

**WASKADA UNIT NO. 4  
WATERFLOOD EOR PROJECT**

**ANNUAL WATERFLOOD PROGRESS REPORT FOR 2016**

**May 8, 2017**

**Tundra Oil and Gas Partnership**

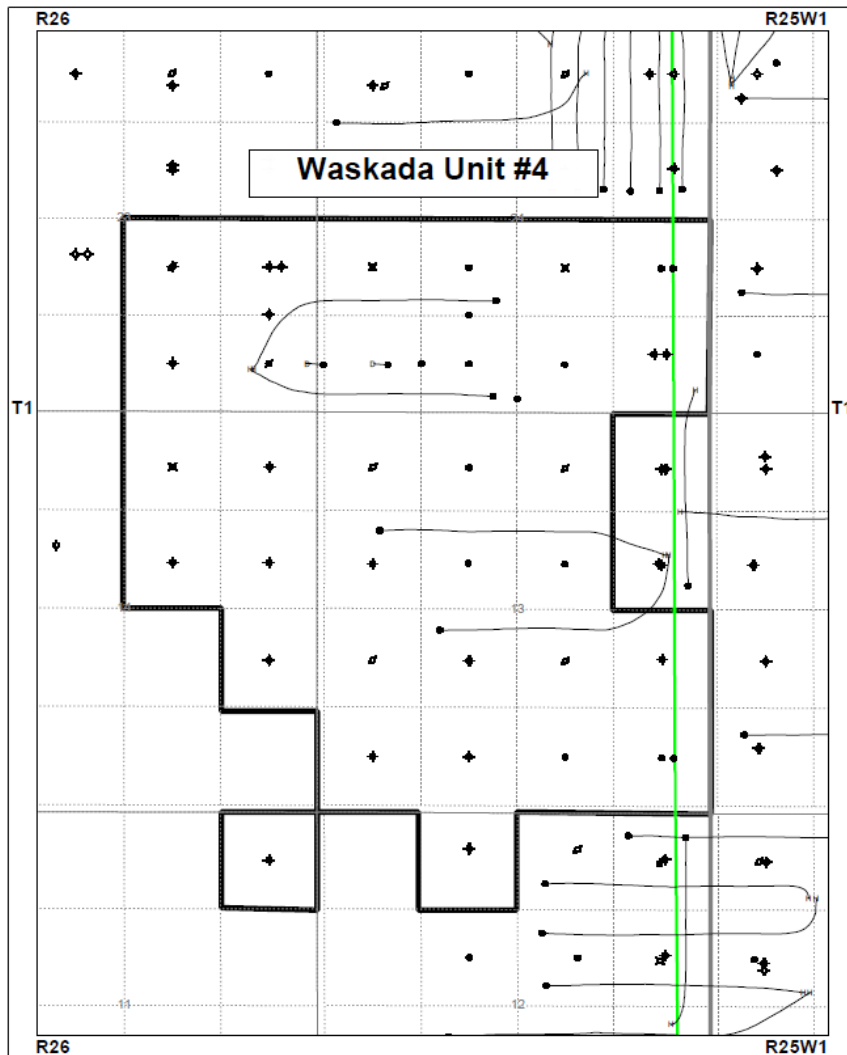
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## **INTRODUCTION**

Waskada Unit No. 4 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Board Order No. PM58 effective June 1984. The Unit area contains 22 abandoned/inactive wells, including 9 inactive/abandoned injectors, and 20 producing wells in 33 LSDs in Township 1 Range 26 W1 as shown in the figure below.

**Figure 1: Waskada Unit 4 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. 4.

## DISCUSSION

### Production History

For the wells included in Waskada Unit No. 4, production started in November 1981 with the 00/15-13-001-26W1/0 and 00/07-24-001-26W1/0 Vertical wells. Average oil production peaked for the first time at 4.6 m<sup>3</sup>/d per well in September 1983. This production was coming from 32 wells and totaled 148.6 m<sup>3</sup>/d for the whole Unit. The production at the end of December 2016 averaged 3.6 m<sup>3</sup>/d per well, totaling 7.2 m<sup>3</sup>/d for the Unit. Water was injected into Waskada Unit No. 4 from April 1985 until 2006, then intermittently in 2007, and from 2009 to the end of 2010. 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 4 Production/Injection Rates and WOR vs Time**

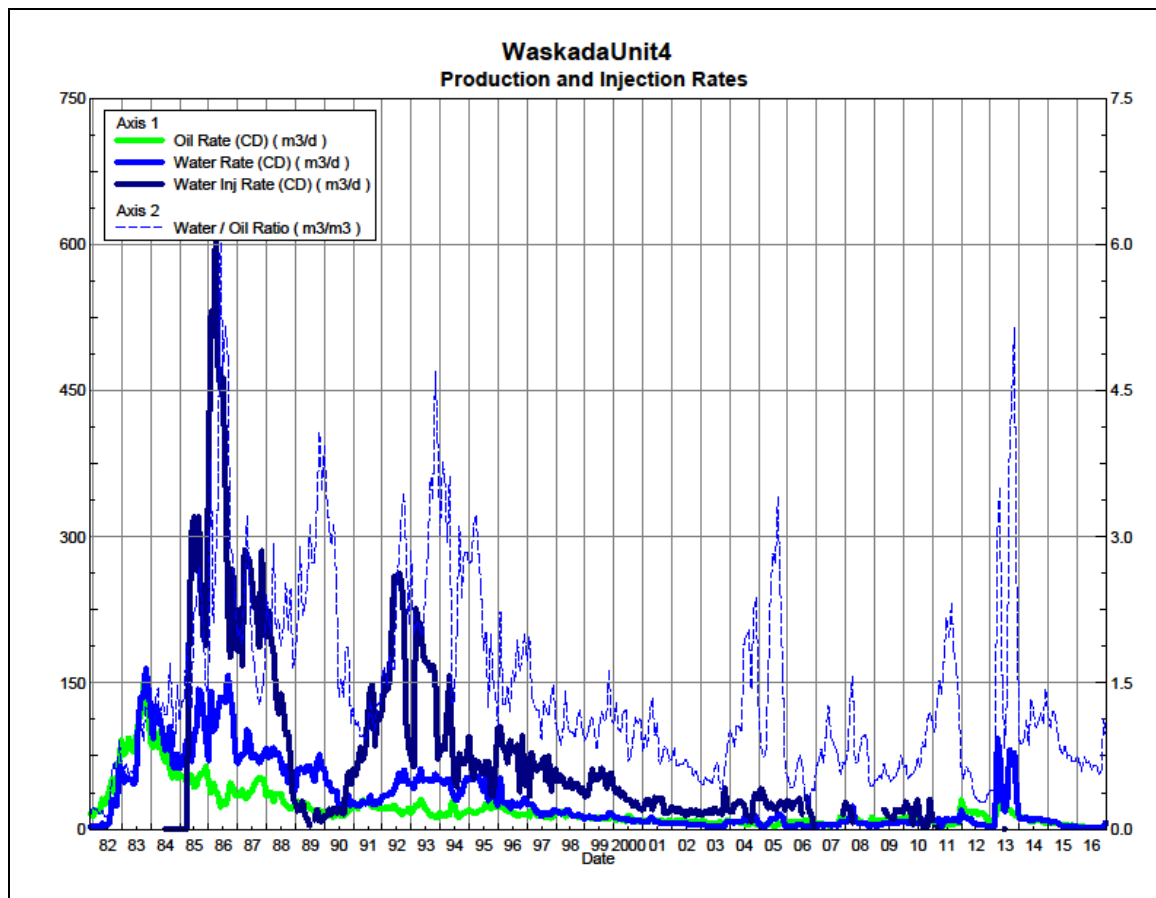
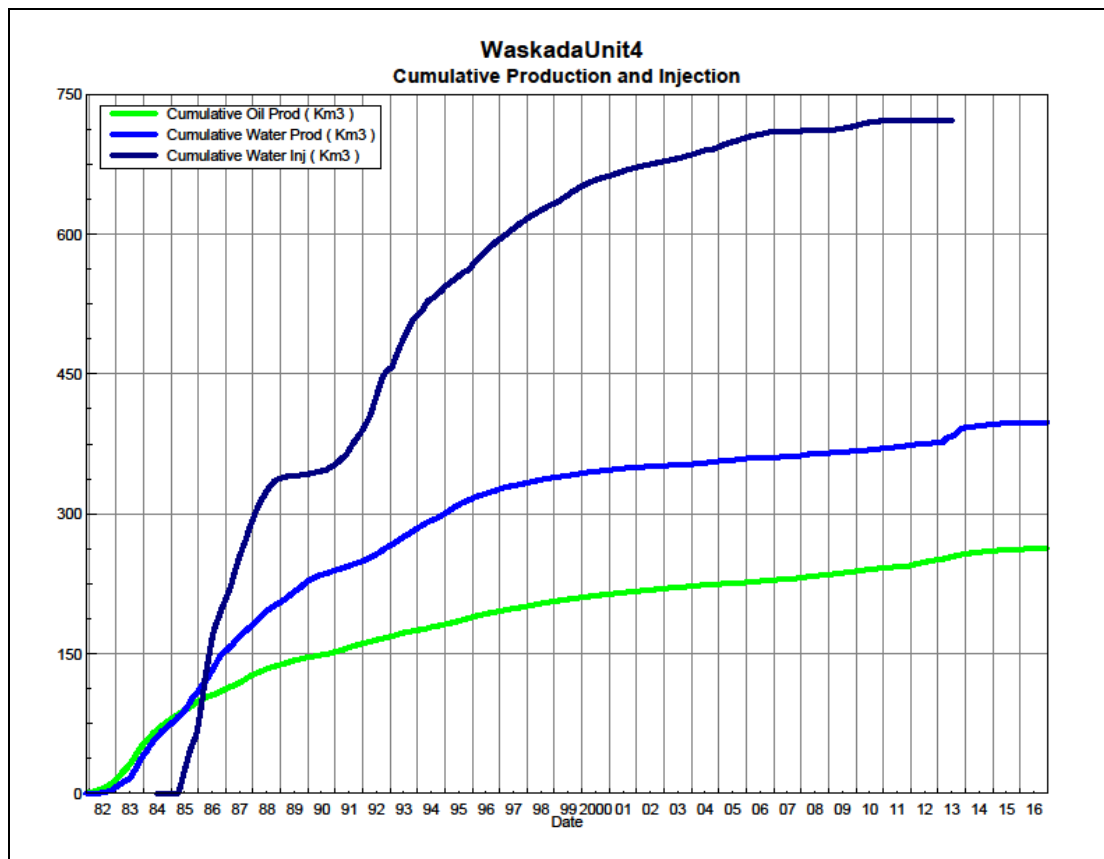


Figure 3 shows the cumulative production for Waskada Unit No. 4 to the end of December 2016 as 263.0 e<sup>3</sup>m<sup>3</sup> of oil, and 398.3 e<sup>3</sup>m<sup>3</sup> of water.

**Figure 3: Waskada Unit 4 Cumulative Oil, Water and Water Injected vs Time**



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

### **Corrosion and Scale Prevention**

The facilities in Unit 4 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

The following table illustrates the maintenance done in the Waskada Unit 4 wells in 2016

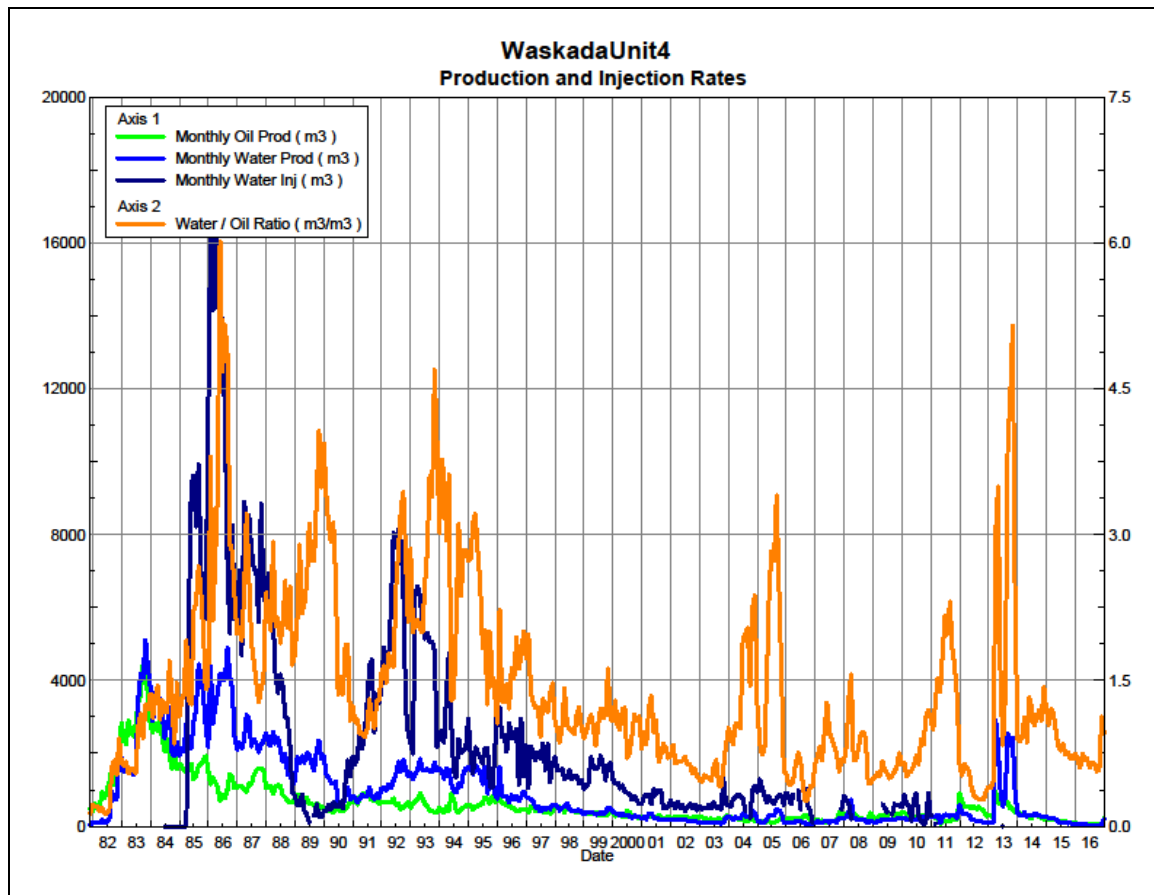
UWI	Workover Type	Date
102.06-24-001-26W1.00	Cemented Liner Cleanout	27-Nov-16

## Waterflood Performance Discussion

From January 1 to December 31 in 2016, Waskada Unit No. 4 produced 1.6 e<sup>3</sup>m<sup>3</sup> of fluid (0.9 e<sup>3</sup>m<sup>3</sup> of Oil, 0.7 e<sup>3</sup>m<sup>3</sup> 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 5 years, down to 1.120.

Table 2 summarizes the yearly and cumulative VRR for Waskada Unit No. 4.

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



**TABLE NO. 1: WASKADA UNIT NO. 4 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>
100/16-11-001-26W1/0	Vertical	Abandoned	8/1/1982	474.4	3864.1	12/31/1985	15531	4/30/1989
100/14-12-001-26W1/0	Vertical	Abandoned	7/1/1982	1009.7	913	7/31/1989	0	
100/01-13-001-26W1/0	Vertical	Producing	3/1/1982	12999.9	11789.9	5/31/2012	0	
100/02-13-001-26W1/0	Vertical	Producing	10/1/1982	11941.8	1612.9	1/31/2012	0	
100/03-13-001-26W1/0	Vertical	Abandoned	10/1/1982	2982.4	1141.6	1/31/1997	0	
100/04-13-001-26W1/0	Vertical	Abandoned	9/1/1982	1842.4	1023.3	3/31/1990	0	
100/05-13-001-26W1/0	Vertical	Injection	9/1/1982	791.7	414.7	5/31/1984	46874.5	6/30/2013
100/06-13-001-26W1/0	Vertical	Abandoned	7/1/1982	6436.5	33350.3	4/30/1990	0	
102/06-13-001-26W1/0	Horizontal	Producing	3/1/2013	301.5	10812.4	4/30/2014	0	
100/07-13-001-26W1/0	Vertical	Injection	9/1/1982	2006.4	375.5	11/30/1985	138303.8	2/28/2011
100/08-13-001-26W1/0	Vertical	Abandoned	11/1/1982	2455.6	460.9	9/30/1989	0	
100/10-13-001-26W1/0	Vertical	Producing	8/1/1982	11745.8	1898.6	4/30/2015	0	
100/11-13-001-26W1/0	Vertical	Producing	11/1/1982	5211.9	3568.8	7/31/2011	0	
100/12-13-001-26W1/0	Vertical	Abandoned	9/1/1982	4216.9	2101.8	9/30/1997	0	
102/12-13-001-26W1/0	Horizontal	Producing	3/1/2013	7774.8	7285.6	12/31/2016	0	
100/13-13-001-26W1/0	Vertical	Injection	7/1/1982	2753.9	1905.4	5/31/1984	78381.8	10/31/2005
100/14-13-001-26W1/0	Vertical	Producing	4/1/1982	11786	6699.3	11/30/2012	0	
100/15-13-001-26W1/0	Vertical	Injection	11/1/1981	3662.9	632.9	5/31/1984	75819.1	10/31/2006
100/08-14-001-26W1/0	Vertical	Abandoned	8/1/1982	7314.6	12918.1	6/30/2000	0	
100/09-14-001-26W1/0	Vertical	Abandoned	11/1/1982	3891.6	12525.8	12/31/1989	0	
100/10-14-001-26W1/0	Vertical	Abandoned	12/1/1982	635.6	10532.7	6/30/1986	0	
100/15-14-001-26W1/0	Vertical	Abandoned	11/1/1982	612.4	4789.6	5/31/1984	29143.7	6/30/2000
100/16-14-001-26W1/0	Vertical	Abandoned	4/1/1982	5246.4	1744.8	1/31/1991	0	
100/01-23-001-26W1/0	Vertical	Producing	8/1/1982	15453.1	11896.8	9/30/2013	0	
100/02-23-001-26W1/0	Vertical	Abandoned	12/1/1982	2263.1	34835.6	3/31/1990	0	
100/07-23-001-26W1/2	Vertical	Abandoned	N/A	0	0		85398.6	9/30/2001
102/08-23-001-26W1/0	Vertical	Abandoned	6/1/1983	6276.5	27058.7	6/30/1996	0	
1A0/08-23-001-26W1/0	Vertical	Producing	3/1/1991	5515.8	1743.6	1/31/2015	0	
102/01-24-001-26W1/0	Vertical	Abandoned	6/1/1983	5262.5	3368.9	5/31/1996	0	
100/02-24-001-26W1/0	Vertical	Producing	12/1/1982	15971.3	14768.2	5/31/2012	0	
1B0/02-24-001-26W1/0	Vertical	Producing	12/1/1997	4788.3	311.3	2/29/2012	0	
100/03-24-001-26W1/0	Vertical	Producing	7/1/1983	19686	63207.2	4/30/2015	0	
102/03-24-001-26W1/0	Horizontal	Producing	12/1/2011	3740.6	1245.2	12/31/2016	0	
1C0/03-24-001-26W1/0	Vertical	Producing	4/1/1991	2710	1668.4	4/30/2015	0	
100/04-24-001-26W1/0	Vertical	Producing	7/1/1983	30167.2	79453.3	4/30/2015	0	
1C0/04-24-001-26W1/0	Dir/Dev	Producing	3/1/1991	3586.3	5264.7	2/29/2012	0	
100/05-24-001-26W1/0	Vertical	Abandoned	7/1/1983	2593.3	2027.4	5/31/1984	106355.8	4/30/1993
100/06-24-001-26W1/0	Vertical	Producing	7/1/1983	12553.6	2598	3/31/2013	0	
102/06-24-001-26W1/0	Horizontal	Producing	12/1/2011	4556.9	2100.3	12/31/2016	0	
1A0/06-24-001-26W1/0	Vertical	Producing	4/1/1991	2659	3284.1	3/31/2011	0	
100/07-24-001-26W1/0	Vertical	Abandoned	11/1/1981	3040.1	290.4	5/31/1984	146072	6/30/2009
102/08-24-001-26W1/0	Vertical	Pumping	8/1/1983	14104.3	10831.1	2/29/2012	0	
				263023.0	398315.2		721880.3	

TABLE NO. 2 - VRR Calculations

Date	Mth Oil Prod m3	Cum Oil Prod Km3	Mth Water Prod m3	Cum Water Prod Km3	Water Oil Ratio m3/m3	Mth Water Inj m3	Cum Water Inj Km3	VRR	Cum VRR
12/31/1981	891	0.891	154	0.154	0.17		0.000	0.000	0.000
12/31/1982	14701	15.592	7215	7.369	0.49		0.000	0.000	0.000
12/31/1983	37397	52.988	34057	41.426	0.91		0.000	0.000	0.000
12/31/1984	26933	79.922	33400	74.826	1.24	0	0.000	0.354	0.137
12/31/1985	19314	99.235	34523	109.349	1.79	73162	73.162	1.999	0.610
12/31/1986	12945	112.180	43742	153.091	3.38	134971	208.133	2.302	0.961
12/31/1987	15258	127.438	28894	181.985	1.89	86108	294.241	1.854	1.088
12/31/1988	10751	138.189	23051	205.037	2.14	43873	338.114	1.239	1.102
12/31/1989	7954	146.143	22723	227.760	2.86	4701	342.815	0.148	1.025
12/31/1990	5812	151.954	11723	239.482	2.02	10613	353.428	0.577	1.005
12/31/1991	8956	160.910	10018	249.500	1.12	36491	389.918	1.796	1.042
12/31/1992	7311	168.221	16486	265.986	2.25	66196	456.114	2.659	1.130
12/31/1993	7060	175.281	18650	284.636	2.64	56746	512.860	2.120	1.184
12/31/1994	6296	181.577	15906	300.543	2.53	30651	543.511	1.324	1.191
12/31/1995	7691	189.267	15621	316.164	2.03	22900	566.411	0.936	1.179
12/31/1996	6364	195.632	10418	326.582	1.64	28328	594.740	1.597	1.193
12/31/1997	5288	200.920	6833	333.415	1.29	21899	616.639	1.696	1.204
12/31/1998	5366	206.286	5577	338.993	1.04	16369	633.008	1.393	1.208
12/31/1999	4174	210.460	4629	343.622	1.11	18559	651.567	1.968	1.220
12/31/2000	3484	213.944	3487	347.109	1.00	10759	662.326	1.436	1.223
12/31/2001	3016	216.960	2747	349.856	0.91	9240	671.566	1.487	1.226
12/31/2002	2981	219.940	1890	351.746	0.63	6490	678.055	1.220	1.226
12/31/2003	2536	222.477	1517	353.262	0.60	7229	685.284	1.631	1.229
12/31/2004	2269	224.746	3251	356.513	1.43	8263	693.547	1.410	1.230
12/31/2005	1789	226.534	2915	359.428	1.63	9895	703.442	1.990	1.236
12/31/2006	2588	229.122	1213	360.641	0.47	5897	709.339	1.408	1.238
12/31/2007	2395	231.517	1809	362.450	0.76	1296	710.634	0.284	1.231
12/31/2008	3357	234.873	2920	365.370	0.87	1513	712.147	0.223	1.220
12/31/2009	3672	238.546	2132	367.502	0.58	4100	716.247	0.645	1.214
12/31/2010	3505	242.050	2692	370.194	0.77	5562	721.809	0.827	1.210
12/31/2011	2765	244.815	3540	373.734	1.28	71	721.880	0.011	1.198
12/31/2012	5839	250.654	2474	376.208	0.42	0	721.880	0.000	1.181
12/31/2013	6394	257.048	16213	392.421	2.54	0	721.880	0.000	1.141
12/31/2014	3336	260.384	3634	396.055	1.09	0	721.880	0.000	1.129
12/31/2015	1753	262.137	1593	397.648	0.91	0	721.880	0.000	1.123
12/31/2016	886	263.023	667	398.315	0.75	0	721.880	0.000	1.120



TABLE NO. 3

**Tundra Oil and Gas  
Waskada Unit No. 4  
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. 4 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. 4 Total:</b>				
	1981	0	0	0.00
	1982	0	0	0.00
	1983	0	0	0.00
	1984	0	0	0.00
	1985	0	199.19	73,162.00
	1986	0	370.41	134,970.90
	1987	0	235.33	86,107.90
	1988	0	120.06	43,873.10
	1989	0	14.1	4,701.20
	1990	0	29.03	10,612.80
	1991	0	99.66	36,490.50
	1992	0	180.8	66,196.00
	1993	0	156.0	56,745.50
	1994	0	84.0	30,651.10
	1995	0	62.6	22,900.30
	1996	0	77.2	28,328.20
	1997	0	60.2	21,899.40
	1998	0	44.9	16,368.60
	1999	0	50.8	18,559.40
	2000	0	29.5	10,758.70
	2001	0	25.3	9,240.20
	2002	0	17.8	6,489.50
	2003	0	19.8	7,229.10
	2004	0	24.7	8,262.50
	2005	0	27.2	9,894.90
	2006	0	21.5	5,896.90
	2007	0	21.1	1,295.60
	2008	0	16.7	1,512.80
	2009	0	16.8	4,100.00
	2010	0	15.3	5,562.30
	2011	0	2.5	70.80
	2012	0	0.0	0.00
	2013	0	0.0	0.10
	2014	0	0.0	0.00
	2015	0	0.0	0.00
	2016	0	0.0	0.00
<b>Group Totals:</b>				<b>721,880.30</b>

TABLE NO. 4

**Tundra Oil and Gas  
Waskada Unit No. 4  
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	1,224	2.21	69	1.51	47	1	2
Feb-16	1,344	2.75	80	1.65	48	1	2
Mar-16	1,440	2.22	69	1.66	52	1	2
Apr-16	1,392	2.20	66	1.49	45	1	2
May-16	1,488	1.99	62	1.37	43	1	2
Jun-16	1,440	1.88	56	1.14	34	1	2
Jul-16	1,464	1.75	54	1.14	35	1	2
Aug-16	1,464	1.67	52	1.09	34	1	2
Sep-16	1,416	1.71	51	0.97	29	1	2
Oct-16	1,488	1.62	50	0.94	29	1	2
Nov-16	1,512	1.80	54	2.03	61	1	2
Dec-16	1,056	7.18	223	6.82	211	1	1
	16,728		886		667		

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
31/12/1981	1584	14.62	891	2.51	154	0.18	1
31/12/1982	63984	40.12	14,701	19.70	7215	0.38	7
31/12/1983	214848	102.38	37,397	93.01	34057	0.87	25
31/12/1984	221112	73.66	26,933	91.37	33400	1.25	25
31/12/1985	203708	52.95	19,314	94.47	34523	1.80	23
31/12/1986	178281	35.57	12,945	119.67	43742	3.57	20
31/12/1987	175996	41.81	15,258	79.15	28894	1.98	20
31/12/1988	160968	29.42	10,751	62.99	23051	2.15	18
31/12/1989	149136	21.78	7,954	62.27	22723	2.96	17
31/12/1990	102504	15.93	5,812	32.21	11723	2.12	12
31/12/1991	130416	24.52	8,956	27.41	10018	1.13	15
31/12/1992	138696	19.99	7,311	45.01	16486	2.33	16
31/12/1993	135240	19.39	7,060	51.12	18650	2.86	15
31/12/1994	128592	17.22	6,296	43.60	15906	2.71	15
31/12/1995	133992	21.03	7,691	42.84	15621	2.12	15
31/12/1996	135168	17.41	6,364	28.46	10418	1.64	15
31/12/1997	127560	14.52	5,288	18.77	6833	1.30	15
31/12/1998	98136	14.72	5,366	15.28	5577	1.05	11
31/12/1999	90672	11.45	4,174	12.69	4629	1.12	10
31/12/2000	91224	9.53	3,484	9.55	3487	1.03	10
31/12/2001	88968	8.26	3,016	7.53	2747	0.91	10
31/12/2002	87624	8.18	2,981	5.18	1890	0.64	10
31/12/2003	78744	6.95	2,536	4.15	1517	0.59	9
31/12/2004	78744	6.21	2,269	8.88	3251	1.51	9
31/12/2005	73152	4.90	1,789	7.96	2915	1.71	8
31/12/2006	84789	7.09	2,588	3.32	1213	0.49	10
31/12/2007	88,269	6.55	2,395	4.95	1809	0.82	10
31/12/2008	93,390	9.17	3,357	7.99	2920	0.84	11
31/12/2009	111,643	10.05	3,672	5.84	2132	0.58	13
31/12/2010	108,469	9.62	3,505	7.37	2692	0.79	13
31/12/2011	90,779	7.55	2,765	9.68	3540	1.57	10
31/12/2012	80,089	15.96	5,839	6.78	2474	0.41	9
31/12/2013	77,670	17.45	6,394	44.15	16213	2.33	9
31/12/2014	62,321	9.15	3,336	9.96	3634	1.11	7
31/12/2015	35,986	4.81	1,753	4.39	1593	0.87	4
31/12/2016	16,728	2.42	886	1.82	667	0.71	2
	3,939,182		263,023		398,315		