

Waskada Unit No. 16

Waterflood Progress Report 2017

January 1st through December 31st 2017

Prepared for:

Manitoba Industry, Economic Development and Mines

Petroleum Branch

Prepared by:

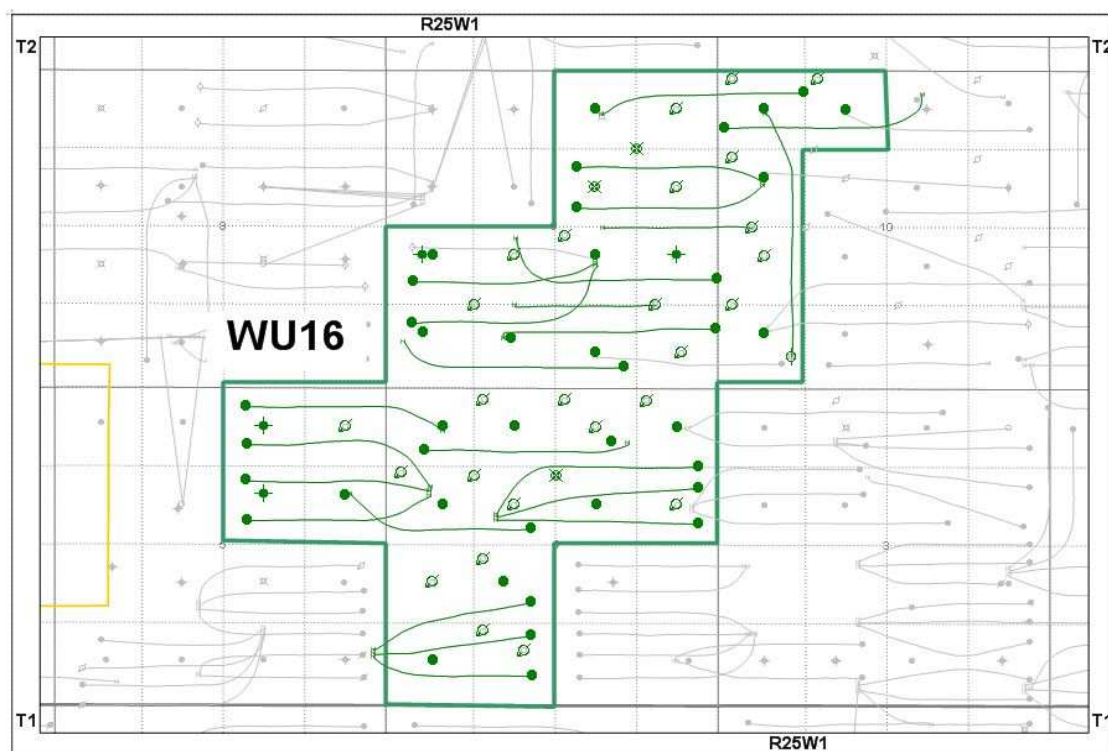
Tundra Oil and Gas

July 18, 2018

INTRODUCTION

The Waskada Unit No.16 pressure maintenance project commenced water injection into the Lower Amaranth A pool in accordance with Manitoba Energy and Mines Order No. PM 57, dated May 1, 1987. This unit was enlarged on October 1, 1988 to its current boundary. Waskada Unit No. 16 was acquired from EOG Resources Canada Inc. effective October 1, 2014 (closing date December 1, 2014) with Tundra Oil and Gas (Tundra) as the new operator. THE EOR project area, outlined in green in Figure 1, contains 73 wells over 33 LSDs in Township 2, Range 25W1.

Figure 1: Waskada Unit No. 16 Area Outline



Waskada Unit No.16

Tundra Oil and Gas (Tundra), as the operator of the Waskada Unit 16 Enhanced Oil Recovery (EOR) project hereby submits the 2017 EOR report as per section 73 of the Drilling and Production Regulations.

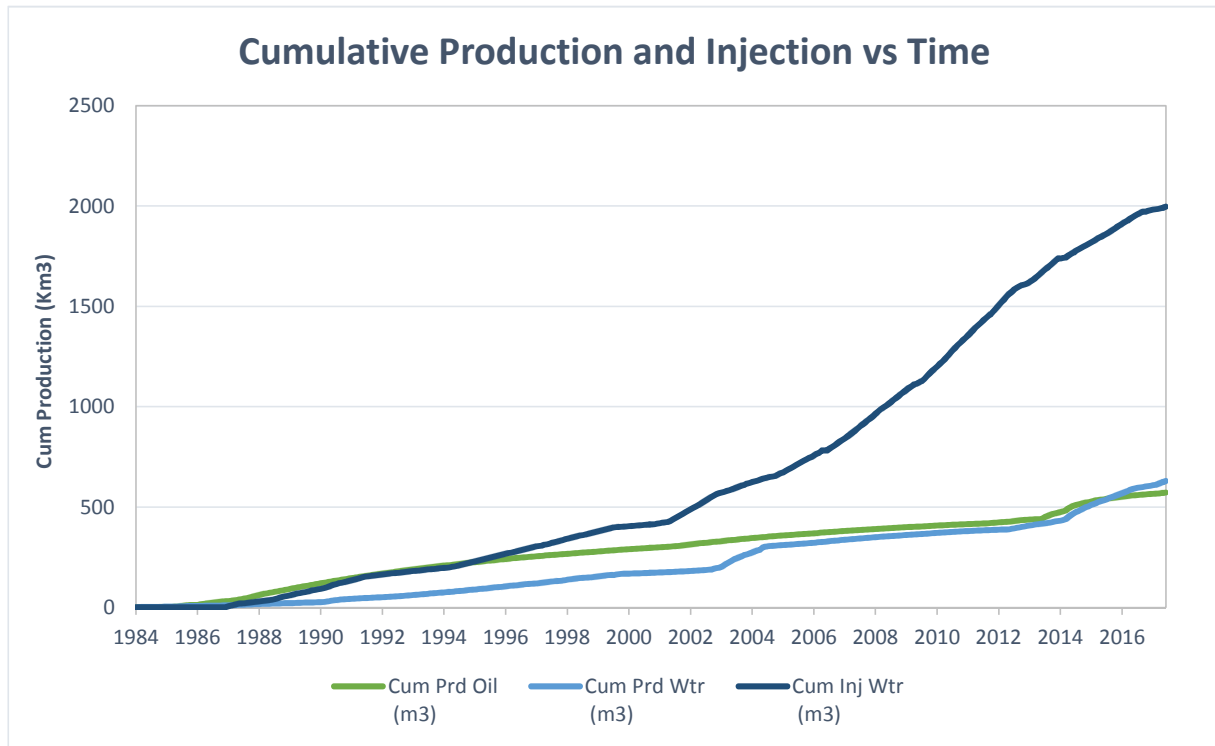
a) Monthly oil and water production rates, injection rate, GOR and WOR

MONTH	Cal Dly Oil m ³ /day	Cal Dly Wtr m ³ /day	Cal Inj Wtr m ³ /day	WOR m ³ /m ³	GOR m ³ /m ³
Jan-2017	37.82	82.45	231.32	2.18	30.54
Feb-2017	38.79	91.48	241.34	2.36	32.23
Mar-2017	24.16	57.02	181.98	2.36	41.39
Apr-2017	32.75	71.51	21.62	2.18	0.00
May-2017	35.67	78.21	117.62	2.19	0.00
Jun-2017	32.19	64.76	112.73	2.01	0.00
Jul-2017	31.73	67.46	98.51	2.13	0.00
Aug-2017	28.57	86.42	53.09	3.02	0.00
Sep-2017	44.77	149.81	62.60	3.35	0.00
Oct-2017	56.80	167.03	114.69	2.94	0.00
Nov-2017	58.26	154.48	118.48	2.65	0.00
Dec-2017	47.22	161.65	136.36	3.42	0.00

b) Cumulative volume of oil, gas and water produced and fluid injected

2017 PRODUCTION	
Produced Oil (m ³)	14,246
Produced Gas (m ³)	102
Produced Water (m ³)	37,486
Fluid Injected (m ³)	45,161
CUMMULATIVE PRODUCTION	
Produced Oil (m ³)	573,589
Produced Water (m ³)	631,053

Waskada Unit No.16



c) Monthly wellhead injection pressure for each injection well

	00/01-09 Inj		00/03-04 Inj		00/05-04 Inj		00/05-10 Inj		00/06-09 Inj		00/09-04 Inj	
MONTH	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)
Jan-2017	116.6	5000	0.0	764	286.5	23	2586.7	2200	49.6	4900	102.9	2999
Feb-2017	98.0	5000	0.0	764	278.7	71	2682.7	2200	43.6	4900	89.1	2983
Mar-2017	106.4	5000	0.0	764	350.1	1447	1641.4	2200	44.3	4900	90.0	2994
Apr-2017	22.9	4833	0.0	764	0.0	1208	0.0	2127	17.6	4753	24.9	2992
May-2017	123.1	5000	0.0	764	0.0	1250	0.0	2200	133.9	5000	98.6	3777
Jun-2017	110.9	5000	0.0	764	0.0	1250	0.0	2200	108.7	5000	265.3	4551
Jul-2017	113.7	5000	0.0	764	32.3	1250	0.0	2200	81.0	5000	235.3	4791
Aug-2017	55.9	4755	0.0	764	11.0	1250	0.0	2200	60.4	4755	151.5	4450
Sep-2017	47.3	5000	0.0	764	113.4	1250	0.0	2200	64.6	5000	158.7	4400
Oct-2017	96.9	5000	0.0	751	138.4	4516	0.0	2200	119.0	5000	260.2	4923
Nov-2017	62.7	5000	0.0	749	84.1	0	0.0	2200	114.1	5000	246.3	5000
Dec-2017	66.9	5000	0.0	749	122.5	0	0.0	2200	112.6	5000	202.2	4866
Total	1021.4		0.0		1417.1		6910.7		949.4		1924.8	
Avg Inj P		4966		760		1126		2194		4934		4060

	00/09-09 Inj		00/11-04 Inj		00/15-04 Inj		00/16-05 Inj		00/16-09 Inj		02/01-09 Inj	
MONTH	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)
Jan-2017	169.2	2970	0.0	0	0.0	0	291.8	1348	0.0	0	105.6	5000
Feb-2017	0.0	2970	0.0	0	0.0	0	275.7	1400	0.0	0	50.8	5000
Mar-2017	0.0	2970	0.0	0	0.0	0	59.7	1400	0.0	0	34.5	5000
Apr-2017	0.0	2970	0.0	0	0.0	0	0.0	1353	0.0	0	35.7	4950
May-2017	0.0	2970	0.0	0	0.0	0	0.0	1400	0.0	0	209.9	5000
Jun-2017	0.0	2970	0.0	0	0.0	0	0.0	1400	0.0	0	236.2	5000
Jul-2017	0.0	2970	0.0	0	0.0	0	0.0	1400	0.0	0	78.3	5000
Aug-2017	0.0	2970	0.0	0	0.0	0	0.0	2329	0.0	0	21.4	4755
Sep-2017	0.0	2970	0.0	0	0.0	0	25.1	5000	0.0	0	94.0	5000
Oct-2017	0.0	2970	0.0	0	0.0	0	163.6	5000	0.0	0	208.1	5000
Nov-2017	74.6	2523	0.0	0	0.0	0	134.5	200	0.0	0	215.0	5000
Dec-2017	246.6	4122	0.0	0	0.0	0	305.1	471	0.0	0	221.3	5000
Total	490.4		0.0		0.0		1255.4		0.0		1510.8	
Avg Inj P		3029		0		0		1892		0		4975

c) Monthly wellhead injection pressure for each injection well

	02/05-10 Inj		C0/03-04 Inj		C0/03-09 Inj		C0/04-10 Inj		C0/06-04 Inj		C0/07-09 Inj	
MONTH	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)
Jan-2017	432.2	4800	241.3	0	210.2	5000	416.6	202	322.6	3477	170.0	4800
Feb-2017	393.3	4800	214.0	64	193.8	5000	419.3	221	256.7	2309	152.4	4800
Mar-2017	410.2	4800	288.1	10	177.3	5000	385.8	198	309.2	2797	141.7	4800
Apr-2017	87.3	4257	11.8	83	2.8	4833	85.4	138	26.8	2530	32.2	4640
May-2017	473.6	3661	106.7	442	211.2	4913	446.8	123	125.2	0	194.7	4800
Jun-2017	14.6	4500	222.5	400	139.5	4980	456.6	100	271.6	1040	160.9	4973
Jul-2017	14.8	4500	190.9	400	190.0	5000	360.9	100	137.0	1200	152.6	5000
Aug-2017	0.0	4500	53.7	297	79.6	4755	217.2	103	19.7	890	106.4	4739
Sep-2017	27.3	4500	56.2	0	62.9	5000	236.3	100	32.5	0	109.5	4700
Oct-2017	274.3	4935	67.9	4355	0.0	5000	427.1	100	108.4	4355	178.1	4961
Nov-2017	355.3	4500	149.4	0	0.0	5000	455.0	100	52.8	0	180.8	5000
Dec-2017	378.4	4061	240.3	0	0.0	5000	492.0	100	214.7	581	180.2	5000
Total	2861.3		1842.8		1267.3		4398.8		1877.1		1759.4	
Avg Inj P		4485		504		4957		132		1598		4851

	C0/11-04 Inj		C0/12-04 Inj		C0/12-10 Inj		C0/13-10 Inj		C0/14-04 Inj		C0/14-10 Inj	
MONTH	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)
Jan-2017	206.8	1387	134.7	4881	273.4	4989	438.7	610	246.2	5000	151.5	4994
Feb-2017	277.4	1280	116.6	4850	256.9	4996	431.6	693	221.1	5000	134.9	4986
Mar-2017	284.1	1160	25.0	4850	274.6	4965	455.7	679	233.5	5000	140.0	4990
Apr-2017	33.6	1115	0.0	4728	86.7	3825	63.7	470	68.3	4833	41.0	3963
May-2017	223.2	1753	0.0	4850	305.1	4887	475.1	608	286.3	5000	172.4	4842
Jun-2017	228.6	960	0.0	4850	288.8	4853	439.3	567	241.9	5000	151.8	4900
Jul-2017	274.2	1000	0.0	4850	306.8	4629	438.2	535	234.6	5000	148.6	4677
Aug-2017	178.0	1497	0.0	4850	143.1	4690	246.3	710	162.1	4816	100.6	4626
Sep-2017	229.8	1500	21.5	4850	87.3	5123	219.4	500	167.5	5000	104.5	5107
Oct-2017	354.2	4548	172.2	4850	96.2	5013	435.9	574	254.9	5000	167.6	4984
Nov-2017	337.3	2900	132.9	4900	42.7	5115	459.1	572	257.1	5000	167.5	5110
Dec-2017	379.0	3171	127.2	5000	22.3	4937	469.7	595	249.7	5000	162.3	5000
Total	3006.2		730.0		2183.9		4572.7		2623.0		1642.7	
Avg Inj P		1856		4859		4835		593		4971		4848

c) Monthly wellhead injection pressure for each injection well

	C0/15-04 Inj		C0/16-04 Inj		Waskada Unit 16	
MONTH	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)
Jan-2017	163.7	4651	54.2	5000	7170.8	2884
Feb-2017	123.3	4875	47.5	5000	6757.4	2852
Mar-2017	133.1	5000	56.8	5000	5641.5	2920
Apr-2017	2.8	4850	5.1	4850	648.7	2733
May-2017	25.2	5003	35.2	5003	3646.1	2817
Jun-2017	15.2	5000	29.4	5000	3382.0	2895
Jul-2017	16.3	5000	48.4	5000	3053.8	2895
Aug-2017	13.2	4816	25.6	4816	1645.6	2859
Sep-2017	12.6	5000	7.6	5000	1877.8	2999
Oct-2017	17.7	5000	14.7	5000	3555.1	3617
Nov-2017	16.3	5000	16.8	5000	3554.2	2841
Dec-2017	16.1	5000	18.1	5000	4227.2	2917
Total	555.4		359.4		45160.2	
Avg Inj P		4933		4972		2936

MONTH	Jan-2017	Feb-2017	Mar-2017	Apr-2017	May-2017	Jun-2017	Jul-2017	Aug-2017	Sep-2017	Oct-2017	Nov-2017	Dec-2017
Total m3	7170.8	6757.4	5641.5	648.7	3646.1	3382.0	3053.8	1645.6	1877.8	3555.1	3554.2	4227.2
Daily (m³/d)	231.32	241.33	181.98	21.62	117.62	112.73	98.51	53.08	62.59	114.68	118.47	136.36

2017 AVG. ANNUAL DAILY INJECTION = 124.19 m3/d

CUMULATIVE INJECTION TO Dec 31, 2016 = 1,951,660 m3

TOTAL 2017 ANNUAL INJECTION = 45,160 m3

CUMULATIVE INJECTION TO Dec 31, 2017 = 1,996,821 m3

d) Summary of the result of any survey of reservoir pressure conducted in 2017. N/A

e) Date and type of any well servicing.

Well	Service Description	Date
100.12-04-002-25W1.00	Rigless Acid Stimulation	12/6/2017
102.13-04-002-25W1.00	Pump Change	9/18/2017
104.03-04-002-25W1.00	Pump Change	11/9/2017
100.09-05-002-25W1.00	Pump Change	12/13/2017
100.02-09-002-25W1.00	Rigless Acid Stimulation	12/6/2017
100.15-09-002-25W1.00	Pump Change	7/6/2017
102.01-09-002-25W1.00	Spearfish Open Hole Add Frac	3/13/2017
102.02-09-002-25W1.00	Pump Change/Lower PSN	11/29/2017
100.13-10-002-25W1.00	Pump Change	12/17/2017

f) Calculations of voidage replacement ratio on a monthly and cumulative basis

VOIDAGE CALCULATIONS

OIL FORMATION VOLUME FACTOR (Rm3/Sm3) = 1.17

MONTH	Mth Oil Prod (m3)	Cum Oil Prod (Km3)	Mth Water Prod (m3)	Cum Water Prod (Km3)	Mth Water Inj (m3)	Cum Water Inj (Km3)	VRR	Cum VRR
Jan-2017	1172.3	560.51	2556.0	596.12	7171.0	1958.83	1.826	1.565
Feb-2017	1086.0	561.60	2561.5	598.68	6757.4	1965.59	1.763	1.565
Mar-2017	749.0	562.35	1767.5	600.45	5641.5	1971.23	2.134	1.566
Apr-2017	982.4	563.33	2145.2	602.60	648.6	1971.88	0.197	1.563
May-2017	1105.8	564.44	2424.5	605.02	3646.2	1975.52	0.981	1.561
Jun-2017	965.7	565.40	1942.8	606.96	3381.8	1978.91	1.101	1.560
Jul-2017	983.6	566.39	2091.2	609.06	3053.8	1981.96	0.942	1.558
Aug-2017	885.8	567.27	2678.9	611.73	1645.7	1983.61	0.443	1.555
Sep-2017	1343.0	568.62	4494.3	616.23	1878.0	1985.48	0.310	1.549
Oct-2017	1760.9	570.38	5178.0	621.41	3555.4	1989.04	0.491	1.543
Nov-2017	1747.9	572.13	4634.4	626.04	3554.3	1992.59	0.532	1.538
Dec-2017	1463.7	573.59	5011.3	631.05	4227.2	1996.82	0.629	1.533

g) An outline of the method used for quality control and treatment of the injected fluid

The injected fluid is treated by filtration.

h) A report of any unusual performance problems and remedial measures taken or being considered. N/A

i) Any other information necessary to evaluate the project

<i>UWI</i>	<i>Type</i>	<i>Status</i>	<i>Future Plans</i>
100/03-04-002-25W1/0	Vertical	Injection	-
103/03-04-002-25W1/0	Horizontal	Producing	-
104/03-04-002-25W1/0	Horizontal	Producing	WIW Conversion
1C0/03-04-002-25W1/0	Vertical	Injection	-
100/04-04-002-25W1/0	Vertical	Producing	-
100/05-04-002-25W1/0	Vertical	Injection	-
100/06-04-002-25W1/0	Vertical	Producing	-
103/06-04-002-25W1/0	Horizontal	Producing	-
1C0/06-04-002-25W1/0	Vertical	Injection	-
100/09-04-002-25W1/0	Vertical	Injection	-
102/09-04-002-25W1/0	Horizontal	Producing	-
103/09-04-002-25W1/0	Horizontal	Producing	-
104/09-04-002-25W1/0	Horizontal	Producing	-
100/10-04-002-25W1/0	Vertical	Producing	-
1C0/10-04-002-25W1/0	Vertical	Abandoned	-
100/11-04-002-25W1/0	Vertical	Injection	-
103/11-04-002-25W1/0	Horizontal	Producing	-
1C0/11-04-002-25W1/0	Vertical	Injection	-
100/12-04-002-25W1/0	Vertical	Producing	-
1C0/12-04-002-25W1/0	Vertical	Injection	-
100/13-04-002-25W1/2	Vertical	Producing	-
102/13-04-002-25W1/0	Horizontal	Producing	-
100/14-04-002-25W1/0	Vertical	Producing	-
1C0/14-04-002-25W1/0	Vertical	Injection	-
100/15-04-002-25W1/0	Vertical	Injection	-
102/15-04-002-25W1/0	Vertical	Producing	-
1C0/15-04-002-25W1/0	Vertical	Injection	-
100/16-04-002-25W1/0	Vertical	Producing	-
1C0/16-04-002-25W1/0	Vertical	Injection	-
100/09-05-002-25W1/0	Vertical	Producing	-
100/10-05-002-25W1/0	Vertical	Abandoned	-
102/10-05-002-25W1/0	Horizontal	Producing	-
103/10-05-002-25W1/0	Horizontal	Producing	-
100/15-05-002-25W1/0	Vertical	Abandoned Zone	-
102/15-05-002-25W1/0	Horizontal	Producing	WIW Conversion
103/15-05-002-25W1/0	Horizontal	Producing	-
100/16-05-002-25W1/0	Vertical	Injection	-
100/01-09-002-25W1/0	Vertical	Injection	-
102/01-09-002-25W1/0	Horizontal	Injection	-
103/01-09-002-25W1/0	Horizontal	Producing	-
100/02-09-002-25W1/0	Vertical	Producing	-
102/02-09-002-25W1/0	Horizontal	Producing	-
100/03-09-002-25W1/0	Vertical	Producing	-
1C0/03-09-002-25W1/0	Vertical	Injection	-
100/04-09-002-25W1/2	Vertical	Producing	-

102/04-09-002-25W1/0	Horizontal	Producing	-
100/05-09-002-25W1/0	Vertical	Abandoned	-
102/05-09-002-25W1/0	Vertical	Pumping	-
103/05-09-002-25W1/0	Horizontal	Producing	-
100/06-09-002-25W1/0	Vertical	Injection	-
100/07-09-002-25W1/0	Vertical	Producing	-
1C0/07-09-002-25W1/0	Vertical	Injection	-
100/08-09-002-25W1/0	Vertical	Abandoned Zone	-
102/08-09-002-25W1/0	Horizontal	Producing	-
100/09-09-002-25W1/0	Vertical	Injection	-
1C0/09-09-002-25W1/0	Vertical	Abandoned	-
100/10-09-002-25W1/0	Vertical	Abandoned	-
102/10-09-002-25W1/0	Horizontal	Producing	-
103/10-09-002-25W1/0	Horizontal	Producing	-
100/15-09-002-25W1/0	Vertical	Producing	-
100/16-09-002-25W1/0	Vertical	Injection	-
100/04-10-002-25W1/0	Vertical	Producing	-
103/04-10-002-25W1/0	Horizontal	Drilled & Cased	-
1C0/04-10-002-25W1/0	Vertical	Injection	-
100/05-10-002-25W1/0	Vertical	Injection	-
102/05-10-002-25W1/0	Horizontal	Injection	-
100/12-10-002-25W1/0	Vertical	Producing	-
1C0/12-10-002-25W1/0	Vertical	Injection	-
100/13-10-002-25W1/0	Vertical	Producing	-
103/13-10-002-25W1/0	Horizontal	Producing	-
104/13-10-002-25W1/0	Horizontal	Producing	-
1C0/13-10-002-25W1/0	Vertical	Injection	-
100/14-10-002-25W1/0	Vertical	Producing	-
1C0/14-10-002-25W1/0	Vertical	Injection	-

k) Discussion

The current pressure maintenance program is having a positive effect on oil production in Waskada Unit No. 16. Tundra will maintain the current pressure maintenance program, and continue to monitor production and pressure performance. Plans for future injection conversions and acid treatments to improve unit performance are being considered for 2018.