

KOLA UNIT NO. 1
WATERFLOOD EOR PROJECT
ANNUAL REPORT FOR 2016

July 31, 2017

Tundra Oil and Gas Partnership

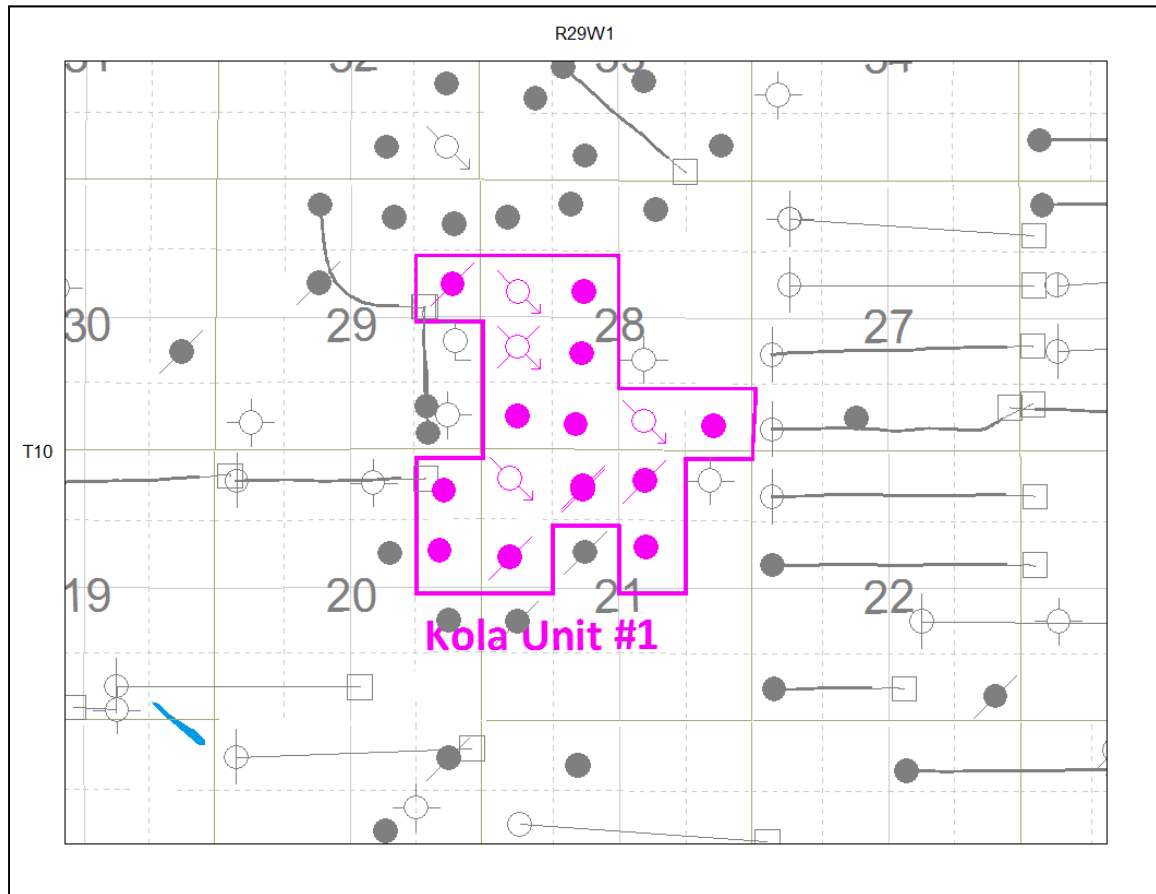
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INTRODUCTION

Kola Unit No. 1 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Board Order No. PM 71 effective October 1, 1993 with Tundra Oil and Gas Ltd. as Operator. In May 1995, Board Order No. PM 71 was replaced by Waterflood Order No. 2. The EOR project area contains 16 wells in 16 LSDs in Township 10, Range 29 W1 as shown in the figure below. Well list and well status is available in Appendix A.

Figure 1: Kola Unit No. 1 Area Outline



In accordance with Section 73 of the Manitoba Drilling and Production Regulation, Tundra hereby submits the 2016 Annual Progress Report for Kola Unit No. 1 as required by Waterflood Order No. 2.

DISCUSSION

Production History

For the wells included in Kola Unit No. 1, production started in October 1985 with 00/13-21-010-29W1/0 well (00/13-21). Oil production peaked at 41.5 m³/d in February 1988. The unit was producing 2.17 m³/d of oil and 23.45 m³/d of water in December 2016. The average WOR in 2015 was 8.3 m³/m³. Oil production rate, injection rate, and WOR during each month for each injection pattern is presented in Appendix D. The rates and WOR are plotted in Figure 2.

Figure 2: Kola Unit No. 1 Production/Injection Rates and WOR vs Time

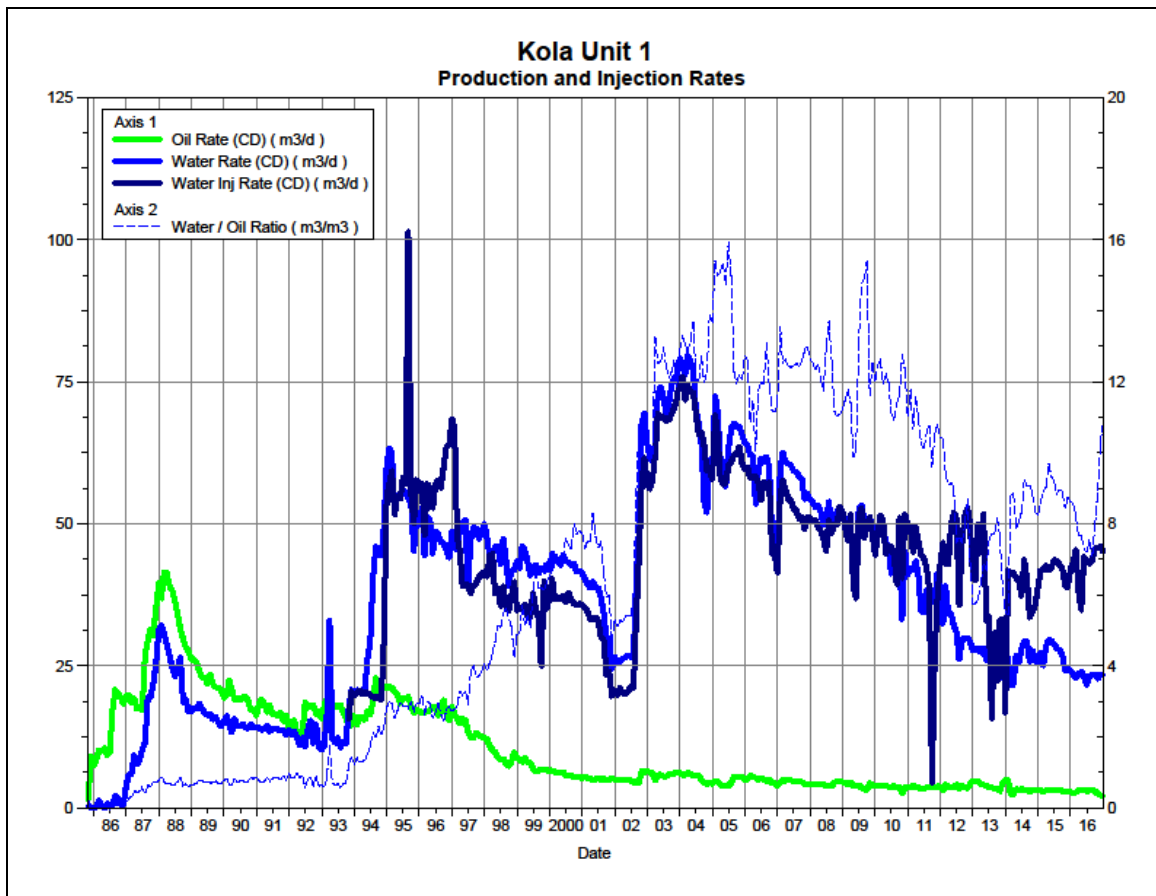
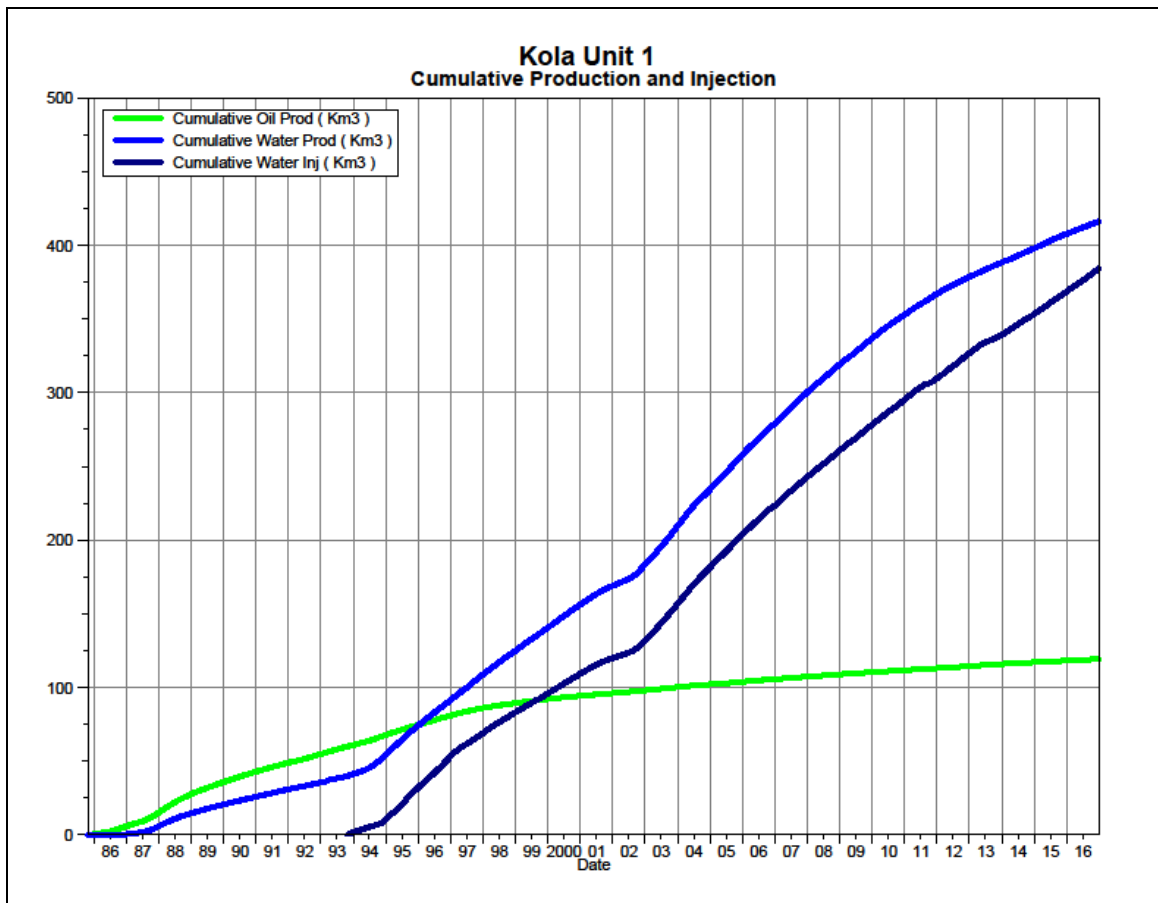


Figure 3 shows the cumulative production for Kola Unit No. 1 to the end of December 2016 as 119 e³m³ of oil, and 416 e³m³ of water. Cumulative water injected is just over 384 e³m³. The cumulative volume of oil, and water produced and fluid injected for each injection pattern is presented in Appendix D.

Figure 3: Kola Unit No. 1 Cumulative Oil, Water and Water Injected vs. Time



Waterflood History

As of December 2016 the Unit has 3 active vertical injectors and 3 injection patterns in place. In November 2010, the vertical injector at 100/05-28-010-29W1 was abandoned. Water injection started in October 1993. An overall summary for each injector pattern is presented in Appendix B.

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

Injected fluid consisted of produced water from the Lodgepole formation, from the unit and surrounding area until November 2013. Injection water for Kola Unit No. 1 is now being provided from the Jurassic source water well at 100/02-25-010-29W1 (2-25). Tundra received approval from the Petroleum Branch in March 2013 to use the 2-25 well

as a source water well for waterflood operations. Jurassic-sourced water is pumped from the 2-25 source well to the Daly 12-24-10-29 battery, where it is filtered to 50 microns and then pumped up to injection system pressure.

Injection Wellhead Pressures

The average monthly wellhead injection pressures for each injection well are summarized in Appendix C, and shows all injection pressures since 2003. The injection pressure in December 2016 was 6425, 6667 and 5766 kPag for 00/13-21, 00/02-28 and 00/12-28-010-29W1, respectively.

Reservoir Pressure

No reservoir pressure measurements were taken at Kola Unit No. 1 in 2016.

Well Servicing

No maintenance was required on the 16 wells in Kola Unit No. 1 in 2016.

Voidage Replacement

Cumulative voidage for the Kola Unit No. 1 was 0.707 in December 2016. Since 2010, the monthly voidage has been greater than 1, which puts the Kola Unit No. 1 on track to achieve a cumulative VRR of 1. Plots of the Voidage Replacement Ratio on a monthly and cumulative basis for each injector pattern is presented in Appendix D.

Waterflood Performance Discussion

The OOIP for Kola Unit No. 1 is estimated at 1547 e^3m^3 . The recovery factor for Kola Unit No. 1 was 7.7% based on 119 e^3m^3 of cumulative oil recovered to the end of 2016. The ultimate expected recoverable reserve based on decline analysis is 135 e^3m^3 or an ultimate recovery factor of 8.7%.

The overall performance of this waterflood has been poor as indicated by low recovery factors, and poor waterflood response. Any increased or supported oil rates, that may be as a result of injected water sweeping the reservoir, are not sustained for a very long time.

Trends in production are very stable and at a mature state. No changes are anticipated in the future trends. While overall cumulative voidage is above unity, an examination of the individual patterns reveals that injected water should be diverted from the 12-28 pattern to the 13-21 and 2-28 patterns, which are under-injected. There is the possibility of an additional injector well to improve sweep efficiency in an area of the reservoir with no waterflood response, and even additional development is possible.

Optimization of the waterflood will be evaluated to inject water in under-supported areas of the pool, with consideration for additional injection. Also, facility enhancements in the area may increase water handling capacity so that sufficient water volumes can be provided to the pool.

List of Appendices

Appendix A: Well Name and Well Status

Appendix B: Injection Pattern Summary

Appendix C: Average Monthly Injection Wellhead Pressures

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

00/13-21-010-29W1

00/02-28-010-29W1

00/12-28-010-29W1

Appendix A

UWI	Well Status
100/09-20-010-29W1/00	Capable of OIL Prod
100/16-20-010-29W1/00	Capable of OIL Prod
100/10-21-010-29W1/00	Capable of OIL Prod
100/12-21-010-29W1/00	ABD Producer
100/13-21-010-29W1/00	WTR Injection
100/14-21-010-29W1/00	ABD Producer
100/14-21-010-29W1/02	ABD Producer
100/15-21-010-29W1/00	ABD Producer
100/01-28-010-29W1/00	Capable of OIL Prod
100/02-28-010-29W1/00	WTR Injection
100/03-28-010-29W1/00	Capable of OIL Prod
100/04-28-010-29W1/00	Capable of OIL Prod
100/05-28-010-29W1/00	ABD WTR Injection
100/06-28-010-29W1/00	Capable of OIL Prod
100/11-28-010-29W1/00	Capable of OIL Prod
100/12-28-010-29W1/00	WTR Injection
100/09-29-010-29W1/00	ABD Producer

Appendix B

Kola Unit No. 1 Pattern Summary as of December 2016

Pattern Name	Injector Location (010-29W)	Injector Surf. Location (010-29W1)	Status	No. of Supported Wells	Supported Wells (010-29W1)	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
00/13-21-010-29W1 Injector	00/13-21	Vertical Well	WTR Injection	7	09-20, 16-20, 12-21	1	Oct 1985	Oct 1993	0.8	10.3	12.51	5.6	52.0	123.9	82.3	0.5	0.46
					14-21, 14-21/2, 04-28	0.5											
					03-28	0.4											
00/02-28-010-29W1 Injector	00/02-28	Vertical Well	WTR Injection	7	10-21, 15-21 , 01-28	1	Jun 1987	Aug 1995	0.6	7.2	11.29	5.9	32.7	193.4	70.6	0.8	0.31
					14-21, 14-21/2, 06-28	0.5											
					03-28	0.4											
00/12-28-010-29W1 Injector	00/12-28	Vertical Well	WTR Injection	5	05-28, 11-28, 09-29	1	Dec 1986	Nov 1994	0.7	5.9	8.39	33.6	34.6	99.0	231.5	5.1	1.70
					04-28, 06-28	0.5											
					03-28	0.2											

Appendix C

Average Monthly Injection Pressure (kPag)

Month	Injection Pressure			
	100/13-21	100/02-28	100/05-28	100/12-28
Jul-02	0	0	0	0
Aug-02	5996	4283	234	2178
Sep-02	10934	7810	426	5108
Oct-02	10934	7810	3013	5600
Nov-02	10934	7810	4071	5600
Dec-02	10934	7810	4071	5600
Jan-03	10366	8490	2919	6206
Feb-03	9905	9697	2840	6147
Mar-03	9745	9752	2840	6096
Apr-03	9735	9062	3053	6107
May-03	10355	8706	3550	6036
Jun-03	10366	8520	3550	6035
Jul-03	10366	8520	3550	6035
Aug-03	10366	8520	3550	6035
Sep-03	10345	8921	3268	6019
Oct-03	10274	10240	2138	5965
Nov-03	10274	10240	2138	5965
Dec-03	10274	10240	2138	5965
Jan-04	10274	10240	2138	5965
Feb-04	10274	10240	2138	5965
Mar-04	10274	10240	2138	5965
Apr-04	10274	10240	2138	5965
May-04	10274	10240	2138	5965
Jun-04	10274	10240	2138	5965
Jul-04	10274	10240	2138	5965
Aug-04	10274	10240	2138	5965
Sep-04	10274	10957	3430	6304
Oct-04	10040	11100	3377	6340
Nov-04	10200	11100	3600	6600
Dec-04	10200	11100	3600	6600
Jan-05	10200	11100	3600	6600
Feb-05	10386	11100	3229	6600
Mar-05	10600	11100	2800	6600
Apr-05	10600	11100	2800	6600
May-05	10600	11100	2800	6600
Jun-05	10013	11103	3040	6573
Jul-05	9052	10986	3300	7262
Aug-05	9781	10835	2700	6232
Sep-05	9920	11033	2813	6067
Oct-05	9800	11200	3700	6400
Nov-05	9920	11100	3620	6410
Dec-05	11000	10200	2900	6500

Month	Injection Pressure			
	100/13-21	100/02-28	100/05-28	100/12-28
Jan-06	11035	10200	2829	6500
Feb-06	10896	10534	2682	6538
Mar-06	10600	11148	2650	6416
Apr-06	10777	9910	2682	6322
May-06	10884	10540	3152	6342
Jun-06	10840	10733	1133	6382
Jul-06	10794	10890	1	6581
Aug-06	10778	10834	404	6479
Sep-06	10801	10750	2850	6520
Oct-06	10801	2416	3000	6578
Nov-06	10867	2280	100	6601
Dec-06	10900	1626	0	6745
Jan-07	9689	5105	1078	6821
Feb-07	10370	9443	-	6731
Mar-07	10452	9923	-	6323
Apr-07	10410	10350	-	6247
May-07	10500	10300	-	6201
Jun-07	10500	10300	-	6201
Jul-07	9871	10523	-	6307
Aug-07	9000	10601	-	6300
Sep-07	9580	10600	-	6397
Oct-07	9600	10600	-	6400
Nov-07	8940	10820	-	6401
Dec-07	8832	11103	-	6503
Jan-08	8300	11200	-	6600
Feb-08	8345	11111	-	6455
Mar-08	8400	11000	-	5803
Apr-08	7960	11107	-	6527
May-08	7990	11190	-	6790
Jun-08	8000	11200	-	6800
Jul-08	8645	11265	-	6800
Aug-08	8710	11087	-	6539
Sep-08	7560	10967	-	4247
Oct-08	7700	11200	-	4000
Nov-08	7967	11300	-	4680
Dec-08	8200	11400	-	5200
Jan-09	8200	11400	-	5200
Feb-09	8200	11400	-	5200
Mar-09	8200	11516	-	5200
Apr-09	8200	11800	-	5200
May-09	8200	11800	-	5362
Jun-09	8187	10254	-	5410
Jul-09	7801	10401	-	5701
Aug-09	7800	4535	-	5700
Sep-09	7800	6200	-	5700
Oct-09	8003	9171	-	5826
Nov-09	5607	11633	-	6274
Dec-09	23	11717	-	6301

Month	Injection Pressure			
	100/13-21	100/02-28	100/05-28	100/12-28
Jan-10	5281	11490	-	6239
Feb-10	9941	11079	-	6161
Mar-10	8703	11397	-	6315
Apr-10	1687	10714	-	6357
May-10	721	11232	-	6397
Jun-10	6230	10437	-	6040
Jul-10	4387	10052	-	5787
Aug-10	6190	2790	-	5300
Sep-10	8860	8510	-	5754
Oct-10	8242	8978	-	5727
Nov-10	8897	8954	-	5704
Dec-10	8977	9239	-	5800
Jan-11	7010	8234	-	5789
Feb-11	8257	7477	-	5784
Mar-11	8963	6076	-	5869
Apr-11	9000	6000	-	5900
May-11	7381	3290	-	5816
Jun-11	7413	4107	-	5767
Jul-11	8387	4806	-	5806
Aug-11	8200	4900	-	-
Sep-11	6232	3284	-	0
Oct-11	7619	3465	-	5213
Nov-11	8000	3600	-	5800
Dec-11	8000	3600	-	5800
Jan-12	7871	3729	-	5929
Feb-12	7800	3800	-	6000
Mar-12	7800	3800	-	6000
Apr-12	7800	3800	-	6000
May-12	7800	3800	-	6000
Jun-12	7800	3800	-	6000
Jul-12	7800	3800	-	6000
Aug-12	7577	3694	-	5835
Sep-12	900	500	-	900
Oct-12	900	500	-	900
Nov-12	900	500	-	900
Dec-12	900	500	-	900
Jan-13	900	500	-	900
Feb-13	900	500	-	900
Mar-13	900	500	-	900
Apr-13	900	500	-	900
May-13	900	500	-	900
Jun-13	390	2257	-	4130
Jul-13	0	3600	-	6600
Aug-13	0	3600	-	6600
Sep-13	0	3600	-	6600
Oct-13	0	3600	-	6600
Nov-13	0	3600	-	6600
Dec-13	2669	4734	-	6040

Month	Injection Pressure			
	100/13-21	100/02-28	100/05-28	100/12-28
Jan-14	6598	6689	-	6106
Feb-14	6715	6725	-	5823
Mar-14	6869	6800	-	6376
Apr-14	6900	6800	-	6400
May-14	6900	6800	-	6402
Jun-14	5975	6808	-	6287
Jul-14	5570	6808	-	6272
Aug-14	5302	6800	-	6155
Sep-14	6592	4192	-	5543
Oct-14	6273	5785	-	6540
Nov-14	6014	5767	-	6486
Dec-14	6076	5582	-	6446
Jan-15	6116	6064	-	6497
Feb-15	6299	6041	-	6392
Mar-15	6582	6296	-	6342
Apr-15	6427	6200	-	6235
May-15	5775	6178	-	6156
Jun-15	6422	6658	-	6058
Jul-15	6209	6667	-	6064
Aug-15	5979	6434	-	5870
Sep-15	5662	6590	-	6069
Oct-15	5227	5844	-	5511
Nov-15	6062	6466	-	5324
Dec-15	6154	6594	-	5204
Jan-16	5804	6438	-	5599
Feb-16	6314	6628	-	5566
Mar-16	6006	6471	-	4234
Apr-16	6467	6609	-	3404
May-16	6372	6575	-	5074
Jun-16	6271	6541	-	5333
Jul-16	3581	6669	-	5444
Aug-16	2847	6679	-	5613
Sep-16	4994	6617	-	5642
Oct-16	6515	6664	-	5669
Nov-16	6624	6681	-	5782
Dec-16	6425	6667	-	5766

Pattern: 00/13-21-010-29Inj Set: KolaUnit#1

Oil Formation Vol Factor : 1.07100 m3/m3

Water Formation Vol Factor : 1.00150 m3/m3

Water / Oil Ratio : 15.29 m3/m3

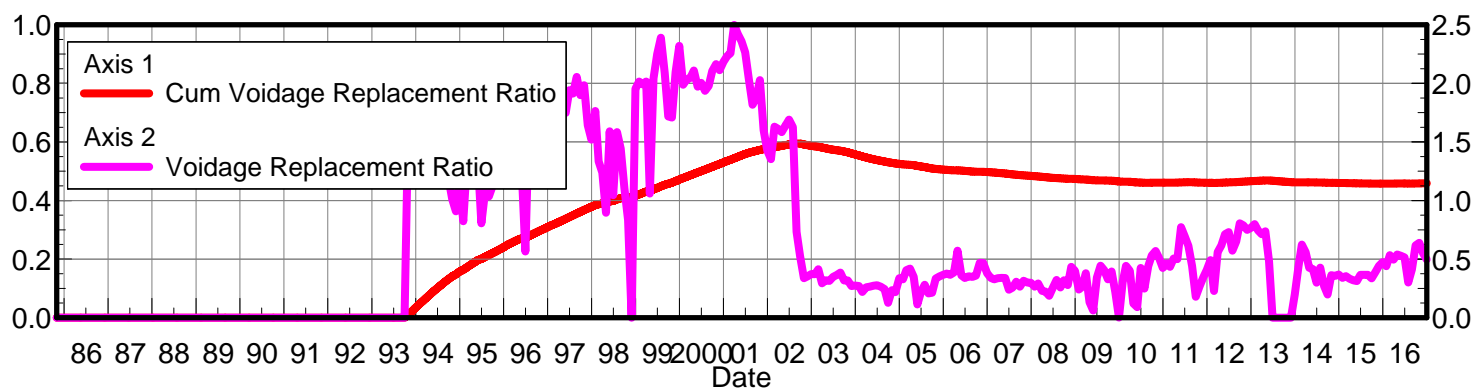
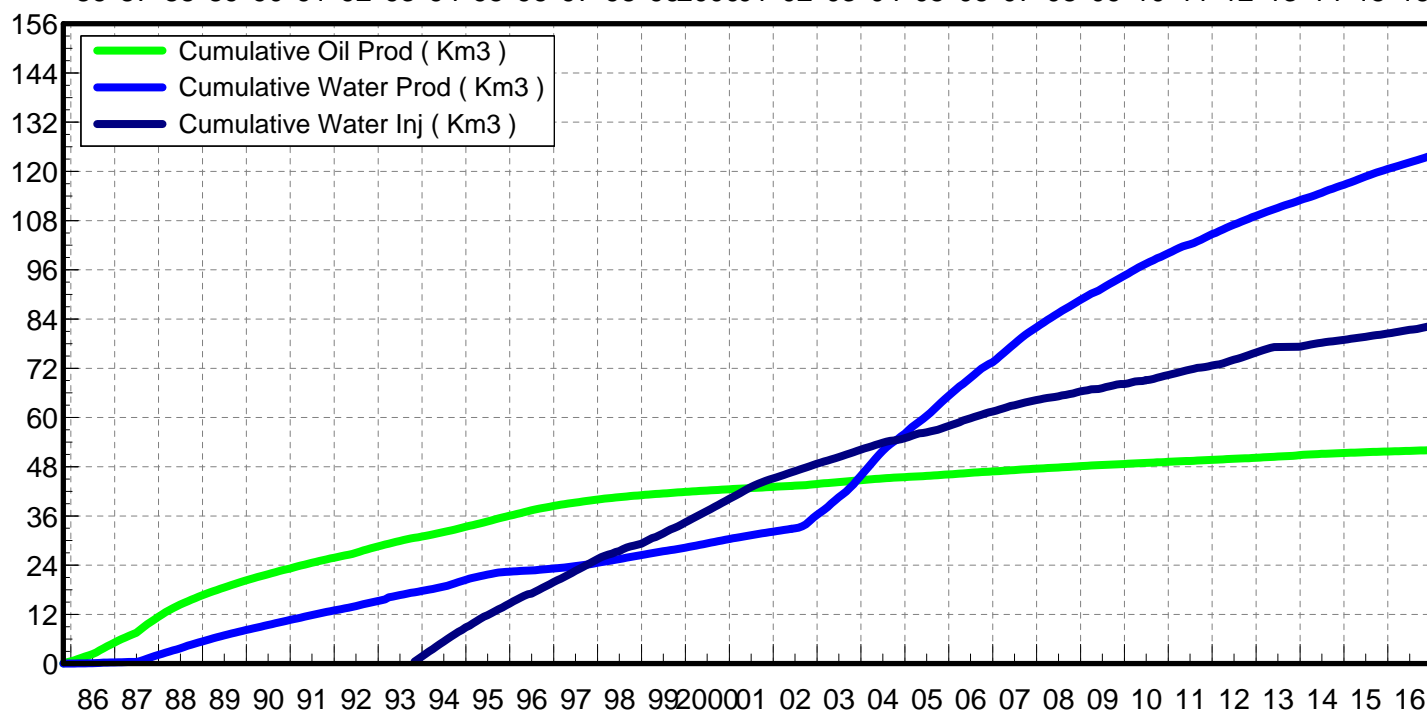
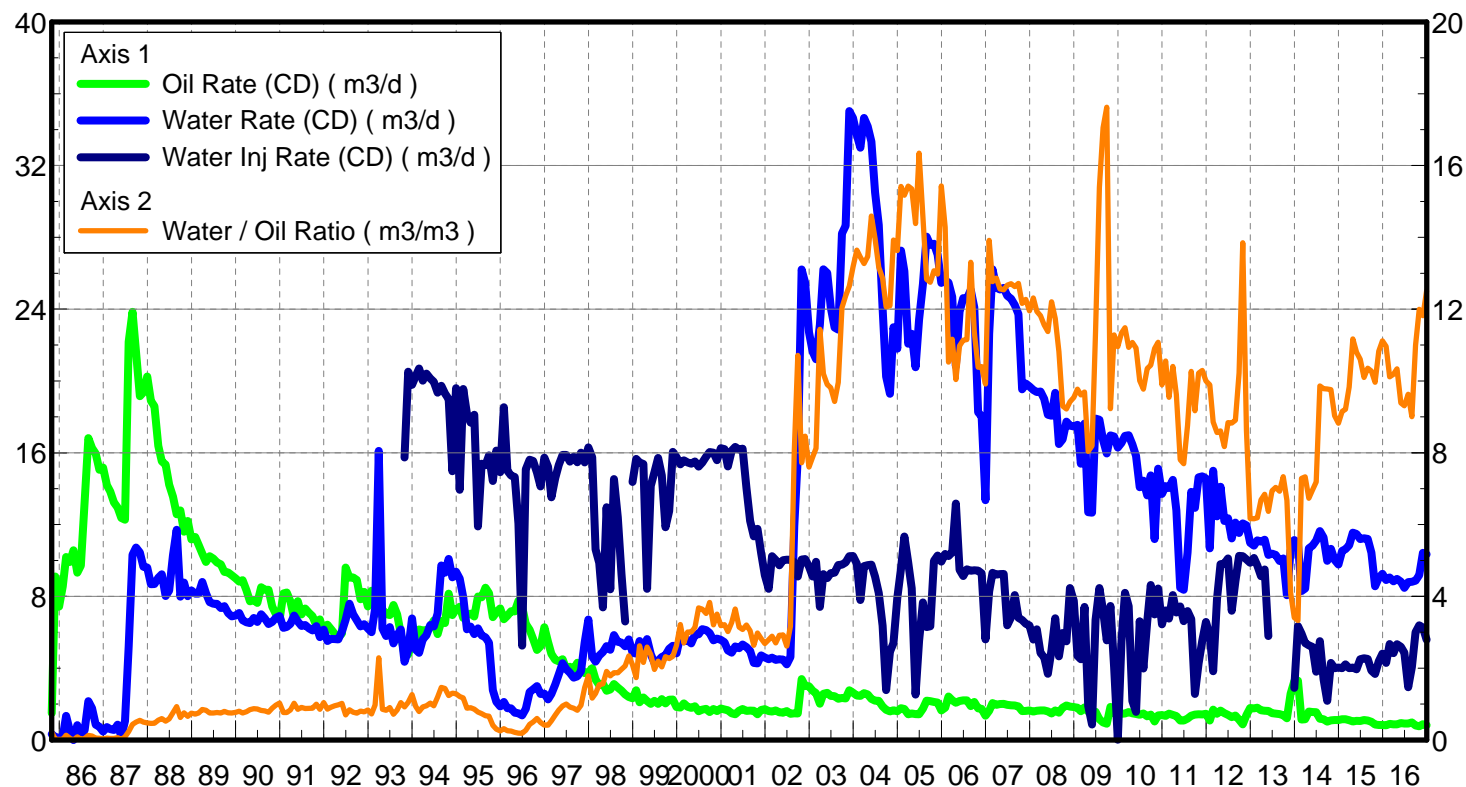
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Oil Rate (CD) : 0.63 m3/d

Water Rate (CD) : 8.00 m3/d

Water Inj Rate (CD) : 5.13 m3/d

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Pattern: 00/02-28-010-29Inj Set: KolaUnit#1

Oil Formation Vol Factor : 1.07100 m3/m3

Water Formation Vol Factor : 1.00150 m3/m3

Water / Oil Ratio : 14.20 m3/m3

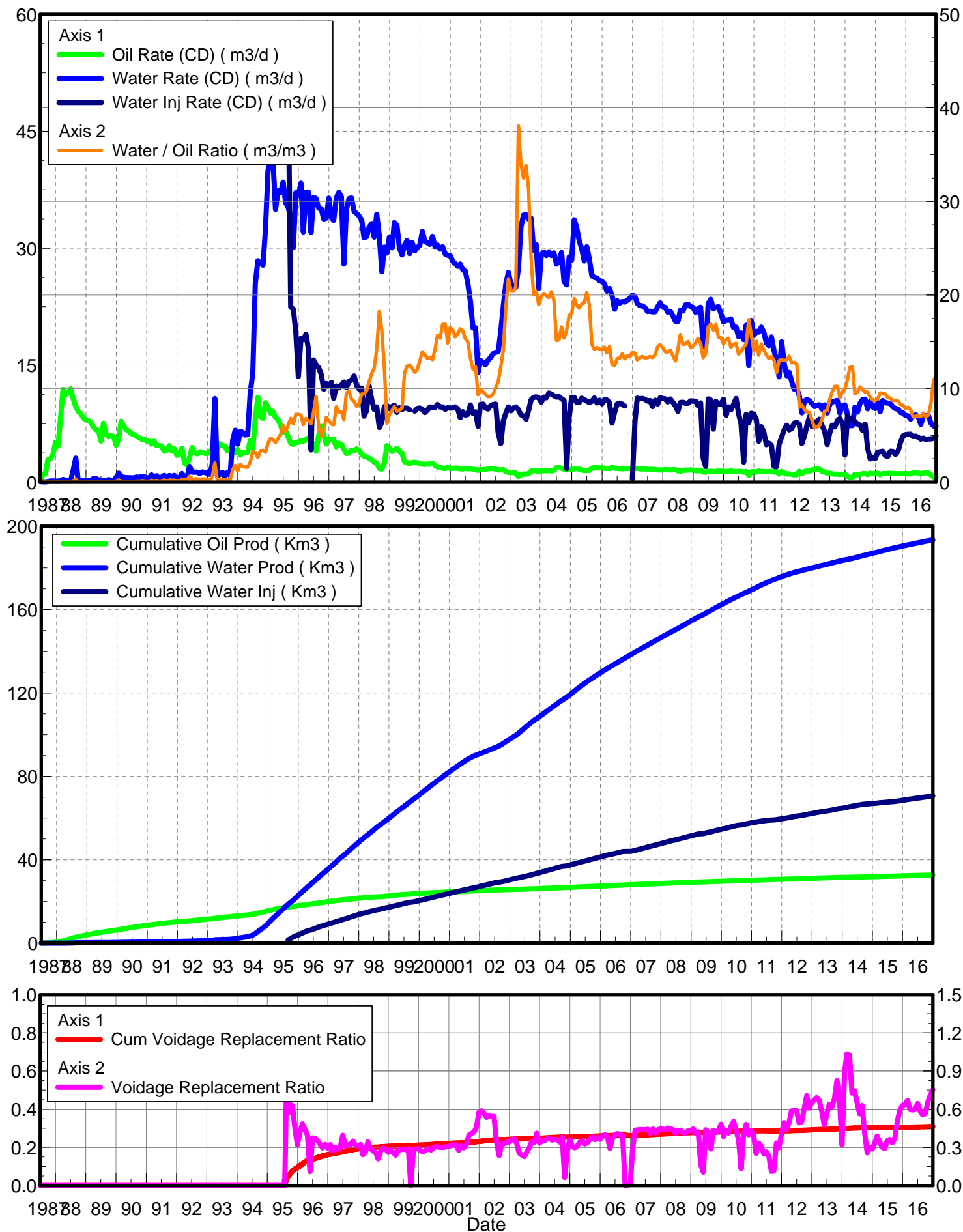
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Oil Rate (CD) : 0.77 m3/d

Water Rate (CD) : 8.99 m3/d

Water Inj Rate (CD) : 4.97 m3/d

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Well: 00/12-28-010-29Inj, Comp: 00/03-28-010-29W1/0, 00/04-28-010-29W1/0, 00/05-28-010-29W1/0

Oil Formation Vol Factor : 1.07100 m3/m3

Oil Rate (CD) : 0.66 m3/d

Water Formation Vol Factor : 1.00150 m3/m3

Water Rate (CD) : 3.84 m3/d

Water / Oil Ratio : 10.31 m3/m3

Operator: TUNDRA_OIL_&_GAS_LIMITED

Water Inj Rate (CD) : 32.27 m3/d

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