

PennWest

Waskada Unit No.9

Waterflood Progress Report

January 1st – December 31st, 2014

Prepared by: Prabhakar Guriro

Table of Contents

- **Introduction**
- **Unit Information and Geology**
- **Discussion**
 - Production Performance
 - Voidage Replacement Ratio
 - Pressure Surveys
 - Corrosion and Scale Prevention
- **Summary and Recommendations**
- **Attachments**
 - 1- Area Map of Unit
 - 2- Spreadsheet of the Unit Well List and History
 - 3- Production and Injection Plot of the Unit.
 - 4- Spreadsheet of Unit Annual Volumes and Rates.
 - 5- Cumulative Production and Injection Plot of the Unit.
 - 6- Unit Voidage Replacement Ratio Plot.
 - 7- Individual Injection Well Performance Plots.

INTRODUCTION:

The Waskada Unit No.9 pressure maintenance project commenced water injection into the Mission Canyon designed and in accordance with Manitoba Energy and Mines Approval No. PM 49.

Please refer to Attachment 1 – Area Map.

PRESSURE MAINTENANCE: Governed by Board Order No. PM 49

UNIT INFORMATION

UNITIZED ZONE: Mission Canyon
Original Unit, April 1, 1986 Board Order; Voluntary

POOL: Waskada Mission Canyon 3b B (03 42B)

POOL: Waskada Mission Canyon 3b C (03 42C) – one well 02/12-27-001-26W1/0

This report documents the performance of the Waskada Unit No.9 pressure maintenance project for the period of January 1 to December 31, 2014. The Unit had production from 1 well and no injection in 2014.

Unit 9 is part of the main Waskada field. The Waskada field is situated on the northeast rim of the Williston Basin in southern Manitoba. It comprises a large portion of Township 1 and 2, Ranges 25 and 26 W1.

GEOLOGY

The Mission Canyon in the Waskada area produces light density crude (approximately 36° API). Stratigraphically the Mission Canyon can be divided up into various members and marker beds (ie. MC3b, MC3a, MC2, MC1). It is overlain by the Charles Formation or the angular Paleozoic/Mississippian Unconformity, with beds dipping to the southwest. The lithology consists of complex interbedded grainstones, packstones, wackestones, and mudstones with some members consisting of predominantly primary anhydrite (ie. MC2). Porous members typically have porosity of 13-15% and permeabilities of 20-40 mD), although localized alteration due to the truncating Mississippian Unconformity can significantly reduce or eliminate those values in certain areas. Oil accumulation is generally found on isolated structural highs or areas with associated updip permeability degradation.

DISCUSSION

Production and Injection Performance

Board Order No. PM 49 provided for pressure maintenance operations in Waskada Unit No.9. The Unit includes 2 injection wells and 10 producers. None are currently active except 14-27, a producer. Pressure maintenance by water injection began in May 1986 and ceased in January 1988 when former Operator Omega made application to suspend water injection.

Please refer to Attachment 2 – A summary of the Unit Well List and History.

Please refer to Attachment 3 – A Production and Injection plot of the Unit.

Please refer to Attachment 4 – A summary of Unit Annual Volumes and Rates.

Please refer to Attachment 5 – A Cumulative Production and Injection plot of the Unit.

Voidage Replacement Ratio Calculation:

The Cumulative VRR from production start is at 0.10 and the Cumulative VRR from injection start is at 0.15. Both have declined gradually since ceasing injection in 1988. The VRR's for the short period of injection in the late 1980's struggled to reach unity. Currently there is no active injector in this Unit and PennWest has no plans to reactivate injection.

Please refer to Attachment 6 – A Unit Voidage Replacement Ratio Plot.

Please refer to Attachment 7 – Individual Injection Well Performance Plots

Pressure Surveys:

No pressure surveys were conducted in 2014.

Corrosion and Scale Prevention Program:

Scale corrosion programs are implemented throughout the field. Wells and pipelines have mitigation measures in place.

SUMMARY AND RECOMMENDATIONS

Since there is only one producer and no injection wells in this unit, we do not have any plans for this unit other than monitoring the only producer.

ATTACHMENT 1 – UNIT AREA MAP

PENN WEST EXPLORATION

OFM 2012 WASKADA

- ◆ Oil Producer
- + Plugged & Abandoned



ATTACHMENT 2- UNIT HISTORY

Unit History : Waskada - Unit #9

<i>UWI</i>	<i>Completion Date</i>	<i>Operator</i>	<i>Status</i>	<i>New Drills</i>	<i>Kb Elevation</i>	<i>Total Depth</i>	<i>First prd Date</i>	<i>Cum Oil Prd</i>	<i>Cum Water Prd</i>	<i>Last Prd Date</i>	<i>First Inj Date</i>	<i>Cum Water Inj</i>	<i>Cum Gas Inj</i>	<i>Last Inj Date</i>
					<i>m</i>	<i>m</i>		<i>m3</i>	<i>m3</i>			<i>m3</i>	<i>scm</i>	
00/01-34-001-26W1/0	11/27/1984	PENN_WEST	ABD-OIL	<N/A>	468.10	960.00	12/1/1984	281.20	4176.30	2/1/1986	1/1/1987	14027.80	0.00	1/1/1988
00/02-34-001-26W1/0	3/16/1983	OMEGA_HYDROC	ABD-OIL	<N/A>	469.50	964.00	6/1/1983	20.70	369.50	8/1/1983		0.00	0.00	
00/11-27-001-26W1/0	9/18/1982	OMEGA_HYDROC	ABD-OIL	<N/A>	468.10	951.00	10/1/1982	2584.70	6471.50	10/1/1989	5/1/1986	19497.40	0.00	12/1/1986
00/13-27-001-26W1/0	12/13/1982	PENN_WEST	ABD-OIL	<N/A>	466.10	957.00	12/1/1982	11442.70	63342.10	2/1/1996		0.00	0.00	
00/14-27-001-26W1/0	11/23/1982	PENN_WEST	OIL	<N/A>	467.20	950.00	12/1/1982	13179.50	73372.50	1/1/2015		0.00	0.00	
00/15-27-001-26W1/0	2/6/1983	OMEGA_HYDROC	ABD-OIL	<N/A>	467.80	948.00	2/1/1983	5156.10	20053.40	10/1/1989		0.00	0.00	
00/16-27-001-26W1/0	10/25/1982	PENN_WEST	ABD-OIL	<N/A>	467.10	955.00	12/1/1982	10801.50	43800.90	4/1/1991		0.00	0.00	
02/12-27-001-26W1/2	7/11/1983	PENN_WEST	ABD-OIL	<N/A>	466.50	948.00	2/1/1986	2850.70	20555.80	2/1/1993		0.00	0.00	
02/13-27-001-26W1/2	6/22/1983	PENN_WEST	ABD-OIL	<N/A>	466.10	957.00	3/1/1989	65.50	2845.90	4/1/1991		0.00	0.00	
02/15-27-001-26W1/2	6/5/1983	OMEGA_HYDROC	ABD-OIL	<N/A>	468.80	952.00	3/1/1989	50.30	9217.00	2/1/1991		0.00	0.00	
02/16-27-001-26W1/2	6/9/1983	PENN_WEST	ABD-OIL	<N/A>	468.80	954.00	6/1/1990	576.90	15167.30	6/1/1996		0.00	0.00	

ATTACHMENT 3 – UNIT PRODUCTION AND INJECTION PLOT

PENN WEST

UNIT: WASKADA_UNIT_NO_9_-_PM_49

Last Prod/Inj Date: 201501

Cumulative Water Prod : 259.37 Mm3

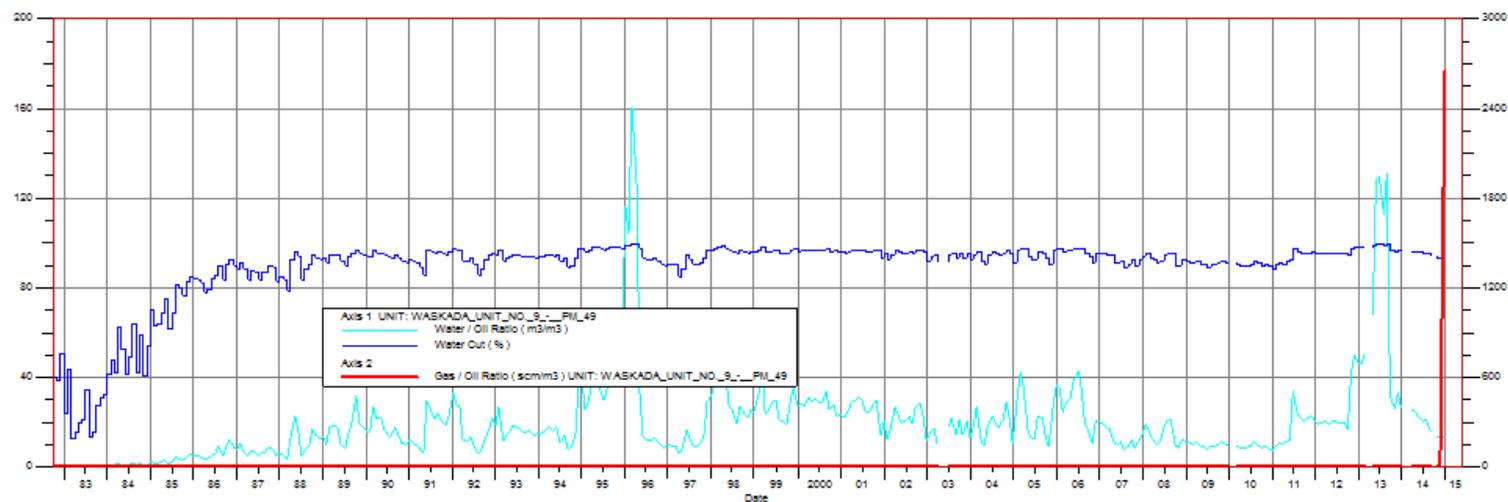
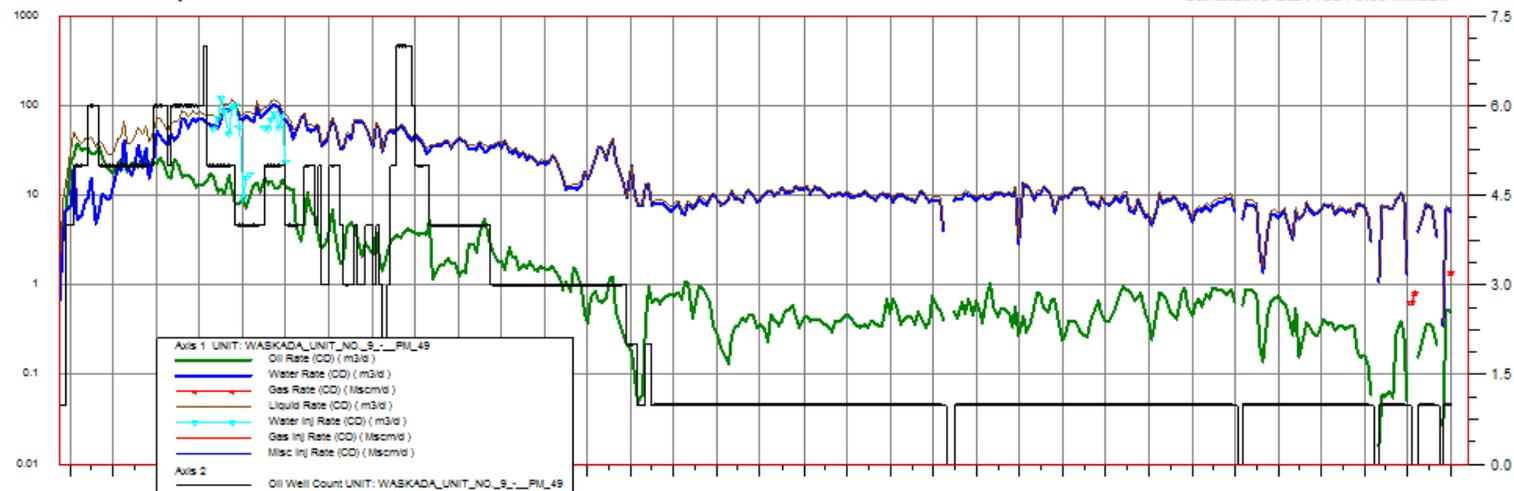
Cumulative Oil Prod : 47.01 Mm3

Cumulative Gas Prod : 0.08 MMscm

Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 33.53 Mm3

Cumulative Misc Inj : 0.00 MMscm



ATTACHMENT 4 –UNIT ANNUAL VOLUMES AND RATES

Unit : Waskada - Unit # 9 --PM49

Rates and Volume History

<i>Date</i>	<i>Annual Oil Prd</i>	<i>Annual Oil Rate</i>	<i>Annual Water Prod</i>	<i>Annual Water Prod Rate</i>	<i>Annual Water Inj</i>	<i>Annual Water Inj Rate</i>	<i>Annual Gas Inj</i>	<i>Annual Gas Inj rate</i>
	<i>m3</i>	<i>m3/d</i>	<i>m3</i>	<i>m3/d</i>	<i>m3</i>	<i>m3/d</i>	<i>Mscm</i>	<i>Mscm/d</i>
1/1/1981	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
1/1/1982	401.10	1.10	339.80	0.93	0	0.00	0.00	0.00
1/1/1983	10722.30	29.38	3450.50	9.45	0	0.00	0.00	0.00
1/1/1984	8359.40	22.84	8730.70	23.85	0	0.00	0.00	0.00
1/1/1985	6953.70	19.05	19766.00	54.15	0	0.00	0.00	0.00
1/1/1986	4623.00	12.67	27610.70	75.65	19497	53.42	0.00	0.00
1/1/1987	4474.80	12.26	30347.80	83.14	13295	36.43	0.00	0.00
1/1/1988	2481.10	6.78	20433.50	55.83	733	0.00	0.00	0.00
1/1/1989	1309.90	3.59	19772.70	54.17	0	0.00	0.00	0.00
1/1/1990	1134.60	3.11	17856.70	48.92	0	0.00	0.00	0.00
1/1/1991	967.10	2.65	13640.40	37.37	0	0.00	0.00	0.00
1/1/1992	983.40	2.69	13127.20	35.87	0	0.00	0.00	0.00
1/1/1993	651.40	1.78	10602.90	29.05	0	0.00	0.00	0.00
1/1/1994	441.90	1.21	6492.20	17.79	0	0.00	0.00	0.00
1/1/1995	237.10	0.65	8990.70	24.63	0	0.00	0.00	0.00
1/1/1996	182.90	0.50	3651.70	9.98	0	0.00	0.00	0.00
1/1/1997	277.90	0.76	2918.40	8.00	0	0.00	0.00	0.00
1/1/1998	117.70	0.32	3459.60	9.48	0	0.00	0.00	0.00
1/1/1999	152.40	0.42	4030.90	11.04	0	0.00	0.00	0.00
1/1/2000	145.40	0.40	4066.70	11.11	0	0.00	0.00	0.00
1/1/2001	148.10	0.41	3656.50	10.02	0	0.00	0.00	0.00
1/1/2002	167.10	0.46	3482.50	9.54	0	0.00	0.00	0.00
1/1/2003	167.40	0.46	2715.60	7.44	0	0.00	0.00	0.00
1/1/2004	214.10	0.58	3689.80	10.08	0	0.00	0.00	0.00
1/1/2005	194.00	0.53	3662.50	10.03	0	0.00	0.00	0.00

1/1/2006	141.50	0.39	3587.60	9.83	0	0.00	0.00	0.00
1/1/2007	247.50	0.68	2978.50	8.16	0	0.00	0.00	0.00
1/1/2008	218.70	0.60	2871.20	7.84	0	0.00	0.00	0.00
1/1/2009	277.10	0.76	2773.40	7.60	0	0.00	0.00	0.00
1/1/2010	211.20	0.58	1946.40	5.33	0	0.00	0.00	0.00
1/1/2011	153.50	0.42	2207.70	6.05	0	0.00	0.00	0.00
1/1/2012	119.00	0.33	2605.60	7.12	0	0.00	0.00	0.00
1/1/2013	48.30	0.13	2342.90	6.42	0	0.00	0.00	0.00
1/1/2014	69.40	0.19	1354.20	3.71	0	0.00	0.00	0.00
Sum	46994.00		259163.50		33525			

ATTACHMENT 5 – UNIT CUMULATIVE PRODUCTION AND INJECTION PLOT

PENNWEST

UNIT: WASKADA_UNIT_NO_9_-_PM_49

Cumulative Water Prod : 259.37 Mm3

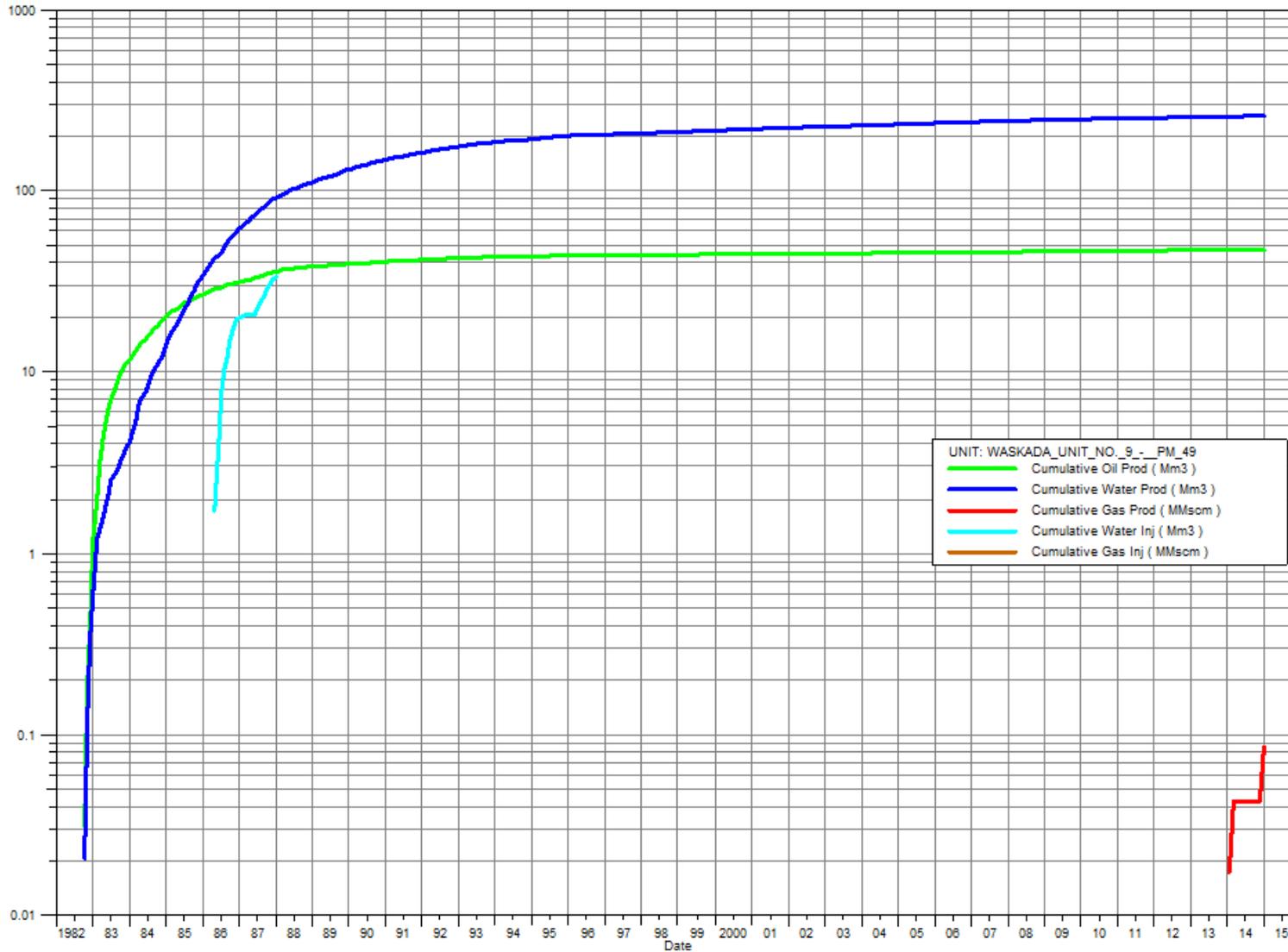
Cumulative Oil Prod : 47.01 Mm3

Cumulative Gas Prod : 0.08 MMscm

Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 33.53 Mm3

Last Prod/Inj Date: 201501



ATTACHMENT 6 – UNIT VOIDAGE REPLACEMENT RATIO PLOT

PENNWEST

UNIT: WASKADA_UNIT_NO_9_-_PM_49

Cumulative Water Prod : 259.37 Mm3

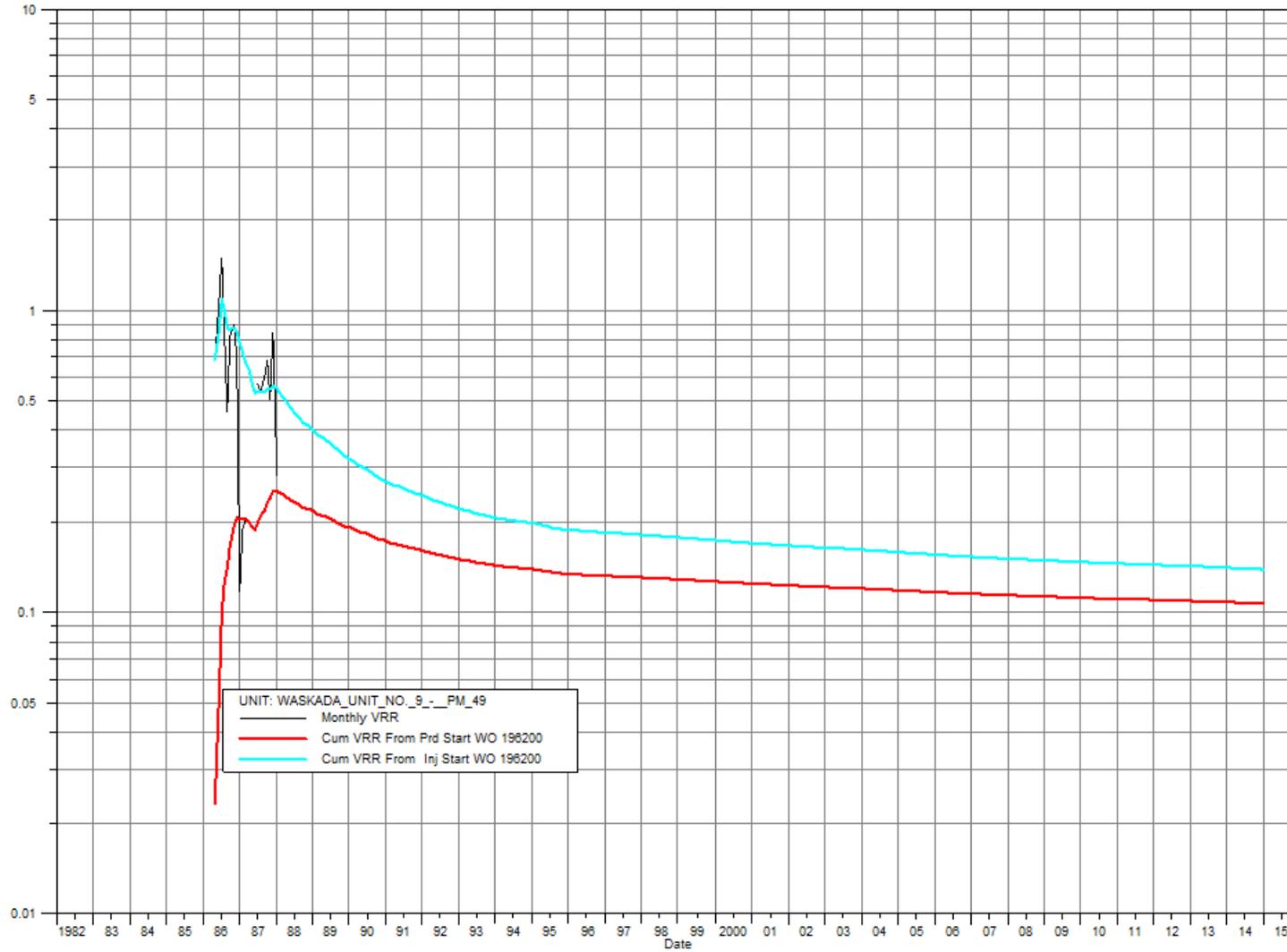
Cumulative Oil Prod : 47.01 Mm3

Cumulative Gas Prod : 0.08 Mm3scm

Cumulative Gas Inj : 0.00 Mm3scm

Cumulative Water Inj : 33.53 Mm3

Last Prod/Inj Date: 201501



ATTACHMENT 7 – INDIVIDUAL INJECTION WELL PERFORMANCE PLOTS (2 WELLS)

Status: ABO-OIL

Unit: WA BKADA_UNIT_NO_9_..._PW_49

Zone: MISSION_CANYON_3B_B

Operator: PENN_WEST Approval: Amaranth

PENNWEST EXPLORATION

00/01-34-001-26W1/0

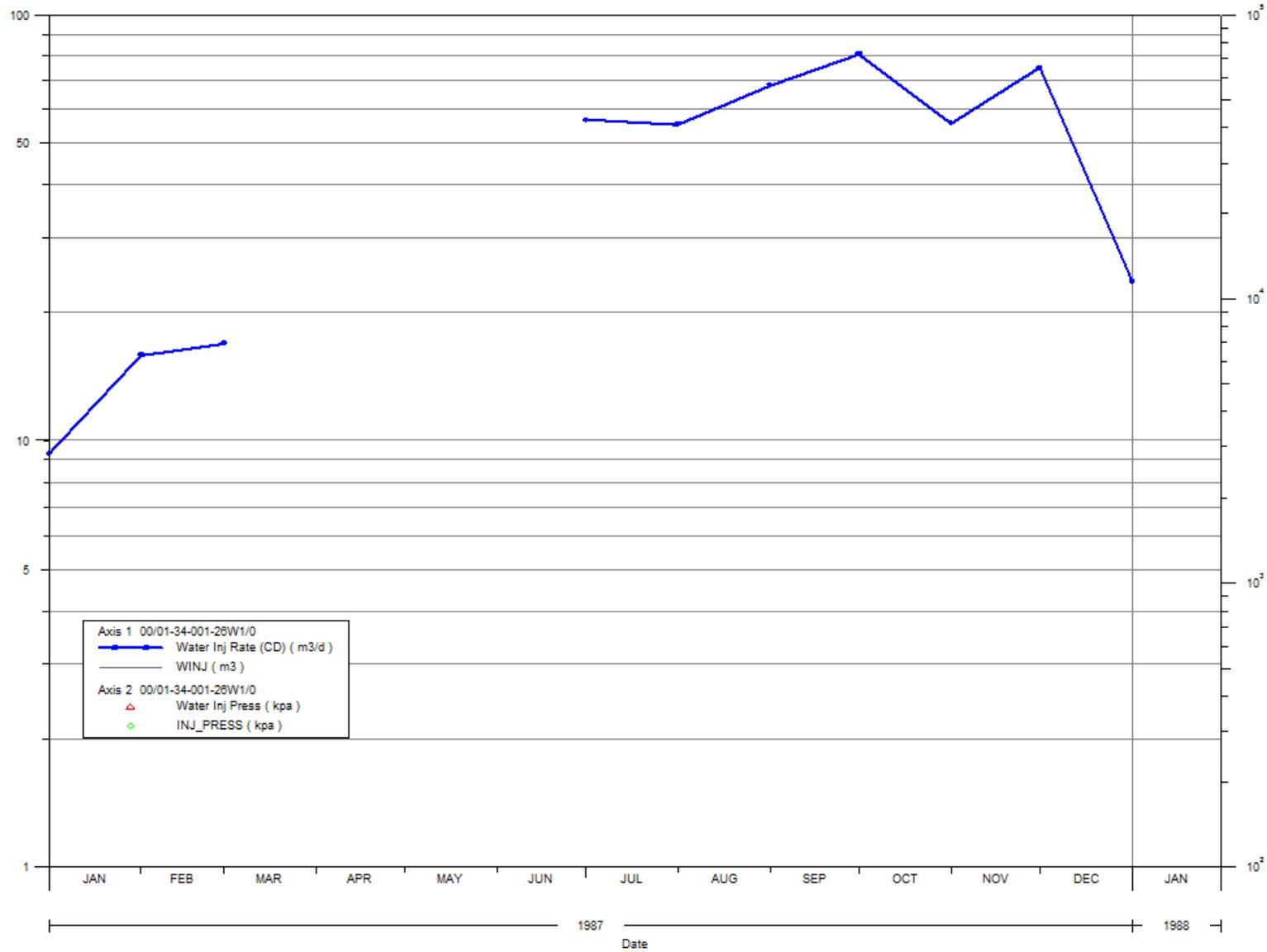
Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 14.03 MM3

Cumulative Water Prod : 4.18 MM3

Cumulative Oil Prod : 0.28 MM3

Cumulative Gas Prod : 0.00 MMscm



Status: ABD-OIL

Unit: WASKADA_UNIT_NO_8_-_FIL49

Zone: MISSION_CANYON_3B_B

Operator: OMEGA_HYDROC Approval: Amaranth

PENNWEST EXPLORATION

00/11-27-001-26W1/0

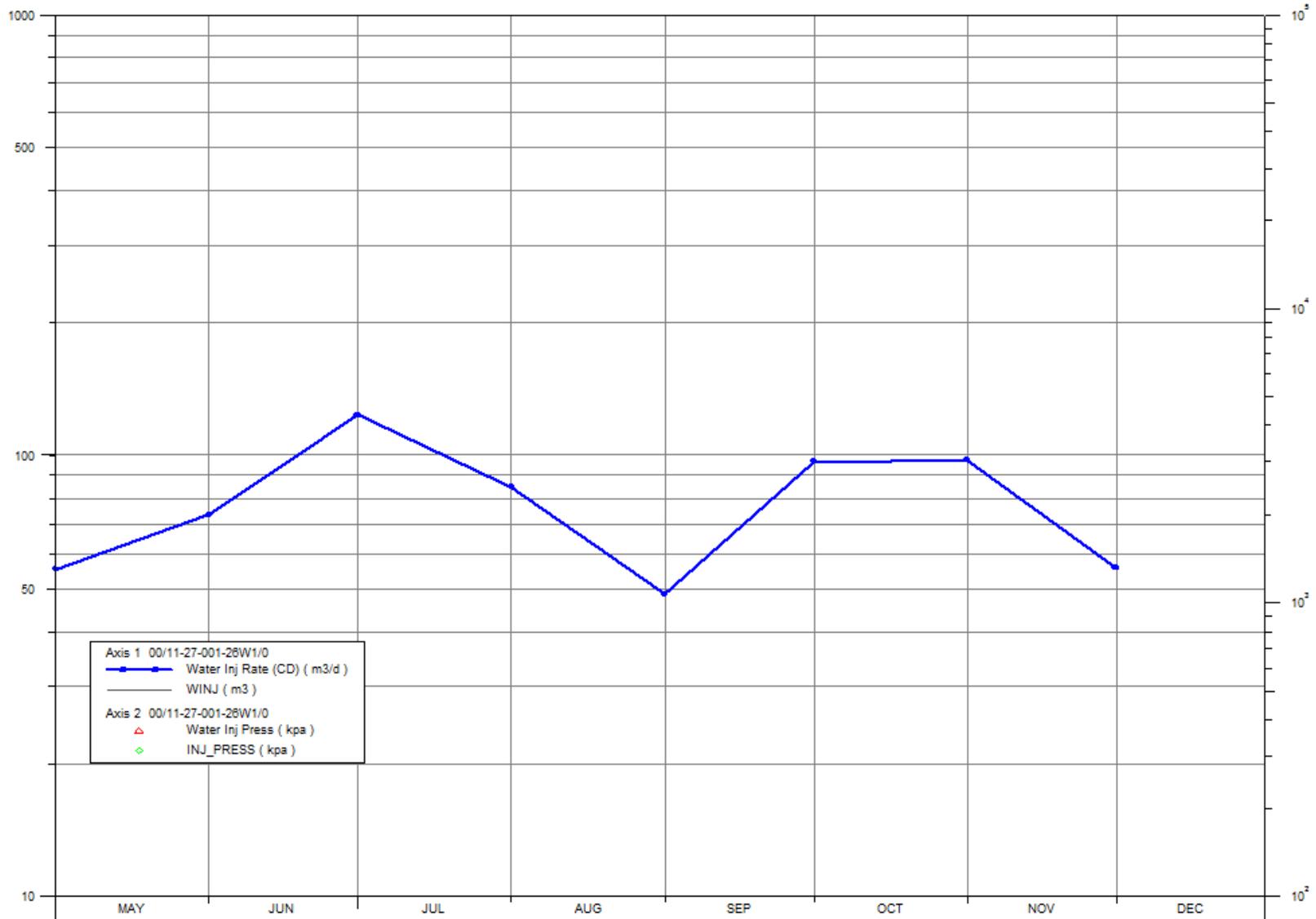
Cumulative Gas Inj : 0.00 MMsm3

Cumulative Water Inj : 19.50 MMm3

Cumulative Water Prod : 6.47 MMm3

Cumulative Oil Prod : 2.58 MMm3

Cumulative Gas Prod : 0.00 MMsm3



Axis 1 00/11-27-001-26W1/0
Water Inj Rate (CD) (m3/d)
WINJ (m3)
Axis 2 00/11-27-001-26W1/0
Water Inj Press (kpa)
INJ_PRESS (kpa)

1988
Date