

**SINCLAIR UNIT NO. 11**  
**WATERFLOOD EOR PROJECT**  
**ANNUAL REPORT FOR 2015**

**June 16, 2016**

**Tundra Oil and Gas Partnership**

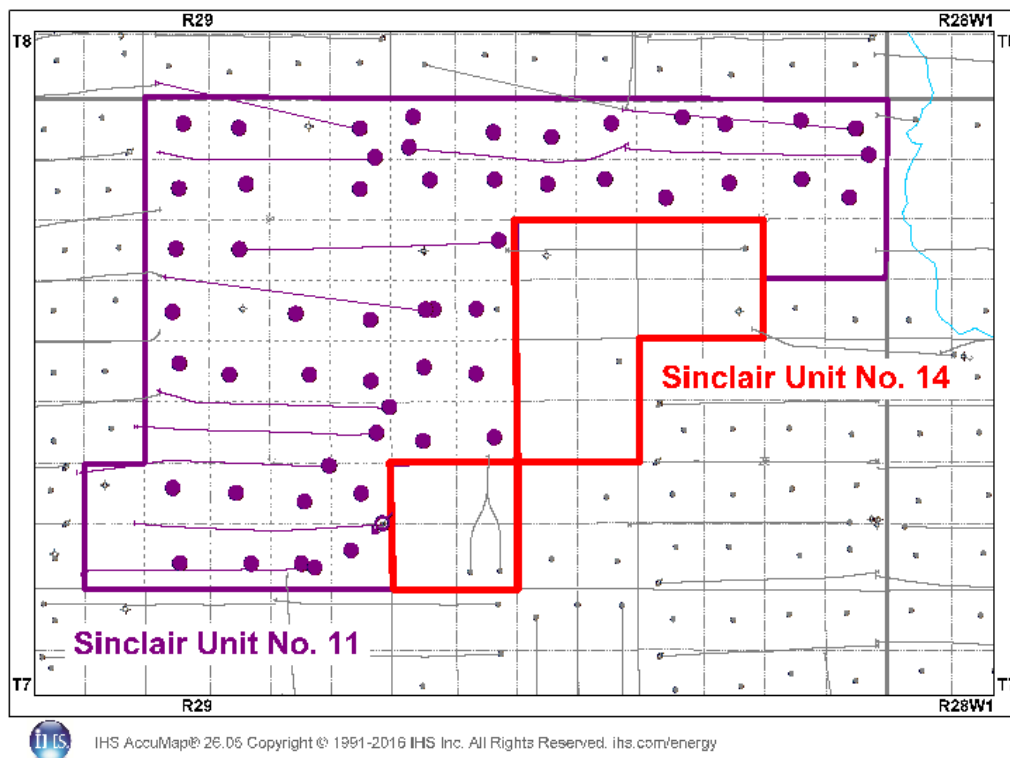
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## **INTRODUCTION**

Sinclair Unit No. 11 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Waterflood Order No. 47, effective August 1, 2015 with Tundra Oil and Gas (Tundra) as Operator. The Unit area contains 54 producing wells and 1 injection well in 60 LSDs in Township 7 Range 29 W1 as shown in the figure below.

**Figure 1: Sinclair Unit No. 11 Area Outline**



In accordance with Section 73 of the Manitoba Drilling and Production Regulation, Tundra hereby submits the following 2015 Annual Progress Report for Sinclair Unit No. 11.

## **DISCUSSION**

### **Production History**

For the wells included in Sinclair Unit No. 11, production started in March 2005 with the 00/09-36-007-29W1 well. Average oil production peaked at 2.39 m<sup>3</sup>/d per well in February 2008. This production was coming from 38 wells and totaled 90.65 m<sup>3</sup>/d for the Unit. In December 2015, the Unit was producing 33.26 m<sup>3</sup>/d of oil and 53.46 m<sup>3</sup>/d of

water. Water injection commenced in Sinclair Unit No. 11 in September 2015. The oil production rate, injection rate, and WOR for each injection pattern is presented in Appendix D. The rates and WOR are presented in Figure 2.

**Figure 2: Sinclair Unit No. 11 Production/Injection Rates and WOR vs Time**

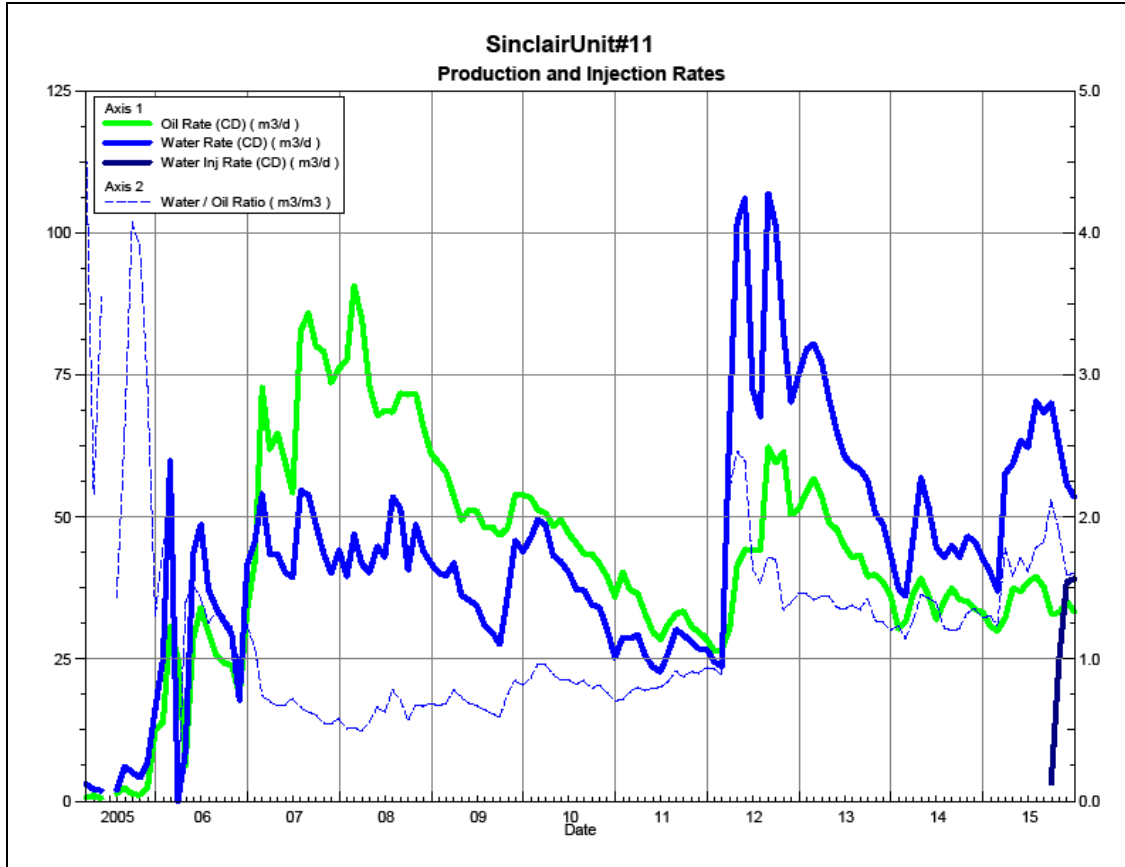
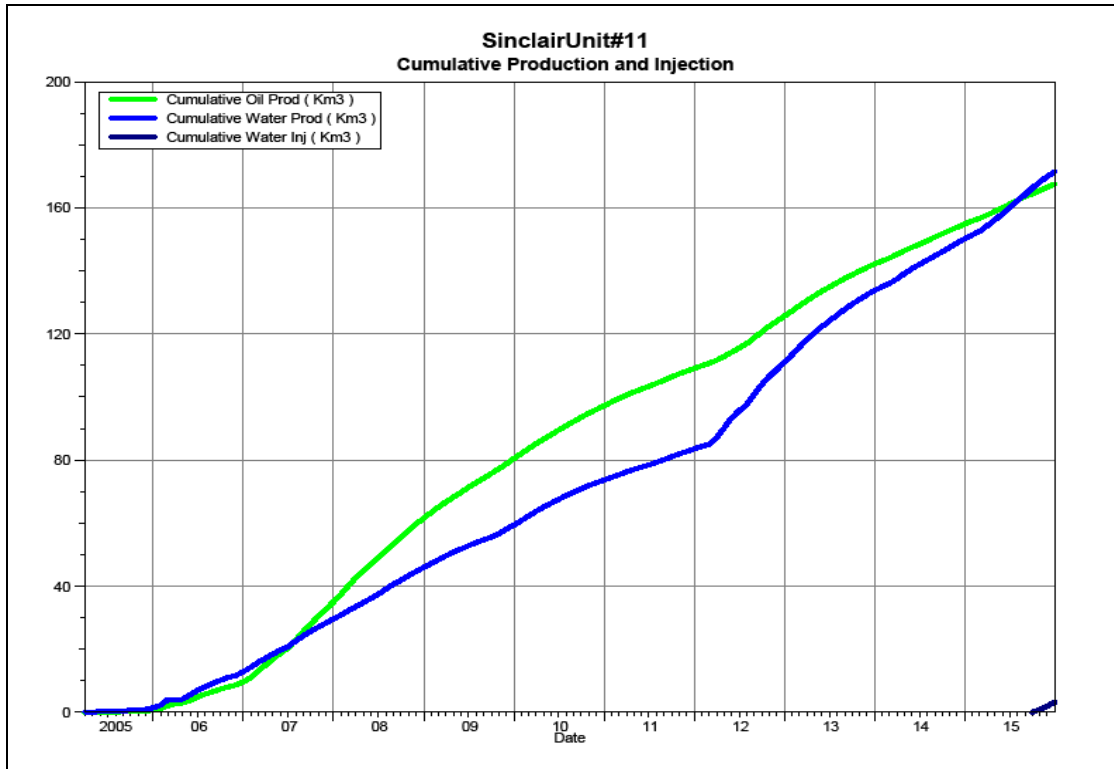


Figure 3 shows the cumulative production for Sinclair Unit No. 11 to the end of December 2015 as 167.63 e³m³ of oil, and 171.60 e³m³ of water, representing a 5.1% recovery factor of the OOIP. The cumulative water injected is 3.24 e³m³. The cumulative volume of oil, and water produced and fluid injected for each injection pattern is presented in Appendix D.

**Figure 3: Sinclair Unit No. 11 Cumulative Oil, Water and Water Injected vs Time**



## **Waterflood Development Plan**

### **Sinclair Unit No. 11 Waterflood (WF) Development Plan**

Sinclair Unit No. 11 is still in the development phase at the end of 2015. The 02/01-27, 02/16-34, 02/13-35 and 02/16-36-007-29W1 wells are existing producers that will be converted to injectors. In 2014, the 02/07-27-007-29W1 proposed horizontal injector was drilled and in 2015, the 02/09-27 and 02/04-35-007-29W1 proposed horizontal injectors were drilled. All of the horizontal wells are fracture stimulated to improve the injection rates. Water injection commenced in Sinclair Unit No. 11 in September 2015 with the conversion of 02/01-27-007-29W1 to an injector. As of Dec 2015, 7 of the proposed 11 future injectors have been drilled. In 2016, Tundra anticipates converting 3 of the existing horizontal producers to injectors.

Production performance by injector pattern is summarized in Appendix A.

Any future revisions to the waterflood development or surveillance plan would be based on new production or performance response data, technical studies, or observed reservoir behavior and reserves recovery interpretations.

## **Waterflood EOR Operating Strategy and Performance**

### **Water Source and Quality**

The injection water for Sinclair Unit No. 11 will be sourced from the 16-32-007-29W1 well (Lodgepole formation). The water is treated at the 03-04-007-29W1 battery where it is filtered to 0.5 microns and has scale inhibitor added. The injection water is then distributed to the injectors through the dedicated infrastructure system.

### **Injection Wellhead Pressures**

Injection started in this Unit in September 2015. The average monthly wellhead injection pressure for each injection well is summarized in Appendix C. Since injection in this Unit is still in the early stages, the injector(s) are still building up to a target injection pressure of 6300 kPaa.

### **Reservoir Pressure**

Where practical, Tundra is committed to collecting pressure data from newly drilled injection wells. For Sinclair Unit No. 11, pressure data taken in 2014-2015 from 3 locations is available. A summary table is presented in Appendix B. Pressures are corrected to a common datum of -450 m SS for comparison with other units in the area.

### **Well Servicing**

The following table summarizes the well servicing performed within Sinclair Unit No. 11 during 2015:

**Table 1: Sinclair Unit No. 11 Well Servicing**

102.07-27-007-29W1.00	Bakken Open Hole Frac	2/19/2015
102.04-35-007-29W1.00	Bakken Open Hole Frac	3/7/2015
100.06-35-007-29W1.00	Pump Change	7/3/2015
102.01-27-007-29W1.00	CL Cleanout and Convert to WIW	8/25/2015

### **Waterflood Performance Discussion**

At the end of 2015, Sinclair Unit No. 11 waterflood area had 1 injection pattern in place. Water injection began in September 2015, after the conversion of 02/01-27-007-29W1 to an injector. The waterflood area had 7 of the proposed 11 horizontal injection wells drilled (6 producing, 1 injector) at the end of 2015. Tundra is planning to convert 3 more locations to injectors in 2016.

Plots of the production and injection data along with the VRR information is presented in Appendix D for each of the injection patterns.

## List of Appendices

Appendix A: Injection Pattern Summary

Appendix B: Reservoir Pressure Summary

Appendix C: Average Monthly Injection Pressure Summary

Appendix D: Injector Pattern Production/Injection Rates, Cumulative and VRR Plots  
for the following injectors:

XX/11-26-007-29W1/0

XX/13-26-007-29W1/0

102/01-27-007-29W1/0

102/07-27-007-29W1/0

102/09-27-007-29W1/0

XX/12-34-007-29W1/0

102/16-34-007-29W1/0

102/04-35-007-29W1/0

XX/11-35-007-29W1/0

102/13-35-007-29W1/0

102/16-36-007-29W1/0

## Appendix A

### Sinclair Unit No. 11 Injection Pattern Summary as of December 2015

Pattern Name	Injector BH Location (007-29W1)	Injector Surf. Location (007-29W1)	Status	No. of Supported Wells	Supported Wells (007-29W1)	Allocation Factor	Pattern Prod Start Month	Inj Start Month	Oil Rate (m³/d)	Water Rate (m³/d)	WOR (m³/m³)	Water Injection (m³/d)	Cum Oil (E³m³)	Cum Water (E³m³)	Cum Inj Water (E³m³)	Monthly VRR	Cum VRR
XX/11-26-007-29W1/0	XX/11-26	02/06-35	Future Location	5	12-26, 13-26, 14-26, 03-35, 04-35	0.5	Nov 2005	-	1.4	0.8	0.56		12.0	8.1	0.0	0.0	0.00
XX/13-26-007-29W1/0	XX/13-26	02/04-34	Future Location	9	13-26, 13-27, 14-27, 15-27, 16-27, 01-34, 02-34, 04-34, 4-35	0.5	Jan 2006	-	1.8	1.3	0.69		18.1	9.2	0.0	0.0	0.00
02/01-27-007-29W1/0	02/01-27	02/08-28	WTR Injection	9	01-27, 02-27, 02/02-27, 03-27, 04-27, 05-27, 06-27, 07-27, 08-27	0.5	Nov 2005	Sep 2015	0.9	2.3	2.48	39.1	9.7	27.4	3.2	11.7	0.09
02/07-27-007-29W1/0	02/07-27	02/07-28	Capable of OIL Prod	5	05-27, 06-27, 07-27, 08-27, 09-27	0.5	Nov 2005	-	3.5	10.8	3.11		8.1	16.9	0.0	0.0	0.00
02/09-27-007-29W1/0	02/09-27	02/13-27	Capable of OIL Prod	6	12-26, 09-27, 13-27, 14-27, 15-27, 16-27	0.5	Jan 2006	-	4.6	7.0	1.52		14.2	15.2	0.0	0.0	0.00
XX/12-34-007-29W1/0	XX/12-34	02/09-34	Future Location	5	06-35, 05-34, 06-34, 11-34, 12-34,	0.2 0.5	Mar 2006	-	1.3	1.9	1.47		8.1	8.2	0.0	0.0	0.00
02/16-34-007-29W1/0	02/16-34	02/13-34	Capable of OIL Prod	6	09-34, 11-34, 12-34, 13-34, 14-34, 16-34	0.5	Jul 2005	-	3.4	3.8	1.11		15.8	16.8	0.0	0.0	0.00
02/04-35-007-29W1/0	02/04-35	02/05-34	Capable of OIL Prod	7	01-34, 02-34, 04-34, 05-34, 06-34, 04-35, 06-35	0.5	Jan 2007	-	4.4	14.0	3.15		13.6	18.8	0.0	0.0	0.00
XX/11-35-007-29W1/0	XX/11-35	02/09-34	Future Location	4	06-35, 09-34, 11-35, 12-35	0.3 0.5	Jul 2005	-	0.8	2.3	2.97		4.1	7.6	0.0	0.0	0.00
02/13-35-007-29W1/0	02/13-35	02/16-35	Capable of OIL Prod	8	09-35, 10-35, 11-35, 12-35, 13-35, 14-35, 15-35, 16-35	0.5	Jan 2007	-	3.6	2.8	0.78		15.5	9.0	0.0	0.0	0.00
02/16-36-007-29W1/0	02/16-36	02/16-35	Capable of OIL Prod	8	09-36, 10-36, 11-36, 12-36, 13-36, 14-36, 15-36, 16-36	0.5	Mar 2005	-	3.78	2.77	0.73		17.49	10.47	0	0	0



## APPENDIX B

### Sinclair Unit No. 11 - Pressure Summary

Location	Test Date	Final Pressure (kPaa)	MPP (mTVD)	KB	Datum Depth	Gradient	Pressure @ -450 masl
02/07-27-007-29W1/0	Mar 12, 2014 - Feb 5, 2015	4950.4	1002.25	526.4	-450	8.25	4737
02/09-27-007-29W1/0	Jan 29 - Feb 12, 2015	2965.1	1004.83	525.8	-450	8.25	2726
02/04-35-007-29W1/0	Feb 1 - 20, 2015	6958.0	992.74	524.3	-450	8.25	6806

## Appendix C

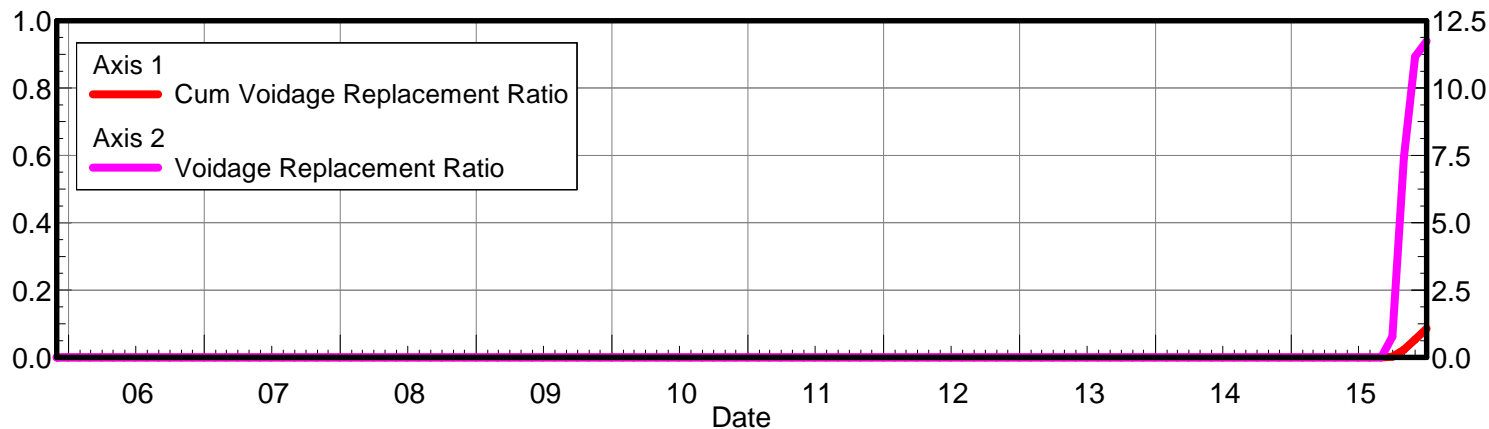
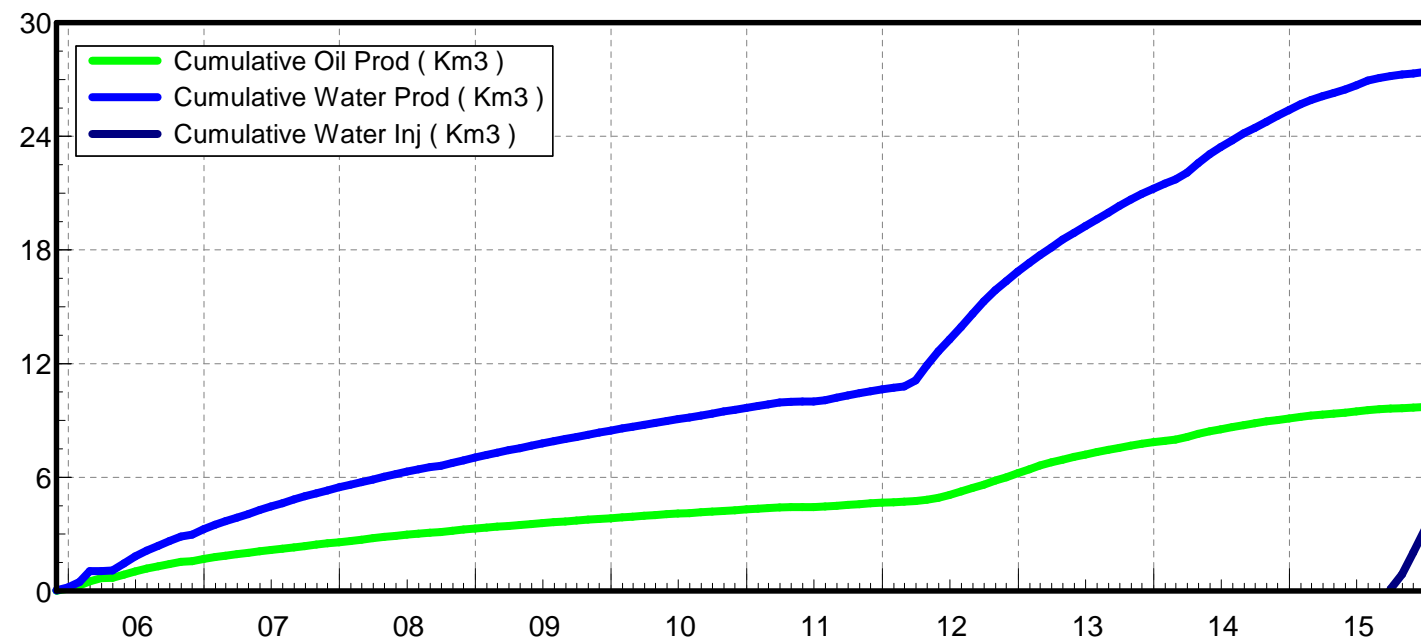
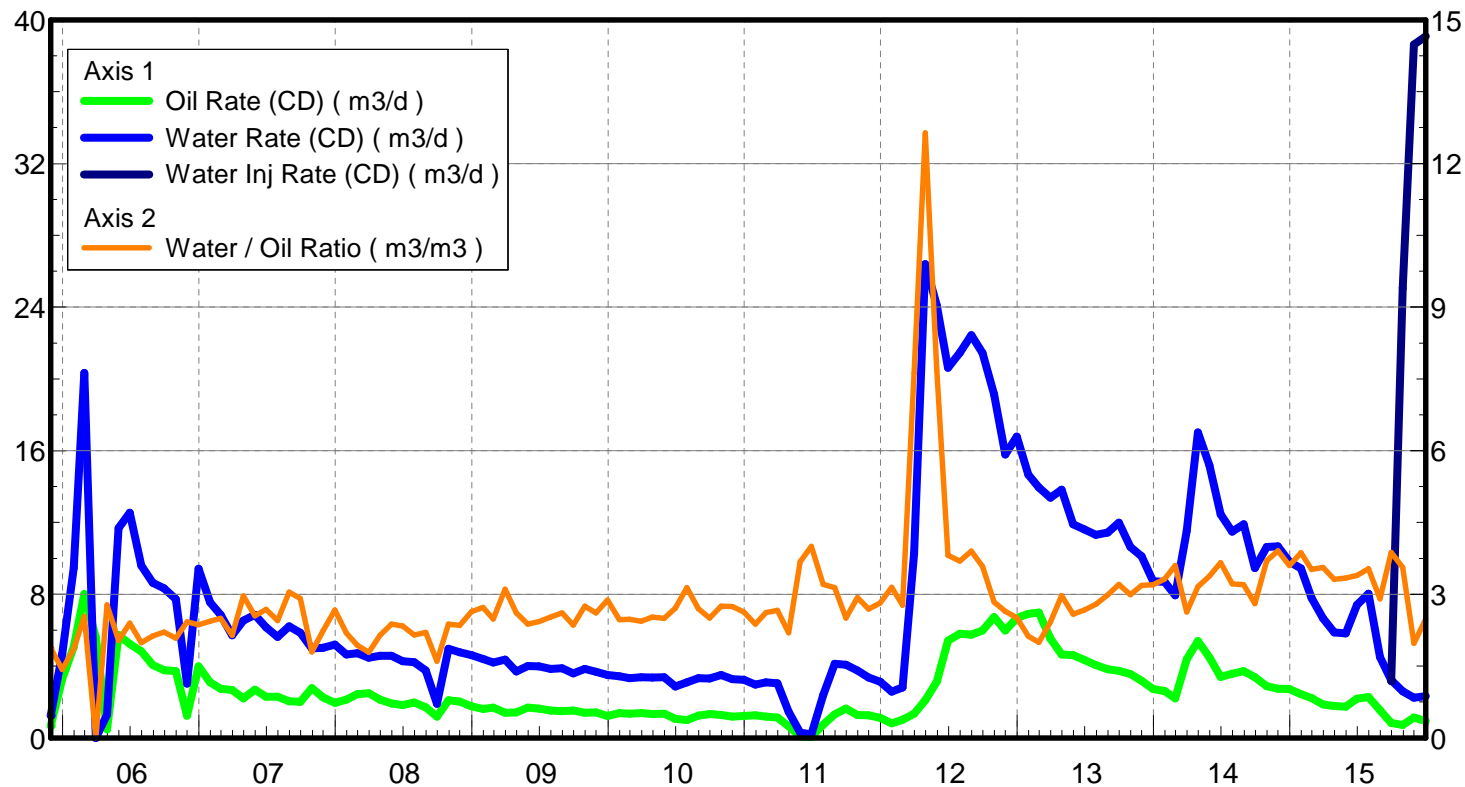
### Average Monthly Injection Pressure (kPag)

Month	Injection Pressure
	102/01-27
Jan-15	-
Feb-15	-
Mar-15	-
Apr-15	-
May-15	-
Jun-15	-
Jul-15	-
Aug-15	-
Sep-15	-3
Oct-15	-82
Nov-15	-89
Dec-15	-88

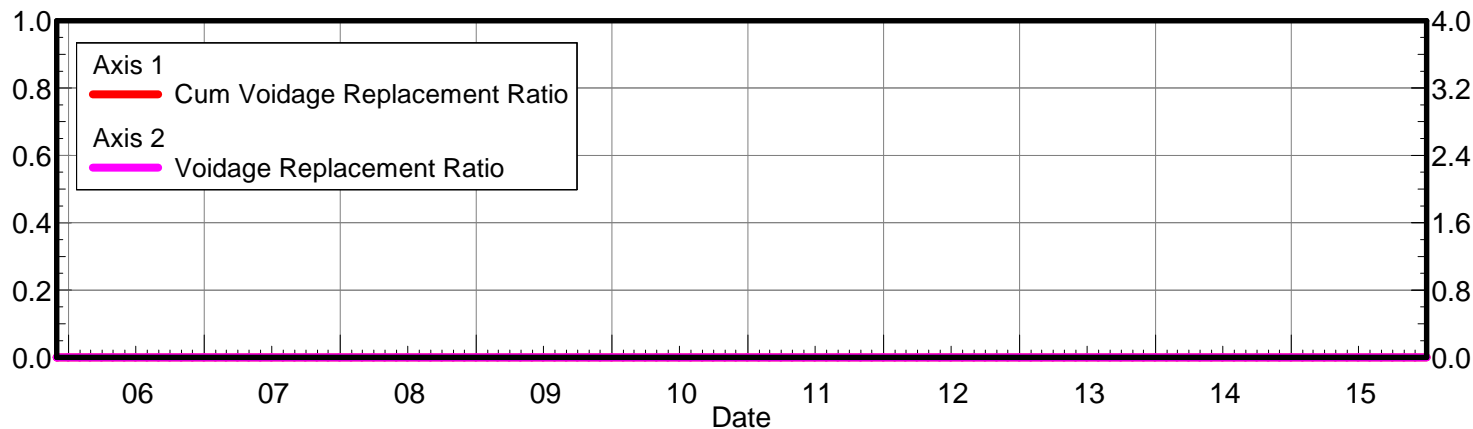
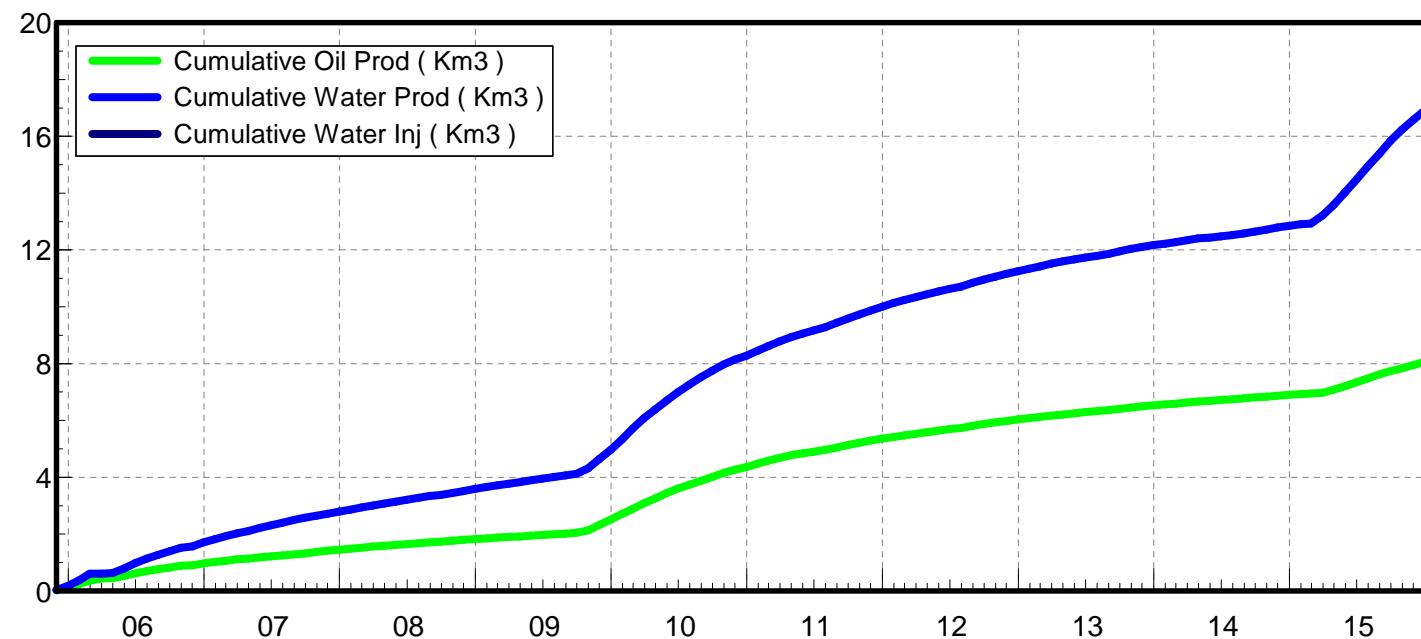
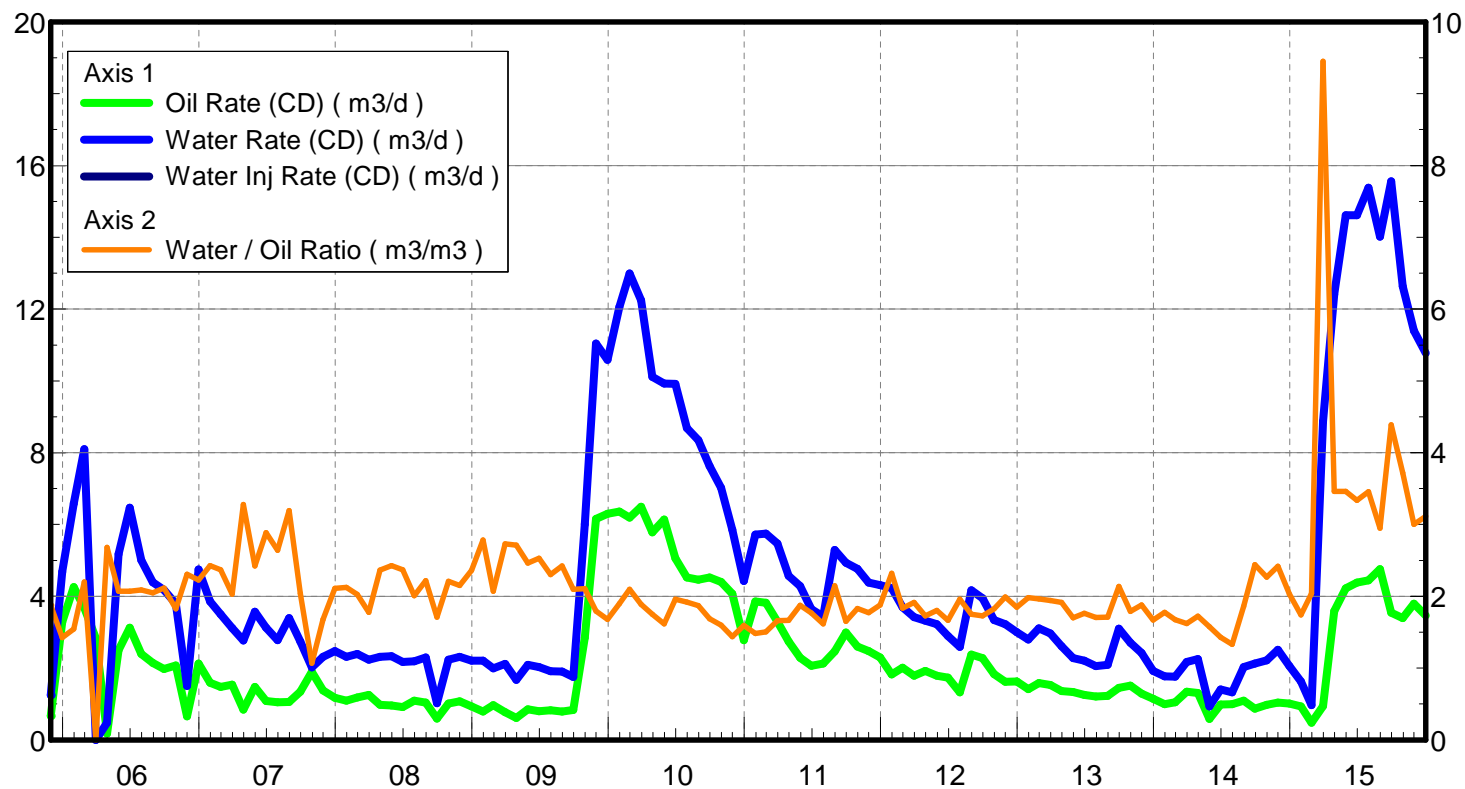
## **Appendix D**

### **Rates and VRR Plots**

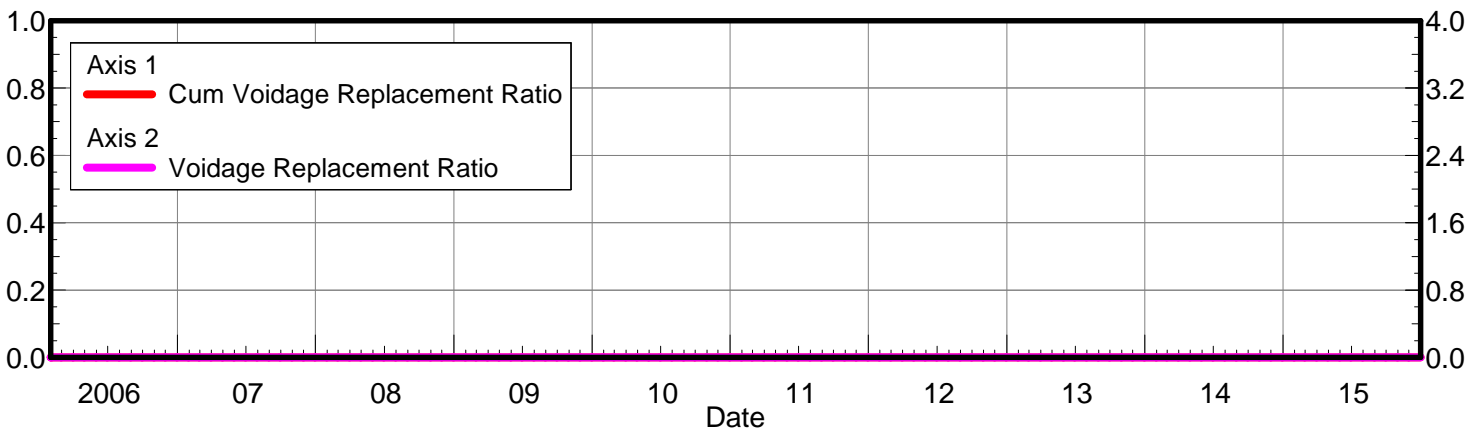
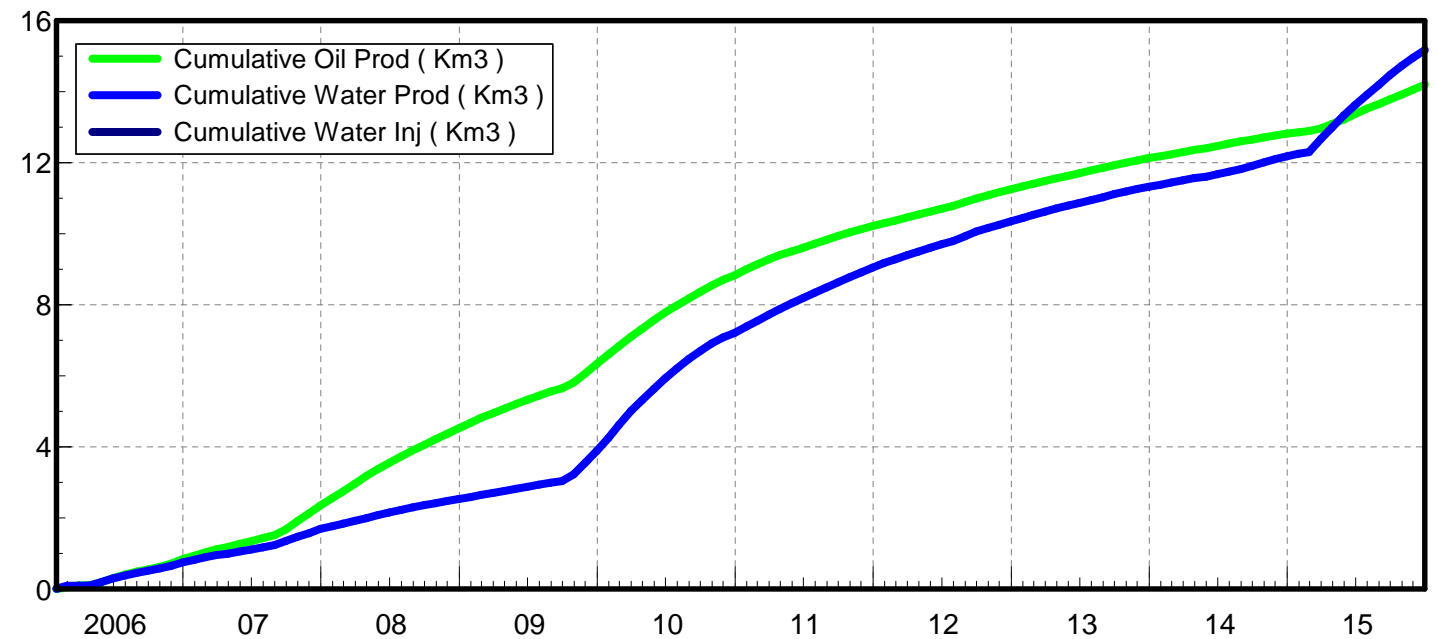
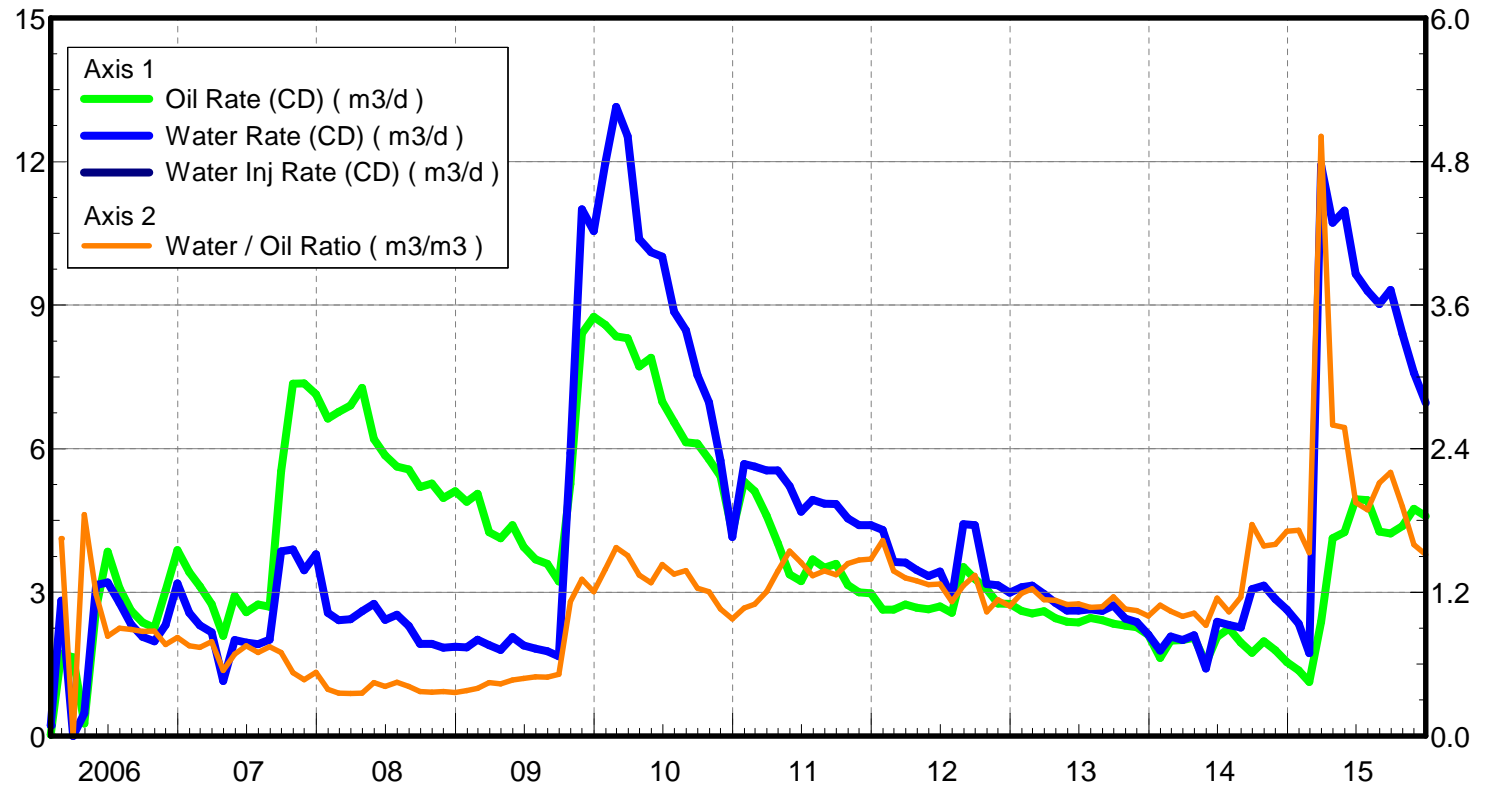
Oil Formation Vol Factor : 1.30 m3/m3  
 Water Formation Vol Factor : 1.00150 m3/m3  
 Water / Oil Ratio : 3.28 m3/m3  
 Pattern : 02/01-27-007-29  
 Inj Set: Sinclair Unit#11  
 June 15, 2016  
 Operator: Tundra\_O&G\_Prtshp  
 Oil Rate (CD) : 0.73 m3/d  
 Water Rate (CD) : 2.38 m3/d  
 Water Inj Rate (CD) : 24.74 m3/d



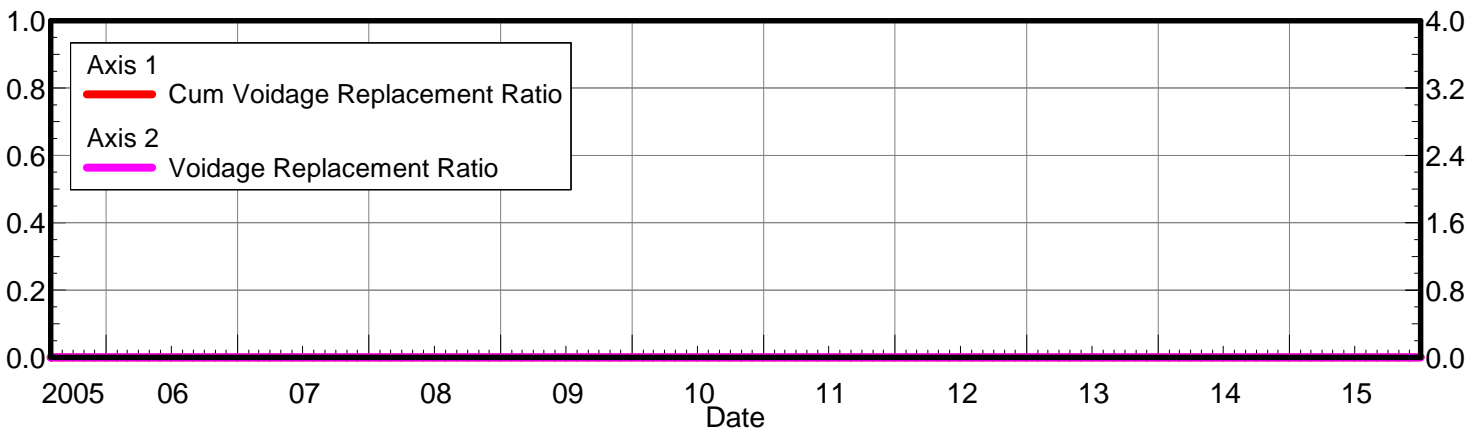
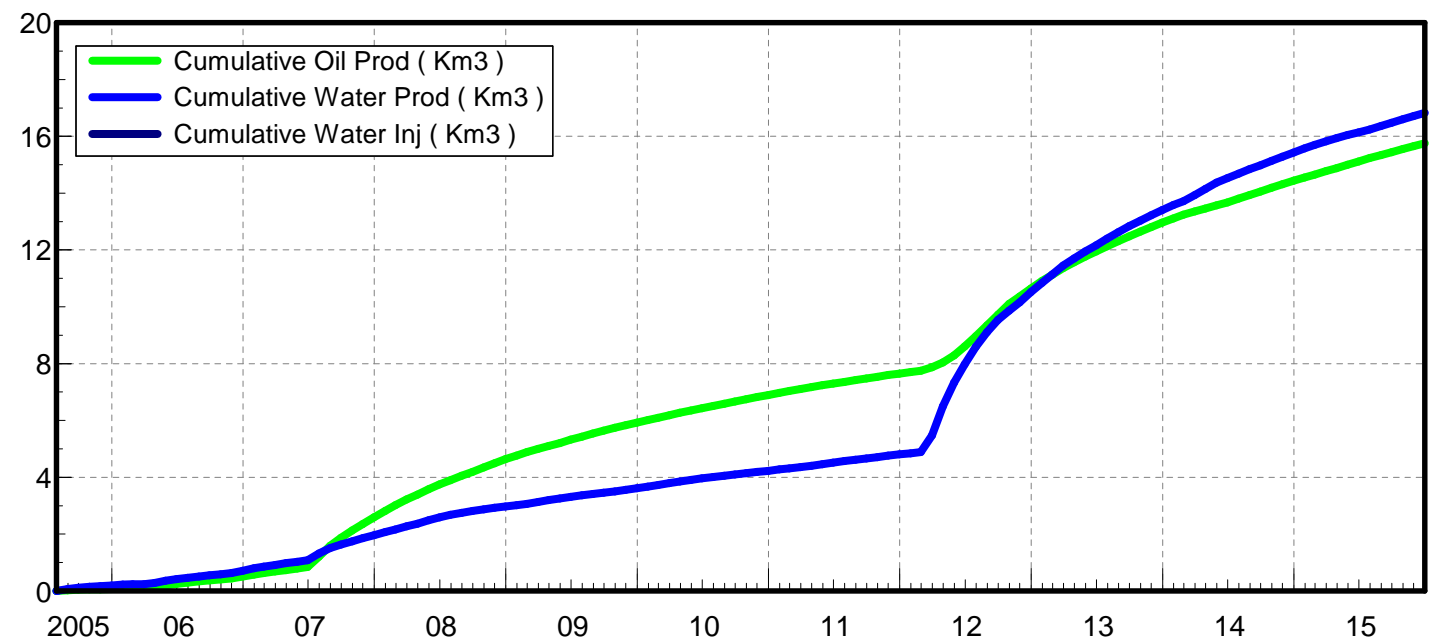
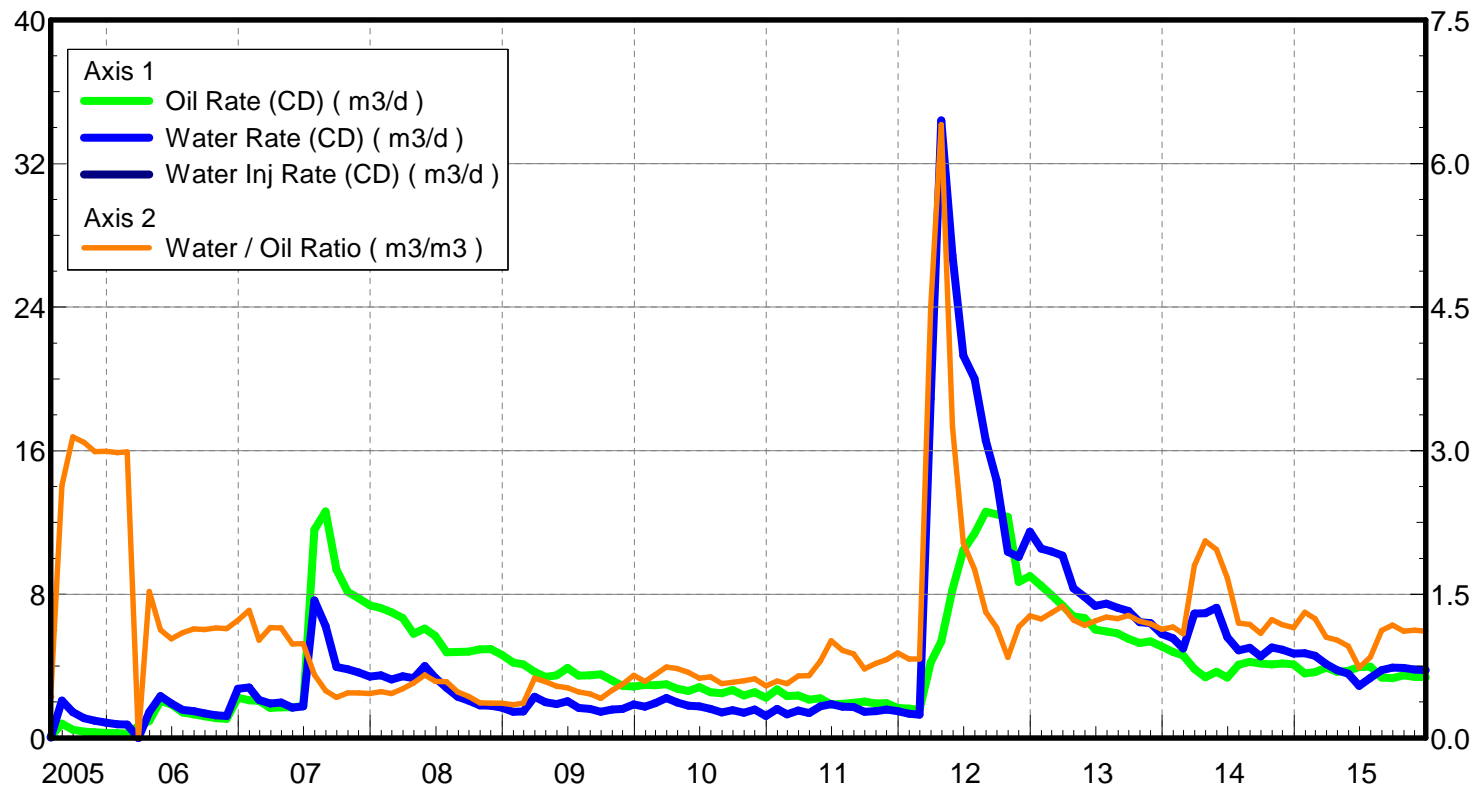
Oil Formation Vol Factor : 1.30 m3/m3  
Water Formation Vol Factor : 1.00150 m3/m3  
Water / Oil Ratio : 3.46 m3/m3  
Pattern : 02/07-27-007-29  
Inj Set: Sinclair  
Unit#11  
June 15, 2016  
Operator: Tundra\_O&G\_Prtshp  
Oil Rate (CD) : 2.70 m3/d  
Water Rate (CD) : 9.34 m3/d  
Water Inj Rate (CD) : \* m3/d



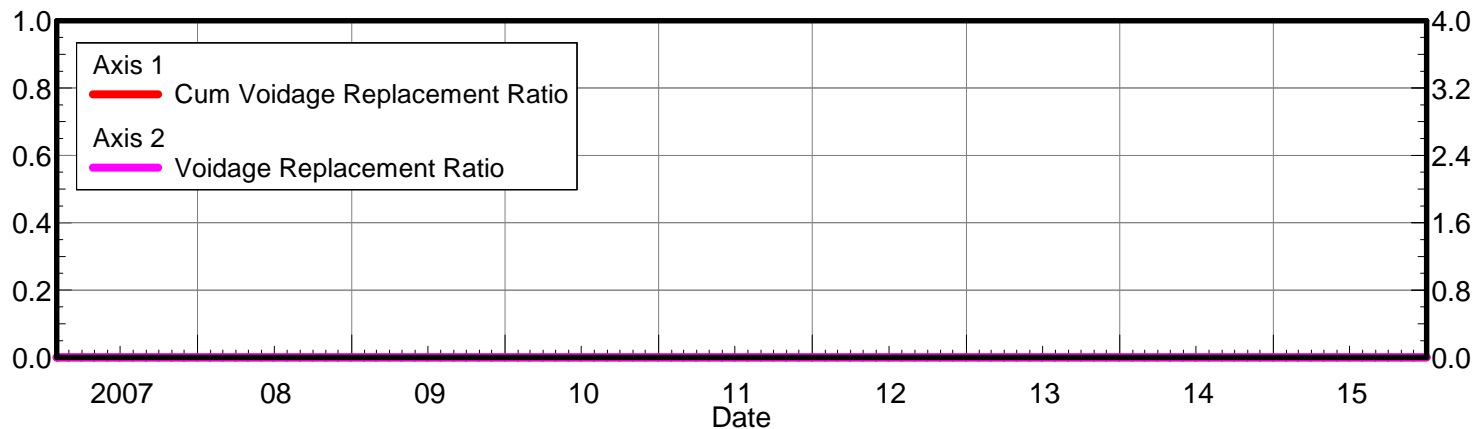
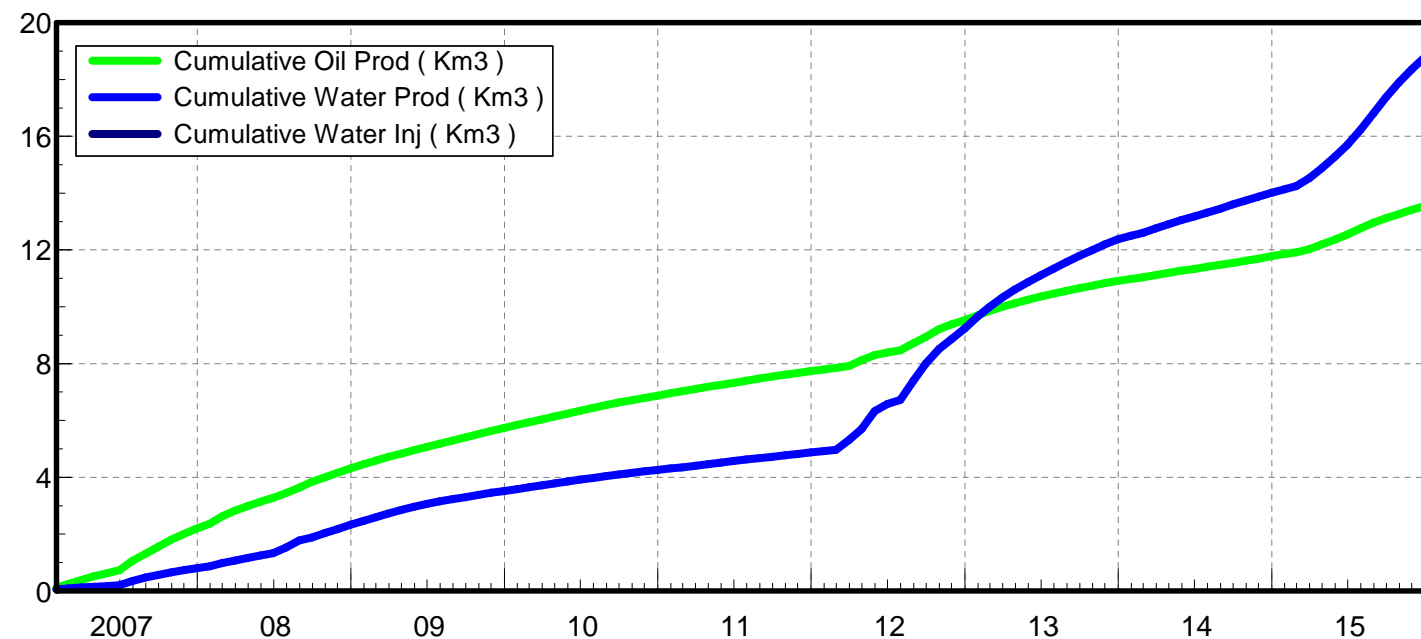
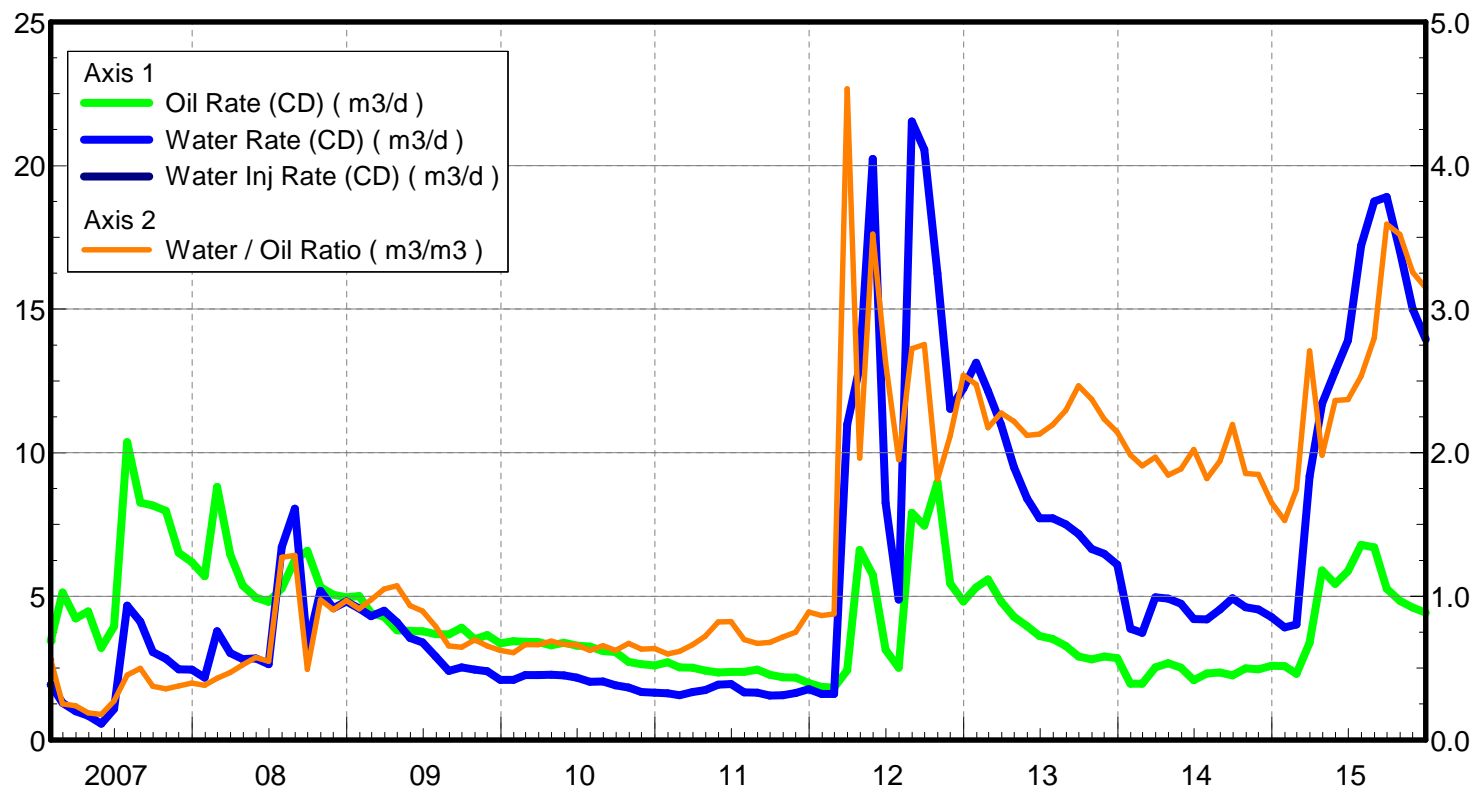
Oil Formation Vol Factor : 1.00150 m3/m3  
 Water Formation Vol Factor : 1.00150 m3/m3  
 Water / Oil Ratio : 1.64 m3/m3  
 Pattern : 02/09-27-007-29  
 Inj Set: Sinclair  
 Unit#11  
 June 15, 2016  
 Operator: Tundra\_O&G\_Prtshp  
 Oil Rate (CD) : 3.84 m3/d  
 Water Rate (CD) : 6.30 m3/d  
 Water Inj Rate (CD) : \* m3/d



Pattern: 02/16-34-007-29 Inj Set: Sinclair Unit#11 Oil Rate (CD) : 3.07 m3/d  
 Water Formation Vol Factor : 1.00150 m3/m3 June 15, 2016 Water Rate (CD) : 3.89 m3/d  
 Water / Oil Ratio : 1.27 m3/m3 Operator: Tundra\_O&G\_Prtshp Water Inj Rate (CD) : \* m3/d

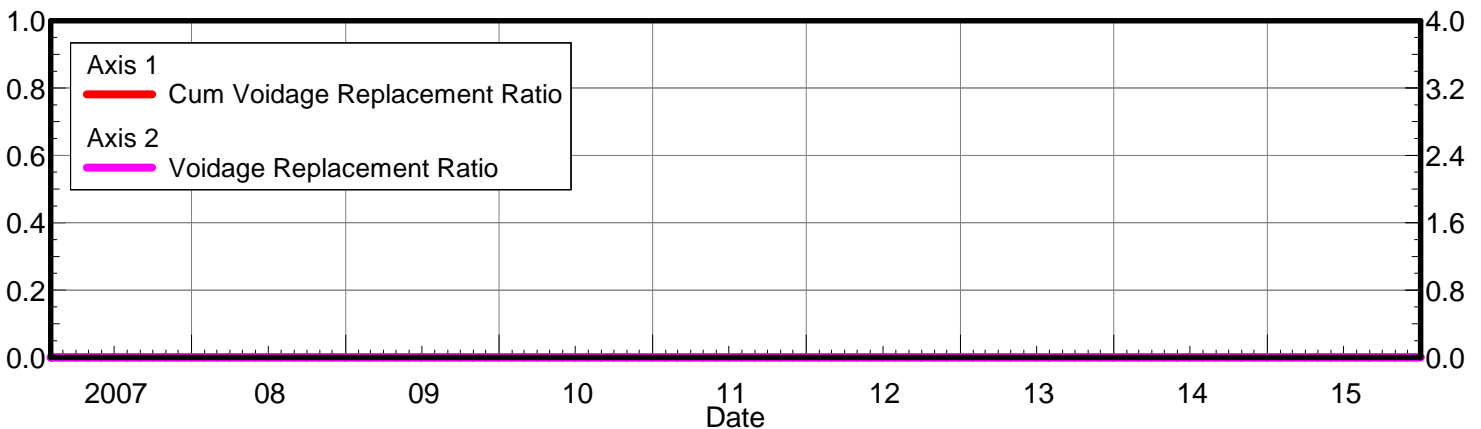
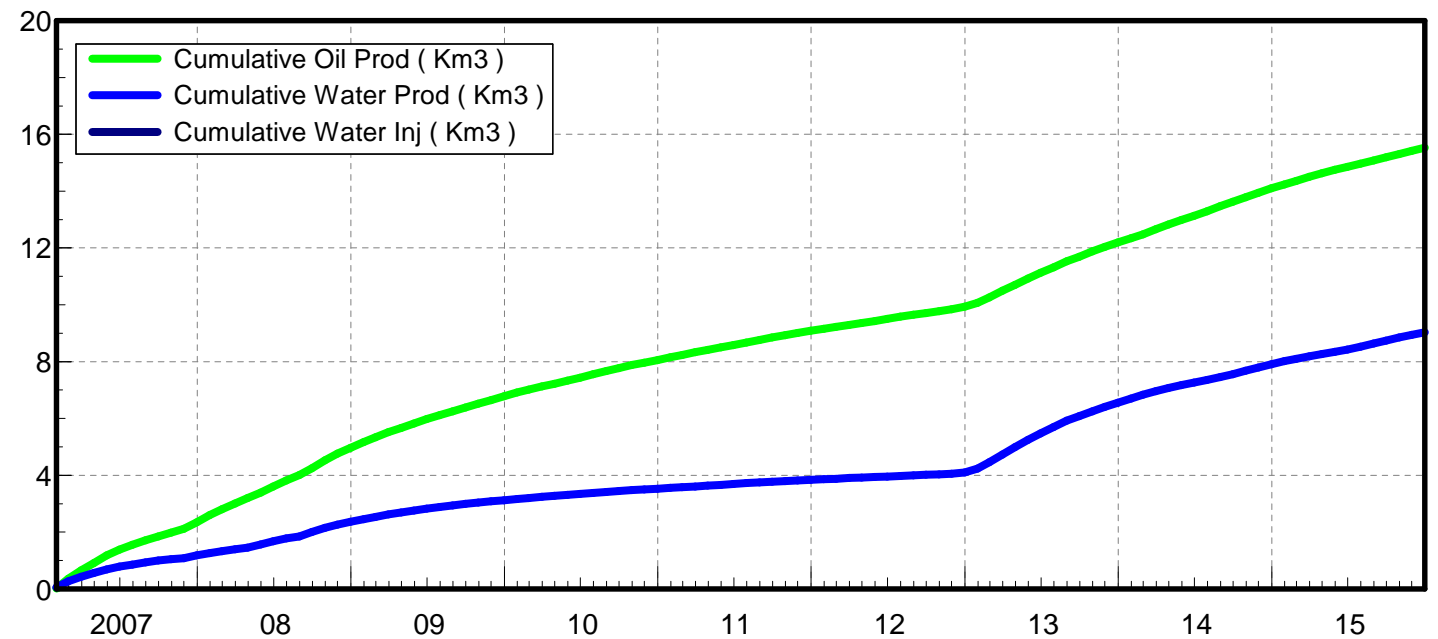
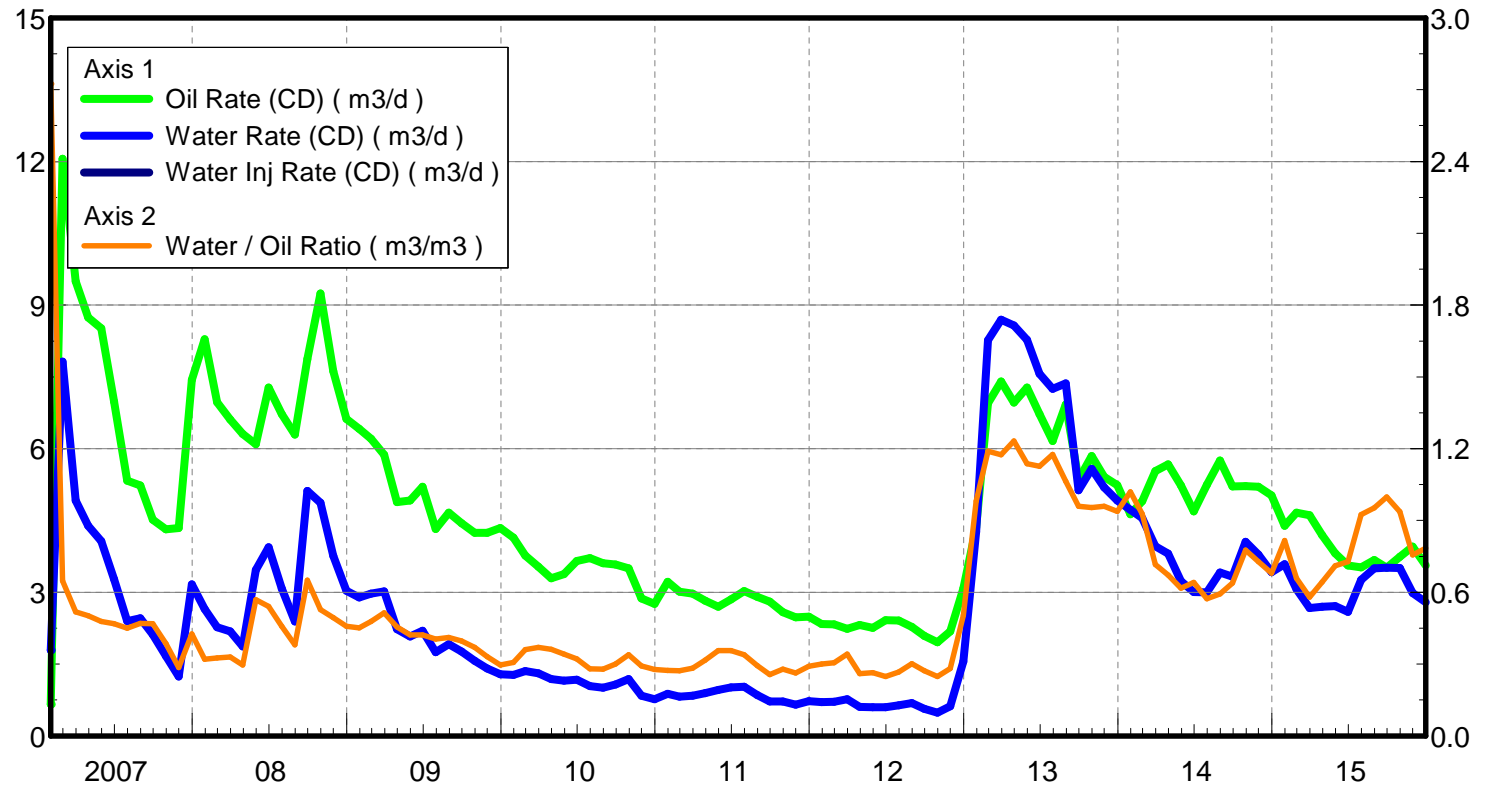


Oil Formation Vol Factor : 1.00150 m3/m3  
 Water Formation Vol Factor : 1.00150 m3/m3  
 Water / Oil Ratio : 3.22 m3/m3  
 Pattern : 02/04-35-007-29  
 Inj Set: Sinclair  
 Unit#11  
 June 15, 2016  
 Operator: Tundra\_O&G\_Prtshp  
 Oil Rate (CD) : 3.64 m3/d  
 Water Rate (CD) : 11.73 m3/d  
 Water Inj Rate (CD) : \* m3/d

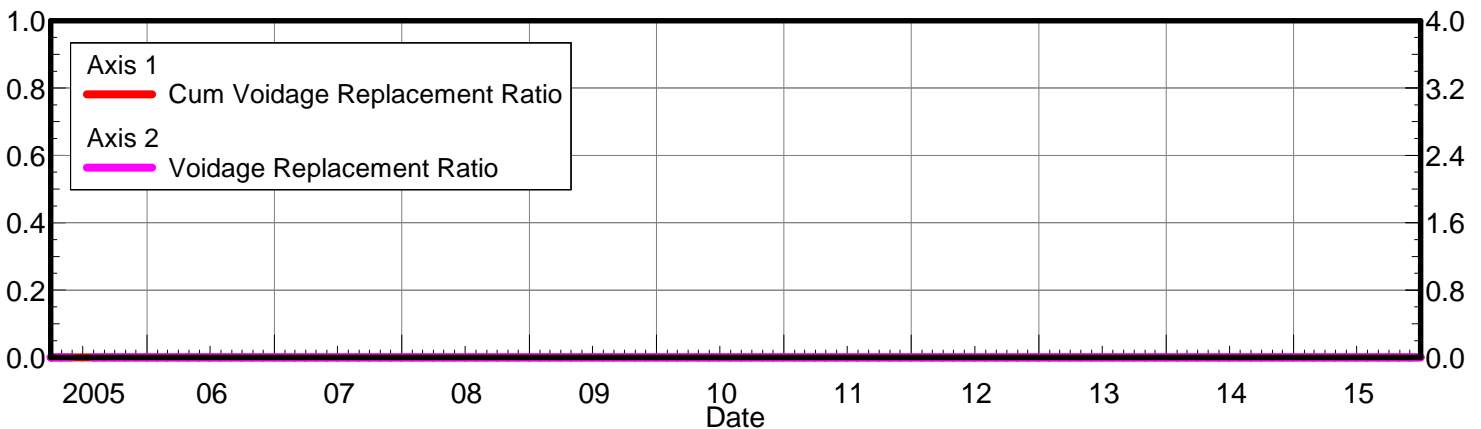
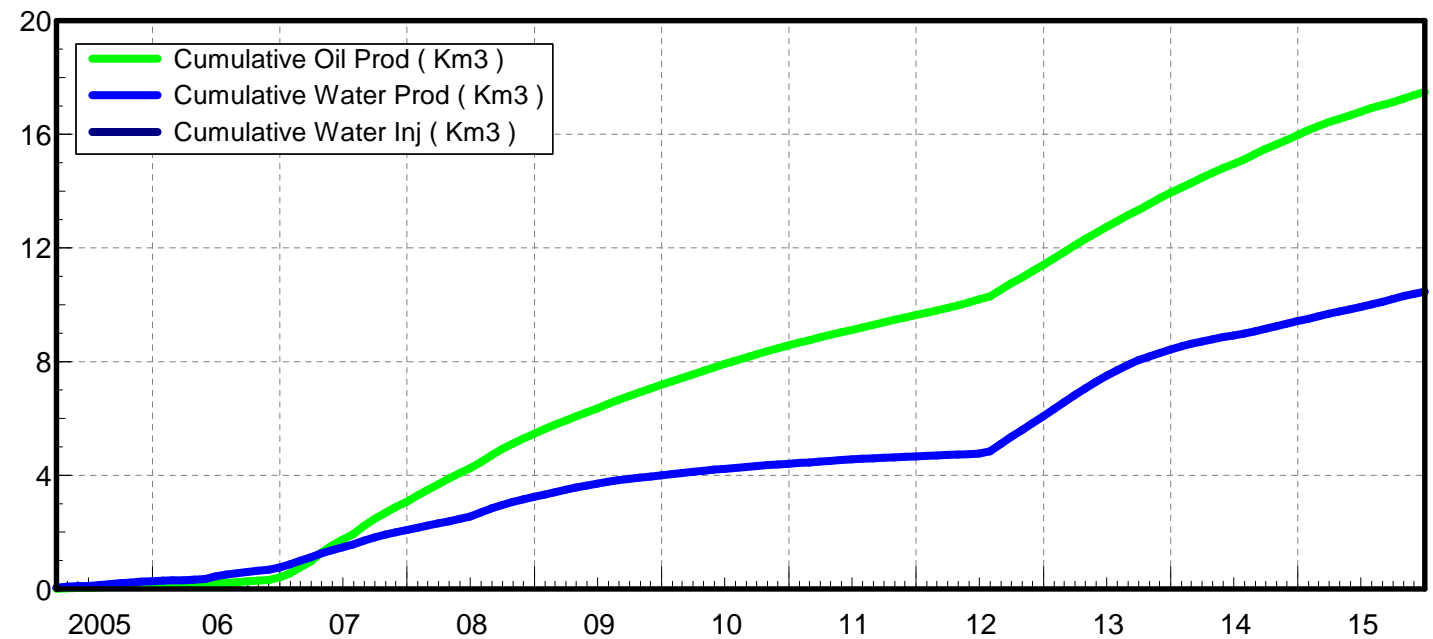
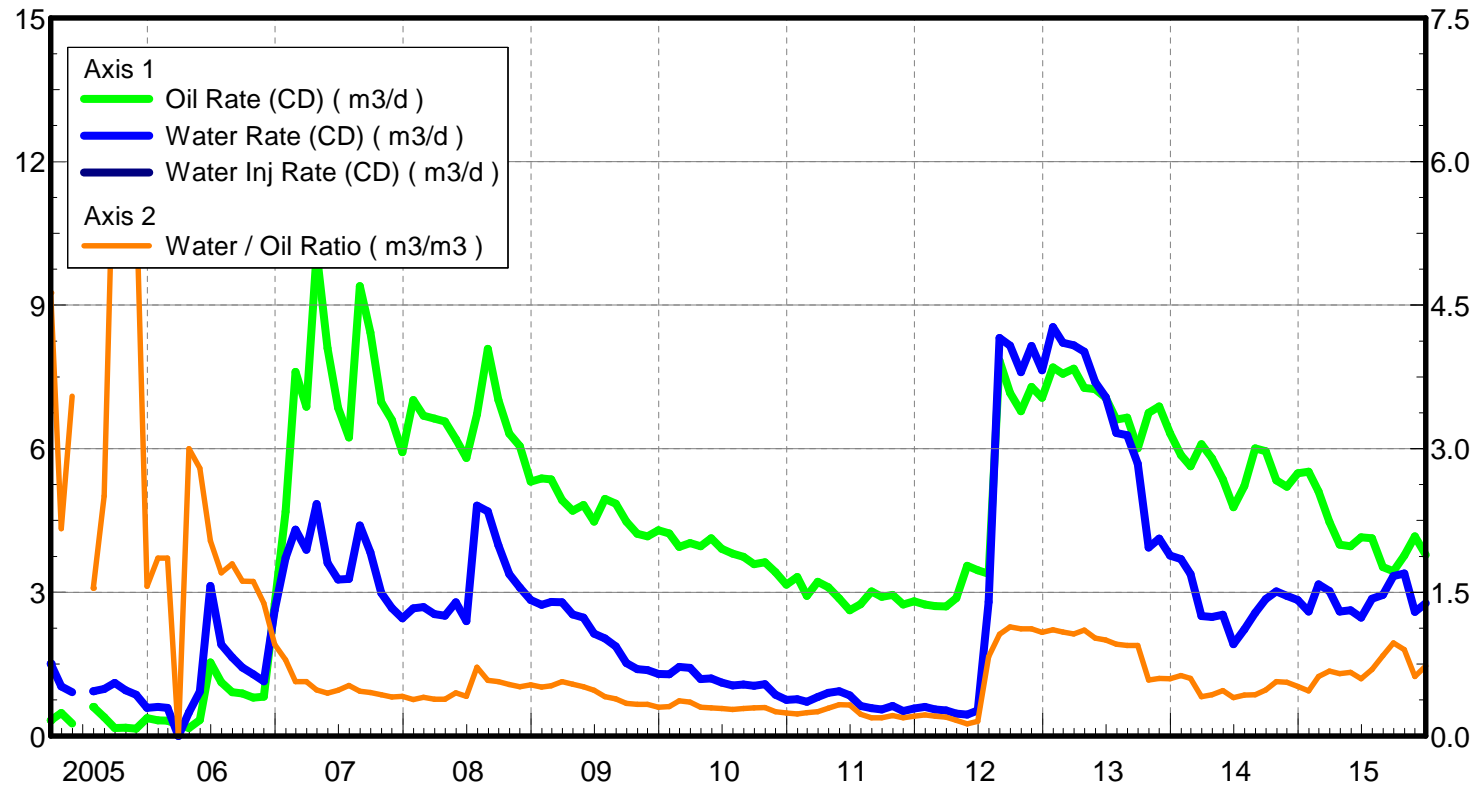


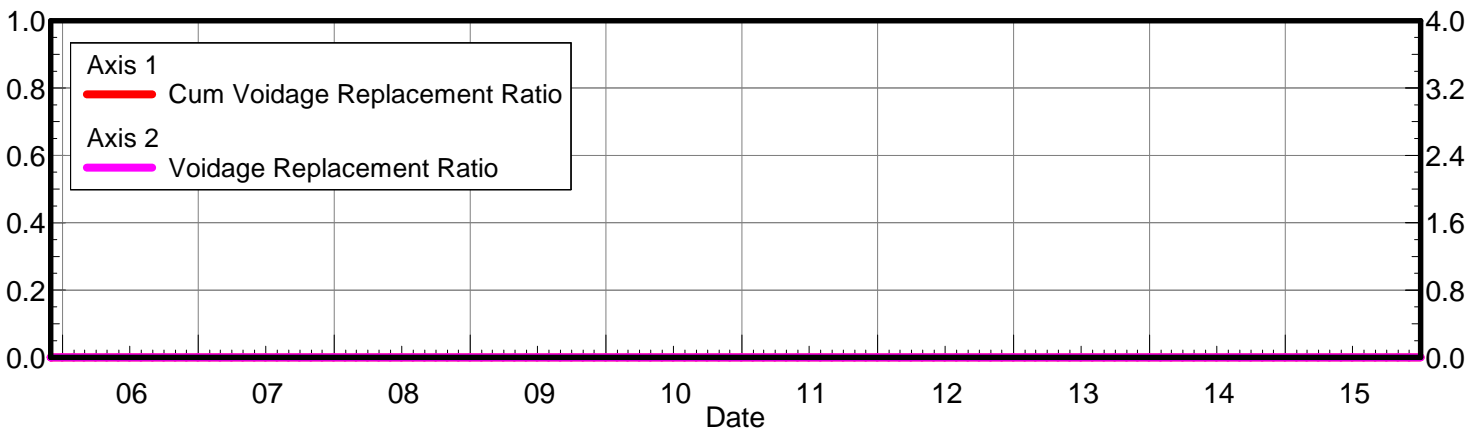
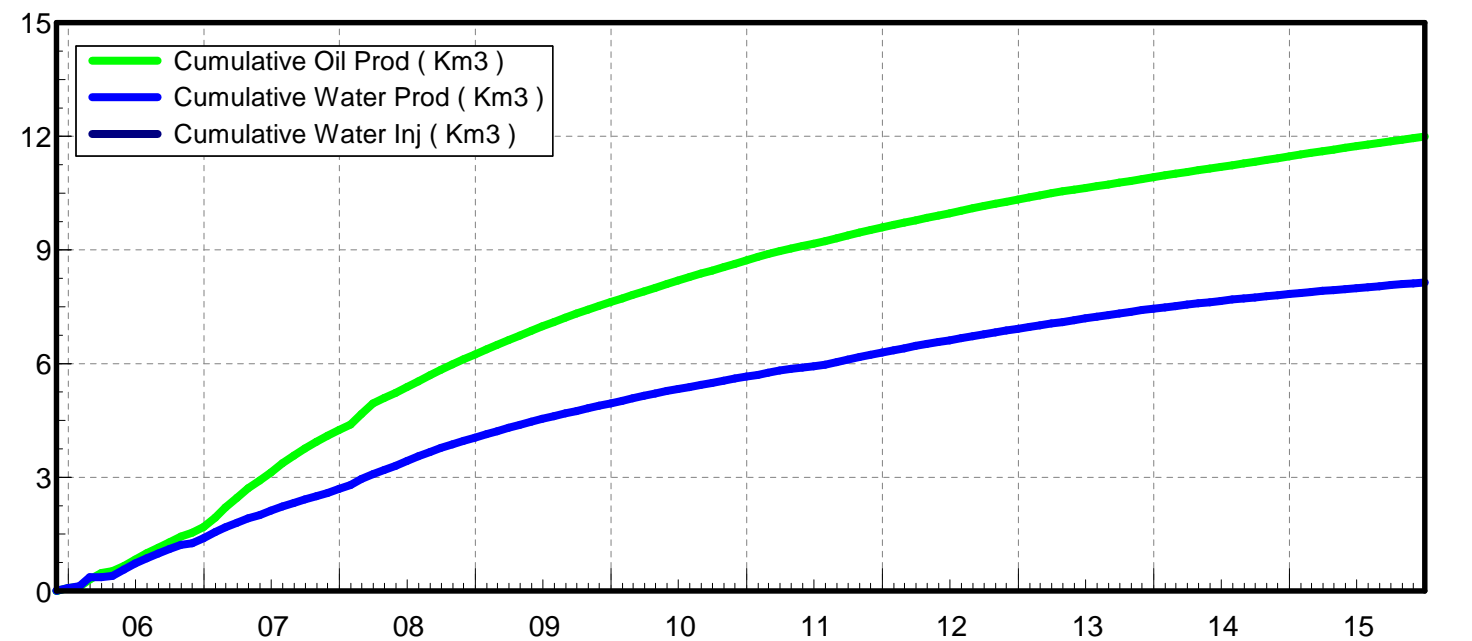
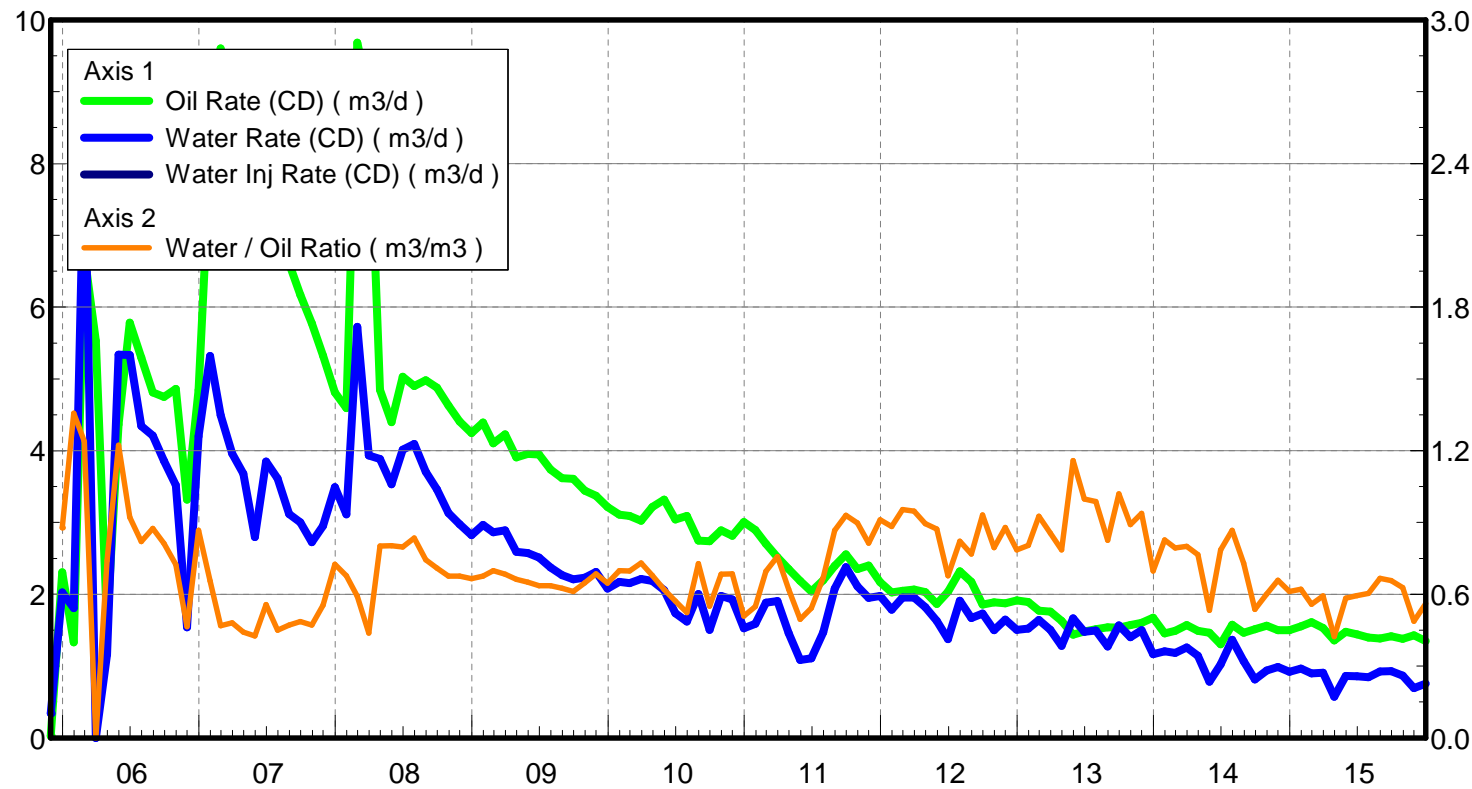


Oil Formation Vol Factor : 0.85 m3/m3  
 Water Formation Vol Factor : 1.00150 m3/m3  
 Water / Oil Ratio : 0.85 m3/m3  
 Pattern : 02/13-35-007-29  
 Inj Set: Sinclair  
 Unit#11  
 June 15, 2016  
 Operator: Tundra\_O&G\_Prtshp  
 Oil Rate (CD) : 3.24 m3/d  
 Water Rate (CD) : 2.76 m3/d  
 Water Inj Rate (CD) : \* m3/d



Oil Formation Vol Factor : 1.3333 m3/m3  
 Water Formation Vol Factor : 1.00150 m3/m3  
 Water / Oil Ratio : 0.84 m3/m3  
 Pattern : 02/16-36-007-29  
 Inj Set: Sinclair  
 Unit#11  
 June 15, 2016  
 Operator: Tundra\_O&G\_Prtshp  
 Oil Rate (CD) : 3.32 m3/d  
 Water Rate (CD) : 2.78 m3/d  
 Water Inj Rate (CD) : \* m3/d





Oil Formation Vol Factor : 1.00150 m3/m3  
 Water Formation Vol Factor : 1.00150 m3/m3  
 Water / Oil Ratio : 0.62 m3/m3  
 Pattern : XX/13-26-007-29  
 Inj Set: Sinclair Unit#11  
 June 15, 2016  
 Operator: Tundra\_O&G\_Prtshp  
 Oil Rate (CD) : 1.93 m3/d  
 Water Rate (CD) : 1.19 m3/d  
 Water Inj Rate (CD) : \* m3/d

