753.1	538.5	0.732
88	1	1027.9	39.2	792.4	561.4	0.806
	2	1222.6	67.1	837.7	584.5	0.927
	3	1694.0	139.1	900.3	601.4	1.245
	4	2304.7	229.2	952.3	619.8	1.642
	5	2796.0	308.2	1000.6	641.0	1.924
	6	3253.1	380.5	1046.9	663.0	2.162
	7	3707.4	446.5	1095.0	684.1	2.374
	8	4166.7	518.8	1142.1	705.2	2.578
	9	4573.5	581.9	1185.4	725.0	2.742
	10	4990.4	652.0	1229.5	745.8	2.902
	11	5388.4	711.2	1271.8	768.1	3.037
	12	5778.0	766.5	1307.0	793.8	3.164
89	1	6141.5	829.3	1344.5	813.2	3.281
	2	6555.4	933.6	1375.6	833.2	3.442
	3	7155.6	1044.4	1591.4	914.3	3.320
	4	7698.5	1121.0	1829.4	954.3	3.210
	5	8168.7	1217.9	2321.8	1032.1	2.829
	6	8770.0	1382.1	2691.9	1092.6	2.707
	7	9411.3	1520.2	3122.5	1149.2	2.579
	8	10077.9	1647.1	3568.7	1187.6	2.481
	9	10653.0	1766.7	3962.2	1222.5	2.409
	10	11199.2	1859.0	4360.6	1281.3	2.326
	11	11699.5	1927.7	4724.7	1325.9	2.263
	12	12205.2	2011.3	5222.5	1404.7	2.154

YR.MN.	Unit #1 Coil (ST.m3)	Unit #1 Cwp (m3)	Unit #2 Coil (ST.m3)	Unit #2 Cwp (m3)	Production Ratio (Unit #1 / Unit #2)
90 1	12681.1	2079.1	5684.5	1496.0	2.064
2	13091.9	2157.2	6048.4	1603.6	2.001
3	13559.7	2235.5	6516.3	1808.6	1.906
4	13976.1	2313.9	6927.3	1869.6	1.860
5	14366.0	2387.0	7326.5	1970.1	1.810
6	14787.8	2461.3	7655.9	2235.9	1.753
7	15263.5	2513.2	8018.6	2560.8	1.690
8	15717.0	2587.4	8401.2	2947.9	1.624
9	16160.4	2635.5	8739.6	3395.8	1.562
10	16601.5	2687.3	9242.3	3765.5	1.496
11	17065.4	2728.6	9701.1	4168.7	1.441
12	17525.6	2780.1	10269.5	4590.0	1.381
91 1	17987.1	2830.3	10849.6	4976.6	1.330
2	18484.7	2892.4	11348.3	5332.0	1.296
3	19095.2	2981.1	11911.4	5778.0	1.262
4	19651.9	3064.0	12638.9	6498.5	1.202
5	20206.2	3148.9	13415.9	7168.0	1.149
6	20715.2	3211.4	14210.6	7907.8	1.096
7	21179.3	3263.7	14980.2	8342.6	1.062
8	21645.5	3321.7	15735.7	9263.5	1.013
9	22059.2	3367.9	16435.2	10156.3	0.971
10	22490.1	3429.8	17167.3	11113.1	0.931
11	22912.1	3487.9	17835.8	12052.1	0.898
12	23375.0	3537.6	18479.8	12997.5	0.870

Note: Production ratio= (Total fluid production from Unit #1) / (Total fluid production from Unit #2)

TABLE 9 : Bakken 'D' Regional Withdrawals - Eastern, Central and Western Strips

YR.MN.	Eastern Wells C.Oil (ST.m3)	Eastern Wells C.Wp (m3)	Center C.Oil	Center C.Wp	West C.oil	West C.Wp	* East/ West	** Center/ West (fraction)
86 12	0.0	0.0	0.0	0.0	15.0	37.5	0.000	0.000
87 1	0.0	0.0	0.0	0.0	106.7	136.4	0.000	0.000
2	0.0	0.0	0.0	0.0	180.6	215.3	0.000	0.000
3	0.0	0.0	0.0	0.0	280.8	271.3	0.000	0.000
4	0.0	0.0	0.0	0.0	335.2	318.3	0.000	0.000
5	0.0	0.0	0.0	0.0	426.6	347.0	0.000	0.000
6	0.0	0.0	4.8	0.0	472.9	377.9	0.000	0.006
7	0.0	0.0	149.0	0.2	512.3	400.2	0.000	0.168
8	0.0	0.0	265.6	0.4	548.1	424.0	0.000	0.281
9	0.0	0.0	385.5	0.4	580.7	444.7	0.000	0.386
10	0.0	0.0	530.7	4.4	625.1	465.9	0.000	0.503
11	0.0	0.0	745.4	26.2	693.0	506.9	0.000	0.658
12	0.0	0.0	890.7	32.8	753.1	538.5	0.000	0.732
88 1	0.0	0.0	1027.9	39.2	792.4	561.4	0.000	0.806
2	0.0	0.0	1219.1	53.7	841.2	597.9	0.000	0.905
3	87.6	10.9	1495.4	67.6	1011.3	662.0	0.060	0.954
4	257.9	25.5	1738.0	71.6	1261.1	751.9	0.143	0.917
5	394.0	42.3	1942.0	75.4	1460.6	831.5	0.193	0.898
6	516.1	56.4	2135.3	82.6	1648.6	904.5	0.228	0.885
7	634.8	69.3	2325.3	89.7	1842.3	971.6	0.254	0.874
8	753.9	79.5	2511.8	98.8	2043.1	1045.7	0.274	0.861
9	856.8	91.7	2681.9	108.6	2220.2	1106.6	0.289	0.854
10	960.8	107.1	2852.1	123.0	2407.0	1167.7	0.303	0.847
11	1064.3	120.3	3016.5	129.4	2579.4	1229.6	0.315	0.840
12	1163.9	132.3	3181.2	135.4	2739.9	1292.6	0.326	0.836
89 1	1256.7	141.7	3332.5	148.4	2896.8	1352.4	0.333	0.833
2	1349.1	150.4	3552.3	210.9	3029.6	1405.5	0.343	0.862
3	1673.9	234.5	3916.0	265.0	3157.1	1459.2	0.418	0.920
4	1952.9	271.1	4259.5	315.0	3315.5	1489.2	0.468	0.966
5	2420.1	328.7	4614.6	382.1	3455.8	1539.2	0.557	1.014
6	2796.9	378.3	5092.2	507.8	3572.8	1588.6	0.622	1.099
7	3225.6	420.8	5532.9	607.5	3775.3	1641.1	0.681	1.148
8	3706.1	454.3	5964.4	696.4	3976.1	1684.0	0.743	1.190
9	4158.4	494.7	6324.8	761.1	4132.0	1733.4	0.802	1.222
10	4613.7	543.9	6661.7	824.5	4284.4	1771.9	0.861	1.250
11	5029.2	590.4	6981.1	872.5	4413.9	1790.7	0.916	1.279
12	5450.1	647.6	7424.2	949.1	4553.4	1819.3	0.967	1.328

YR.MN.	Eastern Wells C.Oil (ST.m3)	Eastern Wells C.Wp (m3)	Center C.Oil	Center C.Wp	West C.oil	West C.Wp	* East/ West (fraction)	** Center/ West (fraction)
90 1	5881.9	697.7	7800.1	1021.2	4683.6	1856.2	1.017	1.363
2	6214.0	747.1	8124.4	1083.0	4801.9	1930.7	1.045	1.382
3	6658.8	795.8	8478.1	1147.3	4939.1	2101.0	1.071	1.382
4	7057.2	835.7	8784.1	1213.8	5062.1	2134.0	1.109	1.404
5	7431.6	871.7	9087.8	1265.1	5173.1	2220.3	1.136	1.415
6	7746.3	900.8	9363.3	1425.5	5334.1	2370.9	1.136	1.415
7	8068.1	942.4	9582.4	1659.2	5631.6	2472.4	1.125	1.400
8	8409.6	994.2	9809.7	1951.5	5898.9	2589.6	1.121	1.397
9	8705.2	1020.3	10061.8	2318.9	6133.0	2692.1	1.115	1.413
10	9009.2	1046.6	10472.3	2611.2	6362.3	2795.0	1.111	1.438
11	9268.5	1065.8	10909.3	2942.8	6588.7	2888.7	1.104	1.470
12	9566.9	1093.0	11408.6	3286.4	6819.6	2990.7	1.100	1.505
91 1	9868.9	1113.6	11914.9	3602.7	7052.9	3090.6	1.096	1.537
2	10169.5	1139.1	12388.4	3893.8	7275.1	3191.5	1.094	1.562
3	10528.5	1207.8	12989.7	4237.5	7488.4	3313.8	1.100	1.601
4	11066.9	1577.8	13520.4	4529.0	7703.5	3455.7	1.146	1.623
5	11596.0	1864.4	14042.9	4824.7	7983.2	3627.8	1.171	1.631
6	12114.8	2174.7	14519.7	5088.2	8291.3	3856.3	1.188	1.620
7	12618.4	2282.4	14978.0	5323.7	8563.1	4000.2	1.198	1.621
8	13129.8	2851.7	15427.3	5567.2	8824.1	4166.3	1.241	1.622
9	13641.9	3459.8	15803.9	5767.9	9048.6	4296.5	1.291	1.622
10	14222.7	4146.6	16127.7	5964.3	9307.0	4432.0	1.345	1.613
11	14744.5	4850.4	16453.8	6125.0	9549.6	4564.6	1.395	1.605
12	15293.6	5537.1	16761.7	6308.7	9799.5	4689.3	1.443	1.597

RATIO OF TOTAL POOL PRODUCTION - 41654.8 m3
EAST 37%
CENTRAL 40%
WEST 23%

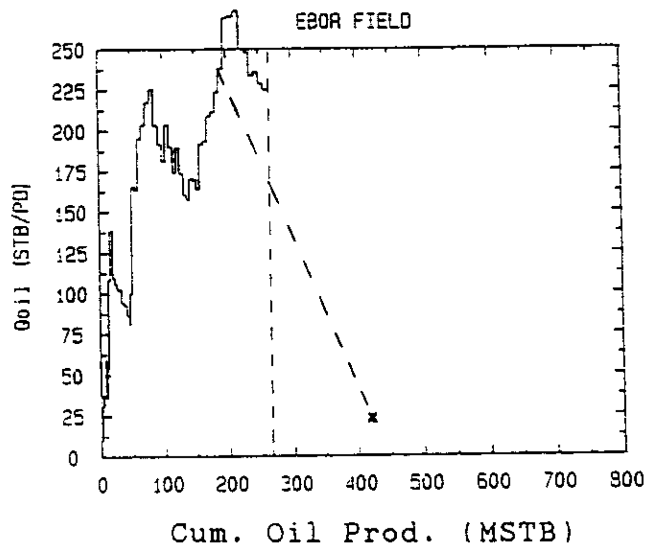
Notes: * - This column shows the ratio between 'eastern strip's production' and 'western strip's production'
** - This column shows the ratio between 'central strip's production' and 'western strip's production'

TABLE 10: Reservoir Voidage Analysis - VRR
(Voidage Replacement Ratio) Calculations

YR.	Mn.	Monthly Oil (m3/mn)	Prod. Water (m3/mn)	Monthly water injection (m3/mn)	VRR-1 (frac.)	VRR-2 (frac.)
86	12	15.0	37.5	0	0	0
87	1	91.7	98.9	0	0	0
	2	73.9	78.9	0	0	0
	3	100.2	56.0	0	0	0
	4	54.4	47.0	0	0	0
	5	91.4	28.7	0	0	0
	6	51.1	30.9	0	0	0
	7	183.6	22.5	0	0	0
	8	152.4	24.0	0	0	0
	9	152.5	20.7	0	0	0
	10	189.6	25.2	0	0	0
	11	282.6	62.8	0	0	0
	12	205.4	38.2	0	0	0
88	1	176.5	29.3	0	0	0
	2	240.0	51.0	0	0	0
	3	534.0	88.9	0	0	0
	4	662.7	108.5	0	0	0
	5	539.6	100.2	0	0	0
	6	503.4	94.3	0	0	0
	7	502.4	87.1	0	0	0
	8	506.4	93.4	0	0	0
	9	450.1	82.9	0	0	0
	10	461.0	90.9	0	0	0
	11	440.3	81.5	0	0	0
	12	424.8	81.0	0	0	0
89	1	401.0	82.2	0	0	0
	2	445.0	124.3	0	0	0
	3	816.0	191.9	0	0	0
	4	780.9	116.6	0	0	0
	5	962.6	174.7	0	0	0
	6	971.4	224.7	0	0	0
	7	1071.9	194.7	0	0	0
	8	1112.8	165.3	0	0	0
	9	968.6	154.5	0	0	0
	10	944.6	151.1	0	0	0
	11	864.4	113.3	0	0	0

YR.	Mn.	Monthly Oil (m3/mn)	Prod. Water (m3/mn)	Monthly water injection (m3/mn)	VRR-1 (frac.)	VRR-2 (frac.)
---	--	------	------	------	------	------
	12	1003.5	162.4	0	0	0
90	1	937.9	159.1	0	0	0
	2	774.7	185.7	0	0	0
	3	935.7	283.3	0	0	0
	4	827.4	139.4	0	0	0
	5	789.1	173.6	0	0	0
	6	751.2	340.1	17.2	0.015	0.017
	7	838.4	376.8	572.6	0.452	0.522
	8	836.1	461.3	651.7	0.483	0.572
	9	781.8	496.0	555.1	0.418	0.517
	10	943.8	421.5	664.6	0.466	0.529
	11	922.7	444.5	419.9	0.295	0.347
	12	1028.6	472.8	644.1	0.411	0.482
91	1	1041.6	436.8	716.7	0.464	0.539
	2	996.3	417.5	647.7	0.439	0.505
	3	1173.6	534.7	615.8	0.346	0.404
	4	1284.2	803.4	614.6	0.283	0.358
	5	1331.3	754.4	529	0.244	0.296
	6	1303.7	802.3	341	0.156	0.190
	7	1233.7	487.1	42.1	0.023	0.027
	8	1221.7	978.9	400.6	0.176	0.236
	9	1113.2	939.0	324.2	0.153	0.211
	10	1163.0	1018.7	926.7	0.411	0.577
	11	1090.5	997.1	1116.1	0.518	0.735
	12	1106.9	1050.7	1413.8	0.635	0.892

<u>Notes:</u>
(1) VRR-1 assumes all the produced water is from Bakken 'D'.
(2) VRR-2, similar to that of VRR-1, except it assumes only 20% of the16-11 and 13-12 produced water is from Bakken 'D'.



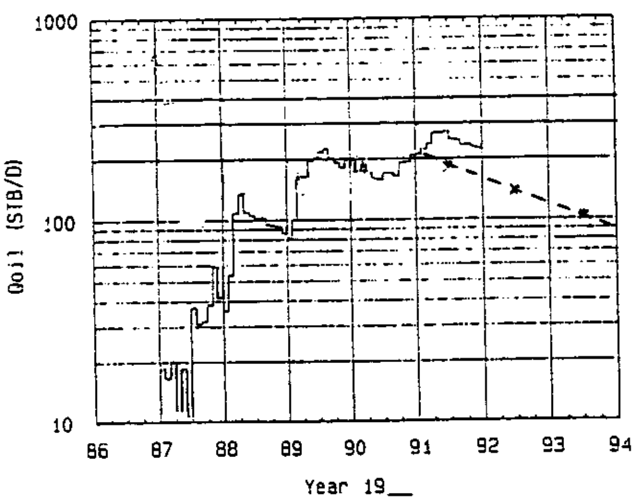
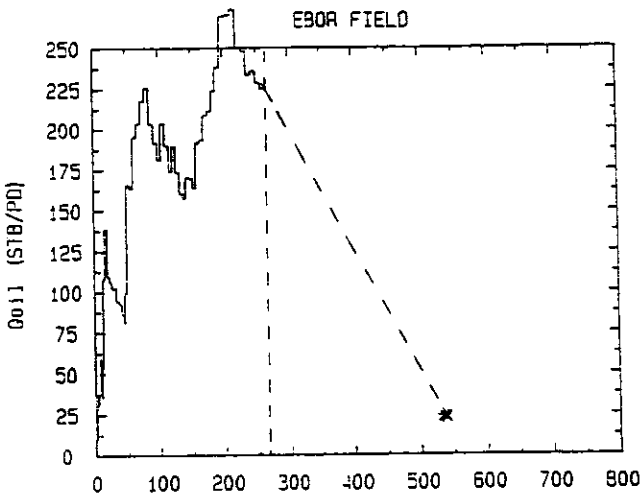


TABLE 11: ULTIMATE OIL RECOVERY
- PRIMARY PRODUCTION CASE

Year	Oil rate (m3/d)	Yearly prod. (m3/Yr)	Oil rate (STB/d)	Yearly prod MSTB/Yr
1991	30	10950.0	188.7	68.9
92	22.00	8031.2	138.40	50.5
93	16.14	5890.5	101.51	37.1
94	11.84	4320.4	74.45	27.2
95	8.68	3168.8	54.61	19.9
96	6.37	2324.1	40.05	14.6
97	4.67	1704.6	29.38	10.7
98	3.43	1250.2	21.55	7.9
Total:		37639.8 (ST.m3)		236.7(MSTB)

Remarks:-
(1) This case assumes no water injection
(2) Cum. oil prod. as of 1990.12.31= 27,795.1 m3
(3) Ultimate reserve = 65,434.9 m3
(4) OOIP = 344,286 m3
(5) Exponential decline rate= 31%
(6) Recovery factor= 19%



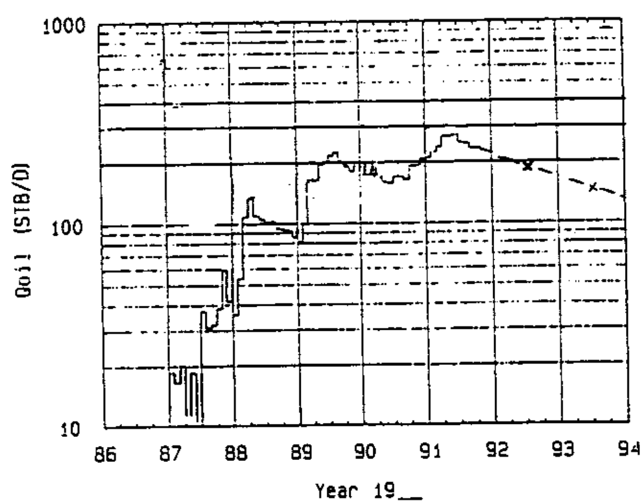
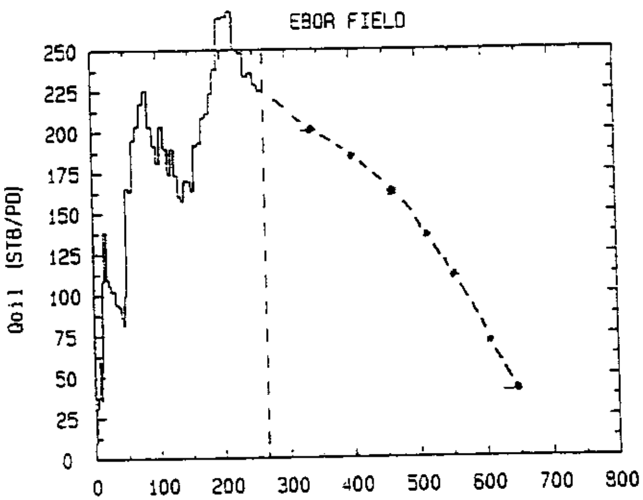


TABLE 12: PRODUCTION FORECAST
- Waterflood 'Base Case'

Year	Oil rate (m3/d)	Yearly prod. (m3/yr)	Oil rate (STB/d)	Yearly prod. MSTB/yr
1992	30.20	11023.0	190.0	69.3
1993	23.29	8499.3	146.5	53.5
1994	17.95	6553.4	112.9	41.2
1995	13.84	5053.0	87.1	31.8
1996	10.67	3896.1	67.1	24.5
1997	8.23	3004.1	51.8	18.9
1998	6.35	2316.3	39.9	14.6
1999	4.89	1786.0	30.8	11.2
'2000	3.77	1377.1	23.7	8.7
	Total=	43508.4(m3)		273.7(MSTB)

<u>Remarks:-</u>

(1) Cum. oil prod. as of 1991.12.31= 41,854.8 m3
(2) Remaining reserve (1992.1.1) = 43,508.4 m3
(3) Ultimate reserve = 85,363.2 m3
(4) OOIP = 344,286 m3
(5) Exponential decline rate = 26%
(6) Recovery factor = 25%



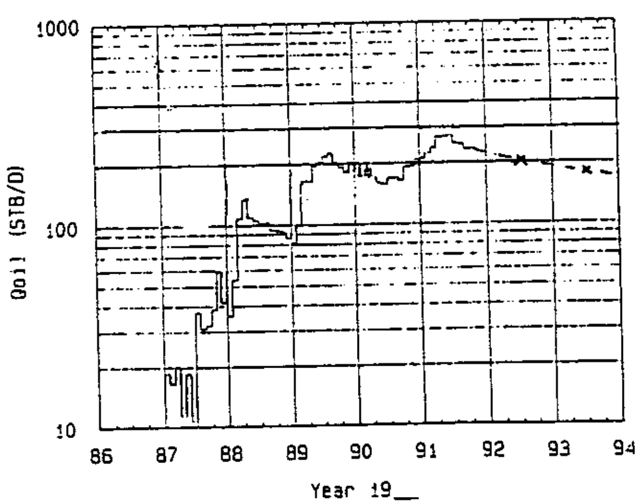


TABLE 13: PRODUCTION FORECAST
- Waterflood 'Optimum Case'

Year	Oil rate (m3/d)	Yearly prod. (m3/yr)	Oil rate (STB/d)	Yearly prod. MSTB/yr
1992	31.08	11607.0	200.0	73.0
93	28.77	10502.4	181.0	66.1
94	26.04	9503.0	163.8	59.8
95	21.32	7780.4	134.1	48.9
96	17.45	6370.1	109.8	40.1
97	13.59	4961.0	85.5	31.2
98	10.59	3863.6	66.6	24.3
99	8.24	3009.0	51.9	18.9
2000	6.42	2343.4	40.4	14.7
		59940.0		377.0

<u>Remarks:-</u>

(1) Cum. oil prod. as of 1991.12.31= 41,854.8 m3
(2) Remaining reserve (1992.1.1) = 59,940.0 m3
(3) Ultimate reserve = 101,794.8 m3
(4) OOIP = 344,286 m3
(5) Exponential decline rate: 10-25%
(6) Recovery factor = 30%

TABLE 14: INJECTION RATE REQUIREMENT
- DALY BAKKEN 'D' POOL

<u>Assumptions:-</u>

1. Future withdrawal rate= 1991 average reservoir withdrawal rate.
2. Oil formation volume factor = 1.09 res.m3/ST.m3
3. Water formation volume factor= 1 res.m3/ST.m3
4. Only 20% of the 16-11 & 13-12 produced water comes from Bakken 'D'

Listed below is 1991 average reservoir withdraw rate calculations:

YR.	MN.	Cum.oil prod. (m3)	Cum.water prod. (m3)	Oil rate m3/d	Water cut (%)	16-11 Water prod. m3/mn.	13-12 Water prod. m3/mn.	Reservoir withdraw rate res.m3/d
1990	12	27795.1	7370.1	33.18	31.49			-
1991	1	28836.7	7806.9	33.60	29.55	269.1	0	43.8
	2	29833.0	8224.4	35.58	29.53	243.3	0	46.7
	3	31006.6	8759.1	37.86	31.30	280.7	40.2	50.2
	4	32290.8	9562.5	42.81	38.48	232.0	331.9	58.4
	5	33622.1	10316.9	42.95	36.17	234.9	244.9	58.8
	6	34925.8	11119.2	43.46	38.10	222.6	268.8	61.0
	7	36159.5	11606.3	39.80	28.31	205.7	65.8	52.1
	8	37381.2	12585.2	39.41	44.48	206.1	523.0	55.7
	9	38494.4	13524.2	37.11	45.76	166.9	568.8	52.1
	10	39657.4	14542.9	37.52	46.69	168.8	640.9	52.9
	11	40747.9	15540.0	36.35	47.76	132.7	665.7	51.6
	12	41854.8	16535.1	35.71	47.34	154.2	648.9	50.3

* 1991 average reservoir withdraw rate (res.m3/d) : 52.8

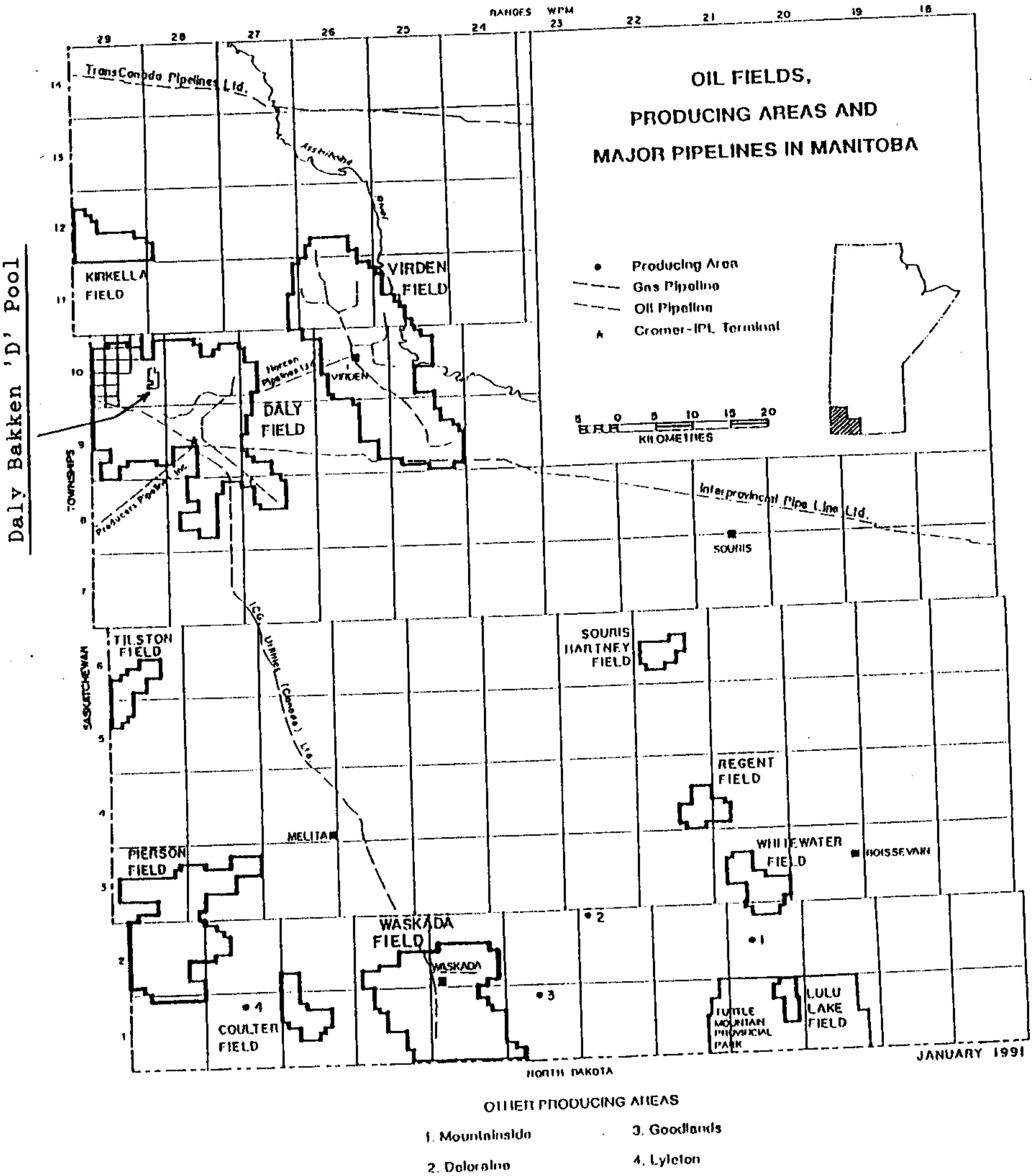


Figure 1: Oil Fields, Producing Areas and Pipelines in MANITOBA

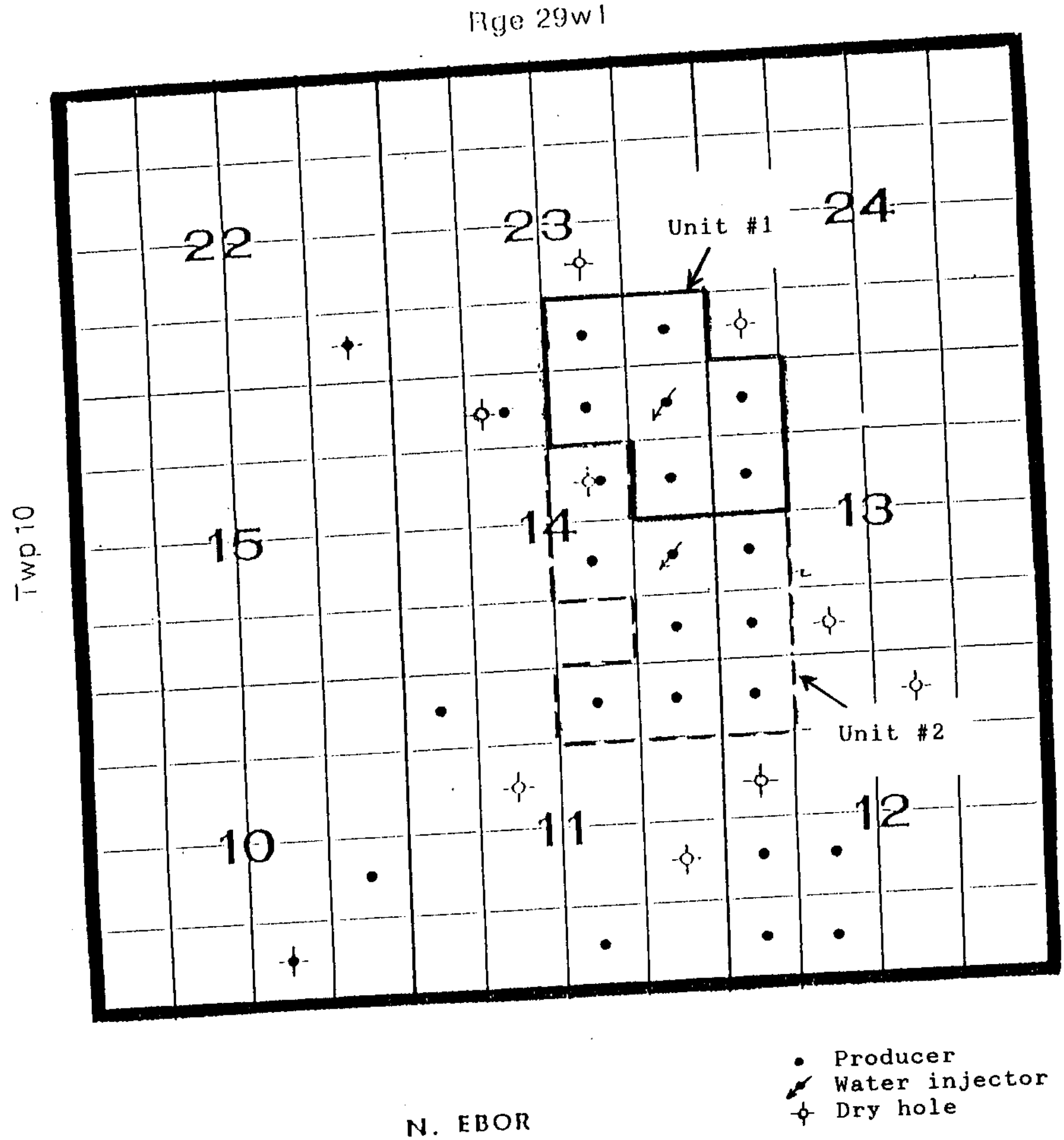


Figure 2: North EBOR Unit #1 & Unit #2
- Daly Bakken 'D' Pool

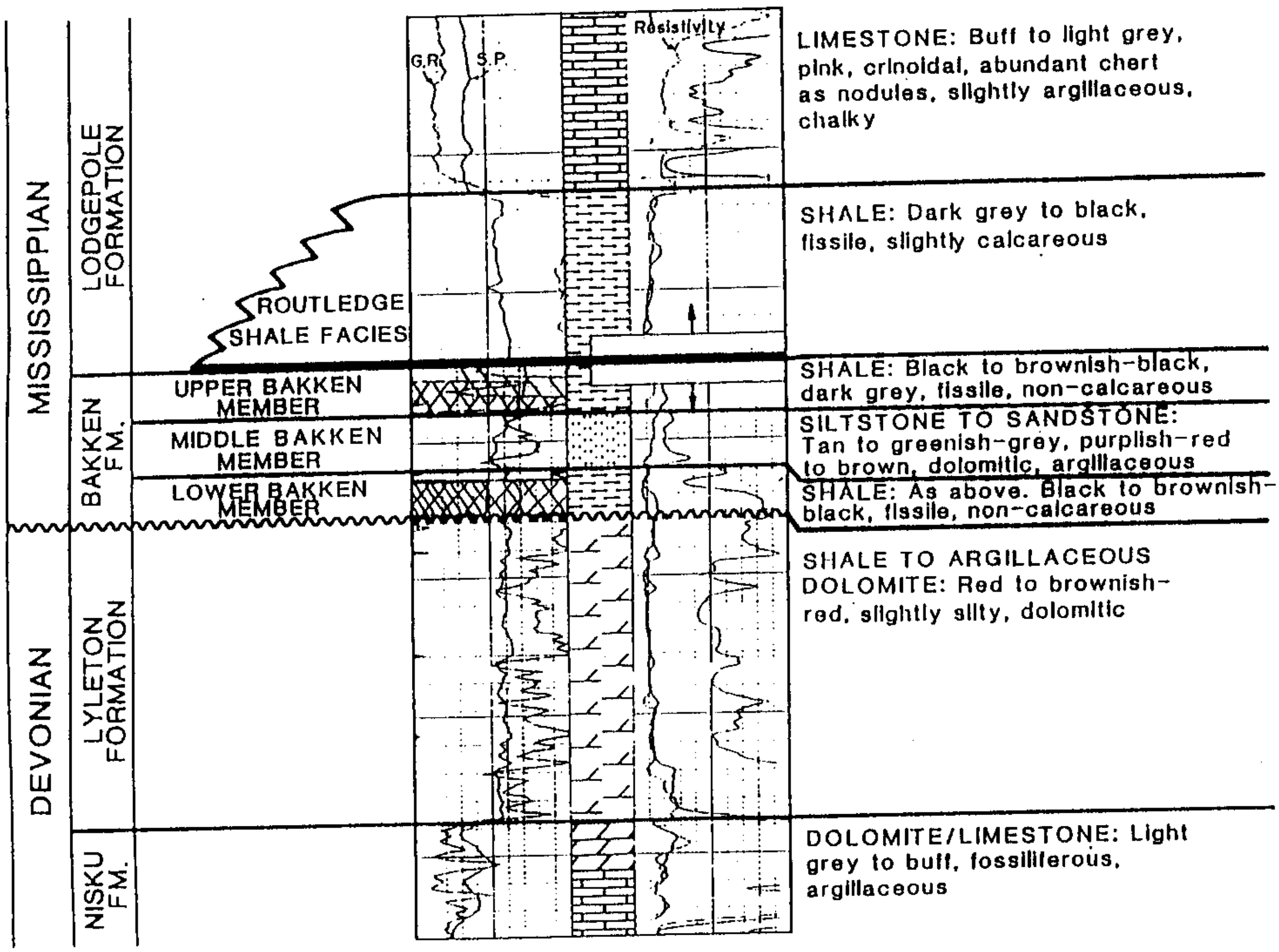


Figure 3: General Stratigraphic Column
- Bakken Formation

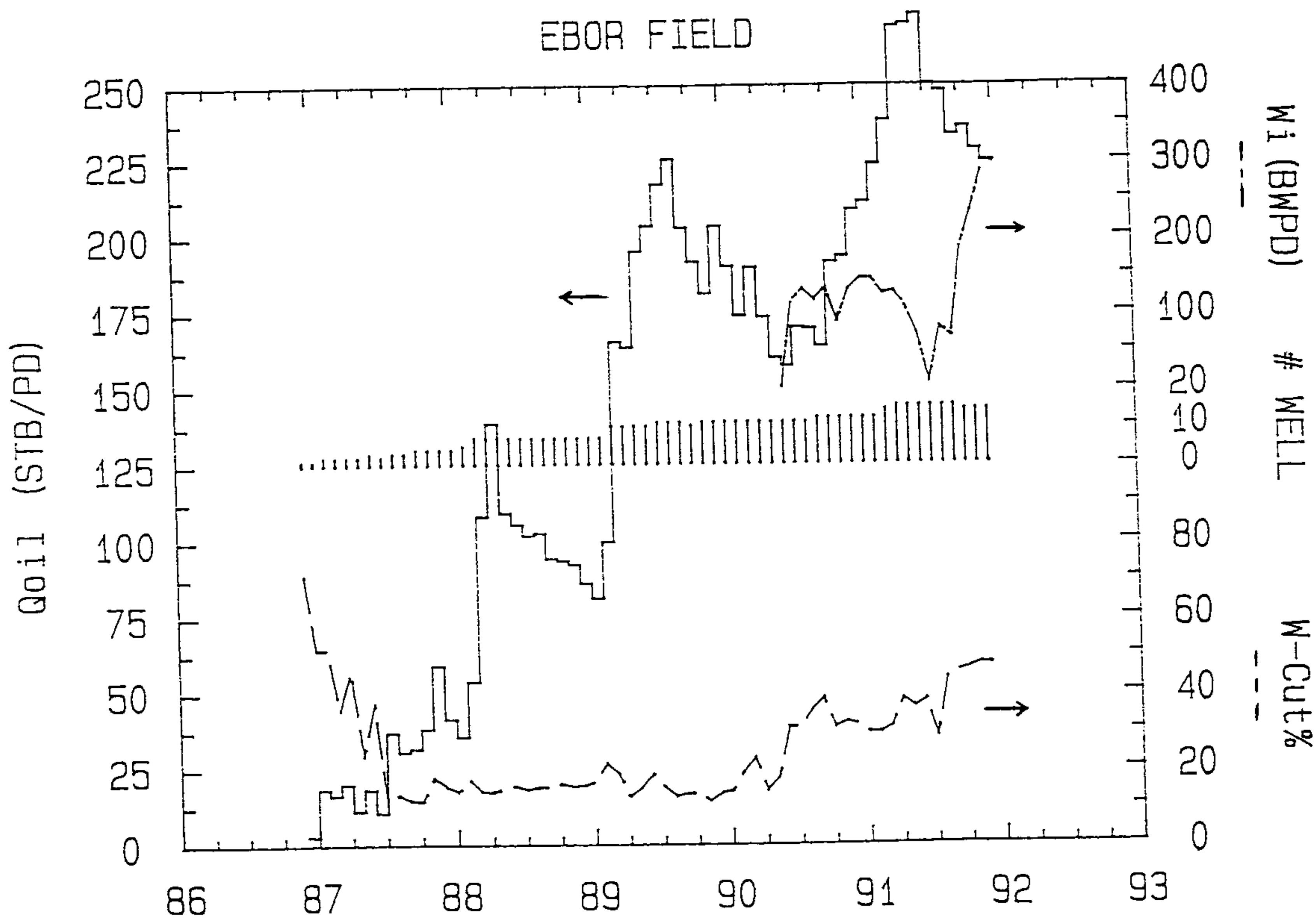
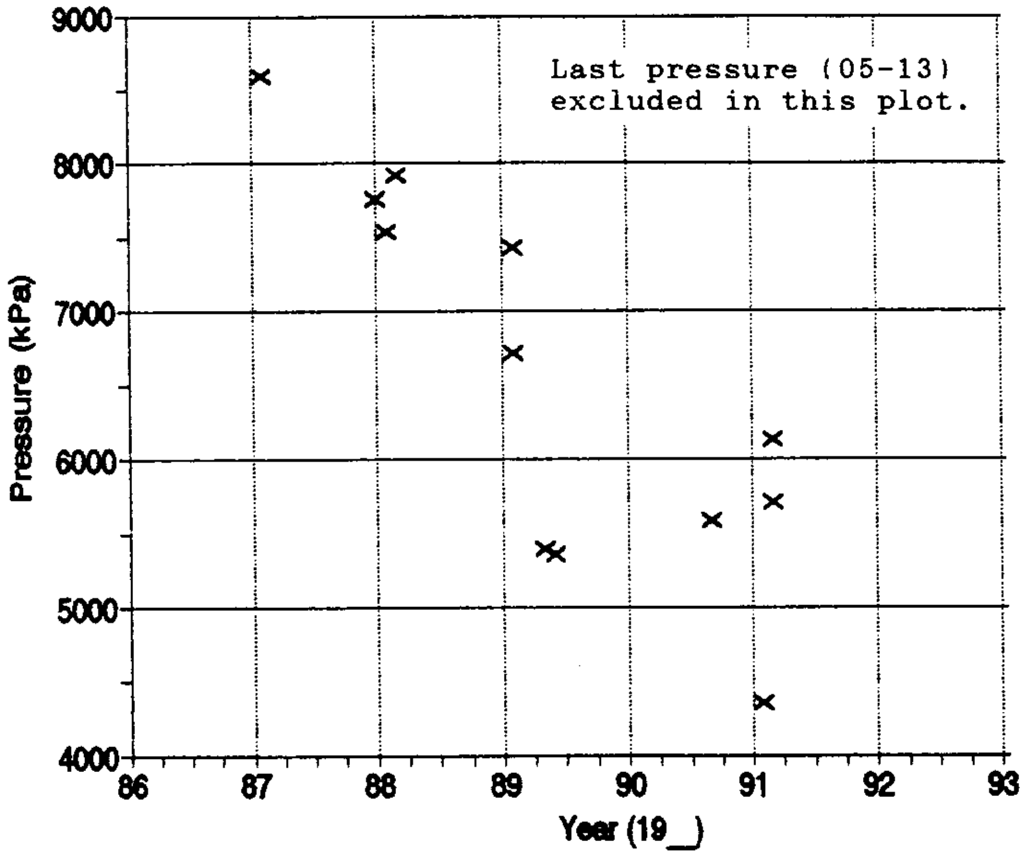
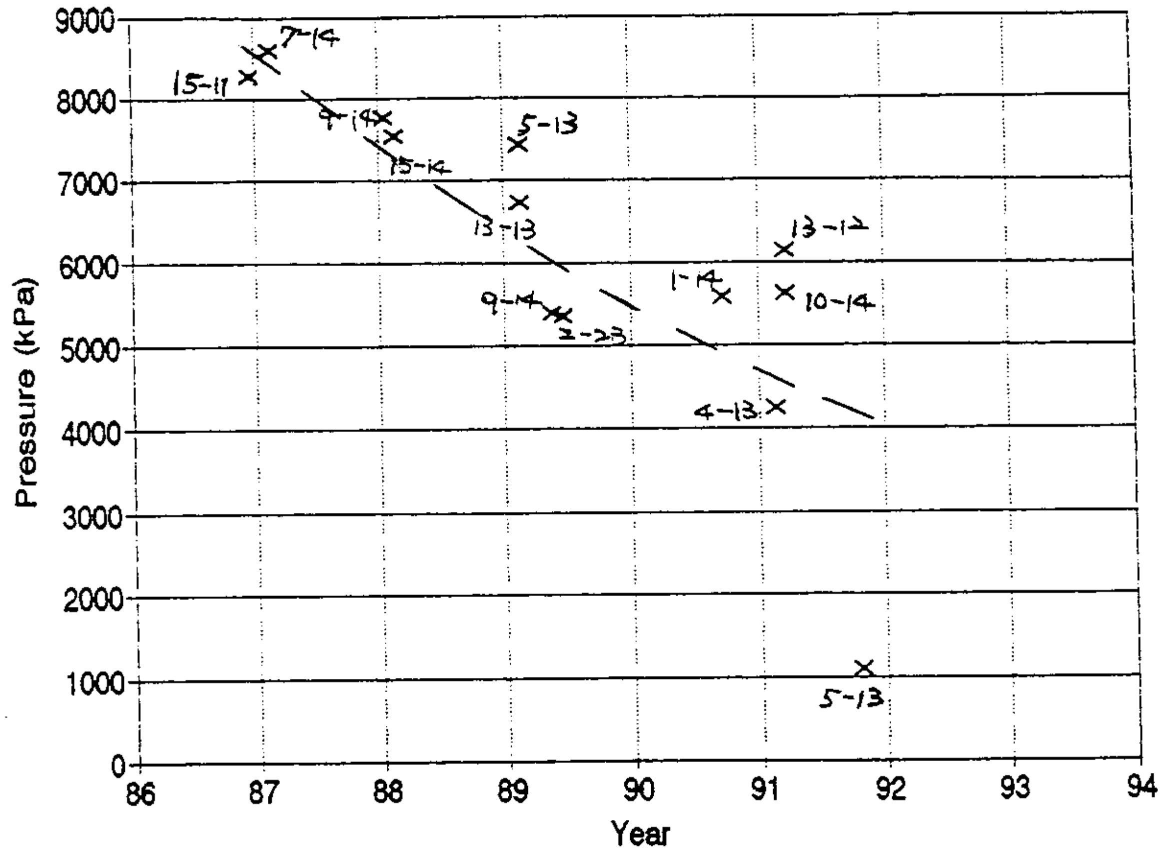


FIGURE 4 : FEILD PERFORMANCE - DALY BAKKEN 'D' POOL



WELL	DATE	Type of Test	P run D. (kPa)
15-11	86.12	DST	8,275
07-14	87.02	DST	8,591
09-14	88.01	DST	7,763
15-14	88.02	DST	7,537
12-13	88.03	DST	-
13-13	89.02	DST	6,719
05-13	89.02	DST	7,426
09-14	89.05	F.L.	5,392
02-23	89.06	DST	5,353
01-14	90.09	DST	5,579 (ISIP)
04-13	91.02	DST	4,255
13-12	91.03	DST	6,130
10-14	91.03	DST	5,610
05-13	91.10	F.L.	1,112

Figiure 5.0: Pressure Measurements- Daly Bakken 'D' Pool

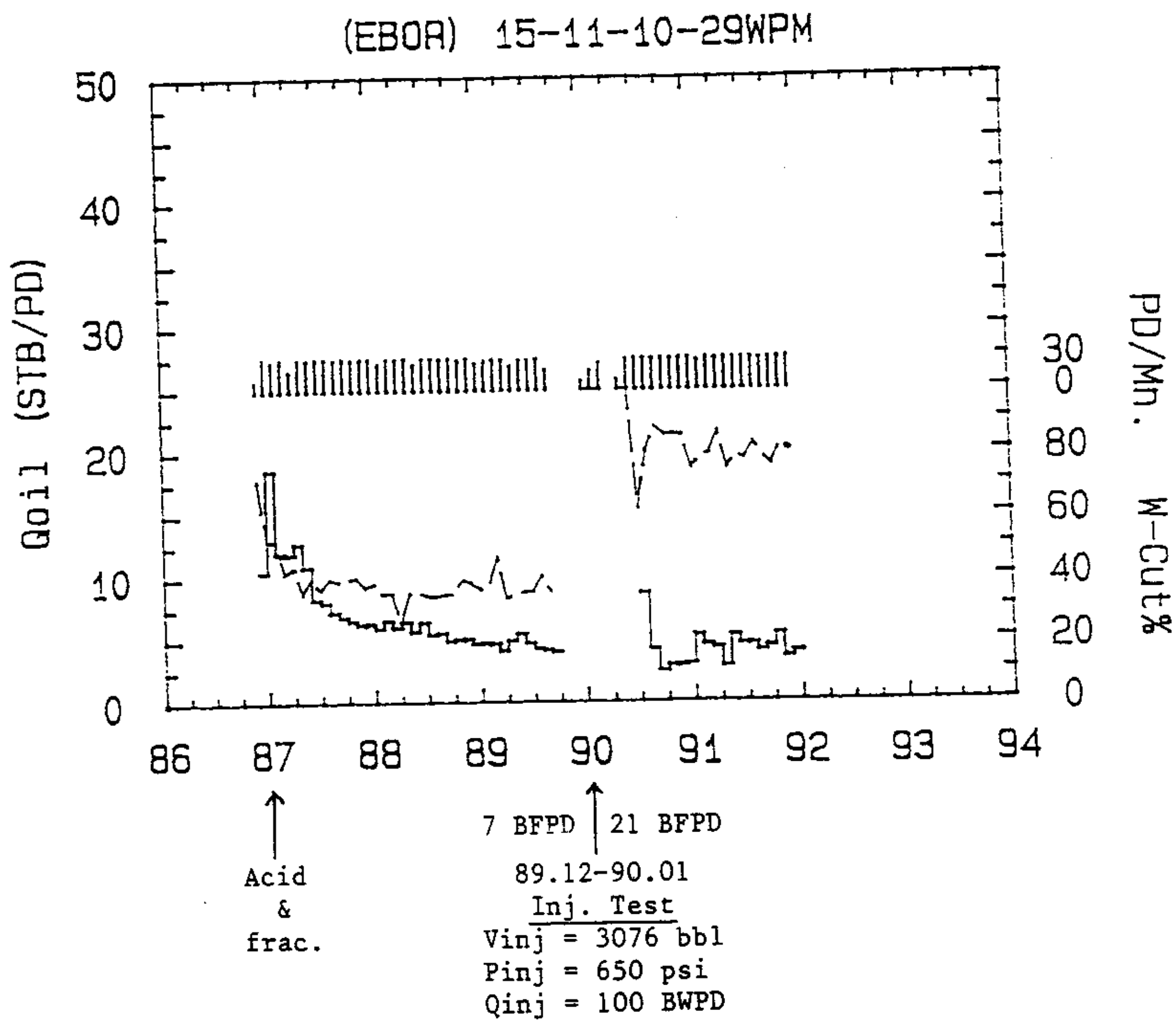


Yr./Mn.	Estimated reservoir P (kPa)
1986.12	8,591
1987.06	8,000
.12	7,450
1988.06	6,850
.12	6,400
1989.06	5,850
.12	5,450
1990.06	5,020
.12	4,650
1991.06	4,300
.12	4,000

FIGURE 5.1 PRESSURE HISTORY - DALY BAKKEN 'D' POOL

FIGURES 6.01 - 6.18 : Individual Well Performance Plots

15-11 (GL= 524.9, KB= 529m)



COMPLETIOMS:-

Date	Perf (m.KB)
86.12	858.5- 863.0 (Acid.& frac.-5 ton. 40/60 sand in gelled crude.)
89.12.05-90.01.21	Injection test - Inj. vol.= 489 m3 - Inj. P.= 4482 kPa - Qinj. stabilized @ 16.7 m3/d

COMMENTS:-

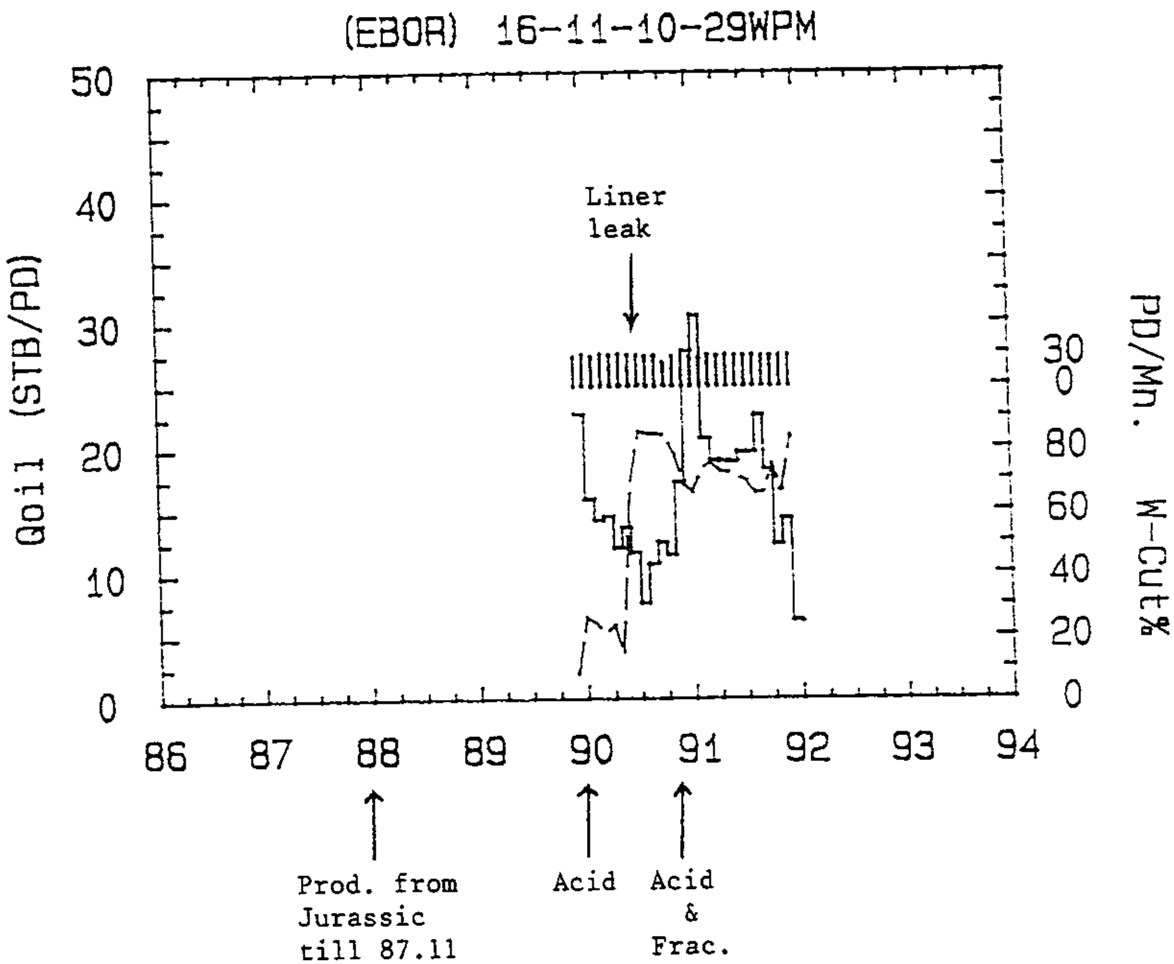
1. W-cut increased sharply after 90.01 inj. test.

   Total fluid prod. inc. from 7 to 21 BFPD after the test.

2. W-cut remained high although by 90.08 well 15-11 had prod. more than what was injected.

   (Wettability altered? or Formation frac'ed?
   - Check water salinity!)

Notes: - Check salinity to determine if water is produced from Bakken 'D' only.
- Potential water injector if Bakken is not in communication with upper zone(s).



16-11 (GL= 524.9, KB= 529.4m)

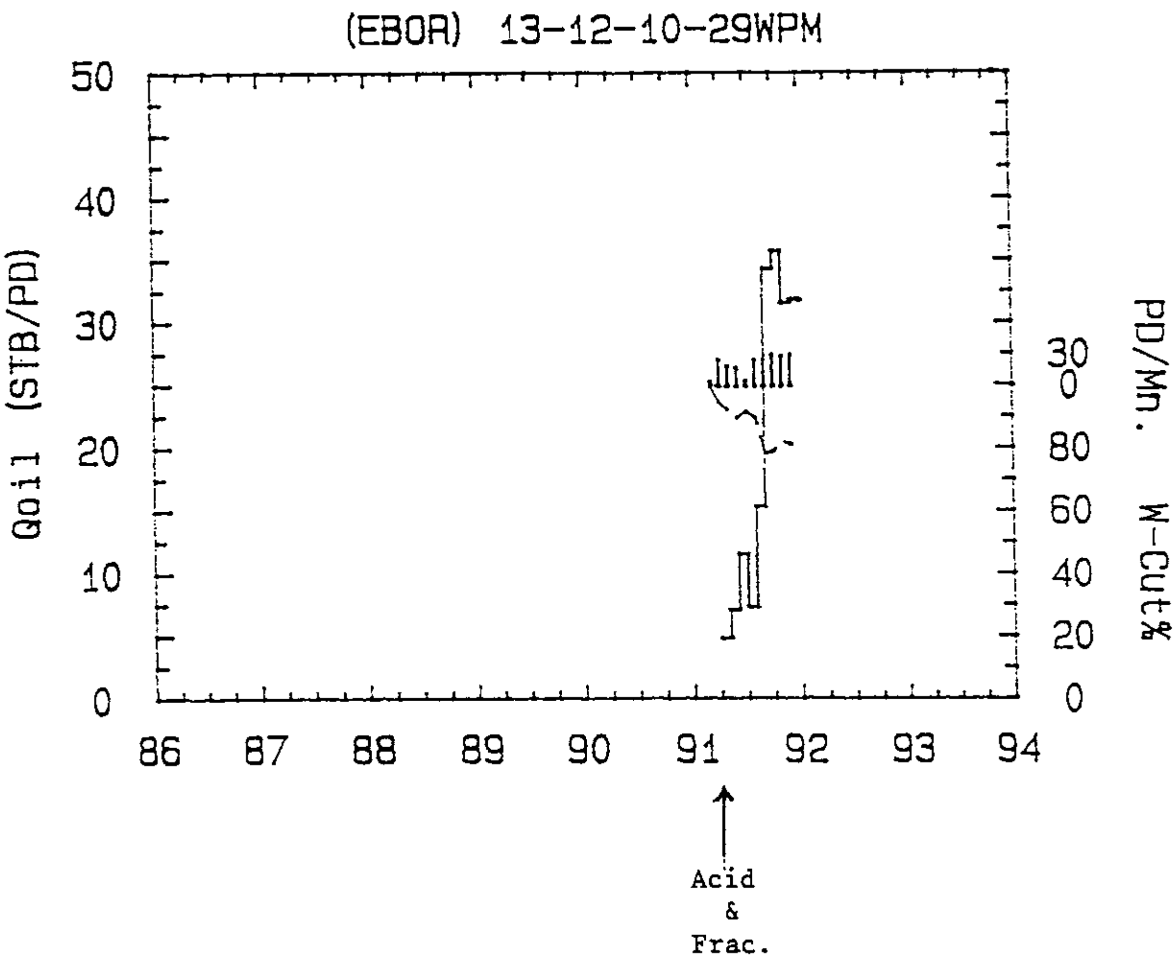
COMPLETIONS:-

Date	Perf.(m.KB)
89.11	861.0- 864.5 (acid.)
90.10	Acid. & frac. (5 ton. 20/40 sand in gelled water.)

Comments:-

1. Produced from Jurassic till 87.11
2. Prod. from Bakken 'D' since 89.11
3. W-cut increased sharply in 90.06 (Liner leak detected - water from Lodgepole or Jurassic? -Check salinity!)
4. 90.10 acid & frac => oil rate increased (regardless of communication.)

Note: - Check salinity to identify water source.



13-12 (GL= 522.9, KB= 527.1m)

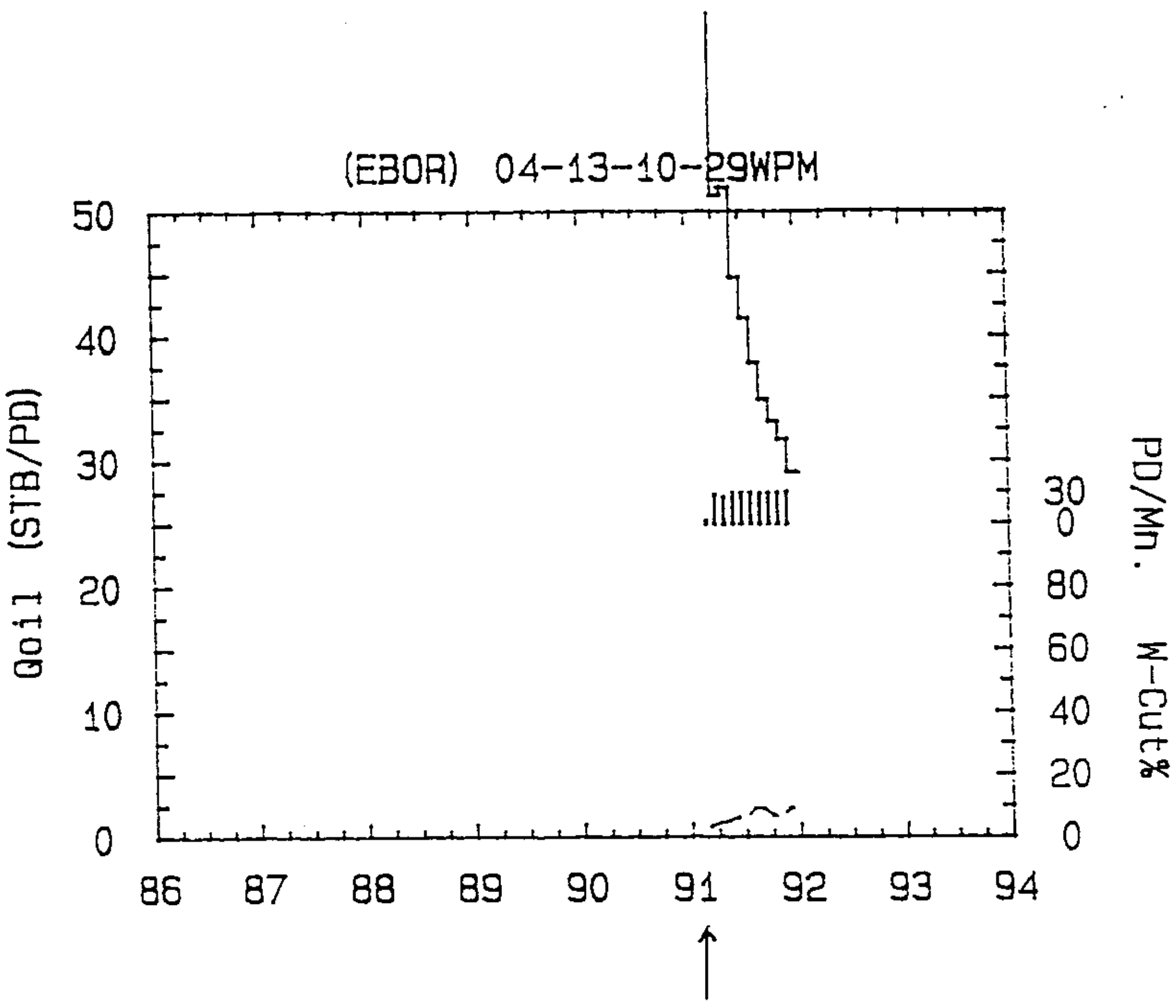
COMPLETIONS:-

Date	Perf.(m.KB)
91.03	859.0- 863.0 (acid.& frac.)
91.07	? Pumped-off

COMMENTS:-

1. Cored (852-869.5m)
2. 91.03 DST:
   P=6130 kPa @ 860.78m
   k=115 md
3. High w-cut producer.
   (caused by 91.03 frac?
   - Check salinity!)
4. Oil rate inc. sharply after
   91.08 (?)
   Good rate since 91.09
   (improved pumping efficiency!)

Note: - Check salinity to identify water source.



04-13 (GL=520.66, KB=524.86m)

COMPLETIONS:-

Date	Perf.(m.KB)
91.02	861.5- 863.0 (Acid.?)

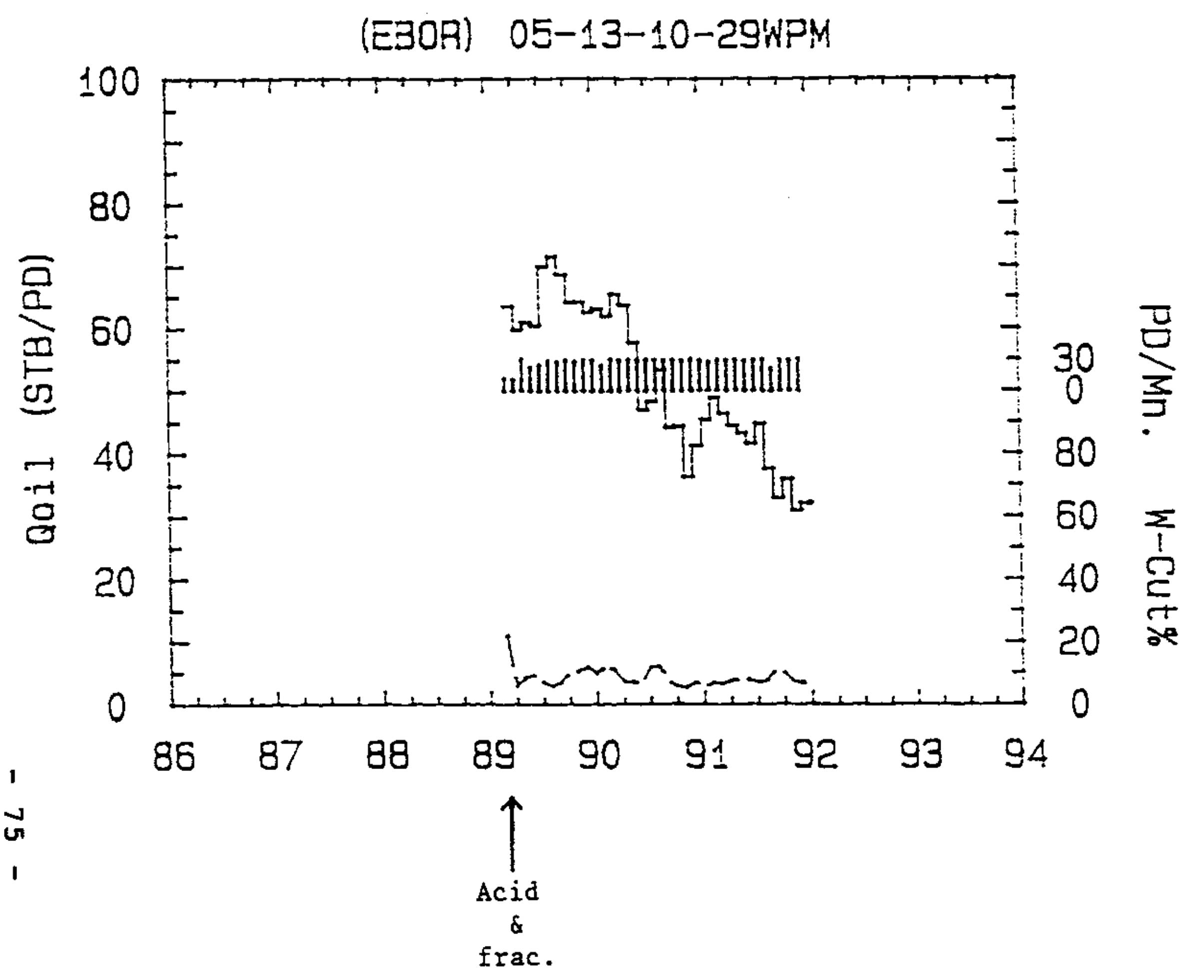
COMMENTS:-

1. 91.02 DST;
   P= 4255 kPa @ D= 862.89 m.KB
   k=312 md

2. Good initial rate (Phi=27%)

   Sharp decline since (due to insufficient reservoir energy and/or competing with 05-13 & 13-12 ?)

Note: - Analyse early-1992 production to determine pressure support in the region (04-13, 05-13 & 13-12)
(A static pressure survey may be required.)



05-13 (GL=520.4, KB=525.25m)

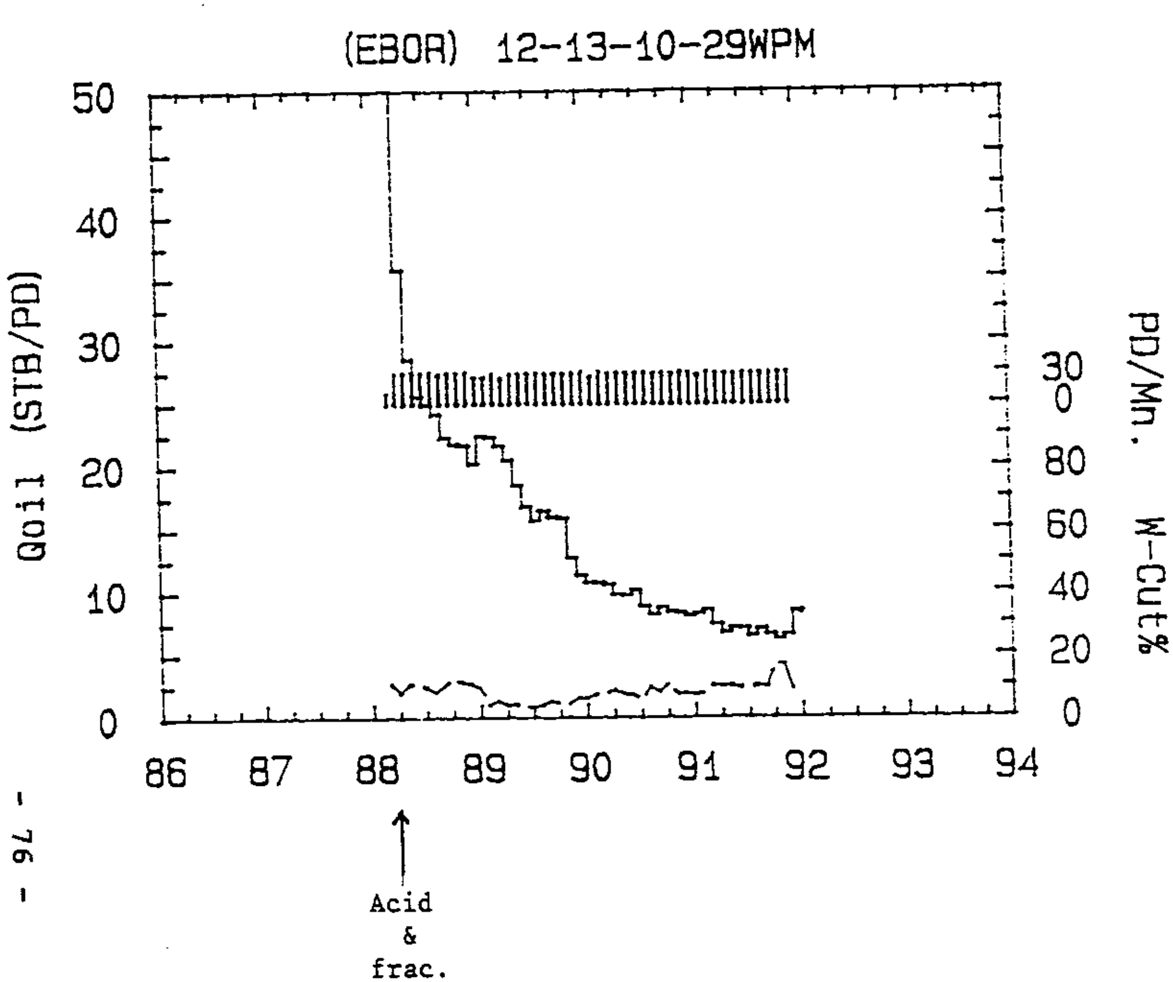
COMPLETIONS:-

Date	Perf.(m.KB)
89.03	860.0- 864.0 (Acid. & frac)

COMMENTS:-

1. Best producer
   (Cum. oil= 7,677 m3 as of 91.12)
2. 90.08 Conservation Board letter:
   MPR= 190 m3/mn.
3. High productivity in 04-13 & 05-13 region.
4. Watch early-1992 production in resp. to WI 08-14
5. 1991.10 P.= 1,112 kPa
   (1 week S.I. prior to 08-14 W.I.)

Notes:
- Different scale used for 05-13 due to high oil rate.
- Area extention to the east should be investigated.
- A pressure survey in 04-13 or 05-13 may be needed to determine the degree of pressure support in the region.



12-13 (GL=523.4, KB=528m)

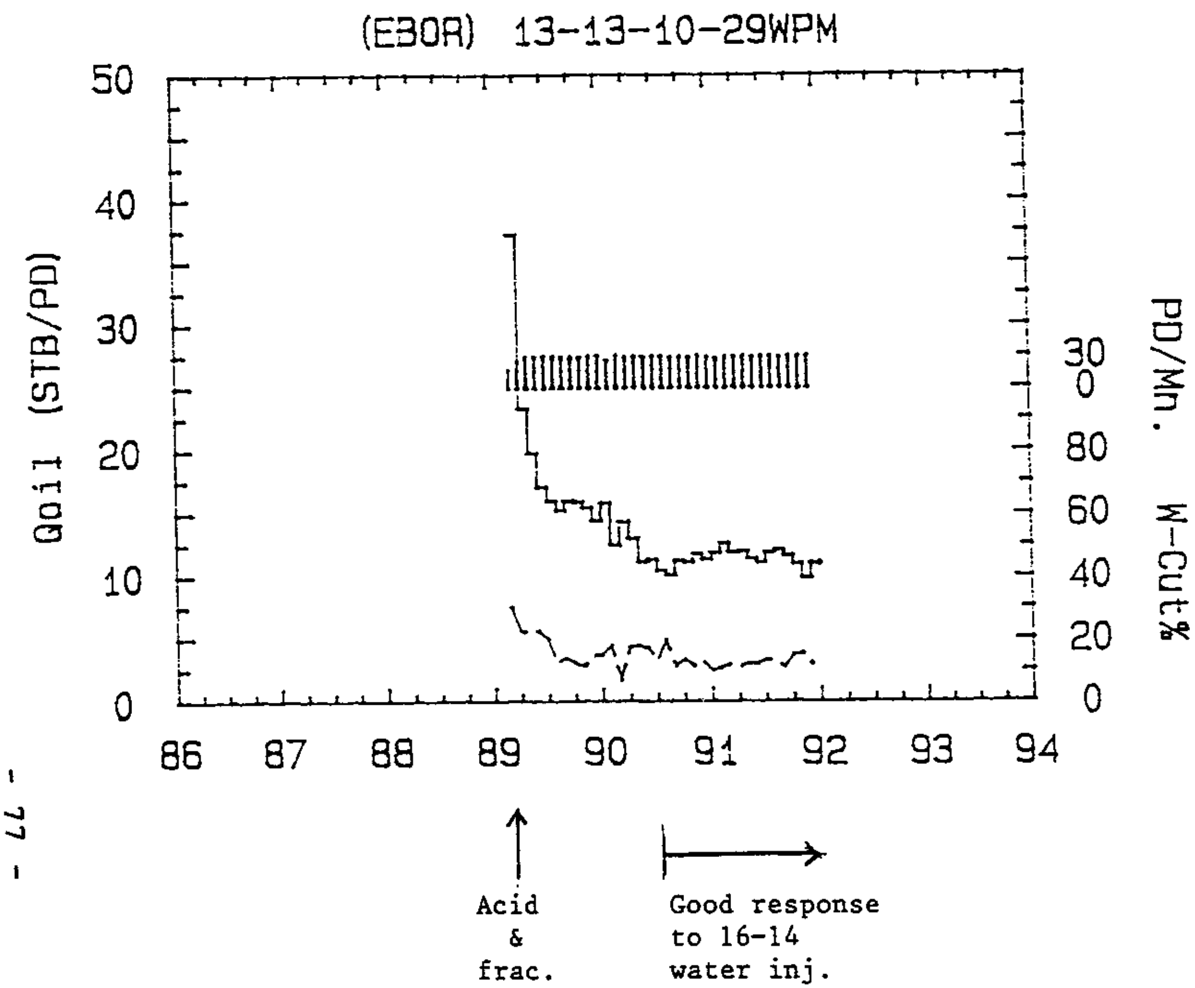
COMPLETIONS:-

Date	Perf.(m.KB)
88.03	857.0- 861.5 Acid & frac (3 ton. 20/40 sand in gelled crude)

COMMENTS:-

1. Cored, 88.03 DST(poor)
2. Flat rate since 90.07 (In response to both 16-14 & 08-14 WI. ?)
3. High initial rate; dropped to less than 1/4 by 90.01 (Re-frac or penetrator candicate)

Note: - Re-frac or penetrator candidate for 1992



13-13 (GL=520.6, KB=524.15m)

COMPLETIONS:-

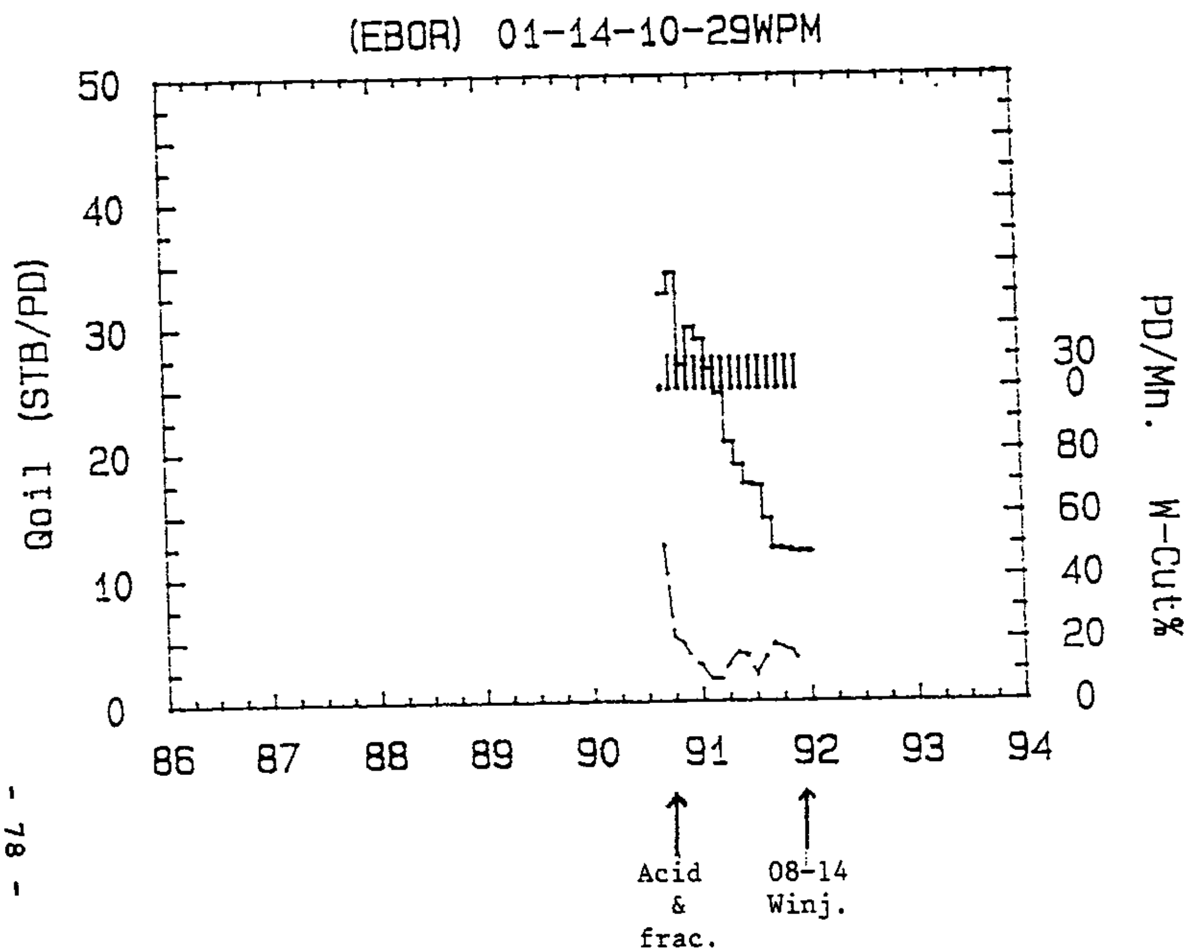
Date	Perf.(m.KB)
89.02	849.5- 853.0 (Acid.& frac)
89.06	Ran Pony Rod

COMMENTS:-

1. 89.02 DST:
   P=6719 kPa @ 851.05 m.KB
   k=5 md

2. Good response to 16-14 W.I.

3. Production remains constant since 90-07
   => Lack of reservoir energy (prior to WI) confirmed.



01-14 (GL=522.46, KB=526.66m)

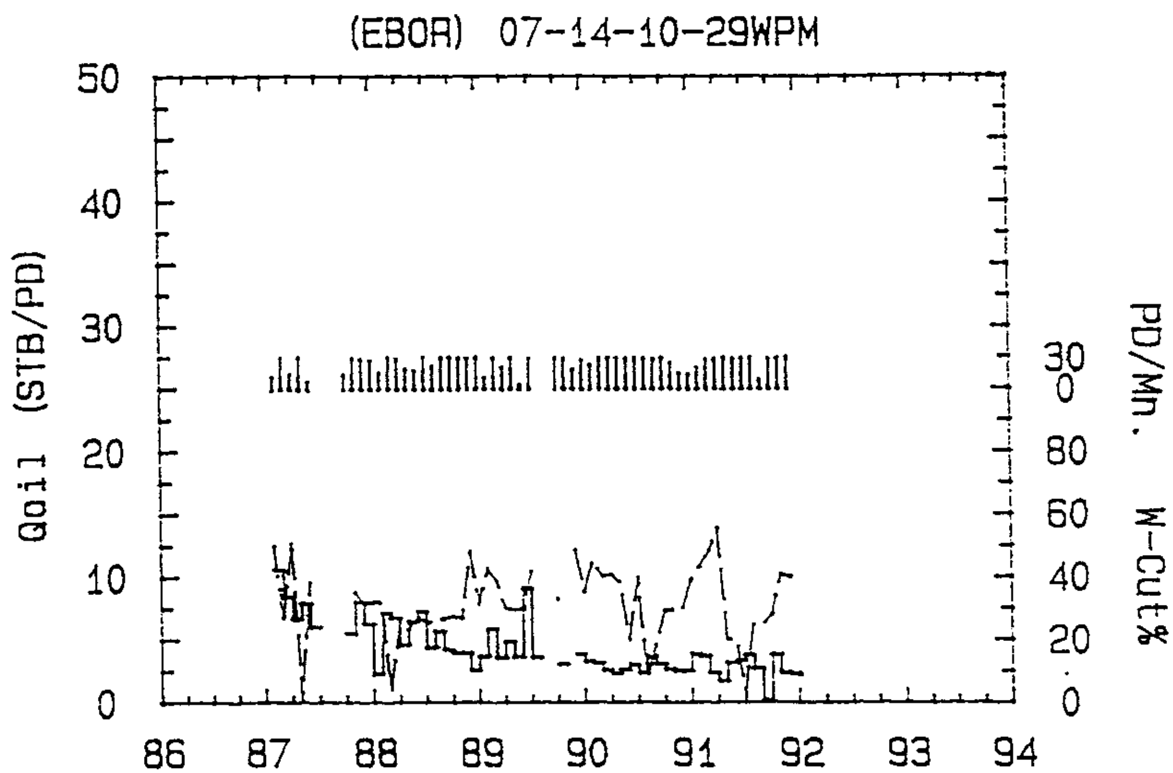
COMPLETIONS:-

Date	Perf.(m.KB)
90.09	857.0- 860.5 (Acid.& frac.)

COMMENTS:-

1. 90.09 DST:
   ISIP= 5579 kPa @ 861.82 m.KB
2. South to WI. 08-14
3. Watch 1992 prod. in resp. to 08-14 water injection.
4. Deep penetration method(s) may be worth trying (as formation appears to be weaker in the south).

Note: - Penetrator candidate (1992)



(Commingle production - Bakken & Lodgepole)

07-14 (GL=523.6, KB=527.4m)

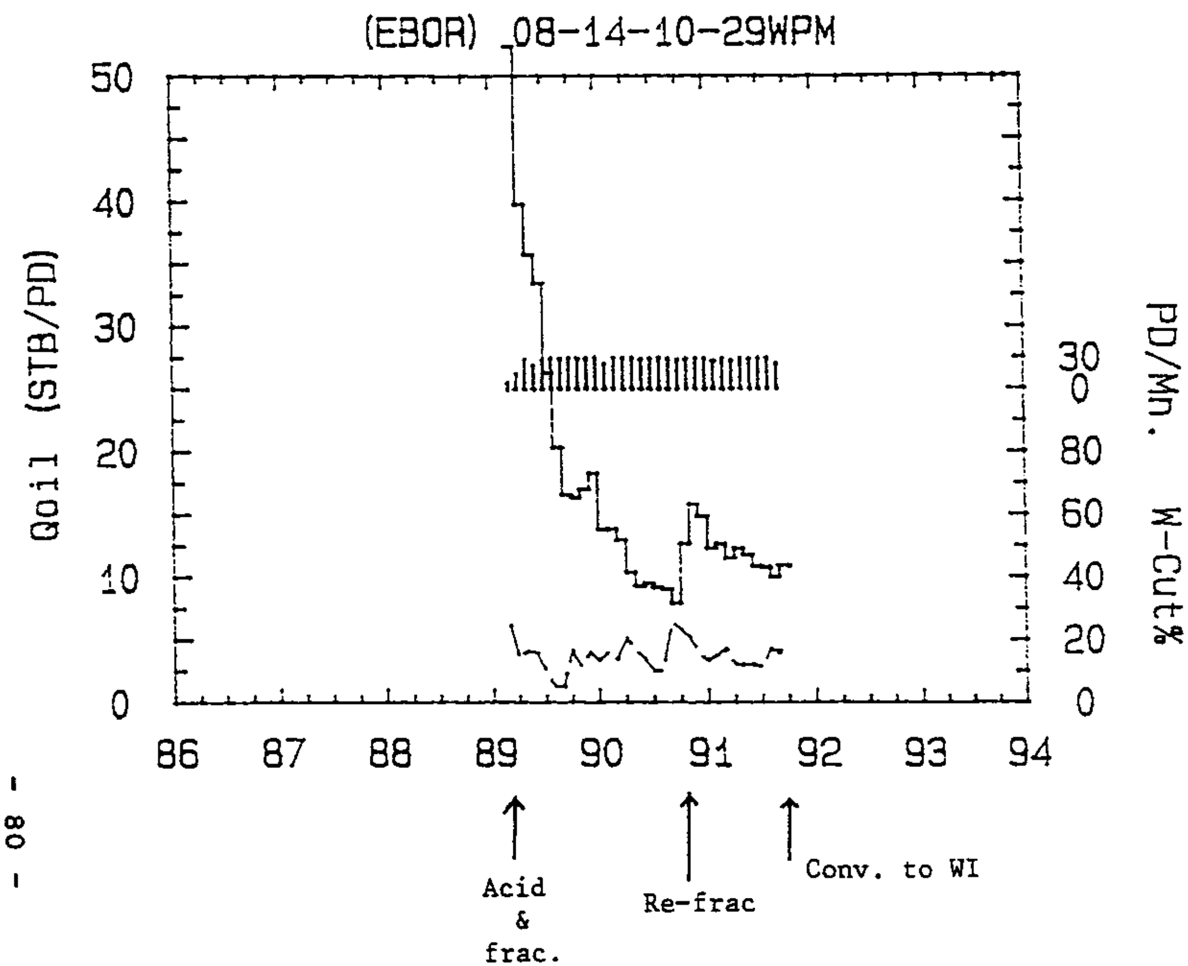
COMPLETIONS:-

Date	Perf.(m.KB)
87.02	857.0- 861.0 Bakken (Acid.)
	792.0-795.0 Lodgepole (Commingle prod.)
91.02	Spot acid
91.09	Pump change

COMMENTS:-

1. Commingle production (from Bakken & Lodgepole)
2. Cored. 87.02 DST:
   P=8591.3 kPa
   ISIP=8024 kPa @ 857.74 m.KB
3. Relatively high w-cut (Check water salinity!)
4. Low pororsity(12%) & oil rate

Note: - Analyse water salinity and compare to 15-11, 16-11 & 13-12 salinities to determine water source(s).



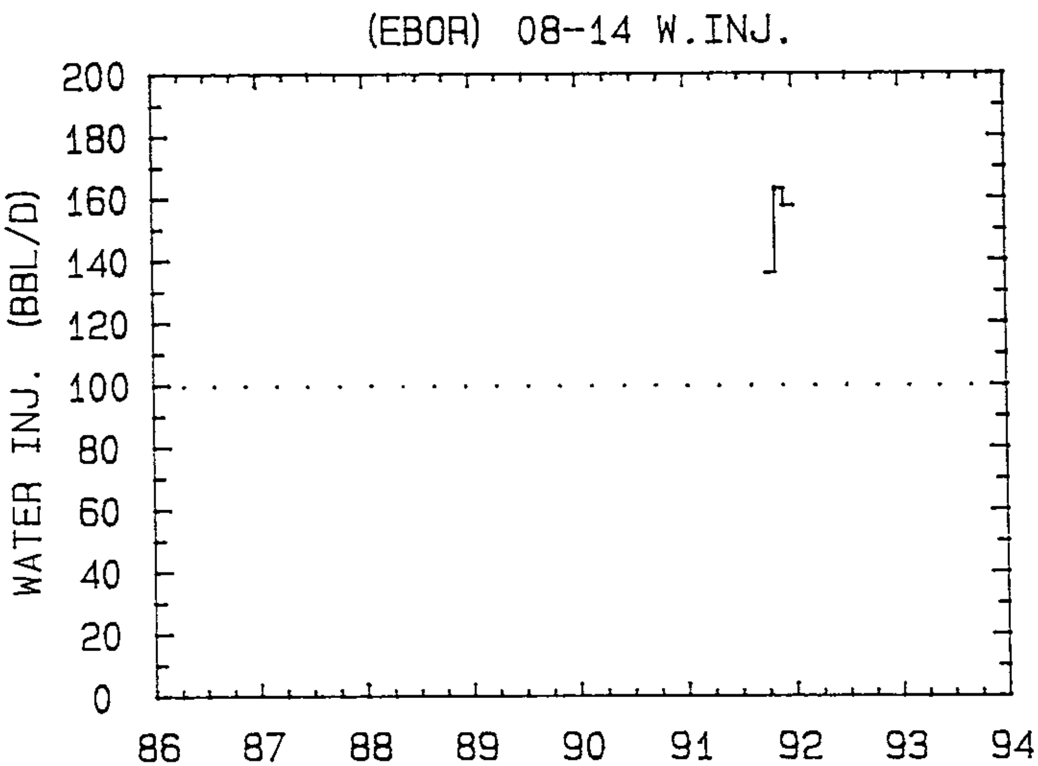
08-14 (GL=522.67, KB=526.42m)

COMPLETIONS:-

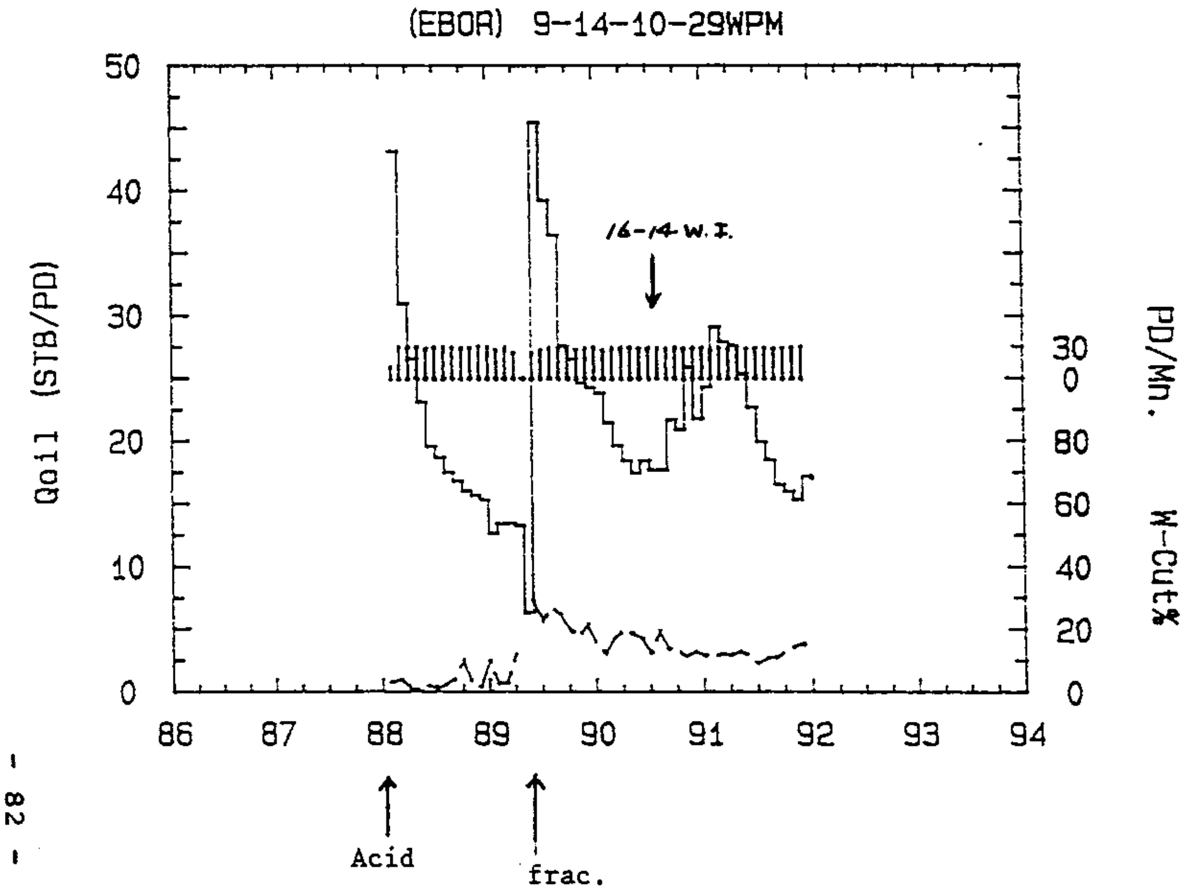
Date	Perf.(m.KB)
89.03	860.0- 864.0 (Acid.& frac.)
90.10	Re-frac
91.09	Conv. to W.I.

COMMENTS:-

1. Qoil declined at slower rate after the 90.10 re-frac
   - possibly due to 08-14 water inj.
2. 91.10- Water inj. commenced (Qinj=25 m3/d @ 820 psi inj.P.)
3. Monitor response in neighboring producers (01-14, 07-14, 09-14, 05-13)



Notes: - Converted to water injector in 1991.09
- Monitor neighboring producers' responses in 1992



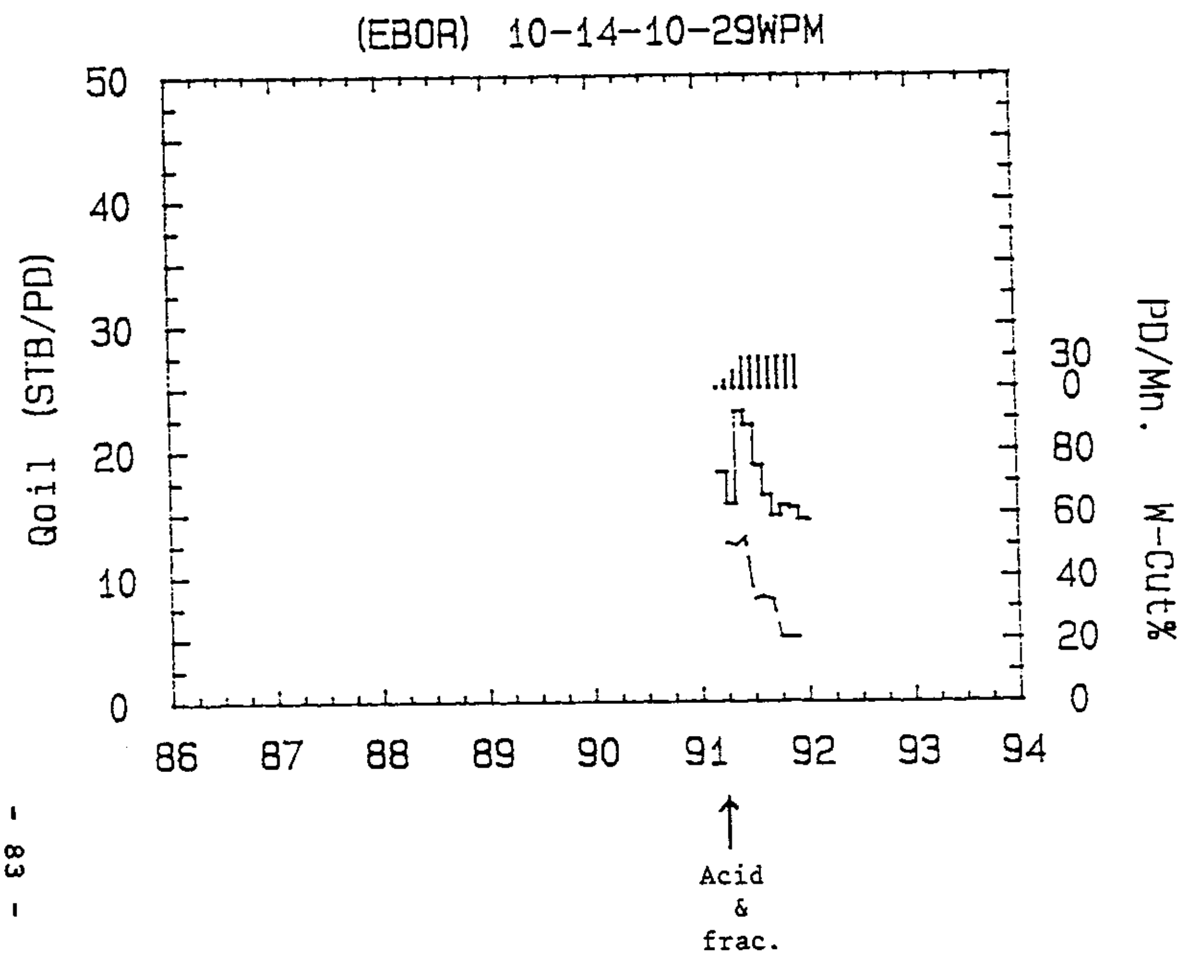
09-14 (GL=522.8, KB=527.4m)

COMPLETIONS:-

Date	Perf.(m.KB)
88.01	856.5- 860.5 (Acid.)
89.05	Frac.

COMMENTS:-
1. Cored. 88.01 DST: P=7763 kPa @ 858.4 m.KB k=64 md
2. 89.05 frac.: Very successful (W-cut inc. slightly)
3. Good response to 16-14 Water injection

Note: - Analyse water salinity for water source determination. (W-cut increased slightly after the 89.05 frac.)



10-14 (GL=522.93, KB=527.13m)

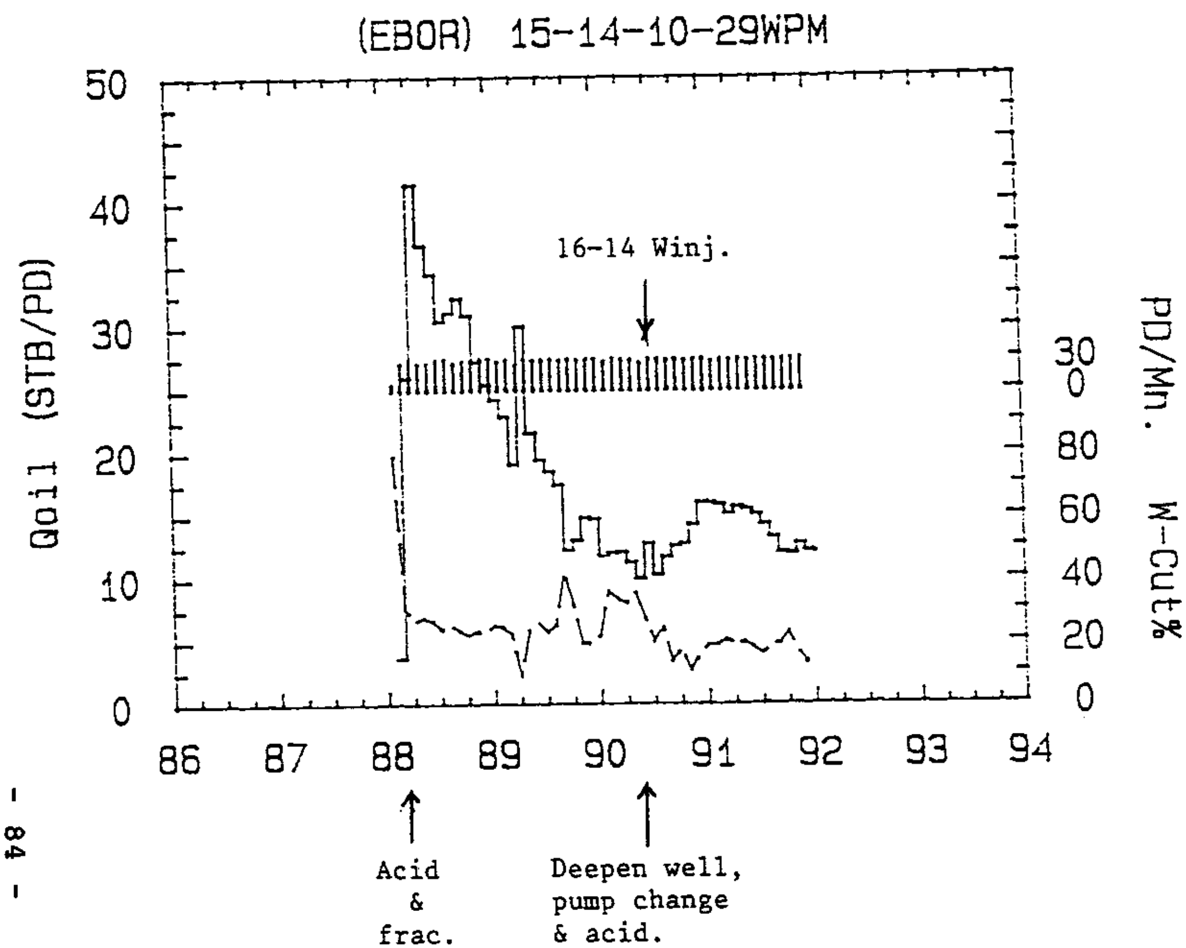
COMPLETIONS:-

Date	Perf.(m.KB)
91.03	857.5- 861.0 (Acid.& frac.)

COMMENTS:-

1. 91.03 DST:
   P=5610 kPa @ 858.25 m.KB
   k=63 md

2. Little decline in oil rate since 91.09 (Supported by WI.)



15-14 (GL=523.4, KB=528 m)

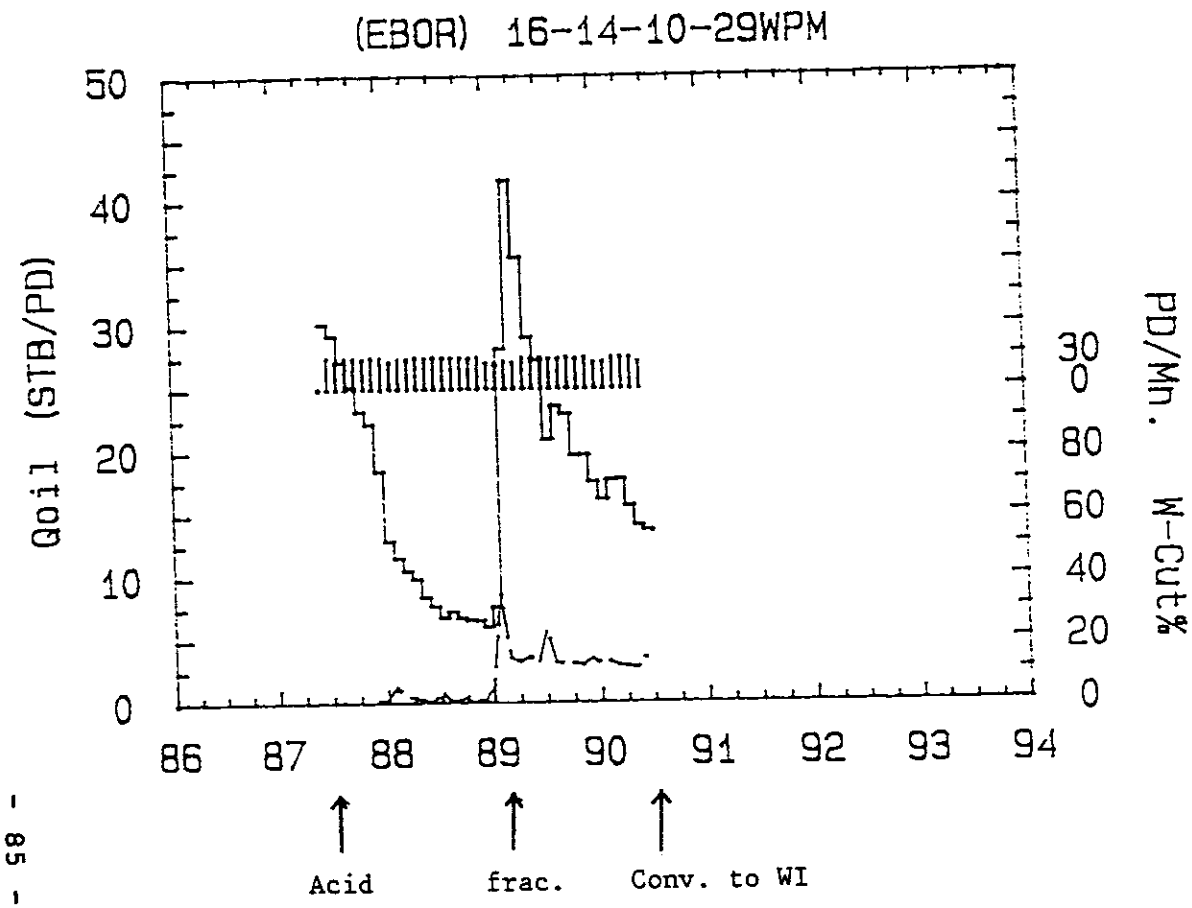
<u>COMPLETIONS:-</u>

<u>Date</u>	<u>Perf.(m.KB)</u>
88.02	855.5- 859.0 (Acid.& frac- 5 ton. 20/40 sand in gelled crude)
90.05	deepen well, pump change & acid.

<u>COMMENTS:-</u>

1. Cored. 88.02 DST:
   P=7537 kPa @ 855.63 m.KB
   k=18.6 md

2. Good resp. to W.I. 16-14
   (Lack of energy prior to WI confirmed)



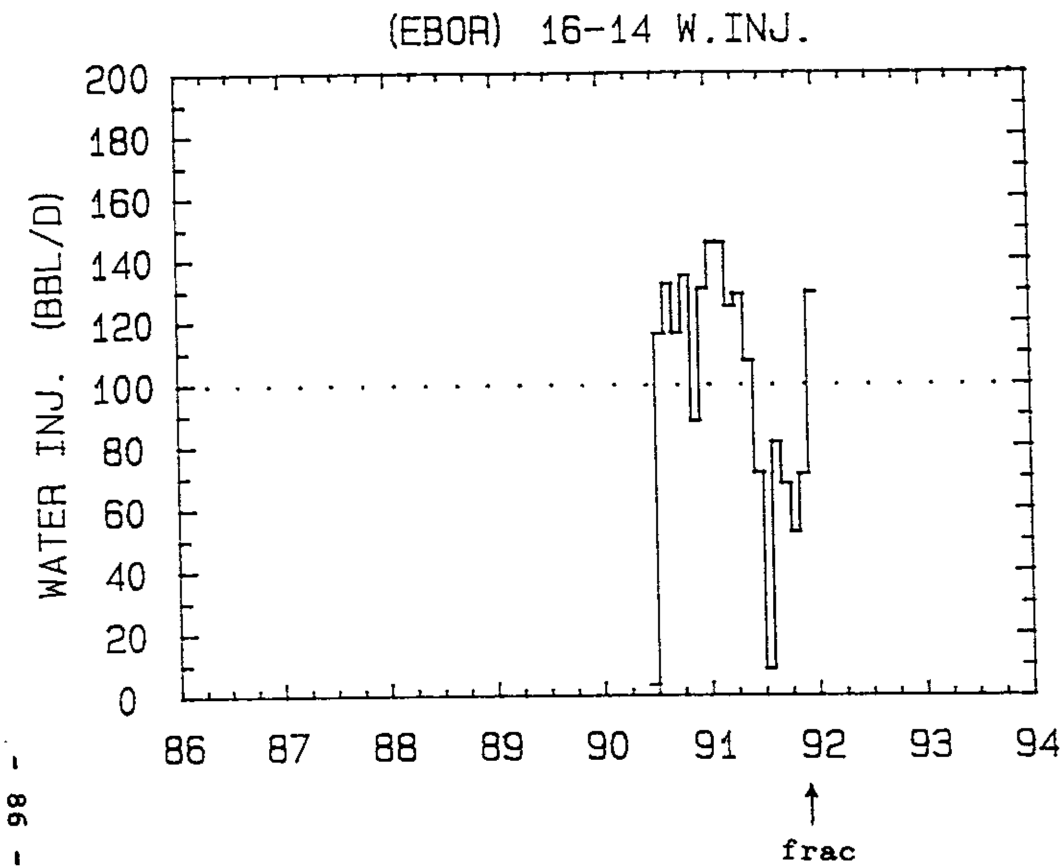
16-14 (GL=524.2, KB=528 m)

COMPLETIONS:-

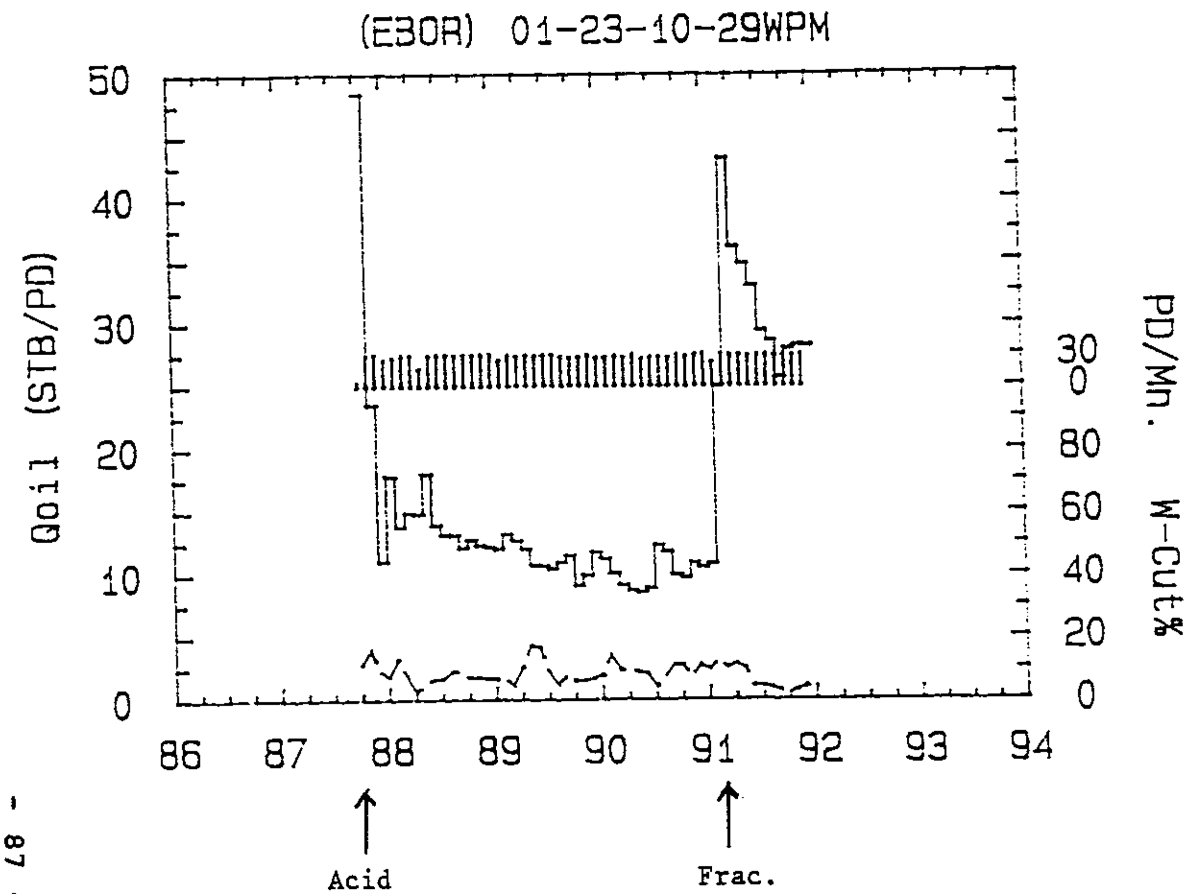
Date	Perf.(m.KB)
87.06	855.0- 859.0 (Acid.)
89.02	Frac.
90.06	Conv. to W.I.
91.11	Frac.

COMMENTS:-

1. Cored.
2. 89.02 frac: successful (W-cut inc. slightly- similar to 09-14)
3. Qinj. dec. since 91.05 (Fines mobilization?, Water quality?)
4. 91.11 re-frac: Qinj returns to 20-21 m3/d
5. Monitor response in neighboring producers to confirm effectiveness of WI!



Notes: - Converted to water injector in 1990.06
- 1991 injectivity decline could be attributed to injection water quality problems
- 1991.11 frac: successful



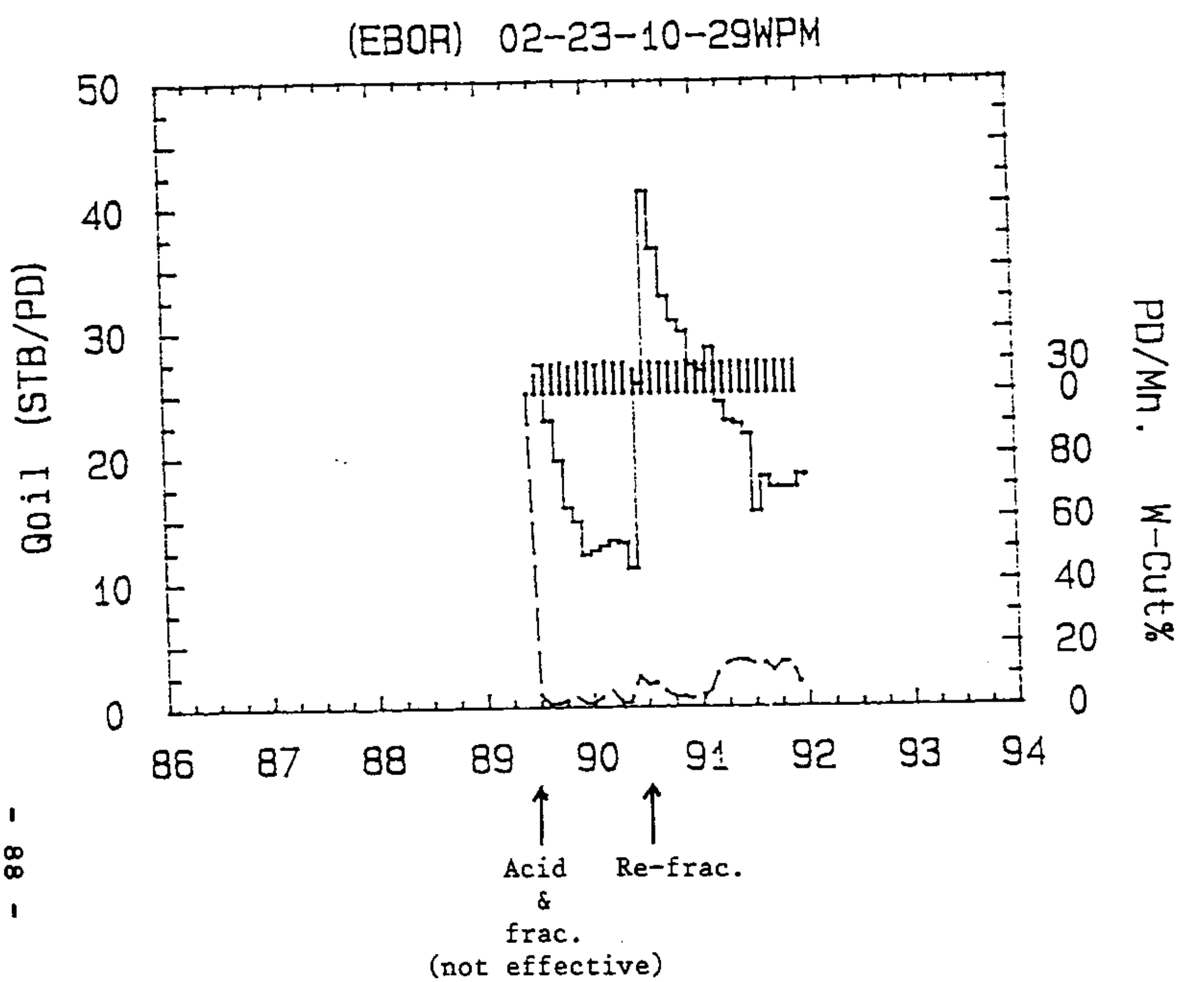
01-23 (GL=520.4, KB=524.2 m)

COMPLETIONS:-

Date	Perf.(m.KB)
87.10	853.0- 854.0 (Acid.)
91.02	Frac.

COMMENTS:-

1. Cored.
2. Steady rate (88-90)
3. 91.02 frac: successful
4. No decline in oil rate since 91-09 (supported by 16-14 WI.)



02-23 (GL=522.35, KB=526.1 m)

COMPLETIONS:-

Date	Perf.(m.KB)
89.06	855.0- 859.0 (Acid.& frac.)
90.06	Re-frac

COMMENTS:-

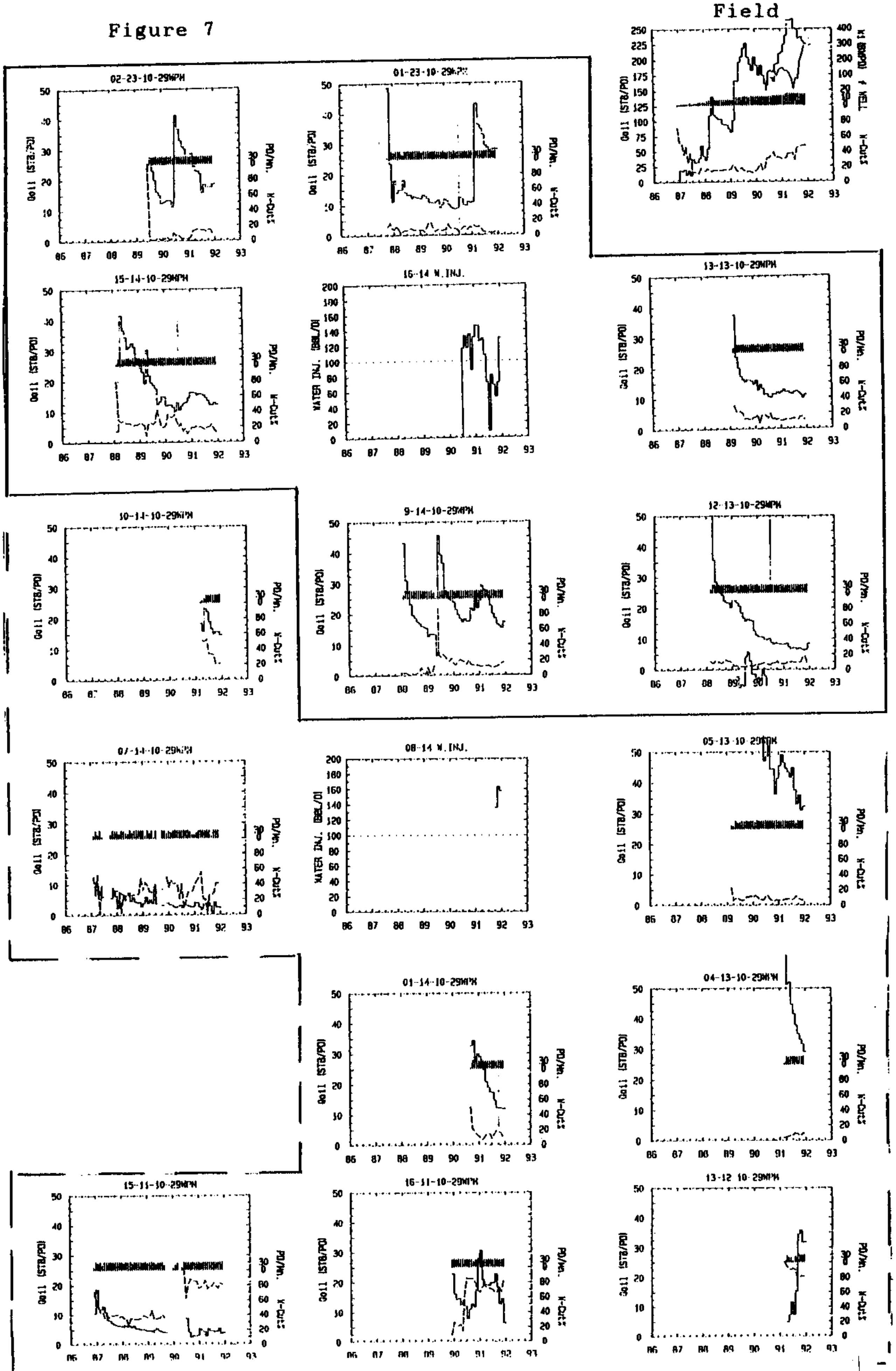
1. 89.06 DST: @ 856.06 m.KB
   P=5353 kPa, k=13 md

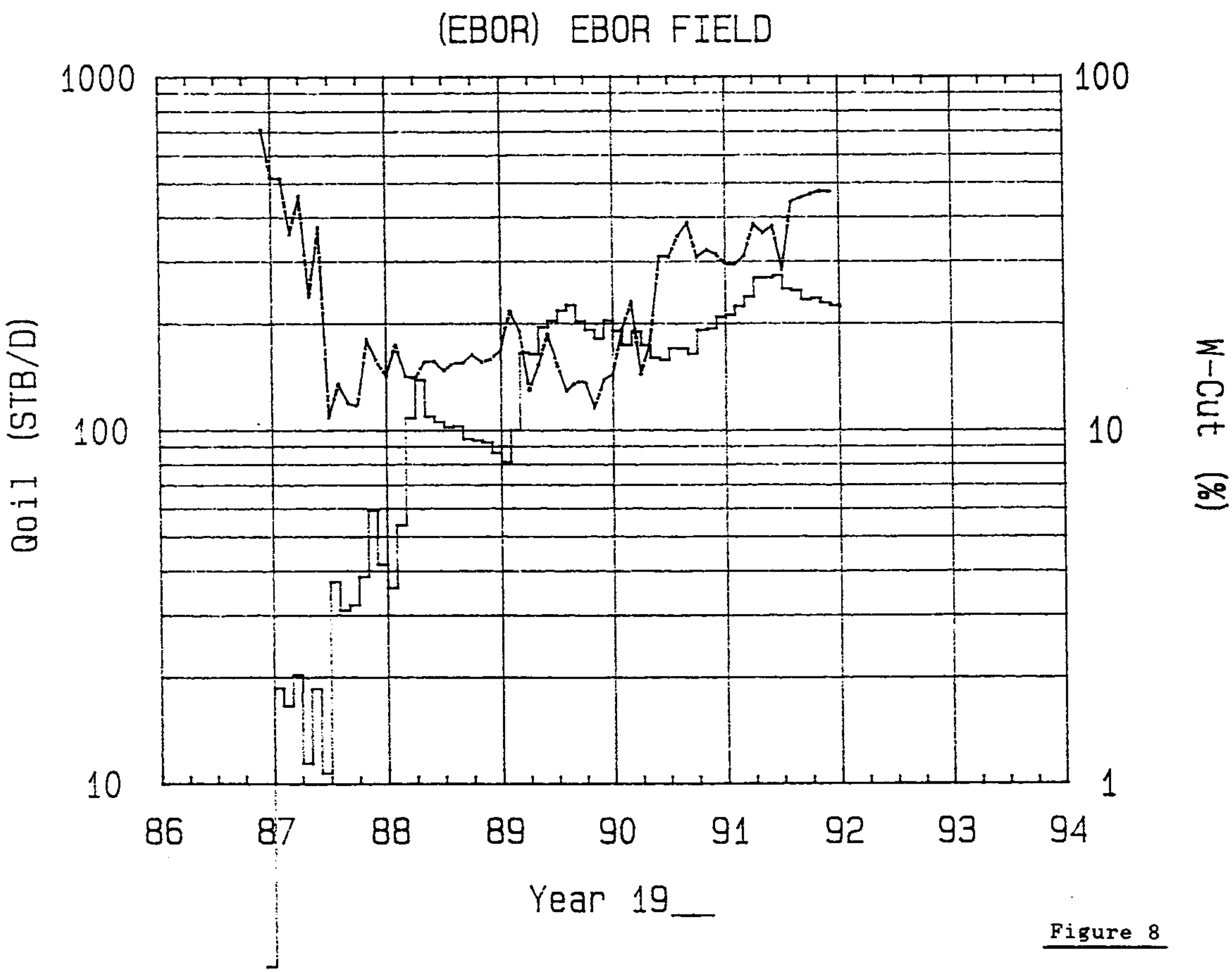
2. 90.06 Re-frac: successful

3. No decline in oil rate since 91-07
   (similar to 01-23?)

4. Check water salinity in this region!

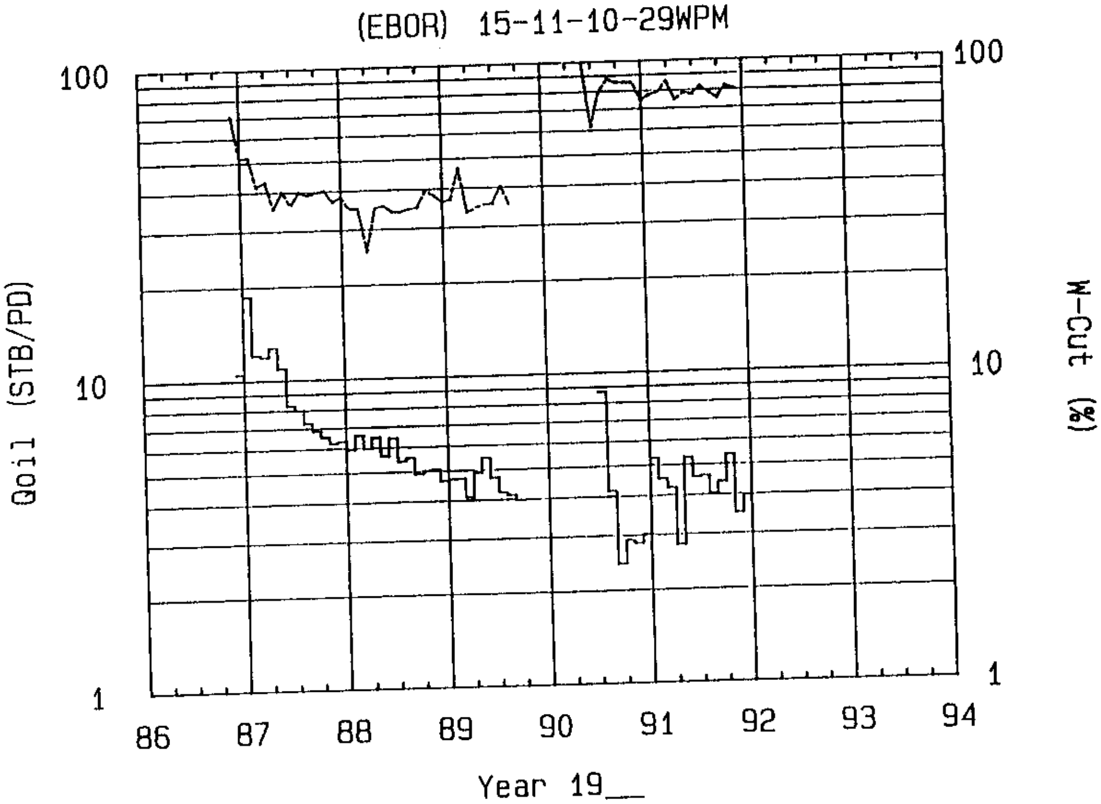
Figure 7


Field
02-23-10-29WPM
01-23-10-29WPM
15-14-10-29WPM
16-14 W.INJ.
13-13-10-29WPM
10-14-10-29WPM
9-14-10-29WPM
12-13-10-29WPM
07-14-10-29WPM
08-14 W.INJ.
05-13-10-29WPM
01-14-10-29WPM
04-13-10-29WPM
15-11-10-29WPM
16-11-10-29WPM
13-12-10-29WPM
Qoil (STB/PD)
PD/Mn.
W-Cut%
WATER INJ. (BBL/D)



(EBOR) EBOR FIELD
1000
100
10
Qoil (STB/D)
100
10
1
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

Figure 8


(EBOR) 15-11-10-29WPM
Qoil (STB/PD)
W-Cut (%)
100
10
1
86
87
88
89
90
91
92
93
94
Year 19__

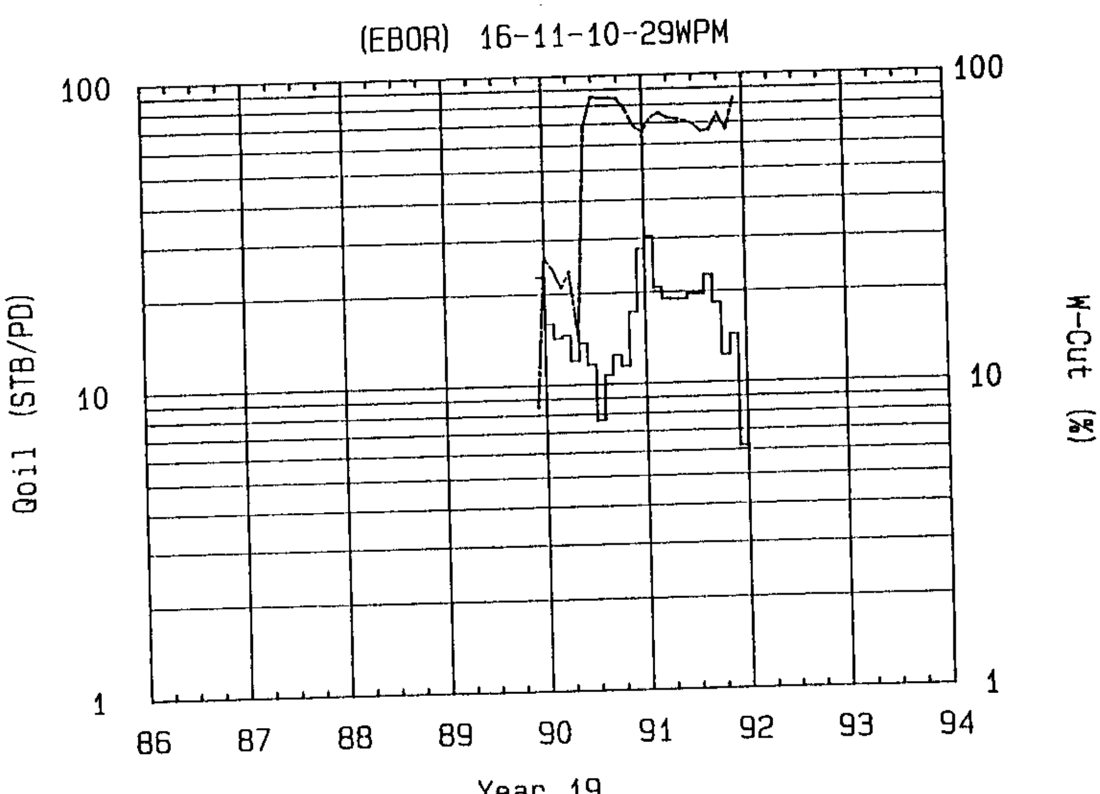
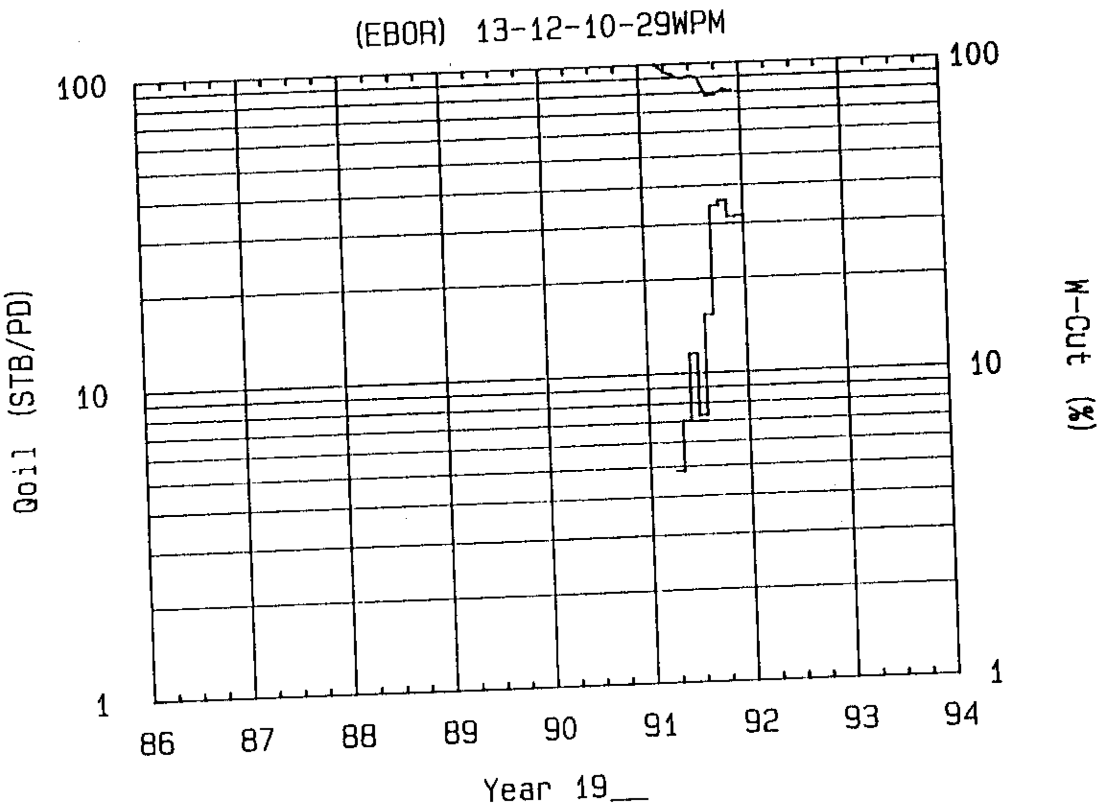

(EBOR) 16-11-10-29WPM
Qoil (STB/PD)
W-Cut (%)
100
10
1
86
87
88
89
90
91
92
93
94
Year 19__

Figure 9.01


(EBOR) 13-12-10-29WPM
100
10
1
Qoil (STB/PD)
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

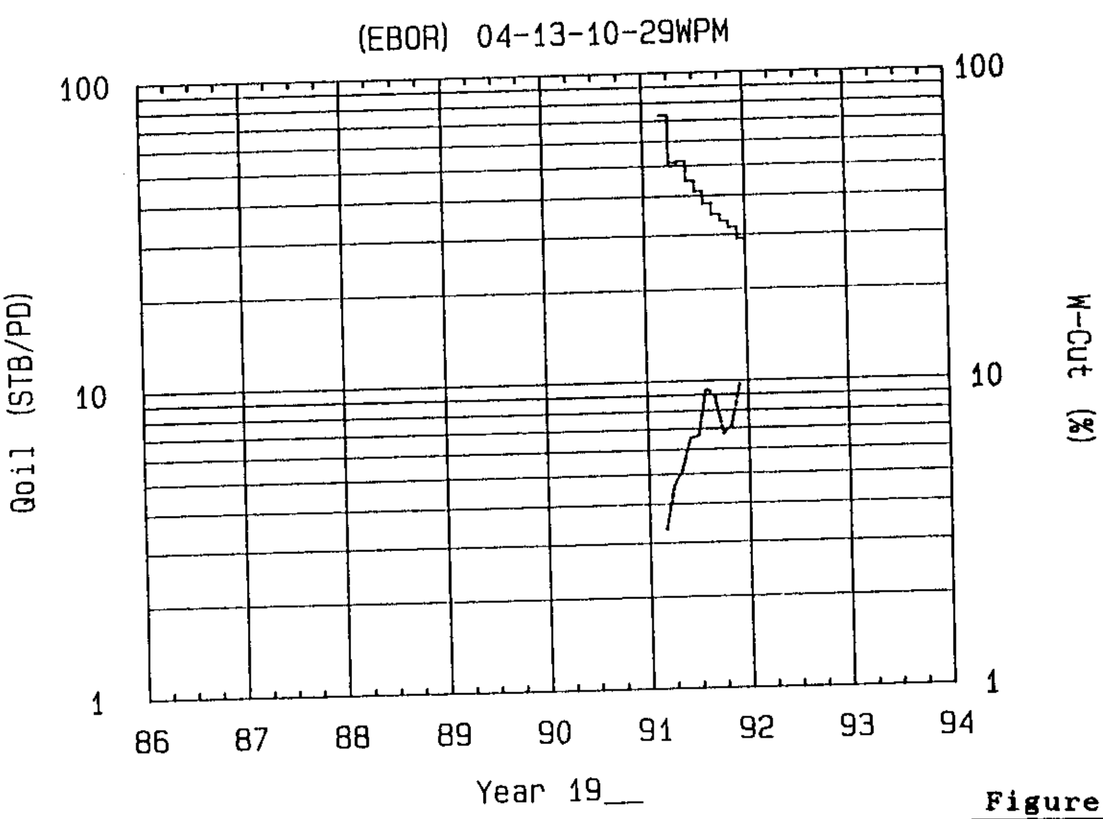
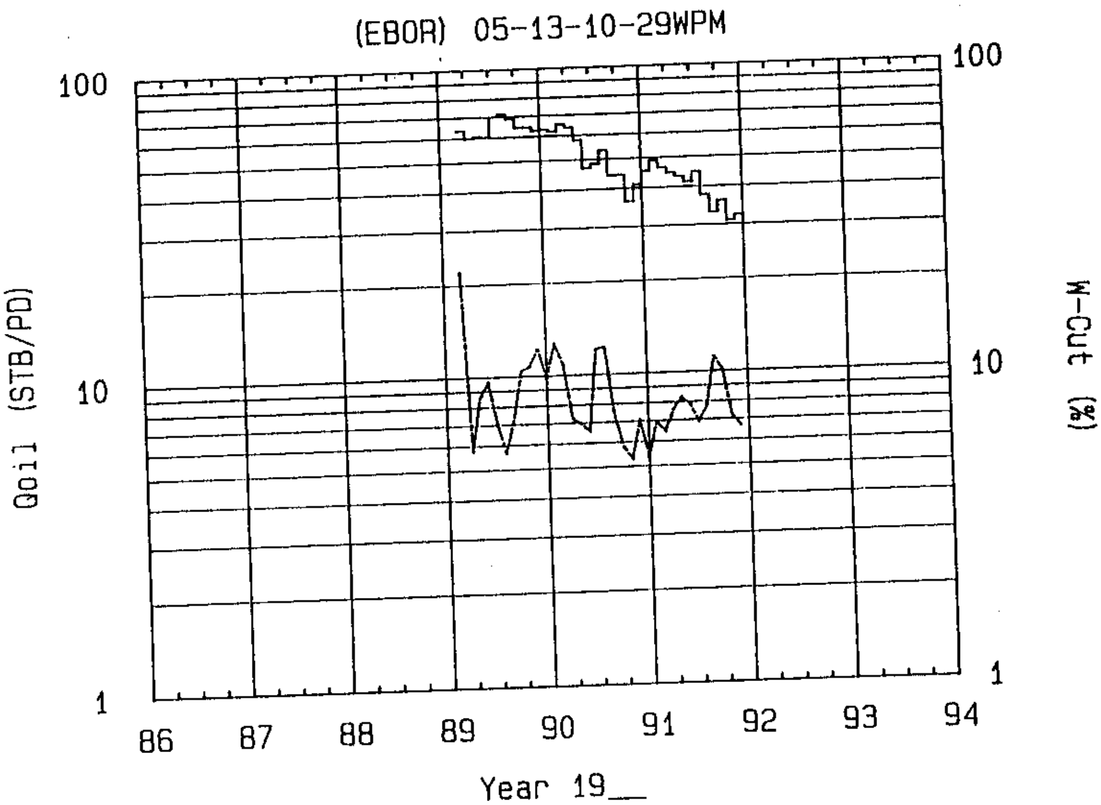

(EBOR) 04-13-10-29WPM
100
10
1
Qoil (STB/PD)
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

Figure 9.02


(EBOR) 05-13-10-29WPM
100
10
1
Qoil (STB/PD)
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

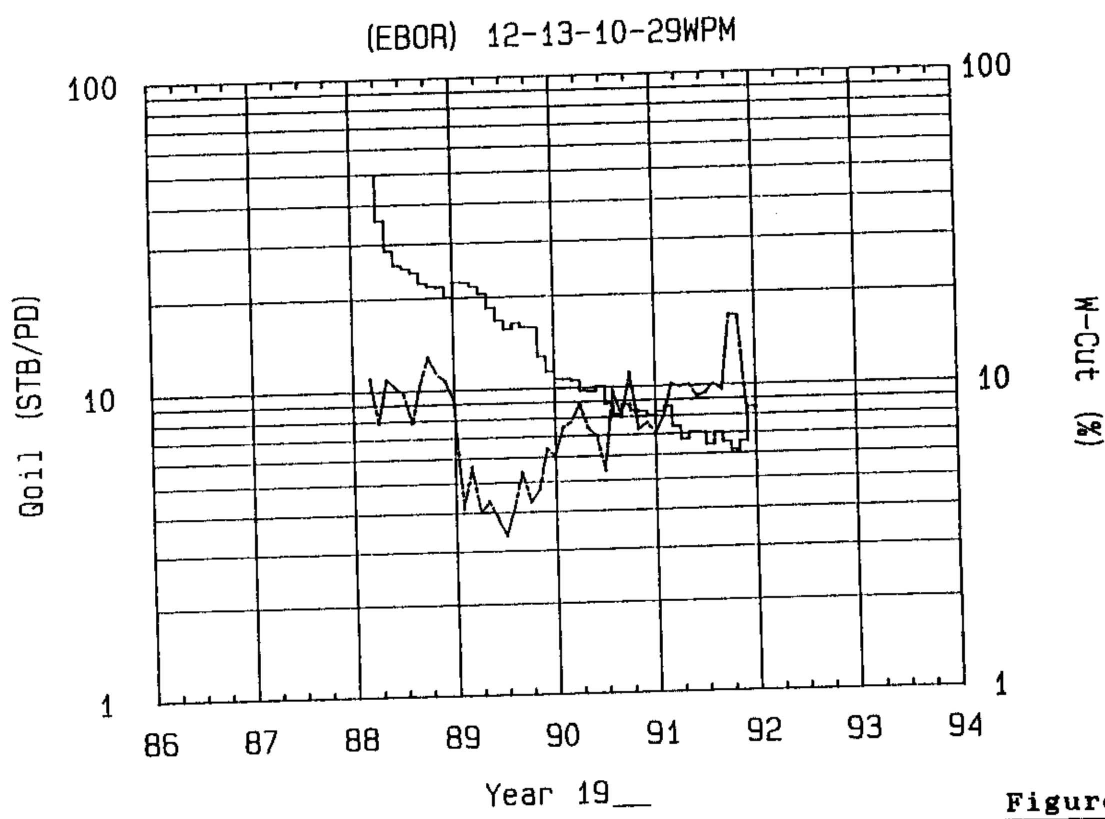
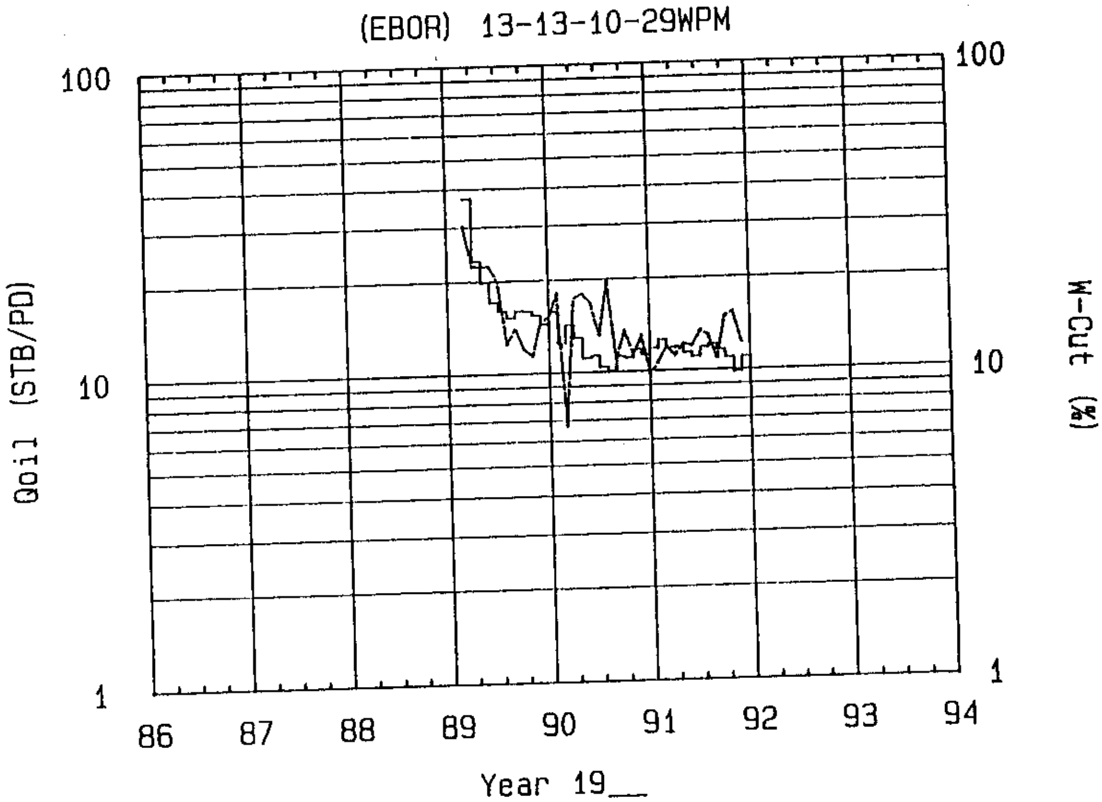
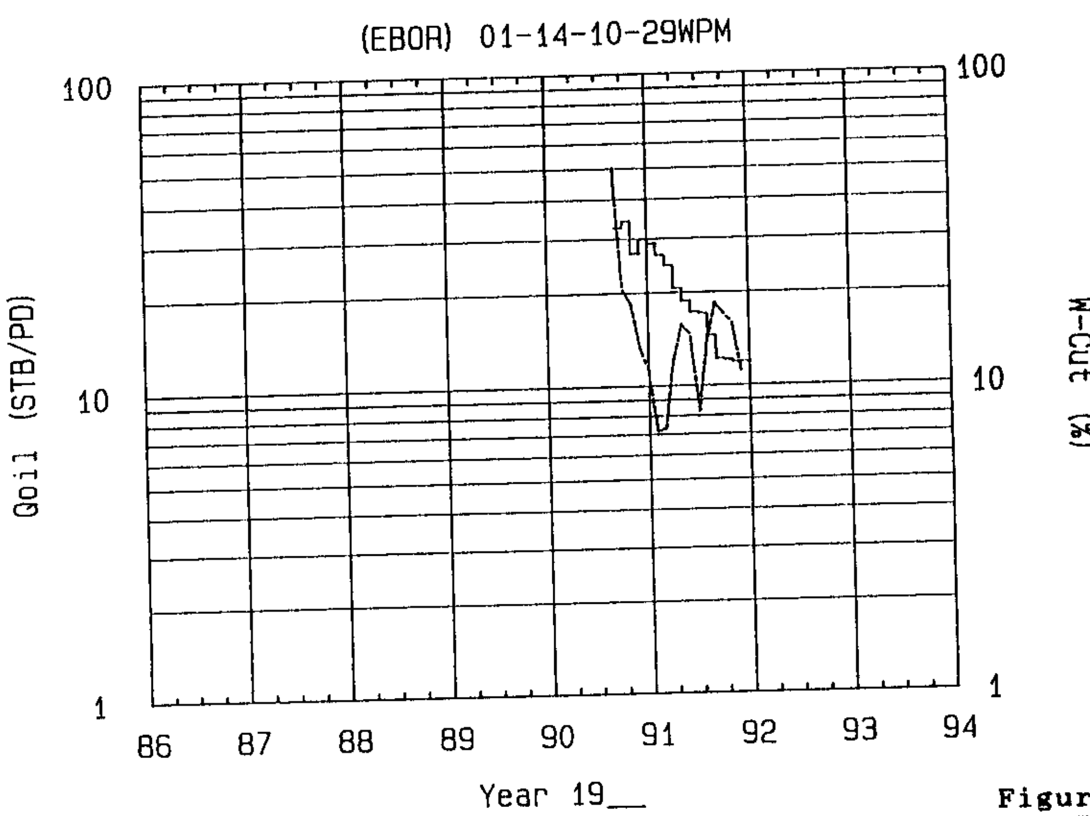

(EBOR) 12-13-10-29WPM
100
10
1
Qoil (STB/PD)
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

Figure 9.03

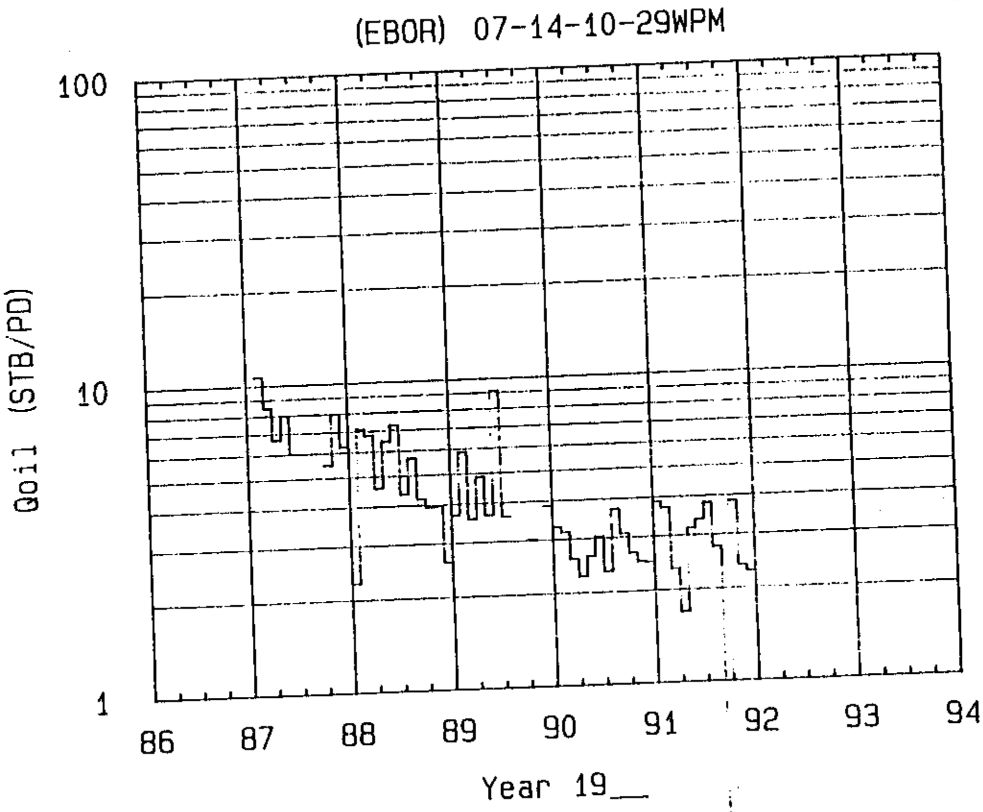


(EBOR) 13-13-10-29WPM
100
10
1
100
10
1
Qoil (STB/PD)
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

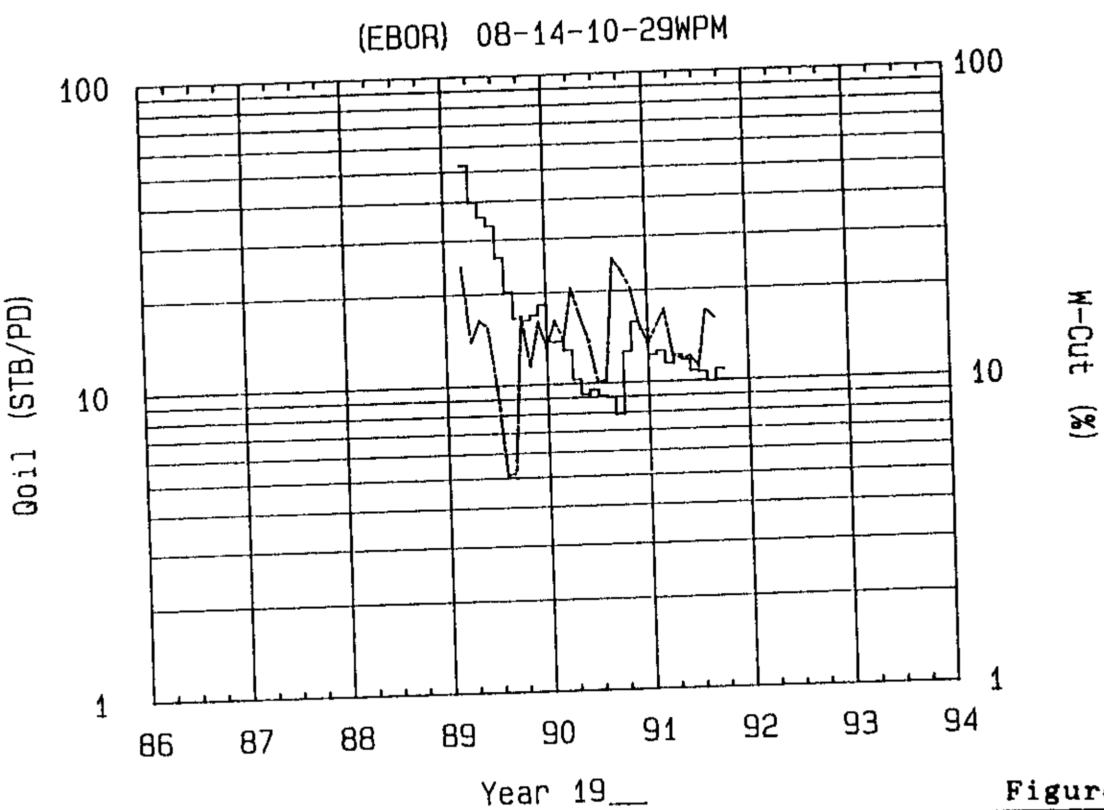


(EBOR) 01-14-10-29WPM
100
10
1
100
10
1
Qoil (STB/PD)
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

Figure 9.04

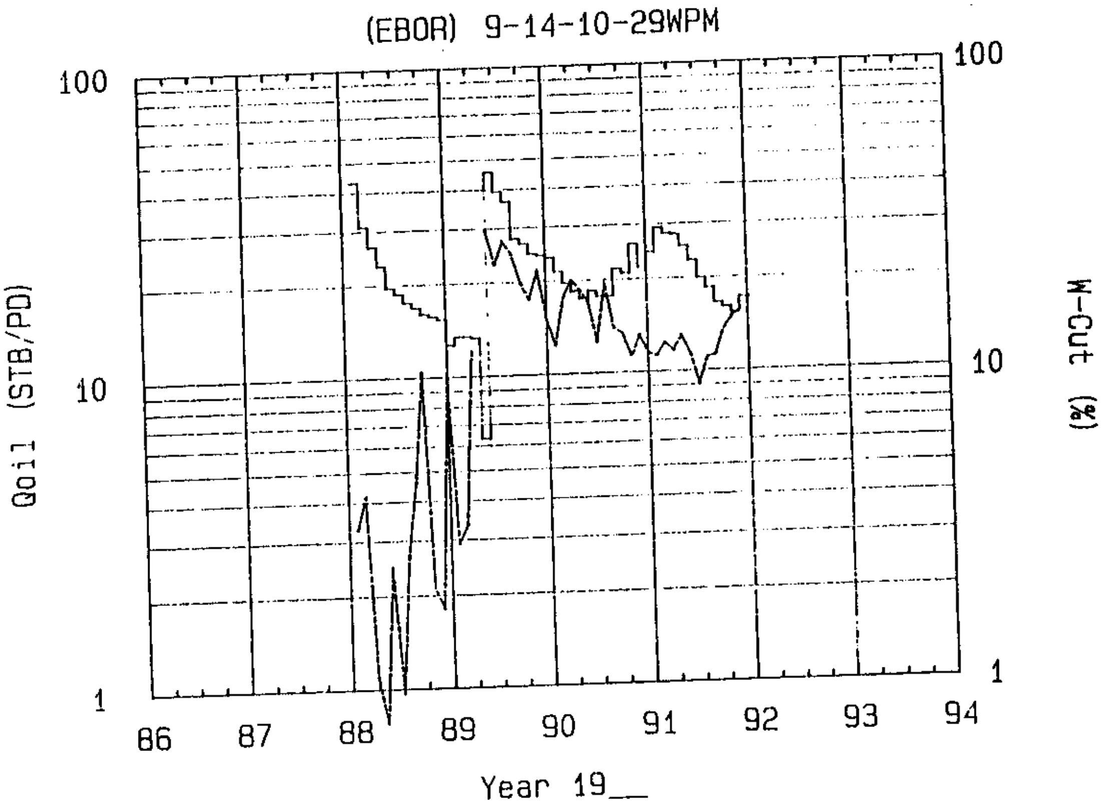


(EBOR) 07-14-10-29WPM
100
10
1
Qoil (STB/PD)
86
87
88
89
90
91
92
93
94
Year 19__



(EBOR) 08-14-10-29WPM
100
10
1
Qoil (STB/PD)
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

Figure 9.05


(EBOR) 9-14-10-29WPM
100
10
1
Qoil (STB/PD)
100
10
1
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

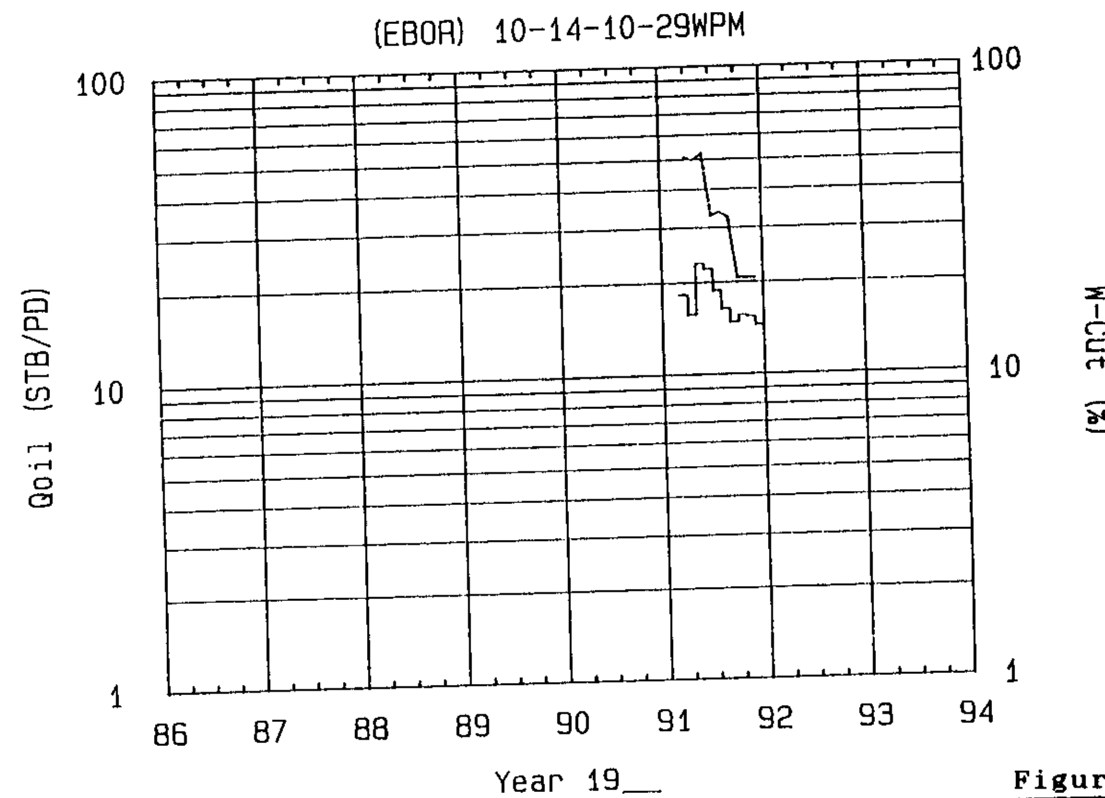
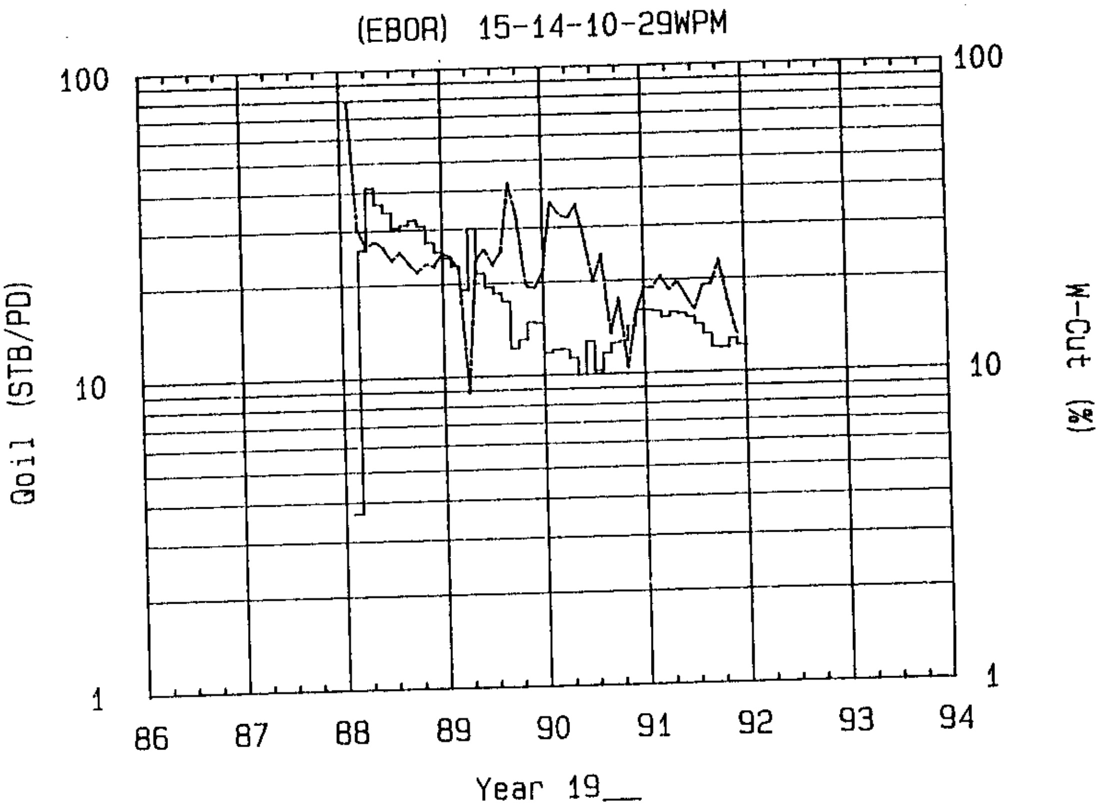

(EBOR) 10-14-10-29WPM
100
10
1
Qoil (STB/PD)
100
10
1
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

Figure 9.06


(EBOR) 15-14-10-29WPM
100
10
1
100
10
1
86
87
88
89
90
91
92
93
94
Qoil (STB/PD)
W-Cut (%)
Year 19__

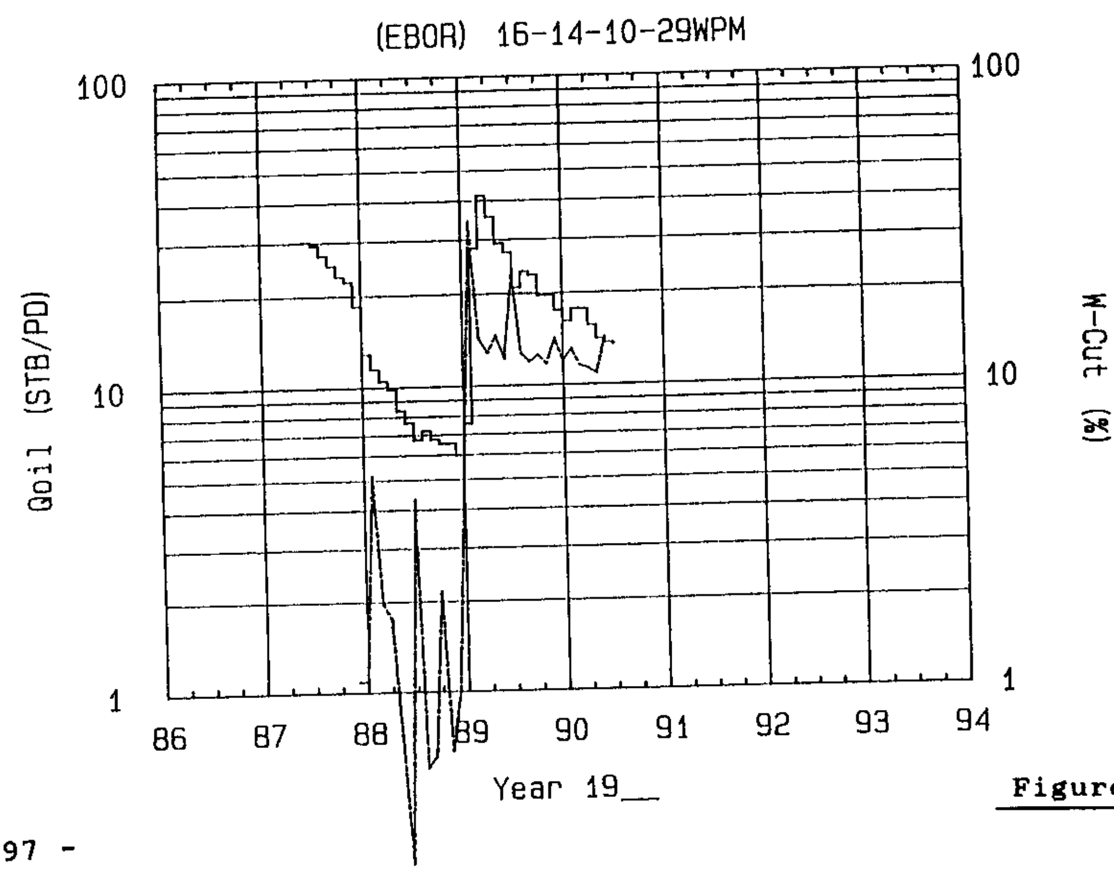
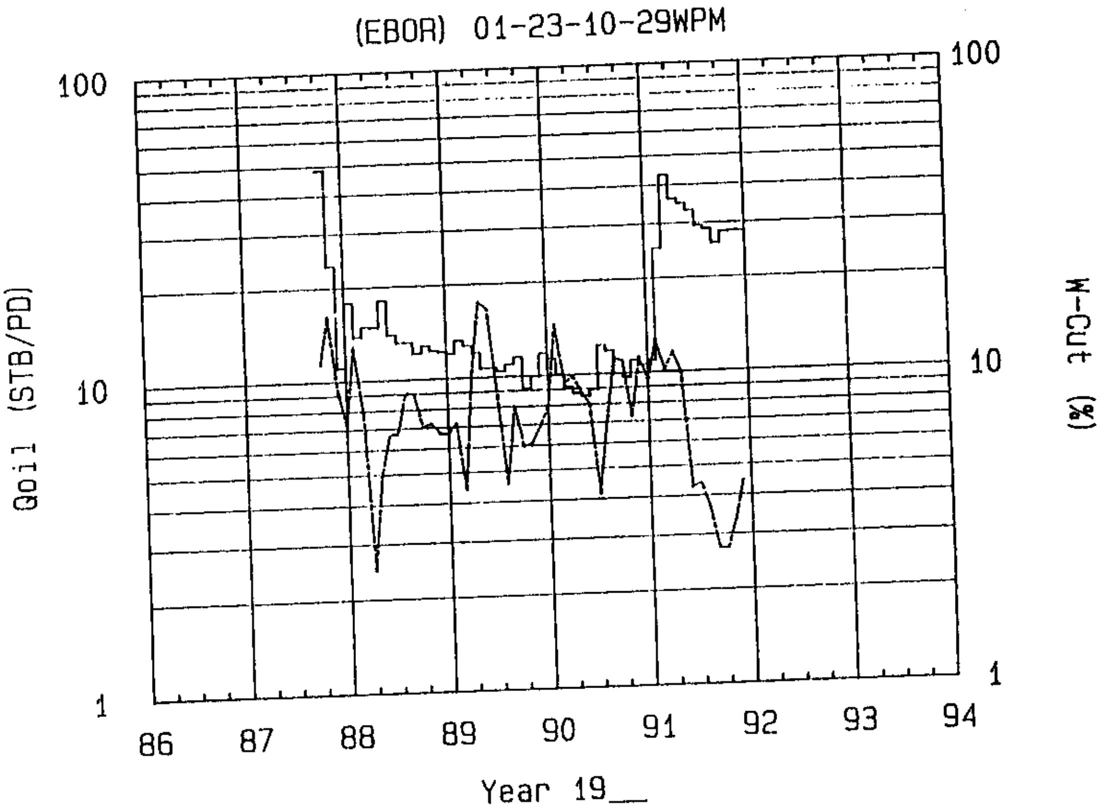

(EBOR) 16-14-10-29WPM
100
10
1
100
10
1
86
87
88
89
90
91
92
93
94
Qoil (STB/PD)
W-Cut (%)
Year 19__

Figure 9.07


(EBOR) 01-23-10-29WPM
100
10
1
Qoil (STB/PD)
100
10
1
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

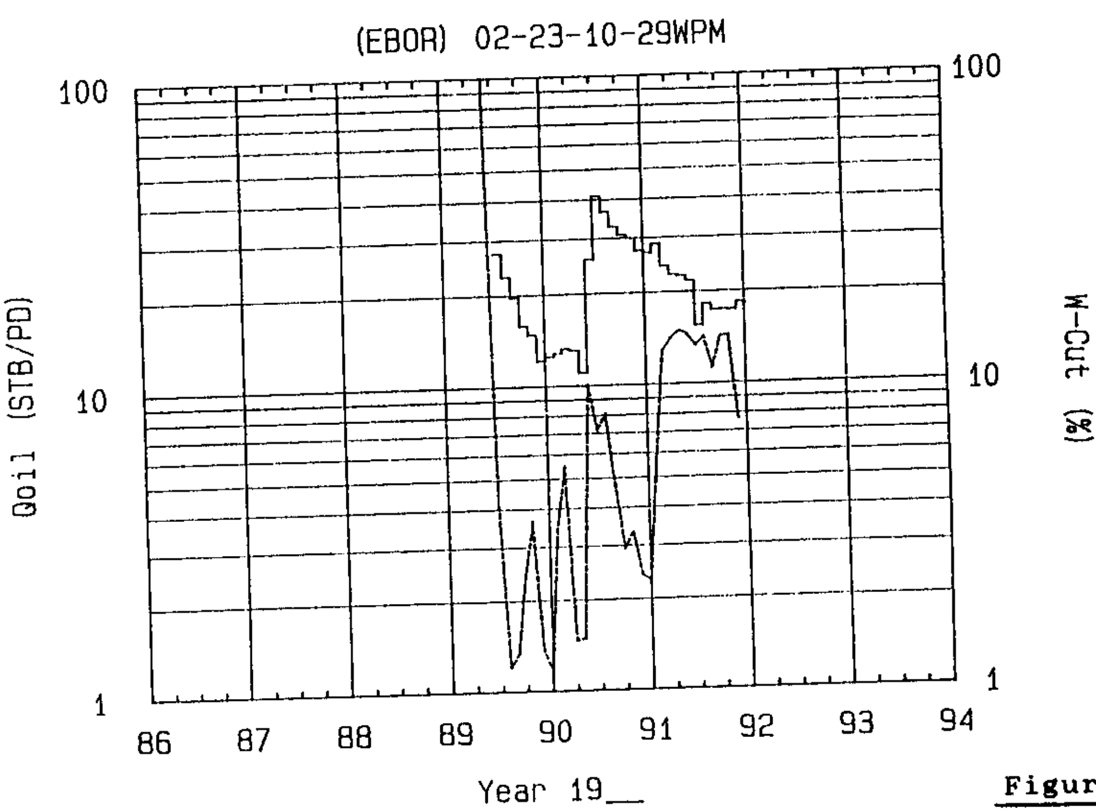
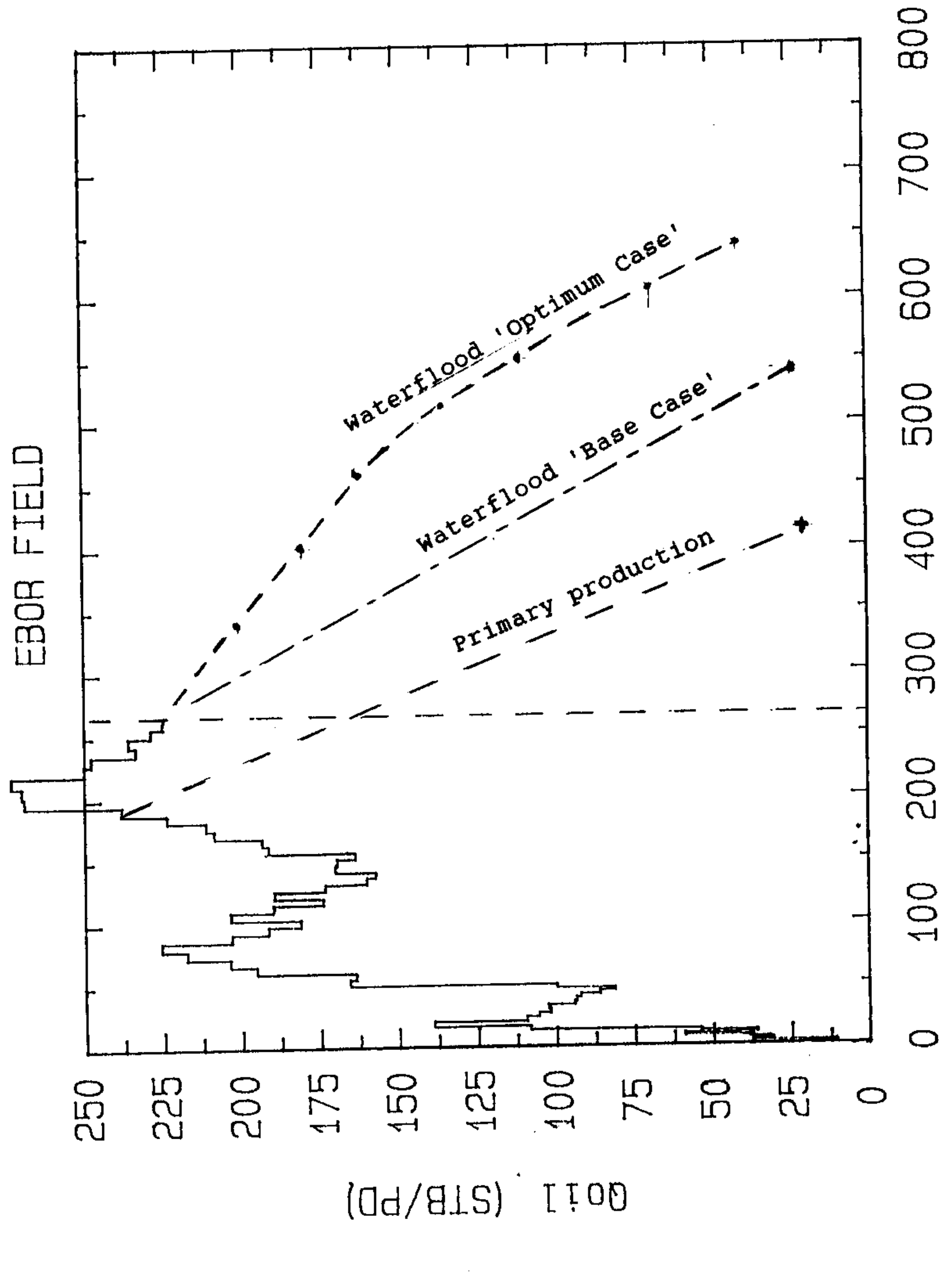

(EBOR) 02-23-10-29WPM
100
10
1
Qoil (STB/PD)
100
10
1
W-Cut (%)
86
87
88
89
90
91
92
93
94
Year 19__

Figure 9.08


EBOR FIELD
Waterflood 'Optimum Case'
Waterflood 'Base Case'
Primary production
Qoil (STB/PD)
250
225
200
175
150
125
100
75
50
25
0
0
100
200
300
400
500
600
700
800

ATTACHMENTS

1. Production and Injection - Daly Bakken 'D' Pool
2. Production and Injection - Daly Bakken 'D' Wells
3. Executive Summary - Waterflood Sensitivity Study
4. Field-wide Performance Plot

ATTACHMENT 1.1 : MONTHLY PRODUCTION/INJECTION SUMMARY - DALY BAKKEN 'D' POOL

YR.	MN.	NW	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Cwi (m3)	Winj (m3/d)
86	12	1	15.0	37.5	0.48	71.43	0	0.00
87	1	1	106.7	136.4	2.96	51.89	0	0.00
	2	2	180.6	215.3	2.64	51.64	0	0.00
	3	2	280.8	271.3	3.23	35.85	0	0.00
	4	2	335.2	318.3	1.81	46.35	0	0.00
	5	2	426.6	347.0	2.95	23.90	0	0.00
	6	3	477.7	377.9	1.70	37.68	0	0.00
	7	2	661.3	400.4	5.92	10.92	0	0.00
	8	3	813.7	424.4	4.92	13.61	0	0.00
	9	3	966.2	445.1	5.08	11.95	0	0.00
	10	4	1155.8	470.3	6.12	11.73	0	0.00
	11	4	1438.4	533.1	9.42	18.18	0	0.00
	12	4	1643.8	571.3	6.63	15.68	0	0.00
88	1	4	1820.3	600.6	5.69	14.24	0	0.00
	2	5	2060.3	651.6	8.57	17.53	0	0.00
	3	7	2594.3	740.5	17.23	14.27	0	0.00
	4	7	3257.0	849.0	22.09	14.07	0	0.00
	5	7	3796.6	949.2	17.41	15.66	0	0.00
	6	7	4300.0	1043.5	16.78	15.78	0	0.00
	7	7	4802.4	1130.6	16.21	14.78	0	0.00
	8	7	5308.8	1224.0	16.34	15.57	0	0.00
	9	7	5758.9	1306.9	15.00	15.55	0	0.00
	10	7	6219.9	1397.8	14.87	16.47	0	0.00
	11	7	6660.2	1479.3	14.68	15.62	0	0.00
	12	7	7085.0	1560.3	13.70	16.01	0	0.00
89	1	7	7486.0	1642.5	12.94	17.01	0	0.00
	2	7	7931.0	1766.8	15.89	21.83	0	0.00
	3	10	8747.0	1958.7	26.32	19.04	0	0.00
	4	10	9527.9	2075.3	26.03	12.99	0	0.00
	5	10	10490.5	2250.0	31.05	15.36	0	0.00
	6	10	11461.9	2474.7	32.38	18.79	0	0.00
	7	11	12533.8	2669.4	34.58	15.37	0	0.00
	8	11	13646.6	2834.7	35.90	12.93	0	0.00
	9	11	14615.2	2989.2	32.29	13.76	0	0.00
	10	10	15559.8	3140.3	30.47	13.79	0	0.00
	11	11	16424.2	3253.6	28.81	11.59	0	0.00
	12	11	17427.7	3416.0	32.37	13.93	0	0.00
90	1	11	18365.6	3575.1	30.25	14.50	0	0.00

YR.	MN.	NW	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Cwi (m3)	Winj (m3/d)
90	1	11	18365.6	3575.1	30.25	14.50	0	0.00
	2	11	19140.3	3760.8	27.67	19.34	0	0.00
	3	11	20076.0	4044.1	30.18	23.24	0	0.00
	4	11	20903.4	4183.5	27.58	14.42	0	0.00
	5	11	21692.5	4357.1	25.45	18.03	0	0.00
	6	11	22443.7	4697.2	25.04	31.16	17.2	0.57
	7	11	23282.1	5074.0	27.05	31.01	589.8	18.47
	8	11	24118.2	5535.3	26.97	35.56	1241.5	21.02
	9	12	24900.0	6031.3	26.06	38.82	1796.6	18.50
	10	12	25843.8	6452.8	30.45	30.87	2461.2	21.44
	11	12	26766.5	6897.3	30.76	32.51	2881.1	14.00
	12	12	27795.1	7370.1	33.18	31.49	3525.2	20.78
91	1	12	28836.7	7806.9	33.60	29.55	4241.9	23.12
	2	12	29833.0	8224.4	35.58	29.53	4889.6	23.13
	3	14	31006.6	8759.1	37.86	31.30	5505.4	19.86
	4	15	32290.8	9562.5	42.81	38.48	6120	20.49
	5	15	33622.1	10316.9	42.95	36.17	6649	17.06
	6	15	34925.8	11119.2	43.46	38.10	6990	11.37
	7	15	36159.5	11606.3	39.80	28.31	7032.1	1.36
	8	15	37381.2	12585.2	39.41	44.48	7432.7	12.92
	9	15	38494.4	13524.2	37.11	45.76	7756.9	10.81
	10	14	39657.4	14542.9	37.52	46.69	8683.6	29.89
	11	14	40747.9	15540.0	36.35	47.76	9799.7	37.20
	12	14	41854.8	16535.1	35.71	47.34	11213.5	45.61

Notes:-

1. NW - No. of producers on production
2. COIL - Cumulative oil production
3. Cwp - Cumulative water production
4. Qoil - Oil rate
5. Wcut - Water cut
6. Cwi - Cumulative water injection
7. Winj - Water injection rate
8. 1990.06 - Water injection commenced in 16-14
   1991.10 - Water injection commenced in 08-14

ATTACHMENT 1.2 : ANNUAL PRODUCTION & INJECTION SUMMARY - DALY BAKKEN 'D' POOL

YR.	Well Count	Cum.Oil Prod. (m3)	Cum.Water Prod. (m3)	Oil Rate m3/d	Water cut (%)	Cum.Water Injection (m3)	Inj. Rate (m3/d)
1986	1	15.0	37.5	0.04	71.43	0	0.00
1987	4	1643.8	571.3	4.46	24.68	0	0.00
1988	7	7085.0	1560.3	14.87	15.38	0	0.00
1989	11	17427.7	3416.0	28.34	15.21	0	0.00
1990	14	27795.1	7370.1	28.40	27.61	3525.2	9.66
1991	16	41854.8	16535.1	38.52	39.46	11213.5	21.06

Notes: - Producers and injectors are included in the 'Well Count'
- 1990.06 : Water injection commenced in 16-14
  1991.10 : Water injection commenced in 08-14

"15-11-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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86	12	9	15.0	37.5	15.0	37.5	1.67	71.43	10.48
87	1	31	91.7	98.9	106.7	136.4	2.96	51.89	18.61
87	2	28	53.6	58.5	160.3	194.9	1.91	52.19	12.04
87	3	31	58.6	41.8	218.9	236.7	1.89	41.63	11.89
87	4	19	38.5	29.6	257.4	266.3	2.03	43.47	12.75
87	5	30	52.1	28.3	309.5	294.6	1.74	35.20	10.92
87	6	30	39.6	26.7	349.1	321.3	1.32	40.27	8.30
87	7	31	39.4	22.3	388.5	343.6	1.27	36.14	7.99
87	8	31	35.8	23.8	424.3	367.4	1.15	39.93	7.26
87	9	30	32.6	20.7	456.9	388.1	1.09	38.84	6.84
87	10	31	32.2	21.2	489.1	409.3	1.04	39.70	6.53
87	11	30	29.8	20.2	518.9	429.5	0.99	40.40	6.25
87	12	31	31.2	18.3	550.1	447.8	1.01	36.97	6.33
88	1	31	29.2	18.1	579.3	465.9	0.94	38.27	5.92
88	2	26	27.2	14.6	606.5	480.5	1.05	34.93	6.58
88	3	31	29.4	15.9	635.9	496.4	0.95	35.10	5.97
88	4	30	30.9	10.6	666.8	507.0	1.03	25.54	6.48
88	5	31	27.8	15.0	694.6	522.0	0.90	35.05	5.64
88	6	25	25.5	14.2	720.1	536.2	1.02	35.77	6.42
88	7	31	26.6	13.7	746.7	549.9	0.86	34.00	5.40
88	8	31	27.3	14.1	774.0	564.0	0.88	34.06	5.54
88	9	30	23.3	12.4	797.3	576.4	0.78	34.73	4.89
88	10	31	24.8	13.4	822.1	589.8	0.80	35.08	5.03
88	11	29	23.4	15.3	845.5	605.1	0.81	39.53	5.08
88	12	31	22.8	14.0	868.3	619.1	0.74	38.04	4.63
89	1	26	19.4	11.0	887.7	630.1	0.75	36.18	4.69
89	2	28	20.9	12.3	908.6	642.4	0.75	37.05	4.70
89	3	30	19.5	17.0	928.1	659.4	0.65	46.58	4.09
89	4	29	22.6	11.3	950.7	670.7	0.78	33.33	4.90
89	5	23	20.0	10.6	970.7	681.3	0.87	34.64	5.47
89	6	29	21.7	11.9	992.4	693.2	0.75	35.42	4.71
89	7	29	19.5	10.8	1011.9	704.0	0.67	35.64	4.23
89	8	30	19.7	13.4	1031.6	717.4	0.66	40.48	4.13
89	9	19	12.0	6.6	1043.6	724.0	0.63	35.48	3.97
89	10	0	0.0	0.0	1043.6	724.0	0.00	0.00	0.00
89	11	0	0.0	0.0	1043.6	724.0	0.00	0.00	0.00
89	12	0	0.0	0.0	1043.6	724.0	0.00	0.00	0.00
90	1	8	0.0	12.4	1043.6	736.4	0.00	100.00	0.00
90	2	18	0.0	33.3	1043.6	769.7	0.00	100.00	0.00
90	3	26	0.0	128.6	1043.6	898.3	0.00	100.00	0.00
90	4	0	0.0	0.0	1043.6	898.3	0.00	0.00	0.00
90	5	9	0.0	52.4	1043.6	950.7	0.00	100.00	0.00
90	6	29	0.0	116.6	1043.6	1067.3	0.00	100.00	0.00
90	7	30	41.4	66.7	1085.0	1134.0	1.38	61.70	8.68
90	8	30	19.9	82.2	1104.9	1216.2	0.66	80.51	4.17

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
90	9	29	11.2	82.7	1116.1	1298.9	0.39	88.07	2.43
90	10	30	13.8	80.2	1129.9	1379.1	0.46	85.32	2.89
90	11	29	13.0	77.0	1142.9	1456.1	0.45	85.56	2.82
90	12	30	14.4	81.9	1157.3	1538.0	0.48	85.05	3.02
91	1	30	25.2	73.6	1182.5	1611.6	0.84	74.49	5.28
91	2	27	19.4	68.2	1201.9	1679.8	0.72	77.85	4.52
91	3	30	20.2	77.8	1222.1	1757.6	0.67	79.39	4.24
91	4	29	12.8	80.2	1234.9	1837.8	0.44	86.24	2.78
91	5	30	25.2	73.0	1260.1	1910.8	0.84	74.34	5.28
91	6	30	21.8	80.2	1281.9	1991.0	0.73	78.63	4.57
91	7	30	22.0	75.3	1303.9	2066.3	0.73	77.39	4.61
91	8	30	19.2	92.4	1323.1	2158.7	0.64	82.80	4.03
91	9	29	20.3	73.9	1343.4	2232.6	0.70	78.45	4.40
91	10	30	25.6	77.8	1369.0	2310.4	0.85	75.24	5.37
91	11	30	16.7	79.4	1385.7	2389.8	0.56	82.62	3.50
91	12	31	19.5	82.0	1405.2	2471.8	0.63	80.79	3.96

"16-11-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
89	12	28	100.9	9.4	100.9	9.4	3.60	8.52	22.67
90	1	31	78.5	27.9	179.4	37.3	2.53	26.22	15.93
90	2	28	63.4	20.1	242.8	57.4	2.26	24.07	14.24
90	3	31	71.8	19.0	314.6	76.4	2.32	20.93	14.57
90	4	30	57.3	17.8	371.9	94.2	1.91	23.70	12.01
90	5	31	67.4	11.0	439.3	105.2	2.17	14.03	13.68
90	6	30	55.5	123.6	494.8	228.8	1.85	69.01	11.64
90	7	30	36.4	214.2	531.2	443.0	1.21	85.47	7.63
90	8	28	47.8	262.8	579.0	705.8	1.71	84.61	10.74
90	9	29	57.6	317.7	636.6	1023.5	1.99	84.65	12.49
90	10	22	40.1	210.5	676.7	1234.0	1.82	84.00	11.46
90	11	28	76.9	266.9	753.6	1500.9	2.75	77.63	17.28
90	12	30	132.2	286.6	885.8	1787.5	4.41	68.43	27.72
91	1	29	140.8	269.1	1026.6	2056.6	4.86	65.65	30.54
91	2	27	89.1	243.3	1115.7	2299.9	3.30	73.19	20.76
91	3	30	90.6	280.7	1206.3	2580.6	3.02	75.60	19.00
91	4	29	87.2	232.0	1293.5	2812.6	3.01	72.68	18.91
91	5	30	90.2	234.9	1383.7	3047.5	3.01	72.25	18.91
91	6	29	90.5	222.6	1474.2	3270.1	3.12	71.10	19.63
91	7	29	90.5	205.7	1564.7	3475.8	3.12	69.45	19.63
91	8	30	107.9	206.1	1672.6	3681.9	3.60	65.64	22.62
91	9	29	84.3	166.9	1756.9	3848.8	2.91	66.44	18.28
91	10	29	56.7	168.8	1813.6	4017.6	1.96	74.86	12.30
91	11	29	66.3	132.7	1879.9	4150.3	2.29	66.68	14.38
91	12	30	29.6	154.2	1909.5	4304.5	0.99	83.90	6.21

"13-12-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
91	3	4	0.0	40.2	0.0	40.2	0.00	100.00	0.00
91	4	25	19.2	331.9	19.2	372.1	0.77	94.53	4.83
91	5	19	21.3	244.9	40.5	617.0	1.12	92.00	7.05
91	6	17	31.2	268.8	71.7	885.8	1.84	89.60	11.54
91	7	5	5.8	65.8	77.5	951.6	1.16	91.90	7.30
91	8	25	61.0	523.0	138.5	1474.6	2.44	89.55	15.35
91	9	29	158.1	568.8	296.6	2043.4	5.45	78.26	34.29
91	10	30	170.3	640.9	466.9	2684.3	5.68	79.01	35.71
91	11	29	145.4	665.7	612.3	3350.0	5.01	82.07	31.54
91	12	30	151.8	648.9	764.1	3998.9	5.06	81.04	31.83

"04-13-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
91	3	4	46.4	1.6	46.4	1.6	11.60	3.33	72.96
91	4	28	228.2	11.0	274.6	12.6	8.15	4.60	51.26
91	5	26	214.6	11.7	489.2	24.3	8.25	5.17	51.92
91	6	30	212.9	14.9	702.1	39.2	7.10	6.54	44.64
91	7	30	197.4	14.1	899.5	53.3	6.58	6.67	41.39
91	8	30	180.2	18.9	1079.7	72.2	6.01	9.49	37.78
91	9	29	160.7	15.8	1240.4	88.0	5.54	8.95	34.86
91	10	30	157.9	11.4	1398.3	99.4	5.26	6.73	33.11
91	11	30	151.0	11.7	1549.3	111.1	5.03	7.19	31.66
91	12	31	143.2	15.4	1692.5	126.5	4.62	9.71	29.06

"05-13-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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89	3	12	121.0	34.3	121.0	34.3	10.08	22.09	63.42
89	4	11	104.6	6.4	225.6	40.7	9.51	5.77	59.81
89	5	30	290.6	27.5	516.2	68.2	9.69	8.65	60.93
89	6	23	220.6	23.6	736.8	91.8	9.59	9.66	60.33
89	7	25	277.7	21.1	1014.5	112.9	11.11	7.06	69.87
89	8	29	329.7	19.8	1344.2	132.7	11.37	5.67	71.51
89	9	28	305.3	24.1	1649.5	156.8	10.90	7.32	68.58
89	10	30	306.4	35.8	1955.9	192.6	10.21	10.46	64.24
89	11	28	286.0	34.5	2241.9	227.1	10.21	10.76	64.25
89	12	30	298.3	41.6	2540.2	268.7	9.94	12.24	62.54
90	1	30	301.1	32.7	2841.3	301.4	10.04	9.80	63.13
90	2	24	236.4	34.4	3077.7	335.8	9.85	12.70	61.96
90	3	31	322.3	39.2	3400.0	375.0	10.40	10.84	65.40
90	4	29	293.7	22.9	3693.7	397.9	10.13	7.23	63.70
90	5	30	275.3	20.6	3969.0	418.5	9.18	6.96	57.72
90	6	29	216.0	15.1	4185.0	433.6	7.45	6.53	46.85
90	7	30	230.3	31.7	4415.3	465.3	7.68	12.10	48.29
90	8	30	254.6	35.7	4669.9	501.0	8.49	12.30	53.38
90	9	29	203.6	16.2	4873.5	517.2	7.02	7.37	44.16
90	10	30	211.5	13.0	5085.0	530.2	7.05	5.79	44.34
90	11	29	166.9	9.3	5251.9	539.5	5.76	5.28	36.20
90	12	31	203.0	15.5	5454.9	555.0	6.55	7.09	41.19
91	1	29	209.4	11.8	5664.3	566.8	7.22	5.33	45.42
91	2	27	209.8	15.8	5874.1	582.6	7.77	7.00	48.88
91	3	30	221.0	15.2	6095.1	597.8	7.37	6.44	46.34
91	4	29	205.0	16.8	6300.1	614.6	7.07	7.57	44.46
91	5	30	206.3	18.7	6506.4	633.3	6.88	8.31	43.25
91	6	29	191.5	16.4	6697.9	649.7	6.60	7.89	41.54
91	7	30	213.4	15.8	6911.3	665.5	7.11	6.89	44.74
91	8	30	179.0	15.0	7090.3	680.5	5.97	7.73	37.53
91	9	21	109.7	13.8	7200.0	694.3	5.22	11.17	32.86
91	10	30	171.2	19.3	7371.2	713.6	5.71	10.13	35.89
91	11	30	147.4	11.5	7518.6	725.1	4.91	7.24	30.90
91	12	31	158.4	11.3	7677.0	736.4	5.11	6.66	32.14

"12-13-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
88	3	11	87.6	10.9	87.6	10.9	7.96	11.07	50.09
88	4	30	170.3	14.6	257.9	25.5	5.68	7.90	35.71
88	5	30	136.1	16.8	394.0	42.3	4.54	10.99	28.54
88	6	30	122.1	14.1	516.1	56.4	4.07	10.35	25.60
88	7	30	118.7	12.9	634.8	69.3	3.96	9.80	24.89
88	8	31	119.1	10.2	753.9	79.5	3.84	7.89	24.17
88	9	29	102.9	12.2	856.8	91.7	3.55	10.60	22.32
88	10	30	104.0	15.4	960.8	107.1	3.47	12.90	21.81
88	11	30	103.5	13.2	1064.3	120.3	3.45	11.31	21.70
88	12	31	99.6	12.0	1163.9	132.3	3.21	10.75	20.21
89	1	26	92.8	9.4	1256.7	141.7	3.57	9.20	22.45
89	2	26	92.4	4.0	1349.1	145.7	3.55	4.15	22.35
89	3	30	103.3	6.2	1452.4	151.9	3.44	5.66	21.66
89	4	25	81.7	3.4	1534.1	155.3	3.27	4.00	20.56
89	5	29	85.3	3.9	1619.4	159.2	2.94	4.37	18.50
89	6	29	77.5	3.1	1696.9	162.3	2.67	3.85	16.81
89	7	30	74.9	2.6	1771.8	164.9	2.50	3.35	15.70
89	8	30	78.4	3.4	1850.2	168.3	2.61	4.16	16.44
89	9	29	73.4	4.2	1923.6	172.5	2.53	5.41	15.92
89	10	30	75.7	3.4	1999.3	175.9	2.52	4.30	15.87
89	11	29	58.5	2.9	2057.8	178.8	2.02	4.72	12.69
89	12	30	53.9	3.7	2111.7	182.5	1.80	6.42	11.30
90	1	31	52.8	3.4	2164.5	185.9	1.70	6.05	10.71
90	2	26	44.2	3.6	2208.7	189.5	1.70	7.53	10.69
90	3	31	52.0	4.4	2260.7	193.9	1.68	7.80	10.55
90	4	29	45.0	4.4	2305.7	198.3	1.55	8.91	9.76
90	5	30	46.2	3.7	2351.9	202.0	1.54	7.41	9.69
90	6	29	46.6	3.5	2398.5	205.5	1.61	6.99	10.11
90	7	30	42.0	2.4	2440.5	207.9	1.40	5.41	8.81
90	8	30	38.9	4.2	2479.4	212.1	1.30	9.74	8.16
90	9	29	40.3	3.5	2519.7	215.6	1.39	7.99	8.74
90	10	30	39.9	5.0	2559.6	220.6	1.33	11.14	8.37
90	11	29	38.2	3.0	2597.8	223.6	1.32	7.28	8.29
90	12	31	39.7	3.3	2637.5	226.9	1.28	7.67	8.06
91	1	29	38.1	2.9	2675.6	229.8	1.31	7.07	8.26
91	2	27	36.8	3.2	2712.4	233.0	1.36	8.00	8.57
91	3	30	35.2	4.0	2747.6	237.0	1.17	10.20	7.38
91	4	29	30.9	3.4	2778.5	240.4	1.07	9.91	6.70
91	5	29	32.6	3.7	2811.1	244.1	1.12	10.19	7.07
91	6	29	32.4	3.3	2843.5	247.4	1.12	9.24	7.03
91	7	30	30.6	3.2	2874.1	250.6	1.02	9.47	6.42
91	8	30	33.6	3.8	2907.7	254.4	1.12	10.16	7.04
91	9	29	30.1	3.2	2937.8	257.6	1.04	9.61	6.53
91	10	30	29.3	6.0	2967.1	263.6	0.98	17.00	6.14
91	11	30	31.2	6.3	2998.3	269.9	1.04	16.80	6.54
91	12	31	41.6	3.6	3039.9	273.5	1.34	7.96	8.44

"13-13-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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89	2	0	0.0	4.7	0.0	4.7	0.00	100.00	0.00
89	3	17	100.5	43.6	100.5	48.3	5.91	30.26	37.19
89	4	25	92.7	26.8	193.2	75.1	3.71	22.43	23.32
89	5	29	91.3	26.2	284.5	101.3	3.15	22.30	19.80
89	6	29	78.7	22.9	363.2	124.2	2.71	22.54	17.07
89	7	30	76.1	18.8	439.3	143.0	2.54	19.81	15.96
89	8	30	72.4	10.3	511.7	153.3	2.41	12.45	15.18
89	9	29	73.6	12.1	585.3	165.4	2.54	14.12	15.96
89	10	29	73.2	10.0	658.5	175.4	2.52	12.02	15.88
89	11	29	71.0	9.1	729.5	184.5	2.45	11.36	15.40
89	12	30	68.7	11.9	798.2	196.4	2.29	14.76	14.40
90	1	31	77.9	14.0	876.1	210.4	2.51	15.23	15.81
90	2	26	51.5	11.4	927.6	221.8	1.98	18.12	12.46
90	3	31	70.5	5.1	998.1	226.9	2.27	6.75	14.30
90	4	29	59.7	12.6	1057.8	239.5	2.06	17.43	12.95
90	5	30	52.9	11.7	1110.7	251.2	1.76	18.11	11.09
90	6	29	52.1	10.5	1162.8	261.7	1.80	16.77	11.30
90	7	30	49.5	7.5	1212.3	269.2	1.65	13.16	10.38
90	8	30	48.0	11.9	1260.3	281.1	1.60	19.87	10.06
90	9	29	51.7	6.4	1312.0	287.5	1.78	11.02	11.21
90	10	30	52.6	8.3	1364.6	295.8	1.75	13.63	11.03
90	11	29	54.2	6.9	1418.8	302.7	1.87	11.29	11.76
90	12	31	55.7	8.4	1474.5	311.1	1.80	13.10	11.30
91	1	29	54.5	5.9	1529.0	317.0	1.88	9.77	11.82
91	2	27	54.0	6.5	1583.0	323.5	2.00	10.74	12.58
91	3	30	56.4	7.7	1639.4	331.2	1.88	12.01	11.83
91	4	29	55.1	6.9	1694.5	338.1	1.90	11.13	11.95
91	5	30	54.3	7.6	1748.8	345.7	1.81	12.28	11.38
91	6	29	50.8	6.9	1799.6	352.6	1.75	11.96	11.02
91	7	30	56.4	8.8	1856.0	361.4	1.88	13.50	11.83
91	8	30	57.6	8.6	1913.6	370.0	1.92	12.99	12.08
91	9	29	53.5	6.5	1967.1	376.5	1.84	10.83	11.60
91	10	30	52.1	9.2	2019.2	385.7	1.74	15.01	10.92
91	11	30	46.8	8.6	2066.0	394.3	1.56	15.52	9.81
91	12	31	54.1	7.5	2120.1	401.8	1.75	12.18	10.98

"01-14-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
90	9	3	15.5	15.6	15.5	15.6	5.17	50.16	32.50
90	10	31	168.4	43.7	183.9	59.3	5.43	20.60	34.17
90	11	28	119.4	26.9	303.3	86.2	4.26	18.39	26.82
90	12	30	142.3	21.8	445.6	108.0	4.74	13.28	29.84
91	1	30	137.7	17.5	583.3	125.5	4.59	11.28	28.87
91	2	27	113.9	8.8	697.2	134.3	4.22	7.17	26.53
91	3	30	117.1	9.3	814.3	143.6	3.90	7.36	24.55
91	4	29	95.3	13.2	909.6	156.8	3.29	12.17	20.67
91	5	30	89.8	16.9	999.4	173.7	2.99	15.84	18.83
91	6	29	79.9	13.7	1079.3	187.4	2.76	14.64	17.33
91	7	30	81.7	7.4	1161.0	194.8	2.72	8.31	17.13
91	8	30	69.3	11.3	1230.3	206.1	2.31	14.02	14.53
91	9	29	56.2	12.8	1286.5	218.9	1.94	18.55	12.19
91	10	30	57.7	11.9	1344.2	230.8	1.92	17.10	12.10
91	11	30	56.7	10.8	1400.9	241.6	1.89	16.00	11.89
91	12	31	58.9	7.4	1459.8	249.0	1.90	11.16	11.95

"07-14-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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87	2	12	20.3	20.4	20.3	20.4	1.69	50.12	10.64
87	3	31	41.6	14.2	61.9	34.6	1.34	25.45	8.44
87	4	15	15.9	17.4	77.8	52.0	1.06	52.25	6.67
87	5	31	39.3	0.4	117.1	52.4	1.27	1.01	7.97
87	6	7	6.7	4.2	123.8	56.6	0.96	38.53	6.02
87	7	0	0.0	0.0	123.8	56.6	0.00	0.00	0.00
87	8	0	0.0	0.0	123.8	56.6	0.00	0.00	0.00
87	9	0	0.0	0.0	123.8	56.6	0.00	0.00	0.00
87	10	14	12.2	0.0	136.0	56.6	0.87	0.00	5.48
87	11	30	38.1	20.8	174.1	77.4	1.27	35.31	7.99
87	12	29	28.9	13.3	203.0	90.7	1.00	31.52	6.27
88	1	28	10.1	4.8	213.1	95.5	0.36	32.21	2.27
88	2	16	18.1	8.5	231.2	104.0	1.13	31.95	7.12
88	3	31	33.2	1.0	264.4	105.0	1.07	2.92	6.74
88	4	29	21.1	7.8	285.5	112.8	0.73	26.99	4.58
88	5	20	20.5	6.2	306.0	119.0	1.03	23.22	6.45
88	6	18	20.8	7.8	326.8	126.8	1.16	27.27	7.27
88	7	31	21.5	7.4	348.3	134.2	0.69	25.61	4.36
88	8	22	19.8	7.0	368.1	141.2	0.90	26.12	5.66
88	9	30	20.0	7.4	388.1	148.6	0.67	27.01	4.19
88	10	31	19.3	7.4	407.4	156.0	0.62	27.72	3.92
88	11	30	18.9	7.0	426.3	163.0	0.63	27.03	3.96
88	12	30	12.4	11.7	438.7	174.7	0.41	48.55	2.60
89	1	31	18.1	8.4	456.8	183.1	0.58	31.70	3.67
89	2	11	10.2	7.7	467.0	190.8	0.93	43.02	5.83
89	3	30	17.0	10.7	484.0	201.5	0.57	38.63	3.56
89	4	21	16.2	7.0	500.2	208.5	0.77	30.17	4.85
89	5	30	17.4	7.3	517.6	215.8	0.58	29.55	3.65
89	6	4	5.8	2.5	523.4	218.3	1.45	30.12	9.12
89	7	29	16.6	12.1	540.0	230.4	0.57	42.16	3.60
89	8	0	0.0	0.0	540.0	230.4	0.00	0.00	0.00
89	9	0	0.0	0.0	540.0	230.4	0.00	0.00	0.00
89	10	30	14.4	7.2	554.4	237.6	0.48	33.33	3.02
89	11	29	0.0	0.0	554.4	237.6	0.00	0.00	0.00
89	12	19	11.6	11.1	566.0	248.7	0.61	48.90	3.84
90	1	28	14.6	8.0	580.6	256.7	0.52	35.40	3.28
90	2	23	11.5	9.6	592.1	266.3	0.50	45.50	3.15
90	3	30	12.3	8.3	604.4	274.6	0.41	40.29	2.58
90	4	30	10.8	7.5	615.2	282.1	0.36	40.98	2.26
90	5	30	12.5	7.7	627.7	289.8	0.42	38.12	2.62
90	6	29	14.0	3.5	641.7	293.3	0.48	20.00	3.04
90	7	30	11.1	7.4	652.8	300.7	0.37	40.00	2.33
90	8	30	17.6	1.5	670.4	302.2	0.59	7.85	3.69
90	9	29	14.2	3.2	684.6	305.4	0.49	18.39	3.08
90	10	30	12.7	5.3	697.3	310.7	0.42	29.44	2.66
90	11	25	9.9	4.2	707.2	314.9	0.40	29.79	2.49

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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90	12	15	5.9	2.5	713.1	317.4	0.39	29.76	2.47
91	1	14	8.6	5.6	721.7	323.0	0.61	39.44	3.86
91	2	21	12.3	9.6	734.0	332.6	0.59	43.84	3.68
91	3	28	10.4	9.8	744.4	342.4	0.37	48.51	2.34
91	4	29	7.8	9.8	752.2	352.2	0.27	55.68	1.69
91	5	30	15.0	3.8	767.2	356.0	0.50	20.21	3.15
91	6	29	15.5	3.9	782.7	359.9	0.53	20.10	3.36
91	7	30	18.1	0.6	800.8	360.5	0.60	3.21	3.79
91	8	30	13.0	4.4	813.8	364.9	0.43	25.29	2.73
91	9	9	0.3	0.1	814.1	365.0	0.03	25.00	0.21
91	10	30	18.2	7.3	832.3	372.3	0.61	28.63	3.82
91	11	30	11.3	7.9	843.6	380.2	0.38	41.15	2.37
91	12	31	11.2	7.6	854.8	387.8	0.36	40.43	2.27

"08-14-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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89	3	7	58.3	19.1	58.3	19.1	8.33	24.68	52.39
89	4	15	94.6	15.3	152.9	34.4	6.31	13.92	39.67
89	5	29	164.4	32.4	317.3	66.8	5.67	16.46	35.66
89	6	23	122.0	22.5	439.3	89.3	5.30	15.57	33.36
89	7	28	116.8	12.6	556.1	101.9	4.17	9.74	26.24
89	8	30	96.8	5.2	652.9	107.1	3.23	5.10	20.30
89	9	29	76.2	4.2	729.1	111.3	2.63	5.22	16.53
89	10	30	77.6	15.8	806.7	127.1	2.59	16.92	16.27
89	11	29	78.1	10.1	884.8	137.2	2.69	11.45	16.94
89	12	30	87.0	16.7	971.8	153.9	2.90	16.10	18.24
90	1	31	67.8	10.3	1039.6	164.2	2.19	13.19	13.76
90	2	24	52.6	10.2	1092.2	174.4	2.19	16.24	13.79
90	3	30	61.5	9.9	1153.7	184.3	2.05	13.87	12.89
90	4	30	49.2	12.8	1202.9	197.1	1.64	20.65	10.32
90	5	30	44.0	8.8	1246.9	205.9	1.47	16.67	9.23
90	6	29	43.9	7.0	1290.8	212.9	1.51	13.75	9.52
90	7	30	43.5	4.9	1334.3	217.8	1.45	10.12	9.12
90	8	30	42.7	4.9	1377.0	222.7	1.42	10.29	8.95
90	9	29	36.3	12.5	1413.3	235.2	1.25	25.61	7.87
90	10	28	56.2	17.0	1469.5	252.2	2.01	23.22	12.62
90	11	29	72.7	18.9	1542.2	271.1	2.51	20.63	15.77
90	12	30	70.6	13.0	1612.8	284.1	2.35	15.55	14.80
91	1	30	58.4	9.0	1671.2	293.1	1.95	13.35	12.24
91	2	27	54.2	9.7	1725.4	302.8	2.01	15.18	12.63
91	3	30	54.5	11.4	1779.9	314.2	1.82	17.30	11.43
91	4	28	54.5	7.5	1834.4	321.7	1.95	12.10	12.24
91	5	30	55.9	7.5	1890.3	329.2	1.86	11.83	11.72
91	6	29	49.8	6.9	1940.1	336.1	1.72	12.17	10.80
91	7	30	51.0	6.4	1991.1	342.5	1.70	11.15	10.69
91	8	30	47.5	9.9	2038.6	352.4	1.58	17.25	9.96
91	9	24	41.6	8.0	2080.2	360.4	1.73	16.13	10.90

"9-14-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
88	2	12	82.3	2.8	82.3	2.8	6.86	3.29	43.14
88	3	31	152.7	6.7	235.0	9.5	4.93	4.20	30.98
88	4	30	126.7	1.4	361.7	10.9	4.22	1.09	26.56
88	5	31	113.8	0.9	475.5	11.8	3.67	0.78	23.09
88	6	29	90.2	2.3	565.7	14.1	3.11	2.49	19.56
88	7	31	91.9	0.9	657.6	15.0	2.96	0.97	18.65
88	8	31	86.2	2.4	743.8	17.4	2.78	2.71	17.49
88	9	30	80.1	3.9	823.9	21.3	2.67	4.64	16.79
88	10	30	76.3	8.9	900.2	30.2	2.54	10.45	16.00
88	11	30	74.6	1.6	974.8	31.8	2.49	2.10	15.64
88	12	31	75.4	1.4	1050.2	33.2	2.43	1.82	15.30
89	1	31	62.2	7.0	1112.4	40.2	2.01	10.12	12.62
89	2	28	59.8	1.8	1172.2	42.0	2.14	2.92	13.43
89	3	31	66.3	2.3	1238.5	44.3	2.14	3.35	13.45
89	4	25	52.7	7.4	1291.2	51.7	2.11	12.31	13.26
89	5	1	1.0	0.0	1292.2	51.7	1.00	0.00	6.29
89	6	25	180.6	75.8	1472.8	127.5	7.22	29.56	45.44
89	7	28	174.6	51.8	1647.4	179.3	6.24	22.88	39.22
89	8	30	173.8	65.3	1821.2	244.6	5.79	27.31	36.44
89	9	29	127.1	41.6	1948.3	286.2	4.38	24.66	27.57
89	10	30	126.6	31.6	2074.9	317.8	4.22	19.97	26.54
89	11	28	109.5	23.3	2184.4	341.1	3.91	17.55	24.60
89	12	30	115.6	32.4	2300.0	373.5	3.85	21.89	24.24
90	1	31	117.2	21.0	2417.2	394.5	3.78	15.20	23.78
90	2	27	92.0	13.0	2509.2	407.5	3.41	12.38	21.43
90	3	30	93.6	19.9	2602.8	427.4	3.12	17.53	19.62
90	4	30	87.8	22.3	2690.6	449.7	2.93	20.25	18.41
90	5	30	83.2	19.2	2773.8	468.9	2.77	18.75	17.44
90	6	29	85.0	17.5	2858.8	486.4	2.93	17.07	18.44
90	7	30	84.3	12.2	2943.1	498.6	2.81	12.64	17.67
90	8	30	84.3	20.6	3027.4	519.2	2.81	19.64	17.67
90	9	29	100.0	16.2	3127.4	535.4	3.45	13.94	21.69
90	10	30	99.7	15.4	3227.1	550.8	3.32	13.38	20.90
90	11	29	119.4	15.1	3346.5	565.9	4.12	11.23	25.90
90	12	30	103.9	15.8	3450.4	581.7	3.46	13.20	21.78
91	1	30	115.9	15.1	3566.3	596.8	3.86	11.53	24.30
91	2	27	125.0	15.9	3691.3	612.7	4.63	11.28	29.12
91	3	30	133.1	18.9	3824.4	631.6	4.44	12.43	27.91
91	4	29	127.4	16.9	3951.8	648.5	4.39	11.71	27.63
91	5	30	120.9	18.2	4072.7	666.7	4.03	13.08	25.35
91	6	29	104.6	13.5	4177.3	680.2	3.61	11.43	22.69
91	7	30	95.0	9.5	4272.3	689.7	3.17	9.09	19.92
91	8	30	88.2	11.0	4360.5	700.7	2.94	11.09	18.49
91	9	29	76.3	9.7	4436.8	710.4	2.63	11.28	16.55
91	10	30	76.2	12.0	4513.0	722.4	2.54	13.61	15.98
91	11	30	73.0	12.7	4586.0	735.1	2.43	14.82	15.31
91	12	31	84.8	15.8	4670.8	750.9	2.74	15.71	17.21

"10-14-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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91	3	1	2.9	0.0	2.9	0.0	2.90	0.00	18.24
91	4	7	17.5	18.1	20.4	18.1	2.50	50.84	15.73
91	5	16	58.7	58.1	79.1	76.2	3.67	49.74	23.08
91	6	29	101.6	112.4	180.7	188.6	3.50	52.52	22.04
91	7	30	89.7	43.7	270.4	232.3	2.99	32.76	18.81
91	8	30	78.4	39.9	348.8	272.2	2.61	33.73	16.44
91	9	29	68.3	32.7	417.1	304.9	2.36	32.38	14.81
91	10	30	74.5	19.4	491.6	324.3	2.48	20.66	15.62
91	11	30	73.7	19.3	565.3	343.6	2.46	20.75	15.45
91	12	31	71.4	18.6	636.7	362.2	2.30	20.67	14.49

"15-14-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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88	2	6	3.5	13.4	3.5	13.4	0.58	79.29	3.67
88	3	26	107.5	47.2	111.0	60.6	4.13	30.51	26.01
88	4	30	197.8	71.5	308.8	132.1	6.59	26.55	41.47
88	5	26	151.2	58.4	460.0	190.5	5.82	27.86	36.58
88	6	26	141.7	51.0	601.7	241.5	5.45	26.47	34.28
88	7	30	145.6	46.0	747.3	287.5	4.85	24.01	30.53
88	8	31	153.7	53.0	901.0	340.5	4.96	25.64	31.19
88	9	26	133.8	41.1	1034.8	381.6	5.15	23.50	32.37
88	10	29	142.7	40.3	1177.5	421.9	4.92	22.02	30.95
88	11	30	130.1	39.6	1307.6	461.5	4.34	23.34	27.28
88	12	31	125.3	37.3	1432.9	498.8	4.04	22.94	25.42
89	1	31	119.4	40.4	1552.3	539.2	3.85	25.28	24.23
89	2	28	101.7	33.1	1654.0	572.3	3.63	24.55	22.85
89	3	30	91.0	26.0	1745.0	598.3	3.03	22.22	19.08
89	4	25	119.6	11.7	1864.6	610.0	4.78	8.91	30.09
89	5	30	102.9	32.1	1967.5	642.1	3.43	23.78	21.57
89	6	29	89.5	31.5	2057.0	673.6	3.09	26.03	19.41
89	7	30	88.4	26.3	2145.4	699.9	2.95	22.93	18.53
89	8	30	83.1	28.3	2228.5	728.2	2.77	25.40	17.42
89	9	29	56.5	41.6	2285.0	769.8	1.95	42.41	12.25
89	10	30	62.3	29.4	2347.3	799.2	2.08	32.06	13.06
89	11	29	68.4	16.5	2415.7	815.7	2.36	19.43	14.84
89	12	30	70.1	16.7	2485.8	832.4	2.34	19.24	14.70
90	1	30	56.1	15.8	2541.9	848.2	1.87	21.97	11.76
90	2	27	51.7	29.6	2593.6	877.8	1.91	36.41	12.04
90	3	31	59.6	29.6	2653.2	907.4	1.92	33.18	12.09
90	4	29	52.0	24.6	2705.2	932.0	1.79	32.11	11.28
90	5	29	45.9	25.4	2751.1	957.4	1.58	35.62	9.96
90	6	26	52.8	19.9	2803.9	977.3	2.03	27.37	12.77
90	7	30	48.9	12.2	2852.8	989.5	1.63	19.97	10.25
90	8	30	55.7	18.1	2908.5	1007.6	1.86	24.53	11.68
90	9	29	57.9	9.1	2966.4	1016.7	2.00	13.58	12.56
90	10	30	61.0	13.1	3027.4	1029.8	2.03	17.68	12.79
90	11	29	65.7	7.7	3093.1	1037.5	2.27	10.49	14.25
90	12	30	76.5	14.3	3169.6	1051.8	2.55	15.75	16.04
91	1	30	76.2	17.8	3245.8	1069.6	2.54	18.94	15.98
91	2	27	67.9	15.8	3313.7	1085.4	2.51	18.88	15.82
91	3	30	72.0	18.8	3385.7	1104.2	2.40	20.70	15.10
91	4	29	72.2	16.5	3457.9	1120.7	2.49	18.60	15.66
91	5	30	73.7	18.2	3531.6	1138.9	2.46	19.80	15.45
91	6	29	69.4	15.0	3601.0	1153.9	2.39	17.77	15.05
91	7	30	68.1	12.9	3669.1	1166.8	2.27	15.93	14.28
91	8	30	63.3	14.9	3732.4	1181.7	2.11	19.05	13.27
91	9	29	55.4	13.3	3787.8	1195.0	1.91	19.36	12.02
91	10	30	56.9	17.1	3844.7	1212.1	1.90	23.11	11.93
91	11	30	60.8	12.5	3905.5	1224.6	2.03	17.05	12.75
91	12	31	59.9	9.2	3965.4	1233.8	1.93	13.31	12.15

"16-14-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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87	6	1	4.8	0.0	4.8	0.0	4.80	0.00	30.19
87	7	31	144.2	0.2	149.0	0.2	4.65	0.14	29.26
87	8	27	116.6	0.2	265.6	0.4	4.32	0.17	27.16
87	9	30	119.9	0.0	385.5	0.4	4.00	0.00	25.14
87	10	31	114.4	0.0	499.9	0.4	3.69	0.00	23.21
87	11	29	102.5	0.0	602.4	0.4	3.53	0.00	22.23
87	12	31	91.0	1.0	693.4	1.4	2.94	1.09	18.46
88	1	31	63.4	0.7	756.8	2.1	2.05	1.09	12.86
88	2	26	47.5	2.6	804.3	4.7	1.83	5.19	11.49
88	3	30	50.0	1.0	854.3	5.7	1.67	1.96	10.48
88	4	29	45.3	0.8	899.6	6.5	1.56	1.74	9.83
88	5	31	41.4	0.3	941.0	6.8	1.34	0.72	8.40
88	6	30	36.5	0.1	977.5	6.9	1.22	0.27	7.65
88	7	31	33.2	1.5	1010.7	8.4	1.07	4.32	6.74
88	8	31	35.6	0.2	1046.3	8.6	1.15	0.56	7.22
88	9	30	32.2	0.2	1078.5	8.8	1.07	0.62	6.75
88	10	30	31.1	0.7	1109.6	9.5	1.04	2.20	6.52
88	11	30	31.1	0.2	1140.7	9.7	1.04	0.64	6.52
88	12	31	29.4	0.3	1170.1	10.0	0.95	1.01	5.97
89	1	25	30.1	1.8	1200.2	11.8	1.20	5.64	7.57
89	2	24	107.5	56.6	1307.7	68.4	4.48	34.49	28.17
89	3	27	178.6	29.9	1486.3	98.3	6.61	14.34	41.61
89	4	25	140.8	20.8	1627.1	119.1	5.63	12.87	35.43
89	5	30	138.7	23.8	1765.8	142.9	4.62	14.65	29.08
89	6	29	125.7	17.6	1891.5	160.5	4.33	12.28	27.26
89	7	30	99.7	30.6	1991.2	191.1	3.32	23.48	20.90
89	8	29	108.7	15.9	2099.9	207.0	3.75	12.76	23.58
89	9	29	105.9	14.4	2205.8	221.4	3.65	11.97	22.97
89	10	30	93.6	13.5	2299.4	234.9	3.12	12.61	19.62
89	11	28	87.6	11.7	2387.0	246.6	3.13	11.78	19.68
89	12	30	83.5	13.9	2470.5	260.5	2.78	14.27	17.51
90	1	25	64.1	8.7	2534.6	269.2	2.56	11.95	16.13
90	2	26	73.1	11.1	2607.7	280.3	2.81	13.18	17.68
90	3	30	84.6	11.1	2692.3	291.4	2.82	11.60	17.74
90	4	30	74.4	9.5	2766.7	300.9	2.48	11.32	15.60
90	5	30	67.1	8.2	2833.8	309.1	2.24	10.89	14.07
90	6	25	54.3	9.1	2888.1	318.2	2.17	14.35	13.66

"01-23-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
87	10	4	30.8	4.0	30.8	4.0	7.70	11.49	48.43
87	11	30	112.2	21.8	143.0	25.8	3.74	16.27	23.52
87	12	31	54.3	5.6	197.3	31.4	1.75	9.35	11.02
88	1	26	73.8	5.7	271.1	37.1	2.84	7.17	17.85
88	2	28	61.4	9.1	332.5	46.2	2.19	12.91	13.79
88	3	31	73.6	6.2	406.1	52.4	2.37	7.77	14.93
88	4	30	70.6	1.8	476.7	54.2	2.35	2.49	14.80
88	5	17	48.8	2.6	525.5	56.8	2.87	5.06	18.06
88	6	30	66.6	4.8	592.1	61.6	2.22	6.72	13.96
88	7	31	64.9	4.7	657.0	66.3	2.09	6.75	13.17
88	8	31	64.7	6.5	721.7	72.8	2.09	9.13	13.13
88	9	30	57.8	5.7	779.5	78.5	1.93	8.98	12.12
88	10	31	62.8	4.8	842.3	83.3	2.03	7.10	12.74
88	11	30	58.7	4.6	901.0	87.9	1.96	7.27	12.31
88	12	31	59.9	4.3	960.9	92.2	1.93	6.70	12.15
89	1	31	59.0	4.2	1019.9	96.4	1.90	6.65	11.97
89	2	25	52.5	4.1	1072.4	100.5	2.10	7.24	13.21
89	3	30	60.5	2.8	1132.9	103.3	2.02	4.42	12.68
89	4	29	55.4	6.5	1188.3	109.8	1.91	10.50	12.02
89	5	30	51.0	10.9	1239.3	120.7	1.70	17.61	10.69
89	6	29	49.3	9.8	1288.6	130.5	1.70	16.58	10.69
89	7	30	49.6	4.7	1338.2	135.2	1.65	8.66	10.40
89	8	30	52.2	2.5	1390.4	137.7	1.74	4.57	10.94
89	9	28	51.2	4.5	1441.6	142.2	1.83	8.08	11.50
89	10	27	39.1	2.5	1480.7	144.7	1.45	6.01	9.11
89	11	28	44.2	2.9	1524.9	147.6	1.58	6.16	9.93
89	12	30	56.1	4.2	1581.0	151.8	1.87	6.97	11.76
90	1	27	48.3	4.2	1629.3	156.0	1.79	8.00	11.25
90	2	27	43.2	7.4	1672.5	163.4	1.60	14.62	10.06
90	3	29	42.2	4.4	1714.7	167.8	1.46	9.44	9.15
90	4	27	37.3	4.1	1752.0	171.9	1.38	9.90	8.69
90	5	31	42.0	4.1	1794.0	176.0	1.35	8.89	8.52
90	6	26	36.8	3.2	1830.8	179.2	1.42	8.00	8.90
90	7	28	54.9	2.4	1885.7	181.6	1.96	4.19	12.33
90	8	28	52.5	4.0	1938.2	185.6	1.88	7.08	11.79
90	9	27	42.7	5.4	1980.9	191.0	1.58	11.23	9.95
90	10	30	46.1	5.7	2027.0	196.7	1.54	11.00	9.67
90	11	28	48.6	3.8	2075.6	200.5	1.74	7.25	10.92
90	12	30	50.3	6.4	2125.9	206.9	1.68	11.29	10.55
91	1	31	53.5	5.6	2179.4	212.5	1.73	9.48	10.86
91	2	23	91.3	13.4	2270.7	225.9	3.97	12.80	24.97
91	3	30	206.0	23.4	2476.7	249.3	6.87	10.20	43.19
91	4	29	166.3	21.9	2643.0	271.2	5.73	11.64	36.07
91	5	30	165.7	18.2	2808.7	289.4	5.52	9.90	34.74
91	6	29	152.0	6.8	2960.7	296.2	5.24	4.28	32.97

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
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91	7	30	140.1	6.5	3100.8	302.7	4.67	4.43	29.37
91	8	30	136.4	5.2	3237.2	307.9	4.55	3.67	28.60
91	9	29	118.2	3.3	3355.4	311.2	4.08	2.72	25.64
91	10	30	133.2	3.7	3488.6	314.9	4.44	2.70	27.93
91	11	29	130.1	4.5	3618.7	319.4	4.49	3.34	28.22
91	12	30	134.6	6.3	3753.3	325.7	4.49	4.47	28.22

"02-23-10-29WPM"

Yr	Mn	pd	OILm m3/mn	H2Om m3/mn	COIL (m3)	Cwp (m3)	Qoil m3/d	Wcut (%)	Qoil STB/d
89	6	1	0.0	3.5	0.0	3.5	0.00	100.00	0.00
89	7	18	78.0	3.3	78.0	6.8	4.33	4.06	27.26
89	8	27	98.0	1.2	176.0	8.0	3.63	1.21	22.83
89	9	28	87.4	1.2	263.4	9.2	3.12	1.35	19.63
89	10	30	75.7	1.9	339.1	11.1	2.52	2.45	15.87
89	11	26	61.1	2.3	400.2	13.4	2.35	3.63	14.78
89	12	30	57.8	0.8	458.0	14.2	1.93	1.37	12.12
90	1	30	59.5	0.7	517.5	14.9	1.98	1.16	12.48
90	2	27	55.1	2.0	572.6	16.9	2.04	3.50	12.84
90	3	31	65.3	3.8	637.9	20.7	2.11	5.50	13.25
90	4	29	60.2	0.9	698.1	21.6	2.08	1.47	13.06
90	5	30	52.6	0.8	750.7	22.4	1.75	1.50	11.03
90	6	23	94.2	10.6	844.9	33.0	4.10	10.11	25.76
90	7	30	196.1	15.2	1041.0	48.2	6.54	7.19	41.12
90	8	30	174.1	15.4	1215.1	63.6	5.80	8.13	36.50
90	9	29	150.8	7.5	1365.9	71.1	5.20	4.74	32.71
90	10	29	141.8	4.3	1507.7	75.4	4.89	2.94	30.76
90	11	29	137.8	4.8	1645.5	80.2	4.75	3.37	29.89
90	12	31	134.1	3.3	1779.6	83.5	4.33	2.40	27.21
91	1	29	123.3	2.9	1902.9	86.4	4.25	2.30	26.74
91	2	27	122.6	7.3	2025.5	93.7	4.54	5.62	28.56
91	3	28	107.8	15.9	2133.3	109.6	3.85	12.85	24.22
91	4	29	104.8	17.3	2238.1	126.9	3.61	14.17	22.73
91	5	30	107.1	19.0	2345.2	145.9	3.57	15.07	22.46
91	6	29	99.8	17.0	2445.0	162.9	3.44	14.55	21.65
91	7	30	73.9	11.4	2518.9	174.3	2.46	13.36	15.49
91	8	30	87.1	14.5	2606.0	188.8	2.90	14.27	18.26
91	9	29	80.2	10.2	2686.2	199.0	2.77	11.28	17.40
91	10	30	83.2	13.9	2769.4	212.9	2.77	14.32	17.44
91	11	29	80.1	13.5	2849.5	226.4	2.76	14.42	17.37
91	12	30	87.9	7.3	2937.4	233.7	2.93	7.67	18.43

INJECTION - 08-14-10-29WPM

Yr	Mn	H2O-m (m3/Mn.)	C-Winj (m3)	Qinj (m3/d)	Qinj (bbl/d)
91	10	668.5	668.5	21.56	135.64
	11	777.4	1445.9	25.91	162.99
	12	775.7	2221.6	25.02	157.39

INJECTION - 16-14-10-29WPM

Yr	Mn	H2O-m (m3/Mn.)	C-Winj (m3)	Qinj (m3/d)	Qinj (bbl/d)
90	6	17.2	17.2	0.57	3.61
	7	572.6	589.8	18.47	116.18
	8	651.7	1241.5	21.02	132.23
	9	555.1	1796.6	18.50	116.39
	10	664.6	2461.2	21.44	134.85
	11	419.9	2881.1	14.00	88.04
	12	644.1	3525.2	20.78	130.69
91	1	716.7	4241.9	23.12	145.42
	2	647.7	4889.6	23.13	145.50
	3	615.8	5505.4	19.86	124.95
	4	614.6	6120	20.49	128.86
	5	529	6649	17.06	107.34
	6	341	6990	11.37	71.50
	7	42.1	7032.1	1.36	8.54
	8	400.6	7432.7	12.92	81.28
	9	324.2	7756.9	10.81	67.97
	10	258.2	8015.1	8.33	52.39
	11	338.7	8353.8	11.29	71.01
	12	638.1	8991.9	20.58	129.47

Attachment 3: Executive Summary- Waterflood Sensitivity Study

This report contains the results of two water/water and one water/rock compatibility (waterflood sensitivity) tests.

The water compatibility study (Section 2) on Bakken brine versus Lodgepole brine and Bakken brine versus Jurassic brine confirmed that both the proposed injection brines are compatible in all proportions with the formation brine.

A waterflood sensitivity test (clay swelling followed by fines mobilization with Jurassic brine) was done on one of the two samples selected from the Bakken Formation in the MOGC DALY 9-14-10-29W1M well.

During the clay swell portion of the test, permeability declined from 11.88 md to 9.10 md during the first 22 pore volumes flooded, but was restored to 11.38 md over the next 8 pore volumes and remained constant, within experimental error, over the subsequent 10 pore volumes. The slight reduction in permeability is attributed to a slight swelling of traces of smectite, in combination with some fines migration. Clay swelling is concluded to be an insignificant problem in the reservoir.

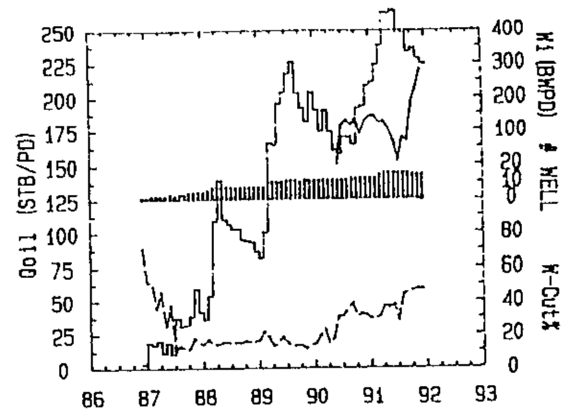
The test showed a serious problem of fines mobilization with a drop in absolute permeability of 82% (12.19 md to 2.24 md) during forward flow. No significant permeability restoration was observed with flow reversal. A low critical velocity of 0.0294 cm/min was measured. This equates to field conditions of 1 to 2 m^3/ per day adjacent to the wellbore which means that fines will be moved within the reservoir at any production rate. The significance of this problem will be dependent upon the areal distribution of the fines.

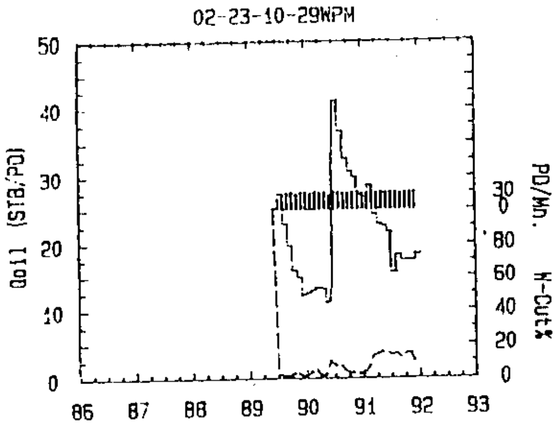
The fines migration problem must be addressed, because blockage of pore throats will result in higher fluid differential pressures and higher residual oil saturations.

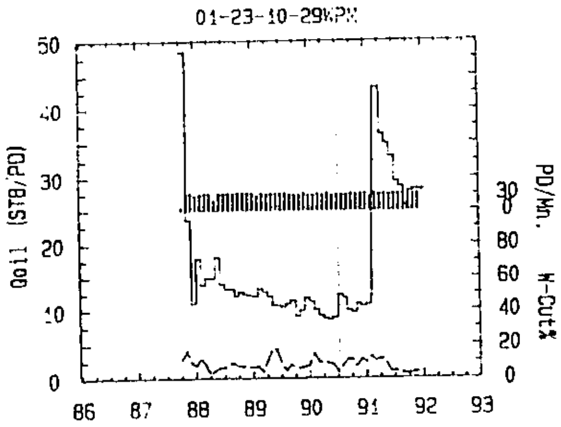
Daly Bakken 'D' Pool

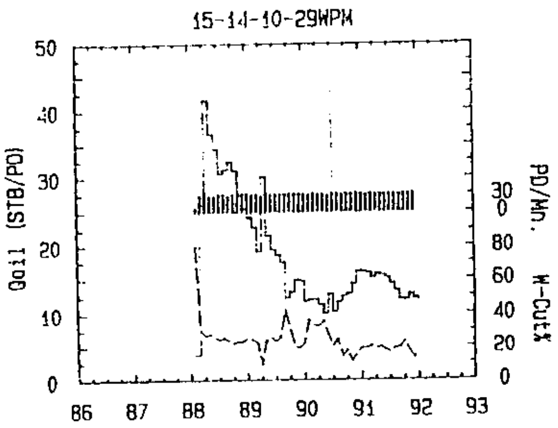
Attachment 4

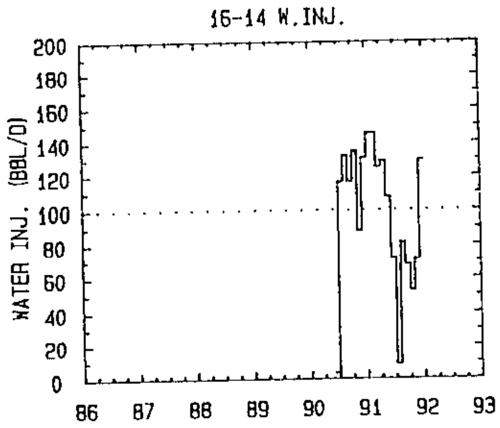
Unit #1

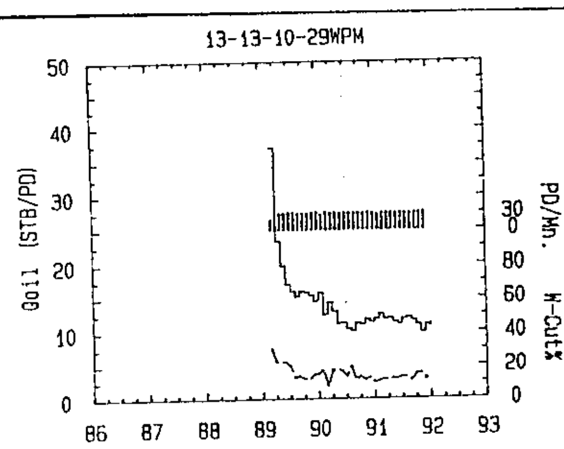


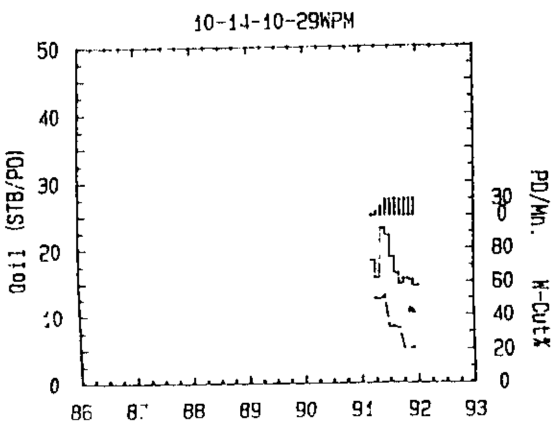


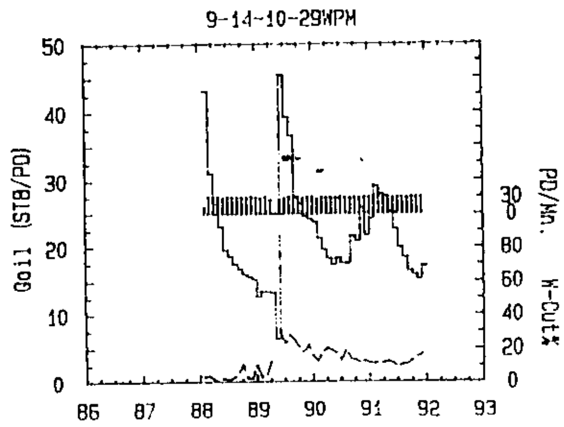


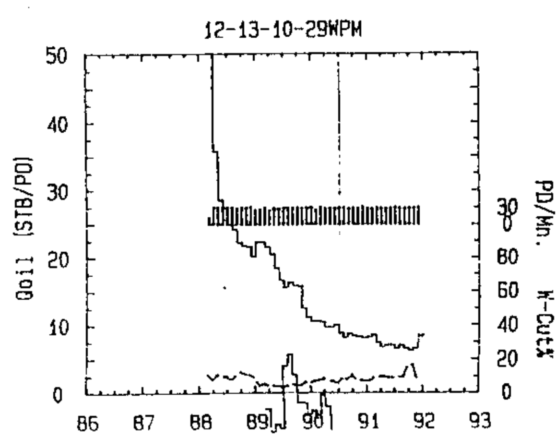


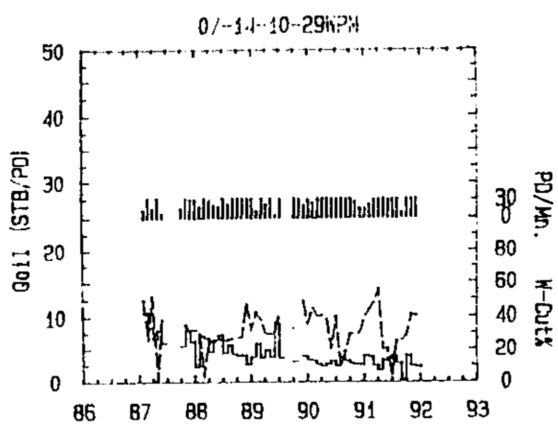


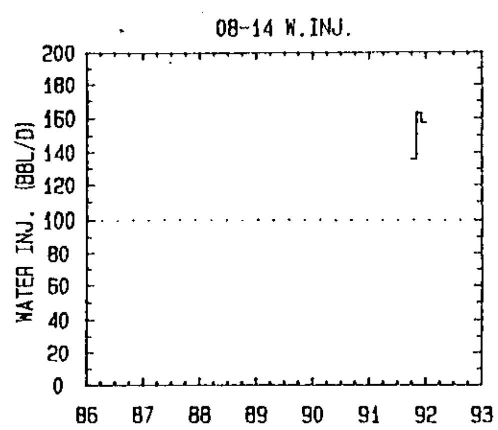


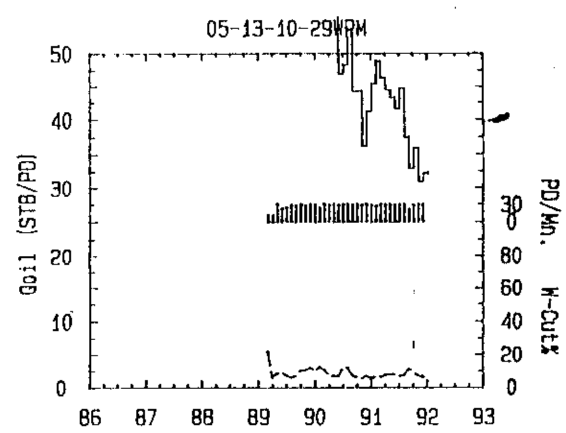












Unit #2