

**EBOR UNIT NO. 2  
WATERFLOOD EOR PROJECT  
ANNUAL REPORT FOR 2013**

**March 3, 2014**

**Tundra Oil and Gas Partnership**

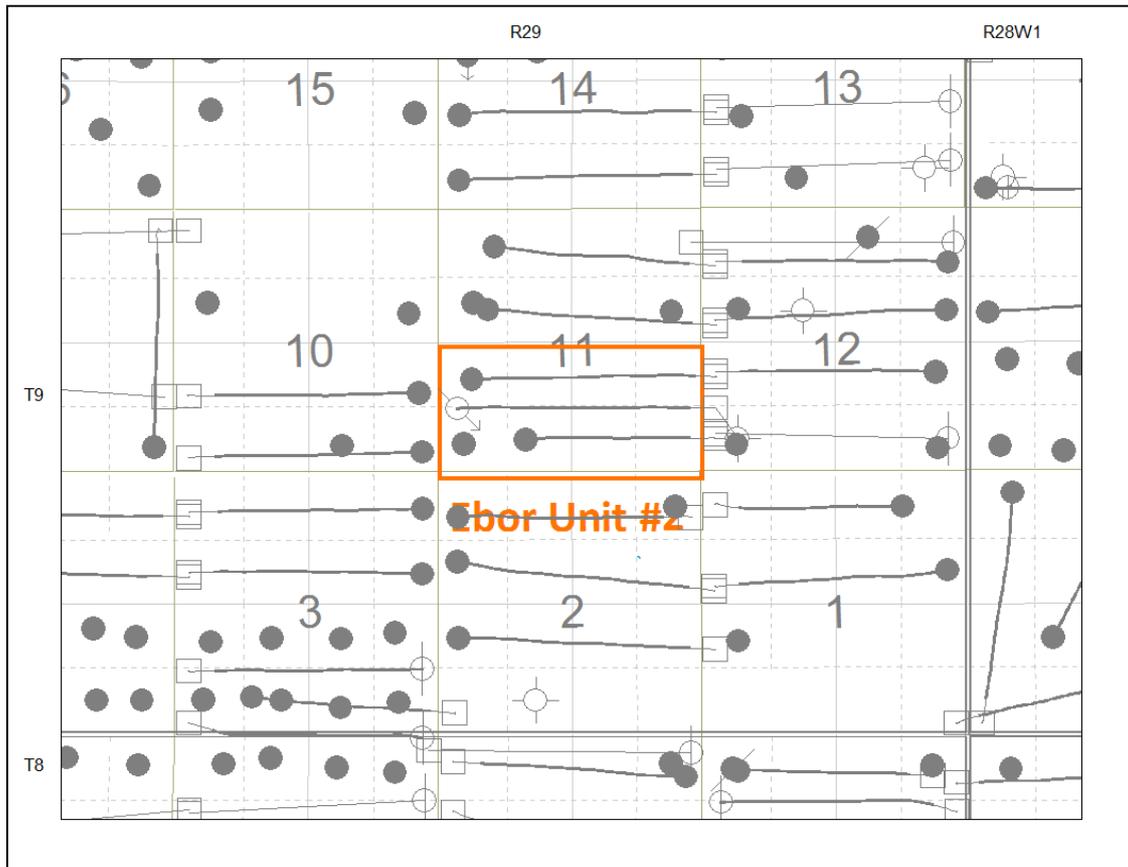
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## **INTRODUCTION**

Ebor Unit No. 2 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Waterflood Order No. 20 effective March 2010 with Tundra Oil and Gas (Tundra) as Operator. The EOR project area, outlined in Orange in Figure 1, contains 4 wells in the South half of Section 11 in Township 9, Range 29 W1. A well list and status is included as Appendix A.

**Figure 1: Ebor Unit No. 2 Area Outline**



In accordance with Section 73 of the Manitoba Drilling and Production Regulation, Tundra submits the following 2013 Annual Progress Report for Ebor Unit No. 2 as required by Waterflood Order No 20.

## **DISCUSSION**

### **Production History**

For the wells included in Ebor Unit No. 2, production started in August 2007 with 00/04-11-009-29W1/0 (00/04-11). Oil production peaked at 17.65 m<sup>3</sup>/d in January of 2009, when the 00/05-11-009-29W1/0 well came on production. In December 2013, the

Unit was producing 2.11 m<sup>3</sup>/d of oil and 14.38 m<sup>3</sup>/d of water. The water oil ratio (WOR) averaged 6.09 m<sup>3</sup>/m<sup>3</sup> in 2013. The rates and WOR are presented in Figure 2.

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

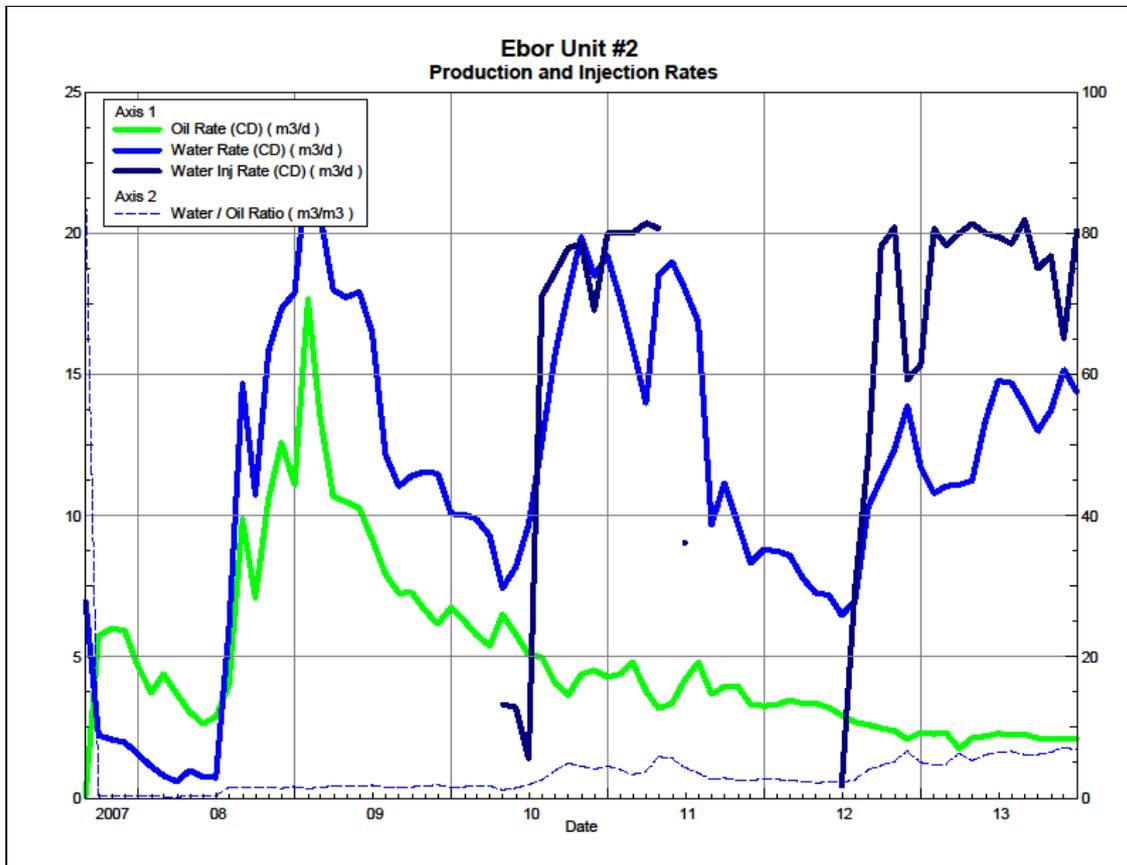
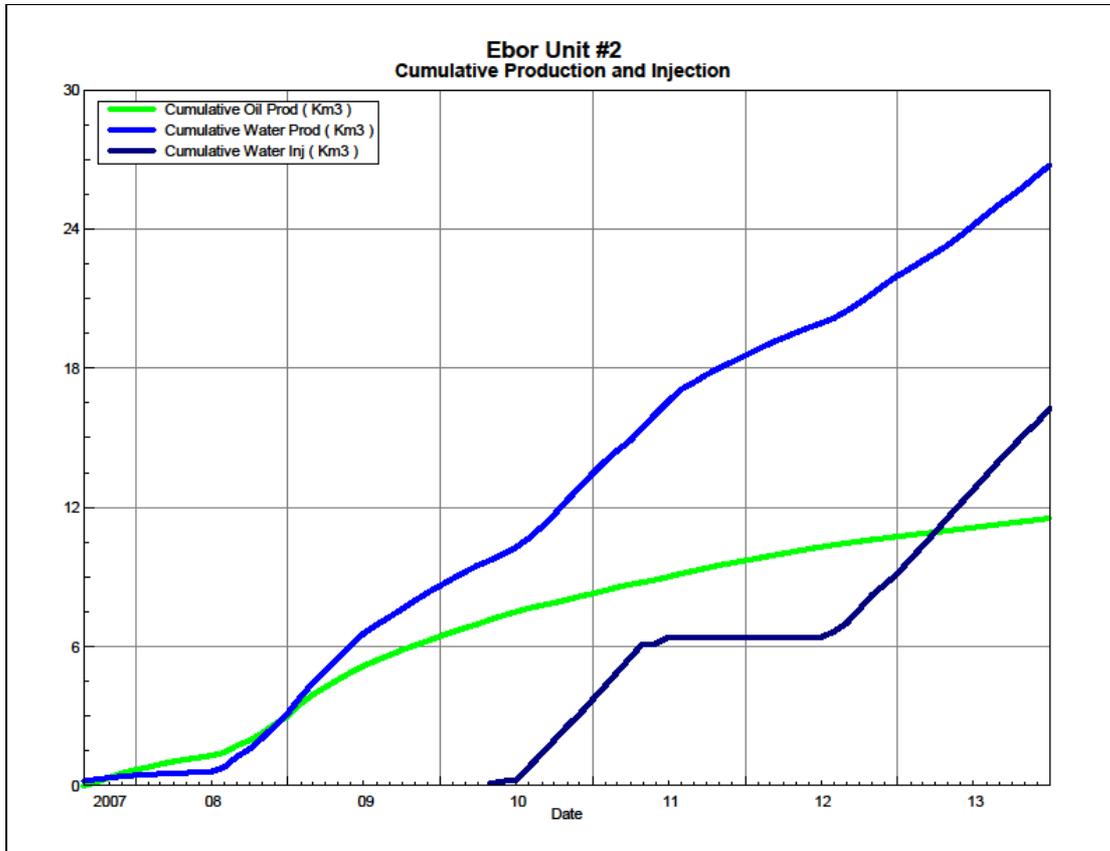


Figure 3 shows the cumulative production for Ebor Unit No. 2 to the end of December 2013 as 11.53 E<sup>3</sup>m<sup>3</sup> of oil, and 26.76 E<sup>3</sup>m<sup>3</sup> of water, representing a 4.7 % recovery factor of the OOIP. Cumulative water injected at the end of 2013 is 16.27 E<sup>3</sup>m<sup>3</sup>.

**Figure 3: Ebor Unit No. 2 Cumulative Oil, Water and Water Injected vs. Time**



### **Waterflood Development Plan**

The Ebor Unit No. 2 has one horizontal water injector, 02/04-11-009-29W1/2 (02/04-11), which started injecting in April 2010. Injection for this unit was suspended in June 2011, to try and mitigate the water breakthrough that had occurred at 00/05-11-009-29W1 (00/05-11) in July 2010.

The 02/04-11 injector had a very high reservoir pressure (~6559 kPaa) when it was placed on injection. It is Tundra's belief that placing an injector with such high reservoir pressure leads to premature water breakthrough. The learning's from this Unit has played a major role in Tundra's new protocol of producing the newly drilled injector wells first prior to putting them on injection to clean-up the area near the wellbore and to reduce the pressure surrounding the injection well. This should lead to better waterflood performance and minimize premature breakthroughs.

It is evident in Figure 2, that since shutting in the injection at 02/04-11, the amount of water being produced from this Unit has decreased without substantially sacrificing the oil production. It is our belief that once the pressure is relieved from this injector, the breakthrough channel that was created between the 02/04-11 and 00/05-11 wells should relax and heal. In July 2012, injection was restarted. Both the 00/03-11-009-29W1/0

(00/03-11) and 00/05-11 horizontal wells and the 00/04-11 vertical well showed waterflood response.

In September 2013, calcium carbonate was used as a bridging agent to repair the direct fracture from the 02/04-11 injector to the 00/05-11 producer. The workover saw an increase in injection pressure. A second workover was done November 2013 which resulted in a reduction in water cut in both the 00/03-11 and 00/05-11 wells.

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 Ebor Unit No. 2 is sourced from the 16-32-007-29W1 well (Lodgepole formation). The water is treated at the 03-04-008-29W1 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**

The monthly wellhead injection pressures for 02/04-11 are summarized in Appendix C. The injection pressures in April and May 2010 are pre-hydraulic fracture. The injection rates during these months were low and hence the well was fractured after which the injection rates improved but led to water breakthrough at the 00/05-11 well.

### **Reservoir Pressure**

No reservoir pressure measurements were taken at Ebor Unit No. 2 in 2013.

### **Well Servicing**

No maintenance was required on the 4 wells in Ebor Unit No. 2 in 2013.

### **Voidage Replacement**

As discussed earlier, the injection was suspended in June 2011. The cumulative VRR had been on a decline with final cumulative VRR for Dec 2011 being 0.221. Tundra restarted injection in Ebor Unit No. 2 in July 2012, to understand if the water channels have been healed from relieving the pressure in this Unit. In December 2013, the monthly VRR was 1.208 and the cumulative VRR for Ebor Unit No. 2 was 0.416.

### **Waterflood Performance Discussion**

At the end of 2013, Ebor Unit No. 2 waterflood area had 1 injector pattern in place. Water injection started in April 2010 and was suspended in June 2011 after signs of breakthrough in the horizontal producer at 00/05-11 shortly after injection began. In July 2012, injection was restarted. Plots and tables of the production and injection data along with the VRR information are presented in Appendix D.

## **List of Appendices**

Appendix A: Ebor Unit No. 2 Well List and Status

Appendix B: Ebor Unit No. 2 Injection Pattern Summary

Appendix C: Monthly Injection Wellhead Pressures Table

Appendix D: Production/Injection Rates, Cumulatives and VRRs

## Appendix A

| <b>UWI</b>          | <b>Surface Location</b> | <b>Well Status</b>        |
|---------------------|-------------------------|---------------------------|
| 00/03-11-009-29W1/0 | 04-12-009-29W1          | Capable of Oil Production |
| 00/04-11-009-29W1/0 |                         | Capable of Oil Production |
| 02/04-11-009-29W1/2 | 02/04-12-009-29W1       | WTR Injection             |
| 00/05-11-009-29W1/0 | 05-12-009-29W1          | Capable of Oil Production |

Appendix B

Ebor Unit No. 2 Pattern Summary as of December 2013

| Pattern Name                | Injector BH Location<br>(009-29W1) | Injector Surf Location<br>(009-29W1) | Status          | Supported Wells<br>(009-29W1) | No. of Supported Wells | Allocation Factor | Pattern Prod Start Month | Inj Start Month | Oil Rate<br>(m <sup>3</sup> /d) | Water Rate<br>(m <sup>3</sup> /d) | WOR<br>(m <sup>3</sup> /m <sup>3</sup> ) | Water Injection<br>(m <sup>3</sup> /d) | Cum Oil<br>(E <sup>3</sup> m <sup>3</sup> ) | Cum Water<br>(E <sup>3</sup> m <sup>3</sup> ) | Cum Inj Water<br>(E <sup>3</sup> m <sup>3</sup> ) | Monthly VRR | Cum VRR |
|-----------------------------|------------------------------------|--------------------------------------|-----------------|-------------------------------|------------------------|-------------------|--------------------------|-----------------|---------------------------------|-----------------------------------|--|--|---|---|---|-------------|---------|
| 02/04-11-09-29W1/2 Injector | 02/04-11                           | 02/04-12                             | Water Injection | 03-11, 04-11, 05-11           | 3                      | 1                 | Aug 2007                 | Apr 2010        | 2.11                            | 14.38                             | 6.81                                     | 20.1                                   | 11.5  | 26.8  | 16.3  | 1.2         | 0.42    |

## Appendix C

| Month  | 102/04-11 |
|--------|-----------|
| Mar-10 | 0         |
| Apr-10 | 4663      |
| May-10 | 5158      |
| Jun-10 | 0         |
| Jul-10 | 0         |
| Aug-10 | 0         |
| Sep-10 | 0         |
| Oct-10 | 0         |
| Nov-10 | 0         |
| Dec-10 | 0         |
| Jan-11 | 0         |
| Feb-11 | 0         |
| Mar-11 | 94        |
| Apr-11 | 481       |
| May-11 | 540       |
| Jun-11 | 703       |
| Jul-11 | 750       |
| Aug-11 | 750       |
| Sep-11 | 750       |
| Oct-11 | 750       |
| Nov-11 | 750       |
| Dec-11 | 750       |
| Jan-12 | 750       |
| Feb-12 | 750       |
| Mar-12 | 750       |
| Apr-12 | 750       |
| May-12 | 750       |
| Jun-12 | 750       |
| Jul-12 | 73        |
| Aug-12 | 0         |
| Sep-12 | 140       |
| Oct-12 | 975       |
| Nov-12 | 881       |
| Dec-12 | 693       |
| Jan-13 | 1451      |
| Feb-13 | 1564      |
| Mar-13 | 1904      |
| Apr-13 | 1961      |
| May-13 | 2103      |
| Jun-13 | 2147      |
| Jul-13 | 2315      |
| Aug-13 | 2621      |
| Sep-13 | 3055      |
| Oct-13 | 3460      |
| Nov-13 | 3720      |
| Dec-13 | 4090      |

**Appendix D**  
**Rates and VRR**  
**Plots and Tables**

# Pattern: 02/04-11-009-29Inj Set: EborUnit#2

Oil Formation Vol Factor : 1.07100 m<sup>3</sup>/m<sup>3</sup>

Water Formation Vol Factor : 1.00150 m<sup>3</sup>/m<sup>3</sup>

Water / Oil Ratio : 6.81 m<sup>3</sup>/m<sup>3</sup>

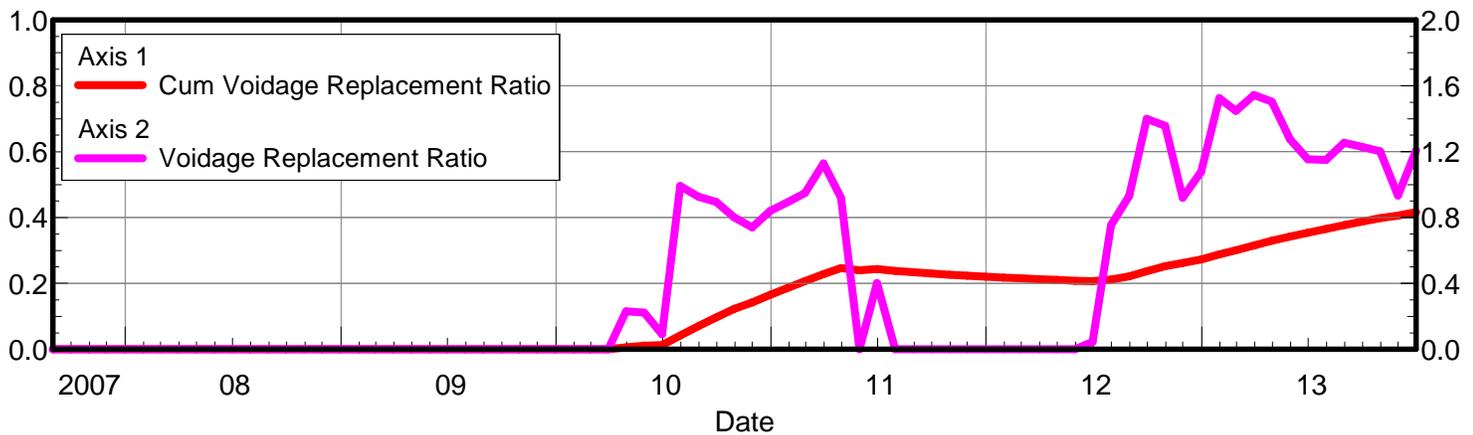
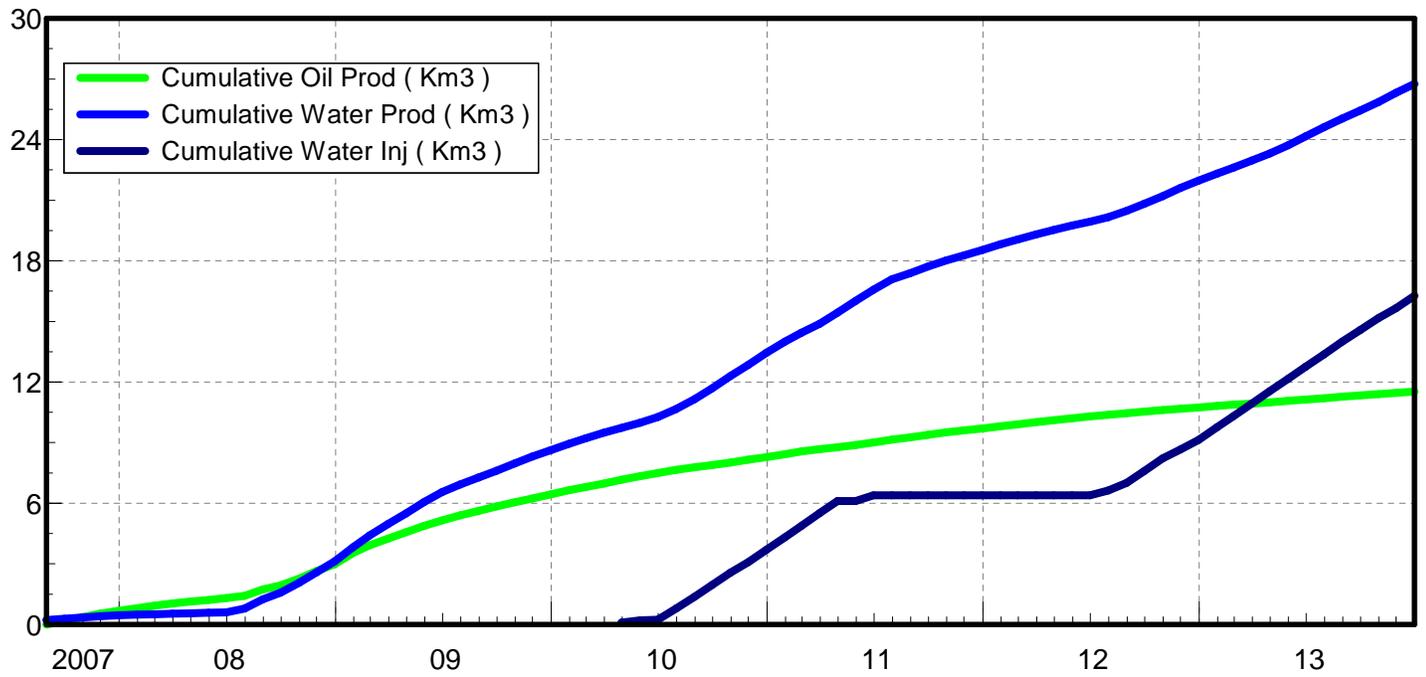
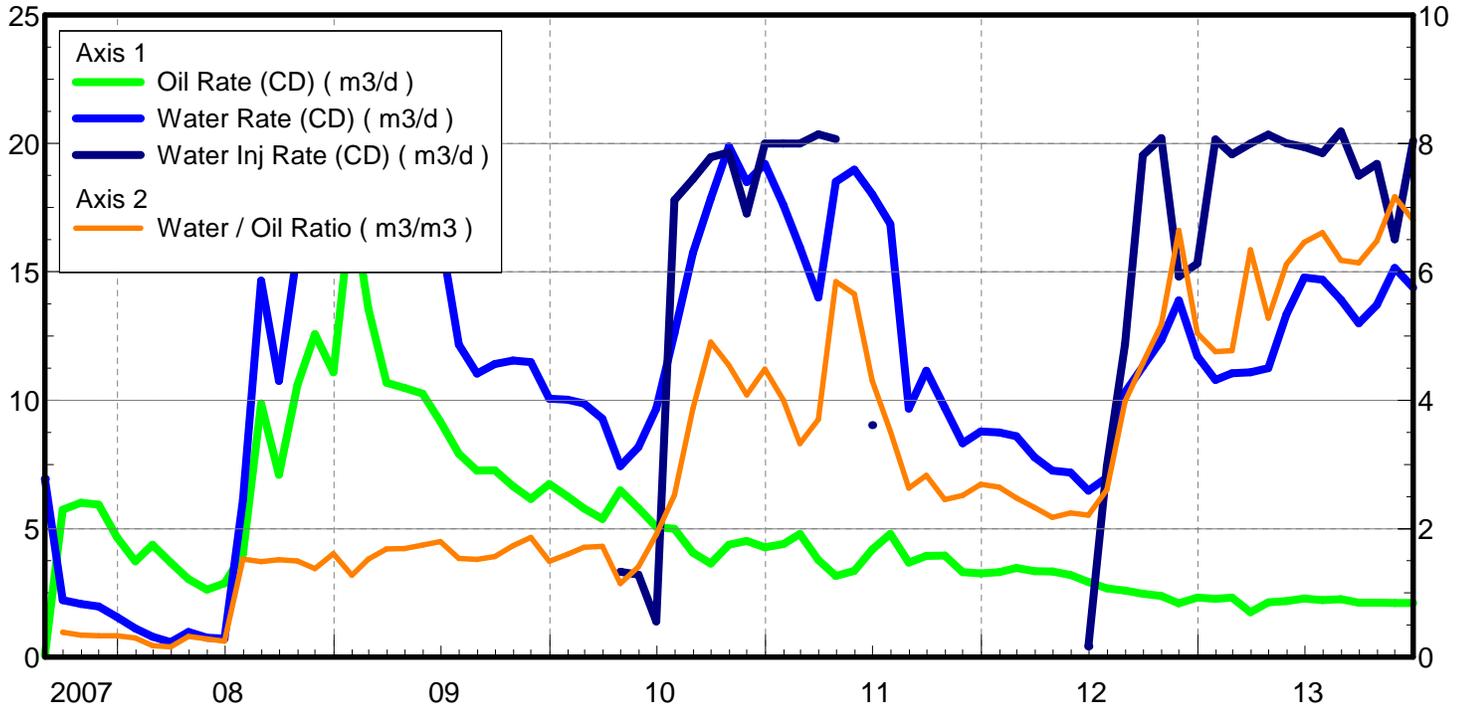
February 27, 2014

Operator: Tundra\_O&G\_Prtshp

Oil Rate (CD) : 2.11 m<sup>3</sup>/d

Water Rate (CD) : 14.38 m<sup>3</sup>/d

Water Inj Rate (CD) : 20.10 m<sup>3</sup>/d



| Date       | Oil Rate (CD) m3/d | Water Rate (CD) m3/d | Water Oil Ratio m3/m3 | Water Inj Rate (CD) m3/d | Cum Oil Prod Km3 | Cum Water Prod Km3 | Cum Water Inj Km3 | Voidage Replacement Ratio | Cum Voidage Replacemnt Ratio |
|------------|--------------------|----------------------|-----------------------|--------------------------|------------------|--------------------|-------------------|---------------------------|------------------------------|
| 8/31/2007  | 0.08               | 6.94                 | 86.04                 |                          | 0.00             | 0.22               | 0.00              | 0.000                     | 0.000                        |
| 9/30/2007  | 5.74               | 2.22                 | 0.39                  |                          | 0.17             | 0.28               | 0.00              | 0.000                     | 0.000                        |
| 10/31/2007 | 6.01               | 2.07                 | 0.34                  |                          | 0.36             | 0.35               | 0.00              | 0.000                     | 0.000                        |
| 11/30/2007 | 5.93               | 1.98                 | 0.33                  |                          | 0.54             | 0.41               | 0.00              | 0.000                     | 0.000                        |
| 12/31/2007 | 4.67               | 1.56                 | 0.33                  |                          | 0.68             | 0.45               | 0.00              | 0.000                     | 0.000                        |
| 1/31/2008  | 3.74               | 1.12                 | 0.30                  |                          | 0.80             | 0.49               | 0.00              | 0.000                     | 0.000                        |
| 2/29/2008  | 4.38               | 0.79                 | 0.18                  |                          | 0.93             | 0.51               | 0.00              | 0.000                     | 0.000                        |
| 3/31/2008  | 3.68               | 0.58                 | 0.16                  |                          | 1.04             | 0.53               | 0.00              | 0.000                     | 0.000                        |
| 4/30/2008  | 3.04               | 0.98                 | 0.32                  |                          | 1.13             | 0.56               | 0.00              | 0.000                     | 0.000                        |
| 5/31/2008  | 2.63               | 0.75                 | 0.29                  |                          | 1.21             | 0.58               | 0.00              | 0.000                     | 0.000                        |
| 6/30/2008  | 2.87               | 0.72                 | 0.25                  |                          | 1.30             | 0.60               | 0.00              | 0.000                     | 0.000                        |
| 7/31/2008  | 4.01               | 6.12                 | 1.53                  |                          | 1.42             | 0.79               | 0.00              | 0.000                     | 0.000                        |
| 8/31/2008  | 9.87               | 14.66                | 1.48                  |                          | 1.73             | 1.25               | 0.00              | 0.000                     | 0.000                        |
| 9/30/2008  | 7.10               | 10.76                | 1.52                  |                          | 1.94             | 1.57               | 0.00              | 0.000                     | 0.000                        |
| 10/31/2008 | 10.59              | 15.84                | 1.50                  |                          | 2.27             | 2.06               | 0.00              | 0.000                     | 0.000                        |
| 11/30/2008 | 12.58              | 17.32                | 1.38                  |                          | 2.65             | 2.58               | 0.00              | 0.000                     | 0.000                        |
| 12/31/2008 | 11.09              | 17.89                | 1.61                  |                          | 2.99             | 3.14               | 0.00              | 0.000                     | 0.000                        |
| 1/31/2009  | 17.65              | 22.49                | 1.27                  |                          | 3.54             | 3.83               | 0.00              | 0.000                     | 0.000                        |
| 2/28/2009  | 13.55              | 20.71                | 1.53                  |                          | 3.92             | 4.41               | 0.00              | 0.000                     | 0.000                        |
| 3/31/2009  | 10.68              | 17.99                | 1.68                  |                          | 4.25             | 4.97               | 0.00              | 0.000                     | 0.000                        |
| 4/30/2009  | 10.49              | 17.73                | 1.69                  |                          | 4.56             | 5.50               | 0.00              | 0.000                     | 0.000                        |
| 5/31/2009  | 10.26              | 17.92                | 1.75                  |                          | 4.88             | 6.06               | 0.00              | 0.000                     | 0.000                        |
| 6/30/2009  | 9.16               | 16.48                | 1.80                  |                          | 5.16             | 6.55               | 0.00              | 0.000                     | 0.000                        |
| 7/31/2009  | 7.92               | 12.16                | 1.54                  |                          | 5.40             | 6.93               | 0.00              | 0.000                     | 0.000                        |
| 8/31/2009  | 7.26               | 11.04                | 1.52                  |                          | 5.63             | 7.27               | 0.00              | 0.000                     | 0.000                        |
| 9/30/2009  | 7.27               | 11.41                | 1.57                  |                          | 5.85             | 7.61               | 0.00              | 0.000                     | 0.000                        |
| 10/31/2009 | 6.65               | 11.55                | 1.74                  |                          | 6.05             | 7.97               | 0.00              | 0.000                     | 0.000                        |
| 11/30/2009 | 6.16               | 11.49                | 1.87                  |                          | 6.24             | 8.32               | 0.00              | 0.000                     | 0.000                        |
| 12/31/2009 | 6.74               | 10.06                | 1.49                  |                          | 6.45             | 8.63               | 0.00              | 0.000                     | 0.000                        |
| 1/31/2010  | 6.26               | 10.03                | 1.60                  |                          | 6.64             | 8.94               | 0.00              | 0.000                     | 0.000                        |
| 2/28/2010  | 5.78               | 9.88                 | 1.71                  |                          | 6.80             | 9.22               | 0.00              | 0.000                     | 0.000                        |
| 3/31/2010  | 5.38               | 9.28                 | 1.72                  |                          | 6.97             | 9.50               | 0.00              | 0.000                     | 0.000                        |
| 4/30/2010  | 6.49               | 7.43                 | 1.15                  | 3.32                     | 7.16             | 9.73               | 0.10              | 0.231                     | 0.006                        |
| 5/31/2010  | 5.80               | 8.18                 | 1.41                  | 3.21                     | 7.34             | 9.98               | 0.20              | 0.223                     | 0.011                        |
| 6/30/2010  | 5.06               | 9.67                 | 1.91                  | 1.39                     | 7.50             | 10.27              | 0.24              | 0.092                     | 0.013                        |
| 7/31/2010  | 4.99               | 12.60                | 2.52                  | 17.79                    | 7.65             | 10.66              | 0.79              | 0.992                     | 0.042                        |
| 8/31/2010  | 4.07               | 15.74                | 3.87                  | 18.61                    | 7.78             | 11.15              | 1.37              | 0.926                     | 0.070                        |
| 9/30/2010  | 3.64               | 17.86                | 4.91                  | 19.47                    | 7.89             | 11.68              | 1.95              | 0.895                     | 0.097                        |
| 10/31/2010 | 4.37               | 19.88                | 4.54                  | 19.65                    | 8.02             | 12.30              | 2.56              | 0.800                     | 0.123                        |
| 11/30/2010 | 4.53               | 18.49                | 4.08                  | 17.27                    | 8.16             | 12.86              | 3.08              | 0.740                     | 0.143                        |
| 12/31/2010 | 4.28               | 19.20                | 4.49                  | 20.00                    | 8.29             | 13.45              | 3.70              | 0.841                     | 0.166                        |
| 1/31/2011  | 4.39               | 17.60                | 4.01                  | 20.00                    | 8.43             | 14.00              | 4.32              | 0.897                     | 0.188                        |
| 2/28/2011  | 4.80               | 15.95                | 3.32                  | 20.00                    | 8.56             | 14.44              | 4.88              | 0.948                     | 0.207                        |
| 3/31/2011  | 3.78               | 13.99                | 3.70                  | 20.35                    | 8.68             | 14.88              | 5.51              | 1.129                     | 0.228                        |
| 4/30/2011  | 3.17               | 18.51                | 5.85                  | 20.17                    | 8.77             | 15.43              | 6.12              | 0.921                     | 0.246                        |
| 5/31/2011  | 3.36               | 18.98                | 5.65                  |                          | 8.88             | 16.02              | 6.12              | 0.000                     | 0.240                        |
| 6/30/2011  | 4.18               | 18.02                | 4.31                  | 9.03                     | 9.00             | 16.56              | 6.39              | 0.402                     | 0.244                        |
| 7/31/2011  | 4.79               | 16.86                | 3.52                  |                          | 9.15             | 17.08              | 6.39              | 0.000                     | 0.238                        |

| Date       | Oil Rate (CD) m3/d | Water Rate (CD) m3/d | Water Oil Ratio m3/m3 | Water Inj Rate (CD) m3/d | Cum Oil Prod Km3 | Cum Water Prod Km3 | Cum Water Inj Km3 | Voidage Replacement Ratio | Cum Voidage Replacemnt Ratio |
|------------|--------------------|----------------------|-----------------------|--------------------------|------------------|--------------------|-------------------|---------------------------|------------------------------|
| 8/31/2011  | 3.68               | 9.68                 | 2.63                  |                          | 9.26             | 17.38              | 6.39              | 0.000                     | 0.234                        |
| 9/30/2011  | 3.94               | 11.15                | 2.83                  |                          | 9.38             | 17.72              | 6.39              | 0.000                     | 0.230                        |
| 10/31/2011 | 3.96               | 9.72                 | 2.45                  |                          | 9.51             | 18.02              | 6.39              | 0.000                     | 0.227                        |
| 11/30/2011 | 3.31               | 8.33                 | 2.52                  |                          | 9.60             | 18.27              | 6.39              | 0.000                     | 0.224                        |
| 12/31/2011 | 3.26               | 8.79                 | 2.69                  |                          | 9.71             | 18.54              | 6.39              | 0.000                     | 0.221                        |
| 1/31/2012  | 3.30               | 8.75                 | 2.65                  |                          | 9.81             | 18.81              | 6.39              | 0.000                     | 0.218                        |
| 2/29/2012  | 3.47               | 8.59                 | 2.48                  |                          | 9.91             | 19.06              | 6.39              | 0.000                     | 0.215                        |
| 3/31/2012  | 3.34               | 7.78                 | 2.33                  |                          | 10.01            | 19.30              | 6.39              | 0.000                     | 0.213                        |
| 4/30/2012  | 3.34               | 7.26                 | 2.17                  |                          | 10.11            | 19.52              | 6.39              | 0.000                     | 0.211                        |
| 5/31/2012  | 3.20               | 7.19                 | 2.25                  |                          | 10.21            | 19.74              | 6.39              | 0.000                     | 0.208                        |
| 6/30/2012  | 2.93               | 6.48                 | 2.21                  | 0.43                     | 10.30            | 19.94              | 6.40              | 0.044                     | 0.207                        |
| 7/31/2012  | 2.68               | 6.98                 | 2.61                  | 7.44                     | 10.38            | 20.15              | 6.63              | 0.755                     | 0.212                        |
| 8/31/2012  | 2.59               | 10.31                | 3.98                  | 12.18                    | 10.46            | 20.47              | 7.01              | 0.931                     | 0.221                        |
| 9/30/2012  | 2.47               | 11.31                | 4.58                  | 19.54                    | 10.54            | 20.81              | 7.59              | 1.400                     | 0.237                        |
| 10/31/2012 | 2.38               | 12.34                | 5.18                  | 20.21                    | 10.61            | 21.20              | 8.22              | 1.357                     | 0.253                        |
| 11/30/2012 | 2.09               | 13.89                | 6.65                  | 14.82                    | 10.67            | 21.61              | 8.66              | 0.919                     | 0.262                        |
| 12/31/2012 | 2.32               | 11.72                | 5.05                  | 15.33                    | 10.75            | 21.98              | 9.14              | 1.079                     | 0.273                        |
| 1/31/2013  | 2.27               | 10.79                | 4.76                  | 20.15                    | 10.82            | 22.31              | 9.77              | 1.525                     | 0.288                        |
| 2/28/2013  | 2.31               | 11.05                | 4.77                  | 19.57                    | 10.88            | 22.62              | 10.31             | 1.447                     | 0.301                        |
| 3/31/2013  | 1.75               | 11.09                | 6.34                  | 20.00                    | 10.93            | 22.96              | 10.93             | 1.543                     | 0.315                        |
| 4/30/2013  | 2.13               | 11.24                | 5.28                  | 20.34                    | 11.00            | 23.30              | 11.54             | 1.504                     | 0.329                        |
| 5/31/2013  | 2.18               | 13.35                | 6.12                  | 20.00                    | 11.07            | 23.71              | 12.16             | 1.276                     | 0.342                        |
| 6/30/2013  | 2.29               | 14.78                | 6.46                  | 19.86                    | 11.13            | 24.16              | 12.76             | 1.153                     | 0.354                        |
| 7/31/2013  | 2.22               | 14.70                | 6.61                  | 19.63                    | 11.20            | 24.61              | 13.37             | 1.149                     | 0.365                        |
| 8/31/2013  | 2.25               | 13.91                | 6.18                  | 20.46                    | 11.27            | 25.05              | 14.00             | 1.254                     | 0.377                        |
| 9/30/2013  | 2.12               | 13.00                | 6.14                  | 18.75                    | 11.34            | 25.43              | 14.56             | 1.228                     | 0.388                        |
| 10/31/2013 | 2.12               | 13.72                | 6.48                  | 19.20                    | 11.40            | 25.86              | 15.16             | 1.202                     | 0.398                        |
| 11/30/2013 | 2.11               | 15.16                | 7.17                  | 16.27                    | 11.47            | 26.31              | 15.65             | 0.934                     | 0.406                        |
| 12/31/2013 | 2.11               | 14.38                | 6.81                  | 20.10                    | 11.53            | 26.76              | 16.27             | 1.208                     | 0.416                        |