Waskada Unit No. 12

Waterflood Progress Report

January 1st – December 31st, 2013

PennWest

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Introduction:

The Waskada Unit No. 12 pressure maintenance project commenced water injection into the Mission Canyon designed and in accordance with Manitoba Energy and Mines Approval No. PM 48.

Please refer to Attachment 1 – Area Map.

PRESSURE MAINTENANCE: Governed by Board Order No. PM 48.

Unit Information

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

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

This report documents the performance of the Waskada Unit No.12 pressure maintenance project for the period of January 1 to December 31, 2013. The Unit had production from 2 wells and no injection in 2013.

Unit 12 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^{o} API). Stratigraphically the Mission Canyon can be divided up into various members and marker beds (ie. MC3b, MC3a, MC2, MC1). It is overladen 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 48 provided for pressure maintenance operations in Waskada Unit No.12. The Unit includes 3 abandoned injection wells and 15 producers. 2 wells produced during 2013. Pressure maintenance by water injection began in April 1986 and ceased in March 1993 and has remained shut in since this date. 5 years of primary production with a rapid decline occurred before water injection.Water injection appears to have accelerated water production while oil production perhaps had reduced decline

rates.Hence water injection has not been an effective enhanced recovery mechanism. The previous operator, Omega, 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 0.31 and the Cumulative VRR from injection start is at 0.40. Both have declined gradually since ceasing injection in 1993. The Monthly VRR for the short period of injection in the late 1980s was initially 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 (3)

Pressure Surveys:

No pressure surveys were conducted in 2013.

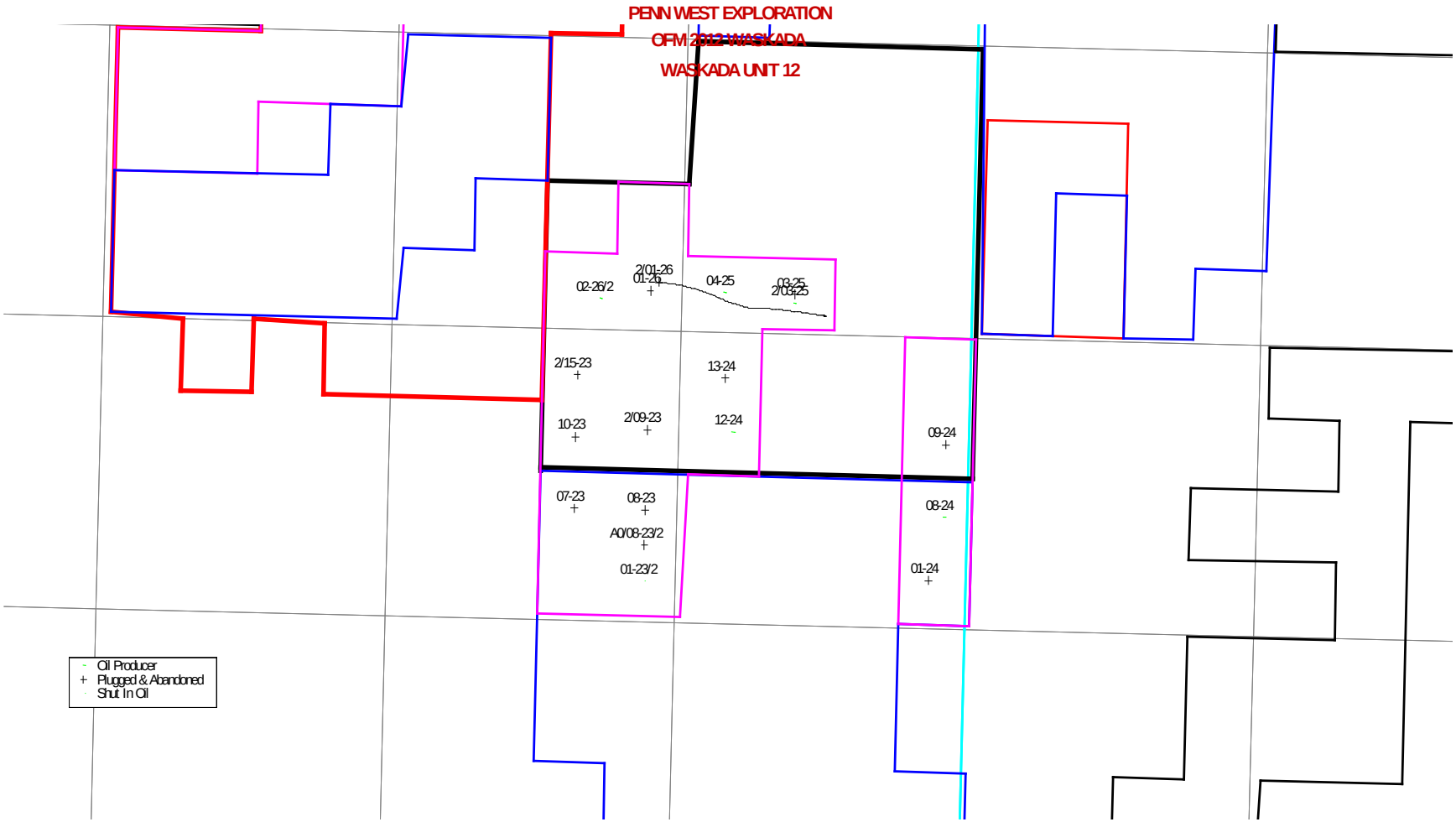
Corrosion and Scale Prevention Program:

We currently inject ScalCor down all the new horizontal wells. PennWest will be installing cathodic protection on the wells. The new gathering system is Fibreglass and as such is not susceptible to corrosion.

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 2 producers.

ATTACHMENT 1 – Unit Area Map



ATTACHMENT 2 Unit History: WASKADA UNIT 12														
					Kelly			Cum	Cum			Cum	Cum	
				New	Bushing	Total	First	Oil	Water	Last	First	Water	Gas	Last
Well	Completion	OPERATOR	STATUS	Drills	Elevation	Depth	Production	Prod	Prod	Production	Injection	Inj	Inj	Injection
	Date				m	m	Date	Mm3	Mm3	Date	Date	Mm3	MMscm	Date
00/01-23-001-26W1/2	7/2/1982	PENN_WEST	SUS-OIL	<N/A>	470.5	953.0	5/1/1989	0.40	0.51	6/1/2002		0.00	0.00	
00/07-23-001-26W1/0	9/20/1982	PENN_WEST	ABD-OIL	<N/A>	470.9	950.0	12/1/1982	0.22	2.49	11/1/1983		0.00	0.00	
00/08-23-001-26W1/0	9/2/1982	PENN_WEST	ABD-OIL	<N/A>	470.4	956.0	12/1/1982	5.62	44.45	6/1/1996		0.00	0.00	
A0/08-23-001-26W1/2	2/28/1991	PENN_WEST	ABD-OIL	<N/A>	468.0	963.0	7/1/1992	0.02	0.08	10/1/1992		0.00	0.00	
02/09-23-001-26W1/0	7/17/1983	PENN_WEST	ABD-OIL	<N/A>	468.9	952.3	4/1/1984	0.12	1.49	9/1/1984	6/1/1987	20.42	0.00	3/1/1993
00/10-23-001-26W1/0	8/30/1982	PENN_WEST	ABD-OIL	<N/A>	465.4	954.0	1/1/1983	2.61	3.42	10/1/1993		0.00	0.00	
02/15-23-001-26W1/0	7/14/1983	PENN_WEST	ABD-OIL	<N/A>	468.8	950.0	8/1/1983	0.31	2.53	8/1/1990	5/1/1986	21.00	0.00	3/1/1988
00/01-24-001-26W1/0	1/18/1981	PENN_WEST	ABD-OIL	<N/A>	468.0	957.0	2/1/1981	3.80	0.47	3/1/1986	4/1/1986	24.83	0.00	11/1/1988
00/08-24-001-26W1/0	10/27/1981	PENN_WEST	OIL	<N/A>	472.1	955.0	11/1/1981	11.04	26.57	1/1/2014		0.00	0.00	
00/09-24-001-26W1/0	12/3/1981	PENN_WEST	ABD-OIL	<N/A>	473.0	944.0	2/1/1982	0.84	0.46	12/1/1991		0.00	0.00	
00/12-24-001-26W1/0	11/6/1981	PENN_WEST	CMG-OIL	<N/A>	468.1	952.0	11/1/1981	2.85	6.47	1/1/2014		0.00	0.00	
00/13-24-001-26W1/0	11/11/1981	PENN_WEST	ABD-OIL	<N/A>	470.0	952.0	4/1/1982	2.92	12.24	7/1/1990		0.00	0.00	
00/03-25-001-26W1/0	7/19/1981	PENN_WEST	ABD-OIL	<N/A>	471.1	956.0	7/1/1981	1.69	1.03	12/1/1982		0.00	0.00	
02/03-25-001-26W1/0	9/12/1982	PENN_WEST	PMP-OIL	<N/A>	471.0	956.0	12/1/1982	11.10	23.62	8/1/2013		0.00	0.00	
00/04-25-001-26W1/0	8/21/1981	PENN_WEST	CMG-OIL	<N/A>	470.8	963.0	9/1/1981	1.99	4.68	2/1/2013		0.00	0.00	
00/01-26-001-26W1/0	9/18/1981	PENN_WEST	ABD-OIL	<N/A>	470.3	960.0	10/1/1981	0.29	1.34	10/1/1990		0.00	0.00	
02/01-26-001-26W1/0	7/17/1994	PENN_WEST	ABD-OIL	<N/A>	471.6	1811.0	7/1/1994	6.78	16.29	1/1/2010		0.00	0.00	
00/02-26-001-26W1/2	11/21/1981	PENN_WEST	CMG-OIL	<N/A>	467.3	952.0	7/1/1989	0.32	0.49	8/1/1991		0.00	0.00	
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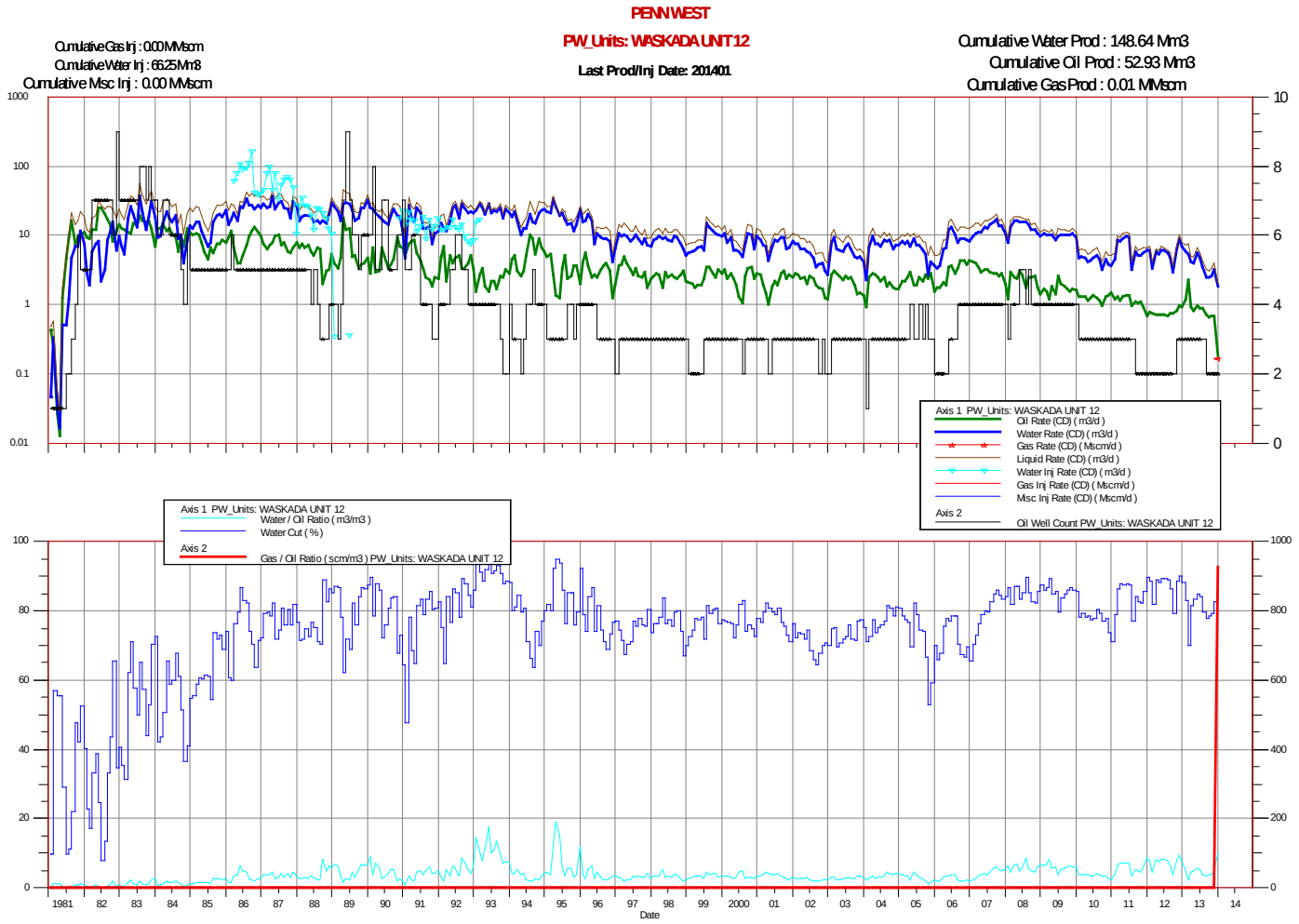
ATTACHMENT 3 – Unit Production and Injection Plot



ATTACHMENT 4	PW_Units: WASKADA UNIT 12								
Rates and Volume History									
	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual	
	Oil	Oil	Water	Water	Water	Water Inj	Gas	Gas Inj	
	Prod	Rate	Prod	Rate	Inj	Rate	Inj	Rate	
Date	m3	m3/d	m3	m3/d	m3	m3/d	Mscm	Mscm/d	
1/1/1981	1816.9	5.0	992.9	2.7					
1/1/1982	5337.4	14.6	2459.9	6.7					
1/1/1983	5125.6	14.0	6662.1	18.3					
1/1/1984	3811.4	10.4	4871.8	13.3					
1/1/1985	2901.4	8.0	5064.8	13.9					
1/1/1986	3066.8	8.4	8584.0	23.5	24010.0	65.8	0.0	0.0	
1/1/1987	2789.1	7.6	9856.4	27.0	21950.0	60.1	0.0	0.0	
1/1/1988	2054.5	5.6	6596.5	18.0	7842.0	21.4	0.0	0.0	
1/1/1989	2454.3	6.7	8796.7	24.1	346.0	1.0	0.0	0.0	
1/1/1990	1807.3	5.0	7577.1	20.8	554.0	1.5	0.0	0.0	
1/1/1991	1771.5	4.9	5499.9	15.1	5719.0	15.7	0.0	0.0	
1/1/1992	1552.1	4.2	7106.8	19.4	4596.0	12.6	0.0	0.0	
1/1/1993	868.5	2.4	8489.1	23.3	1232.0	3.4	0.0	0.0	
1/1/1994	2015.9	5.5	6303.7	17.3					
1/1/1995	1279.0	3.5	7183.9	19.7					
1/1/1996	1162.4	3.2	4551.7	12.4					
1/1/1997	1125.2	3.1	3227.2	8.8					
1/1/1998	937.4	2.6	3104.5	8.5					
1/1/1999	897.1	2.5	3119.1	8.6					
1/1/2000	898.8	2.5	2895.5	7.9					
1/1/2001	809.0	2.2	2798.0	7.7					
1/1/2002	802.1	2.2	2010.0	5.5					
1/1/2003	806.9	2.2	2221.7	6.1					
1/1/2004	757.2	2.1	2548.4	7.0					
1/1/2005	845.5	2.3	2398.5	6.6					
1/1/2006	1052.1	2.9	2835.5	7.8					
1/1/2007	1185.5	3.3	4600.3	12.6					
1/1/2008	847.8	2.3	4866.8	13.3					
1/1/2009	615.5	1.7	3632.7	10.0					
1/1/2010	464.2	1.3	1777.2	4.9					
1/1/2011	433.0	1.2	2362.0	6.5					
1/1/2012	276.2	0.8	2045.0	5.6					
1/1/2013	352.6	1.0	1541.5	4.2					
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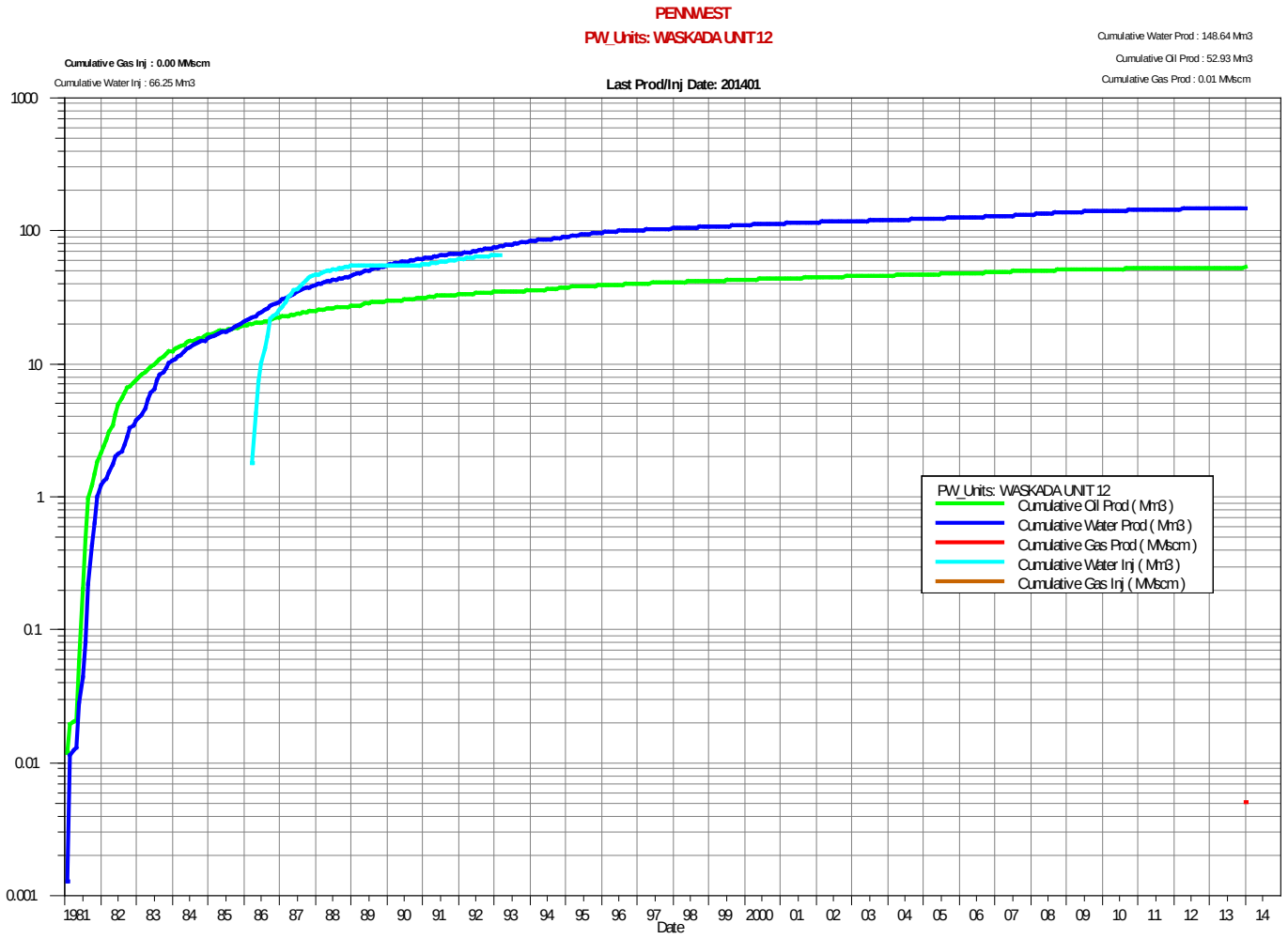
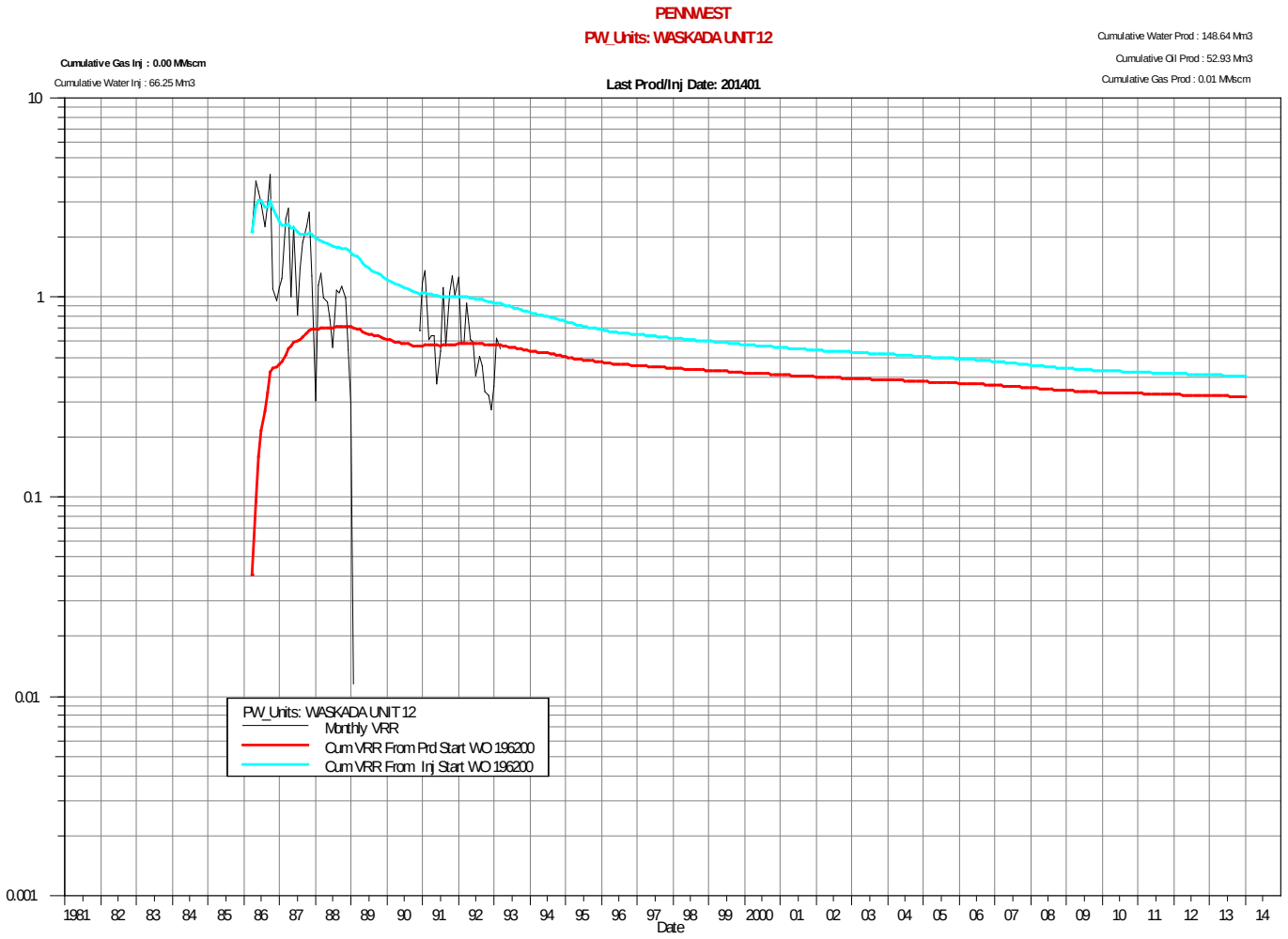
	52920.2		148581.2		66249.0				Sum
3/19/2014 10:40	/								

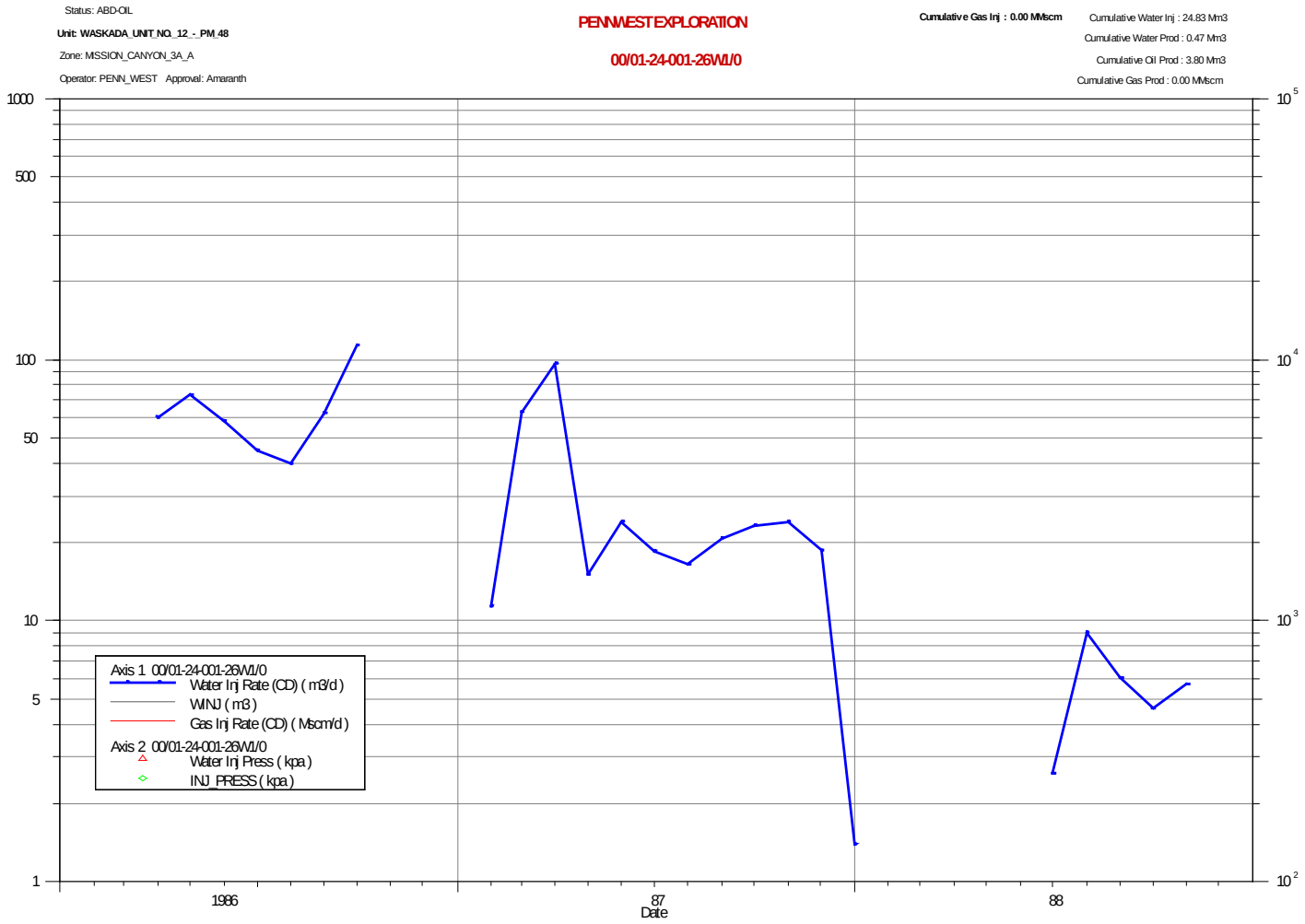
ATTACHMENT 5 – Unit Cumulative Production and Injection Plot

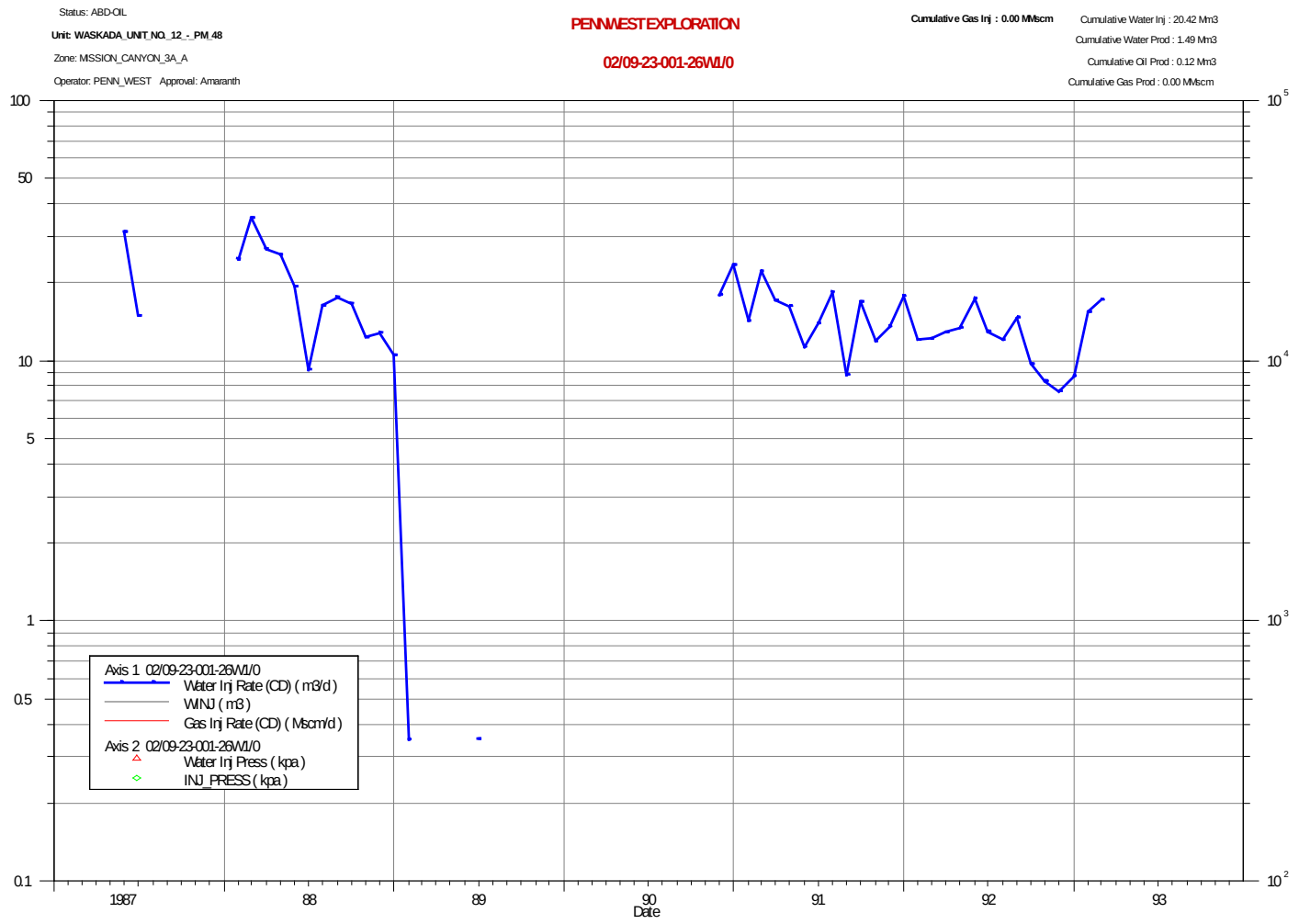


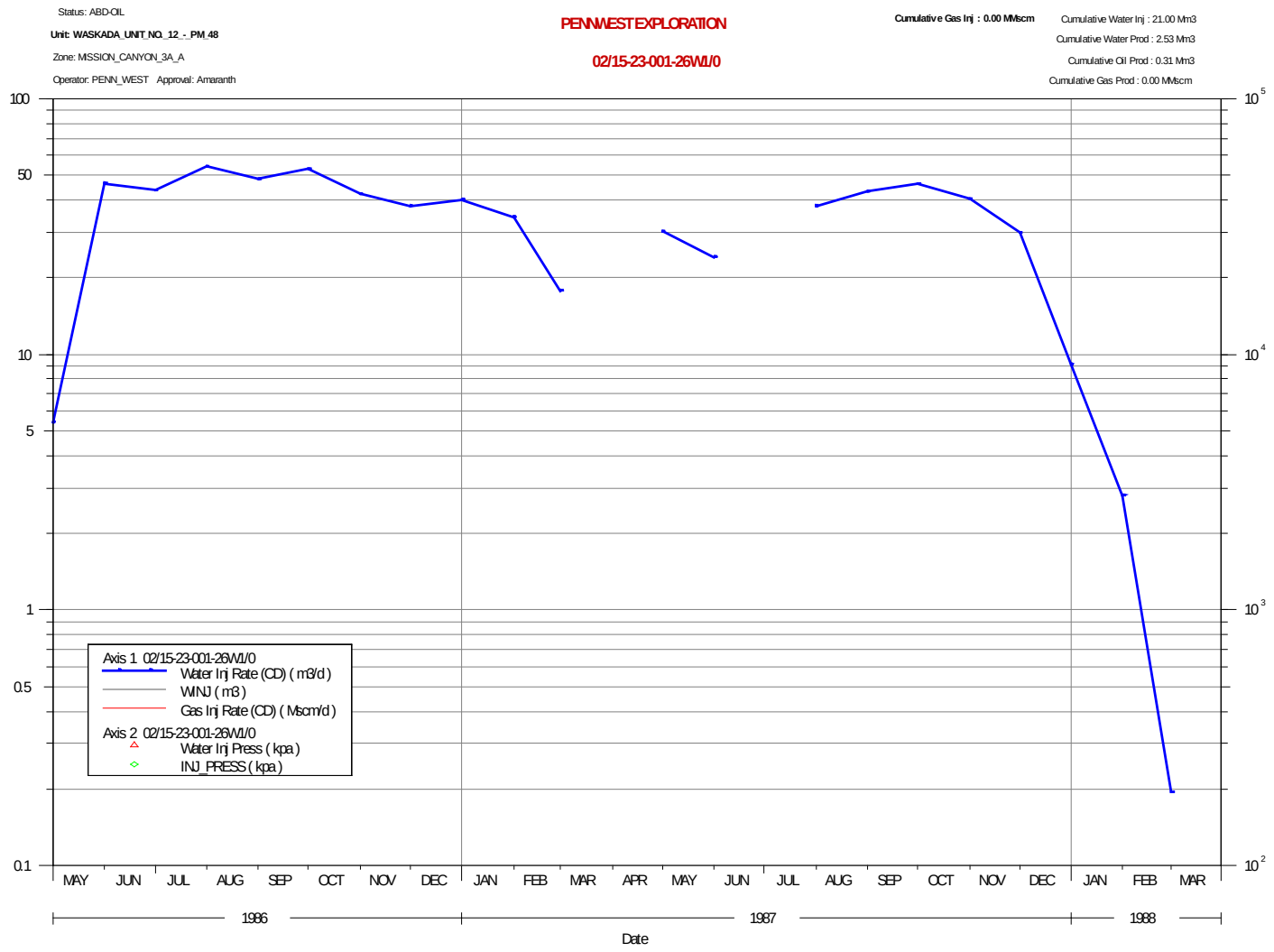
ATTACHMENT 6 – Unit Voidage Replacement Ratio Plot



ATTACHMENT 7 – Individual Injection Well performance Plots (3 Wells)




Status: ABD-OIL
Unit: WASKADA_UNIT NO_12_-_PM_48
Zone: MISSION_CANYON_3A_A
Operator: PENN_WEST Approval: Amaranth
PENNWEST EXPLORATION
02/09-23-001-26W1/0
Cumulative Gas Inj : 0.00 MMscm
Cumulative Water Inj : 20.42 Mm3
Cumulative Water Prod : 1.49 Mm3
Cumulative Oil Prod : 0.12 Mm3
Cumulative Gas Prod : 0.00 MMscm
100
50
10
5
1
0.5
0.1
10^5
10^4
10^3
10^2
Axis 1 02/09-23-001-26W1/0
Water Inj Rate (CD) (m3/d)
WINJ (m3)
Gas Inj Rate (CD) (Mscm/d)
Axis 2 02/09-23-001-26W1/0
Water Inj Press (kpa)
INJ_PRESS (kpa)
1987
88
89
90
91
92
93
Date


Status: ABD-OIL
Unit: WASKADA_UNIT NO_12_-_PM_48
Zone: MISSION_CANYON_3A_A
Operator: PENN_WEST Approval: Amaranth
PENNWEST EXPLORATION
02/15-23-001-26W1/0
Cumulative Gas Inj : 0.00 MMscm
Cumulative Water Inj : 21.00 Mm3
Cumulative Water Prod : 2.53 Mm3
Cumulative Oil Prod : 0.31 Mm3
Cumulative Gas Prod : 0.00 MMscm
100
50
10
5
1
0.5
0.1
10^5
10^4
10^3
10^2
Axis 1 02/15-23-001-26W1/0
Water Inj Rate (CD) (m3/d)
WINJ (m3)
Gas Inj Rate (CD) (Mscm/d)
Axis 2 02/15-23-001-26W1/0
Water Inj Press (kpa)
INJ_PRESS (kpa)
MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR
1986
1987
1988
Date