

PennWest

Waskada Unit No.10

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. 10 pressure maintenance project commenced water injection into the Mission Canyon designed and in accordance with Manitoba Energy and Mines Approval No. PM 46.

Please refer to Attachment 1 – Area Map.

PRESSURE MAINTENANCE: Governed by Board Order No. PM 46

UNIT INFORMATION

UNITIZED ZONE: Mission Canyon
Original Unit, February 1, 1986 Board Order; Voluntary
First Enlargement, September 1, 1986

POOL: Waskada Mission Canyon 3a C (03 43C)

This report documents the performance of the Waskada Unit No.10 pressure maintenance project for the period of January 1 to December 31, 2014. The Unit had no production and injection in 2014.

Unit 10 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 46 provided for pressure maintenance operations in Waskada Unit No.10. The Unit includes 2 abandoned injection wells and 6 producers. 3 wells produced for a short while in 2013, but there has been no production in 2014. Pressure maintenance by water injection began in February 1986 and ceased in March 1987 and has remained shut in since this date. Water injection appears to have accelerated water production while having little positive effect on oil production hence water injection has not been an effective enhanced recovery mechanism. The previous operator, Omega, therefore abandoned the injectors.

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 0.17 and the Cumulative VRR from injection start is at 0.19. Both have declined gradually since ceasing injection in 1987. The Monthly VRR for the short period of injection in the late 1980s was well above 1.0 and could have easily contributed to high water production. 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.

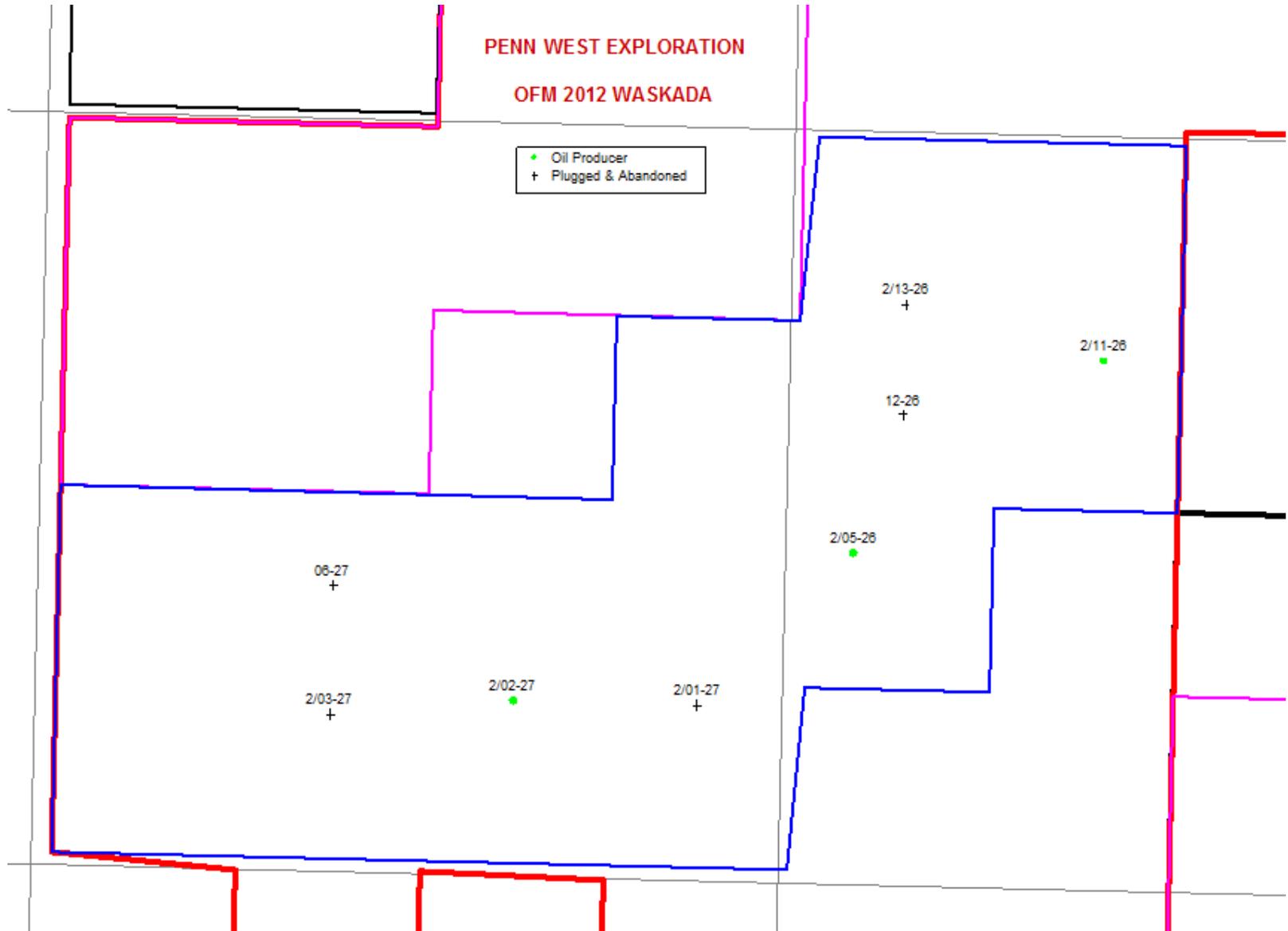
Corrosion and Scale Prevention Program:

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

SUMMARY AND RECOMMENDATIONS

Since there is no active producer and injector well in this unit, we do not have any plans for this unit.

ATTACHMENT 1 – UNIT AREA MAP



ATTACHMENT 2- UNIT HISTORY

Unit History : Waskada -Unit#10

<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>	
00/06-27-001-26W1/0	6/10/1982	PENN_WEST	ABD-OIL	<N/A>	466.60	939.00	6/1/1982	9516.30	72103.60	3/1/1994		0.00	0.00	
00/12-26-001-26W1/0	8/7/1982	PENN_WEST	ABD-OIL	<N/A>	471.10	951.00	10/1/1982	2468.80	10515.60	9/1/1995		0.00	0.00	
02/01-27-001-26W1/0	7/14/1983	PENN_WEST	ABD-OIL	<N/A>	467.80	949.00	11/1/1985	2817.90	3839.80	4/1/1992		0.00	0.00	
02/02-27-001-26W1/0	7/15/1983	PENN_WEST	OIL	<N/A>	467.40	957.00	9/1/1985	6317.30	17903.50	4/1/2013		0.00	0.00	
02/03-27-001-26W1/0	7/5/1983	PENN_WEST	ABD-OIL	<N/A>	466.30	950.00	7/1/1983	1111.10	6683.30	2/1/1986	3/1/1986	23063.40	0.00	3/1/1987
02/05-26-001-26W1/0	7/3/1983	PENN_WEST	PMP-OIL	<N/A>	470.00	955.00	7/1/1983	9962.80	42074.70	2/1/2013		0.00	0.00	
02/11-26-001-26W1/0	7/9/1983	PENN_WEST	PMP-OIL	<N/A>	473.70	950.00	7/1/1983	11223.80	59764.10	5/1/2013		0.00	0.00	
02/13-26-001-26W1/0	6/18/1983	PENN_WEST	ABD-WINJ	<N/A>	469.10	950.00	6/1/1983	606.60	5841.50	1/1/1986	2/1/1986	20396.10	0.00	3/1/1987

ATTACHMENT 3 – UNIT PRODUCTION AND INJECTION PLOT

PENN WEST

UNIT: WASKADA_UNIT_NO_10_-_PM_46

Cumulative Water Prod : 218.73 Mm3

Cumulative Oil Prod : 44.02 Mm3

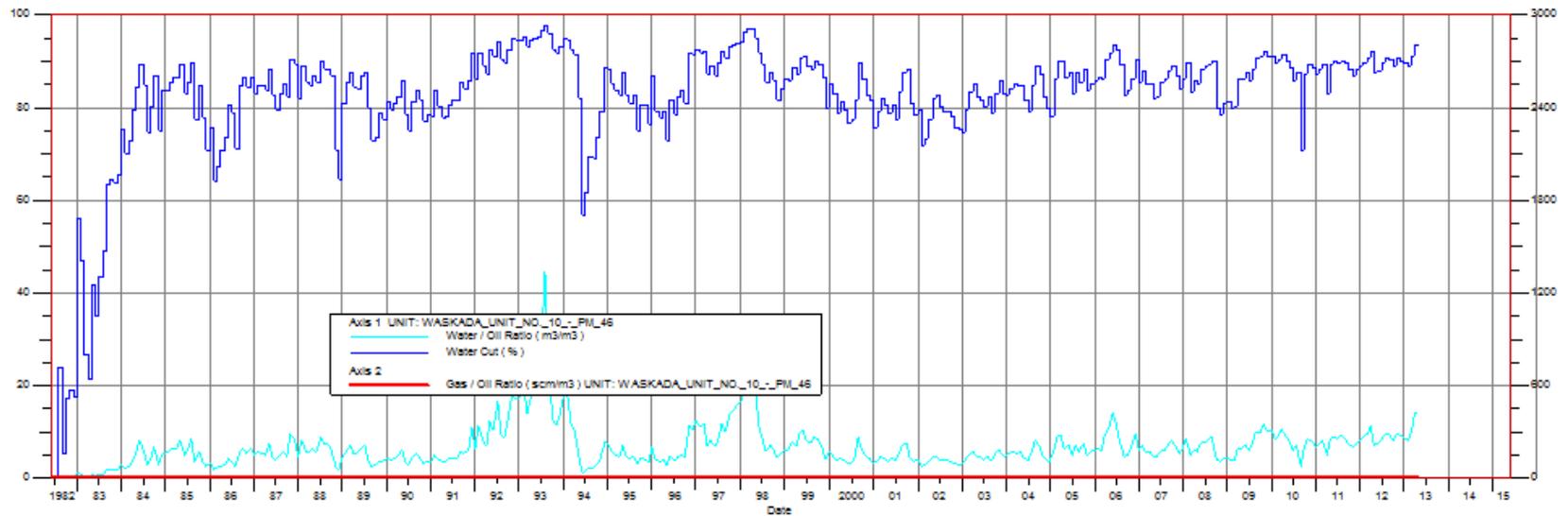
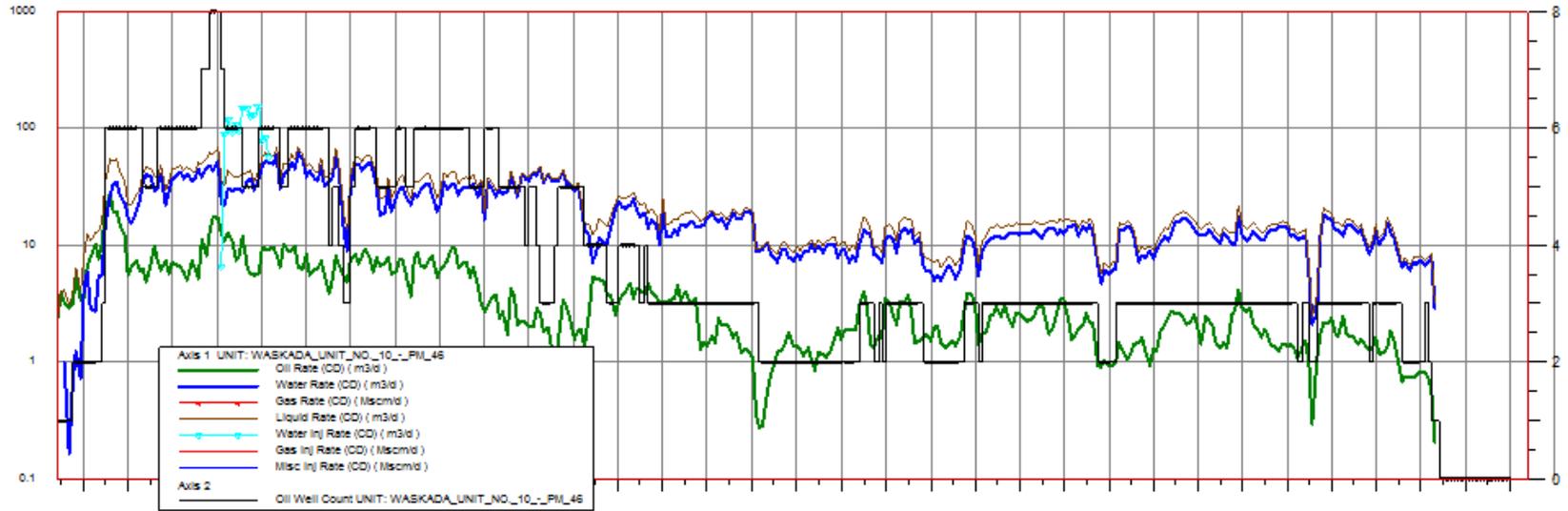
Last Prod/Inj Date: 201305

Cumulative Gas Prod : 0.00 MMscm

Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 43.46 Mm3

Cumulative Misc Inj : 0.00 MMscm



ATTACHMENT 4 –UNIT ANNUAL VOLUMES AND RATES

Unit : Waskada - Unit # 10 --PM46								
Rates and Volume History								
Date	Annual Oil Prd	Annual Oil Rate	Annual Water Prod	Annual Water Prod Rate	Annual Water Inj	Annual Water Inj Rate	Annual Gas Inj	Annual Gas Inj rate
	m3	m3/d	m3	m3/d	m3	m3/d	Mscm	Mscm/d
1/1/1981								
1/1/1982	745.80	2.04	116.10	0.32				
1/1/1983	4862.20	13.32	5681.50	15.57				
1/1/1984	2459.30	6.72	10450.70	28.55				
1/1/1985	3081.90	8.44	14962.90	40.99				
1/1/1986	3480.20	9.53	11800.70	32.33	36972	101.29	0.00	0.00
1/1/1987	3134.10	8.59	17724.10	48.56	6487	17.77	0.00	0.00
1/1/1988	2244.20	6.13	13246.10	36.19				
1/1/1989	2712.00	7.43	13189.30	36.14				
1/1/1990	2461.40	6.74	10116.00	27.72				
1/1/1991	2410.20	6.60	11202.00	30.69				
1/1/1992	1058.70	2.89	11251.00	30.74				
1/1/1993	790.50	2.17	13790.30	37.78				
1/1/1994	1223.10	3.35	5883.20	16.12				
1/1/1995	1429.60	3.92	6861.80	18.80				
1/1/1996	1164.40	3.18	5412.10	14.79				
1/1/1997	616.70	1.69	6347.90	17.39				
1/1/1998	351.50	0.96	3445.40	9.44				
1/1/1999	466.00	1.28	3341.80	9.16				
1/1/2000	767.30	2.10	3450.60	9.43				
1/1/2001	940.90	2.58	3999.80	10.96				
1/1/2002	749.60	2.05	2592.70	7.10				
1/1/2003	882.20	2.42	3962.00	10.85				
1/1/2004	930.40	2.54	4774.40	13.04				
1/1/2005	701.00	1.92	4306.90	11.80				
1/1/2006	445.00	1.22	3616.10	9.91				

1/1/2007	797.50	2.18	4784.10	13.11				
1/1/2008	781.60	2.14	4508.40	12.32				
1/1/2009	708.40	1.94	4654.70	12.75				
1/1/2010	502.40	1.38	4002.60	10.97				
1/1/2011	621.60	1.70	4714.10	12.92				
1/1/2012	410.30	1.12	3576.30	9.77				
1/1/2013	94.60	0.26	960.50	2.63				
1/1/2014	0.00	0.00	0.00	0.00				
Sum	44024.60		218726.10		43460			

ATTACHMENT 5 – UNIT CUMULATIVE PRODUCTION AND INJECTION PLOT

PENNWEST
UNIT: WASKADA_UNIT_NO._10_-_PM_46

Cumulative Water Prod : 218.73 Mm3

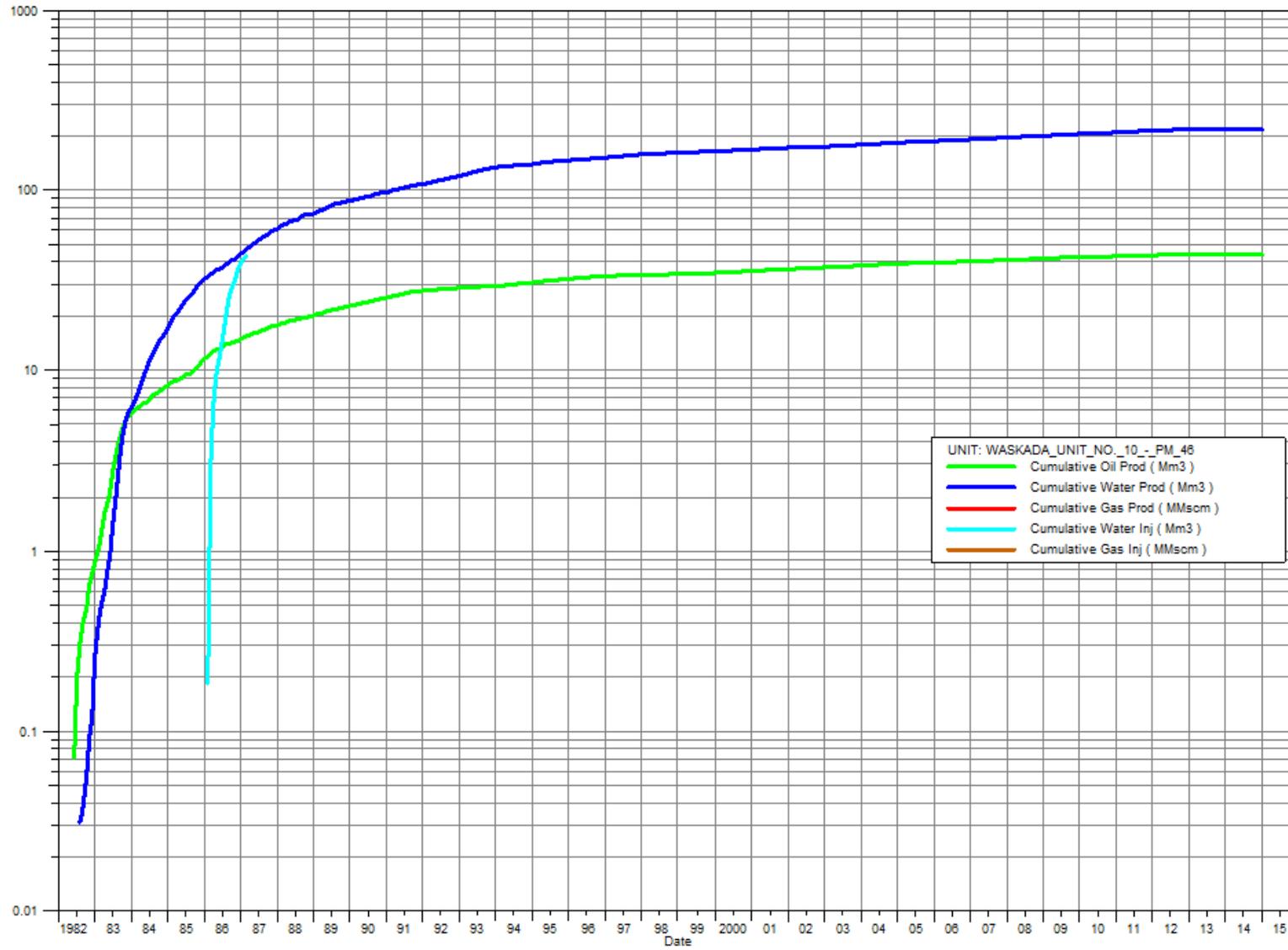
Cumulative Oil Prod : 44.02 Mm3

Cumulative Gas Prod : 0.00 MMscm

Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 43.46 Mm3

Last Prod/Inj Date: 201305



ATTACHMENT 6 – UNIT VOIDAGE REPLACEMENT RATIO PLOT

PENNWEST

UNIT: WASKADA_UNIT_NO._10_-_PM_46

Cumulative Water Prod : 218.73 MM3

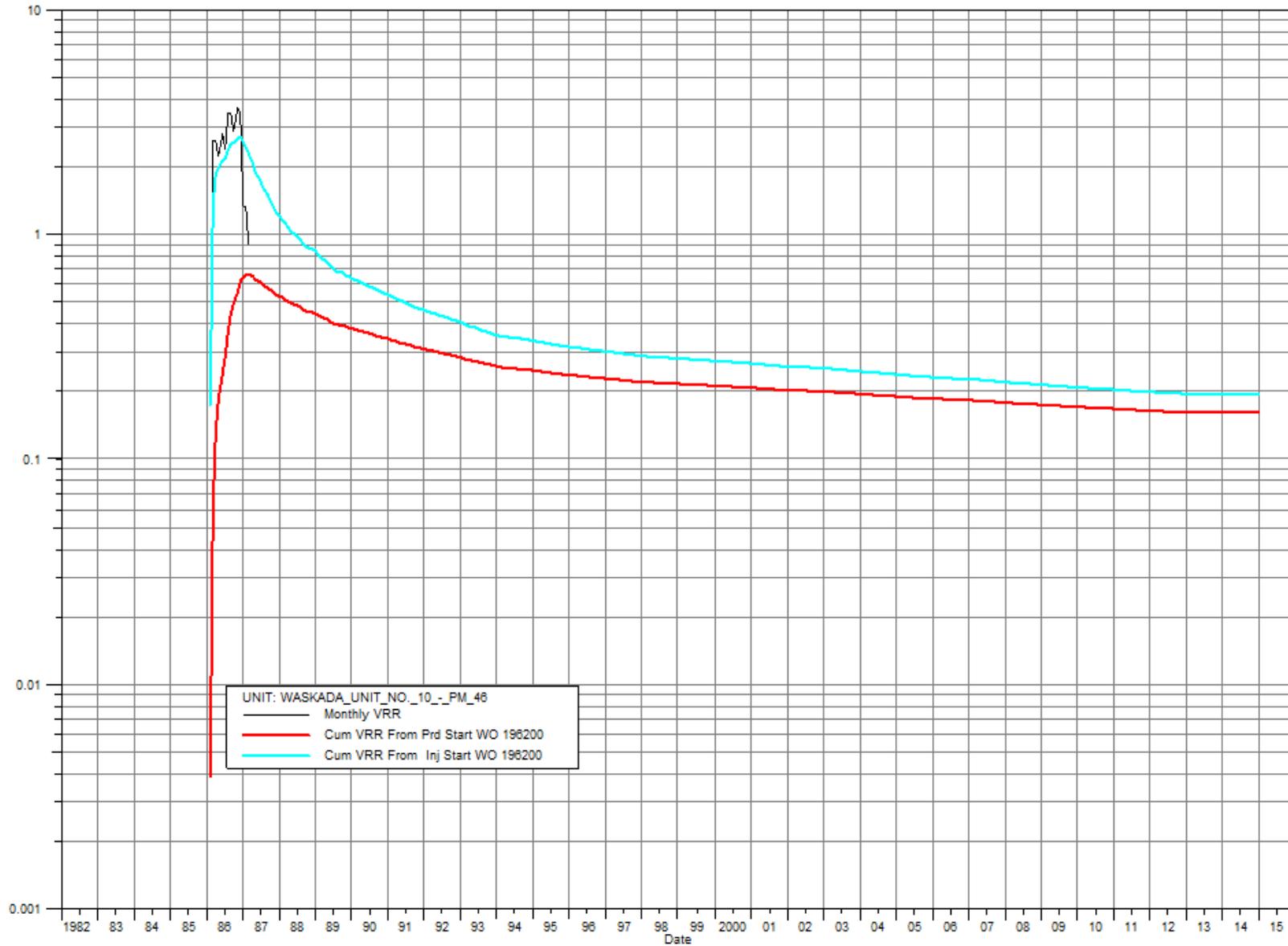
Cumulative Oil Prod : 44.02 MM3

Cumulative Gas Prod : 0.00 MMscm

Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 43.46 MM3

Last Prod/Inj Date: 201305



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

Status: ABD-OIL

Unit: WABKADA_UNIT_NO_10_-_PW_48

Zone: MISSION_CANYON_3A_C

Operator: PENN_WEST Approval: Amaranth

PENNWEST EXPLORATION

02/03-27-001-26W1/0

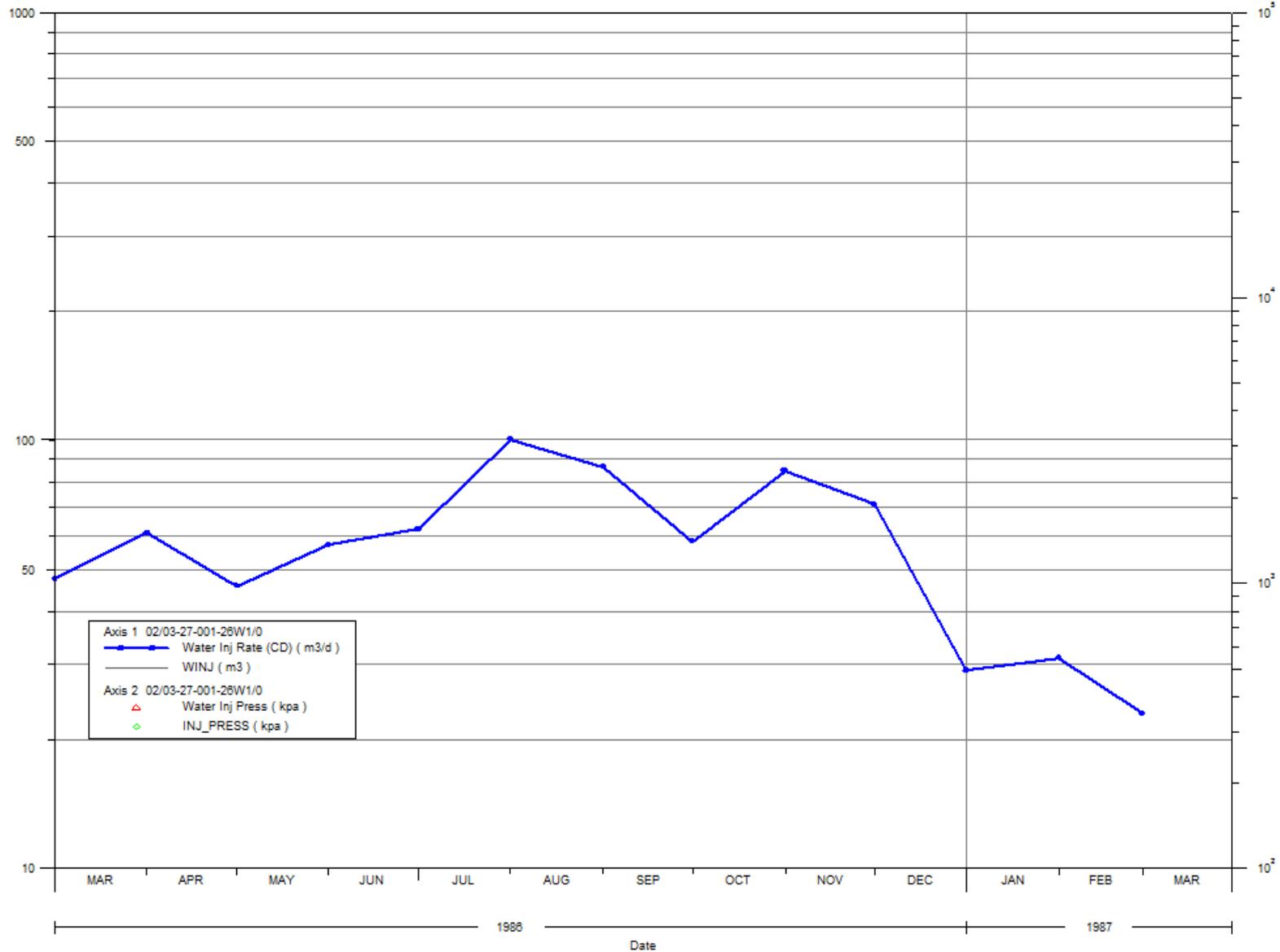
Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 23.06 Mm3

Cumulative Water Prod : 6.68 Mm3

Cumulative Oil Prod : 1.11 Mm3

Cumulative Gas Prod : 0.00 MMscm



Status: ABD-WINJ

Unit: WASKADA_UNIT_NO_10_-_PM_48

Zone: MISSION_CANYON_3A_C

Operator: PENN_WEST Approval: Amaranth

PENNWEST EXPLORATION

02/13-26-001-26W1/0

Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 20.40 Mm3

Cumulative Water Prod : 5.84 Mm3

Cumulative Oil Prod : 0.61 Mm3

Cumulative Gas Prod : 0.00 MMscm

