M E M O R A N D U M

DATE: June 29, 1989

c.c.: R. Dobek

TO: Richard Brekke
Gordon Cormack

FROM: David Cridland

RE: LAm C Sand Wet Stringer Review

Historically, high initial water cuts have been observed from the Lower Amaranth in the northwest portion of Waskada and in particular from some wells in sections 26,27,33,34 and 35-1-26 WPM. Previous studies have concluded that the abnormally high water production is the result of a highly permeable, water wet stringer in the C sand. Unfortunately, no core information is available from the Lower Amaranth within the wet stringer zone, but the wet stringer is easily recognized on logs. Past studies typically describes the wet stringer as having a deep induction resistivity readings of less than 3.0 ohm/m, a spontaneous potential log response greater than 30 mV and a porosity value in excess of 18%. Armed with these characteristics, the areal extent of the wet stringer can be mapped (see figure 1). But what controls the extent of the stringer?

The purpose of this study was to review the previous work, add some new ideas and gain what ever information we can about the factors controlling the extent of the wet stringer.

The results of the review indicate that the areal extent of the wet stringer is controlled by a combination of the depositional extent of the high porosity sands, post Triassic faulting and capillary forces.

The high porosity sand deposits found in the wet stringer were derived from a northeast source and transported through a narrow pathway (the C_2 trend) from the northeast to the southwest (see Figure 2). A sudden decrease in velocity, caused by the widening of the trend, resulted in a dumping of the coarse grains and the deposition of the wet stringer sands. These sands can also be recognized on logs and the depositional extent can be mapped (see Figure 2).

After the Lower Amaranth was deposited, post Triassic movement in the basement faulted the sands and produced a very complex fault pattern. The deformation and the relative movement of the blocks can be observed in a structure map of the C sand (see Figure 3). The wet stringer was affected by this faulting and is found to occupy the high porosity sands in the fault block lows. The invasion pathway into the field, by the wet stringer, occurs from one low block to another across non-sealing fault planes. However, sealing faults are also found and prevent the wet stringer from expanding into the remaining low blocks. An example of the affects of a sealing fault can be observed between LSD 1 and 2-33-1-26 WPM.

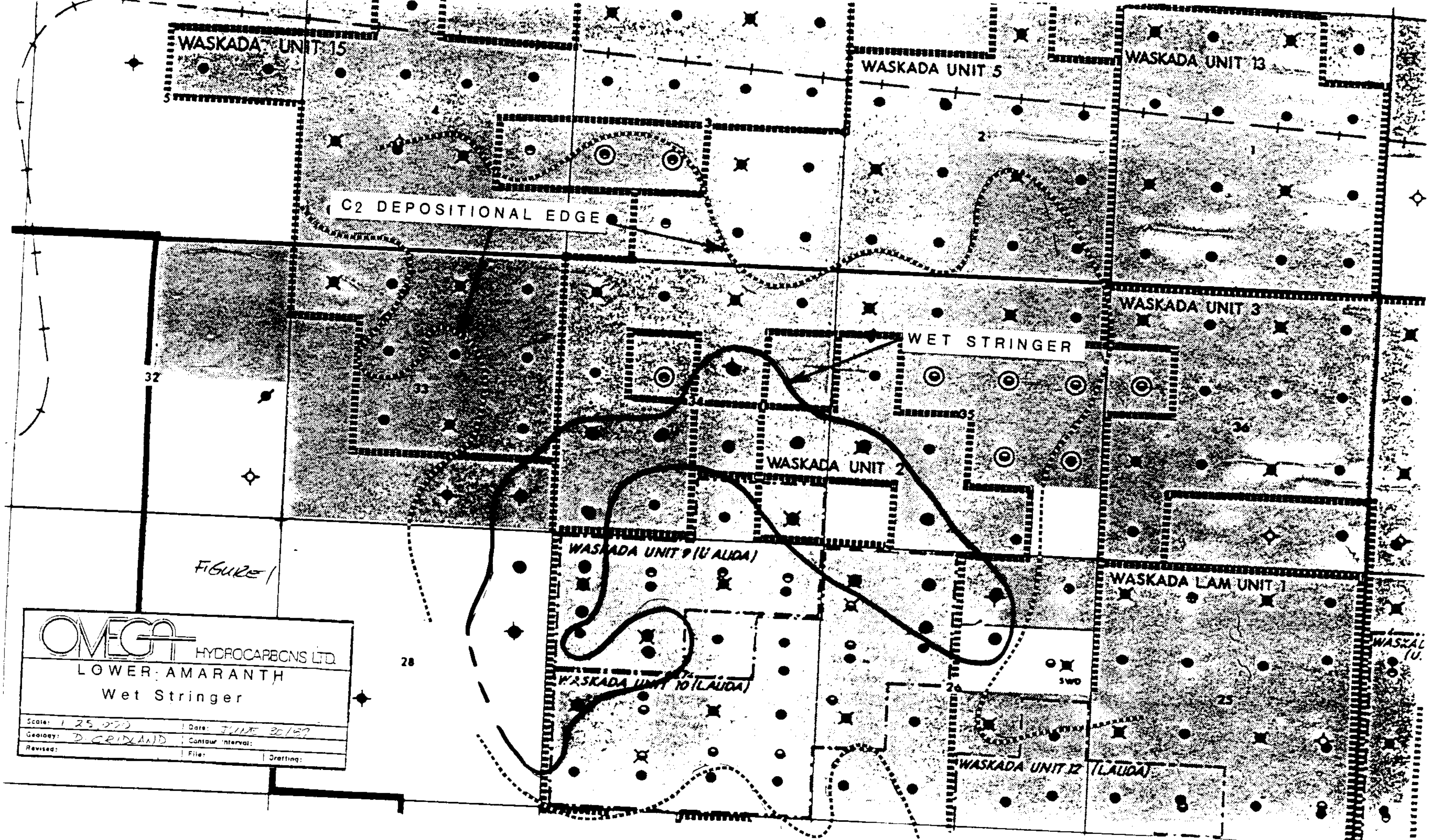
The wet stringer is occasionally found in the high porosity sands on up faulted blocks. This suggests that capillary forces are responsible for invading these zones and play a role in the areal extent of the wet stringer.

In addition to the faulted nature of the Lower Amaranth, the structurally low, down dip situation of the wet stringer suggests that communication will exist with the regional water leg. Therefore, any effort to depleat the wet stringer of water and then complete the B sands, would be futile. Also if we choose to only complete and produce from the B sand, it seems very unlikely that a fracture stimulation would stay within the zone when only a few metres of silt and shale separate the two zones.

Economic oil production from a Lower Amaranth wet stringer well would be rare and high water cuts will be expected for the entire life of the well. Therefore, Lower Amaranth wells producing within this zone and operating at a marginal rate, are candidates for abandonments.

If you have any questions or comments please come and see me.

D. Cridland D. Cridland

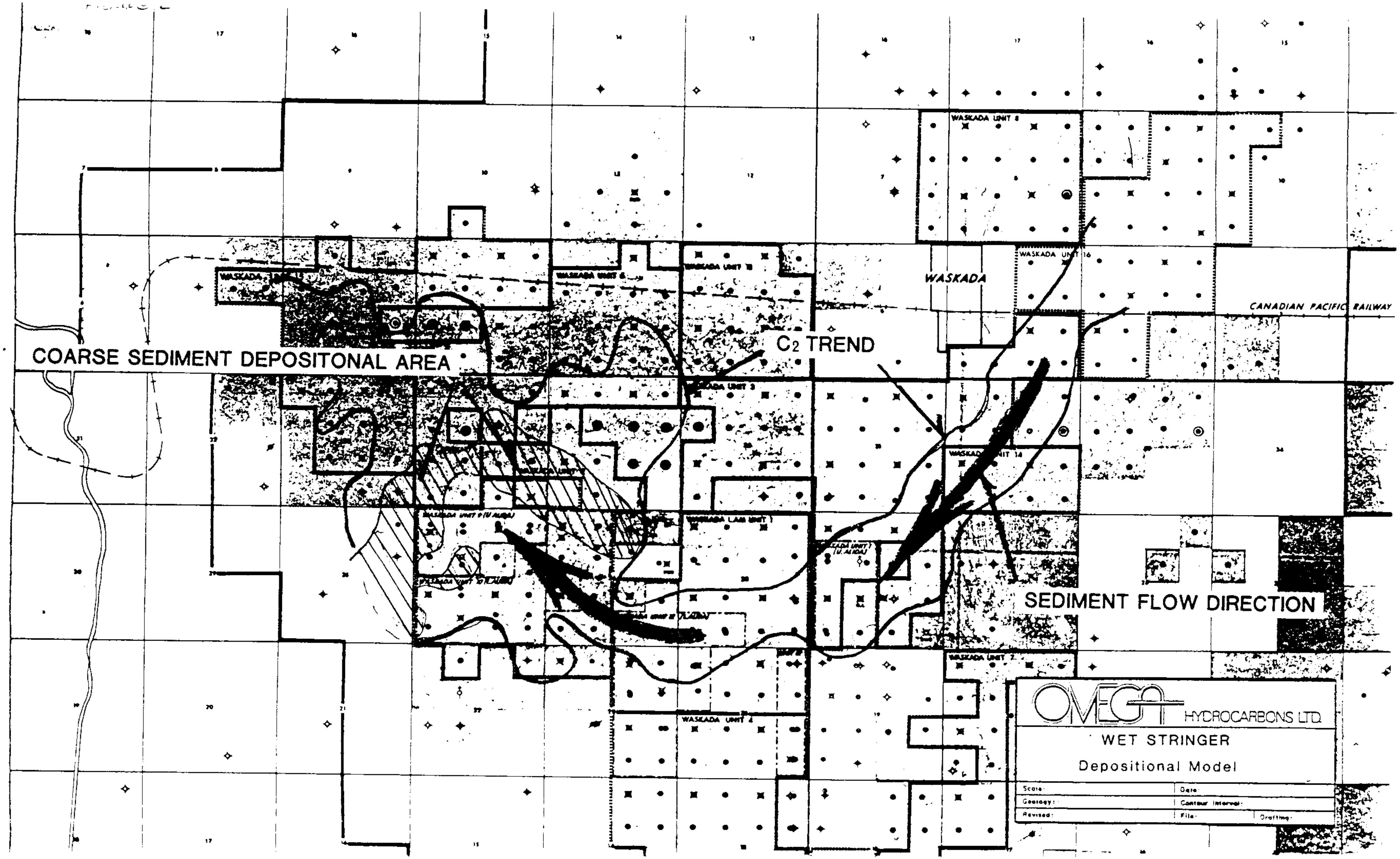


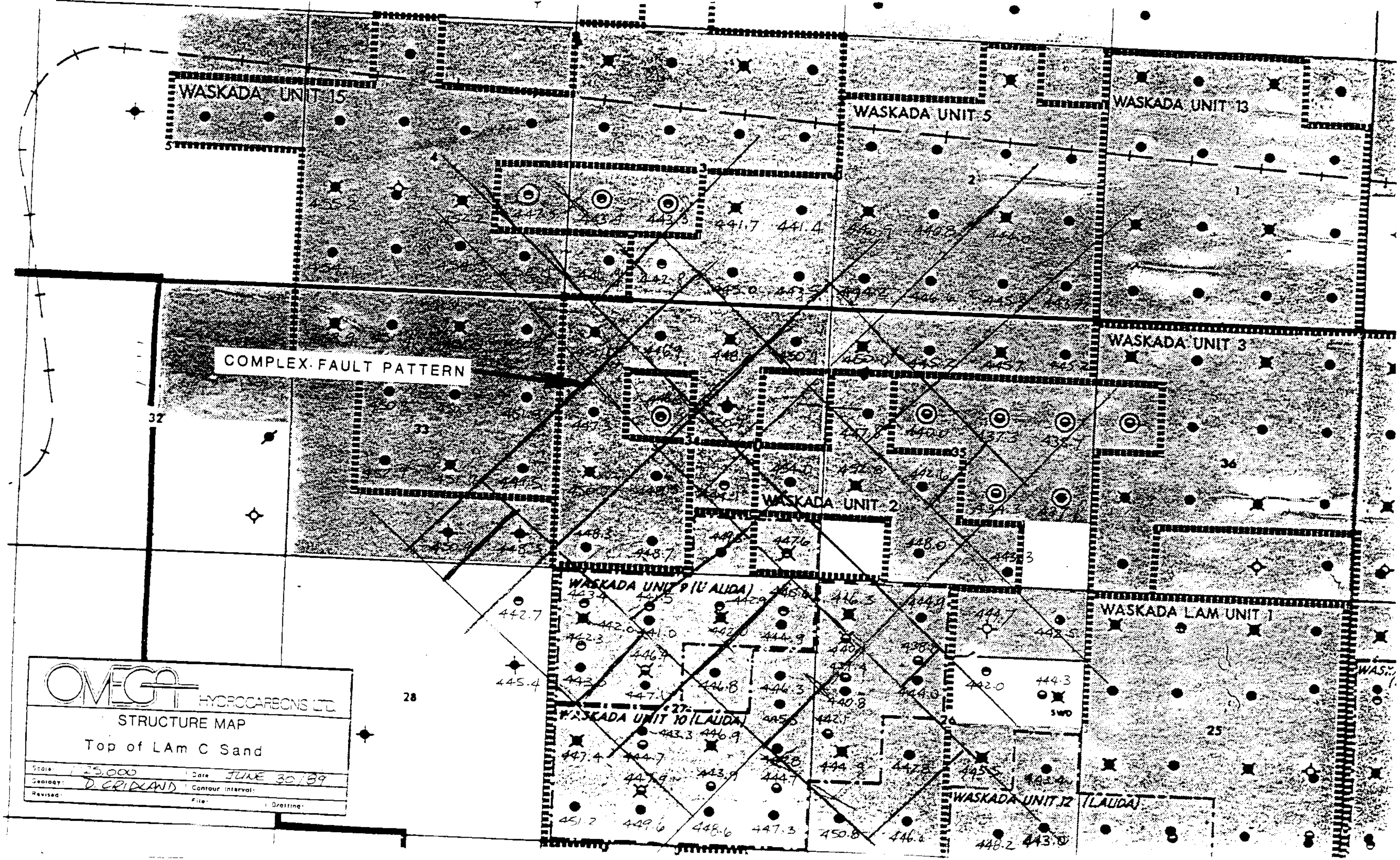
OMEGA HYDROCARBONS LTD.

LOWER AMARANTH

Wet Stringer

Scale: 1:25,000	Date: JUNE 30/87	
Geology: D. GRIDLAND	Contour Interval:	
Revised:	File:	Drafting:


COARSE SEDIMENT DEPOSITONAL AREA
C2 TREND
SEDIMENT FLOW DIRECTION
WASKADA
CANADIAN PACIFIC RAILWAY
WASKADA UNIT 8
WASKADA UNIT 16
WASKADA UNIT 14
WASKADA UNIT 7
WASKADA UNIT 4
WASKADA UNIT 3
WASKADA UNIT 6
WASKADA LAM UNIT 1
OMEGA HYDROCARBONS LTD.
WET STRINGER
Depositional Model
Scale:
Date:
Geology:
Contour Interval:
Revised:
File:
Drafting:


OMEGA HYDROCARBONS LTD.
STRUCTURE MAP
Top of LAm C Sand
Scale: 1:25,000
Date: JUNE 30/89
Geology: D. CRIDLAND
Contour Interval:
Revised:
File:
Drafting:
COMPLEX FAULT PATTERN
WASKADA UNIT 15
WASKADA UNIT 5
WASKADA UNIT 13
WASKADA UNIT 3
WASKADA UNIT 2
WASKADA UNIT 9 (L AUDA)
WASKADA UNIT 10 (LAUDA)
WASKADA UNIT 12 (LAUDA)
WASKADA LAM UNIT 1
32
33
34
35
36
28
27
26
25
SWD

M E M O R A N D U M

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c.c.: R. Dobek

TO: Richard Brekke
Gordon Cormack

FROM: David Cridland

RE: LAm C Sand Wet Stringer Review

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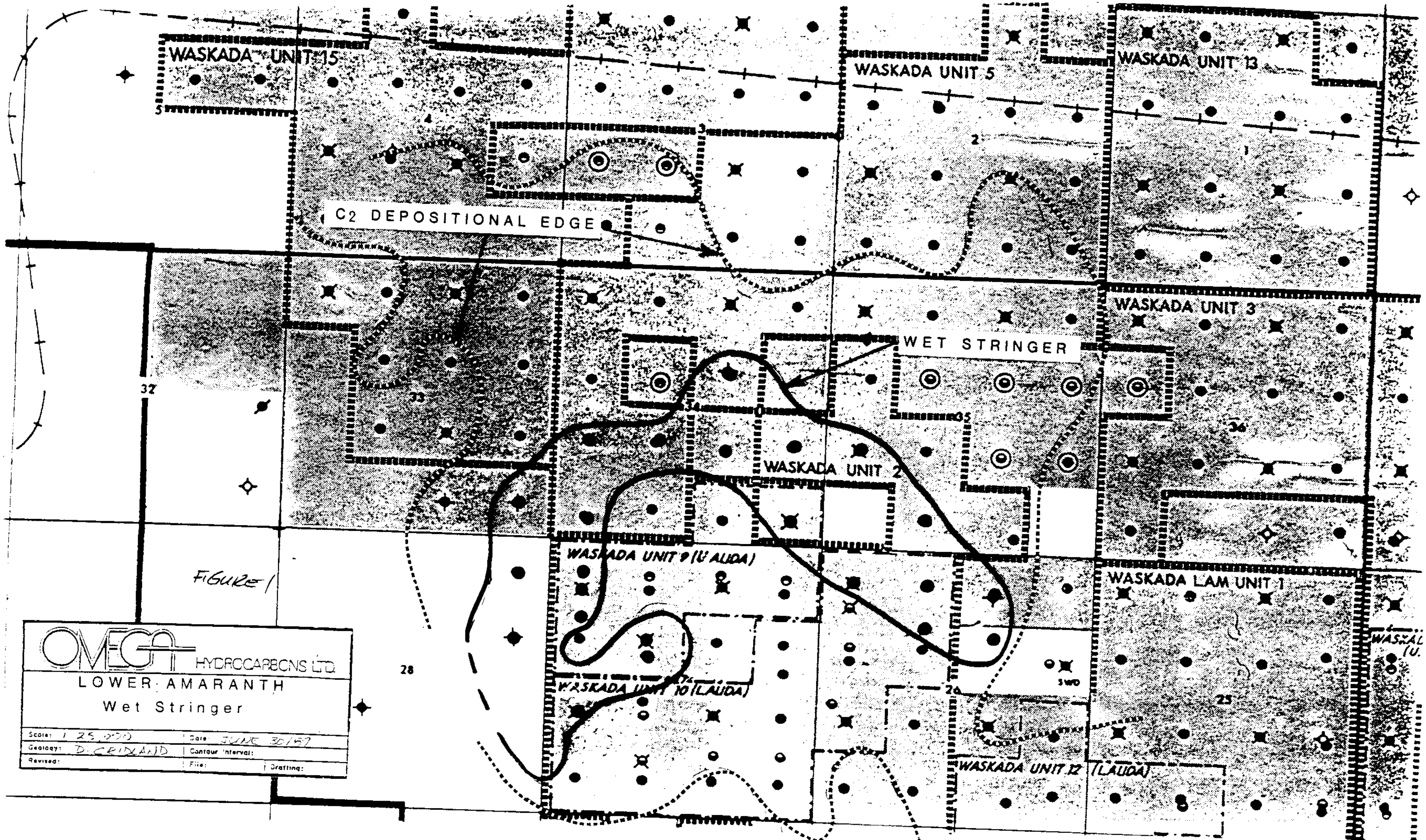

OMEGA HYDROCARBONS LTD.

LOWER AMARANTH

Wet Stringer

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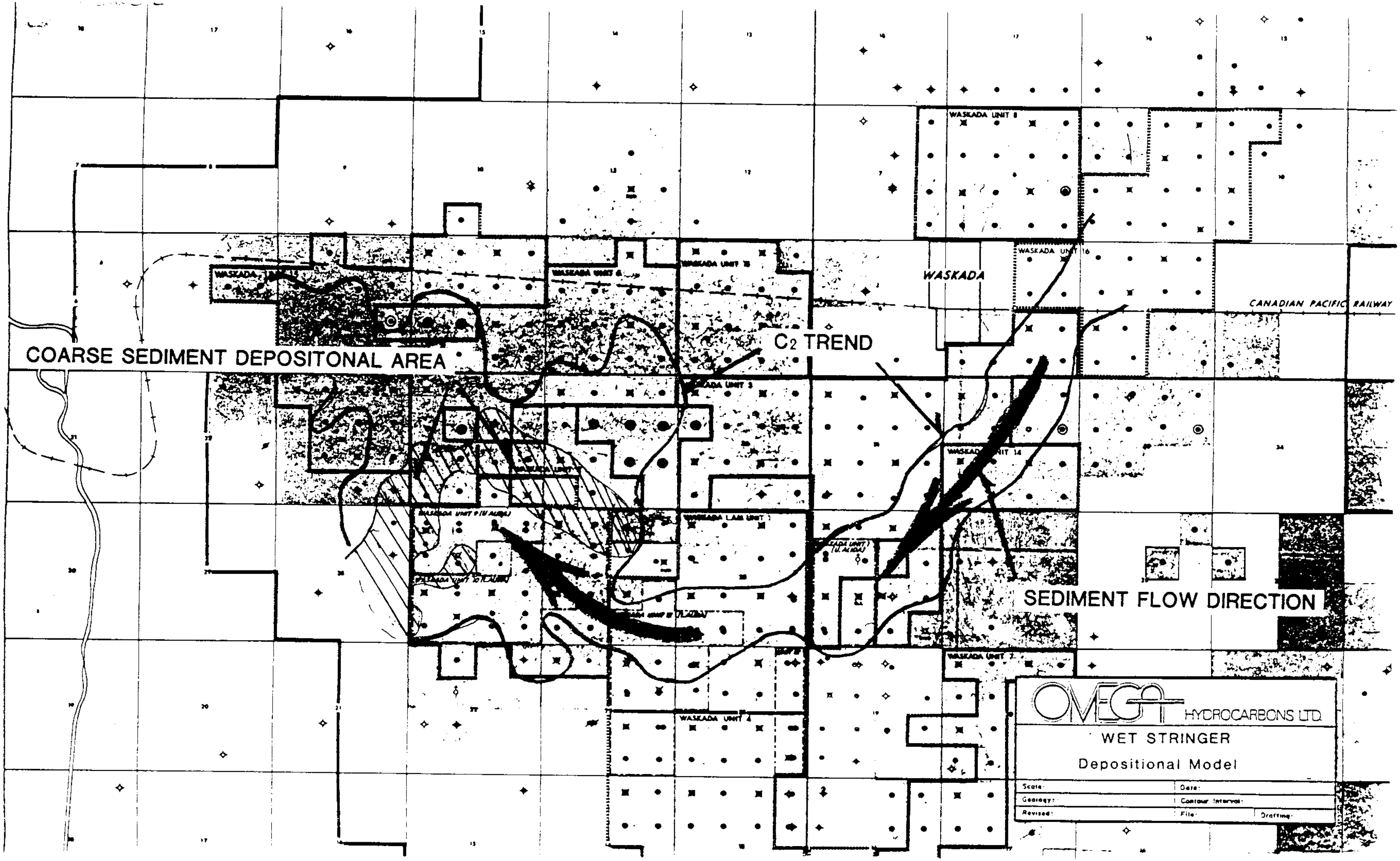
Geology: D. CRIDLAND	Contour Interval:
Revised:	File: / Drafting: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WASKADA
CANADIAN PACIFIC RAILWAY
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OMEGA HYDROCARBONS LTD.
WET STRINGER
Depositional Model
Scale:
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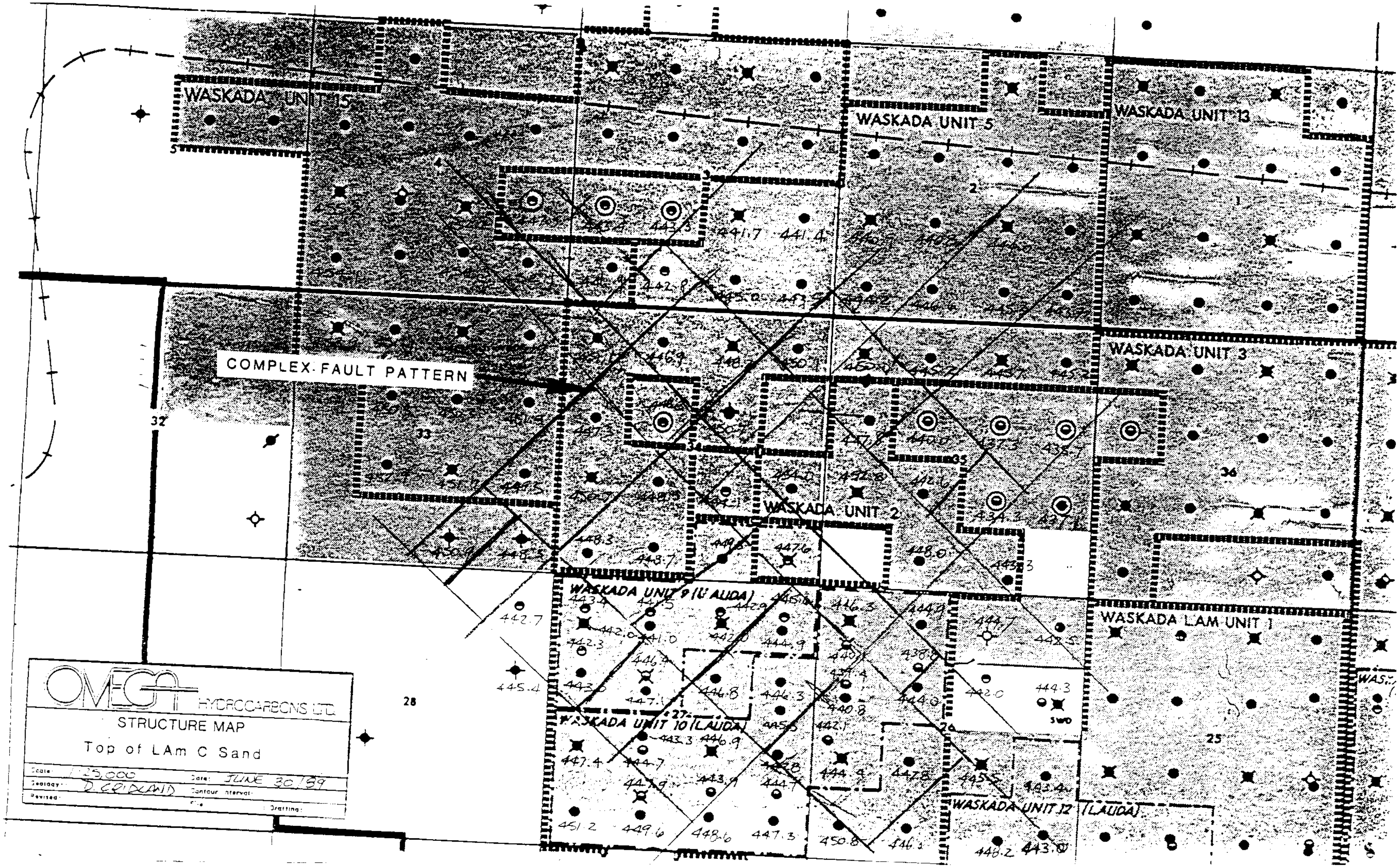
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WASKADA UNIT 10 (LAUDA)
WASKADA UNIT 12 (LAUDA)
WASKADA LAM UNIT 1

M E M O R A N D U M

DATE: August 11, 1989

TO: Gordon Cormack

FROM: Richard Brekke

RE: Waskada Unit No. 1 (U.Alida)
Gas Injection Project Review

==

The Upper Alida oil wells located in Sections 19 and 30-1-25 WPM were produced under primary depletion until a portion of the pool was unitized by Omega in June 1976. Water injection was initiated at well 6-30-1-25 WPM in April 1976 for the purpose of pressure maintenance. Significiant water breakthrough had occurred at wells 3-30, 4-30 and 5-30-1-25 WPM by December 1977. The monthly water injection volumes were reduced to minimize water cycling and injection continued until December 1983. During the time period between January 1984 and February 1986. The pool was produced without pressure maintenance. Some wells has an increase in oil productivity during this period possibly due to the recovery of oil previously swept by the producers during waterflooding. In March 1986 gas injection began at well 6-30-1-25 WPM and is still being injected at the present time for secondary recovery purposes.

Attachment 1 contains oil recovery calculations for the subject Unit at various points during its history. At present the calculated oil recovery from Waskada Unit No. 1 is approximately 60% based on current geological mapping. The non-operated oil wells in Section 19-1-25 WPM indicate similar oil recoveries which suggests that minimal oil migration has occurred within the pool. Attachment 2 illustrates that Waskada Unit No. 1 has almost reached the end of its economic life based on projected decline curves. Incremental oil recoveries under waterflooding and gasflooding are estimated to be in the order of 19% and 6%, respectively for the subject pool. It should be noted that at the initiation of the gasflood wells 3-30, 4-30 and 12-30-1-25 WPM were all producing at economic rates therefore the actual incremental recovery due to gas injection alone is likely closer to 4%. Taking into consideration the current economic environment the following future strategies are recommended,

1) Gas injection and oil production should be continued until the economic limit for each remaining well (0.5 m^3/d) has been reached. Attachment 3 contains 1989 production data for the existing producers in Waskada Unit No. 1. It may be possible to extend the pool life by reducing the mobility of the injected gas, however, any incremental oil recoveries are likely to be small thus the costs associated with implementing mobility control must be minimized. A water alternating gas injection system could be considered since it meets these criteria.

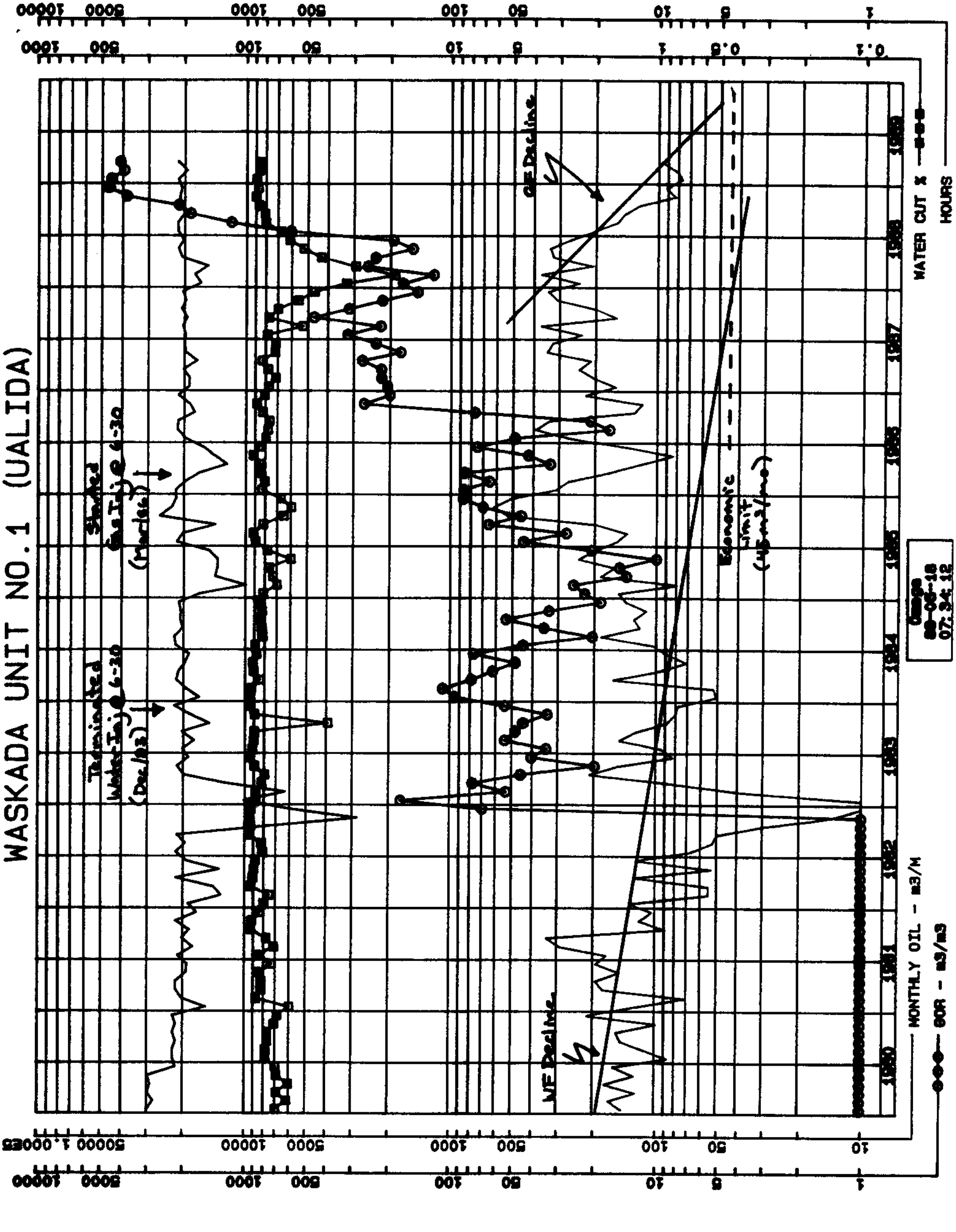
2) Based on current gas plant liquid recovery and individual well gas/oil ratios hydrocarbon stripping is presently occurring in the reservoir. When the pool reaches its economic oil production limit the project should be reevaluated to determine whether or not the liquid recoveries from gas cycling justify continued injection. If gas cycling is deemed uneconomic the excess produced gas should be flared since no other economic use is seen for the gas at this time.

c.c.: D. Boyko
D. Sharp
D. Cridland
Waskada Unit No. 1 File
Waskada Geological/Reservoir Study File

Waskada Unit No. 1(UAlida)

Historical Oil Recovery Review

Well Name	OOIP (m^3)	Oil Recovery Prior to Waterflood (75 05 30) (m^3)	Oil Recovery Prior to Gasflood (86 03 31) (m^3)	Oil Recovery to Date (89 06 30) (m^3)	Maximum Incremental Gasflood Oil Recovery (m^3)
3-30-1-25	22635.1	7395.7	14419.9	17376.3	2956.4
4-30-1-25	39812.2	7605.7	19529.4	22159.1	2629.7
5-30-1-25	27297.4	14862.4	15939.6	15939.6	Nil
6-30-1-25	15476.9	10290.3	10286.4	10286.4	Nil
11-30-1-25	16480.0	5176.0	6239.2	6239.2	Nil
12-30-1-25	21562.4	7397.4	12735.2	15102.8	2367.6
	143264.0	52727.5 (36.8% OOIP)	79149.7 (55.2% OOIP)	87103.4 (60.7% OOIP)	7953.7 (5.5% OOIP)


WASKADA UNIT NO.1 (UALIDA)
MONTHLY OIL - m3/M
GOR - m3/m3
WATER CUT %
HOURS
Terminated Water Inj @ 6-30 (Dec/83)
Started Gas Inj @ 6-30 (Mar/86)
WF Decline
GI Decline
Economic Limit (45 m3/mo)

PAGE NO. 1

*** S T O R E ***
OMEGA PRODUCTION DATA BASE
WELL (0)03-30-001-25 W1M(0)

Omega
89-08-10
10:10:45

FIELD 1
POOL 2
BLOCK 0
ACCTG 4141

PROVINCE MAN.
WORKING INTEREST 100.00000%
ON PROD 1967-12-??
ON INJN NOT ON YET

LAND01 0
LAND02 0
LAND03 0

MONTH	HOURS	OIL m3/M	WATER m3/M	GAS km3/M	OIL m3/d	WATER m3/d	FLUID m3/d	WOR	GOR m3/m3	I.WATER m3/M	I.GAS km3/M	CUM.OIL m3	CUM.WAT m3	CUM.GAS km3	C.I.WAT m3	C.I.GAS km3
1989-01	744	20.0	79.9	126.2	0.6	2.6	3.2	4.00	6310	0.0	0.0	17191.0	21033.0	1999.8	0.0	0.0
1989-02	672	23.5	84.6	124.2	0.8	3.0	3.9	3.60	5285	0.0	0.0	17214.5	21117.6	2124.0	0.0	0.0
1989-03	680	23.3	76.6	130.9	0.8	2.7	3.5	3.29	5618	0.0	0.0	17237.8	21194.2	2254.9	0.0	0.0
1989-04	719	69.5	84.7	113.9	2.3	2.8	5.1	1.22	1639	0.0	0.0	17307.3	21278.9	2368.8	0.0	0.0
1989-05	744	40.8	54.7	72.9	1.3	1.8	3.1	1.34	1787	0.0	0.0	17348.1	21333.6	2441.7	0.0	0.0
1989-06	720	28.2	30.7	76.3	0.9	1.0	2.0	1.09	2706	0.0	0.0	17376.3	21364.3	2518.0	0.0	0.0

*** S T O R E ***
OMEGA PRODUCTION DATA BASE
WELL (0)04-30-001-25 W1M(0)

FIELD 1
POOL 2
BLOCK 0
ACCTG 3

PROVINCE MAN.
WORKING INTEREST 100.00000%
ON PROD 1967-12-??
ON INJN NOT ON YET

LAND01 0
LAND02 0
LAND03 0

MONTH	HOURS	OIL m3/M	WATER m3/M	GAS km3/M	OIL m3/d	WATER m3/d	FLUID m3/d	WOR	GOR m3/m3	I.WATER m3/M	I.GAS km3/M	CUM.OIL m3	CUM.WAT m3	CUM.GAS km3	C.I.WAT m3	C.I.GAS km3
1989-01	692	44.7	421.7	219.1	1.6	14.6	16.2	9.43	4902	0.0	0.0	21950.7	50393.6	1291.1	0.0	0.0
1989-02	632	45.3	323.9	195.5	1.7	12.3	14.0	7.15	4316	0.0	0.0	21996.0	50717.5	1486.6	0.0	0.0
1989-03	744	59.1	377.6	263.2	1.9	12.2	14.1	6.39	4453	0.0	0.0	22055.1	51095.1	1749.8	0.0	0.0
1989-04	639	44.5	238.2	154.9	1.7	8.9	10.6	5.35	3481	0.0	0.0	22099.6	51333.3	1904.7	0.0	0.0
1989-05	680	34.1	218.0	123.9	1.2	7.7	8.9	6.39	3633	0.0	0.0	22133.7	51551.3	2028.6	0.0	0.0
1989-06	620	25.4	170.2	105.6	1.0	6.5	7.5	6.70	4157	0.0	0.0	22159.1	51721.5	2134.2	0.0	0.0

*** S T O R E ***
OMEGA PRODUCTION DATA BASE
WELL (0)12-30-001-25 W1M(0)

FIELD 1
POOL 2
BLOCK 0
ACCTG 4140

PROVINCE MAN.
WORKING INTEREST 100.00000%
ON PROD 1967-12-??
ON INJN NOT ON YET

LAND01 0
LAND02 0
LAND03 0

MONTH	HOURS	OIL m3/M	WATER m3/M	GAS km3/M	OIL m3/d	WATER m3/d	FLUID m3/d	WOR	GOR m3/m3	I.WATER m3/M	I.GAS km3/M	CUM.OIL m3	CUM.WAT m3	CUM.GAS km3	C.I.WAT m3	C.I.GAS km3
1989-01	712	11.7	119.4	0.8	0.4	4.0	4.4	10.21	68	0.0	0.0	15037.0	8606.6	149.3	0.0	0.0
1989-02	632	12.6	93.5	0.4	0.5	3.6	4.0	7.42	32	0.0	0.0	15049.6	8700.1	149.7	0.0	0.0
1989-03	714	13.7	103.9	0.7	0.5	3.5	4.0	7.58	51	0.0	0.0	15063.3	8804.0	150.4	0.0	0.0
1989-04	670	6.7	56.1	0.6	0.2	2.0	2.2	8.37	90	0.0	0.0	15070.0	8860.1	151.0	0.0	0.0
1989-05	720	15.6	121.0	1.2	0.5	4.0	4.6	7.76	77	0.0	0.0	15085.6	8981.1	152.2	0.0	0.0
1989-06	677	17.2	125.0	1.0	0.6	4.4	5.0	7.27	58	0.0	0.0	15102.8	9106.1	153.2	0.0	0.0

M E M O R A N D U M

DATE: May 3, 1989

TO: G.A. Cormack

FROM: D.M. Boyko

RE: Lower Alida Production Optimization

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As a result of the thorough geological review of the Lower Alida pools in the Waskada field, an overall examination of the production performance was performed. This included estimating original reserves in place in these pools on an individual well basis as well as calculating the percent recovery to date. The calculations as well as the structure and øh mapping for the different Lower Alida pools are attached. Wells with low recoveries with significant reserves have been identified and remedial work is being recommended in these cases. Following is a discussion of each pool's performance and workover recommendations.

AREA A

This pool includes wells 7-35, 8-35, 9-35, 10-35, 11-35 and 12-36-1-26 WPM. At this time all of these wells are commingled. This pool has considerable structure as the difference in elevation between the highest well and the original oil/water contact is approximately 16 meters. To date the total pool recovery is only 5% of the reserves in place. This recovery is quite low as all of these wells except for 8-35 have been on production for almost 6 years. The only well that has an acceptable recovery is 12-36 at 17%. It is believed that this recovery is due to a large acid job that was performed. In order to increase the production on the other wells in this pool stimulation is recommended. Since acidizing is significantly less expensive than hydraulic fracturing, a large acid job (5.0 m^3) is suggested. Following an evaluation of the results of acidizing, additional stimulation can then be considered if necessary. It should also be noted that wells 7-35 and 11-35 have a shot density of only 7 SPM and increasing this density should be considered.

AREAS B & C

This area basically includes Unit No. 10 . The present recovery from this area is approximately 18% which is quite acceptable. Recoveries from wells 5-26, 11-26 and 12-26-1-26 WPM are low, however fluid rates from these wells are high indicating that there is not a problem with inflow on these wells. (Wells 5-26 and 12-26 were fraced in 1988). It is believed that the large amount of water that is being produced is from the water injection that occurred at wells 3-27 and 11-27. Well 3-27 was converted to a Lower Amaranth producer in November 1988. Well 11-27 has been converted to a Lower Alida producer in order to drain some of the excess injected water. The result of this effort will determine whether it is worth while to recomplete the 12-27

(LAm) well as it is presently thought that this well may be saturated with water that was injected into the Lower Alida zone. Also consideration should be given to the fact that this well is only 1 meter above the original oil/water contact before this well is recompleted. At this time the strategy recommended for this area is to continue to produce as is and monitor the oil production on the watered out wells.

AREA D

This is the largest Lower Alida pool for both area and reserves. Wells that are exhibiting low recoveries include 14-13, 1-23, 7-23, 10-23, 15-23, 3-24, 5-24, 6-24, 12-24, 13-24, 1-25, 4-25, 1-26, 2-26 and 8-26-1-26 WPM. In the area, wells 1-23, 9-24, 12-24, 4-25 and 1-26 are commingling candidates and all except 4-25 have been programmed and AFE'd to be recompleted. Well 4-25 has been given a parakleen treatment order to increase the Lower Amaranth production. Wells 14-13, 3-24, 5-24, 6-24, 13-24, 1-25, 2-26 and 8-26-1-26 WPM are contingent on the results of the commingled wells. Wells 13-24 and 1-25-1-26 WPM have both had cement squeezes performed. As yet, there has not been an increase in oil production. Additional work on these wells will depend on the success of the commingled wells each is contingent on. Well 7-23-1-26 has been reviewed and it has been determined that it does not have potential in the Lower Alida due to a poor completion. Well 15-23-1-26 has been converted from an injector to a producer with the expectation that it will begin to produce oil as the excess injected water is drained. Well 1-24 was originally a producer but was converted to a water injector prior to a thorough review of this area. As this well has been determined to be structurally higher than most of the surrounding wells, it is recommended that this well be converted back to a production well or its offset 1-24-1-26 (LAm) be commingled. It should be noted that the Lower Amaranth well has a significantly higher Lower Alida ϕh value (0.31 vs. 0.05). Well 10-23-1-26 WPM has a low fluid inflow and has been suspended for the last while. It is suggested that this well be acidized in order to increase production.

AREA E

This area is a single well pool with well 10-30-1-25 WPM. This well has produced a substantial amount of oil. Its recovery is quite high at approximately 30% and it is believed that the well is nearing it ultimate recovery. It is felt that this well is in communication with the Upper Alida zone and as a result it is producing the gas that is being injected at 6-30-1-25 WPM. Its present GOR is 885 m^3/m^3. The similiarity of the gas analysis between the gas injected and produced also supports the case for the existence of communication between zones at this wellbore. This well also has an excellent Lower Amaranth zone as do a number of wells in this area. Since the strategy for these other locations are contingent upon the success of the Lower Amaranth at this well, it is recommended that this zone be tested and possibly commingled.

AREA F

This area is also a small pool with only two wells in it. Well 9-36-1-26 WPM was originally in the Lower Alida and produced for 1 year prior to recompleting the Lower Amaranth. The average oil production from this zone was 2.0 m^3/d. Well 5-31-1-26 WPM is presently a Lower Amaranth water injector. This well has been AFE'd to temporarily recomplete the Lower Alida in order to test its productivity. Based on the results, well 9-36-1-26 WPM may be recommended for commingling.

AREA K

Area K is a new area. Well 9-32-1-25 WPM has just recently been commingled in the L.Amaranth and L.Alida zones. Well 8-32-1-25 WPM was originally completed in the L.Alida and was making 1.5 m^3/d of oil before being recompleted in the L.Amaranth. Well 8-32-1-25 WPM has been AFE'd to be commingled and this work is expected to occur shortly. Pending a successful test on 8-32, wells 1-32 and 2-32 could be recommended as commingling candidates as well.

Should you have any questions regarding this review please contact me.

c.c.: R.A. Bekke
R.T. Dobek
D.A. Cridland
W. Sharp
Waskada Reservoir Study

AREA A

LOWER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	RECOVERED (M3)	PERCENT RECOVERY
7-35-1-26	20.0	0.87	61.7	1.15	57949.6	1809.9	3.1
8-35-1-26	16.0	0.76	57.0	1.15	45467.8	575.6	1.3
9-35-1-26	16.0	0.61	44.7	1.15	46932.9	3751.1	8.0
10-35-1-26	16.0	1.00	44.8	1.15	76800.0	3748.3	4.9
11-35-1-26	20.0	0.94	41.8	1.15	95144.3	4328.0	4.5
12-36-1-26	16.0	0.24	42.5	1.15	19200.0	3309.2	17.2
					=========	=========	
					341494.6	17522.1	5.1

AREA B & C

LOWER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	RECOVERED (M3)	PERCENT RECOVERY
5-26-1-26	6.0	0.76	48.0	1.15	20619.1	2885.7	14.0
11-26-1-26	8.0	0.74	47.0	1.15	27283.5	2220.4	8.1
12-26-1-26	8.0	0.65	63.2	1.15	16640.0	1413.2	8.5
1-27-1-26	8.0	0.07	55.7	1.15	2157.2	2008.6	93.1
2-27-1-26	10.0	0.05	38.5	1.15	2673.9	2180.9	81.6
3-27-1-26	6.0	0.14	53.0	1.15	3433.0	1111.1	32.4
6-27-1-26	16.0	0.32	35.3	1.15	28805.6	8030.7	27.9
11-27-1-26	10.0	0.07	54.0	1.15	2800.0	2567.3	91.7
12-27-1-26	8.0	0.18	50.5	1.15	6198.3	0.0	0.0
* 9-28-1-26	16.0	0.17	47.3	1.15	12464.7	0.0	0.0
					=========	=========	
					123075.3	22417.9	18.2

* - DENOTES NON-OPERATED WELL

AREA D

LOWER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	OIL RECOVERED (M3)	PERCENT RECOVERY
* 4-19-1-25	16.0	0.35	70.7	1.15	14267.8	0.0	0.0
* 6-19-1-25	16.0	0.23	47.8	1.15	16704.0	5968.6	35.7
* 11-19-1-25	12.0	NDE	0.0	1.15	0.0	0.0	ERR
14-13-1-26	12.0	0.26	43.0	1.15	15464.3	0.0	0.0
1-23-1-26	16.0	0.33	58.7	1.15	18962.1	0.0	0.0
7-23-1-26	12.0	0.41	55.0	1.15	19252.2	222.5	1.2
8-23-1-26	12.0	0.65	52.8	1.15	32013.9	4044.4	12.6
10-23-1-26	16.0	0.30	49.2	1.15	21203.5	1956.8	9.2
14-23-1-26	16.0	0.01	51.0	1.15	681.7	0.0	0.0
15-23-1-26	16.0	0.61	54.0	1.15	39168.0	312.7	0.8
1-24-1-26	12.0	0.18	53.0	1.15	8827.8	3813.3	43.2
3-24-1-26	12.0	0.12	51.0	1.15	6135.7	0.0	0.0
5-24-1-26	8.0	0.57	61.4	1.15	15305.7	0.0	0.0
6-24-1-26	8.0	0.16	38.0	1.15	6900.9	0.0	0.0
8-24-1-26	12.0	0.15	53.7	1.15	7247.0	6185.7	85.4
9-24-1-26	8.0	0.06	39.0	1.15	2546.1	688.7	27.0
12-24-1-26	16.0	0.62	55.0	1.15	39067.8	247.6	0.6
13-24-1-26	16.0	0.60	54.0	1.15	38400.0	2769.6	7.2
1-25-1-26	12.0	0.90	36.7	1.15	59447.0	3737.4	6.3
2-25-1-26	12.0	0.12	60.0	1.15	5008.7	987.6	19.7
3-25-1-26	12.0	1.10	40.6	1.15	68180.9	5822.0	8.5
4-25-1-26	16.0	0.51	38.2	1.15	43851.1	933.9	2.1
1-26-1-26	16.0	0.28	42.7	1.15	22322.1	80.6	0.4
2-26-1-26	12.0	0.48	50.0	1.15	25043.5	0.0	0.0
8-26-1-26	12.0	0.52	49.5	1.15	27401.7	0.0	0.0
					==================		
					553403.5	37771.4	6.8

* - DENOTES NON-OPERATED WELL

AREA E

LOWER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	OIL RECOVERED (M3)	PERCENT RECOVERY
10-30-1-25	20.0	0.42	48.3	1.15	37943.3	11217.8	29.6
					==================		
					37943.3	11217.8	29.6

AREA F

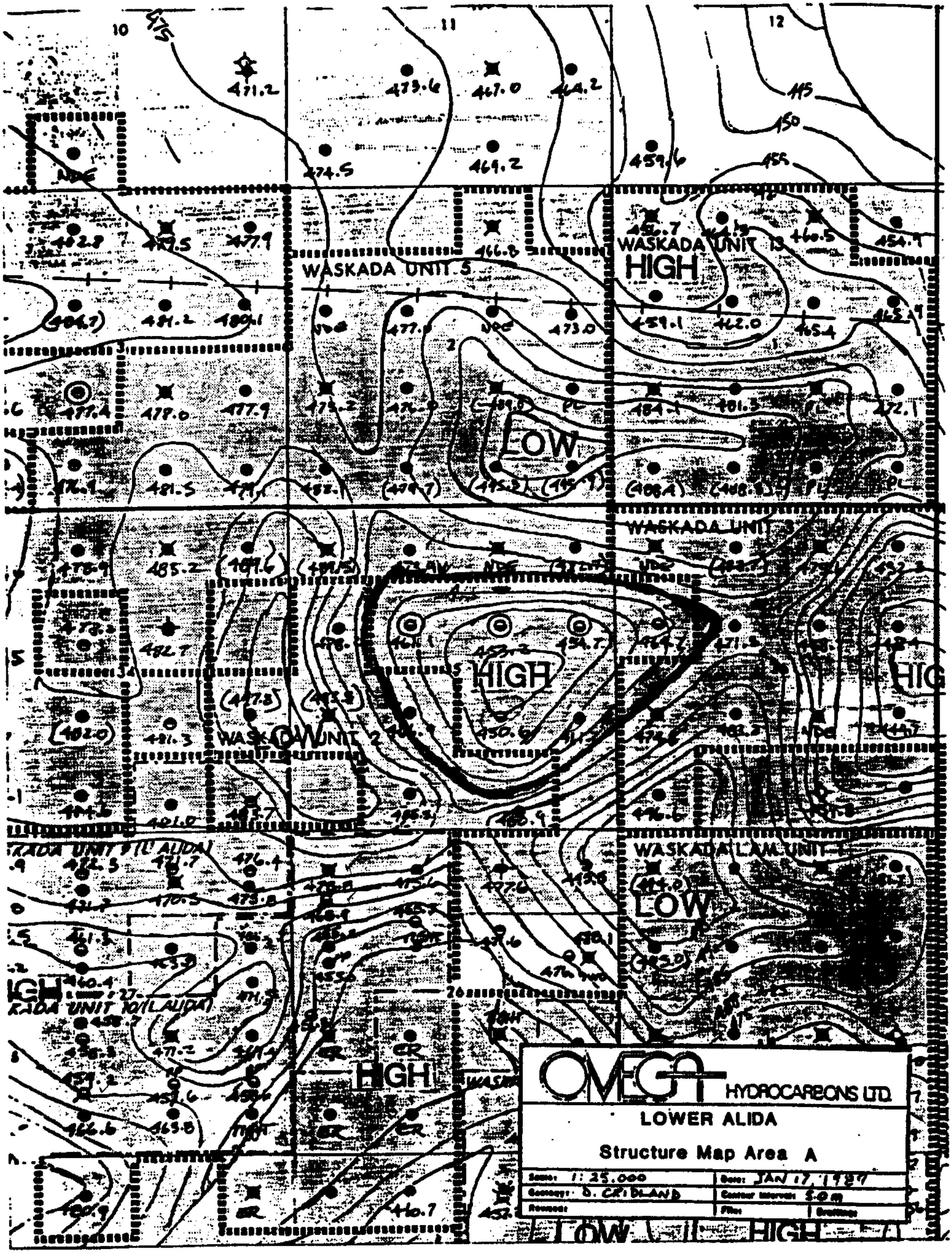
LOWER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	OIL RECOVERED (M3)	PERCENT RECOVERY
5-31-1-25	16.0	0.22	27.0	1.15	22039.7	0.0	0.0
9-36-1-26	10.0	0.12	46.0	1.15	5540.9	807.9	14.6
					==================		
					27580.5	807.9	2.9

AREA K

LOWER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	OIL RECOVERED (M3)	PERCENT RECOVERY
1-32-1-25	16.0	0.30	59.7	1.15	16820.9	0.0	0.0
2-32-1-25	12.0	0.25	51.0	1.15	12782.6	0.0	0.0
8-32-1-25	16.0	0.31	53.0	1.15	20271.3	333.5	1.6
9-32-1-25	12.0	0.38	53.0	1.15	18636.5	153.5	0.8
					68511.3	487.0	0.7



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Date: JAN 17 1987
Contour Interval: 5.0 m
Revised:
File:
Drafting:
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HIGH
LOW
10
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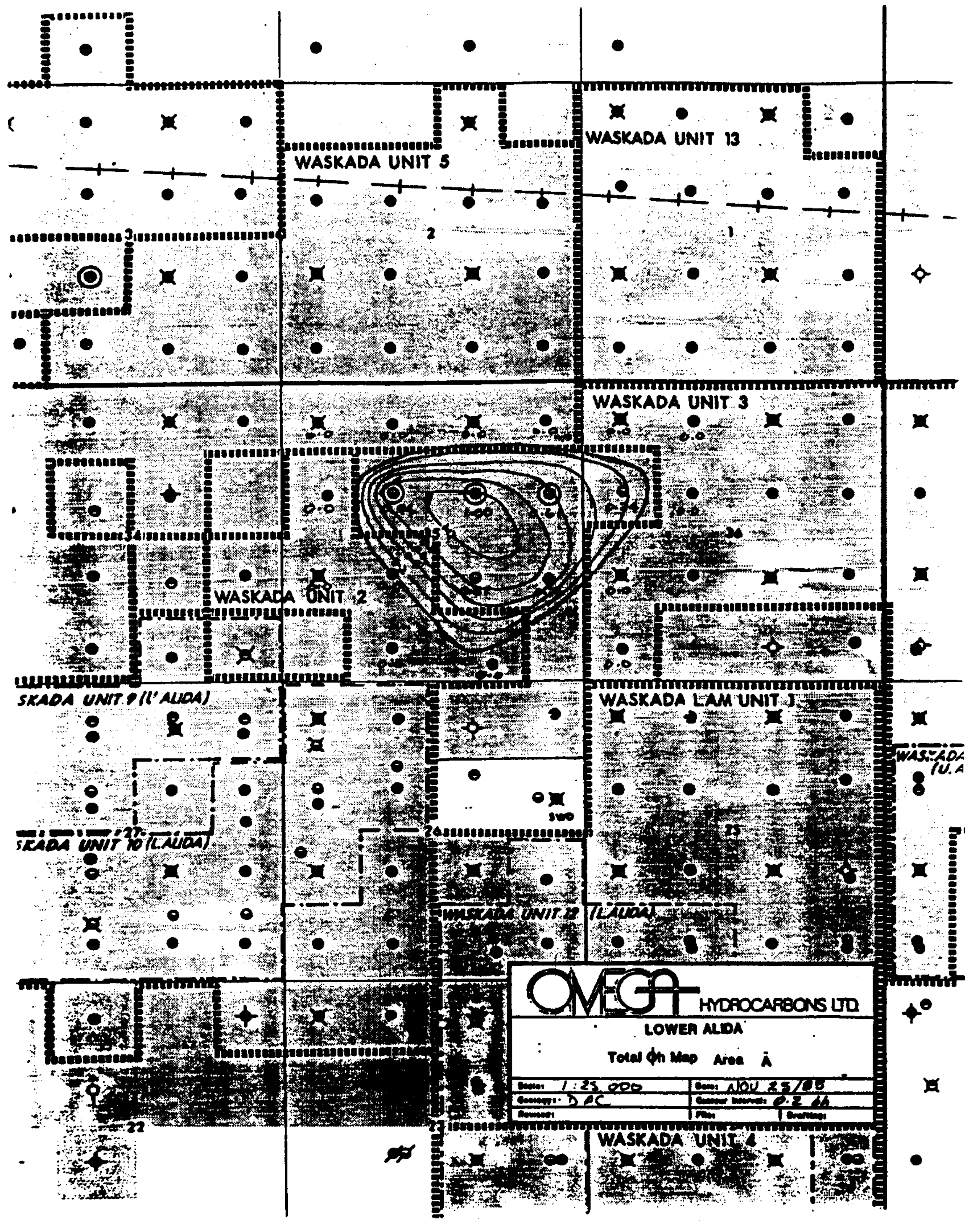
12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WASKADA UNIT 12 (L. ALIDA)
WASKADA UNIT 4
SWD
OMEGA HYDROCARBONS LTD.
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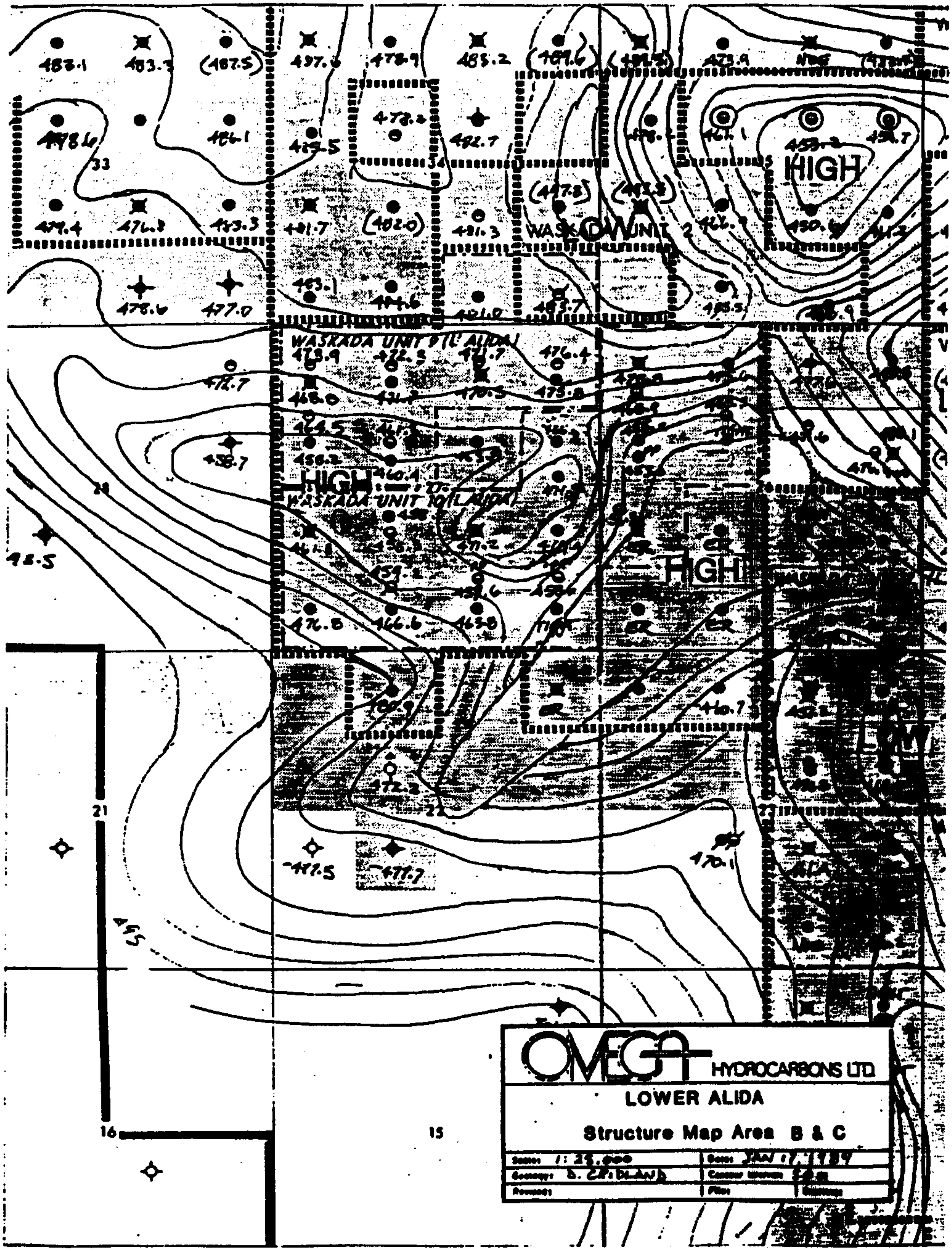
OMEGA HYDROCARBONS LTD.
LOWER ALIDA
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JAN 17, 1989
D. CRIDLAND
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HIGH
HIGH
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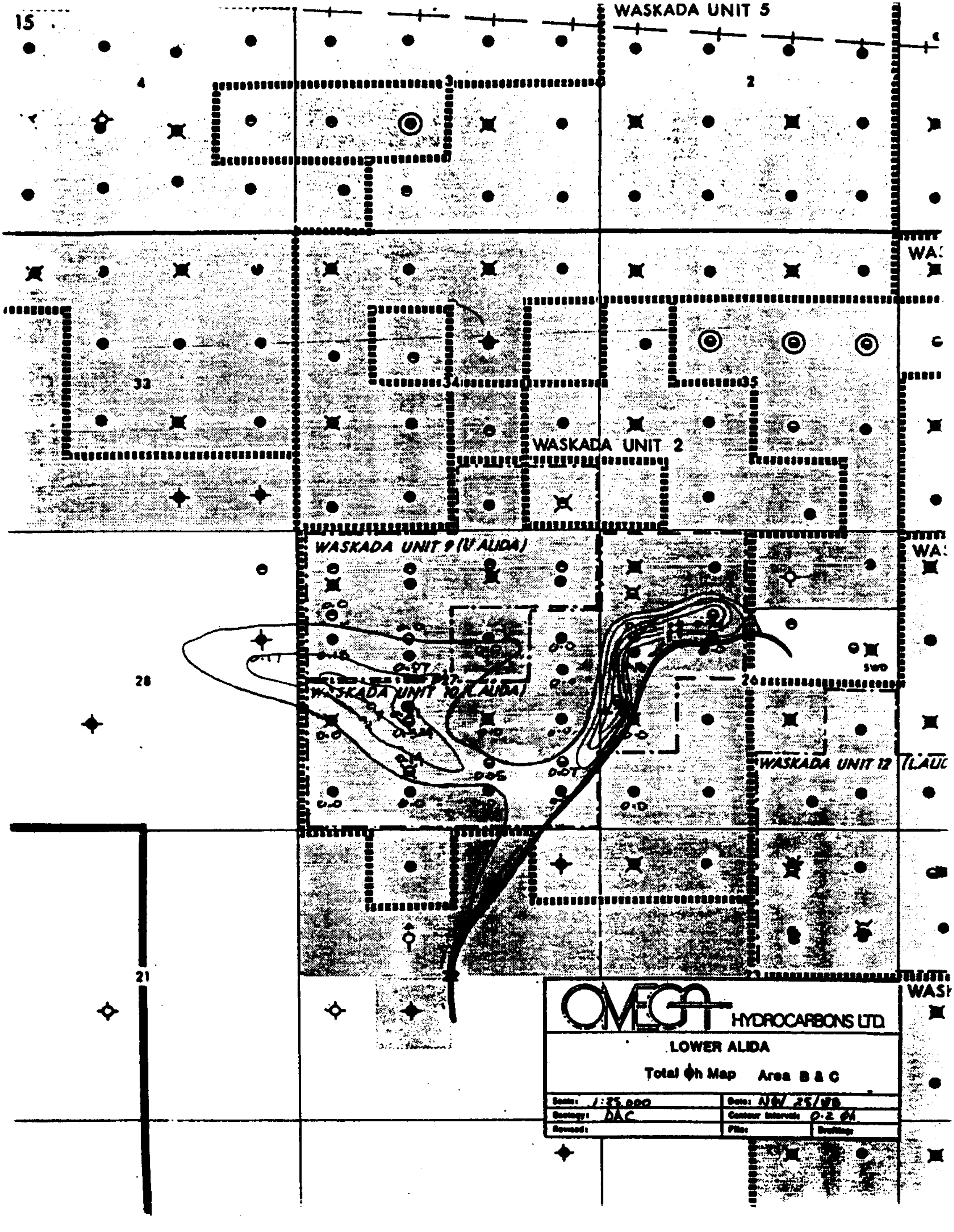
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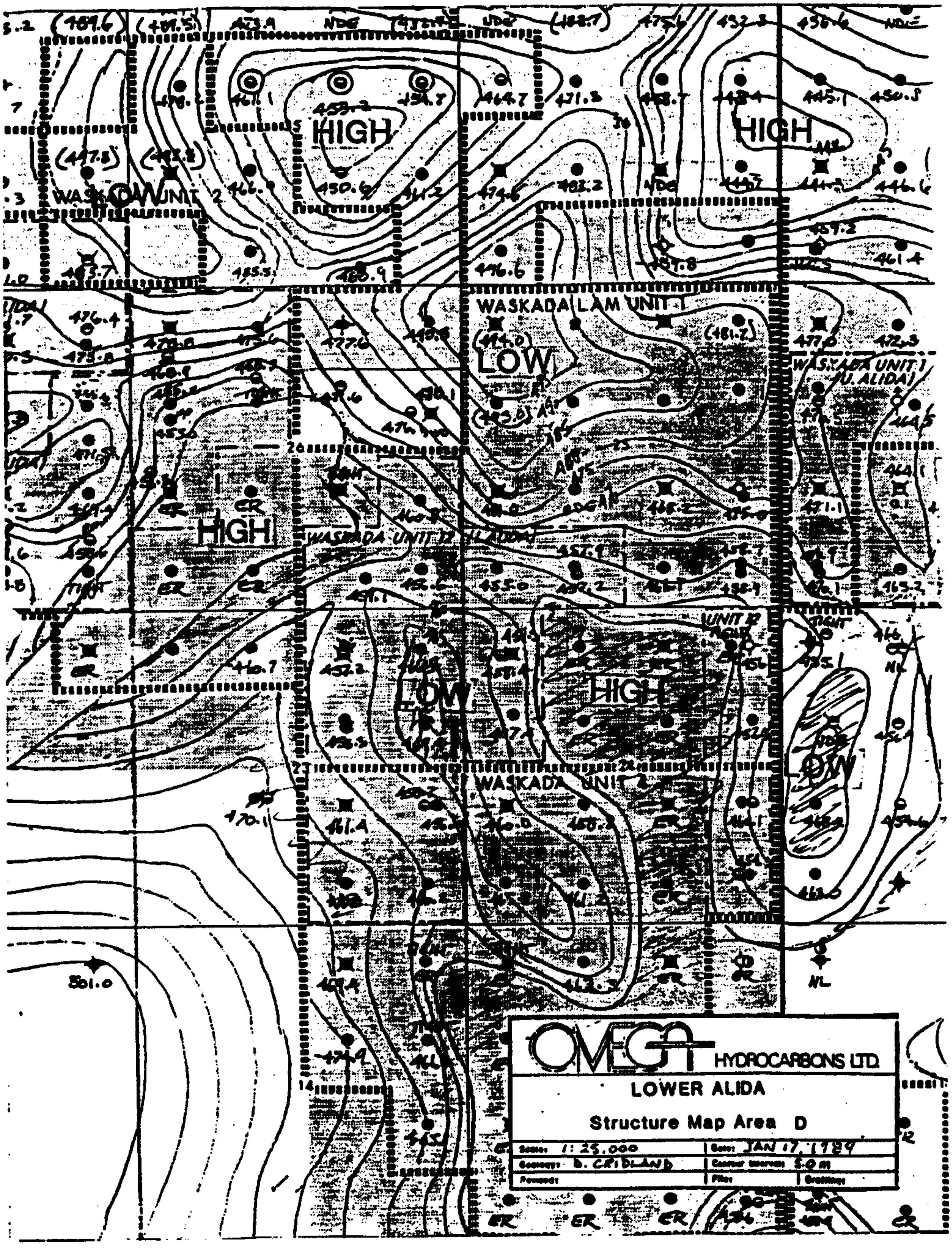
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LOWER ALIDA
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JAN 17, 1989
D. CRIDLAND
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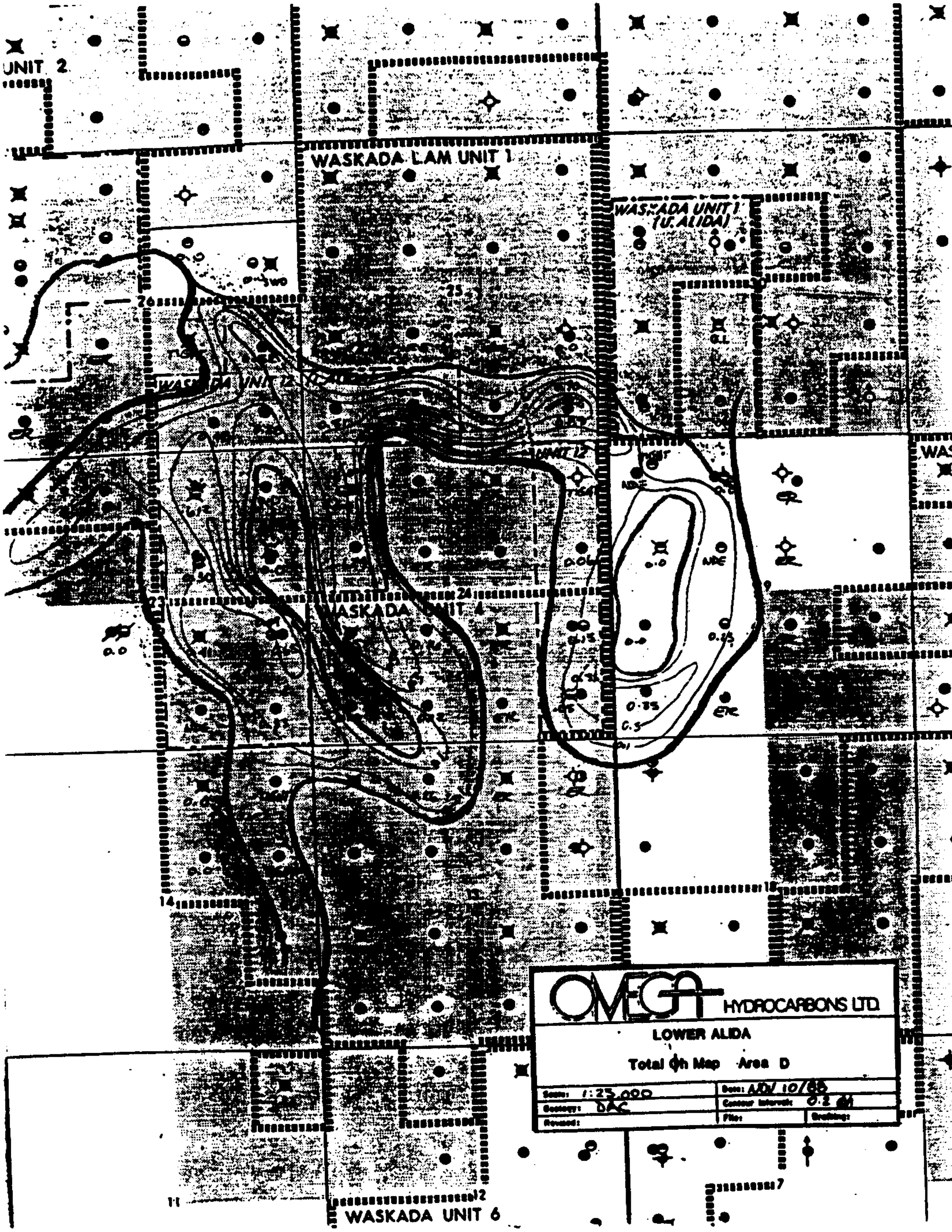

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UNIT 12
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LOWER ALIDA
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Revised:
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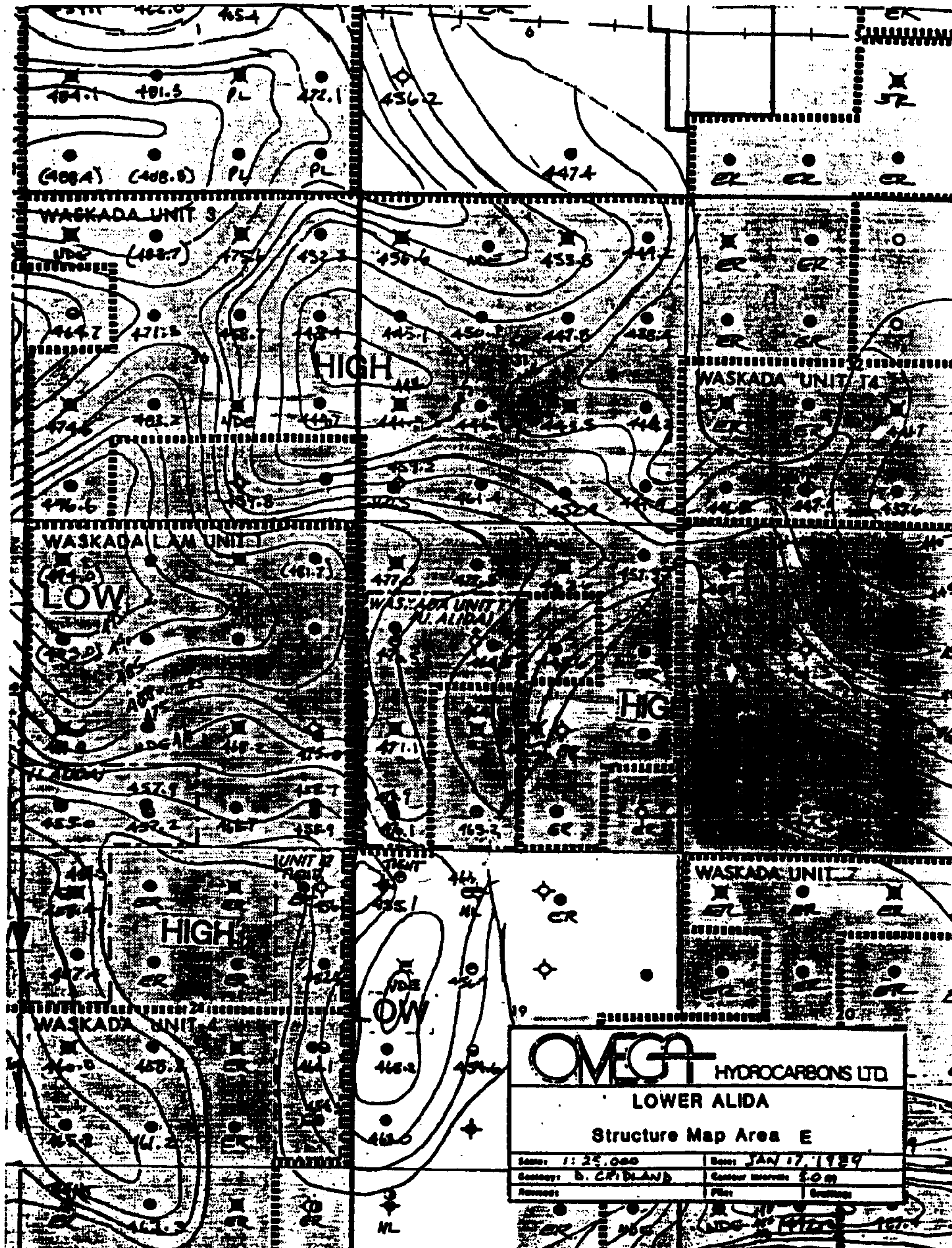
Drafting: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LOWER ALIDA
Structure Map Area E
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JAN 17, 1989
D. CRIDLAND
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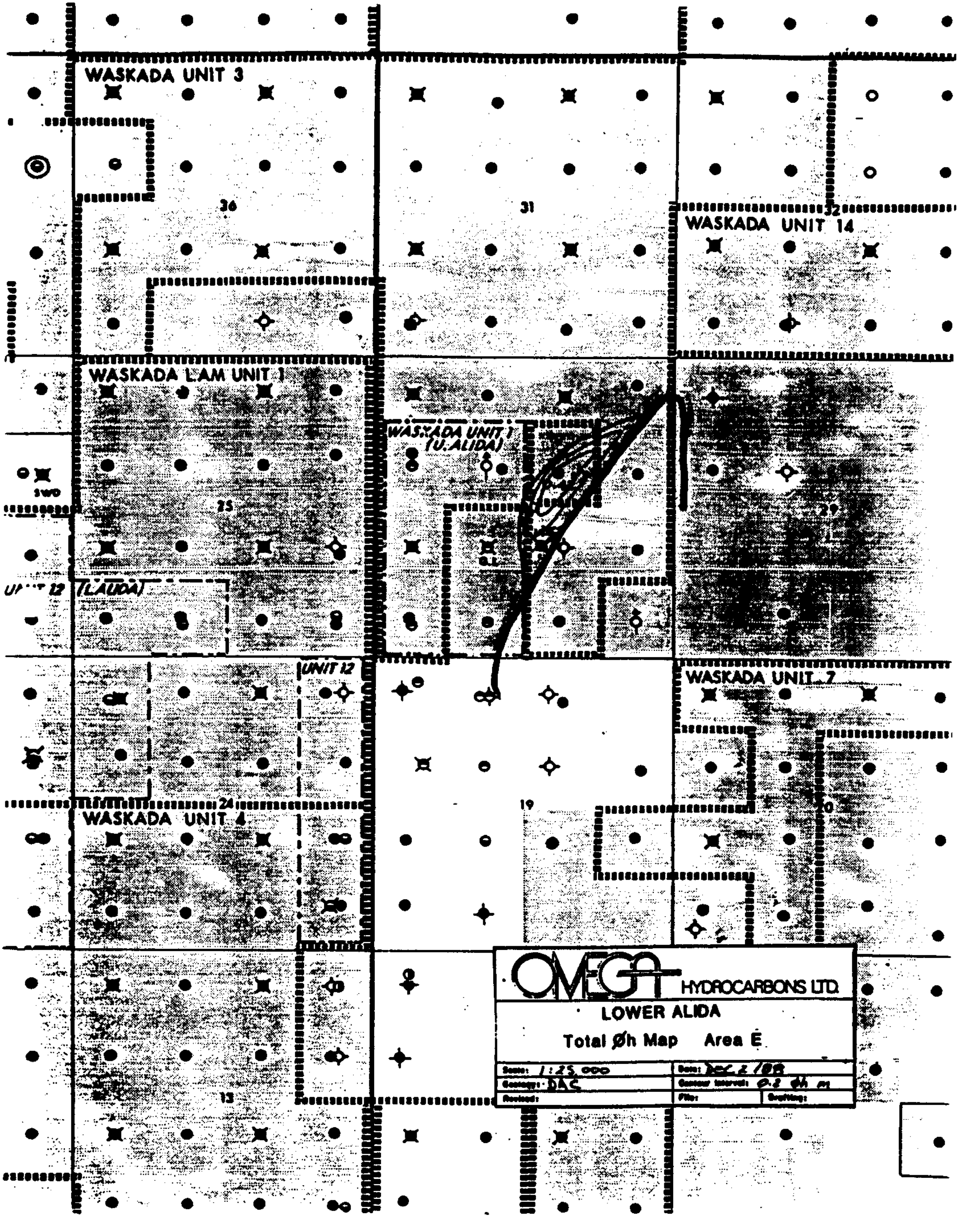
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(U. ALIDA)
SWD
25
29
(L.ALIDA)
UNIT 12
WASKADA UNIT 7
24
19
20
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OMEGA HYDROCARBONS LTD.
LOWER ALIDA
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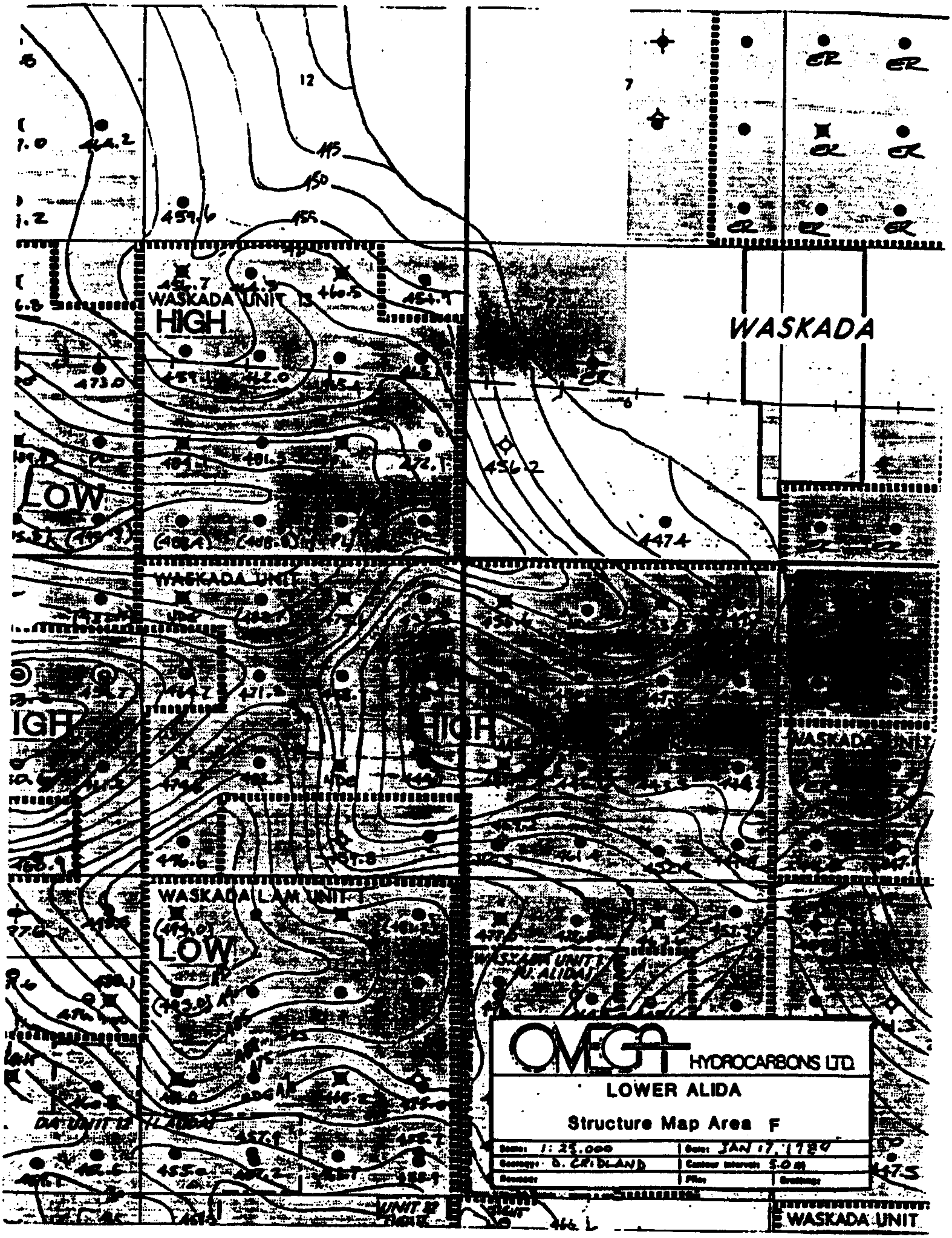
Revised:
File:
Drafting: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WASKADA LAM UNIT 1
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OMEGA HYDROCARBONS LTD.
LOWER ALIDA
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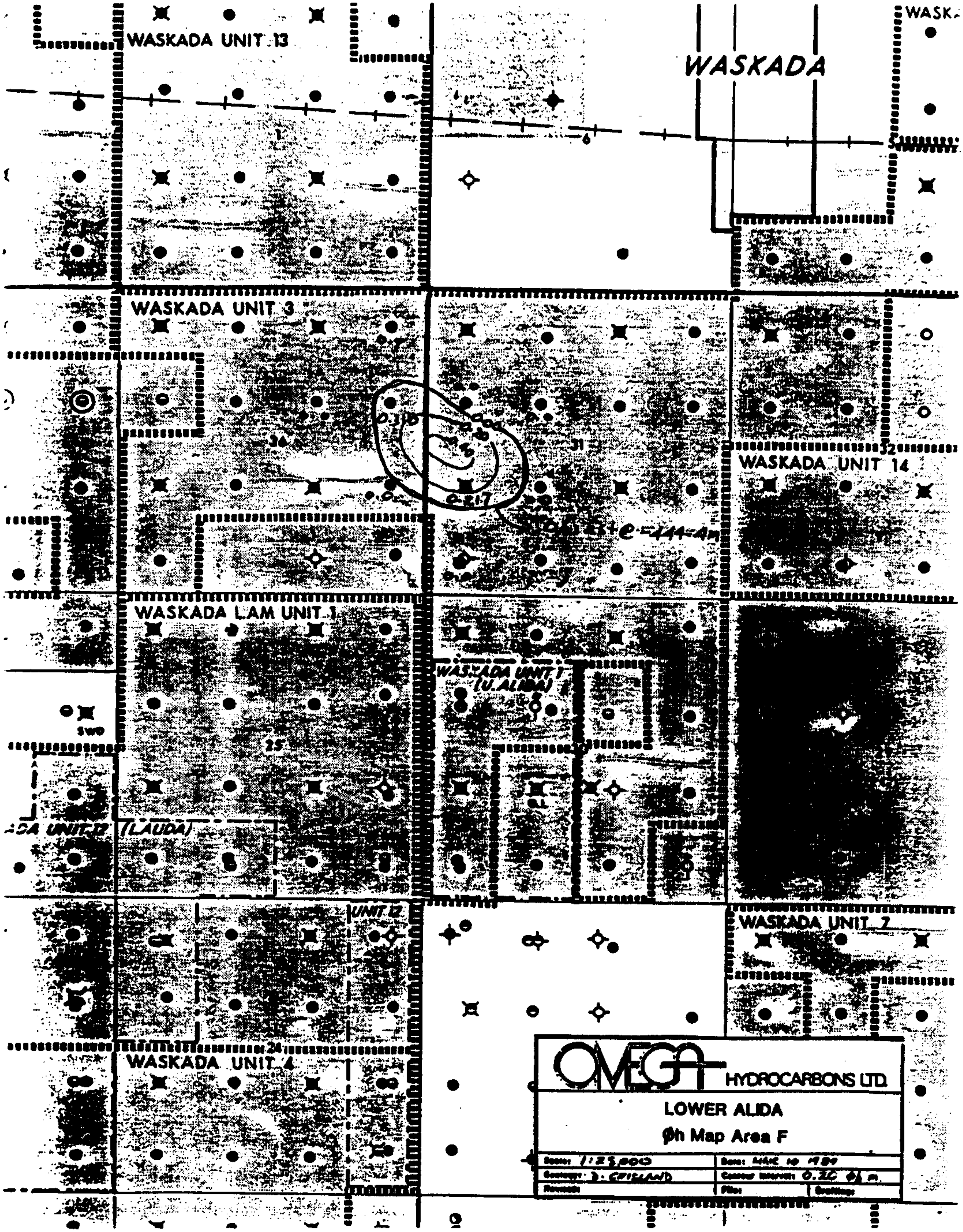
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SWD
UNIT 12 (LAUDA)
UNIT 12
WASKADA UNIT 7
WASKADA UNIT 4
OMEGA HYDROCARBONS LTD.
LOWER ALIDA
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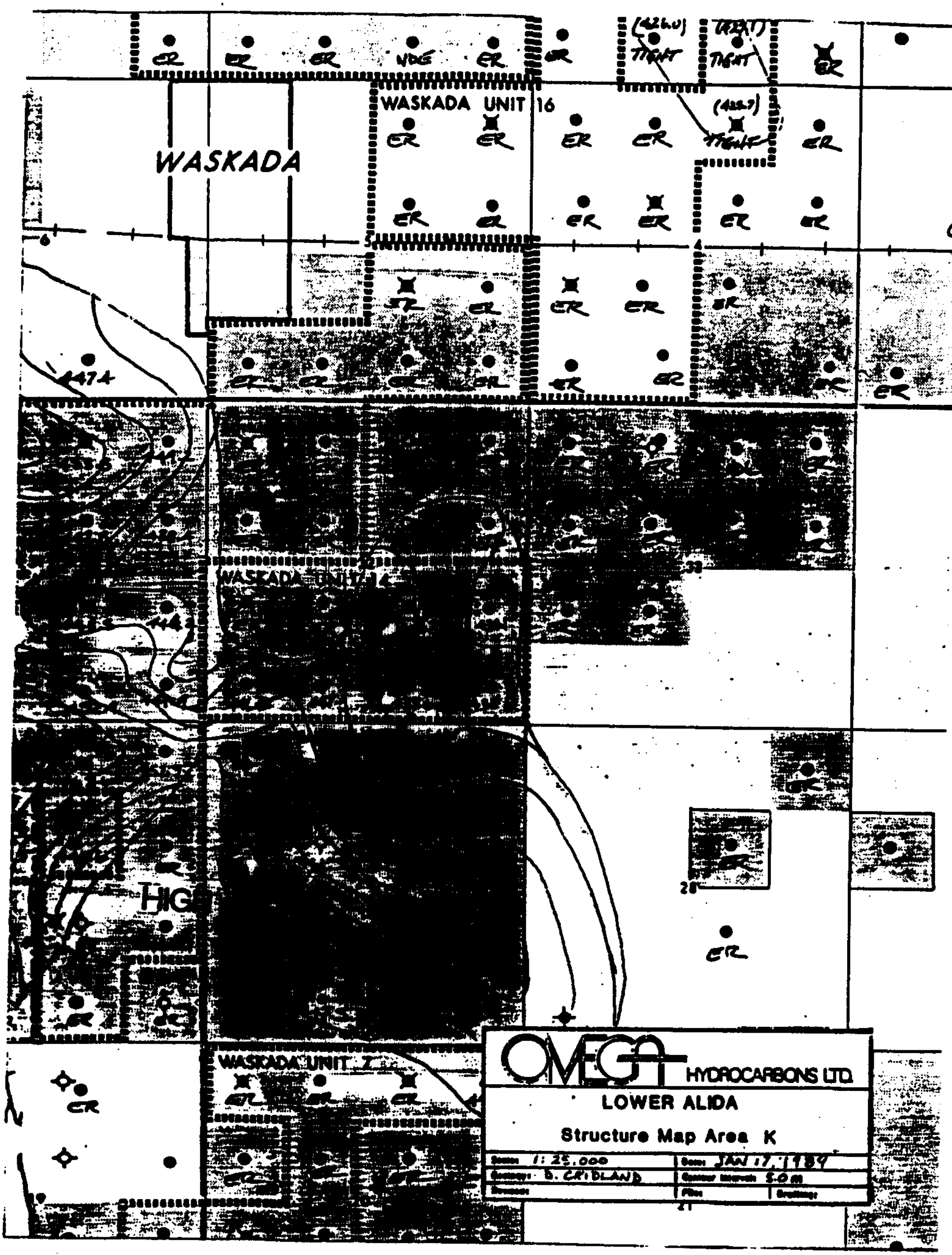
Geology: D. CRISLAND
Contour Interval: 0.20 Øh m.



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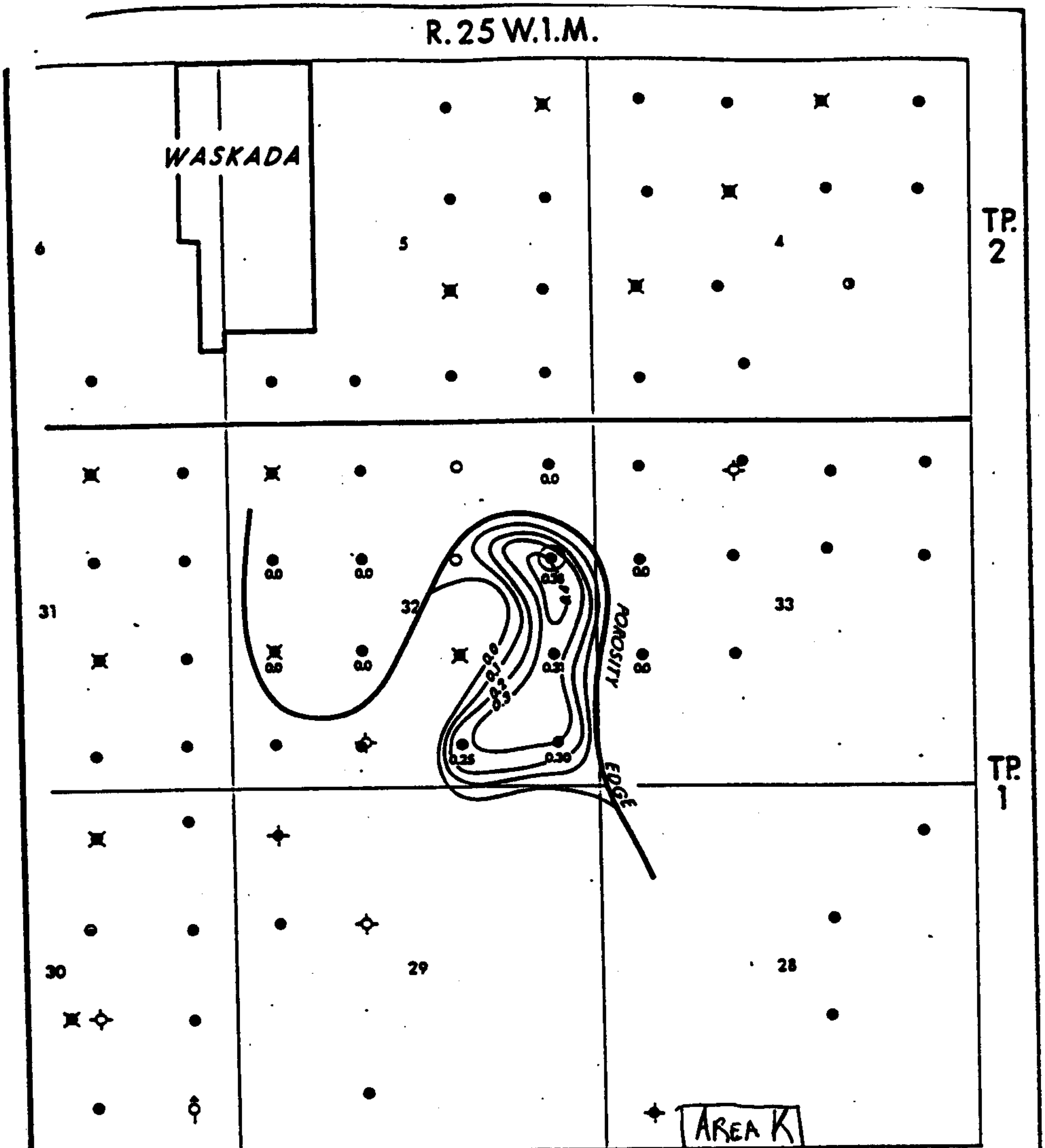
WASKADA UNIT 14
WASKADA UNIT 7
ER
NDG
TIGHT
1474
OMEGA HYDROCARBONS LTD.
LOWER ALIDA
Structure Map Area K
1:25,000
JAN 17, 1989
D. CRIDLAND
5.0 m



- ◉ Proposed Commingled Well
- ● SPEAR FISH OIL WELL
- UPPER ALIDA(MC 3b) WELL
- LOWER ALIDA(MC3a) WELL
- TILSTON(MC1) WELL
- WATER INJECTION WELL
- WATER SOURCE WELL
- SUSPENDED WELL
- ABANDONED WELL

Schedule "C" Attachment 1c

OMEGA HYDROCARBONS LTD.

WASKADA, MN.
Lower Alida(MC3a) ϕh Map

Scale: 1:25,000	Date: JAN. 25, [illegible]		
[illegible] D. [illegible]	Contour interval: 0.1 ϕh		
[illegible]	[illegible]	[illegible]	[illegible]

MEMORANDUM

DATE: December 14, 1988

TO: G.A. Cormack

FROM: D.M. Boyko

RE: <u>Waskada Upper Alida Optimization Review</u>

==

Recently a geological reveiw of the Upper Alida (MC3b) pools in the Waskada field was performed. The review included structure mapping original oil water contacts, water saturations and Øh mapping. This has allowed for the estimation of reserves and pool recoveries based on production to date. This has also allowed for the development of a production strategy for the different pools in order to optimize production. The following is a production review of the different pools which include the Øh maps and the reserves calculations.

Area D includes 3 wells, 5-25 (Omega), 9 and 10-26-1-26 WPM (Enron). This pool is essentially a one well pool as only 10-26 exhibits a signficant Øh value and hence is the only well assigned significant reserves. (Figure #1, Table #1). As expected recovery from an Upper Alida pool is approximately 30%, it appears that there is only a small amount of incremental oil left to recover. It is therefore recommended that no work be done in this area.

Area E includes 12-27,13-27,13A-27,14-27,14A-27,15-27,15A-27,16-27,16A-27 and 16-28-1-26 WPM. All of these wells are operated by Omega except 16-28 which is operated by Enron (Figure #2). Recovery to date in this pool is approximately 21% (Table #2). Based on this it is felt that there is still some significant oil production left to recover. The Upper Alida zone in the L. Amaranth wells in this area is higher structurally than in the Upper Alida well. Since there is a potential for water encroachment from the north, optimizing production from the Upper Alida is suggested as follows.

- Well 13-27 (MC3b) should be suspended. Its counterpart, 13A-27 (LAm), should be cement squeezed in the Lower Amaranth zone and be recompleted in the Upper Alida.

- Well 14-27 (MC3b) should be reviewed as it does not seem to have optiminum inflow. Its counterpart 14A-27 (LAm) is presently producing 2.4 m^3/D of oil and is thus recommended that nothing be done on it.

- Well 15-27 (MC3b) should be suspended. Its counterpart, 15A-27 (LAm), should be cement squeezed in the Lower Amaranth zone and completed in the Upper Alida zone.

- Well 16-27 (MC3b) should be suspended. Its counterpart, 16A-27 (LAm), should be tested in the Upper Alida zone in order to compare production against its counterpart.

Area F includes all indicated by Figure #3 and listed on Table #3. The best well in this pool is 5-3-2-26 WPM. The overall recovery from this pool is low at only 11%. This suggests that there is potential in this area and thus the following wells have been suggested for workovers.

- Well 7-34-1-26 WPM is not producing the fluid it should be capable of. It is recommended that it be reperfed and acidized in order to optimize production.

  Well 14-34-1-26 is presently a Lower Amaranth well and has potential in the Upper Alida zone. It is recommended that the Upper Alida zone be completed and this well be commingled.

- Well 3-3-2-26 is an Upper Alida well. It was originally completed in the Lower Amaranth zone. Presently it is making all water due to a 5T ultravis fracture and poor cement bond. It is suggested that a circulation cement squeeze be performed in order to shut off the communication. The Upper Alida zone would then have to be reperf and acidized in order to restore production.

- Well 13-3-2-26 is presently a Lower Amaranth injection well. It exhibits a lower Øh value but might be considered as an injector/producer candidate.

- Well 8-4-2-26 is currently a U. Alida producer. It has an excellent Lower Amaranth zone and is in the process of being commingled.

Area G is the old Unit I with the inclusion of the Tundra wells in section 19 (Figure #L). The original OOIP for this area estimated to be approximately 265,000 m^3. To date 143,318 m^3 or over 50% of the reserves have been recovered (Table #4). This indicates that this area is approaching its recovery limit. Based on this, the following strategy is put forward.

- Well 3-30 is exhibiting gas breakthrough as its GOR has been increasing dramatically since July and is presently over 4000 m^3/m^3. However, this well has an excellent L. Amaranth zone and its oil productivity is estimated to be 3.0 m^3/d. It is recommended that the Upper Alida zone be suspended and the L. Amaranth be completed.

- Well 4-30 (LAm) was completed in the L. Amaranth with a 27 tonne polyemulsion frac. This well has a caprock thickness of 3 meters. As this well is also showing some signs of gas breakthrough, (GOR = 500) it is thought that this may be due to the size of the fracture. Thus it is recommended that the L. Amaranth zone be cement squeezed in order to prevent communication between the U. Alida and L. Amaranth zones and suspended.

- Well 4-30 (MC3b) is definitely indicating gas breakthrough. This well has a L. Amaranth zone which is better than 4-30 (LAm) well. It is recommended that a bridge plug be set above the U. Alida zone and the well be completed in the L. Amaranth zone.

- Well 5-30 is presently a LAm injection well. This well has produced almost 16,000 m^3 of oil before it watered out. It is believed that there is little potential left in the U. Alida zone. Thus it is recommended that nothing be done on this well.

- Well 6-30 is presently a gas injector. It has an excellent L.Amaranth zone. The suggested strategy for this well is to recomplete in the L. Amaranth based upon the results of 3-30 and 10-30-1-25 WPM.

- Well 11-30 (LAm) has poor porosity in the U. Alida and is at the same structure as the gas injection well 6-30-1-25 WPM. Thus it is recommended that nothing be done on this well.

- Well 11-30 (Source well) has extremely bad casing with a number of packers downhole. It is recommended to abandon this well if it is not needed as a water source well.

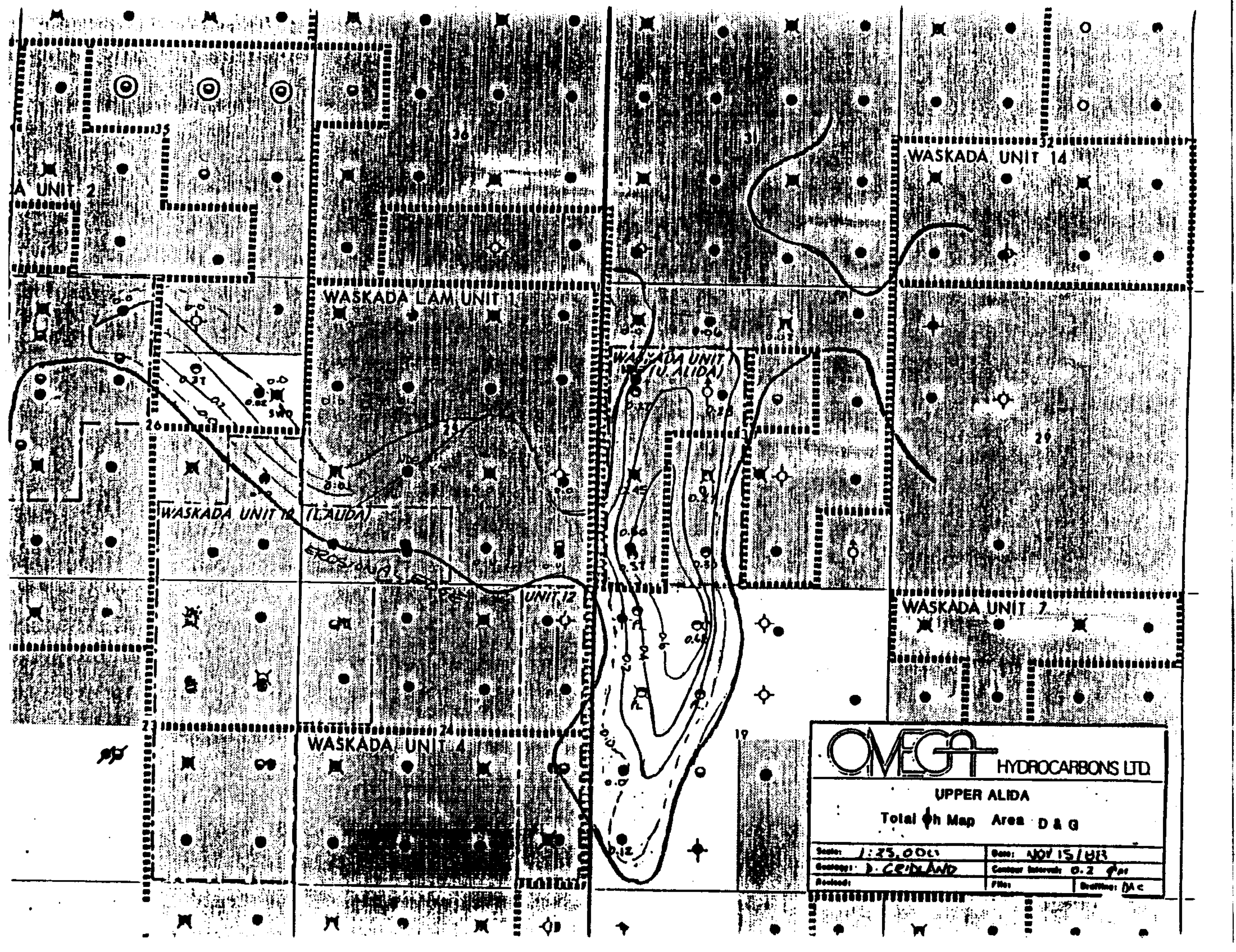
- Well 12-30 (MC3b) the only Omega well in this U. Alida pool that is not exhibiting gas breakthrough. It is presently producing about 1.5 m^3/d of oil. It is suggested that no work is required on this well. It should be noted that this well has an excellent L. Amaranth zone which is better than the 12-30 (LAm) well.

- Well 12-30 (LAm) also has an excellent L. Amaranth zone. It was completed with a 27 tonne poly frac. This well is not deep enough to indicate how much caprock is present or the quality of U. Alida zone. Presently this well is producing 1.2 m^3/d of oil. It is suggested that this well be reviewed in order to determine if a workover program is required as this should be capable of more inflow.

The AFE's and programs for the above recommendations will be generated and forwarded. It is expected that this will allow the work to be performed early in the new year. Should you have any concerns or questions, please see me.

D. Boyko

c.c.: R. A. Brekke
D. Cridland
W. Sharp
Waskada Reservoir Study



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WASKADA UNIT 1 (U ALIDA)
WASKADA UNIT 12 (L ALIDA)
EROSIONAL EDGE
UNIT 12
WASKADA UNIT 7
WASKADA UNIT 4
A UNIT 2
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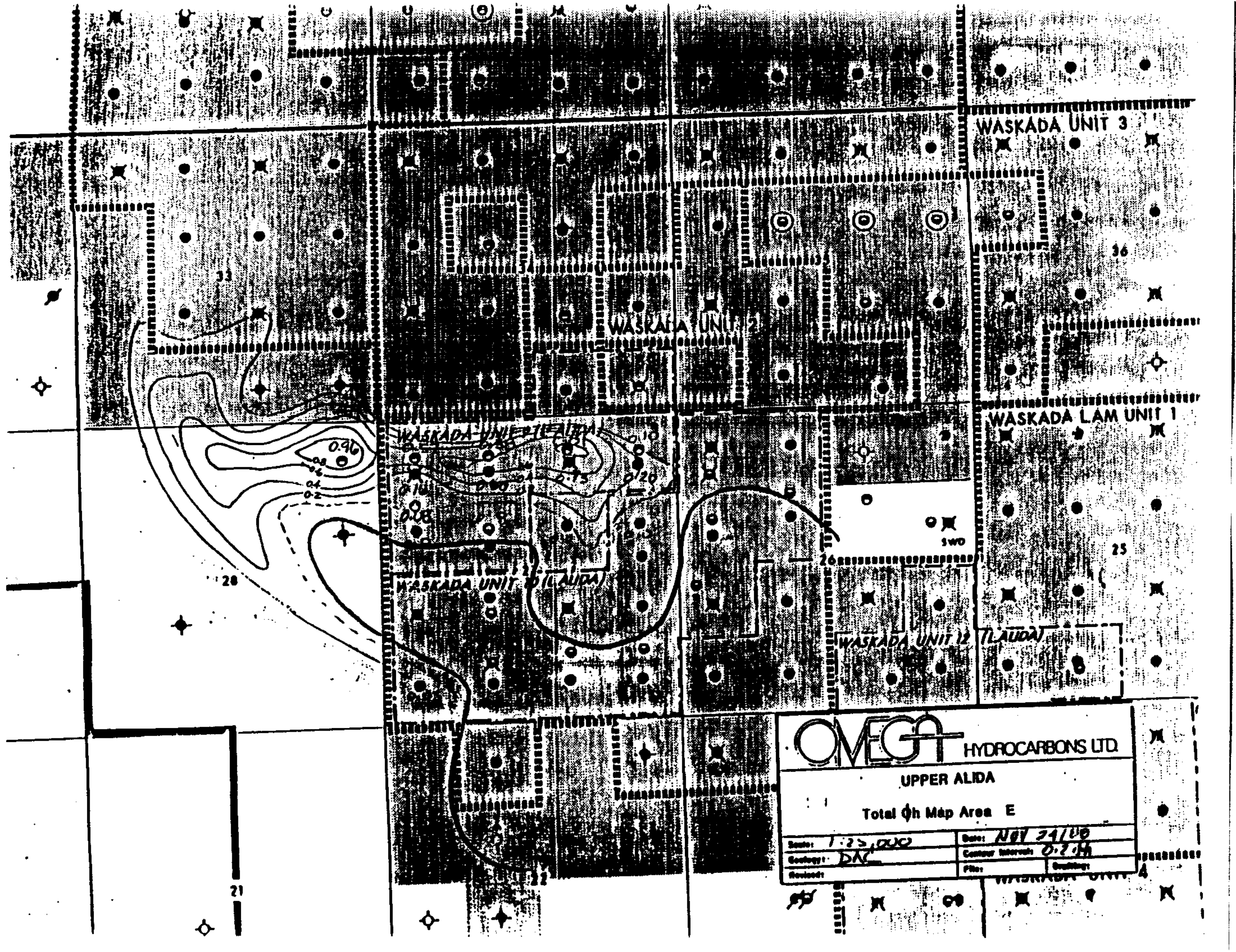
Revised:
File:
Drafting: DAC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36
25
26
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SWD
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0.6
0.4
0.2
0.08
0.15
0.20
OMEGA HYDROCARBONS LTD.
UPPER ALIDA
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Revised:
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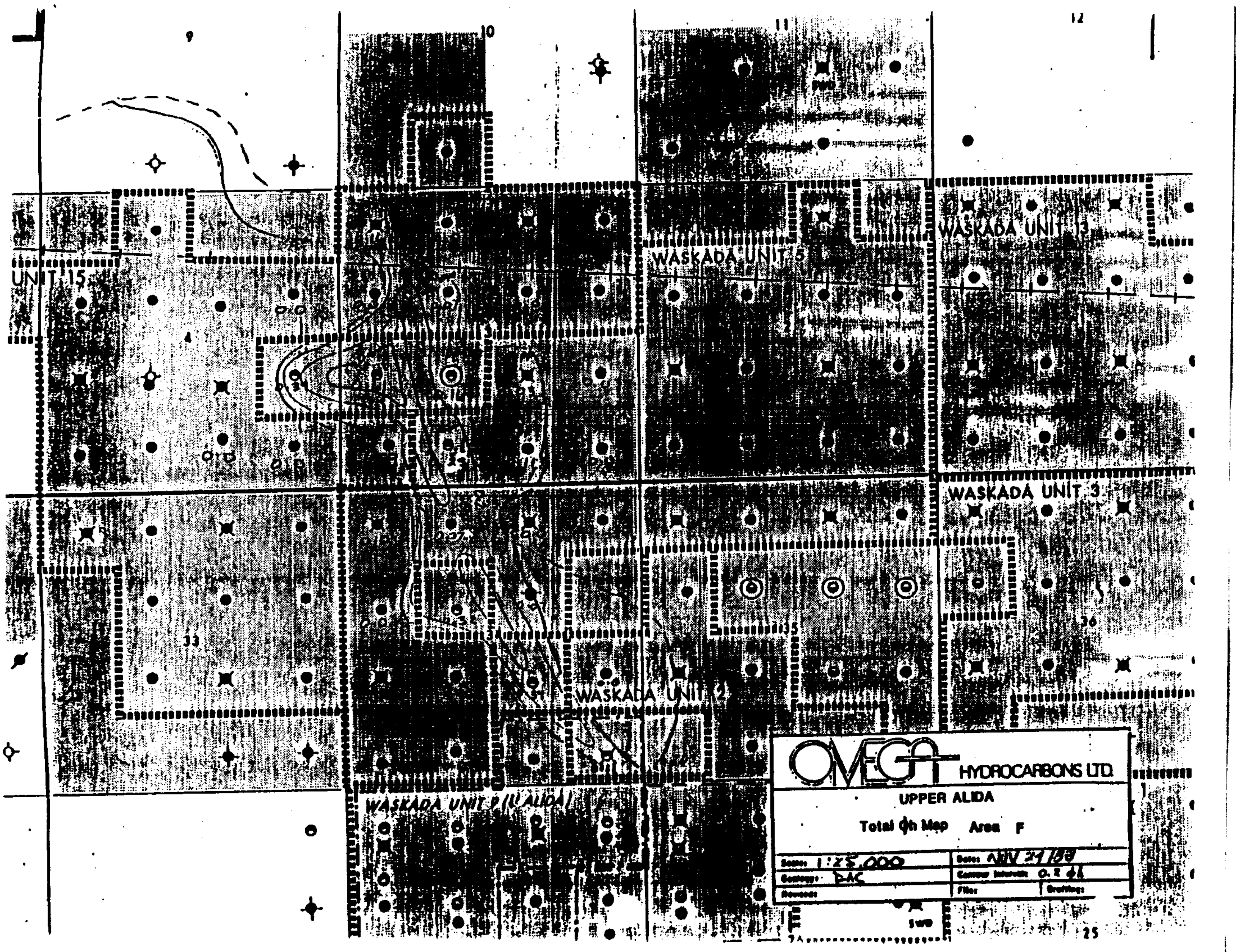
Drafting: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UNIT 15
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35
36
25
OMEGA HYDROCARBONS LTD.
UPPER ALIDA
Total Φh Map Area F
Scale: 1:25,000
Date: NOV 24/88
Geology: DAC
Contour Interval: 0.2 Φh
Files:
Drafting:

UPPER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	OIL RECOVERED (M3)	PERCENT RECOVERY
5-25-1-26	8.0	0.01	40.0	1.15	417.4	0.0	0.0
9-26-1-26	8.0	0.02	40.0	1.15	834.8	0.0	0.0
10-26-1-26	16.0	0.37	41.3	1.15	30217.7	6231.9	20.6
					31469.9	6231.9	19.8

AREA E

UPPER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	OIL RECOVERED (M3)	PERCENT RECOVERY
12-27-1-26	8.0	0.08	59.5	1.15	2253.9	2995.0	132.9
13-27-1-26	16.0	0.57	40.0	1.15	47582.6	9331.7	19.6
14-27-1-25	16.0	0.58	43.0	1.15	45996.5	8229.3	17.9
15-27-1-25	16.0	0.81	40.8	1.15	66715.8	5156.2	7.7
16-27-1-25	16.0	0.10	52.0	1.15	6678.3	10485.1	157.0
16-28-1-25	16.0	0.96	61.4	1.15	51556.2	9594.5	18.6
					220783.3	45791.8	20.7

AREA F

UPPER ALIDA RESERVES CALCULATIONS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	OIL RECOVERED (M3)	PERCENT RECOVERY
1-34-1-26	8.0	0.11	45.0	1.15	4208.7	281.2	6.7
7-34-1-26	16.0	0.39	52.5	1.15	25773.9	186.4	0.7
10-34-1-26	8.0	0.07	58.0	1.15	2045.2	0.0	0.0
11-34-1-26	16.0	0.32	28.4	1.15	31877.6	6232.1	19.6
14-34-1-26	16.0	0.37	48.2	1.15	26665.7	0.0	0.0
2-3-2-26	8.0	0.11	47.0	1.15	4055.7	0.0	0.0
3-3-2-26	16.0	0.23	38.8	1.15	19600.0	369.8	1.9
4-3-2-26	8.0	0.09	35.0	1.15	4069.6	34.3	0.8
5-3-2-26	16.0	0.61	38.8	1.15	51940.2	8822.3	17.0
6-3-2-26	16.0	0.16	31.5	1.15	15248.7	3383.6	22.2
7-3-2-26	16.0	0.03	38.0	1.15	2587.8	0.0	0.0
11-3-2-26	16.0	0.07	41.0	1.15	5746.1	0.0	0.0
13-3-2-26	16.0	0.16	49.7	1.15	11197.2	0.0	0.0
8-4-2-26	10.0	0.39	42.2	1.15	19601.7	3575.1	18.2
					224618.1	22884.8	10.2

AREA 6
(UNIT 1)
UPPER ALIDA RESERVES CALCULATIONS

OMEGA WELLS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)	OIL RECOVERED (M3)	PERCENT RECOVERY
3-30-1-25	16.0	0.33	50.7	1.15	22635.1	17073.3	75.4
4-30-1-25	16.0	0.59	51.5	1.15	39812.2	21760.2	54.7
5-30-1-25	16.0	0.45	56.4	1.15	27297.4	15939.6	58.4
6-30-1-25	16.0	0.27	58.8	1.15	15476.9	10291.6	66.5
11-30-1-25	16.0	0.23	48.5	1.15	16480.0	6145.9	37.3
12-30-1-25	16.0	0.27	42.6	1.15	21562.4	14972.8	69.4
					143264.0	86183.4	

TUNDRA WELLS

WELL	AREA(ha)	PHI H(m)	AVG SW(%)	BOI	OOIP(M3)
4-19-1-25	16.0	0.12	50.0	1.15	8347.8
11-19-1-25	16.0	0.20	50.0	1.15	13913.0
12-19-1-25	16.0	0.35	50.0	1.15	24347.8
13-19-1-25	16.0	0.40	50.0	1.15	27826.1
14-19-1-25	16.0	0.68	50.0	1.15	47304.3
					121739.1

PRODUCTION TO DATE (M3)

OMEGA:	86183.4	OMEGA'S RECOVERY (%):	60.2
TUNDRA:	57134.7	TUNDRA'S RECOVERY (%):	46.9
TOTAL POOL:	143318.1	TOTAL POOL RECOVERY (%):	54.1

M E M O R A N D U M

DATE: July 26, 1989

TO: T.J. Hall
G.A. Cormack

FROM: D.A. Brekke

RE: Waskada Production Performance Review to the End of June, 1989

==

Please find attached historical production plots for all pools and Units within the Waskada field. In order to compare actual performance versus predicted production, decline curves from the 1988 D & S Reserve Report have been superimposed onto the plots. The following observations are noted for each of the plots:

1) Total Waskada Production - the average monthly oil production to date for 1989 is 10,548 m^3. This is equivalent to 345 m^3/d and is a decline of 11.2% from the 1988 average monthly oil production. The present production rates must be maintained during the next six months to achieve an acceptable yearend decline rate. The producing well count during 1988 and 1989 has remained relatively constant at 285 wells as a result of commingling, new well drilling and abandonments. The injection well count has declined from 68 to 38 active injectors during the past year due to injection strategies in place.

2) Total LAm Production - during 1989 the total LAm monthly oil production has fluctuated between 7851 m^3 and 9296 m^3. The lower production volume months have been caused by poor weather, shut in periods during the commingling process and higher than anticipated decline rates within certain LAm Units. A recently completed LAm reservoir review and an injection pattern review which is underway are expected to stablize production at 9000 m^3/month by the next quarterly review.

3) Total Mississippian Production - the detrimental effects of commingling seen on LAm production have alternatively been positive for the Mississippian production at Waskada with only a 3.4% decline in production observed to date. Additional gains in oil productivity appear to be limited considering the current oil recoveries in several of the Mississippian pools, however, an annual decline of 10% for 1989 certainly appears achievable at this time.

4) Waskada Unit No. 1 (UAlida) - The average monthly oil production for 1989 is 89 m^3 compared to 211 m^3 for 1988. This decrease is due to gas breakthrough at wells 3-30 and 4-30-1-25 WPM as well as water encroachment from the aquifer on the west side of the pool. Oil recovery calculations of 60.2% indicate that this pool has almost been depleted. Future gas injection/storage strategies are being discussed with the Manitoba Government.

5) Waskada Unit No. 1 (LAm) - during the past few months oil production within this Unit has been adversely affected by the initial production testing of 5 commingled wells. Based on the above average reservoir quality and low water/oil ratios for this portion of the pool the oil decline rate for this Unit should be closer to 10%. Recommendations for acid treatments, condensate squeezes and workovers have been made to maximize oil productivity from this Unit.

6) Waskada Unit No. 2 (LAm) - the oil productivity in this Unit has declined to 517 m^3/month and the water/oil ratio has increased to above 4.0 during the past year, without additional injection into the area. Due to prior water injection, Mississippian communication and the existence of a wet LAm stringer it is felt that the water/oil ratio trend will continue to increase. Oil recovery from this portion of the reservoir has been reasonably high as indicated by the fact that 15 wells within the Unit have cumulative production in excess of 3000 m^3.

7) Waskada Unit No. 3 (LAm) - the average monthly oil production has declined from 1044 m^3 in 1988 to 785 m^3 in 1989. The majority of this loss in oil productivity is attributed to water breakthrough within the Unit. Water injection was significantly reduced in March 1989 in an effort to reverse the trend. The historic water cuts in this Unit have been abnormally high when compared to other areas of the field therefore it is recommended that a geological review be undertaken to assist in planning future operating strategies.

8) Waskada Unit No. 4 (LAm) - the monthly oil production for this Unit has fluctuated between 623 m^3 and 880 m^3 during the last six months. The water cuts at wells 3-24 and 4-24-1-26 WPM are still high but are showing signs of improvement. It is recommended that the strategy to terminate offset injection at wells 13-13, 15-13, 5-24 and 7-24-1-26 WPM be continued until oil productivity improves within the Unit.

9) Waskada Unit No. 5 (LAm) - the average monthly oil production for this Unit has remained relatively constant of 276 m^3 during 1989. The injectors in Section 2-2-26 WPM were overinjected during 1988 in an effort to increase productivity from this area, some success is apparent. This Unit is marginally economic and certain wells may be recommended for abandonment at a later date in an effort to reduce operating costs.

10) Waskada Unit No. 7 (LAm) - the average monthly oil production has declined from 332 in 1988 to 212 in 1989. This decrease is due almost entirely to change in water cut at well 14-20-1-25 WPM which is confirmed to be in communication with the Tilston formation. Geology is currently reviewing the area to determine the existence of Tilston oil potential.

11) Waskada Unit No. 8 (LAm) - the 1989 average monthly oil production for this Unit has only declined by 4.6% from the 1988 yearly average. This Unit is capable of maintaining current oil rates through a conservative injection strategy and minimizing well downtime.

12) Waskada Unit No. 9 (UAlida) - the average monthly oil production for 1989 currently stands at 112 m^3. This rate is significantly lower than the 400 m^3/month rates seen in 1987 and is believed to be caused by water encroachment of the aquifer. At present oil recovery from the pool is approximately 21%. Since, this value is considered relatively low the existing strategy is to maxmize the number of wells in the pool and to produce all the wells at high water/oil ratios.

13) Waskada Unit No. 10 (LAlida) - the 1989 average monthly oil production has fluctuated between 217 m^3 and 286 m^3. The 29.4% increase in oil productivity during 1989 can be attributed to minimal well downtime and restimulation work done in late 1988. The termination of water injection in March 1987 into this pool does not appear to be affecting performance.

14) Waskada Unit No. 12 (LAlida) - as a result of commingled production we have seen an increase in oil production of approximately 200 m^3/month within this Unit. Additional commingling and workovers are planned for this Unit which should at least maintain the current production rates. Water injection into all the Mississippian Units has been temporarily terminated and pressure tests are planned to investigate the degree of aquifer support.

15) Waskada Unit No. 13 (LAm) - the drop in oil production from 241 m^3/month in 1988 to 154 m^3/month in 1989 is due to well downtime. This Unit is marginally economic thus all repairs have been reviewed by the Waskada and Calgary offices prior to any work being done. The pool pressure in this portion of the reservoir is currently above 10,000 kPa and is being maintained at this level to maximize fluid displacement.

16) Waskada Unit No. 14 (LAm) - the average monthly oil production has remained constant between 1988 and 1989 at 147 m^3. The decline in Unit water/oil ratio is a result of shutting in wells 1-32 and 2-32-1-25 WPM which are off trend high water cut wells. This Unit is marginally economic therefore operating costs must be monitored closely during the remainder of the year.

17) Waskada Unit No. 15 (LAm) - the 1989 average monthly oil production for this Unit has declined by 10.2% from the 1988 yearly average. This Unit is complicated by the fact it contains a wet LAm zone and areas of higher oil viscosity in comparison to the rest of the field. At present the Unit is marginally economic, however, some restimulation potential does exist which may improve oil productivity.

The attached tables compare the average oil production rates for 1988 and 1989. The Waskada pool and Unit production have been sorted by % difference and are listed in descending order. Positive % changes indicate increases in production and an acceptable decline rate is between 10 and 15 percent.

c.c.: W. Sharp
D. Boyko
D. Sharp
Circulation Copy
Waskada (LAm) Pressure Maintenance Monitoring File

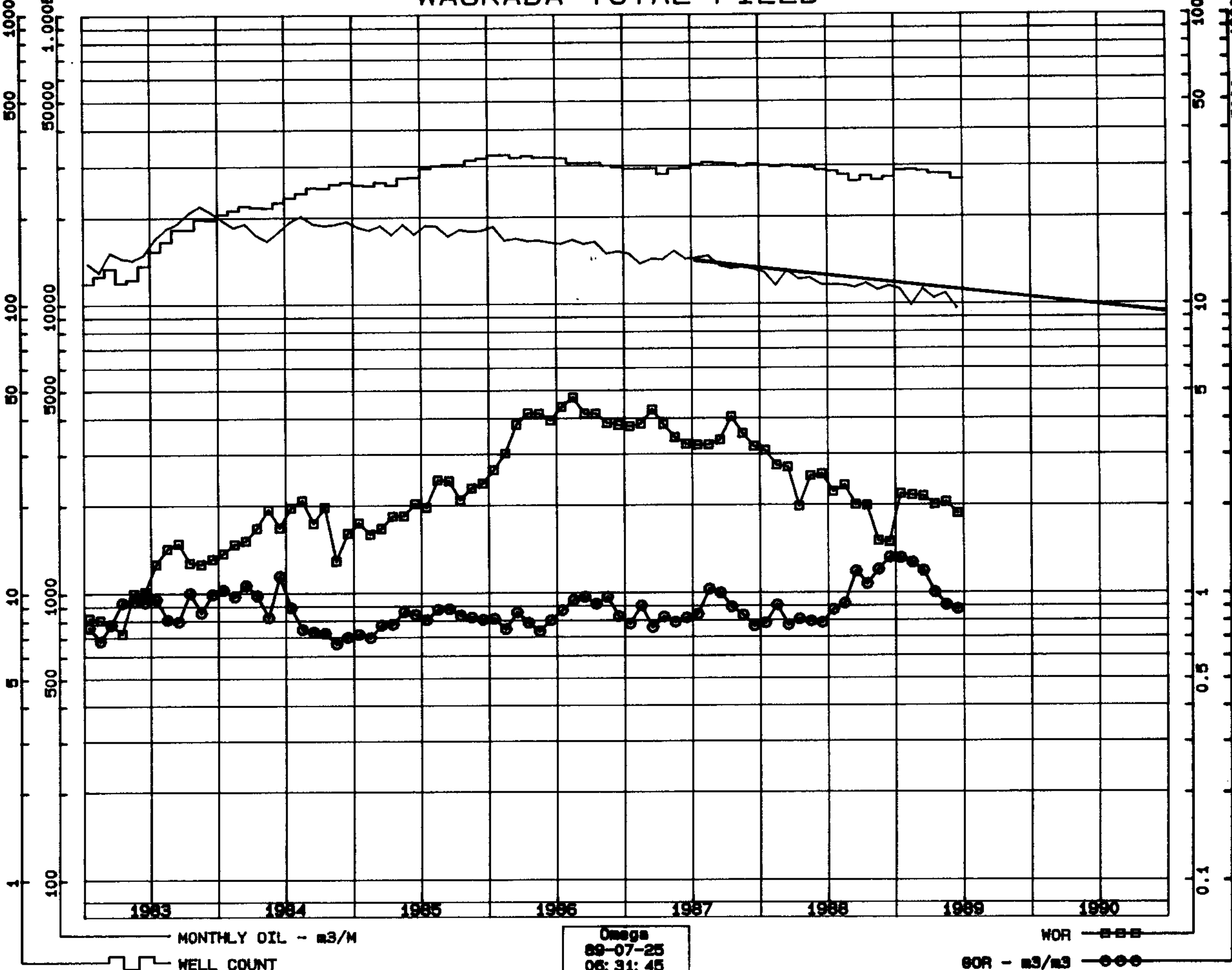
Waskada Oil Productivity Review
Pool Ranking By Percent Difference

	June 1989 Rates (m^3)	1988 Monthly Avg. (m^3)	1989 Monthly YTD Avg. (m^3)	Difference (m^3)	Difference (%)
Waskada Total LAlida	1165	978	1215	+237	+24.2
Waskada Total Miss.	1791	1958	1892	66	3.4
Waskada Total Field	**9642**	**11882**	**10548**	**1334**	**11.2**
Waskada Total LAm	7851	9924	8655	1269	12.8
Waskada Total Tilson	164	251	218	33	13.1
Waskada Total UAlida	462	729	460	269	36.9

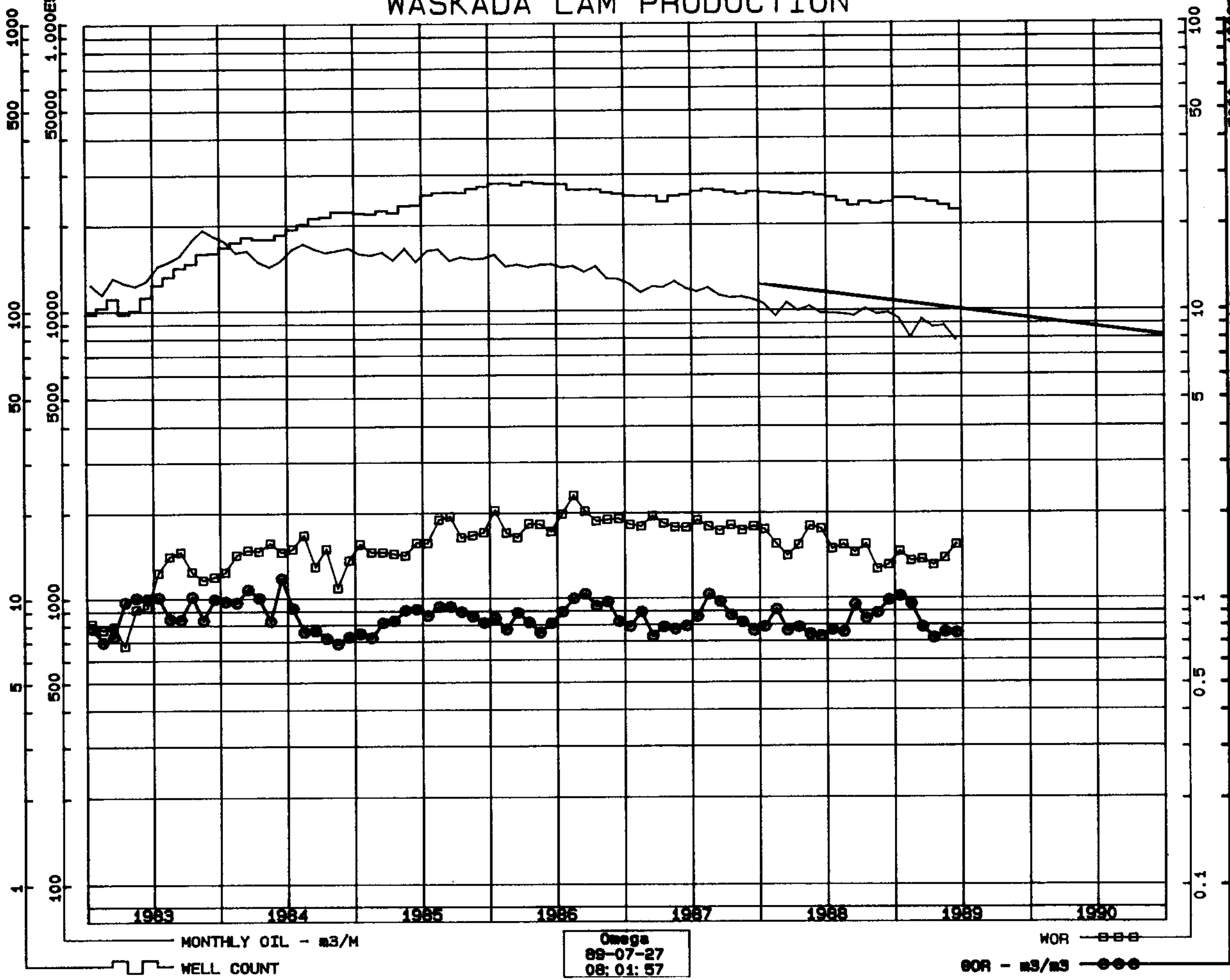
Waskada Oil Productivity Review
Unit Ranking By Percent Difference

	June 1989 Rates (m^3)	1988 Monthly Avg. (m^3)	1989 Monthly YTD Avg. (m^3)	Difference (m^3)	Difference (%)
Waskada Unit No. 12 (LAlida)	356	171	237	+66	+38.6
Waskada Unit No. 10 (LAlida)	233	187	242	+55	+29.4
Waskada Unit No. 14 (LAm)	141	148	147	1	0.0
Waskada Unit No. 8 (LAm)	925	996	950	46	4.6
Waskada Unit No. 15 (LAm)	263	314	282	32	10.2
Waskada Unit No. 4 (LAm)	623	896	758	138	15.4
Waskada Unit No. 1 (LAm)	1727	2333	1902	431	18.5
Waskada Unit No. 3 (LAm)	663	1044	785	259	24.8
Waskada Unit No. 5 (LAm)	285	371	276	95	25.6
Waskada Unit No. 2 (LAm)	464	752	517	235	31.2
Waskada Unit No. 7 (LAm)	195	332	212	120	36.1
Waskada Unit No. 13 (LAm)	134	241	154	87	36.1
Waskada Unit No. 9 (UAlida)	127	207	112	95	45.9
Waskada Unit No. 1 (UAlida)	71	211	89	122	57.8

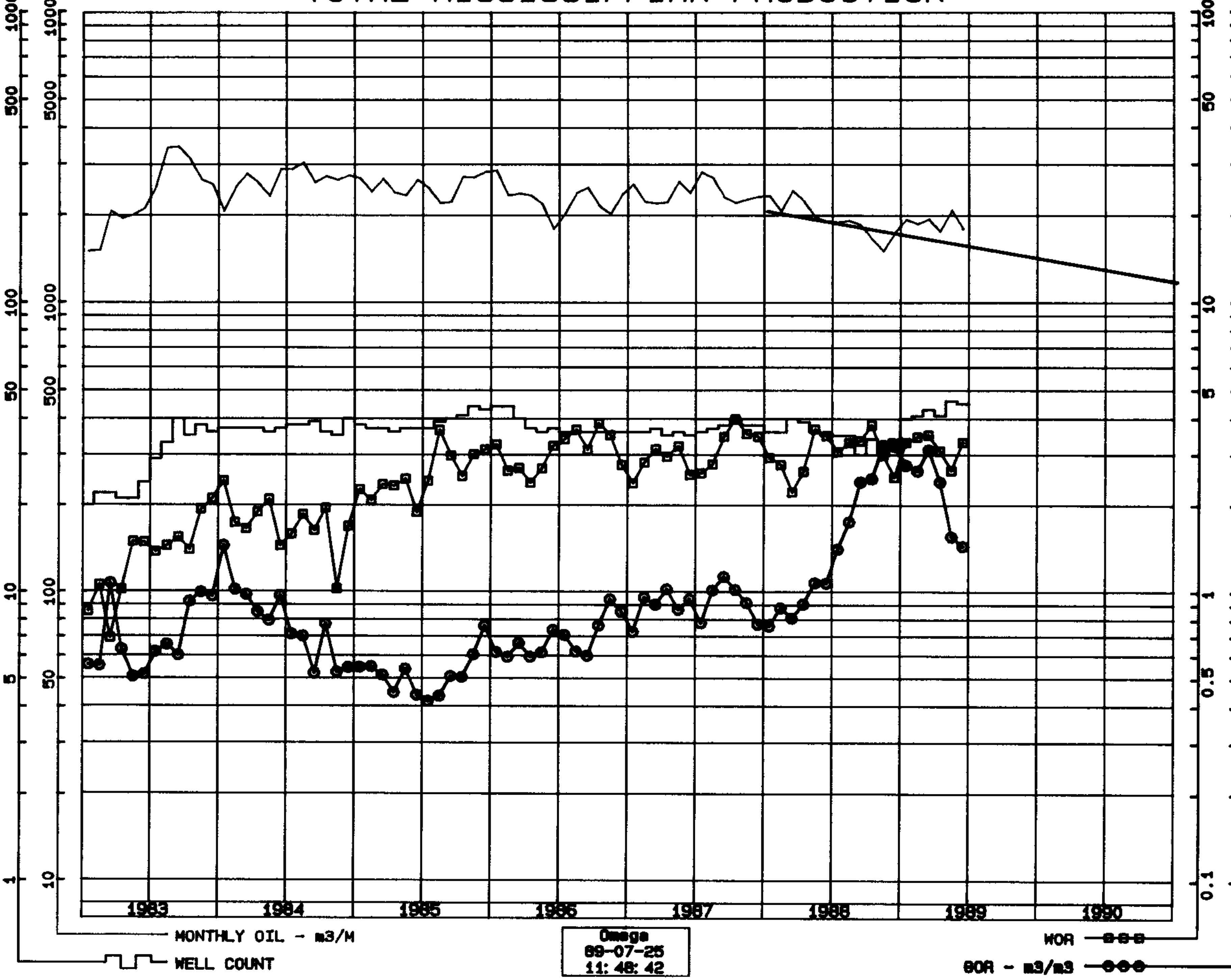
WASKADA TOTAL FIELD



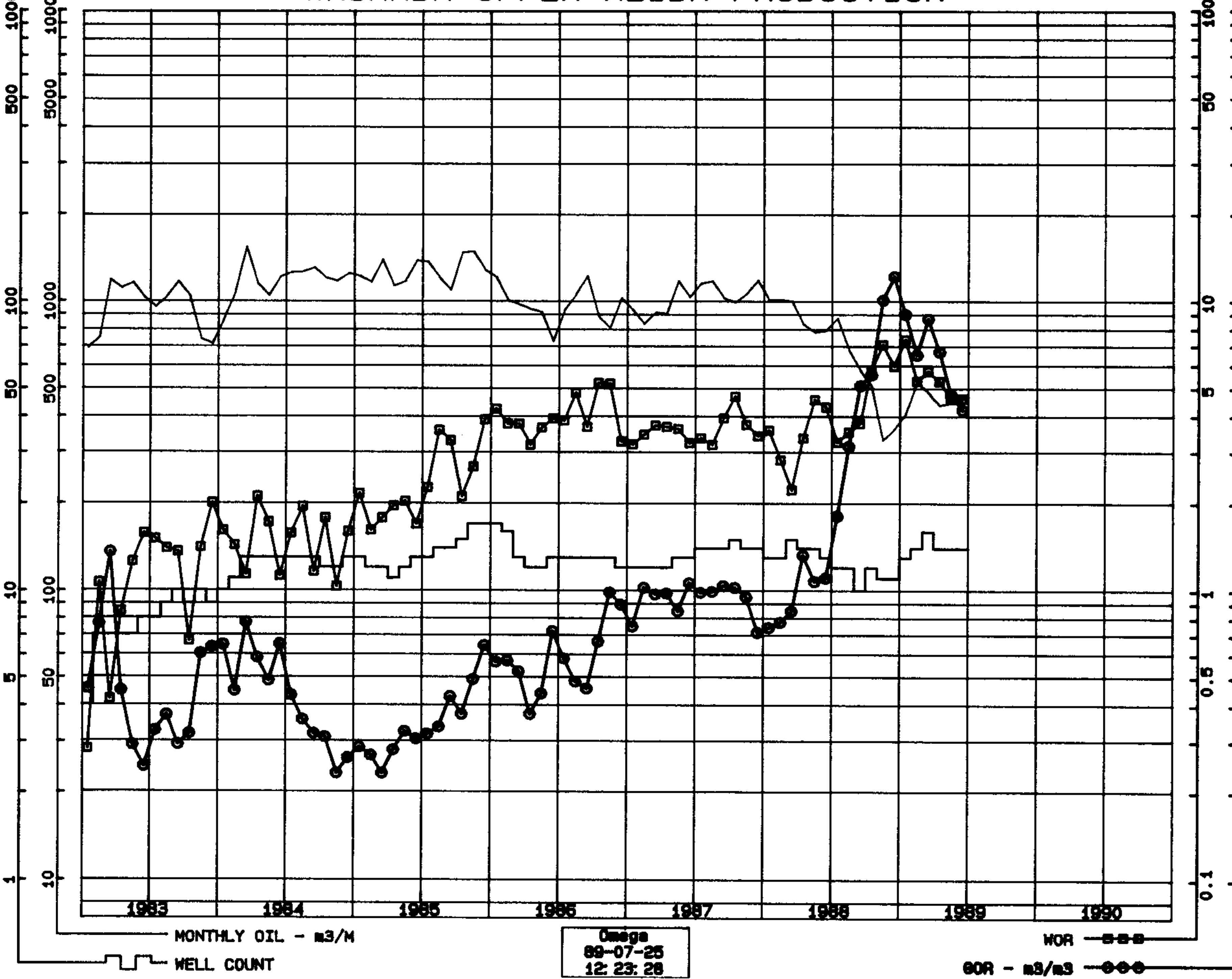
WASKADA LAM PRODUCTION

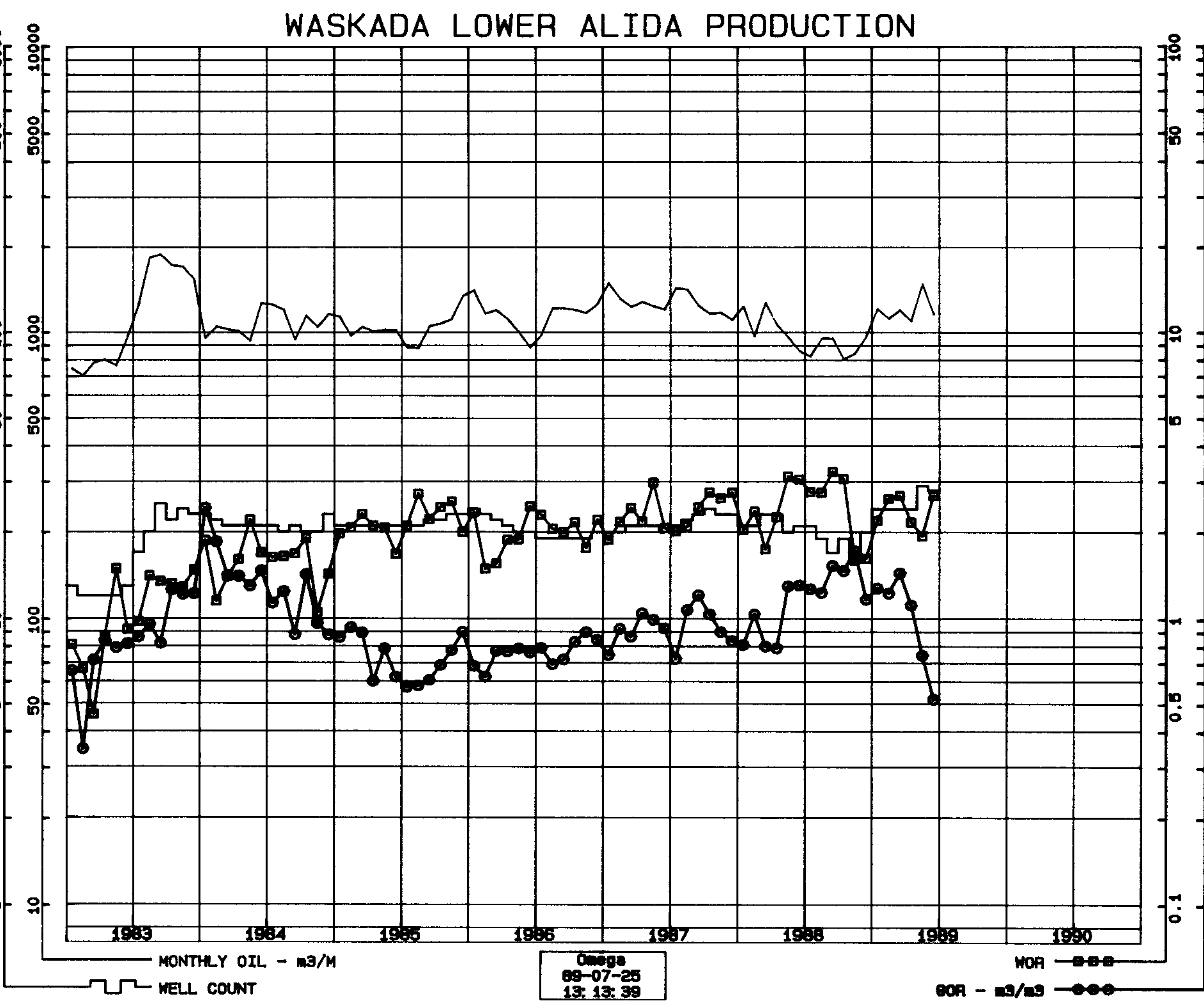


TOTAL MISSISSIPPIAN PRODUCTION



WASKADA UPPER ALIDA PRODUCTION





WASKADA LOWER ALIDA PRODUCTION
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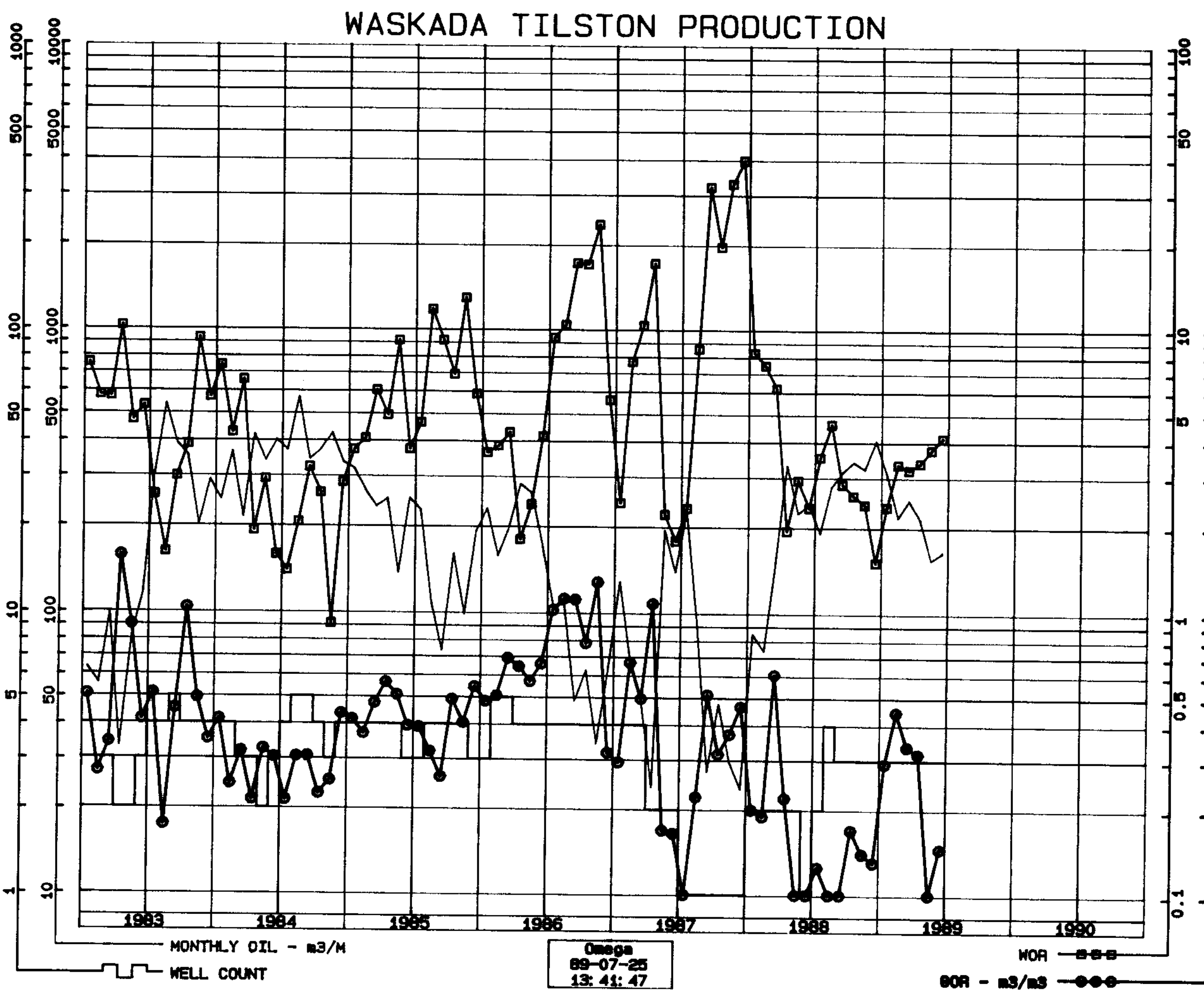
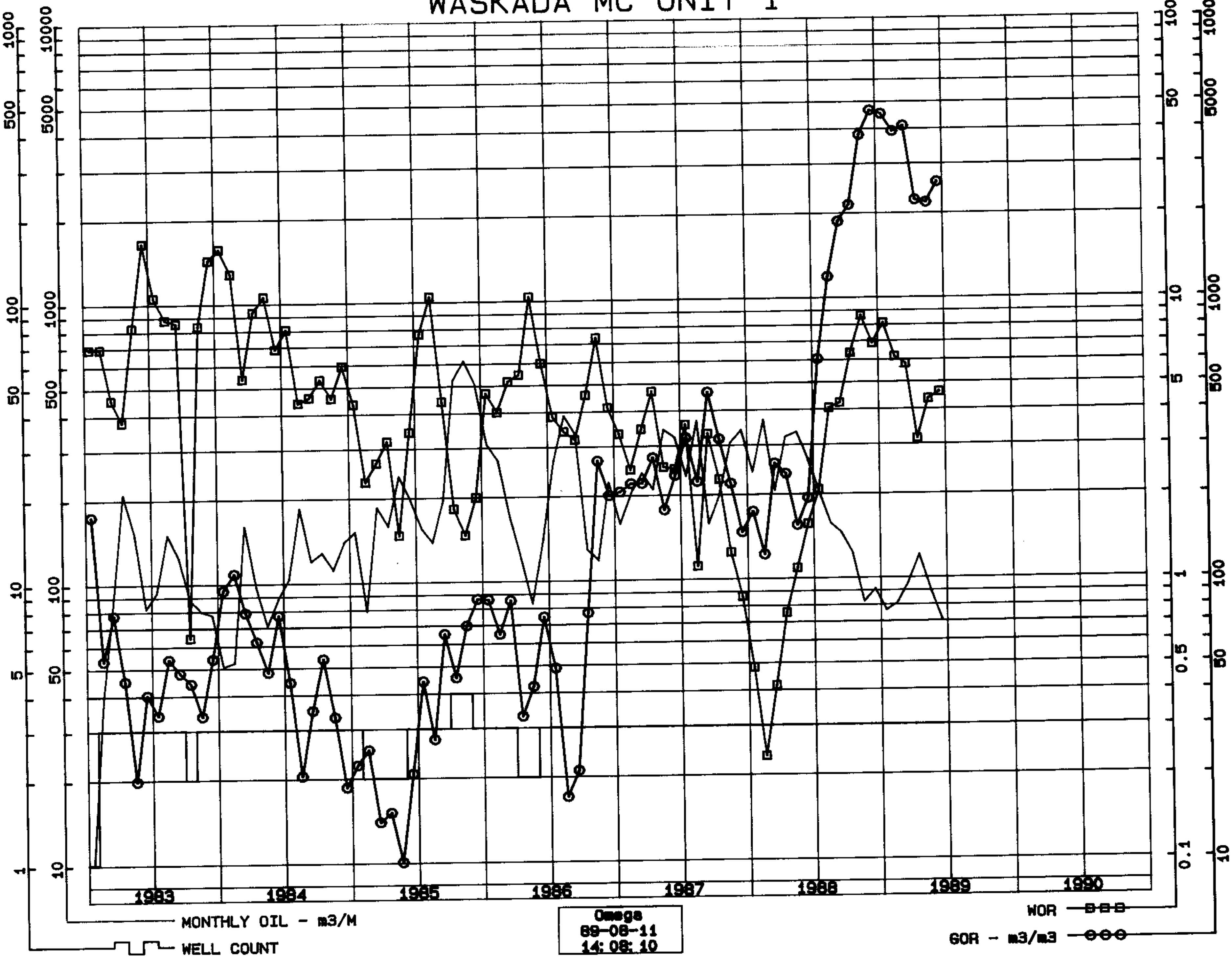
10000
500
5000
100
1000
50
500
10
100
5
50
1
10
1983
1984
1985
1986
1987
1988
1989
1990
100
10000
50
5000
10
1000
5
500
1
100
0.5
50
0.1
10
MONTHLY OIL - m3/M
WELL COUNT
Omega
89-07-25
13:13:39
WOR
GOR - m3/m3


WASKADA TILSTON PRODUCTION
1983
1984
1985
1986
1987
1988
1989
1990
MONTHLY OIL - m3/M
WELL COUNT
Omega
89-07-25
13: 41: 47
WOR
GOR - m3/m3
10
50
100
500
1000
5000
10000
1
5
10
50
100
500
1000
0.1
0.5
1
5
10
50
100

WASKADA MC UNIT 1



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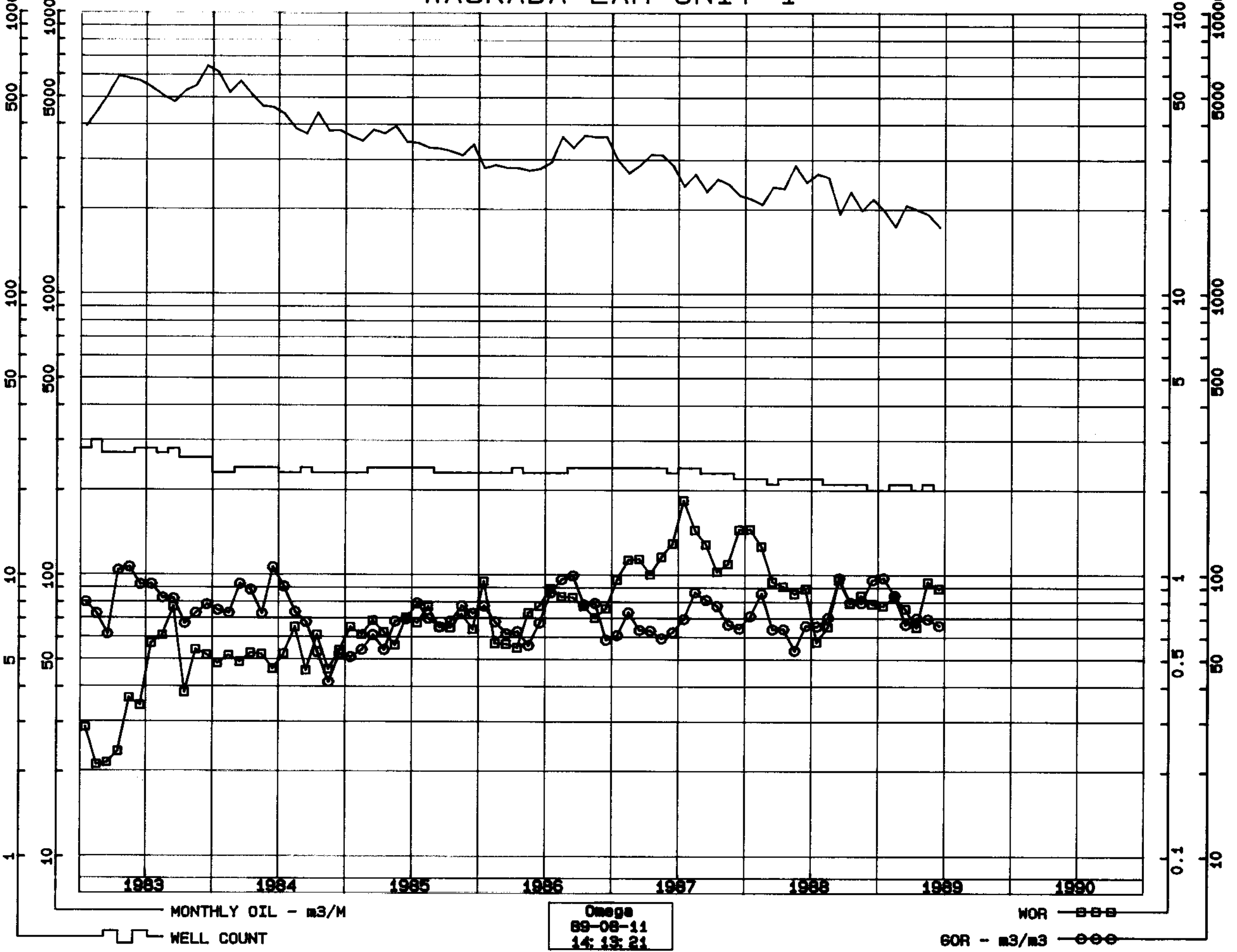

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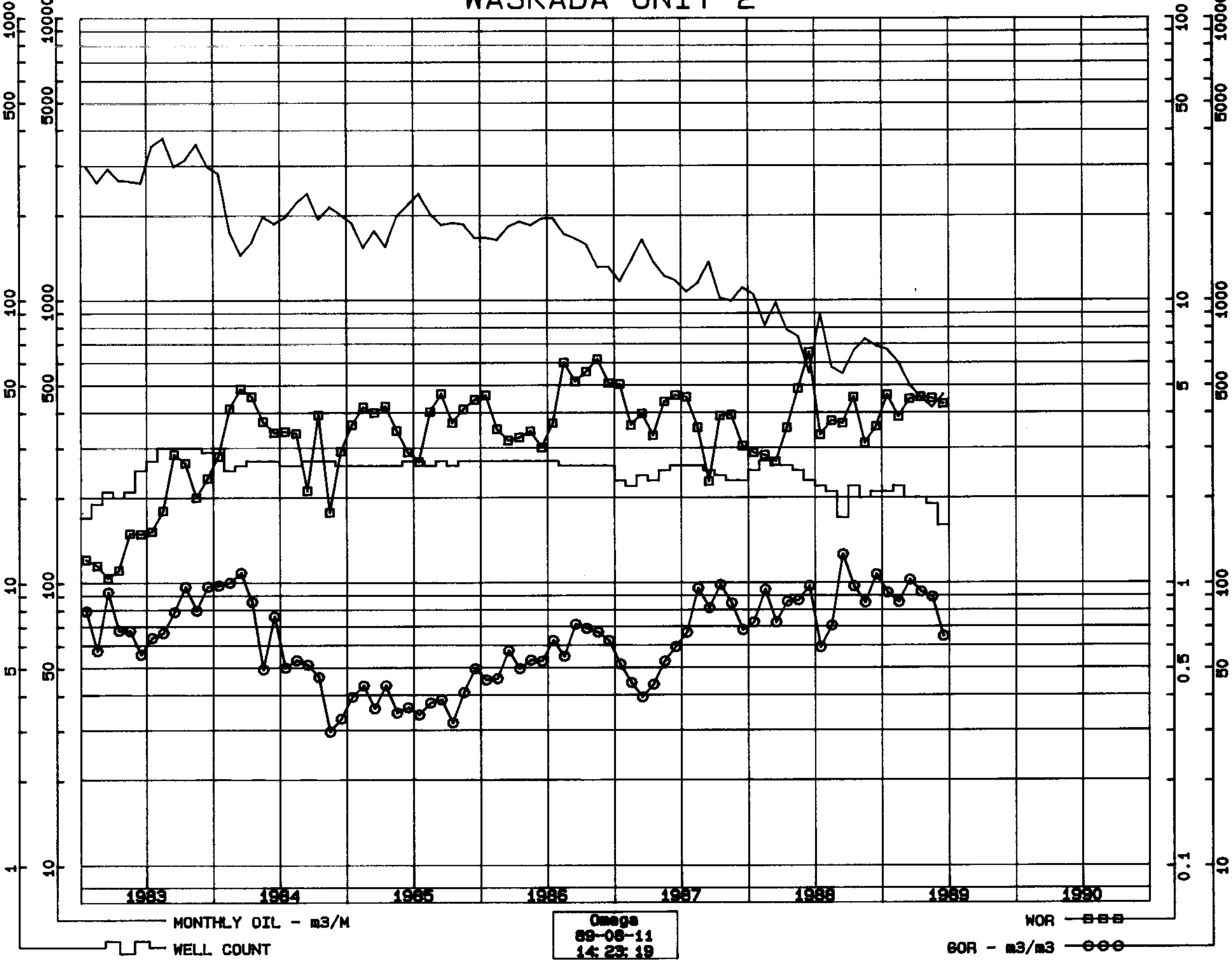

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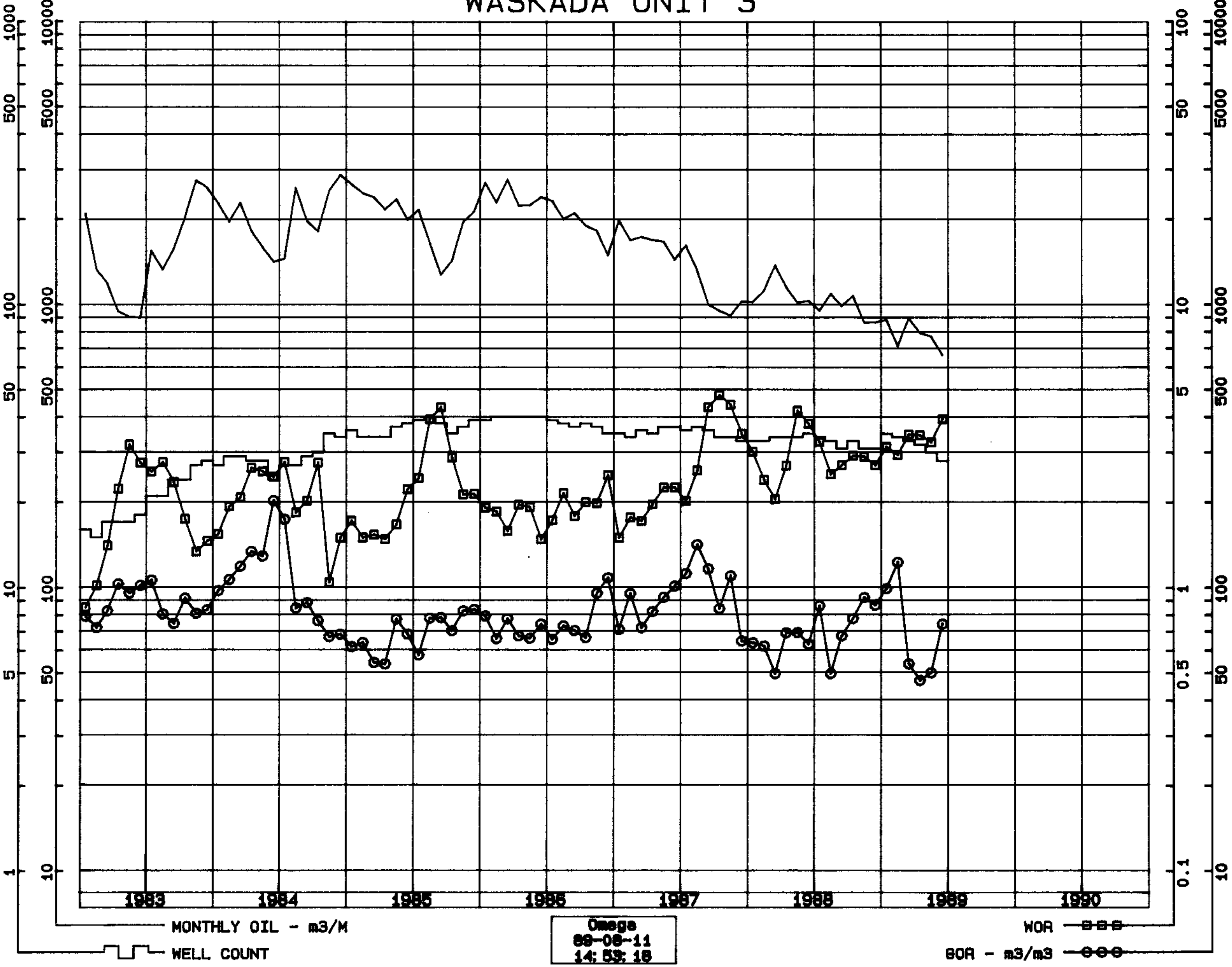
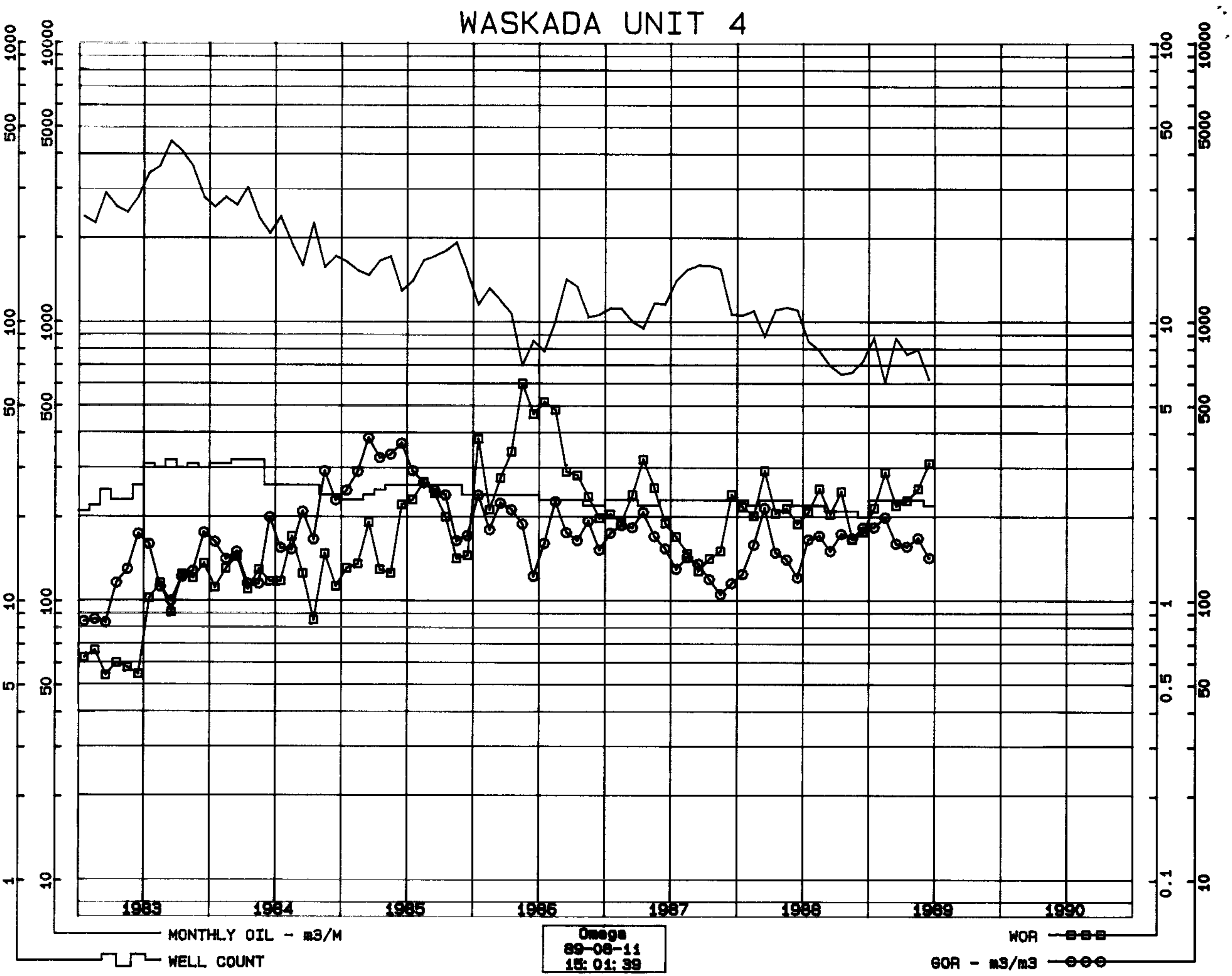
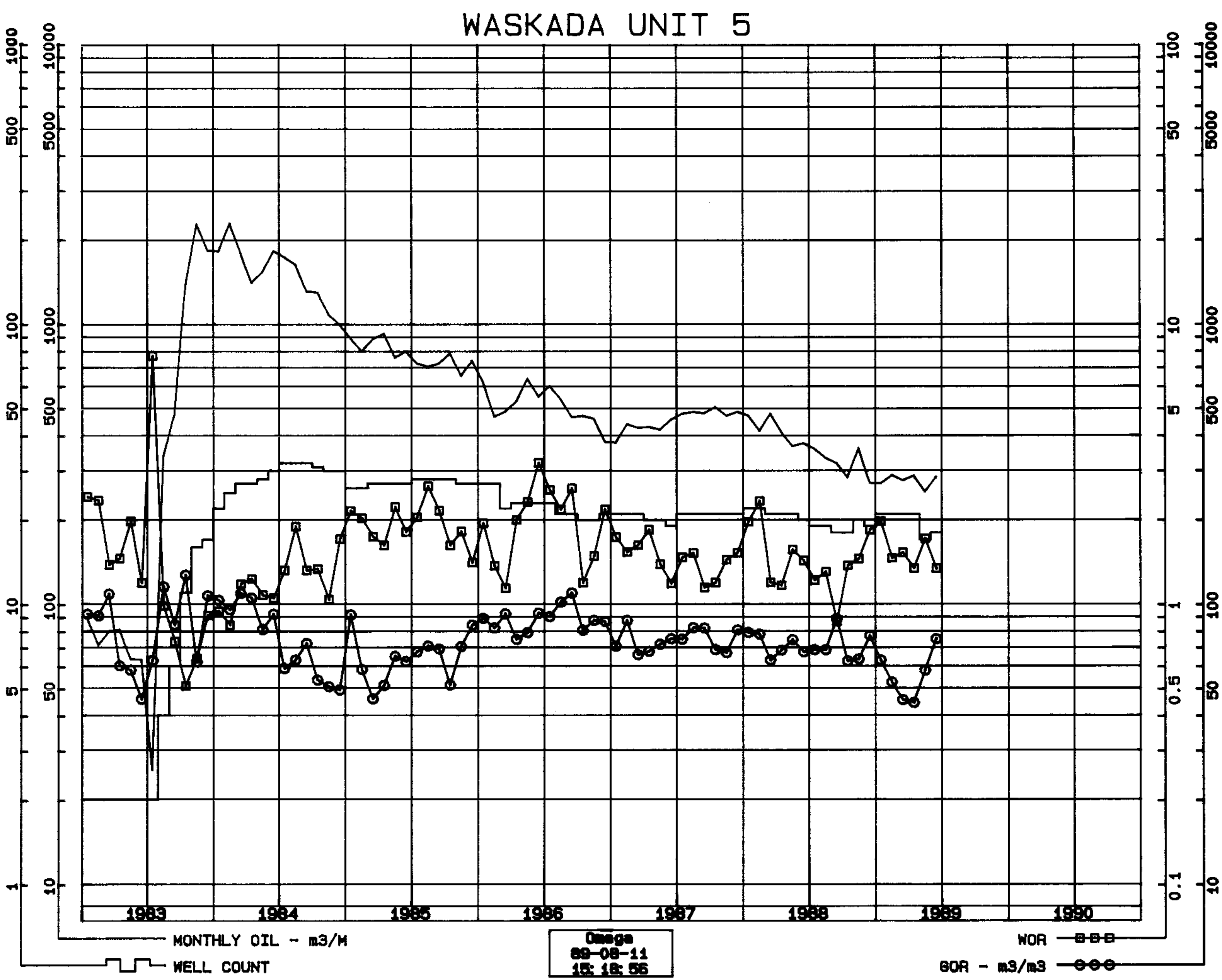




WASKADA UNIT 4
1983
1984
1985
1986
1987
1988
1989
1990
MONTHLY OIL - m3/M
WELL COUNT
WOR
GOR - m3/m3
Omega
89-08-11
15:01:39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500
100
50
10
5
1
10000
5000
1000
500
100
50
10
100
50
10
5
1
0.5
0.1
10000
5000
1000
500
100
50
10
1983
1984
1985
1986
1987
1988
1989
1990
MONTHLY OIL - m3/M
WELL COUNT
Omega
89-08-11
15:18:56
WOR
GOR - m3/m3

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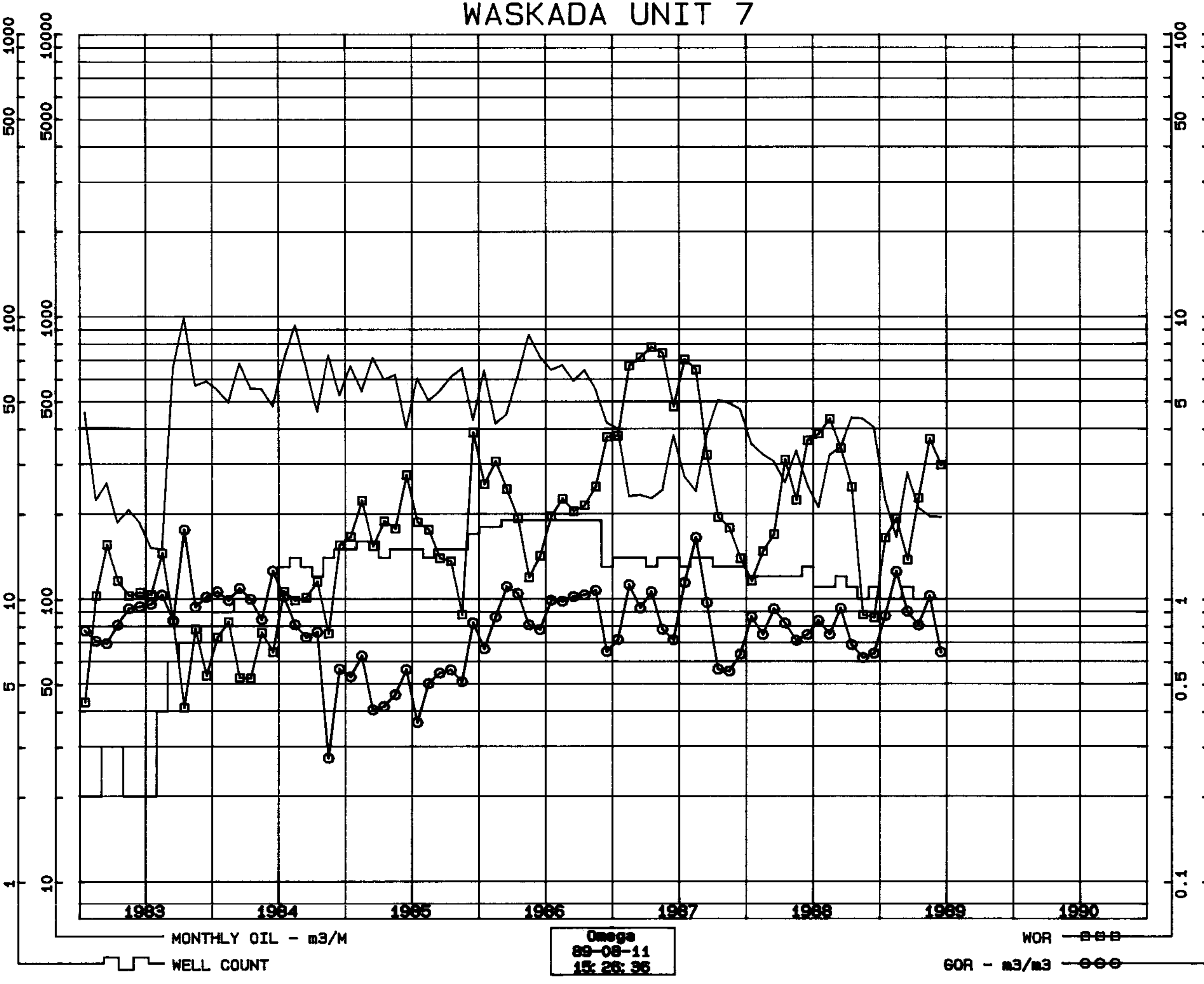

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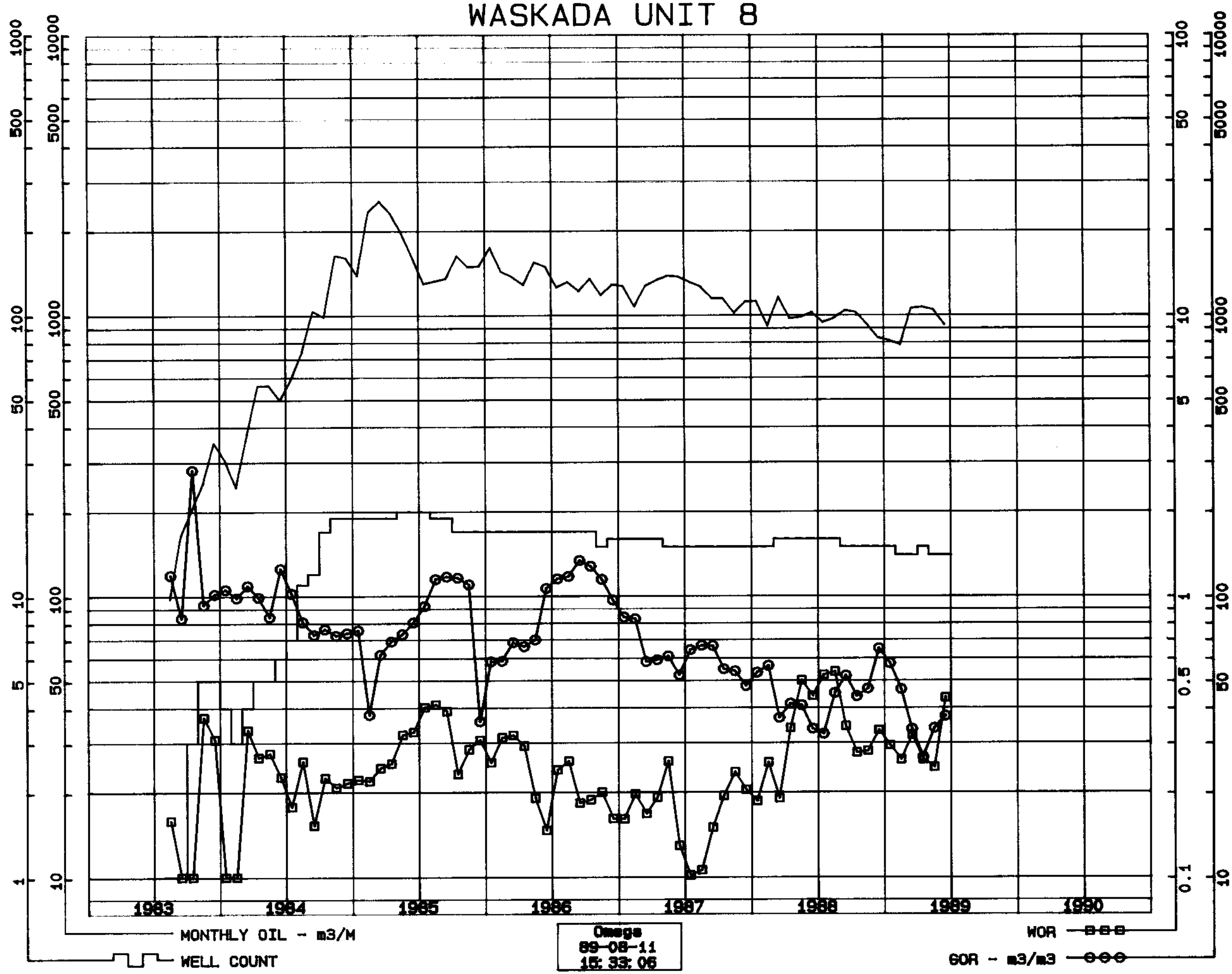

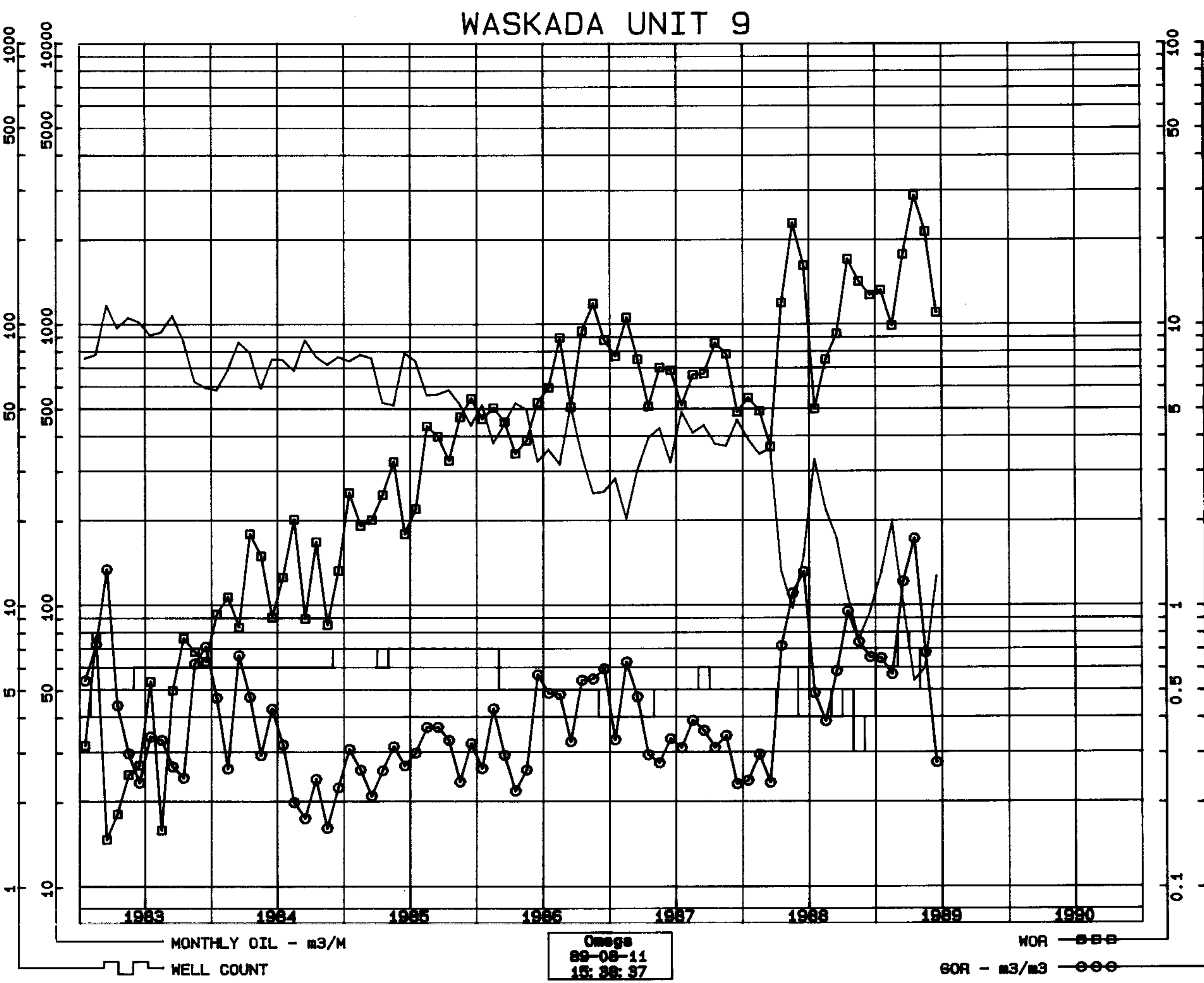

WASKADA UNIT 9
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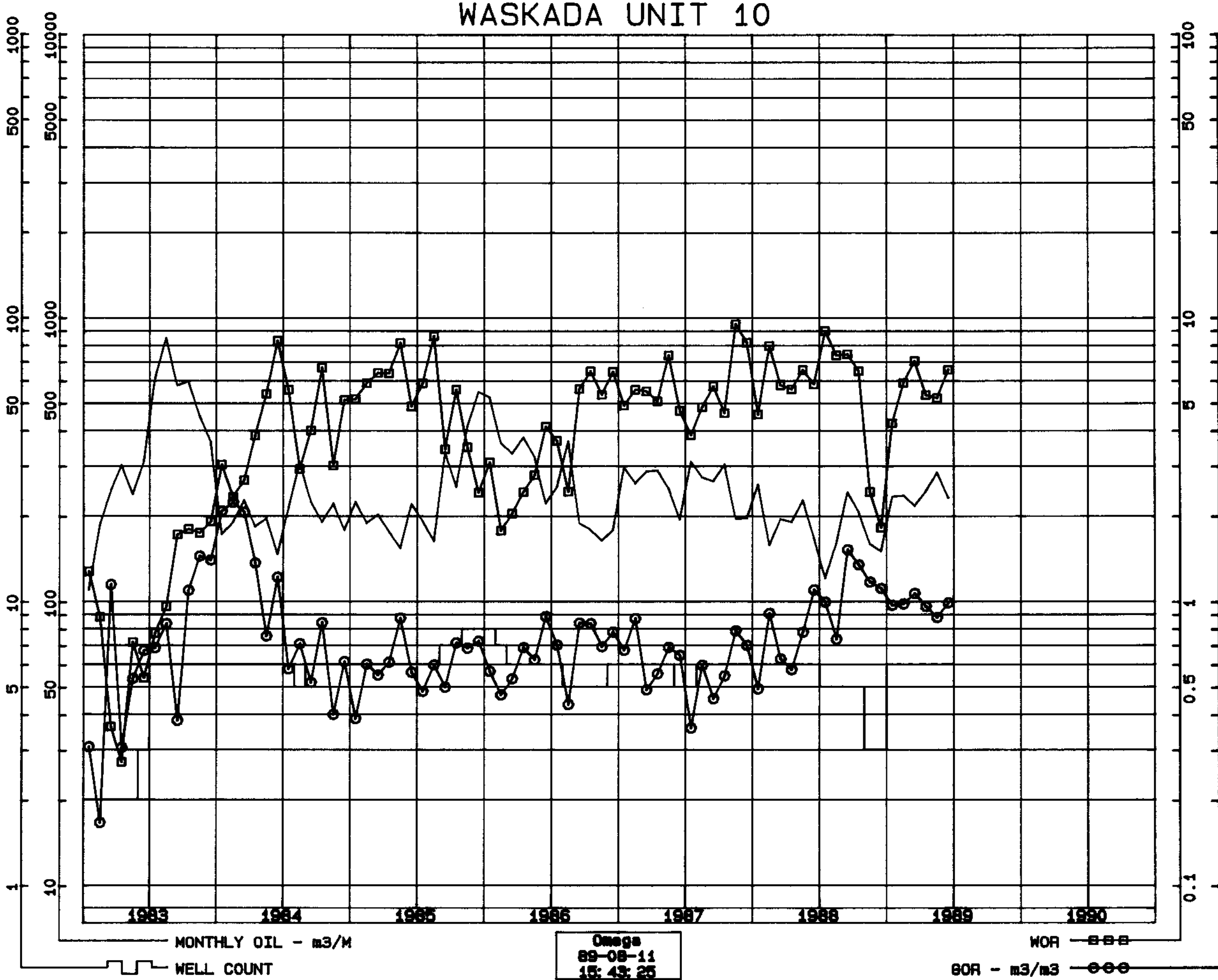
10
5
1
10000
5000
1000
500
100
50
10
100
50
10
5
1
0.5
0.1
10000
5000
1000
500
100
50
10
1983
1984
1985
1986
1987
1988
1989
1990
MONTHLY OIL - m3/M
WELL COUNT
Omega
89-08-11
15:38:37
WOR
GOR - m3/m3

WASKADA UNIT 10



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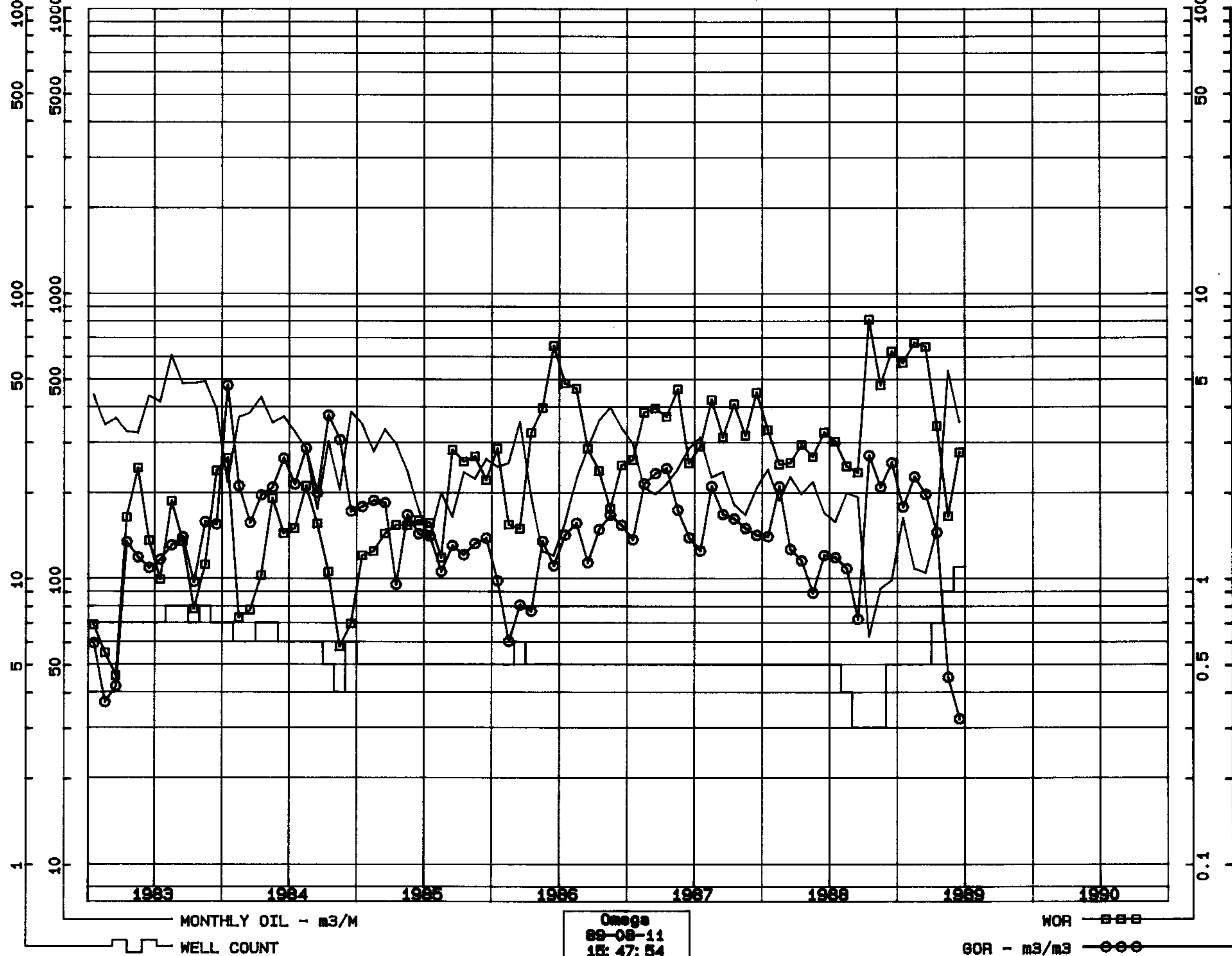

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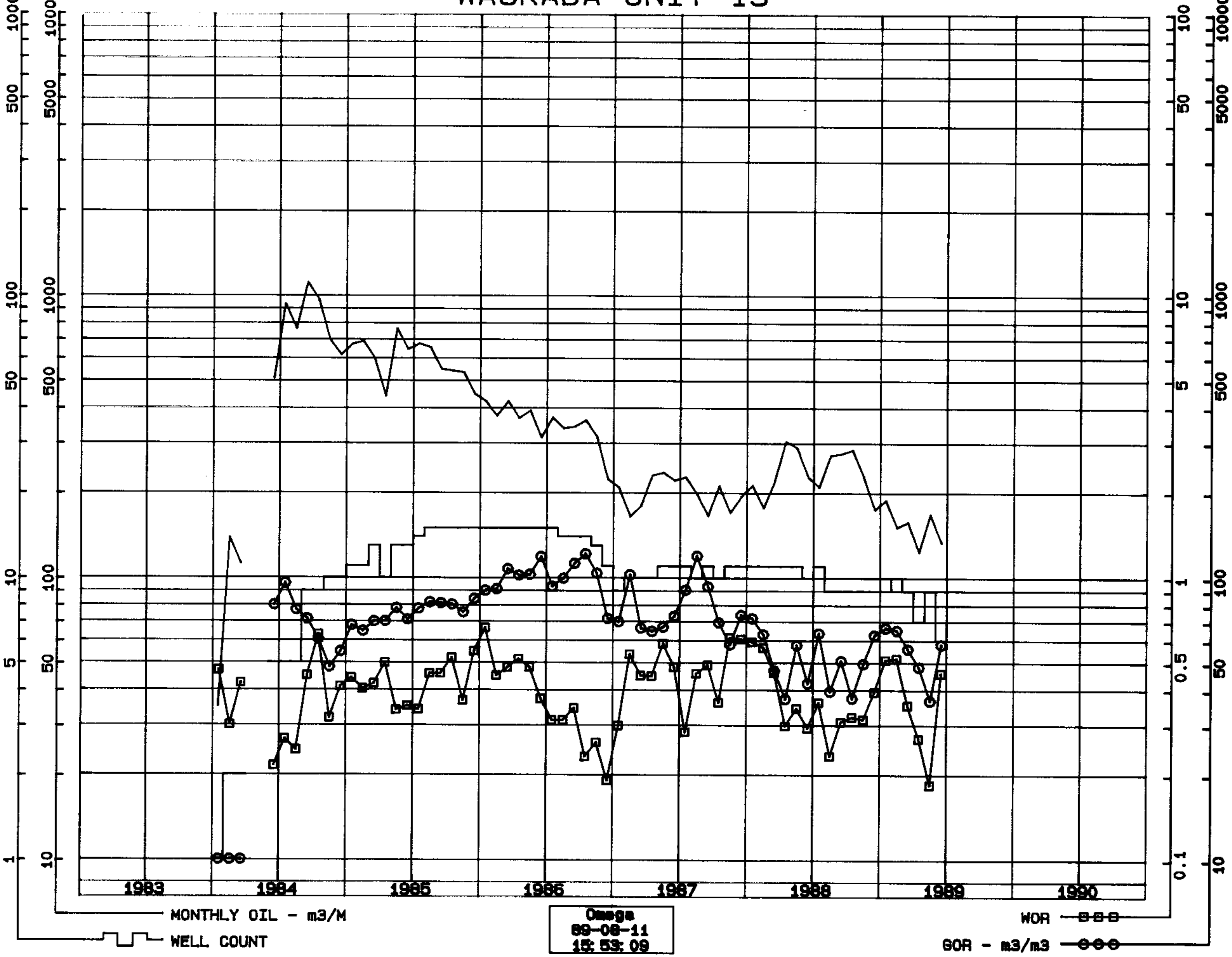

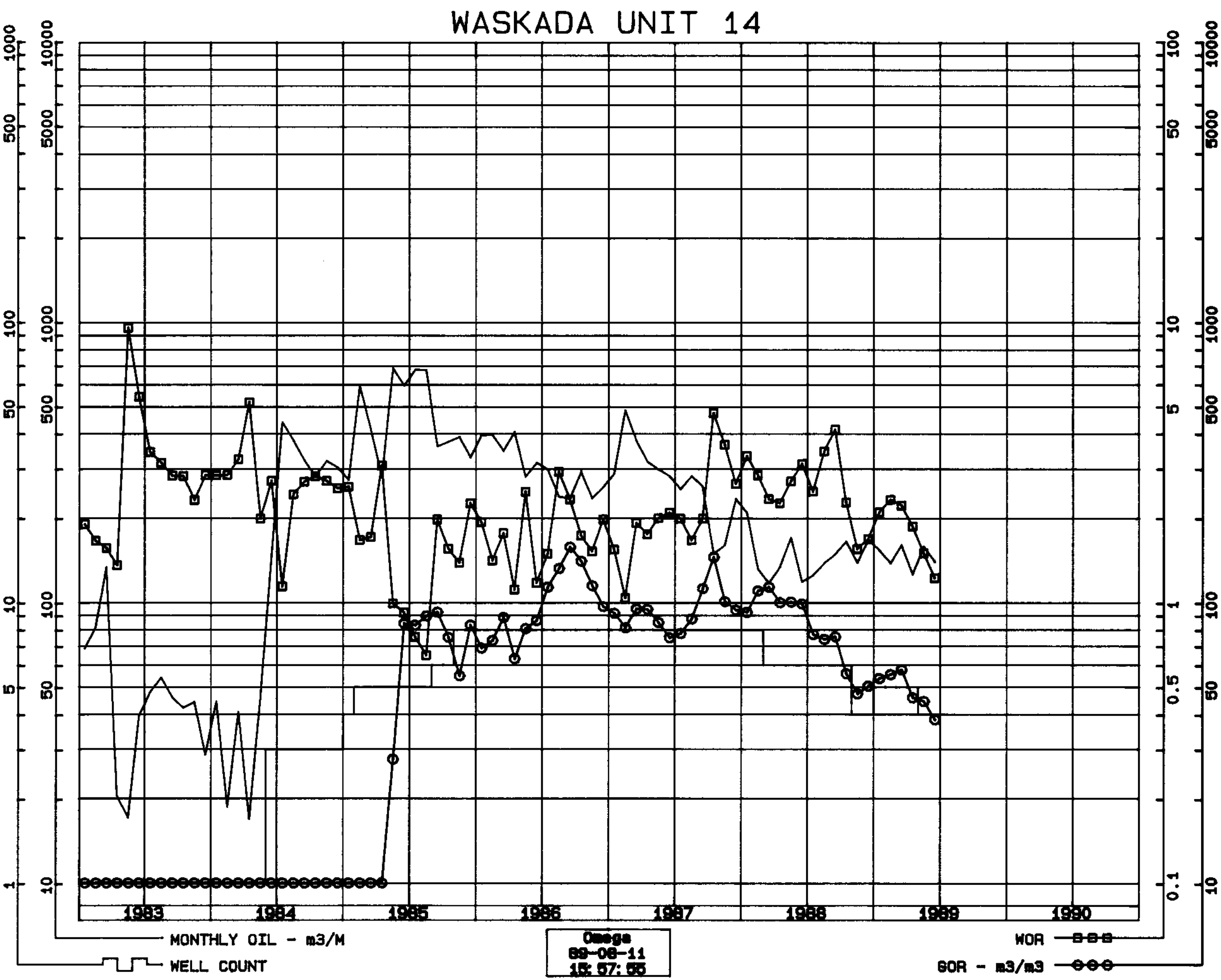
WASKADA UNIT 14
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5000
100
1000
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500
10
100
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1
10
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50
5000
10
1000
5
500
1
100
0.5
50
0.1
10
1983
1984
1985
1986
1987
1988
1989
1990
MONTHLY OIL - m3/M
WELL COUNT
Omega
89-08-11
15:57:55
WOR
GOR - m3/m3

WASKADA UNIT 15