

**EWART UNIT NO. 5
WATERFLOOD EOR PROJECT

ANNUAL REPORT FOR 2018**

July 15, 2019

Tundra Oil and Gas Partnership

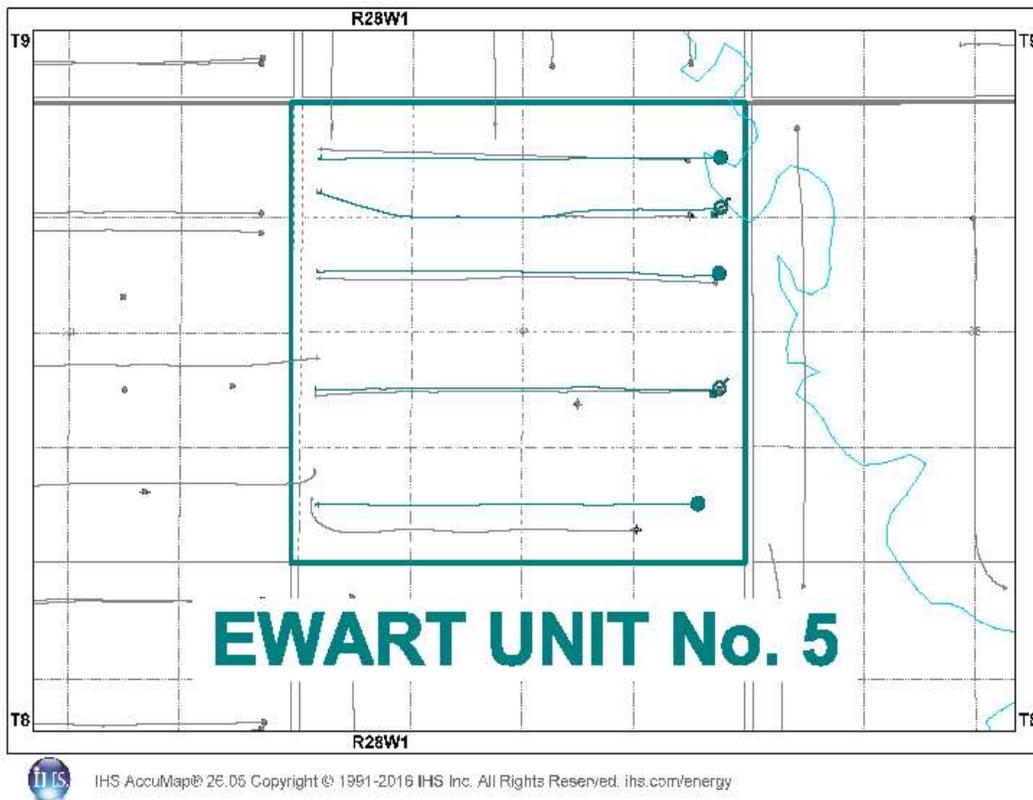
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INTRODUCTION

Ewart Unit No. 5 Enhanced Oil Recovery (EOR) Scheme was approved under EOR Order No. 35 effective April 1, 2014 with Tundra Oil and Gas (Tundra) as Operator. The EOR project area contains 3 horizontal producing wells and 2 horizontal injection wells in Section 34 Township 8 Range 28 W1 as shown in the figure below.

Figure 1: Ewart Unit No. 5 Area Outline



In accordance with Section 73 of the Manitoba Drilling and Production Regulation, Tundra hereby submits the following 2018 Annual Progress Report for Ewart Unit No. 5.

DISCUSSION

Production History

For the wells included in Ewart Unit No. 5, production started in July 2008 with the 00/01-34-008-28W1 well. Average oil production peaked at 14.17 m³/d per well in December of 2009. This production was coming from 3 wells and totaled 42.52 m³/d for the Unit. In December 2018, the Unit was producing 2.43 m³/d of oil and 2.34 m³/d of

water. Water injection commenced in Ewart Unit No. 5 in March 2015. Gas injection commenced in September 2015 in the 02/16-34-008-28W1 location. The rates and WOR are presented in Figure 2.

Figure 2: Ewart Unit No. 5 Production/Injection Rates and WOR vs Time

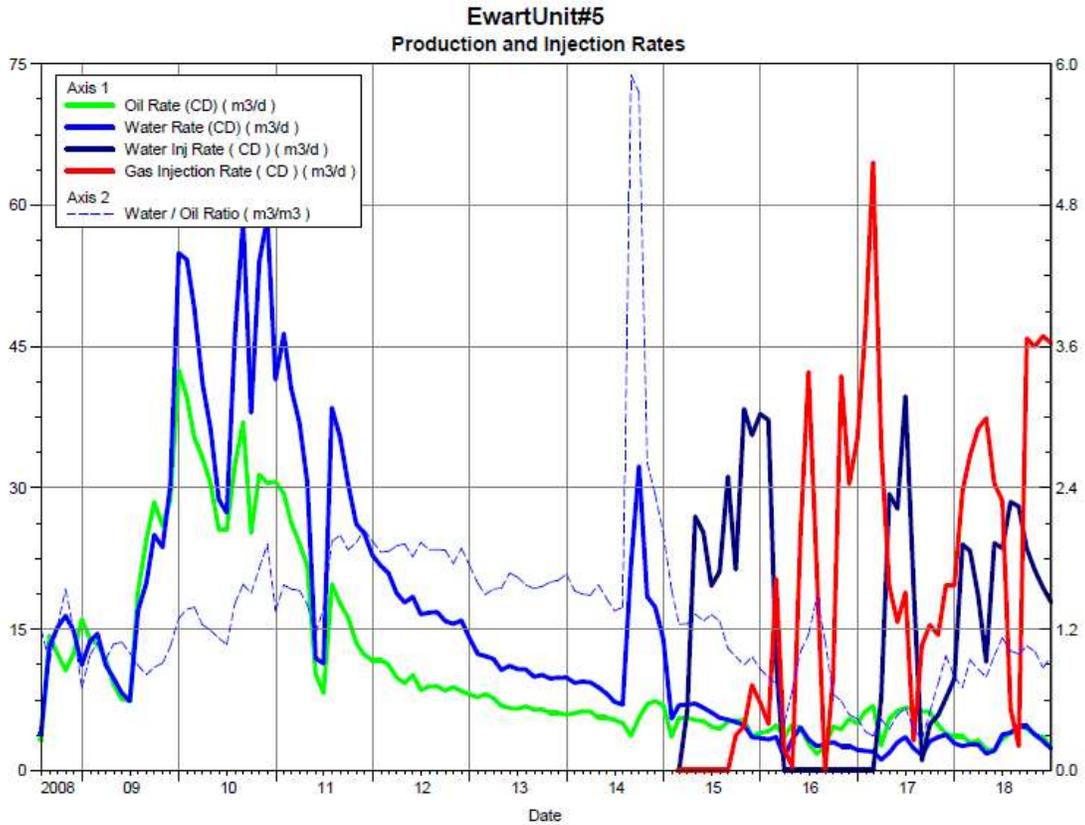
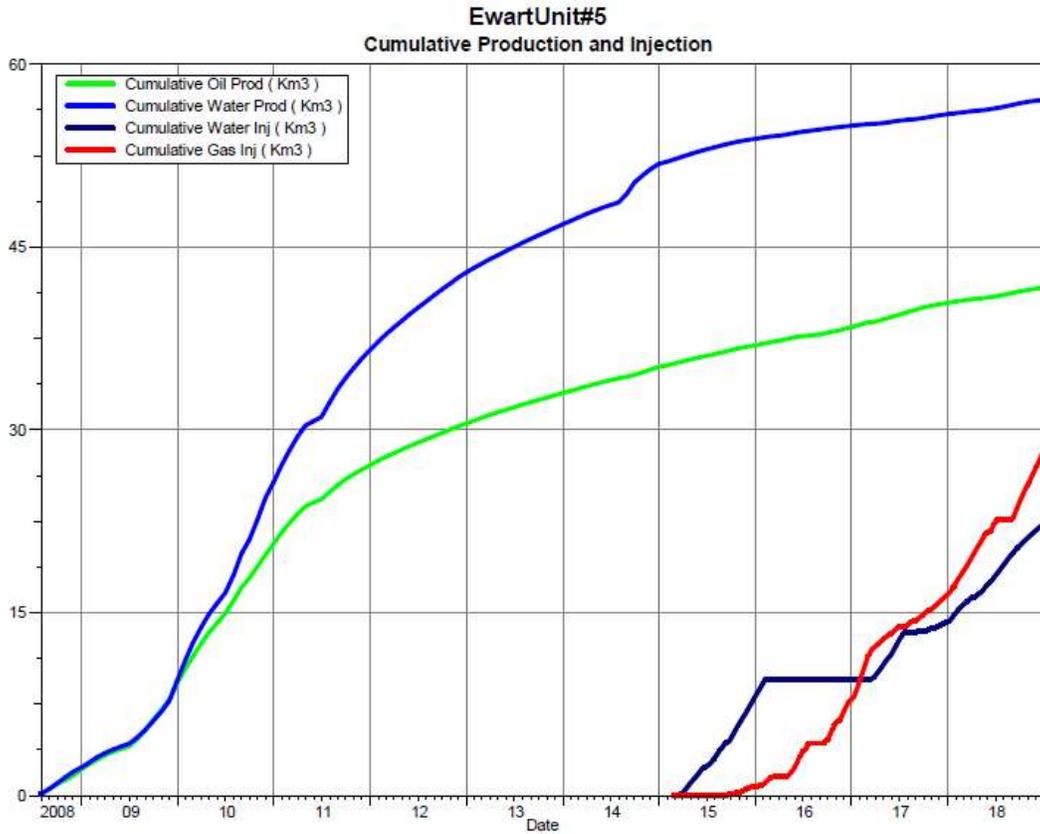


Figure 3 shows the cumulative production for Ewart Unit No. 5 to the end of December 2017 as 41.65 e³m³ of oil, and 57.07 e³m³ of water, representing an 9.4% recovery factor of the OOIP (442.0 e³m³). The cumulative water injected is 22.26 re³m³ and the cumulative gas injected is 28.28 re³m³ (Table 2, Appendix A)

Figure 3: Ewart Unit No. 5 Cumulative Oil, Water and Water Injected vs Time



Waterflood Development Plan

Ewart Unit No. 5 Waterflood (WF) Development Plan

Ewart Unit No. 5 is still in the development phase at the end of 2018. The purpose of this Immiscible Gas Injection Pilot is to install gas injection in Section 34 and evaluate over a 5 year period whether water alternating gas (WAG) injection will result in improved oil recovery in areas where waterflooding and miscible gas flooding could be economically challenged due to poor reservoir quality.

Two injection wells are proposed for the unit. The 08-34-008-28W1 (08-34) is an existing producer that will be converted to an injector. In July 2014, the 02/16-34-008-28W1 (02/16-34) proposed horizontal injector was drilled between 09-34 and 16-34-008-28W1. The new horizontal well was not fracture stimulated unlike the 08-34 future injector.

Tundra plans to inject water prior to gas in both wells to allow the reservoir pressure to build up without the risk of early gas breakthrough. Due to 08-34 having spent several years as a producer, Tundra expects the voidage around this wellbore to take a bit longer

to fill up. Tundra plans to alternate water and gas injection in the two injection wells. The duration and frequency between the WAG cycles will depend on:

- the well's injectivity to each substance (water and nitrogen),
- production response from the offset producers, and
- the capacity of the nitrogen generating equipment being reached.

Water injection began in Ewart Unit No. 5 in March 2015, after the conversion of the 08-34 and 02/16-34 existing horizontal producers to injection wells. Tundra commenced gas injection in the 02/16-34 well and in the 08-34 well in September 2015 and February 2016, respectively. Production performance by injector pattern is summarized in Appendix A.

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

N₂ Source

The N₂ for this pilot is generated on site through an N₂ PSA Generator. In general transporting liquid nitrogen is much more difficult than CO₂ due to its low boiling point temperature. This unit filters the N₂ from the atmosphere and compresses and stores it on site.

Water Source and Quality

The injection water for Ewart Unit No. 5 was sourced from the 02/16-32-007-29W1 well (Lodgepole formation) until June 2016 when it was switched over to the newly recompleted source water well at 02/14-30-007-28W1 (Mannville formation). The water is treated at the 04-01-008-29W1 filtration plant where it is filtered to 0.1 microns and has scale inhibitor and biocide added. The injection water is then distributed to the injectors through the dedicated infrastructure system.

Injection Wellhead Pressures

Water injection started in this Unit in March 2015. The average monthly wellhead injection pressure for each injector is summarized in Appendix B. Since injection in this Unit is still in the early stages, the injectors are still building up to a target injection pressure of 7,000 kPaa for water injection and 13,200 kPaa for gas injection.

Reservoir Pressure

Where practical, Tundra is committed to collecting pressure data from newly drilled injection wells. For Ewart Unit No. 5, pressure data is currently available for the 02/16-34 location. A summary table is presented in Appendix C. Pressures are corrected to a common datum of -450 m SS for comparison with other units in the area.

Well Servicing

The following table summarizes the well servicing performed within Ewart Unit No. 5 in 2018:

100.01-34-008-28W1.00	Pump Change	1/25/2018
100.09-34-008-28W1.00	Pump Change	5/29/2018

Waterflood Performance Discussion

At the end of 2018, Ewart Unit No. 5 had 2 injection patterns in place. In 2015, the 2 horizontal producers, 08-34 and 02/16-34-008-28W1 were converted to injectors. This unit has a combination of waterflood patterns at 20 acre and 40 acre spacing having utilized the existing horizontal wells in the area.

Tundra expects to alternate N₂ and water injection every 1-6 months to optimize the flood front and minimize gas channeling and breakthroughs. The initial Voidage Replacement Ratio (VRR) is expected to be approximately 1.25 to 3.00 within the patterns during the fill up period. As the cumulative VRR approaches 1, target reservoir operating pressure for waterflood operations will be 75-90% of original reservoir pressure.

A summary table of the injector pattern(s) is presented in Appendix A.

Table No. 1

	00/08-34			02/16-34		
	Avg Gas Inj (sm3/d)	Avg Gas Inj (rm3/d)*	Wtr Inj (rm3/d)	Avg Gas Inj (sm3/d)	Avg Gas Inj (rm3/d)*	Wtr Inj (rm3/d)
2015						
Feb	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.00	6.10	0.00	0.00	2.47
Apr	0.00	0.00	18.17	0.00	0.00	8.79
May	0.00	0.00	19.35	0.00	0.00	5.90
Jun	0.00	0.00	15.23	0.00	0.00	4.40
Jul	0.00	0.00	20.65	0.00	0.00	0.48
Aug	0.00	0.00	26.71	0.02	0.00	4.48
Sep	0.00	0.00	21.37	252.14	3.74	0.00
Oct	0.00	0.00	38.35	319.49	4.73	0.00
Nov	0.00	0.00	35.60	613.62	9.09	0.00
Dec	0.00	0.00	37.84	485.16	7.19	0.00
2016						
Jan	0.00	0.00	37.19	334.22	4.95	0.00
Feb	138.22	2.05	11.45	1232.23	18.26	0.00
Mar	137.78	2.04	0.00	15.93	0.24	0.00
Apr	28.14	0.42	0.00	0.00	0.00	0.00
May	595.63	8.83	0.00	1104.90	16.37	0.00
Jun	1683.62	24.95	0.00	1169.49	17.33	0.00
Jul	953.47	14.13	0.00	469.66	6.96	0.00
Aug	88.57	1.31	0.00	20.59	0.31	0.00
Sep	399.75	5.92	0.00	261.24	3.87	0.00
Oct	1787.15	26.48	0.00	1036.88	15.37	0.00
Nov	1199.04	17.77	0.00	856.27	12.69	0.00
Dec	1024.17	15.18	0.00	1354.76	20.08	0.00
2017						
Jan	1827.42	27.08	0.00	1351.28	20.02	0.00
Feb	3007.45	44.57	0.00	1347.52	19.97	0.00
Mar	1135.45	16.83	8.00	1220.01	18.08	0.00
Apr	0.00	0.00	29.33	1321.10	19.58	0.00
May	0.00	0.00	27.81	1064.68	15.78	0.00
Jun	0.00	0.00	39.70	1275.54	18.90	0.00
Jul	0.00	0.00	19.55	217.74	3.23	0.00
Aug	0.00	0.00	1.09	899.27	13.33	0.00
Sep	0.00	0.00	4.90	1044.54	15.48	0.00
Oct	0.00	0.00	5.90	972.65	14.41	0.00
Nov	0.00	0.00	7.70	1327.51	19.67	0.00
Dec	0.00	0.00	9.74	1325.96	19.65	0.00

* 7.0 MPa @ 30 oC

	00/08-34			02/16-34		
	Avg Gas Inj (sm3/d)	Avg Gas Inj (rm3/d)*	Wtr Inj (rm3/d)	Avg Gas Inj (sm3/d)	Avg Gas Inj (rm3/d)*	Wtr Inj (rm3/d)
2018						
Jan	0.00	0.00	24.00	2003.88	29.69	0.00
Feb	0.00	0.00	23.32	2257.29	33.45	0.00
Mar	0.00	0.00	18.58	2450.42	36.31	0.00
Apr	0.00	0.00	11.57	2524.81	37.41	0.00
May	0.00	0.00	24.13	2054.89	30.45	0.00
Jun	0.00	0.00	23.60	1931.72	28.63	0.00
Jul	0.00	0.00	28.52	443.30	6.57	0.00
Aug	0.00	0.00	28.03	177.69	2.63	0.00
Sep	0.00	0.00	23.57	3093.84	45.85	0.00
Oct	0.00	0.00	21.26	3036.96	45.00	0.00
Nov	0.00	0.00	19.43	3111.98	46.11	0.00
Dec	0.00	0.00	17.87	3062.47	45.38	0.00

* 7.0 MPa @ 30 oC

Table No. 2

WELL	Date	Mth_Inj_N2 (kgs)	Mth_Inj_N2* (rm3)	Mth_Inj_Water (rm3)	Avg_WH_Inj_Pressure (kPa)
00/08-34-008-28W1/0	03/01/2015	0	0	189	19
00/08-34-008-28W1/0	04/01/2015	0	0	545	-77
00/08-34-008-28W1/0	05/01/2015	0	0	600	-81
00/08-34-008-28W1/0	06/01/2015	0	0	457	-80
00/08-34-008-28W1/0	07/01/2015	0	0	640	-78
00/08-34-008-28W1/0	08/01/2015	0	0	828	-79
00/08-34-008-28W1/0	09/01/2015	0	0	641	-81
00/08-34-008-28W1/0	10/01/2015	0	0	1189	432
00/08-34-008-28W1/0	11/01/2015	0	0	1068	1124
00/08-34-008-28W1/0	12/01/2015	0	0	1173	2025
00/08-34-008-28W1/0	01/01/2016	0	0	1153	2606
00/08-34-008-28W1/0	02/01/2016	4730	59	332	6309
00/08-34-008-28W1/0	03/01/2016	5040	63	0	7235
00/08-34-008-28W1/0	04/01/2016	996	13	0	6703
00/08-34-008-28W1/0	05/01/2016	21788	274	0	6338
00/08-34-008-28W1/0	06/01/2016	59600	748	0	6358
00/08-34-008-28W1/0	07/01/2016	34878	438	0	6259
00/08-34-008-28W1/0	08/01/2016	3240	41	0	5964
00/08-34-008-28W1/0	09/01/2016	14151	178	0	5874
00/08-34-008-28W1/0	10/01/2016	65374	821	0	6344
00/08-34-008-28W1/0	11/01/2016	42446	533	0	6131
00/08-34-008-28W1/0	12/01/2016	37464	470	0	5922
00/08-34-008-28W1/0	01/01/2017	66847	839	0	6439
00/08-34-008-28W1/0	02/01/2017	99366	1248	0	7171
00/08-34-008-28W1/0	03/01/2017	40195	505	240	4612
00/08-34-008-28W1/0	04/01/2017	0	0	880	2159
00/08-34-008-28W1/0	05/01/2017	0	0	862	3002
00/08-34-008-28W1/0	06/01/2017	0	0	1191	4161
00/08-34-008-28W1/0	07/01/2017	0	0	606	3507
00/08-34-008-28W1/0	08/01/2017	0	0	34	1248
00/08-34-008-28W1/0	09/01/2017	0	0	147	1463
00/08-34-008-28W1/0	10/01/2017	0	0	183	1528
00/08-34-008-28W1/0	11/01/2017	0	0	231	2041
00/08-34-008-28W1/0	12/01/2017	0	0	302	2718
00/08-34-008-28W1/0	01/01/2018	0	0	744	4340
00/08-34-008-28W1/0	02/01/2018	0	0	653	4970
00/08-34-008-28W1/0	03/01/2018	0	0	576	4929
00/08-34-008-28W1/0	04/01/2018	0	0	347	4223
00/08-34-008-28W1/0	05/01/2018	0	0	748	5553
00/08-34-008-28W1/0	06/01/2018	0	0	708	5397
00/08-34-008-28W1/0	07/01/2018	0	0	884	5770
00/08-34-008-28W1/0	08/01/2018	0	0	869	6199
00/08-34-008-28W1/0	09/01/2018	0	0	707	6210
00/08-34-008-28W1/0	10/01/2018	0	0	659	6280
00/08-34-008-28W1/0	11/01/2018	0	0	583	6290
00/08-34-008-28W1/0	12/01/2018	0	0	554	6275
02/16-34-008-28W1/2	03/01/2015	0	0	7	1
02/16-34-008-28W1/2	04/01/2015	0	0	264	2180

WELL	Date	Mth_Inj_N2 (kgs)	Mth_Inj_N2* (rm3)	Mth_Inj_Water (rm3)	Avg_ WH_Inj_Pressure (kPa)
02/16-34-008-28W1/2	05/01/2015	0	0	183	3179
02/16-34-008-28W1/2	06/01/2015	0	0	132	3221
02/16-34-008-28W1/2	07/01/2015	0	0	15	109
02/16-34-008-28W1/2	08/01/2015	0	0	139	3969
02/16-34-008-28W1/2	09/01/2015	8926	112	0	6702
02/16-34-008-28W1/2	10/01/2015	11687	147	0	6540
02/16-34-008-28W1/2	11/01/2015	21722	273	0	6913
02/16-34-008-28W1/2	12/01/2015	17747	223	0	6696
02/16-34-008-28W1/2	01/01/2016	12226	154	0	5835
02/16-34-008-28W1/2	02/01/2016	42167	530	0	7544
02/16-34-008-28W1/2	03/01/2016	583	7	0	6053
02/16-34-008-28W1/2	04/01/2016	0	0	0	5730
02/16-34-008-28W1/2	05/01/2016	40417	508	0	6598
02/16-34-008-28W1/2	06/01/2016	41400	520	0	6993
02/16-34-008-28W1/2	07/01/2016	17180	216	0	6231
02/16-34-008-28W1/2	08/01/2016	753	9	0	5084
02/16-34-008-28W1/2	09/01/2016	9248	116	0	5010
02/16-34-008-28W1/2	10/01/2016	37929	476	0	6279
02/16-34-008-28W1/2	11/01/2016	30312	381	0	6083
02/16-34-008-28W1/2	12/01/2016	49557	622	0	6679
02/16-34-008-28W1/2	01/01/2017	49430	621	0	6779
02/16-34-008-28W1/2	02/01/2017	44522	559	0	6859
02/16-34-008-28W1/2	03/01/2017	44628	560	0	6545
02/16-34-008-28W1/2	04/01/2017	46767	587	0	6639
02/16-34-008-28W1/2	05/01/2017	38946	489	0	6344
02/16-34-008-28W1/2	06/01/2017	45154	567	0	6284
02/16-34-008-28W1/2	07/01/2017	7965	100	0	5283
02/16-34-008-28W1/2	08/01/2017	32895	413	0	5625
02/16-34-008-28W1/2	09/01/2017	36977	464	0	5044
02/16-34-008-28W1/2	10/01/2017	35579	447	0	5886
02/16-34-008-28W1/2	11/01/2017	46994	590	0	5979
02/16-34-008-28W1/2	12/01/2017	48504	609	0	6038
02/16-34-008-28W1/2	01/01/2018	73302	921	0	6557
02/16-34-008-28W1/2	02/01/2018	74581	937	0	6981
02/16-34-008-28W1/2	03/01/2018	89636	1126	0	7126
02/16-34-008-28W1/2	04/01/2018	89378	1122	0	7237
02/16-34-008-28W1/2	05/01/2018	75168	944	0	7033
02/16-34-008-28W1/2	06/01/2018	68383	859	0	6544
02/16-34-008-28W1/2	07/01/2018	16216	204	0	5799
02/16-34-008-28W1/2	08/01/2018	6500	82	0	4637
02/16-34-008-28W1/2	09/01/2018	109522	1375	0	6632
02/16-34-008-28W1/2	10/01/2018	111092	1395	0	7417
02/16-34-008-28W1/2	11/01/2018	110164	1383	0	7457
02/16-34-008-28W1/2	12/01/2018	112025	1407	0	7440

*7.0 MPa @ 30 oC

List of Appendices

Appendix A: Injection Pattern Summary

Appendix B: Injection Pressure Summary

Appendix C: Reservoir Pressure Summary

Appendix A

Ewart Unit No. 5 Injection Pattern Summary as of December 2018

Pattern Name	Injector BH Location (008-28W1)	Injector Surf. Location (008-28W1)	Status	No. of Supported Wells	Supported Wells (008-28W1)	Allocation Factor	Pattern Prod Start Month	Inj Start Month	Oil Rate (sm ³ /d)	Water Rate (sm ³ /d)	WOR (m ³ /m ³)	Water Injection (sm ³ /d)	N2 Injection (rm ³ /d)	N2 Injection (sm ³ /d)	Cum Oil (E ³ m ³)	Cum Water (E ³ m ³)	Cum Inj Water (E ³ m ³)	Cum Inj N2 (rE ³ m ³)	Cum Inj N2 (sE ³ m ³)	Monthly VRR	Cum VRR
00/08-34-008-28W1 Injector	00/08-34	00/05-34	WTR & N2 Injection	2	01-34, 09-34	0.5	Jul 2008	Mar 2015 (Wtr Inj)	0.7	0.9	1.26	17.9	0.0	0.0	20.0	30.8	21.5	6.2	420.4	1.018	0.530
								Feb 2016 (N2 Inj)													
02/16-34-008-28W1 Injector	02/16-34	02/13-34	WTR & N2 Injection	2	09-34,16-34	0.5	Jul 2009	Mar 2015 (Wtr Inj) Sep 2015 (N2 Inj)	0.8	0.6	0.78	0.0	45.4	3062.5	11.9	13.5	0.7	22.1	1488.3	2.998	0.866

Appendix B

Average Monthly Injection Pressure (kPag)

Date	100/08-34	102/16-34
01/01/2015	0	0
02/01/2015	0	0
03/01/2015	19	1
04/01/2015	-77	2180
05/01/2015	-81	3179
06/01/2015	-80	3221
07/01/2015	-78	109
08/01/2015	-79	3969
09/01/2015	-81	6702
10/01/2015	432	6540
11/01/2015	1124	6913
12/01/2015	2025	6696
01/01/2016	2606	5835
02/01/2016	6309	7544
03/01/2016	7235	6053
04/01/2016	6703	5730
05/01/2016	6338	6598
06/01/2016	6358	6993
07/01/2016	6259	6231
08/01/2016	5964	5084
09/01/2016	5874	5010
10/01/2016	6344	6279
11/01/2016	6131	6083
12/01/2016	5922	6679
01/01/2017	6439	6779
02/01/2017	7171	6859
03/01/2017	4612	6545
04/01/2017	2159	6639
05/01/2017	3002	6344
06/01/2017	4161	6284
07/01/2017	3507	5283
08/01/2017	1248	5625
09/01/2017	1463	5044
10/01/2017	1528	5886
11/01/2017	2041	5979
12/01/2017	2718	6038
01/01/2018	4340	6557
02/01/2018	4970	6981
03/01/2018	4929	7126
04/01/2018	4223	7237
05/01/2018	5553	7033
06/01/2018	5397	6544
07/01/2018	5770	5799
08/01/2018	6199	4637
09/01/2018	6210	6632
10/01/2018	6280	7417
11/01/2018	6290	7457
12/01/2018	6275	7440

APPENDIX C

Ewart Unit No. 5 - Pressure Summary

Location	Test Date	Final Pressure (kPaa)	MPP (mTVD)	KB	Datum Depth	Gradient	Pressure @ -450 masl
102/16-34-008-28W1/02	July 29th - Sept 7th, 2014	3402.9	874.9	484.5	-450	8.25	3895