

**WASKADA UNIT NO. 13  
WATERFLOOD EOR PROJECT**

**ANNUAL WATERFLOOD PROGRESS REPORT FOR 2016**

**June 30, 2017**

**Tundra Oil and Gas Partnership**

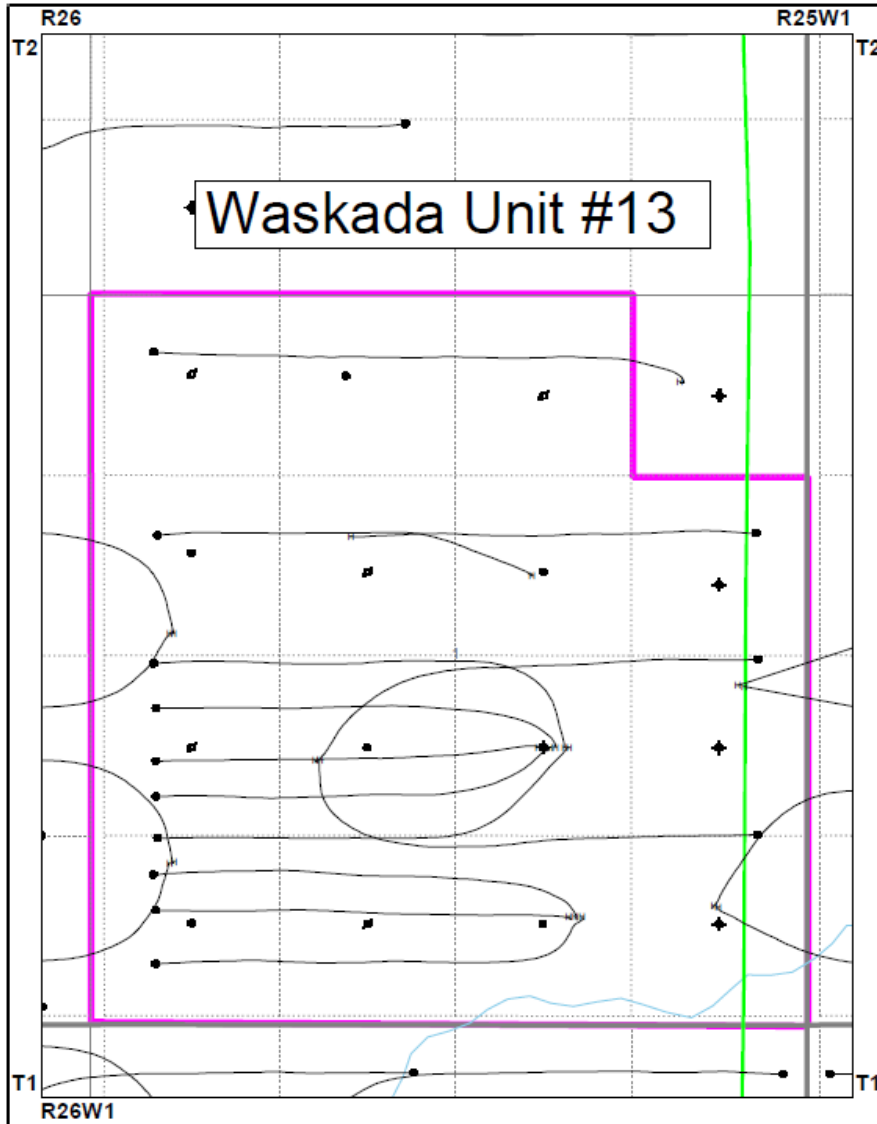
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## **INTRODUCTION**

Waskada Unit No. 13 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Board Order No. PM 58 effective December 1986. The Unit area contains 11 abandoned/suspended wells, including 5 abandoned/inactive injectors, and 17 producing/inactive wells in 15 LSDs in Township 2, Range 26 W1 as shown in the figure below.

**Figure 1: Waskada Unit 13 Area Outline**



In accordance with Section 73 of the Manitoba Drilling and Production Regulation, Tundra hereby submits the following 2016 Annual Progress Report for Waskada Unit No. 13.

## DISCUSSION

### Production History

For the wells included in Waskada Unit No. 13, production started in January 1984 with the 00/13-01-002-26W1/0 Vertical well. Average oil production peaked for the first time at 3.7 m<sup>3</sup>/d per well in September 1984. This production was coming from 10 wells and totaled 37.3 m<sup>3</sup>/d for the whole Unit. The production at the end of December 2016 averaged 2.2 m<sup>3</sup>/d per well, totaling 2.2 m<sup>3</sup>/day for the Unit. Water injection commenced in Waskada Unit No. 13 in December 1986 until end of September 2001. The rates and WOR are presented in Figure 2. There was no water injection through 2016, and there are no plans for injector re-activation.

**Figure 2: Waskada Unit 13 Production/Injection Rates and WOR vs Time**

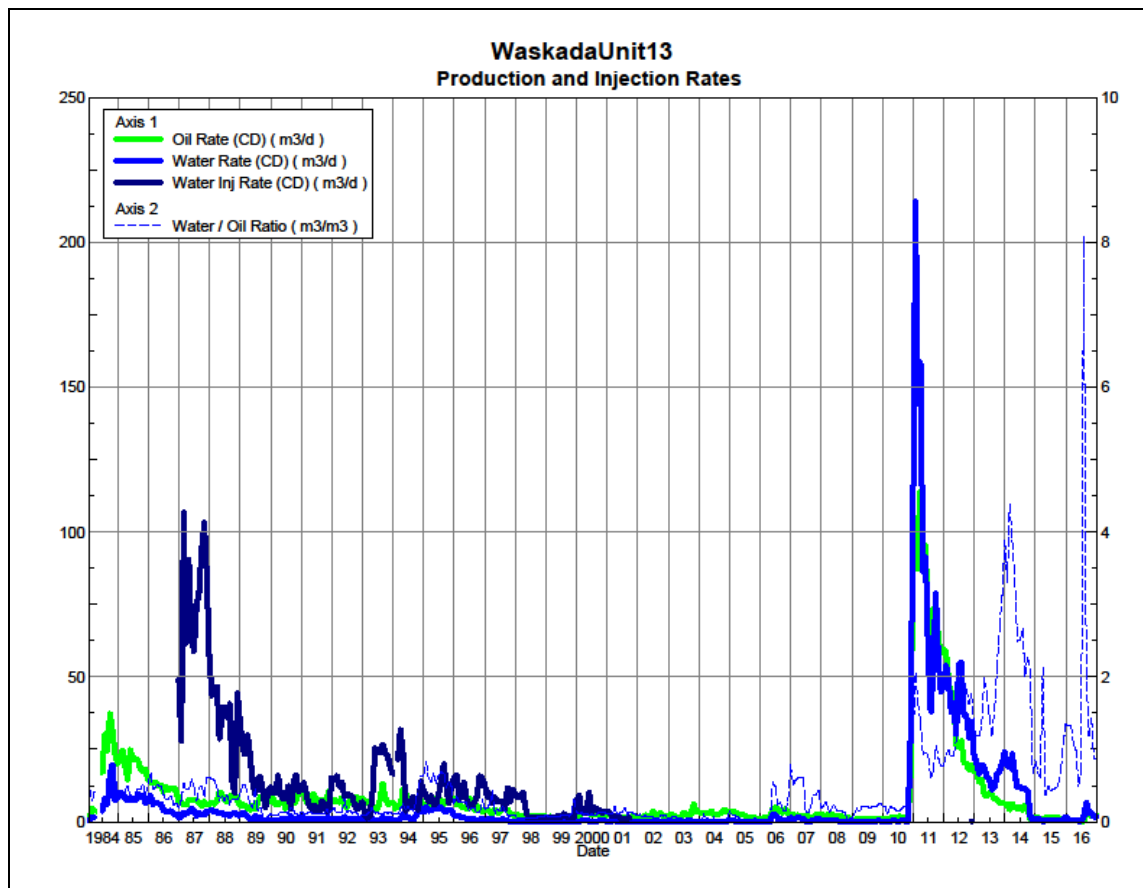
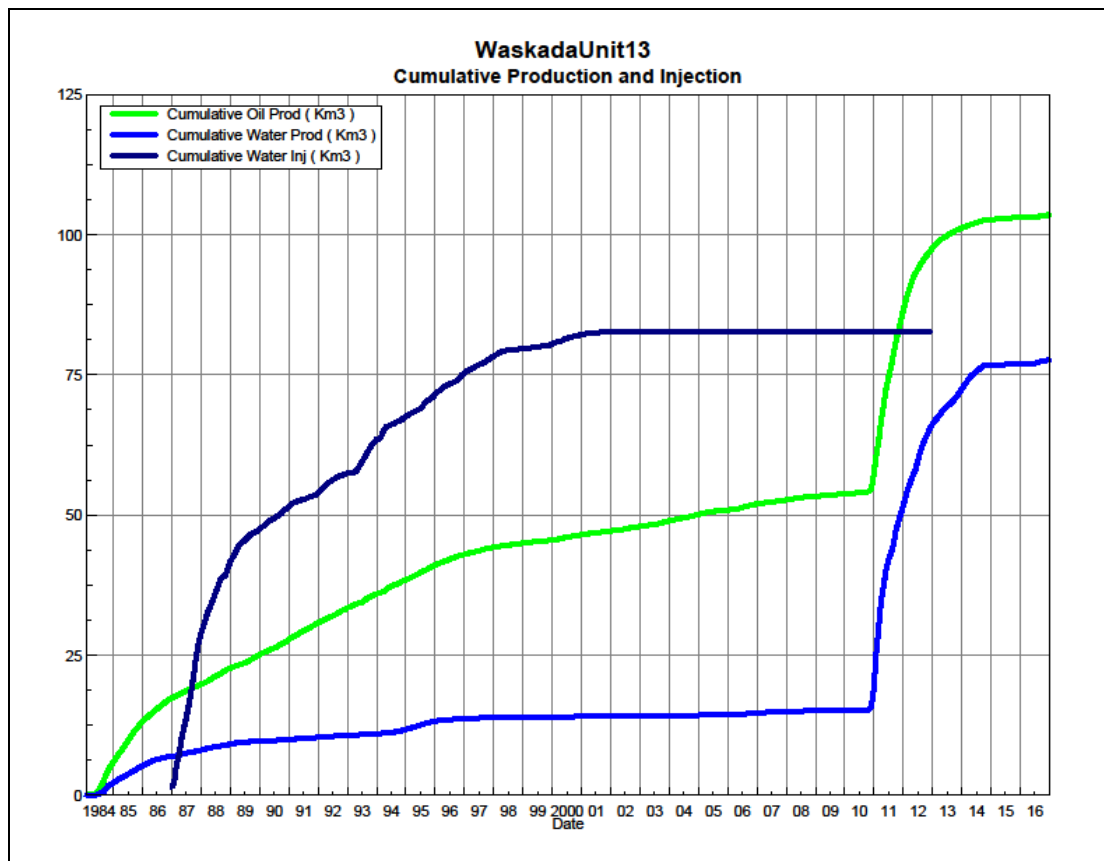


Figure 3 shows the cumulative production for Waskada Unit No. 13 to the end of December 2016 as 103.5 e<sup>3</sup>m<sup>3</sup> of oil, and 76.6 e<sup>3</sup>m<sup>3</sup> of water.

**Figure 3: Waskada Unit 13 Cumulative Oil, Water and Water Injected vs Time**



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

### **Corrosion and Scale Prevention**

The facilities in Unit 13 are currently using cathodic and chemical protection against corrosion and scale in the new horizontal wells. All facilities are monitored every 3 months to assess the corrosion and ensure that proper electrical current is being supplied. There have been no issues with corrosion or scale to date.

### **Injection Wellhead Pressures**

No injection wellhead pressures were recorded in 2016.

### **Reservoir Pressure**

Where practical, Tundra is committed to collecting pressure data from newly drilled injection wells. Since no new wells were drilled in the Unit, therefore, no pressure surveys were conducted in 2016.

## Well Servicing

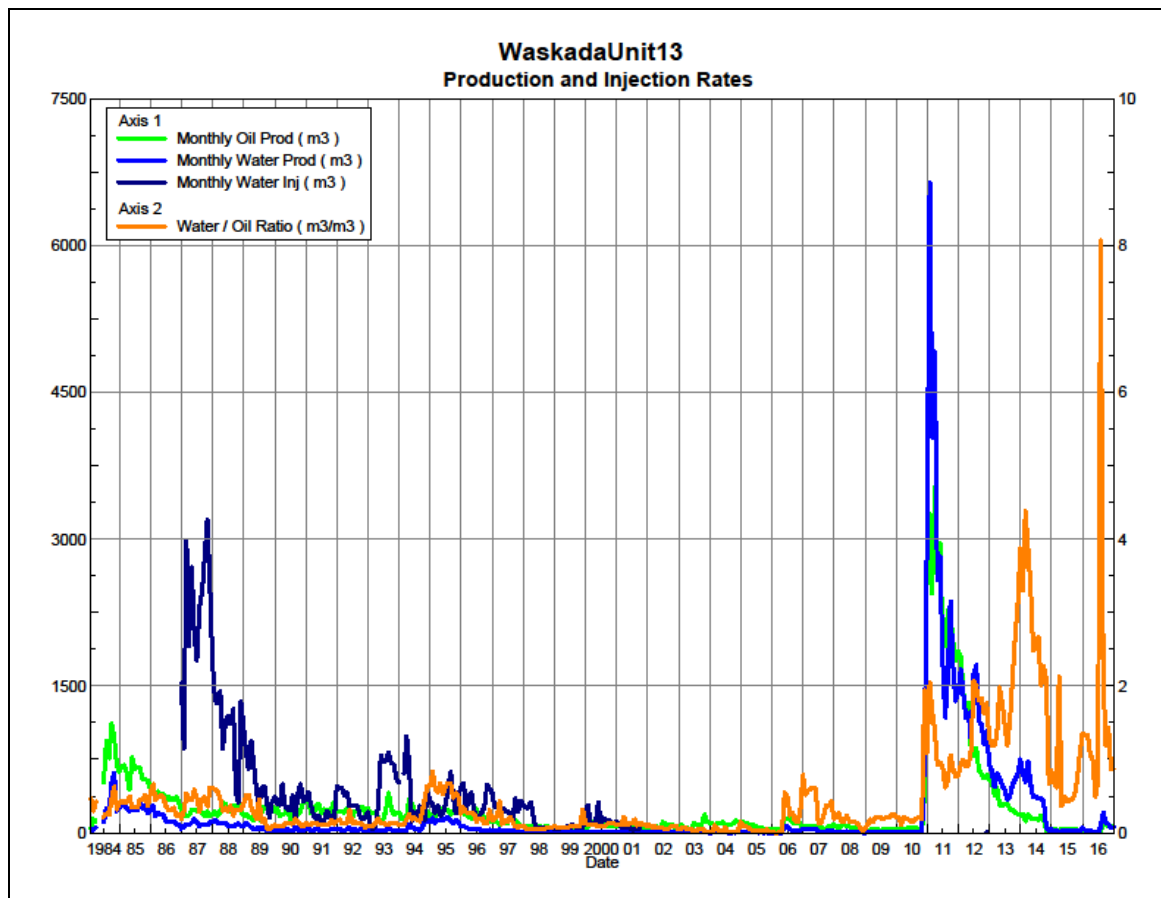
No well servicing was performed in 2016 for Waskada Unit No. 13.

## Waterflood Performance Discussion

From January 1 to December 31 in 2016, Waskada Unit No. 13 produced 1.1 e3m3 of fluid (0.5 e3m3 of Oil, 0.6 e3m3 of Water). There is no active injection in this Unit, and Tundra Oil and Gas has no plans to reactivate injection in the near future. Due to the horizontal wells being produced and no pressure support occurring in the Unit, the cumulative VRR has dropped in the last 15 years, down to 0.419.

Table 2 summarizes the yearly and cumulative VRR for Waskada Unit No. 13.

**Figure 4: Waskada Unit 13 Production and Injection Rate**



**TABLE NO. 1: WASKADA UNIT NO. 13 WELL SUMMARY**

<i>UWI</i>	<i>Type</i>	<i>Status</i>	<i>On Prod Date</i>	<i>Cum Prd Oil (m3)</i>	<i>Cum Prd Water (m3)</i>	<i>Last Prod Date</i>	<i>Cum Inj Water (m3)</i>	<i>Last Inj Date</i>
100/01-01-002-26W1/0	Vertical	Abandoned	9/2/1984	900.7	1029.2	2/28/1989	0	
100/02-01-002-26W1/0	Vertical	Producing	9/2/1984	6335	958.7	10/31/2012	0	
100/03-01-002-26W1/0	Vertical	Suspended	7/3/1984	5992.6	2666.7	5/31/2008	0	
100/04-01-002-26W1/0	Vertical	Producing	6/29/1984	7802.8	1382.6	7/31/2011	0	
102/04-01-002-26W1/0	Horizontal	Producing	12/23/2010	4994.7	6987.1	4/30/2014	0	
103/04-01-002-26W1/0	Horizontal	Suspended	8/23/2011	2423.6	2561.7	4/30/2014	0	
104/04-01-002-26W1/0	Horizontal	Producing	9/3/2011	3526.9	2464.1	8/31/2016	0	
105/04-01-002-26W1/0	Horizontal	Suspended	8/23/2011	2149.5	2390.7	5/31/2014	0	
100/05-01-002-26W1/0	Vertical	Injection	6/21/1984	2256	515.9	12/31/1986	22330.4	1/31/2000
102/05-01-002-26W1/0	Horizontal	Producing	12/22/2010	5072.4	7708.1	1/31/2015	0	
103/05-01-002-26W1/0	Horizontal	Producing	12/22/2010	4049.1	7155.9	4/30/2014	0	
104/05-01-002-26W1/0	Horizontal	Producing	12/21/2010	3453.9	4782.5	5/31/2015	0	
105/05-01-002-26W1/0	Horizontal	Producing	12/22/2010	3537.7	4399	4/30/2014	0	
100/06-01-002-26W1/0	Vertical	Producing	6/13/1984	7435.8	1130.5	2/28/2013	0	
100/07-01-002-26W1/0	Vertical	Abandoned	9/12/1984	1211.4	622.3	11/30/1986	29150.1	9/30/2001
100/08-01-002-26W1/0	Vertical	Abandoned	9/3/1984	1942.6	1680.5	1/31/1996	0	
102/08-01-002-26W1/0	Horizontal	Producing	11/17/2010	3695.1	6932.3	12/31/2016	0	
100/09-01-002-26W1/0	Vertical	Abandoned	7/11/1985	319.2	625.9	7/31/1988	0	
102/09-01-002-26W1/0	Horizontal	Producing	11/17/2010	3854.2	5430.4	12/31/2016	0	
103/09-01-002-26W1/0	Horizontal	Producing	12/7/2010	1897.6	3625.8	4/30/2014	0	
100/10-01-002-26W1/0	Vertical	Producing	11/4/1984	4854.3	2100.7	12/31/2016	0	
100/11-01-002-26W1/0	Vertical	Injection	12/23/1984	5677.3	1546	8/31/2011	6.3	11/30/2012
100/12-01-002-26W1/0	Vertical	Producing	1/21/1985	5432	1018.9	12/31/2010	0	
102/12-01-002-26W1/0	Horizontal	Producing	12/9/2010	5256.6	2963.8	12/31/2016	0	
100/13-01-002-26W1/0	Vertical	Suspended	1/25/1984	936.3	314.8	10/31/1986	17994.6	4/30/1998
102/13-01-002-26W1/0	Horizontal	Producing	12/10/2010	5038.2	3788.3	12/31/2016	0	
100/14-01-002-26W1/0	Vertical	Producing	2/15/1984	3023.6	498.2	11/30/1999	0	
100/15-01-002-26W1/0	Vertical	Suspended	8/1/1985	485.9	364.4	12/31/1986	13172.4	4/30/1998
				103555.0	77645.0		82653.8	

TABLE NO. 2 - VRR Calculations

Date	Mth Oil Prod m3	Cum Oil Prod m3	Mth Water Prod m3	Cum Water Prod m3	Water Oil Ratio m3/m3	Mth Water Inj m3	Cum Water Inj m3	VRR	Cum VRR
12/31/1984	5912	5912.300	2244	2243.700	0.38		0.000	0.000	0.000
12/31/1985	7234	13145.800	3043	5286.400	0.42		0.000	0.000	0.000
12/31/1986	4259	17404.700	1699	6985.600	0.40	1530	1530.300	0.232	0.057
12/31/1987	2417	19821.900	1118	8103.900	0.46	27340	28870.400	7.014	0.934
12/31/1988	2887	22709.100	1045	9149.100	0.36	12821	41691.000	2.937	1.182
12/31/1989	2393	25102.200	516	9665.300	0.22	5873	47563.700	1.797	1.234
12/31/1990	2733	27835.300	330	9995.100	0.12	3919	51483.100	1.129	1.226
12/31/1991	2966	30800.800	373	10367.900	0.13	2521	54004.100	0.666	1.179
12/31/1992	2638	33438.700	365	10732.400	0.14	3493	57497.100	1.028	1.169
12/31/1993	2518	35956.800	306	11038.400	0.12	6013	63510.300	1.878	1.212
12/31/1994	2516	38473.000	724	11762.600	0.29	4084	67593.900	1.129	1.207
12/31/1995	2613	41085.900	1488	13250.800	0.57	3903	71496.400	0.869	1.182
12/31/1996	1903	42989.200	430	13681.100	0.23	3873	75368.900	1.479	1.194
12/31/1997	1282	44271.300	214	13895.500	0.17	2950	78319.100	1.747	1.208
12/31/1998	729	45000.300	44	13939.300	0.06	1354	79673.200	1.535	1.213
12/31/1999	509	45508.800	51	13990.000	0.10	816	80489.300	1.284	1.214
12/31/2000	982	46490.600	107	14097.300	0.11	1696	82185.000	1.372	1.216
12/31/2001	680	47170.200	87	14184.500	0.13	463	82647.500	0.532	1.208
12/31/2002	805	47974.900	57	14241.500	0.07		82647.500	0.000	1.191
12/31/2003	994	48968.500	37	14278.200	0.04		82647.500	0.000	1.171
12/31/2004	1160	50128.900	49	14327.200	0.04		82647.500	0.000	1.148
12/31/2005	773	50901.700	39	14366.200	0.05		82647.500	0.000	1.134
12/31/2006	1067	51968.500	312	14678.300	0.29		82647.500	0.000	1.110
12/31/2007	746	52714.500	303	14981.500	0.41		82647.500	0.000	1.093
12/31/2008	677	53391.700	107	15088.000	0.16		82647.500	0.000	1.081
12/31/2009	379	53770.300	77	15164.500	0.20		82647.500	0.000	1.073
12/31/2010	3704	57473.900	3989	19153.500	1.08		82647.500	0.000	0.969
12/31/2011	28900	86374.000	32442	51595.800	1.12		82647.500	0.000	0.548
12/31/2012	11245	97618.600	14623	66218.700	1.30	6	82653.800	0.000	0.463
12/31/2013	3577	101195.500	6290	72508.500	1.76		82653.800	0.000	0.438
12/31/2014	1488	102683.600	4236	76744.400	2.85		82653.800	0.000	0.424
12/31/2015	403	103086.600	249	76993.500	0.62		82653.800	0.000	0.422
12/31/2016	468	103555.000	652	77645.000	1.39		82653.800	0.000	0.419



TABLE NO. 3

**Tundra Oil and Gas  
Waskada Unit No. 13  
2016 Injection Volumes**

Well Location	Date	Hours On	H <sub>2</sub> O Inj Cal-d avg (m <sup>3</sup> /d)	Monthly Injected H <sub>2</sub> O (m <sup>3</sup> )
<b>Unit No. 13 Total:</b>				
	Jan-16	0	0.0	0.00
	Feb-16	0	0.0	0.00
	Mar-16	0	0.0	0.00
	Apr-16	0	0.0	0.00
	May-16	0	0.0	0.00
	Jun-16	0	0.0	0.00
	Jul-16	0	0.0	0.00
	Aug-16	0	0.0	0.00
	Sep-16	0	0.0	0.00
	Oct-16	0	0.0	0.00
	Nov-16	0	0.0	0.00
	Dec-16	0	0.0	0.00
<b>2016 Group Totals:</b>				<b>0.00</b>
<b>Unit No. 13 Total:</b>				
	1981	0	0	0.00
	1982	0	0	0.00
	1983	0	0	0.00
	1984	0	0	0.00
	1985	0	0	0.00
	1986	0	49.36	1,530.30
	1987	0	75.2	27,340.10
	1988	0	35.1	12,820.60
	1989	0	16.1	5,872.70
	1990	0	10.7	3,919.40
	1991	0	6.9	2,521.00
	1992	0	9.6	3,493.00
	1993	0	16.4	6,013.20
	1994	0	12.3	4,083.60
	1995	0	10.7	3,902.50
	1996	0	10.6	3,872.50
	1997	0	8.1	2,950.20
	1998	0	3.7	1,354.10
	1999	0	2.2	816.10
	2000	0	4.6	1,695.70
	2001	0	1.7	462.50
	2002	0	0.0	0.00
	2003	0	0.0	0.00
	2004	0	0.0	0.00
	2005	0	0.0	0.00
	2006	0	0.0	0.00
	2007	0	0.0	0.00
	2008	0	0.0	0.00
	2009	0	0.0	0.00
	2010	0	0.0	0.00
	2011	0	0.0	0.00
	2012	0	0.2	6.30
	2013	0	0.0	0.00
	2014	0	0.0	0.00
	2015	0	0.0	0.00
	2016	0	0.0	0.00
<b>Group Totals:</b>				<b>82,653.80</b>

TABLE NO. 4

**Tundra Oil and Gas  
Waskada Unit No. 13  
2016 Production Volumes**

Date	Hours On	Oil Rate (CD) m3/d	Monthly Oil Prod m3	Water Rate (CD) m3/d	Monthly Water Prod m3	Water Oil Ratio m3/m3	Well Count
Jan-16	552	0.65	20	0.87	27	1	1
Feb-16	696	0.36	11	0.48	14	1	1
Mar-16	744	0.62	19	0.67	21	1	1
Apr-16	720	0.47	14	0.47	14	1	1
May-16	744	0.48	15	0.24	7	0	1
Jun-16	648	0.34	10	0.24	7	1	1
Jul-16	768	0.22	7	1.80	56	8	1
Aug-16	1,056	3.18	99	6.65	206	2	1
Sep-16	696	2.83	85	3.36	101	1	1
Oct-16	672	2.01	62	2.87	89	1	1
Nov-16	576	1.98	60	1.72	52	1	1
Dec-16	672	2.16	67	1.87	58	1	1
	8,544		468		652		

Date	Hours On	Oil Rate (CD) m3/d	Monthly Oil Prod m3	Water Rate (CD) m3/d	Monthly Water Prod m3	Water Oil Ratio m3/m3	Well Count
31/12/1984	36216	19.35	5,912	7.34	2244	0.37	5
31/12/1985	107641	19.84	7,234	8.34	3043	0.43	12
31/12/1986	108997	11.68	4,259	4.66	1699	0.38	13
31/12/1987	73437	6.62	2,417	3.07	1118	0.47	8
31/12/1988	68376	7.89	2,887	2.86	1045	0.37	8
31/12/1989	55848	6.55	2,393	1.42	516	0.25	7
31/12/1990	58584	7.47	2,733	0.90	330	0.12	7
31/12/1991	71448	8.12	2,966	1.02	373	0.13	8
31/12/1992	72264	7.21	2,638	0.99	365	0.14	8
31/12/1993	60816	6.89	2,518	0.84	306	0.12	7
31/12/1994	61296	6.90	2,516	1.98	724	0.28	7
31/12/1995	68208	7.15	2,613	4.08	1488	0.58	8
31/12/1996	52440	5.21	1,903	1.18	430	0.23	6
31/12/1997	55896	3.52	1,282	0.59	214	0.17	6
31/12/1998	38904	2.00	729	0.12	44	0.06	5
31/12/1999	29760	1.40	509	0.14	51	0.11	3
31/12/2000	32736	2.68	982	0.29	107	0.11	4
31/12/2001	32664	1.86	680	0.24	87	0.13	4
31/12/2002	30792	2.20	805	0.16	57	0.07	4
31/12/2003	33528	2.72	994	0.10	37	0.04	4
31/12/2004	41232	3.17	1,160	0.13	49	0.04	5
31/12/2005	32040	2.13	773	0.11	39	0.04	4
31/12/2006	45932	2.91	1,067	0.85	312	0.25	5
31/12/2007	48,615	2.05	746	0.83	303	0.40	6
31/12/2008	50,868	1.85	677	0.29	107	0.15	6
31/12/2009	48,312	1.04	379	0.21	77	0.20	6
31/12/2010	44,271	10.01	3,704	10.80	3989	0.41	5
31/12/2011	102,611	79.17	28,900	89.10	32442	1.06	12
31/12/2012	116,211	30.79	11,245	40.02	14623	1.44	13
31/12/2013	112,754	9.82	3,577	17.23	6290	1.96	13
31/12/2014	47,993	4.08	1,488	11.65	4236	2.54	6
31/12/2015	16,504	1.11	403	0.68	249	0.77	2
31/12/2016	8,544	1.28	468	1.77	652	1.70	1
	1,865,738		103,555		77,645		