

Waskada Unit No. 8

Waterflood Progress Report

January 1st – December 31st, 2013

PennWest

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Introduction:

The Waskada Unit No.8 pressure maintenance project commenced water injection into the Lower Amaranth designed and in accordance with Manitoba Energy and Mines Approval No. PM 58.

Please refer to Attachment 1 – Area Map.

PRESSURE MAINTENANCE: Governed by Board Order No. PM 58

Unit Information

UNITIZED ZONE: Lower Amaranth

Original Unit, September 1, 1985 Board Order – Voluntary

First Enlargement, June 1, 1986 Board Order - Voluntary

POOL: Waskada Lower Amaranth A (03 29A)

This report documents the performance of the Waskada Unit No. 8 pressure maintenance project for the period of January 1 to December 31, 2013. The Unit had 4 active producers and 1 active injector at the end of 2013. There were no new drills in 2013.

Unit No. 8 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 Waskada Fields produce light density crude (approximately 36° API), predominantly from the Lower Amaranth formation. This is an interlaminated, shallow marine to subtidal succession of sandstones, siltstones, and shale progressively onlaps the Mississippian unconformity surface from basin center, up dip to the north and eastern basin limits in Saskatchewan and Manitoba. The fine grained reservoir rock has a complex reservoir characterization with 13 to 16 % porosity and permeability on the order of 0.5 to 15 md. The Lower Amaranth, the oldest Mesozoic unit, is a clastic red bed sequence lying directly on the Paleozoic erosional surface. It consists of a series of dolomitic siltstones and sandstones interbedded with argillaceous siltstones and shales. The section is usually subdivided into a lower sandy unit and an overlying shale unit. The lower sequence is the oil production zone. The bulk of pay is found in the laminated sandstone/siltstone facies.

The Lower Amaranth has been classified into four general lithological types:

1. Interbedded shale/siltstone/sandstone by grain size, color and texture
2. Siltstone – This lithology occurs in distinct intervals up to two or three metres in thickness. It is generally light green in color and dolomitic.

3. Laminated sandstone – This occurs in distinct sandy intervals with a wide range of grain sizes and primary sedimentary structures.
4. Massive sandstone – This lithology occurs in thin intervals and usually associated with the laminated sandstones facies. Beds are usually light grey to reddish grey in color and coarse to medium – grained.

Discussion

Production and Injection Performance

Board Order No. PM 58 provided for pressure maintenance operations in Waskada Unit No.8. From the startup of injection in October 1985, injection rates fluctuated to the same degree in each injector, making it difficult to link any production responses to any injector. The Unit includes 4 injection wells; at the end of 2013 one was active. Injection ceased in the other 3 in 2006. There are currently 4 active producers.

Please refer to Attachment 2 – A Summary of the Unit Well List and History with New Drills
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 1.8; the Cumulative VRR from injection start is at 2.1. This indicates overinjection. Both have increased in the last 6 years due to a Monthly VRR consistently above 1.0 as such it has been reduced in the last year. PennWest has no plans to reactivate at this time any of the other injectors.

Please refer to Attachment 6 – A Unit Voidage Replacement Ratio Plot.
Please refer to Attachment 7 – Individual Injection Well Performance Plots (5).

Pressure Surveys:

There were no pressure surveys 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.

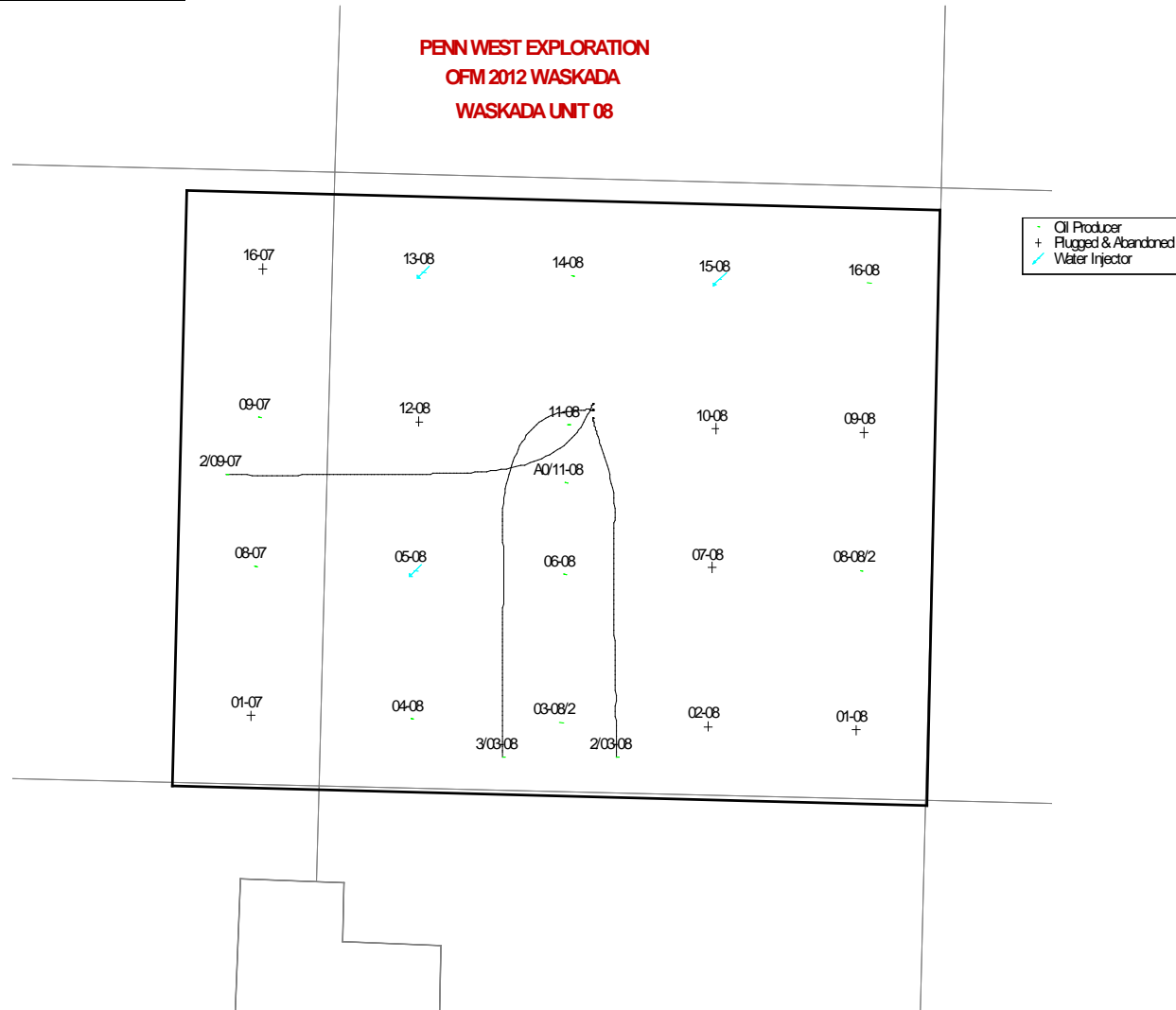
Summary and Recommendations

The behaviour of Waskada Unit 8 producers are indicated by good initial oil productivity, rapidly declining to low rates, with almost no discernible water flood response. It is also believed that fracture stimulation treatments, performed on these wells prior to initiation of water

injection, “broke through” into the higher productivity Mississippian and that the majority of injected water to date has entered this zone. This is one of the major explanations for lack of waterflood response to date and the continued decline in oil productivities.

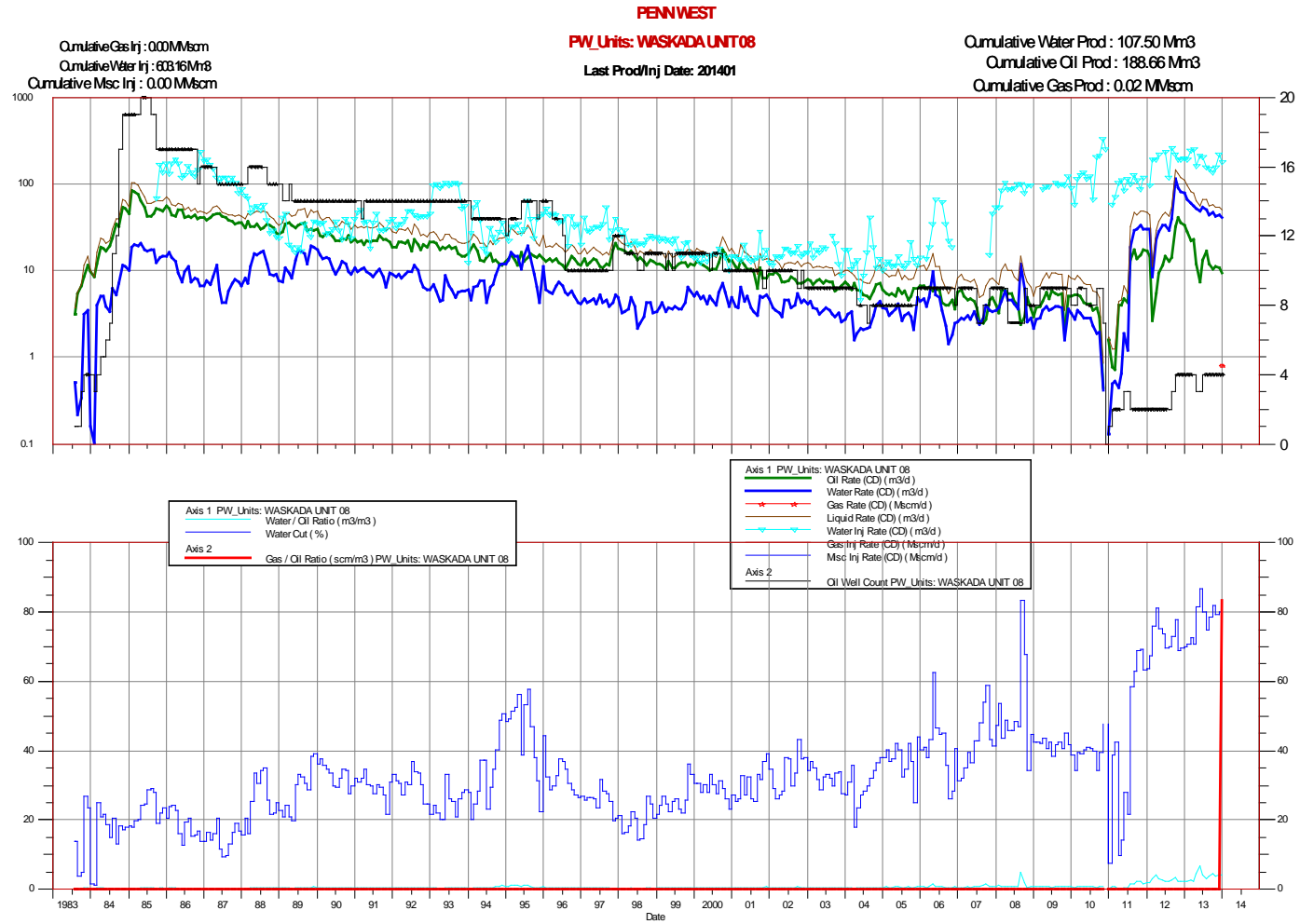
A horizontal producer and conversion of vertical producers to injector well pilot was contemplated for the Lower Amaranth targeting Unit 13 with results scalable to all Lower Amaranth Units. It is currently inactive pending evaluation of alternative schemes.

ATTACHMENT 1 – Unit Area Map

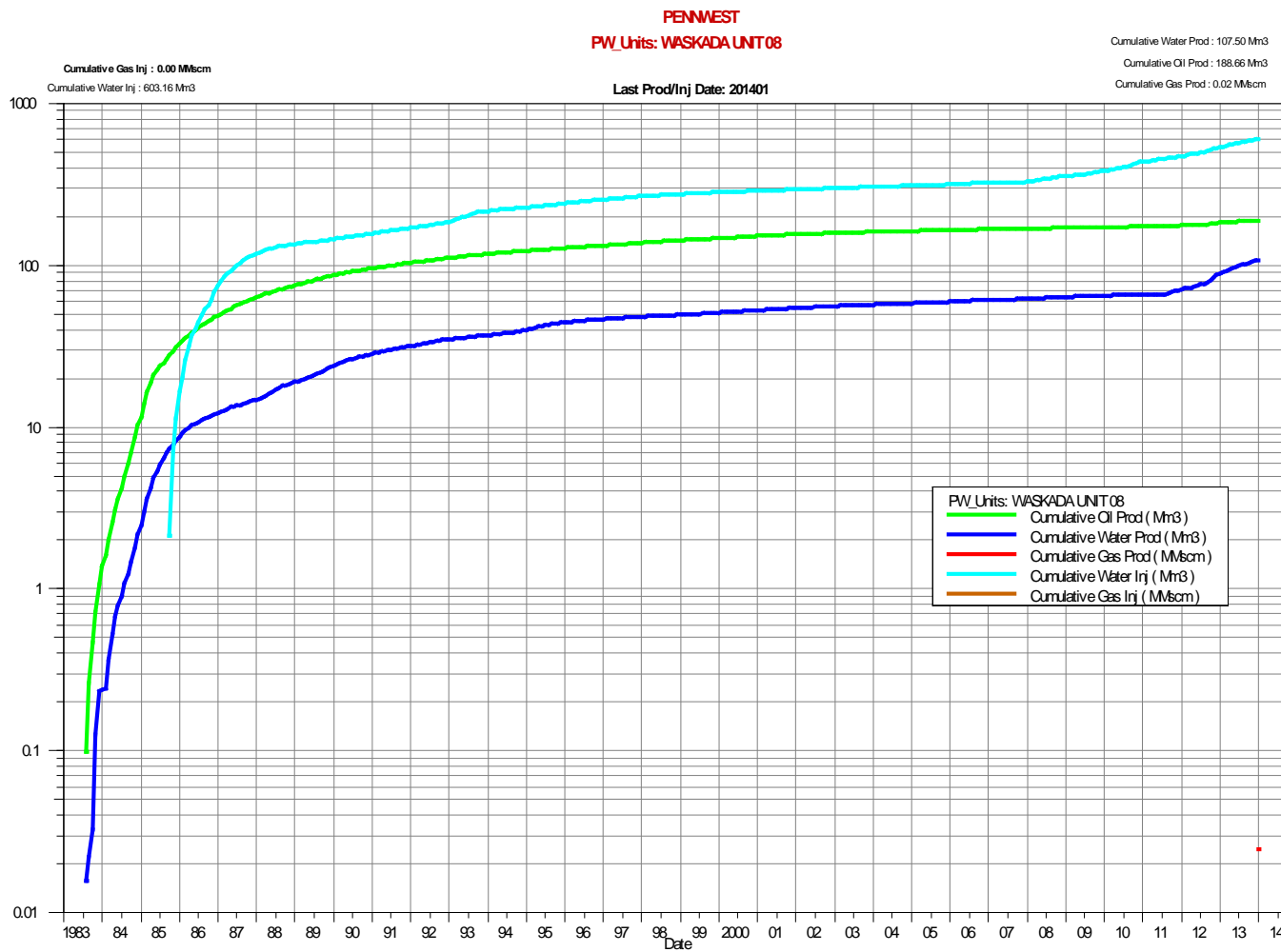


ATTACHMENT 2 Unit History: WASKADA UNIT 08														
					Kelly			Cum	Cum			Cum	Cum	
				New	Bushing	Total	First	Oil	Water	Last	First	Water	Gas	Last
Well	Completion	OPERATOR	STATUS	Drills	Elevation	Depth	Production	Prod	Prod	Production	Injection	Inj	Inj	Injection
	Date				m	m	Date	Mm3	Mm3	Date	Date	Mm3	MMscm	Date
00/01-07-002-25W1/0	8/12/1984	OMEGA_HYDROC	ABD-OIL	<N/A>	474.4	919	10/1/1984	0.24	0.25	4/1/1989		0	0	
00/08-07-002-25W1/0	8/15/1984	PENN_WEST	OIL	<N/A>	474.1	923	8/1/1984	9.6	1.96	11/1/2010		0	0	
00/09-07-002-25W1/0	8/8/1984	PENN_WEST	OIL	<N/A>	475.8	919	8/1/1984	12.99	2.31	11/1/2010		0	0	
02/09-07-002-25W1/0	8/15/2012	PENN_WEST	OIL	<N/A>	477.5	1785	10/1/2012	4.48	14.4	1/1/2014		0	0	
00/16-07-002-25W1/0	8/4/1984	PENN_WEST	ABD-OIL	<N/A>	472.7	924	10/1/1984	5.01	4.59	6/1/1996		0	0	
00/01-08-002-25W1/0	7/11/1984	OMEGA_HYDROC	ABD-OIL	<N/A>	476.6	924	10/1/1984	0.79	0.99	8/1/1988		0	0	
00/02-08-002-25W1/0	6/10/1984	PENN_WEST	ABD-OIL	<N/A>	476.5	904	6/1/1984	3.32	1.47	2/1/1998		0	0	
00/03-08-002-25W1/2	7/6/1984	PENN_WEST	OIL	<N/A>	476.4	927	11/1/1984	10.21	8.56	7/1/2011		0	0	
02/03-08-002-25W1/0	2/24/2011	PENN_WEST	OIL	<N/A>	477.1	1693	8/1/2011	5.89	19.61	1/1/2014		0	0	
03/03-08-002-25W1/0	8/10/2012	PENN_WEST	OIL	<N/A>	477.6	1770	9/1/2012	3.25	7.36	1/1/2014		0	0	
00/04-08-002-25W1/0	7/3/1984	PENN_WEST	OIL	<N/A>	475.7	923	8/1/1984	23.34	7.75	11/1/2010		0	0	
00/05-08-002-25W1/0	10/28/1983	PENN_WEST	WTR-INJ	<N/A>	475.9	905	11/1/1983	1.97	1.93	9/1/1985	10/1/1985	90.56	0	6/1/2006
00/06-08-002-25W1/0	9/23/1983	PENN_WEST	OIL	<N/A>	477.9	902	10/1/1983	14.84	3.07	11/1/2010		0	0	
00/07-08-002-25W1/0	7/18/1983	PENN_WEST	ABD-WINJ	<N/A>	477	940	8/1/1983	5.59	0.13	10/1/1986	11/1/1986	68.84	0	11/1/2006
00/08-08-002-25W1/2	7/14/1984	PENN_WEST	CMG-OIL	<N/A>	476.9	920	5/1/1985	2.23	1.19	10/1/2010		0	0	
00/09-08-002-25W1/0	9/19/1983	PENN_WEST	ABD-OIL	<N/A>	477.9	900	10/1/1983	3.91	2.22	7/1/1996		0	0	
00/10-08-002-25W1/0	10/31/1983	PENN_WEST	ABD-OIL	<N/A>	476.9	900	11/1/1983	13.26	11.6	9/1/2000		0	0	
00/11-08-002-25W1/0	7/24/1984	PENN_WEST	OIL	<N/A>	476.5	924	9/1/1984	20.1	6.61	7/1/2011		0	0	
A0/11-08-002-25W1/0	10/22/1997	PENN_WEST	OIL	<N/A>	477.1	926	11/1/1997	4.98	0.78	11/1/2010		0	0	
00/12-08-002-25W1/0	7/28/1984	PENN_WEST	ABD-OIL	<N/A>	477.1	924	11/1/1984	2.26	1.9	7/1/1996		0	0	
00/13-08-002-25W1/0	7/31/1984	PENN_WEST	WTR-INJ	<N/A>	475.2	919	10/1/1984	0.12	0.07	9/1/1985	10/1/1985	63.43	0	6/1/2006
00/14-08-002-25W1/0	6/13/1984	PENN_WEST	OIL	<N/A>	475.5	908	8/1/1984	19.99	2.62	1/1/2014		0	0	
00/15-08-002-25W1/0	7/20/1984	PENN_WEST	WTR-INJ	<N/A>	478.5	915	10/1/1984	0.55	0.37	9/1/1985	10/1/1985	380.33	0	1/1/2014
00/16-08-002-25W1/0	7/17/1984	PENN_WEST	OIL	<N/A>	477.6	921	7/1/1984	19.74	5.75	3/1/2011		0	0	
3/12/2014 14:04 /														

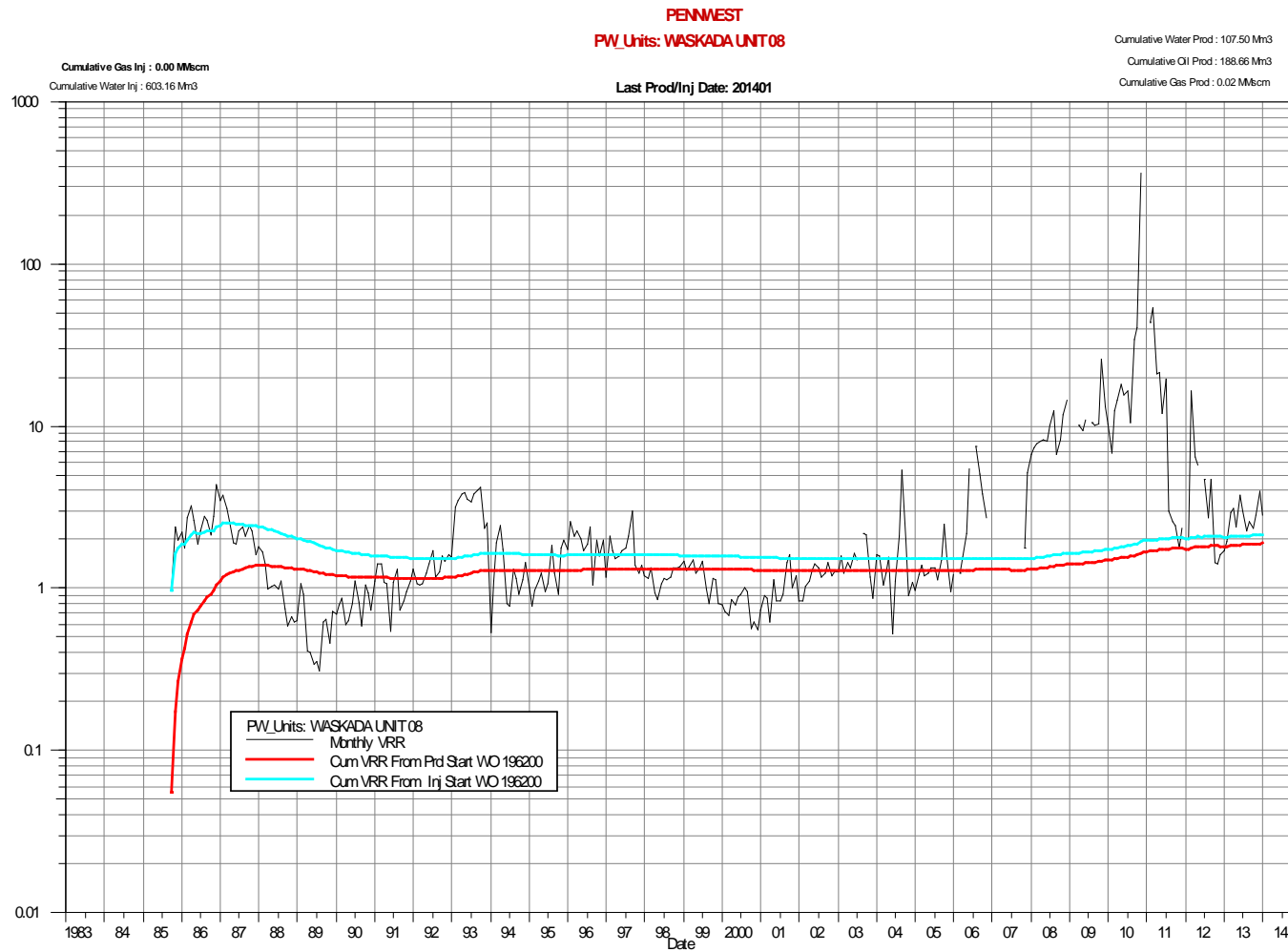
ATTACHMENT 3 – Unit Production and Injection Plot



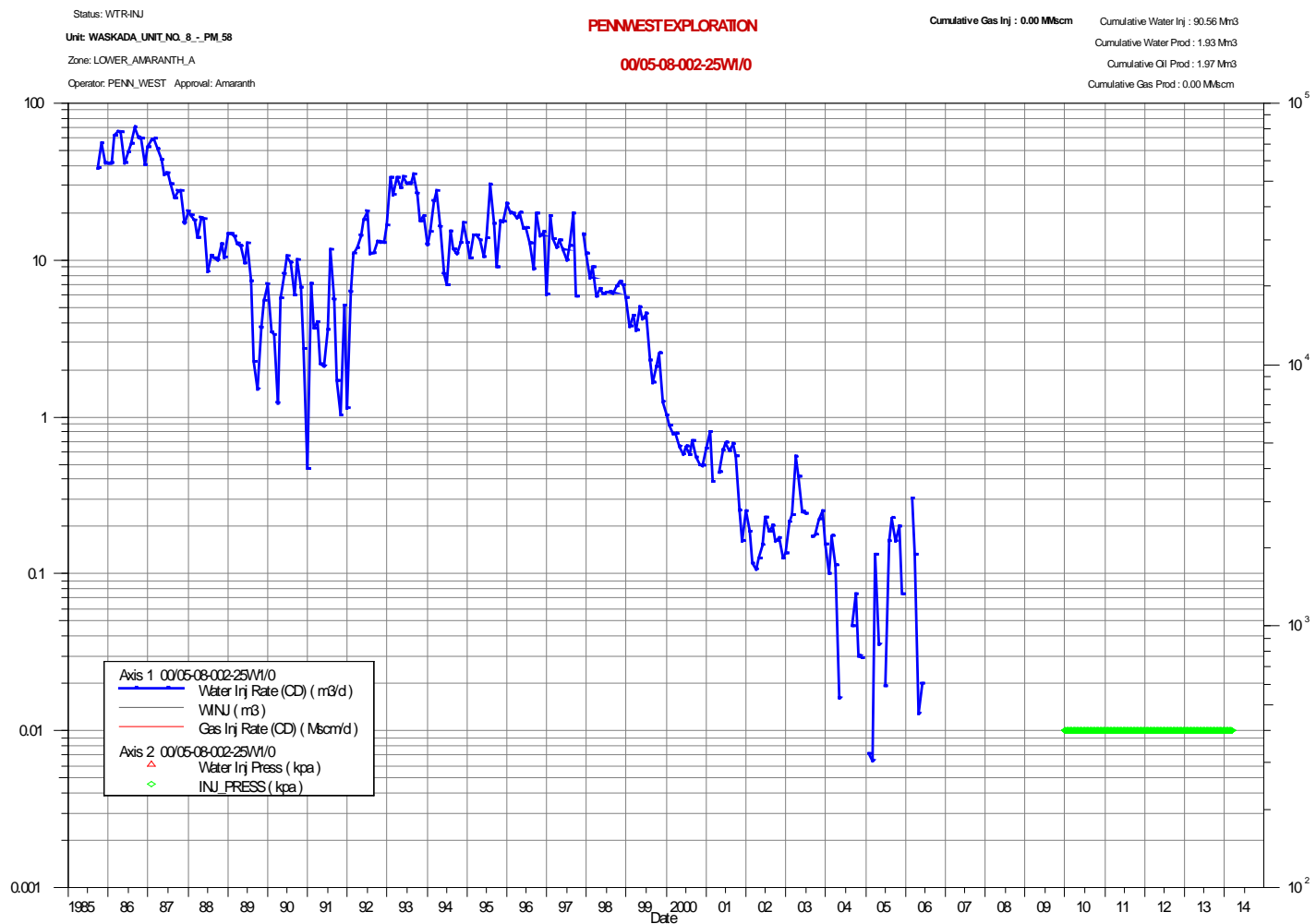
ATTACHMENT 5 – Unit Cumulative Production and Injection Plot



ATTACHMENT 6 – Unit Voidage Replacement Ratio Plot



ATTACHMENT 7 – Individual Injection Well Performance Plots (4 Wells)



Status: ABD-WINJ

Unit: WASKADA_UNIT_NO.8 - PM_58

Zone: LOWER_AMARANTH_A

Operator: PENN_WEST Approval: Aamaranth

PENNVEST EXPLORATION

00/07-08-002-25W1/O

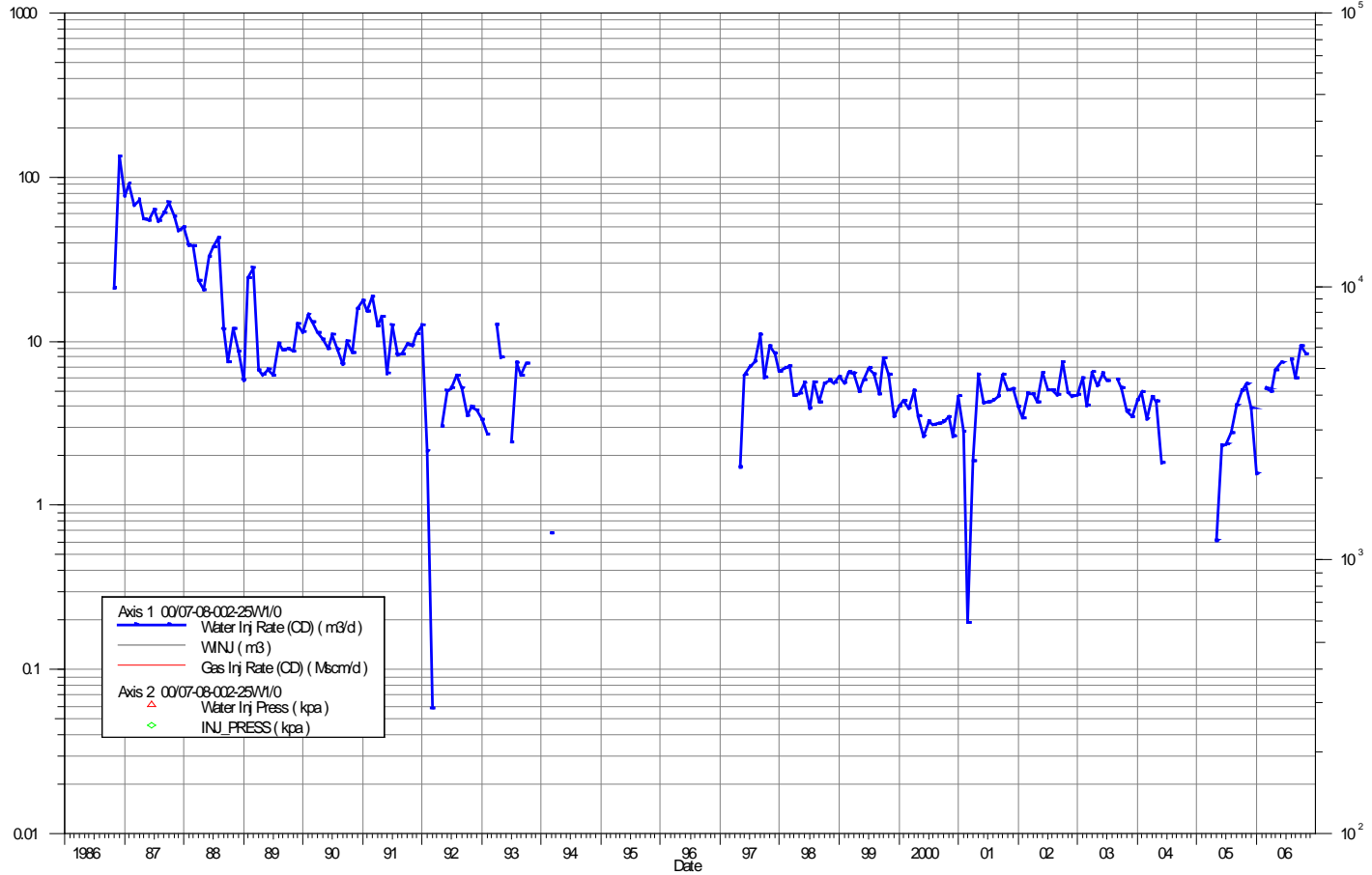
Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 68.84 Mn3

Cumulative Water Prod : 0.13 Mn3

Cumulative Oil Prod : 5.59 Mn3

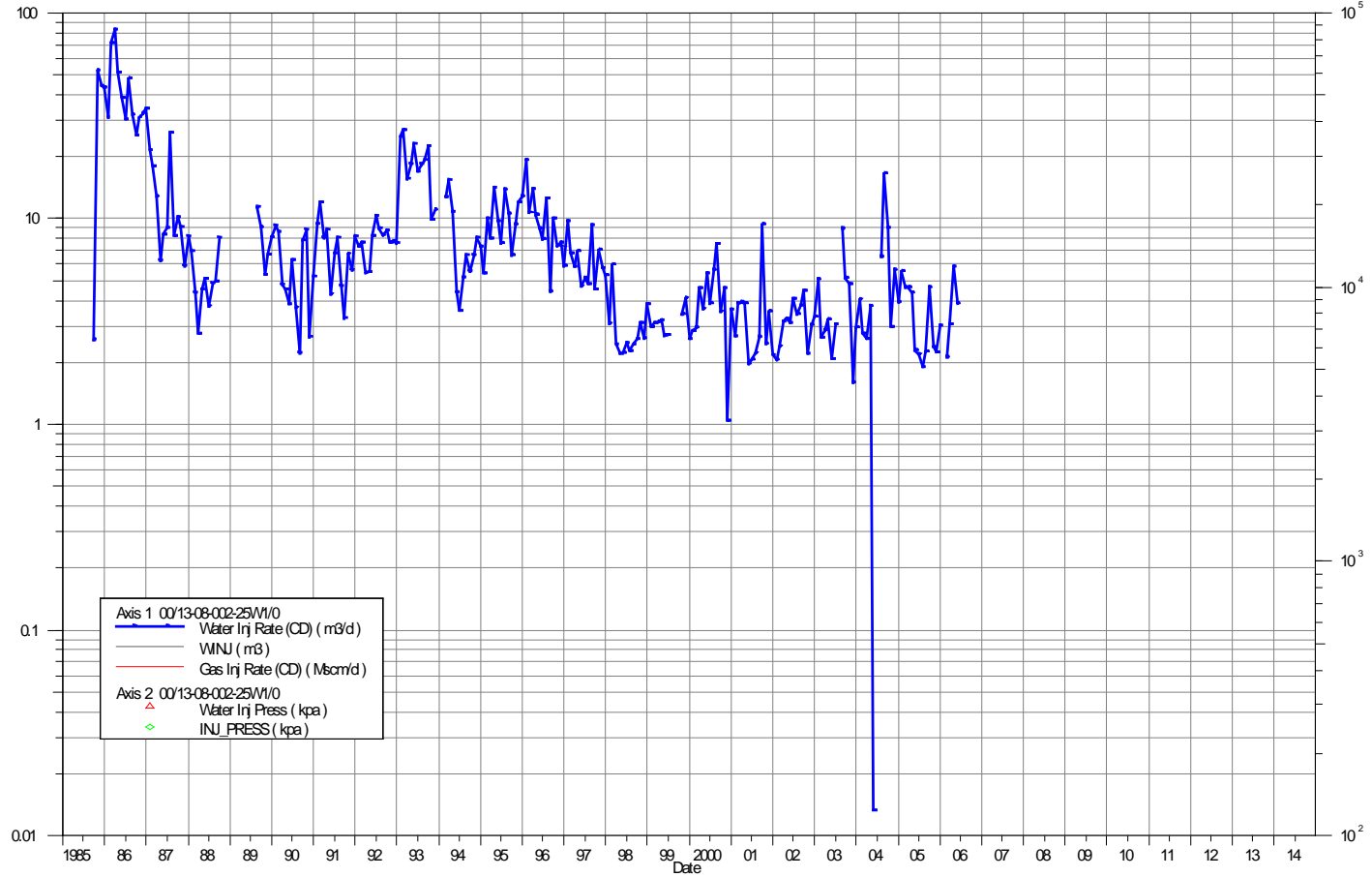
Cumulative Gas Prod : 0.00 MMscm



Status: WTR-INJ
Unit: WASKADA_UNIT_NO_8 - PM_58
Zone: LOWER_AMARANTH_A
Operator: PENN_WEST Approval: Aamaranth

PENNVEST EXPLORATION
00/13-08-002-25W1/0

Cumulative Gas Inj : 0.00 MMscm
Cumulative Water Inj : 63.43 Mn3
Cumulative Water Prod : 0.07 Mn3
Cumulative Oil Prod : 0.12 Mn3
Cumulative Gas Prod : 0.00 MMscm



Status: WTR-INJ

Unit: WASKADA_UNIT_NO.8_-_PM_58

Zone: LOWER_AMARANTH_A

Operator: PENN_WEST Approval: Amaranth

PENNAESTEXPLORATION

00/15-08-002-25W/0

Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 380.33 Mm3

Cumulative Water Prod : 0.37 Mm3

Cumulative Oil Prod : 0.55 Mm3

Cumulative Gas Prod : 0.00 MMscm

