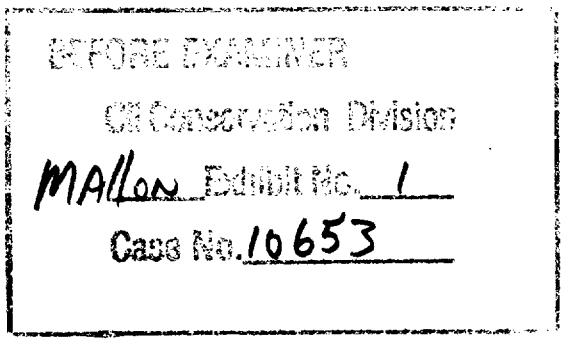
LEA, NE DELAWARE POOL ALLOWABLE

EXAMINER HEARING
MARCH 16, 1995



MALLON OIL COMPANY
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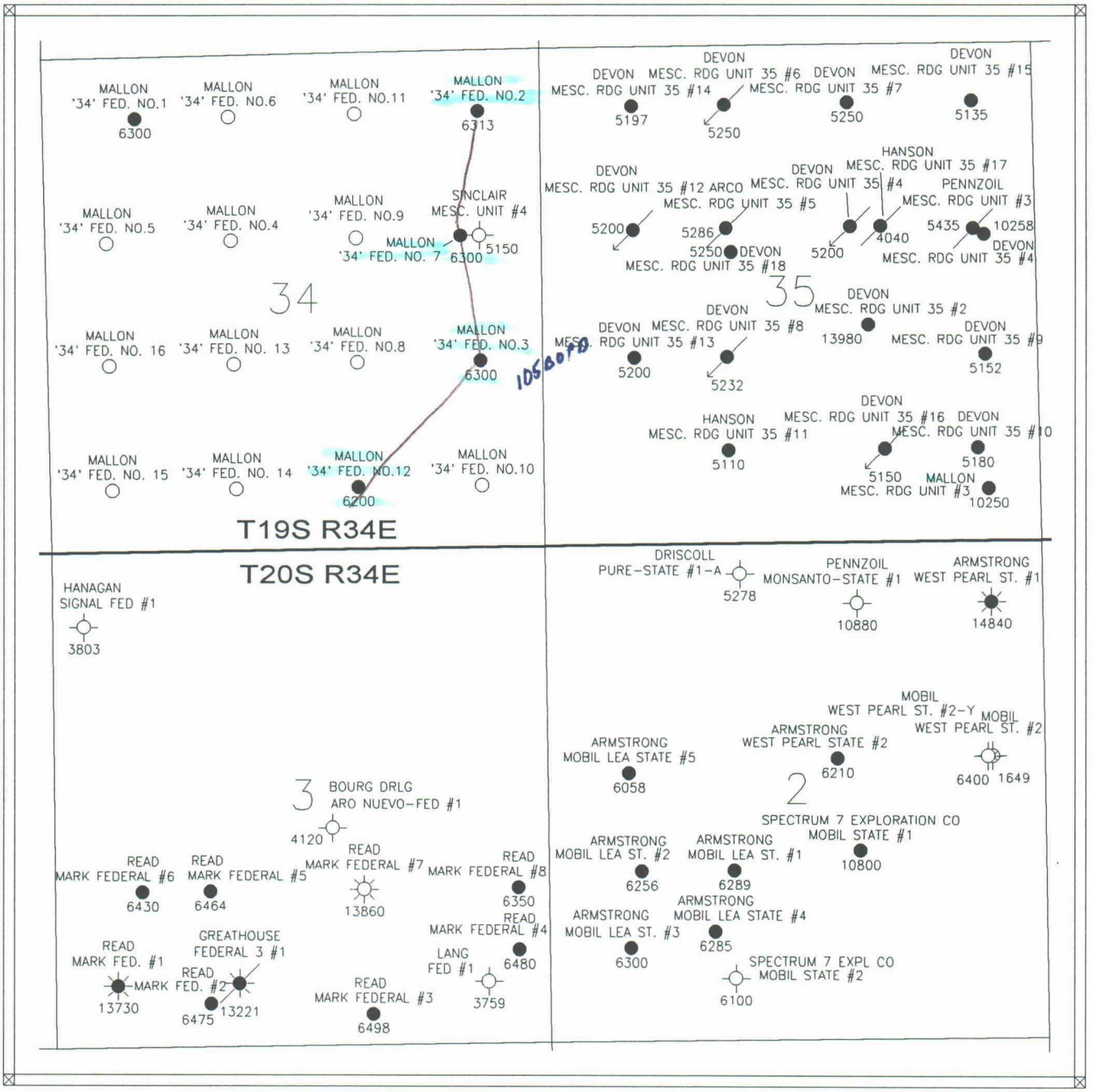
Mallon Oil Company supports making the current 300 BOPD allowable permanent for the Lea NE Delaware pool.

Multiple Delaware sand intervals have a capacity that exceeds allowables. As not all sands are produced at lower allowables, inequities will occur. ~ Variations in sand qualities, not all wells are completed in the same sands.

All production sands should be fraced initially to treat all zones. Waiting until one zone is depleted before treating remaining zones will result in other zones not being treated. If one sand is completed and produced, the other zone will not and cannot take a frac completely.

A 300 BOPD allowable is needed to ensure that all treated zones are effectively cleaned up and produced.

Many wells are capable of producing in excess of the 107 BOPD allowable



0.1 0. 0.1 0.2 0.3 0.4 0.5 miles

MALLON OIL COMPANY

Location Map
T19S R34E - T20S R34E
Lea County, New Mexico

		3/14/95

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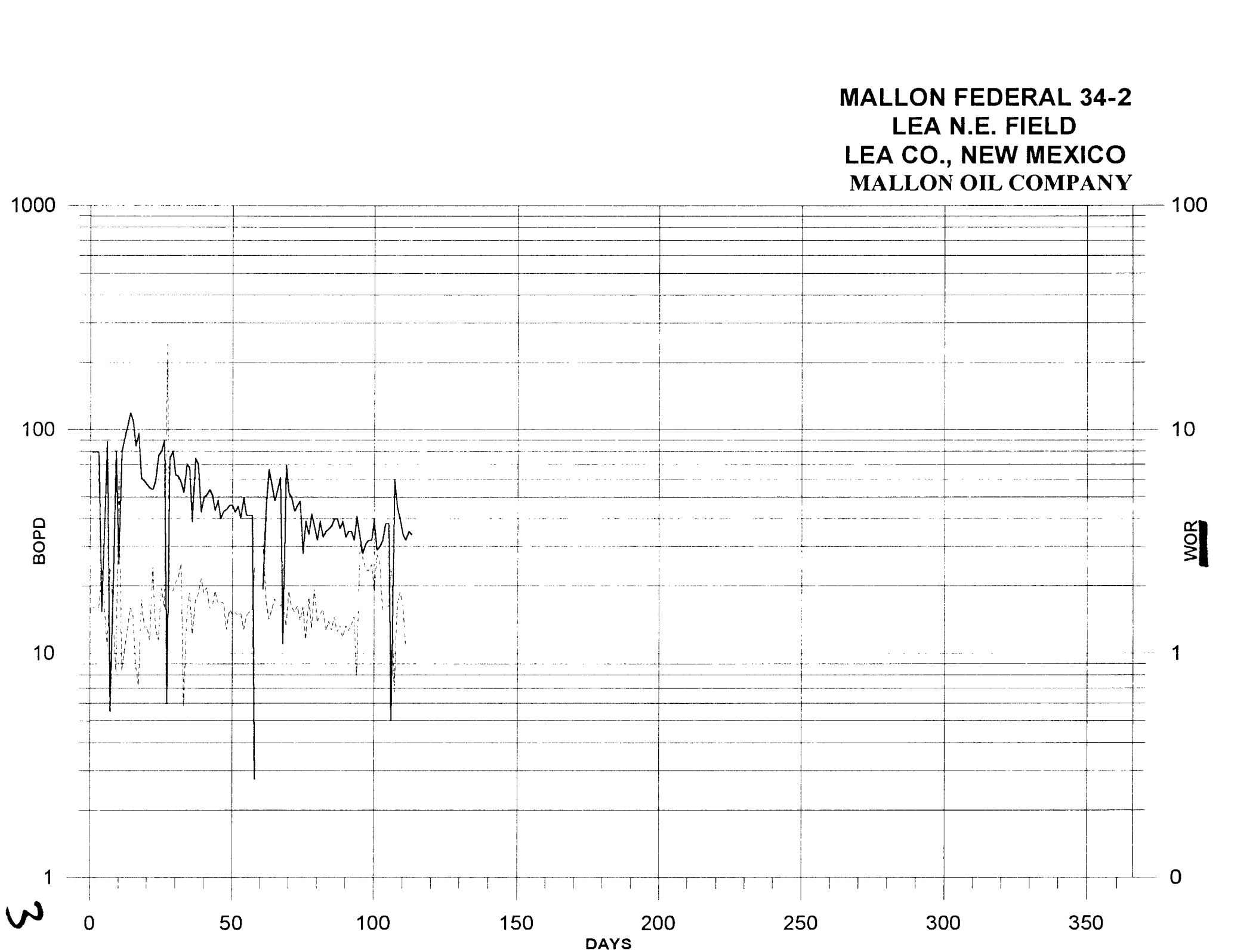
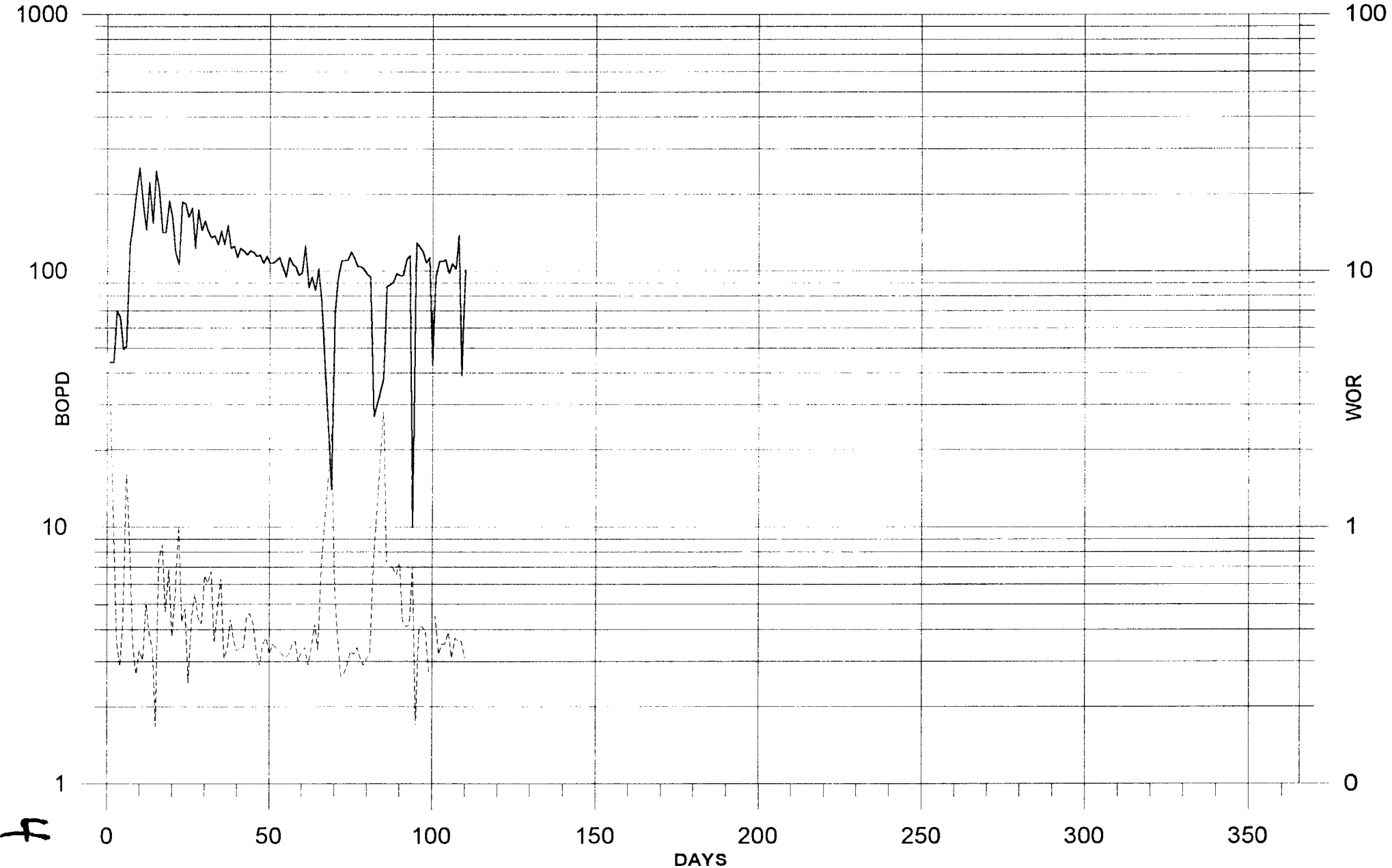

MALLON FEDERAL 34-2
LEA N.E. FIELD
LEA CO., NEW MEXICO
MALLON OIL COMPANY
1000
100
10
1
BOPD
100
10
1
0
WOR
0
50
100
150
200
250
300
350
DAYS

MALLON FEDERAL 34-3
LEA N.E. FIELD
LEA CO., NEW MEXICO

MALLON OIL COMPANY



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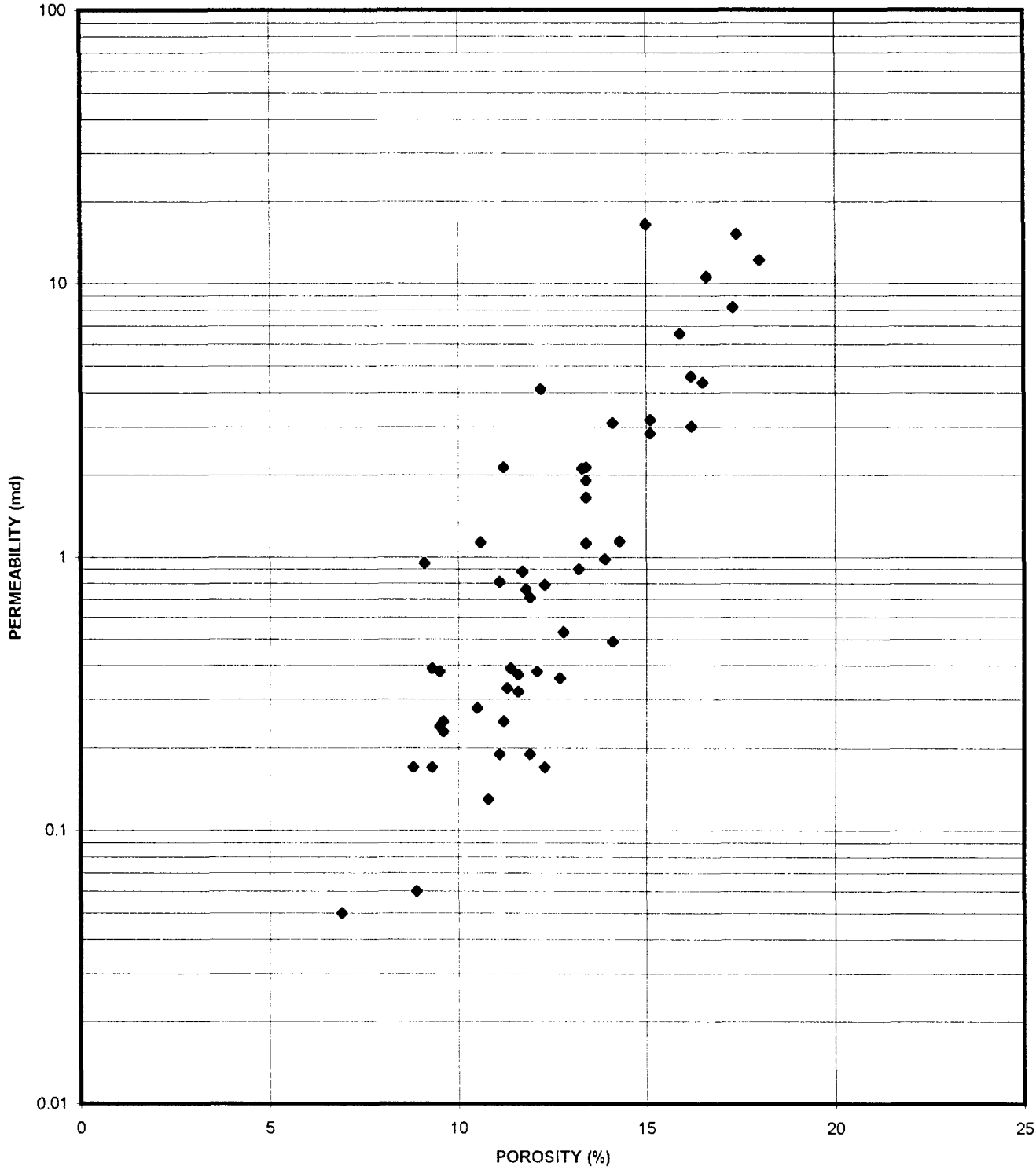
A significant amount of oil exists in the Delaware sands of wells operated by Mallon Oil Company. Mallon 34 Federal No. 3 well (NESE Sec. 34 T19S R34E) and Mallon 34 Federal No. 12 (SWSE Sec. 34 T19S R34E) are used as an example of expected OOIP and recoverable reserves.

Zone	Porosity (FRAC)	Net h (FRACT)	Sw (FRAC)	OOIP (FRAC)	RF (FRAC)	Reserves (MBBLS)
Mallon 34 Federal No. 3						
3	0.157	7.5	0.358	204	.15	31
2	0.128	21	0.509	356	.10	36
1	0.162	37.5	0.558	725	.13	94
Mallon 34 Federal No. 12						
4	0.141	26	0.383	610	.14	85
3	0.127	51	0.457	1091	.12	130
2	0.128	26	0.645	319	.08	26
1	0.152	38	0.662	527	.10	53

The porosity, Net h, and Sw values are based upon log analysis. Recovery factors used are reasonable for this rock quality and assumed depletion method. The recovery factors were adjusted by zone in an effort to acknowledge differences in porosity and water saturation would yield differences in expected recovery factors.

This does show that significant reserves are present in the various Delaware zones. A reduction in recovery of 10 percent due to ineffective completion would yield significant losses in ultimate recovery for any zone not properly stimulation treated.

POROSITY vs. PERMEABILITY
DELAWARE SANDS
MALLON 34 FEDERAL NO. 2, 3, & 12



A REVIEW OF NEW TECHNIQUES AND METHODS OF COMPLETING THE DELAWARE FORMATION OF S.E. NEW MEXICO

Vithal Pai and Morris Keith
The Western Company of North America

ABSTRACT

With improved oil prices the Delaware formation of S.E. New Mexico has become a hot bed of activity since early 1990. The paper presents background information such as lithology, formation rock characteristics, X-Ray Diffraction and SEM analysis. Completion practices and perforation programs are reviewed for nine different fields along with analysis of different stimulation practices. The paper also reviews stimulation fluids, volumes, injection rates, types of proppant used and fracture geometries to provide an optimum completion program.

INTRODUCTION

Although the Delaware formation of Southeast New Mexico has been explored and investigated since early to mid seventies, it is only since the late eighties and early nineties that this formation has seen a very high level of drilling and completion activity. The Delaware formation which has a thickness in excess of 3000 ft. in some areas[1] consists of the Bell Canyon, the Cherry Canyon and the Brushy Canyon. The present study focuses on only the Cherry Canyon and the Brushy Canyon. Greater emphasis is placed on the Brushy Canyon which is more prolific in most instances.

The Brushy Canyon sands predominate the lower Delaware Mountain Group and consists of layers of sand, shale and some thin layers of dolomite. Depending on the area, the Brushy Canyon interval varies in thickness and exhibits a lenticular framework with individual stringers varying in oil and water saturation. The close proximity of water bearing sands, both above and below the oil bearing sands, poses some interesting completion challenges. This problem has been alleviated using different fracturing techniques.

The Delaware formation in most areas consists of over 80% quartz[1] and almost always requires to be hydraulically fractured to be economically lucrative. For the purposes of this study we reviewed completion practices of 26 different operators in S.E. New Mexico from January 1, 1988 to May 31, 1993. The Delaware wells in the field are drilled generally on 40 acre spacing. Production is highly variable with production after fracturing varying from 30 BOPD to 187 BOPD (top allowable) and water varying from none to 300 BOPD. Gas production ranges where applicable from 50 to 400 MCFPD. Many of the wells, especially in the Sand Dunes, E. Loving and the Livingston Ridge area produce flowing.

Generally, the lack of competent barriers to fracture height growth results in vertical fractures in excess of 200 ft and these interconnect several productive "stringers" as well as the water saturated sands. Methods have been devised to reduce this problem[2]. Lithology of some of the fields has been presented to help in designing completion fluid formulations.

SUMMARY OF FINDINGS

1. Most Delaware wells need to be fractured to be economical. They exhibit a tendency towards excessive fracture height growth which can be controlled by using cluster perforating the approximate center porosity as opposed to blanket perforating the entire interval. This method also seems to reduce water production and post frac proppant flowback problem. Proppant flowback can be further helped by tailing in with curable resin coated sand. The formation is sensitive to completion fluid formulation, therefore care should be taken in completion fluid design.

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It is expected that poor cleanup of the less permeable sands will result if the 107 BOPD allowable is restated. This will result in less effective production from the less permeable zones and a reduction in recovery. There is a significant change in the time to reach capacity production and ensure cleanup if the 300 BOPD allowable is reduced to 107 BOPD. The following example calculations show the number of days a well would have to produce under a 107 BOPD allowable to be at full capacity production and ensuring maximum possible cleanup of the fractured zones as compared to a capacity of 300 BOPD or less and an allowable of 300 BOPD.

Well Capacity (BOPD)	Assumed Decline (%/YR)	Time to Reach Capacity at 107 BOPD Allowable (Days)
300	30	1846
300	60	719
250	60	532
200	60	346
150	60	160

If the wells capacity is 300 BOPD and it would normally decline at a rate of 30 %/year, 1846 days of 107 BOPD production would be required before the well was producing at capacity. As shown above, significant time elapse is required if the wells are produced at an allowable of 107 BOPD before the well is producing at capacity and maximum cleanup ensured. A negative impact upon cleanup and ultimate recovery from the less permeable zones would undoubtedly occur.

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Individual Delaware sands cannot be effectively fracture treated after one sand has been depleted.

It has been reported in the literature[1] and observed in other Delaware fields that effective barriers do not exist between Delaware Sands. If one sand is completed and produced before other sands are completed, the sand treated first is expected to accept future fracture treatments rather than the intended zone.

Theoretically, this can be shown with the fracture initiation and extension equations as shown below:

To initiate a vertical fracture:

$$P_{f\,init} = 2(v/(1-v))\,(P_{ob} - P_p) + P_p$$

To extend a vertical fracture:

$$P_{f\,ext} = (v/(1-v))\,(P_{ob} - P_p) + P_p$$

Example results are shown for initial pressure conditions of 2500 PSI at 5800 feet and depleted pressure condition of 1000 PSI

	$P_{f\,init}$	$P_{f\,ext}$
P_p 2500	5606	4053
P_p 1000	5518	3259

As shown above, due to the lower required treating pressures in the depleted zones, the fracture would preferentially initiate and continue in the depleted zone.

[1] *"A Review of New Techniques and Methods of Completing the Delaware Formation of SE New Mexico"*, by Vithal Pai and Morris Keith

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Significant reserves exist in Lea, NE Delaware pool wells operated by Mallon Oil Company. The quality of the Delaware sands varies and hydraulic fracture treatments are required to produce the zones. Total sand thickness has ranged up to over 100 feet in up to 4 separate sands in Section 34 T19S R34E.

In order to deplete all zones effectively, they must be hydraulically fraced upon initial completion and produced to effectively clean up the fracture. A single zone may have the capacity to exceed an allowable of 107 BOPD for extended periods of time. This would not allow less permeable zones to clean up and produce as effectively as they would otherwise. Waiting to frac zones at a later date would result in loss of those zones.

There are no definitive barriers between the different Delaware sands. Waiting to frac remaining sands after one sand has been depleted would result in the depleted zone accepting additional fracture treatments. The intended zones would not be treated and the reserves attributable to those zones would be lost.

Mallon Oil Company recommends making the 300 BOPD allowable permanent. This will allow effective treating and depletion of all sands in the Delaware.