

# **WASKADA UNIT NO. 10**

## **WATERFLOOD PROGRESS REPORT**

**January 1, through December 31, 2011**

### **PennWest Exploration**

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## **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. (See Appendix A – Area Map)

**PRESSURE MAINTENANCE:** Governed by Board Order No. PM 46

### **UNIT INFORMATION:**

UNITIZED ZONE: Mission Canyon

Original Unit, Feb. 1, 1986 Board Order; Voluntary

First Enlargement, Sep. 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, 2011.

Unit # 10 is part of main Waskada. 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 (WPM).

The Waskada Fields produce light density crude (approximately 36° API), predominantly from the Lower Amaranth formation. The 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 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 founded 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 meters 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.

### **UNIT HISTORY**

#### **Waskada Unit # 10 (Unit History)**

<b>Abbreviated Well ID</b>	<b>Date Well Spudded</b>	<b>On Prod YYYY/MM</b>	<b>Org Operator Name</b>	<b>Ground Elevation (m)</b>	<b>TVD (m)</b>
02/05-26-001-26W1/0	6/29/1983	1983/07	Omega Hydcbns Ltd	465.8	950
02/11-26-001-26W1/0	7/5/1983	1983/07	Omega Hydcbns Ltd	468.5	950
00/12-26-001-26W1/0	8/3/1982	1982/10	Omega Hydcbns Ltd	466.6	951
02/13-26-001-26W1/0	6/15/1983	1983/06	Omega Hydcbns Ltd	464.7	950
02/01-27-001-26W1/0	7/9/1983	1985/11	Omega Hydcbns Ltd	463.6	949
02/02-27-001-26W1/0	7/12/1983	1985/09	Omega Hydcbns Ltd	462.9	948
02/03-27-001-26W1/0	7/1/1983	1983/07	Omega Hydcbns Ltd	461.8	947
00/06-27-001-26W1/0	6/5/1982	1982/06	Omega Hydcbns Ltd	462.4	939

### Waskada Unit #10 (Production & Injection History)

Abbreviated Well ID	First Prod YYYY/MM	On Inject. YYYY/MM	Last Prod. YYYY/MM	Cumulative OIL Prod. (m3)	Cumulative WTR Prod. (m3)	Last Inject. YYYY/MM
02/05-26-001-26W1/0	1983/07		2011/10	9866	41117	
02/11-26-001-26W1/0	1983/07		2011/11	10836	56066	
00/12-26-001-26W1/0	1982/10		1995/09	2469	10516	
02/13-26-001-26W1/0	1983/06	1986/02	1986/01	607	5842	1987/03
02/01-27-001-26W1/0	1985/11		1992/04	2818	3840	
02/02-27-001-26W1/0	1985/09		2011/11	6251	17712	
02/03-27-001-26W1/0	1983/07	1986/03	1986/02	1111	6683	1987/03
00/06-27-001-26W1/0	1982/06		1994/03	9516	72104	

### **DISCUSSION:**

#### **Production Performance**

Board Order No. PM 46 provided for pressure maintenance operations in the Waskada Unit No. 10. The Unit included the two injection wells, 02/13-26-001-26W1/0 and 02/03-27-001-26W1/0 (both are abandoned since 1987/04), and Seven producers (only three of them active now) in the Waskada MC3a C Pool .Pressure maintenance by water injection in February 1985 and continued until March 1987. And remained shut in since this date. Although, water injection appears to have accelerated water production while having little positive effect on oil production, further, based on the observations, looks like water injection has not been an effective enhanced recovery. Most probably, because of that the operator, at that time, abandoned the injectors. Currently included in the Unit Area are three active producers, with three abandoned wells, and 2 abandoned injectors. (See Appendix D for oil, water and injection rates).

### **Voidage Replacement Ratio Calculation:**

Upon review of the voidage replacement ratio (VRR) for the Waskada Unit # 10 area, it was shown that the area has been under injected (Cum VRR). This is shown by instantaneous and cumulative VRR for the Waskada Unit # 10 (Please see the Appendix C). Currently there is no active injector in this unit, and PennWest has no plan to re-activate any of the old injectors.

### **Corrosion and Scale Prevention Program**

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

## **SUMMARY AND RECOMMENDATIONS**

### **Producers:**

#### **Current Producing Wells**

1. 02/02-27-001-26W1/0
2. 02/05-26-001-26W1/0
3. 02/11-26-001-26W1/0

#### **Current Suspended Producing Wells**

None

#### **Abandoned Producing Wells**

1. 00/12-26-001-26W1/0 (since 1995/10)
2. 02/01-27-001-26W1/0 (since 1992/05)
3. 00/06-27-001-26W1/0 (since 1994/04)

**Injectors:**

**Current Injecting Wells**

None

**Current Suspended Injection Wells**

None

**Abandoned Injection Wells**

1. 02/13-26-001-26W1/0 (since 1987/04)
2. 02/03-27-001-26W1/0 (since 1987/04)

Currently, there are only three active producers and no injection well in this unit; we do not have any plan for this unit other than monitoring the producers. PennWest Exploration's plan is to concentrate on Lower Amaranth Formation for now.

## **TABLES**

### **Waskada Unit #10**

**Table 1: Rates History**

Date	Oil		Water		Inj Water	
Year	m3/year	m3/day	m3/year	m3/day	m3/year	m3/day
1982	746	2.04	116	0.32	0	0.00
1983	4,862	13.32	5,682	15.57	0	0.00
1984	2,459	6.74	10,451	28.63	0	0.00
1985	3,082	8.44	14,963	40.99	0	0.00
1986	3,480	9.53	11,801	32.33	36,972	101.29
1987	3,134	8.59	17,724	48.56	6,487	17.77
1988	2,244	6.15	13,246	36.29	0	0.00
1989	2,712	7.43	13,189	36.14	0	0.00
1990	2,461	6.74	10,116	27.72	0	0.00
1991	2,410	6.60	11,202	30.69	0	0.00
1992	1,059	2.90	11,251	30.82	0	0.00
1993	791	2.17	13,790	37.78	0	0.00
1994	1,223	3.35	5,883	16.12	0	0.00
1995	1,430	3.92	6,862	18.80	0	0.00
1996	1,164	3.19	5,412	14.83	0	0.00
1997	617	1.69	6,348	17.39	0	0.00
1998	352	0.96	3,445	9.44	0	0.00
1999	466	1.28	3,342	9.16	0	0.00
2000	767	2.10	3,451	9.45	0	0.00
2001	941	2.58	4,000	10.96	0	0.00
2002	750	2.05	2,593	7.10	0	0.00
2003	882	2.42	3,962	10.85	0	0.00
2004	930	2.55	4,774	13.08	0	0.00
2005	701	1.92	4,307	11.80	0	0.00
2006	445	1.22	3,616	9.91	0	0.00
2007	798	2.18	4,784	13.11	0	0.00
2008	782	2.14	4,508	12.35	0	0.00
2009	710	1.95	4,655	12.75	0	0.00
2010	502	1.38	4,003	10.97	0	0.00
2011	575	1.75	4,403	12.06	0	0.00



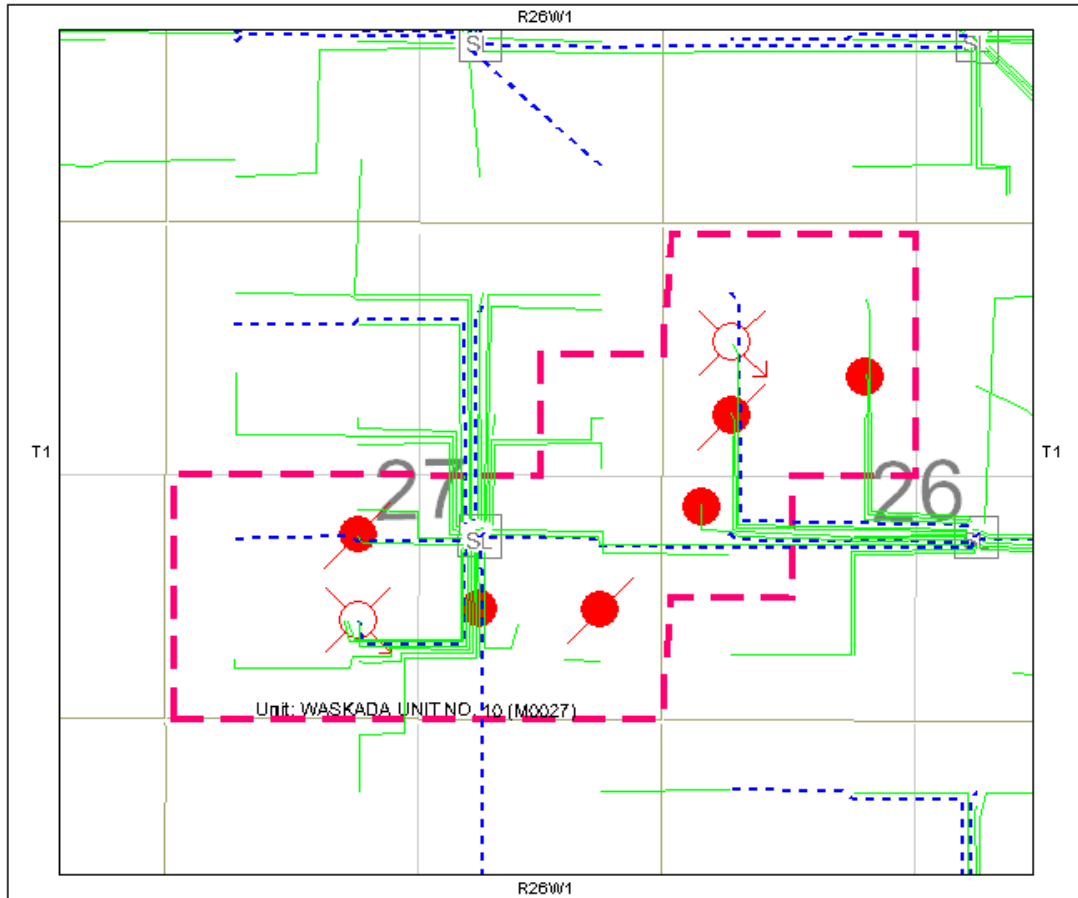
### Waskada Unit #10

Table 2: Pressure Survey

Location	Shut In Date	Date of Survey	Type of Survey	Pressure @ Datum Depth (kPa)
02/02-27-001- 26W1/0	26-Nov-06	11-Dec-06	Acoustic Build Up	2220


## **APPENDIX A**

## Appendix A – Area Map



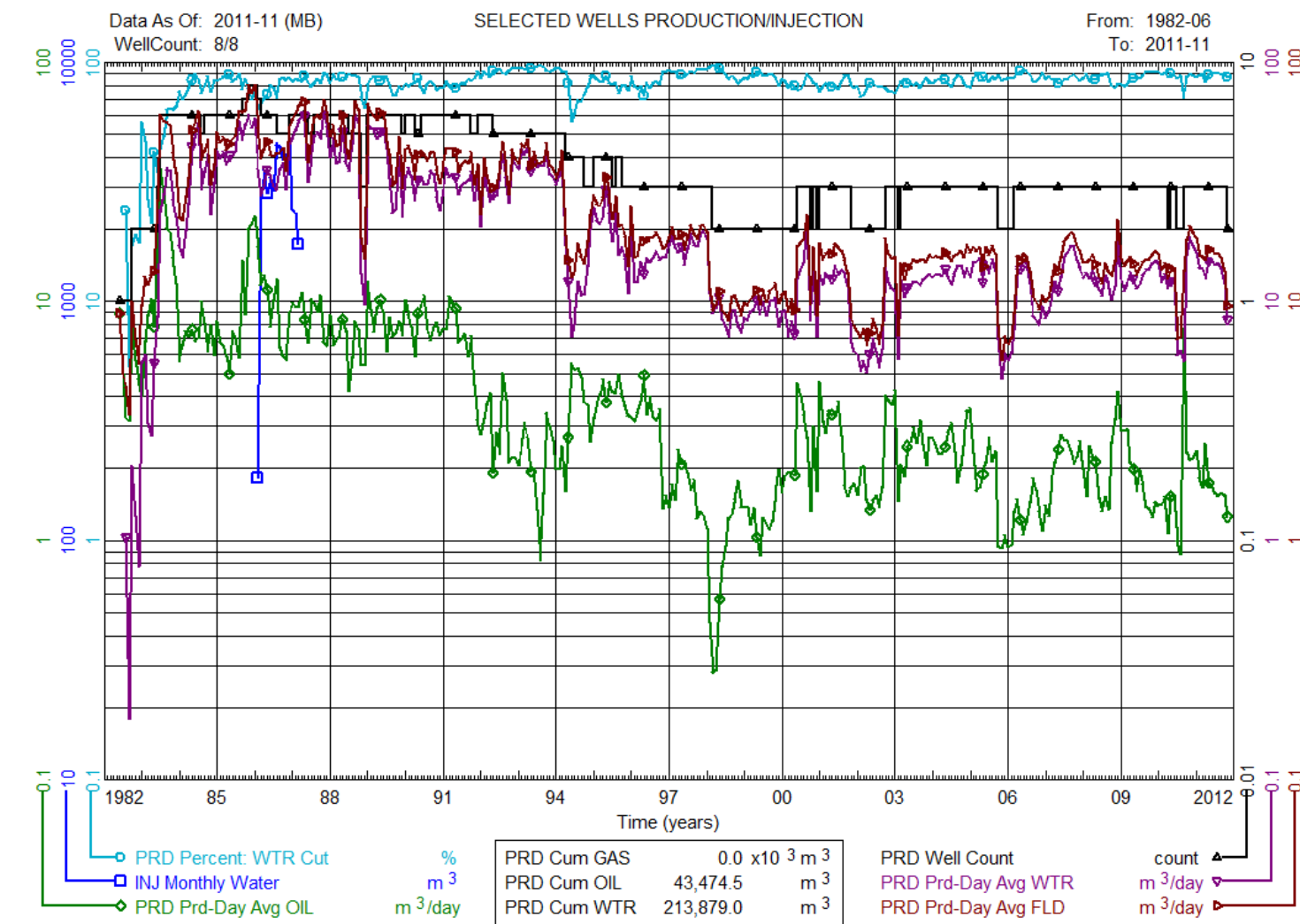
WELL SYMBOLS

• OIL	AO	φ PTN	⊕ DSA	⊕ WI
○ UCT	AWI	φ STN	⊕ CMM	⊕ DRL
⊙ RDR	WD	φ AWS	⊕ AWD	⊕ SWI
▲ SO	WDC	• J&A	□ SL	

<b>PennWest</b> Exploration		
Waskada Unit #10		
 <small>www.geoscout.com</small>	By :	Date : 2011/04/14
	Scale = 1:17650	Project : Waskada

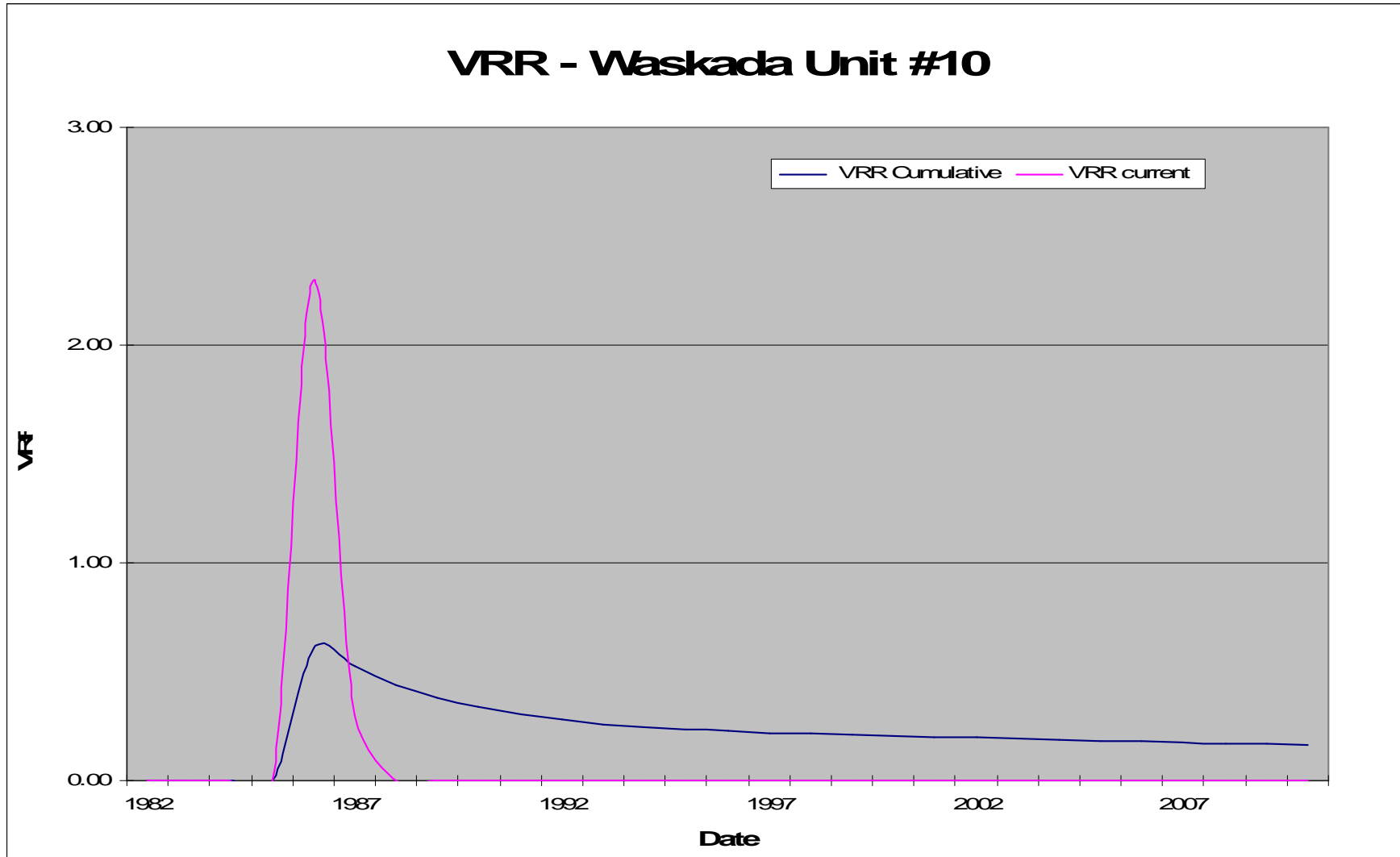
## **APPENDIX B**

## Appendix B – Production and Injection History plot



## **APPENDIX C**

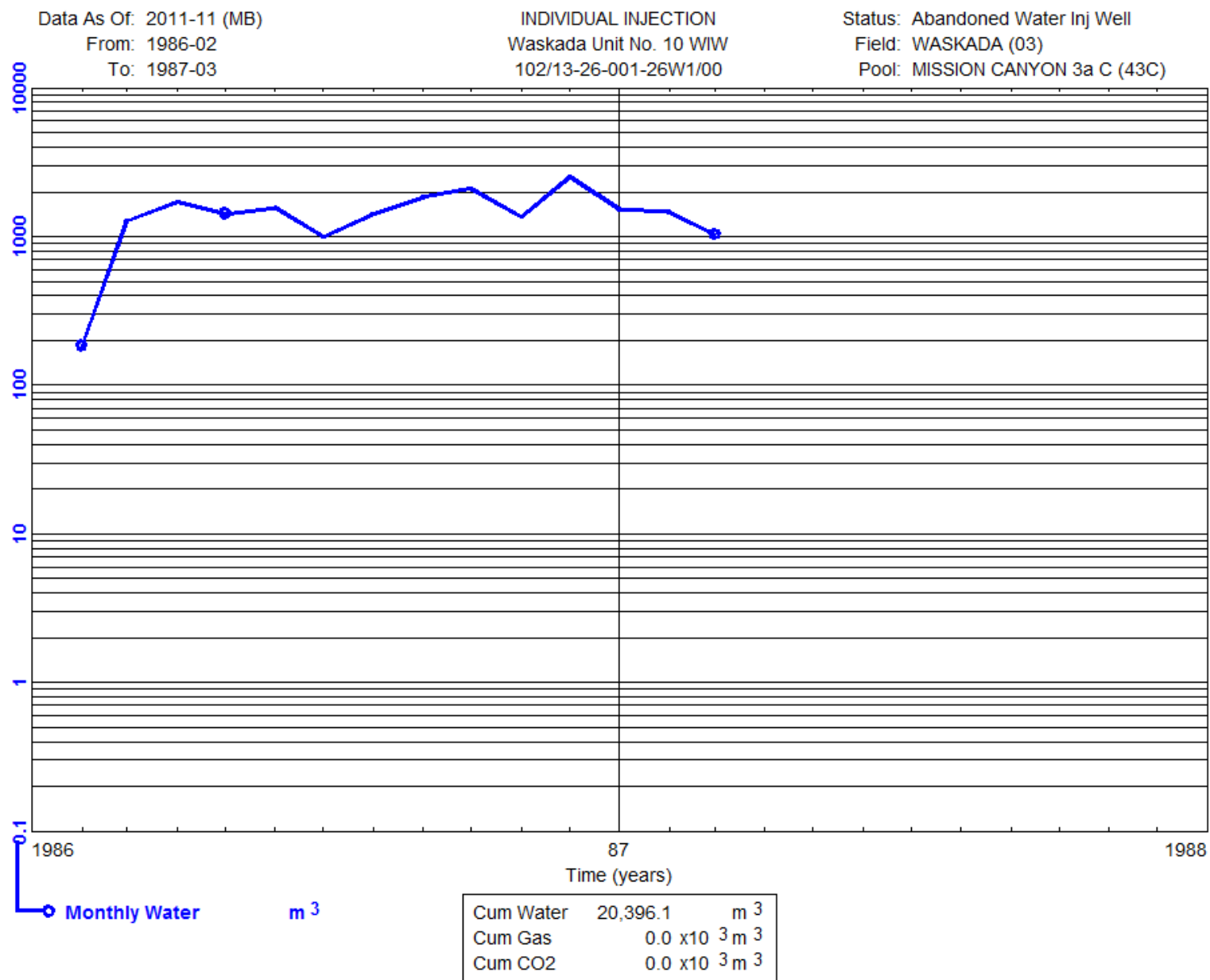
## Appendix C – Voidage Replacement Ratio VRR



## **APPENDIX D**



## Appendix D – Production and Injection Profiles



Data As Of: 2011-11 (MB)

From: 1986-03

To: 1987-03

INDIVIDUAL INJECTION

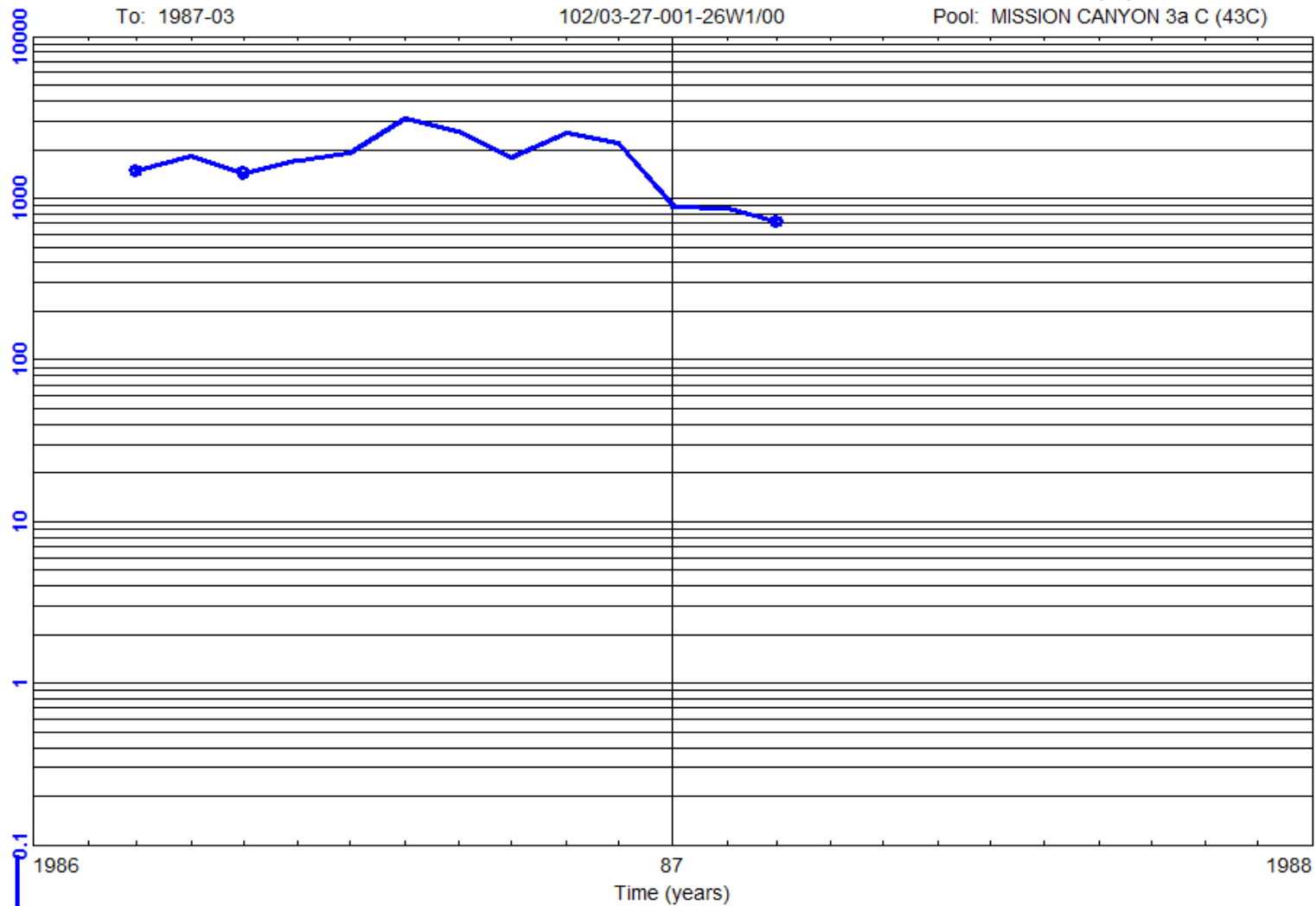
Waskada Unit No. 2 WIW

102/03-27-001-26W1/00

Status: Abandoned Water Inj Well

Field: WASKADA (03)

Pool: MISSION CANYON 3a C (43C)



Monthly Water

m<sup>3</sup>

Cum Water	23,063.4	m <sup>3</sup>
Cum Gas	0.0 x10 <sup>3</sup>	m <sup>3</sup>
Cum CO2	0.0 x10 <sup>3</sup>	m <sup>3</sup>

Data As Of: 2011-11 (MB)

From: 1983-07

To: 2011-10

INDIVIDUAL PRODUCTION

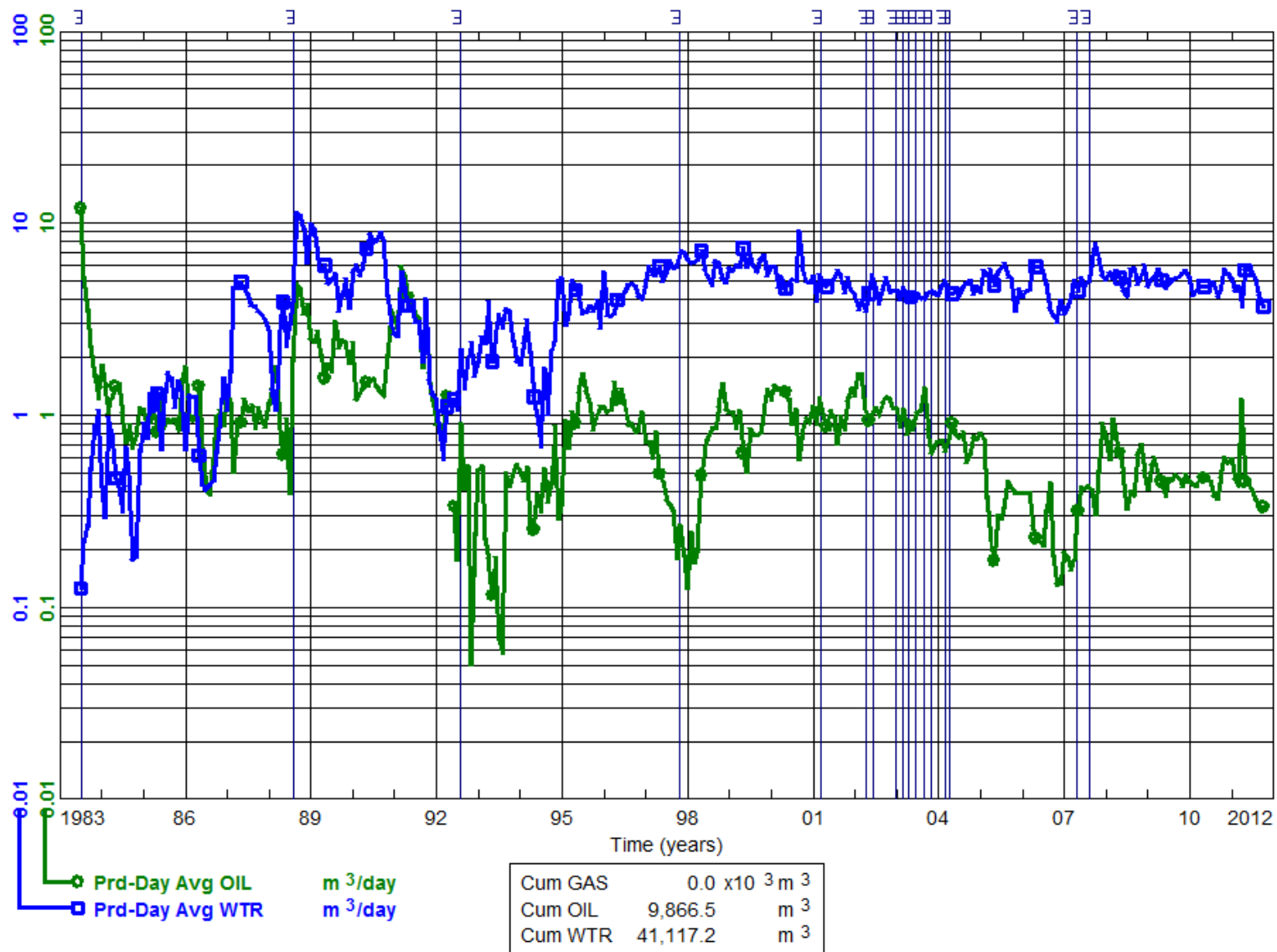
Waskada Unit No. 10

102/05-26-001-26W1/00

Status: Capable Of Oil Prod

Field: WASKADA (03)

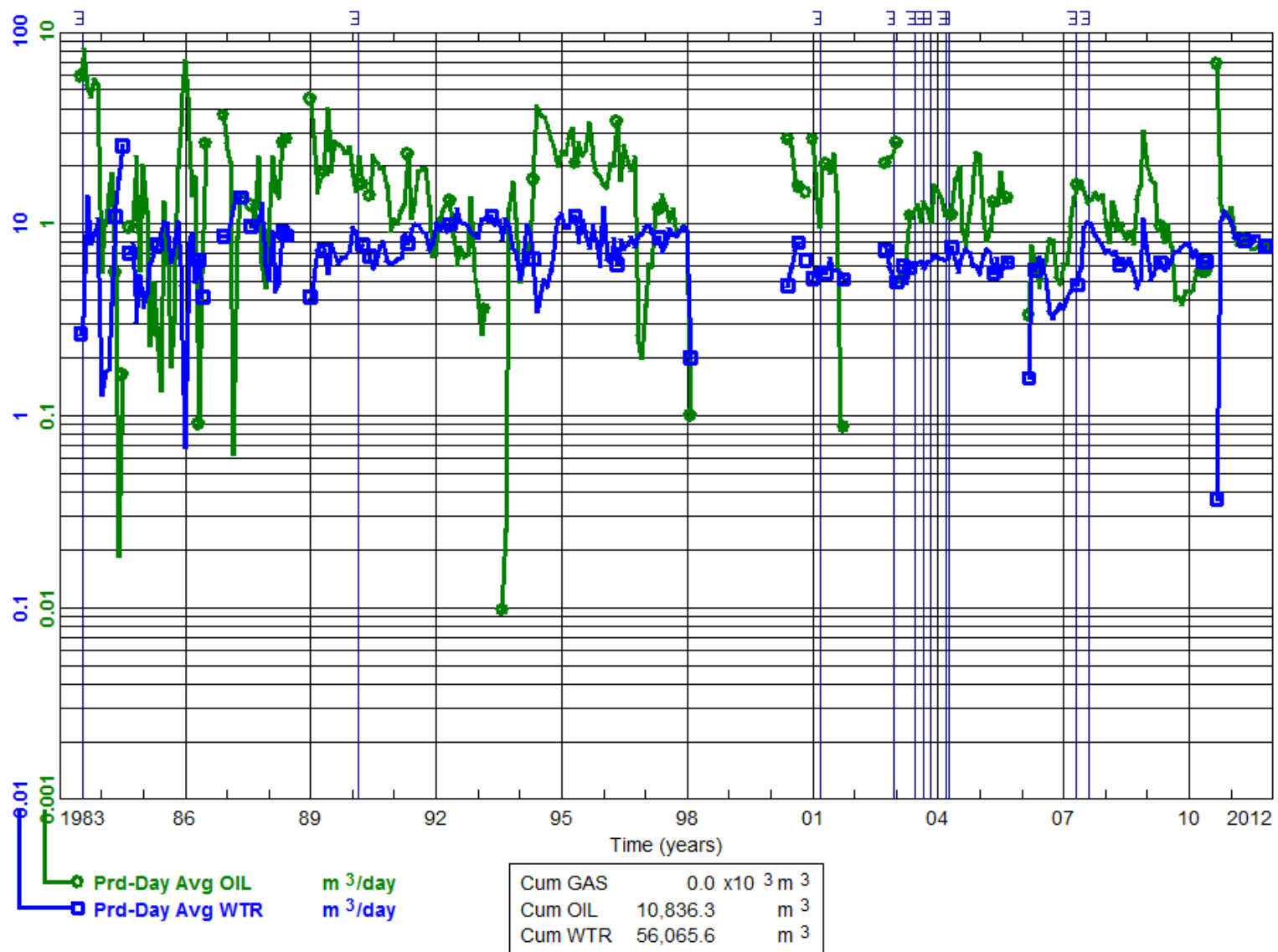
Pool: MISSION CANYON 3a C (43C)



Data As Of: 2011-11 (MB)  
 From: 1983-07  
 To: 2011-11

INDIVIDUAL PRODUCTION  
 Waskada Unit No. 10  
 102/11-26-001-26W1/00

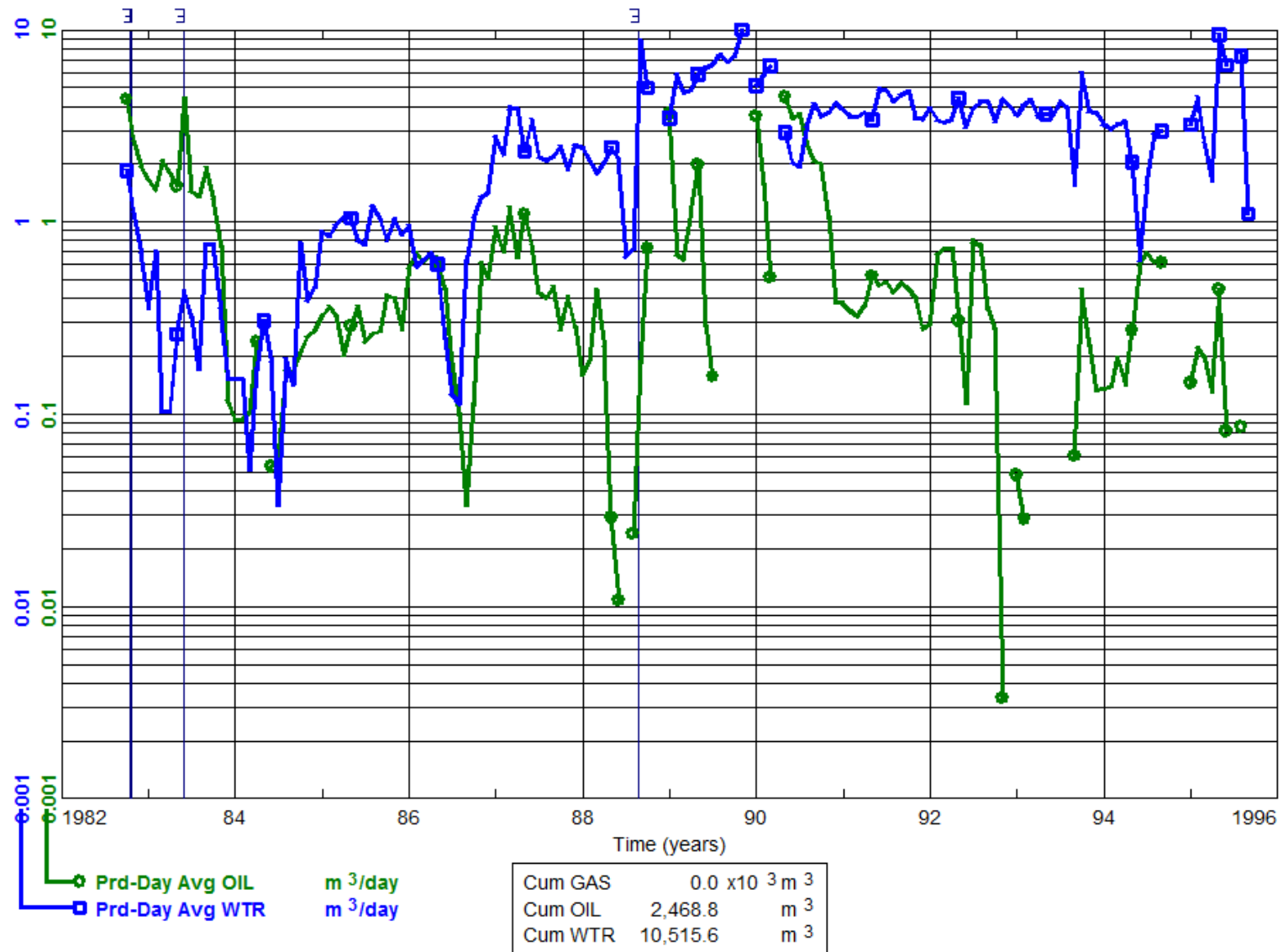
Status: Capable Of Oil Prod  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3a C (43C)



Data As Of: 2011-11 (MB)  
 From: 1982-10  
 To: 1995-09

INDIVIDUAL PRODUCTION  
 Waskada Unit No. 10  
 100/12-26-001-26W1/00

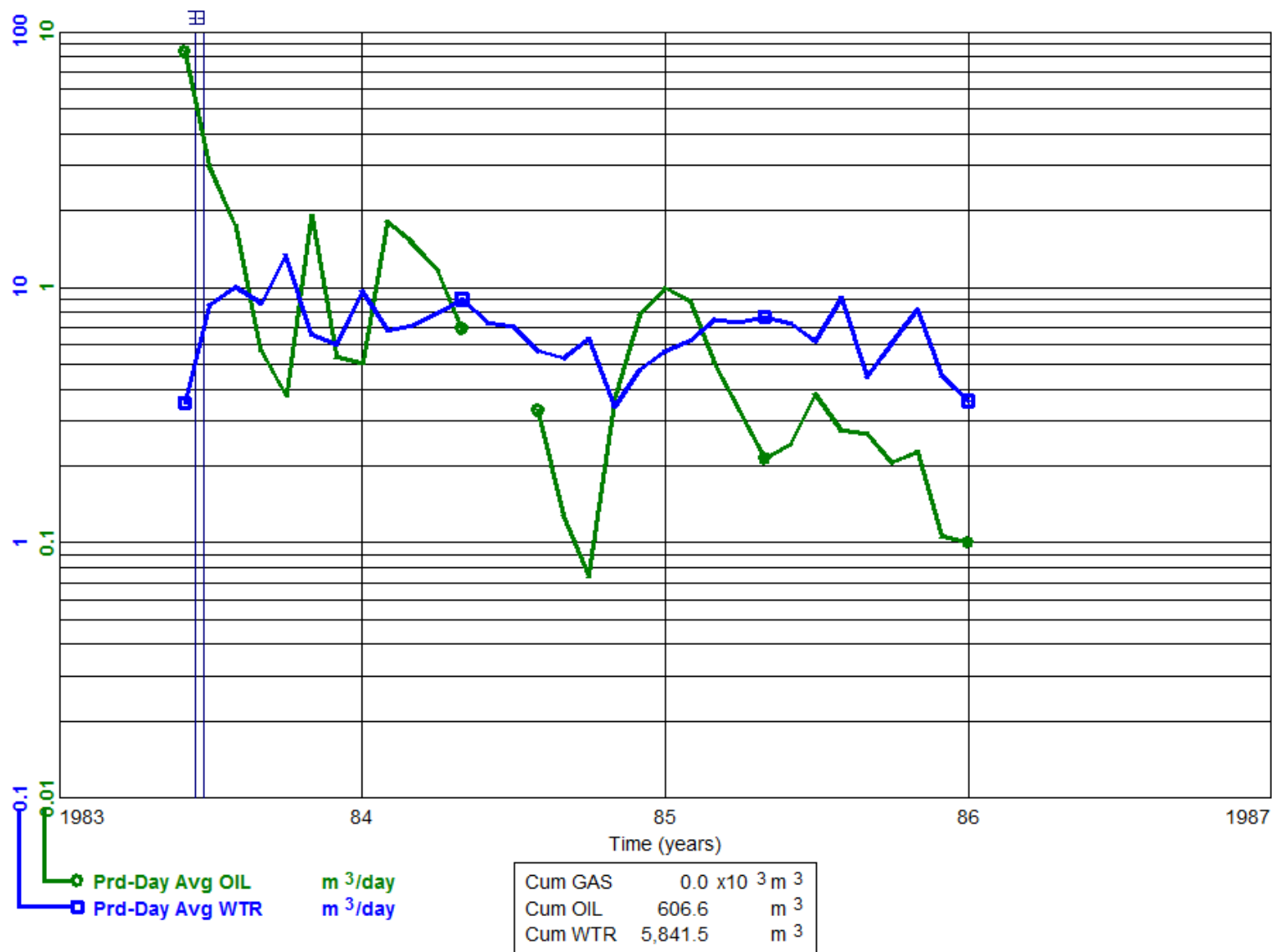
Status: Abandoned Producer  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3a C (43C)



Data As Of: 2011-11 (MB)  
 From: 1983-06  
 To: 1986-01

INDIVIDUAL PRODUCTION  
 Waskada Unit No. 10 WIW  
 102/13-26-001-26W1/00

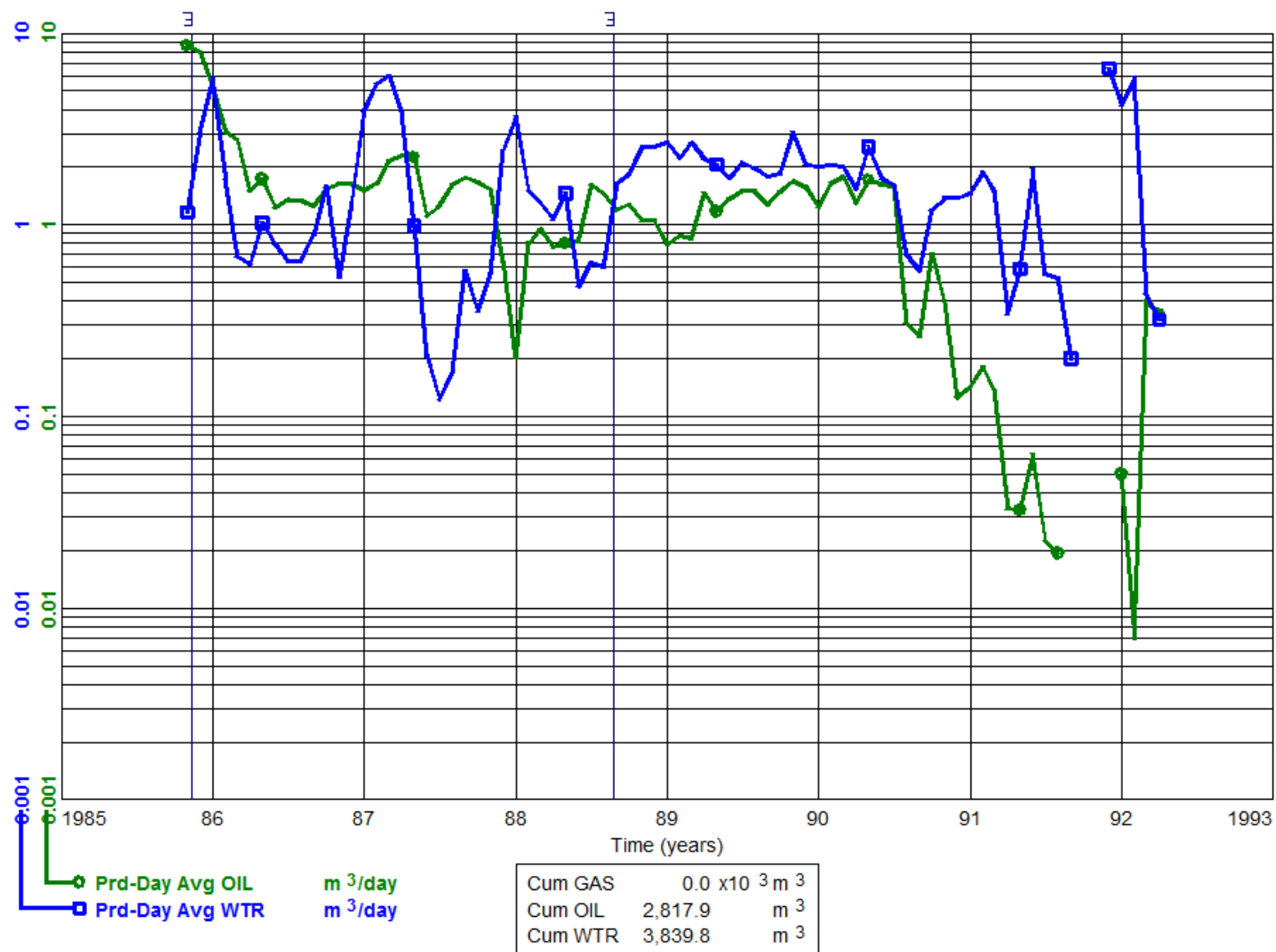
Status: Abandoned Water Inj Well  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3a C (43C)



Data As Of: 2011-11 (MB)  
 From: 1985-11  
 To: 1992-04

INDIVIDUAL PRODUCTION  
 Waskada Unit No. 10  
 102/01-27-001-26W1/00

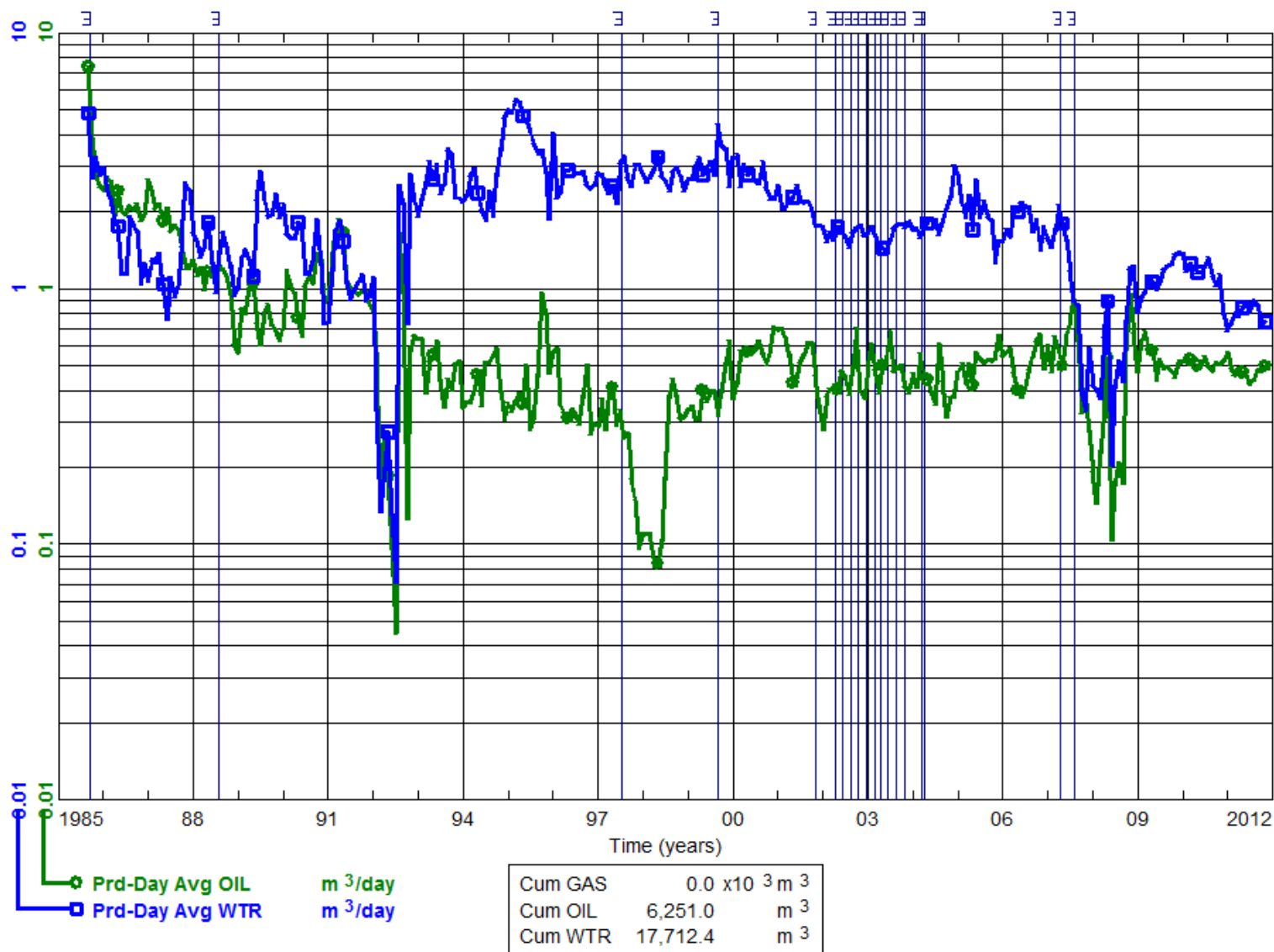
Status: Abandoned Producer  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3a C (43C)



Data As Of: 2011-11 (MB)  
 From: 1985-09  
 To: 2011-11

INDIVIDUAL PRODUCTION  
 Waskada Unit No. 10  
 102/02-27-001-26W1/00

Status: Capable Of Oil Prod  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3a C (43C)

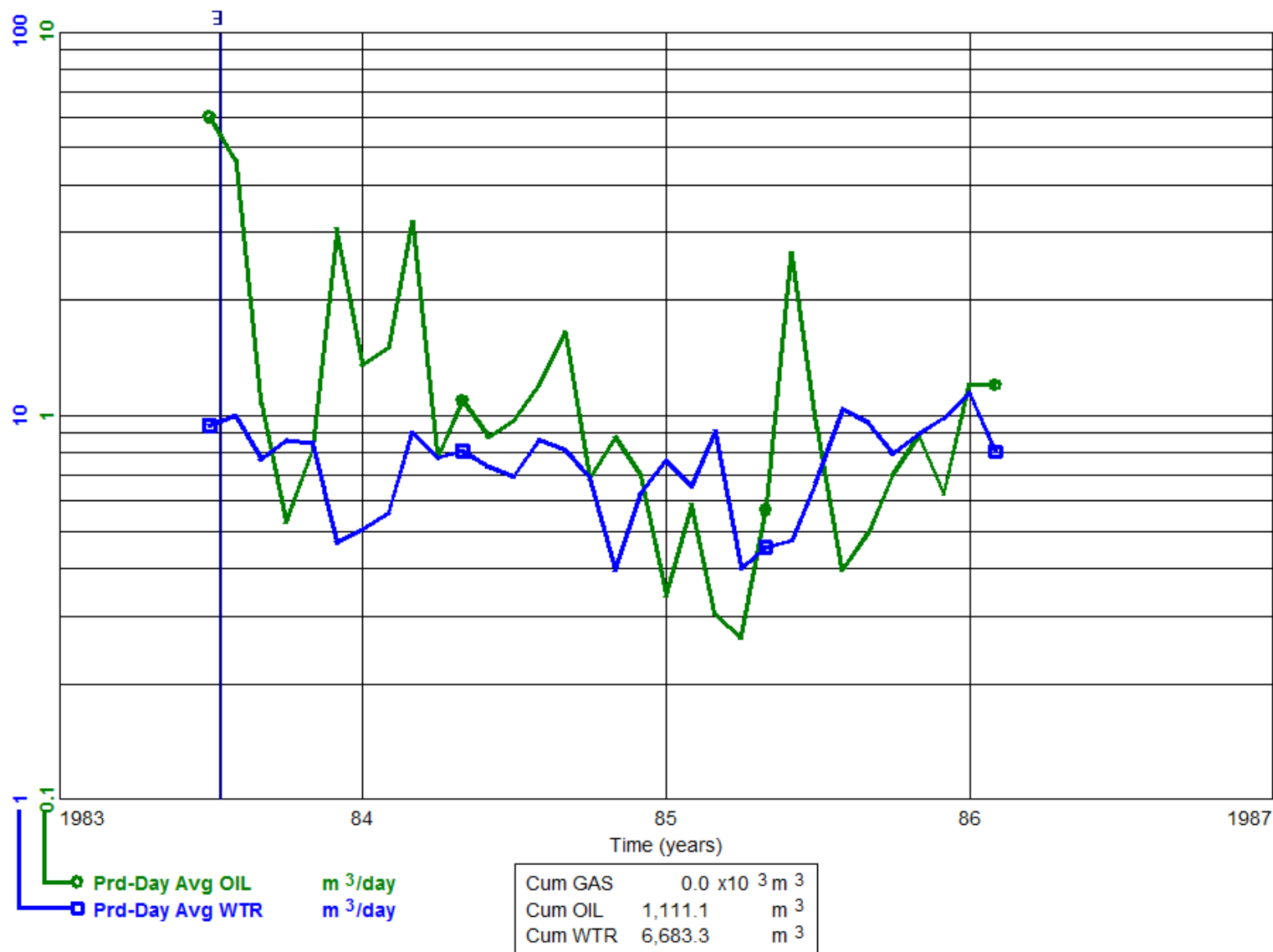




Data As Of: 2011-11 (MB)  
 From: 1983-07  
 To: 1986-02

INDIVIDUAL PRODUCTION  
 Waskada Unit No. 2 WIW  
 102/03-27-001-26W1/00

Status: Abandoned Water Inj Well  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3a C (43C)



Data As Of: 2011-11 (MB)

From: 1982-06

To: 1994-03

INDIVIDUAL PRODUCTION

Waskada Unit No. 10

100/06-27-001-26W1/00

Status: Abandoned Producer

Field: WASKADA (03)

Pool: MISSION CANYON 3a C (43C)

