

2019



VERMILION
E N E R G Y



Sinclair Unit No.4 Waterflood Project 2019 Performance Report

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[2019 WATERFLOOD PERFORMANCE REPORT]

Manitoba Mineral Resources requires the annual waterflood performance reports as per Manitoba Petroleum Guideline 11 – Enhanced Oil Recovery (EOR) Annual Report.



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1.0 ANNUAL REPORT

The Sinclair Unit No. 4 is a two section area located in Sections 11 and 14-007-29W1 (referred to as the “project area” or “scheme area”). The waterflood is operated by Vermilion Energy and utilizes two injection patterns in the Three Forks formation. The first waterflood pattern is located in Section 14-007-29W1 and consists of three (3) injectors, three (3) horizontal producers and two (2) vertical producers. Please see below for the wells associated with the first injection pattern:

Injection wells in Section 14-007-29W1:

- 100/13-14-007-29W1/03 HZ
- 100/15-14-007-29W1/00 HZ
- 100/16-14-007-29W1/00 HZ

Production wells in Section 14-007-29W1:

- 100/04-14-007-29W1/00 VT
- 100/09-14-007-29W1/00 HZ
- 100/11-14-007-29W1/00 VT
- 100/14-14-007-29W1/00 HZ
- 102/16-14-007-29W1/00 HZ

The second injection pattern encompasses Section 11-007-29W1 and consists of two (2) horizontal injectors, four (4) horizontal producers, two (2) vertical producers, and one (1) horizontal well which was downhole abandoned in 2016 (100/13-11-007-29W1/00). Please see below for the wells associated with the second injection pattern:

Injection wells in the Section 11-007-29W1:

- 102/02-11-007-29W1/00 HZ
- 100/03-11-007-29W1/00 HZ

Production wells in Section 11-007-29W1:

- 100/01-11-007-29W1/00 HZ
- 100/02-11-007-29W1/00 HZ
- 100/04-11-007-29W1/00 HZ
- 100/06-11-007-29W1/00 VT
- 102/13-11-007-29W1/00 HZ
- 100/14-11-007-29W1/00 VT



Please see Figure 1 below for the project area map displaying the wellbore layouts:

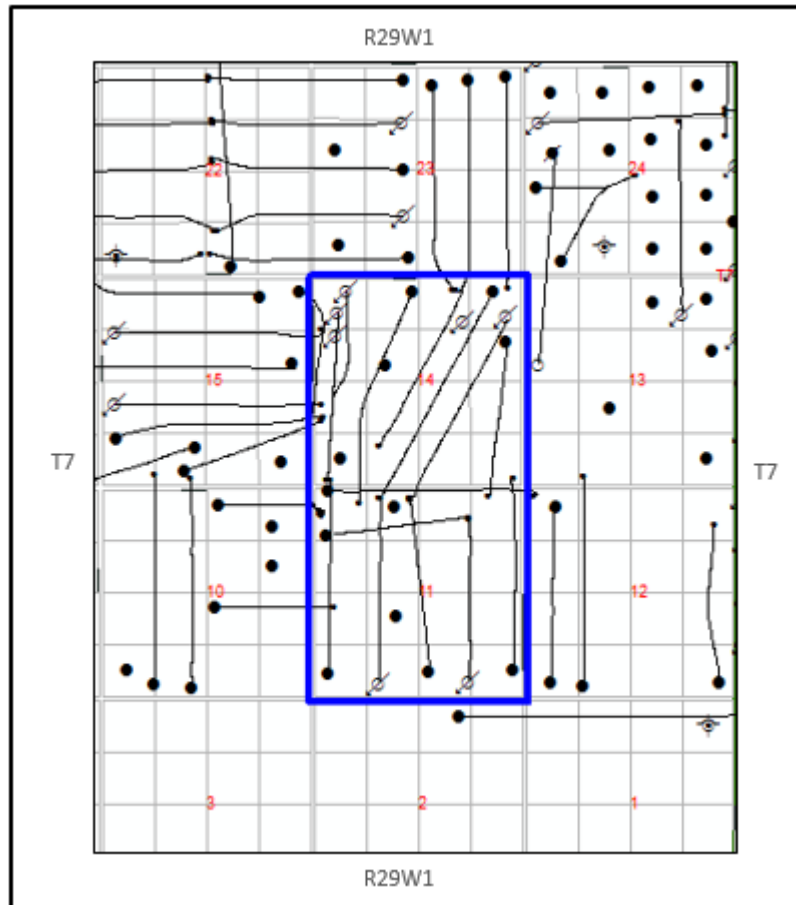


Figure 1: Sinclair Unit No. 4 Map

Unit No. 4 water flood continues to show positive response to water injection since optimization work was performed on the horizontal injection wells in 2017.

The original oil in place (OOIP) for the Sinclair Unit No 4 is estimated to be approximately 1.4 e6m3 (8,551 mstb), of which approximately 8% is recoverable under primary production. To date, the scheme area has produced approximately 71.7 e3m3 of oil, which accounts to approximately 5.1% of OOIP. To date the scheme has injected approximately 201.8 e3m3 of water back into pool.

1.1 OIL PRODUCTION RATE, INJECTION RATE, GOR, & WOR (ANNUAL AND CUMULATIVE)

Detailed production and injection data for the whole project area can be found in Table #1 below and in Attachment 1. The provided data outlines production and injection volumes, instantaneous and cumulative voidage replacement ratios (VRR) and water/oil ratios (WOR) on an annual and cumulative basis.

Table 1: Sinclair Unit #4 Produced Fluids for 2019

Sinclair Unit #4 Produced Fluids

2019 Oil Production m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019	CTD
Pattern #1 Production	33932.65	84.70	75.70	91.90	78.80	87.80	72.00	74.60	73.30	84.30	84.00	81.60	81.20	969.90	34902.55
Pattern #2 Production	35570.06	111.10	105.80	117.10	105.40	98.30	99.50	99.80	105.40	107.70	102.30	106.00	99.80	1258.20	36828.26
Total Oil Production	69502.71	195.80	181.50	209.00	184.20	186.10	171.50	174.40	178.70	192.00	186.30	187.60	181.00	2228.10	71730.81

2019 Water Production m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019	CTD
Pattern #1 Production	73014.40	299.40	230.90	286.30	243.40	302.90	235.50	278.70	244.00	204.10	178.60	174.30	172.80	2850.90	75865.30
Pattern #2 Production	158445.31	910.60	793.90	843.90	761.70	951.90	916.20	906.20	614.80	653.50	651.70	647.90	631.70	9284.00	167729.31
Total Water Production	231459.71	1210.00	1024.80	1130.20	1005.10	1254.80	1151.70	1184.90	858.80	857.60	830.30	822.20	804.50	12134.90	243594.61

Scheme Area WOR	3.33	6.18	5.65	5.41	5.46	6.74	6.72	6.79	4.81	4.47	4.46	4.38	4.44	5.45	3.40
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2019 Water Injection m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019	CTD
Pattern #1 Injection	78514.50	735.20	655.30	676.20	663.60	661.60	647.80	682.80	680.40	669.20	643.10	418.20	407.80	7541.20	86055.70
Pattern #2 Injection	107454.24	639.60	612.80	669.30	679.20	765.00	722.10	696.20	710.40	644.00	665.70	726.60	777.10	8308.00	115762.24
Total Water Injection	185968.74	1374.80	1268.10	1345.50	1342.80	1426.60	1369.90	1379.00	1390.80	1313.20	1308.80	1144.80	1184.90	15849.20	201817.94

Scheme Area VRR	0.62	0.98	1.05	1.00	1.13	0.99	1.04	1.01	1.34	1.25	1.29	1.13	1.20	1.10	0.64
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Overall water-to-oil ratios (WOR) for the unit averaged 5.46 for 2019, which brings the cumulative WOR for the unit to 3.40 at the end of 2019. Injected volumes have shown improvement overall for 2019. Instantaneous VRR for the year averaged 1.12, which has increased the cumulative VRR for the unit to 0.64 at year-end. Overall performance for the unit is represented in both tabular and graphical formats on a monthly and cumulative basis for 2019 (Attachment 1).

Pattern #1: Section 14-007-29W1

As mentioned above, Pattern #1 is found in Section 14. The section's WOR fluctuated throughout the year, ranging from 2.13 to 3.74. WOR for the year averaged 2.95, resulting in the cumulative WOR of 2.17 to date. VRR ranged from 1.61 to 2.45 throughout the year. Average VRR for 2019 is 1.98, resulting in the cumulative VRR to increase from 0.73 at the beginning of the year to 0.78 at the end of the year. Please refer to Table 2 below and Attachment 2 for the graphical data.



Table 2: Production Volumes for Pattern #1

Sinclair Unit #4 Produced Fluids: Pattern #1 Sec 14-7-29W1M

	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019	CTD
Oil Production m3/month	33932.65	84.70	75.70	91.90	78.80	87.80	72.00	74.60	73.30	84.30	84.00	81.60	81.20	969.90	34902.55
Water Production m3/month	73014.40	299.40	230.90	286.30	243.40	302.90	235.50	278.70	244.00	204.10	178.60	174.30	172.80	2850.90	75865.30
Water Injection m3/month	78514.50	735.20	655.30	676.20	663.60	661.60	647.80	682.80	680.40	669.20	643.10	418.20	407.80	7541.20	86055.70
Pattern #1 WOR	2.20	3.53	3.05	3.12	3.09	3.45	3.27	3.74	3.33	2.42	2.13	2.14	2.13	2.94	2.17
Pattern #1 VRR	0.78	1.91	2.14	1.79	2.06	1.69	2.11	1.93	2.14	2.32	2.45	1.63	1.61	1.97	0.78

Pattern #2: Section 11-007-29W1

The second waterflood pattern is found in Section 11-07-029W1. The section's WOR fluctuated throughout the year, ranging from 5.83 to 9.68. WOR for the year averaged 7.4, resulting in the cumulative WOR of 4.55 to date. VRR for the section ranged from 0.63 to 0.99 throughout the year. Average VRR for 2019 is 0.79, resulting in the cumulative VRR to increase from 0.55 at the beginning of the year to 0.57 at the end of the year. Please refer to Table 3 below and Attachment 3 for the graphical data.

Table 3: Production Volumes for Pattern #2

Sinclair Unit #4 Produced Fluids: Pattern #2 Sec 11-7-29W1M

	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019	CTD
2019 Oil Production m3/month	35570.1	111.1	105.8	117.1	105.4	98.3	99.5	99.8	105.4	107.7	102.3	106.0	99.8	1258.2	36828.3
2019 Water Production m3/month	158445.3	910.6	793.9	843.9	761.7	951.9	916.2	906.2	614.8	653.5	651.7	647.9	631.7	9284.0	167729.3
2019 Water Injection m3/month	107454.2	639.6	612.8	669.3	679.2	765.0	722.1	696.2	710.4	644.0	665.7	726.6	777.1	8308.0	115762.2
Pattern #2 WOR	4.56	8.20	7.50	7.21	7.23	9.68	9.21	9.08	5.83	6.07	6.37	6.11	6.33	7.38	4.55
Pattern #2 VRR	0.57	0.63	0.68	0.70	0.78	0.73	0.71	0.69	0.99	0.85	0.88	0.96	1.06	0.79	0.57

1.2 MONTHLY WELLHEAD INJECTION PRESSURE

Please refer to Attachment 4 for production plots showing injection rate vs pressure for each injection well for 2019, and Attachment 5 for the monthly average rate and pressure data.

1.3 SURVEY OF RESERVOIR PRESSURE

There were no pressure surveys executed in Unit No. 4 in 2019.

1.4 WELL SERVICING

The only well servicing that occurred in 2019 resulted from routine pump changes. No other servicing operations were completed within Unit in 2019.



1.5 METHOD OF QUALITY CONTROL AND TREATMENT

Injection water for Sinclair Unit No. 04 is sourced from the Mannville formation via the 100/14-09-007-29W1 water source well. The 100/14-09 source well is pipeline connected to Vermilion's 08-16 facility. At 08-16, injection water is filtered to 1 micron nominal remaining particulate through two six-bag canister filters and injected down the 5 unit injection wells. All water is treated with scale inhibitor and biocide.

2.0 ATTACHMENTS

Attachment 1: Produced Fluids for Whole Waterflood Project (Tabular and Graphical)

Attachment 2: Produced Fluids for Pattern #1 of the Waterflood Project (Tabular and Graphical)

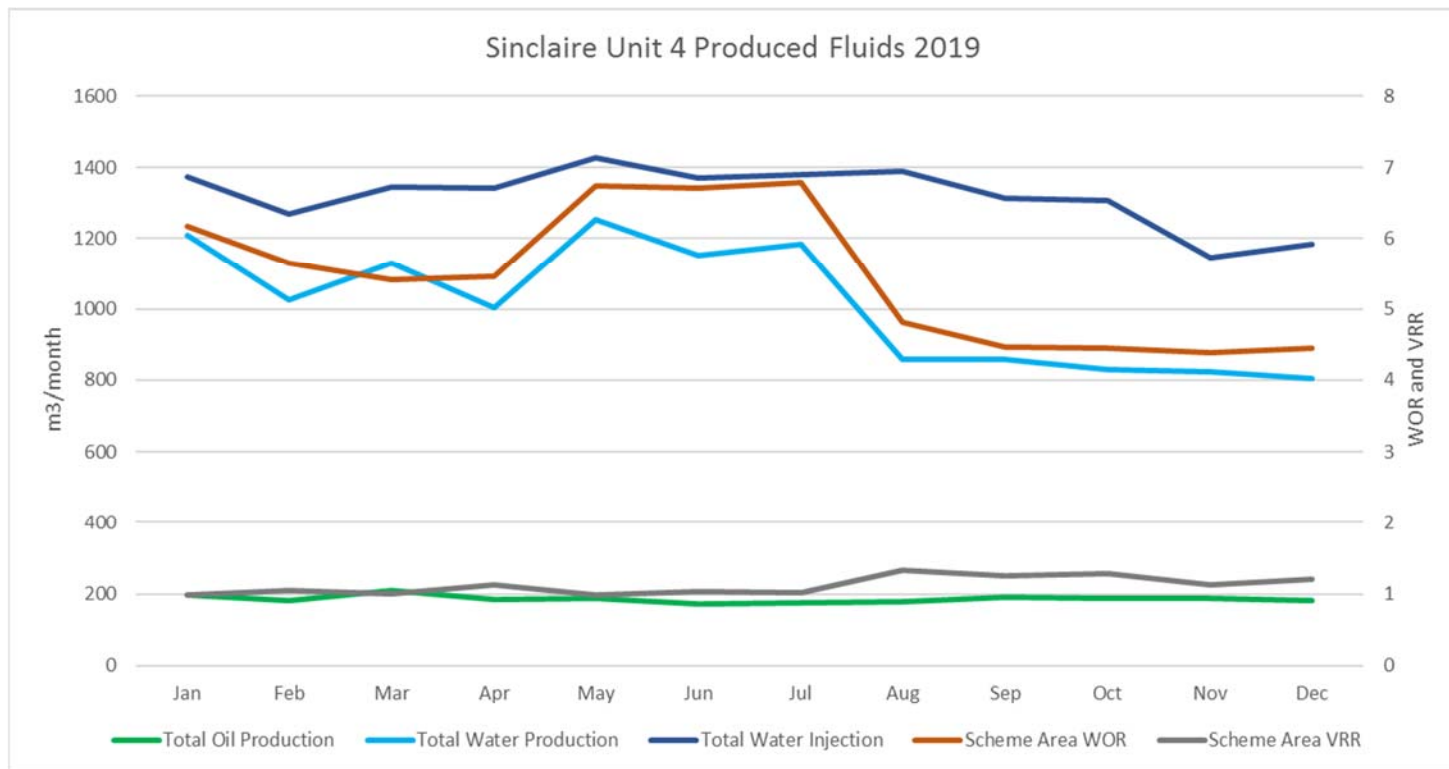
Attachment 3: Produced Fluids for Pattern #2 of the Waterflood Project (Tabular and Graphical)

Attachment 4: Injection Rate Vs Pressure for Injection Wells

Attachment 5: Monthly Average Rate and Pressure Data



ATTACHMENT 1: PRODUCED FLUIDS FOR WHOLE WATERFLOOD PROJECT (TABULAR AND GRAPHICAL)



Sinclair Unit #4 Produced Fluids

2019 Oil Production m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019	CTD
Pattern #1 Production	33932.65	84.70	75.70	91.90	78.80	87.80	72.00	74.60	73.30	84.30	84.00	81.60	81.20	969.90	34902.55
Pattern #2 Production	35570.06	111.10	105.80	117.10	105.40	98.30	99.50	99.80	105.40	107.70	102.30	106.00	99.80	1258.20	36828.26
Total Oil Production	69502.71	195.80	181.50	209.00	184.20	186.10	171.50	174.40	178.70	192.00	186.30	187.60	181.00	2228.10	71730.81

2019 Water Production m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019	CTD
Pattern #1 Production	73014.40	299.40	230.90	286.30	243.40	302.90	235.50	278.70	244.00	204.10	178.60	174.30	172.80	2850.90	75865.30
Pattern #2 Production	158445.31	910.60	793.90	843.90	761.70	951.90	916.20	906.20	614.80	653.50	651.70	647.90	631.70	9284.00	167729.31
Total Water Production	231459.71	1210.00	1024.80	1130.20	1005.10	1254.80	1151.70	1184.90	858.80	857.60	830.30	822.20	804.50	12134.90	243594.61

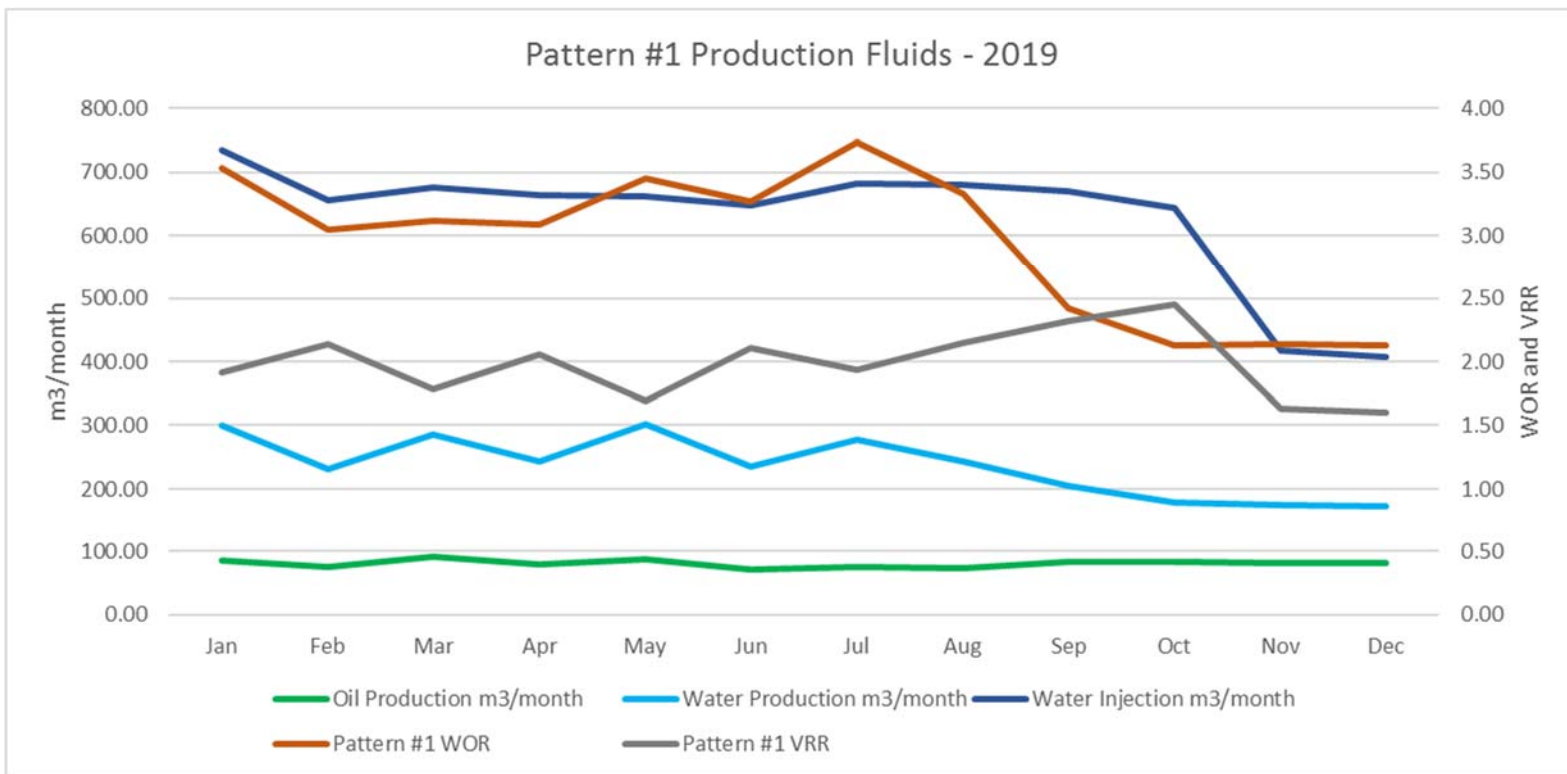
Scheme Area WOR	3.33	6.18	5.65	5.41	5.46	6.74	6.72	6.79	4.81	4.47	4.46	4.38	4.44	5.45	3.40
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2019 Water Injection m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019	CTD
Pattern #1 Injection	78514.50	735.20	655.30	676.20	663.60	661.60	647.80	682.80	680.40	669.20	643.10	418.20	407.80	7541.20	86055.70
Pattern #2 Injection	107454.24	639.60	612.80	669.30	679.20	765.00	722.10	696.20	710.40	644.00	665.70	726.60	777.10	8308.00	115762.24
Total Water Injection	185968.74	1374.80	1268.10	1345.50	1342.80	1426.60	1369.90	1379.00	1390.80	1313.20	1308.80	1144.80	1184.90	15849.20	201817.94

Scheme Area VRR	0.62	0.98	1.05	1.00	1.13	0.99	1.04	1.01	1.34	1.25	1.29	1.13	1.20	1.10	0.64
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ATTACHMENT 2: PRODUCED FLUIDS FOR PATTERN #1 OF THE WATERFLOOD PROJECT (TABULAR AND GRAPHICAL)

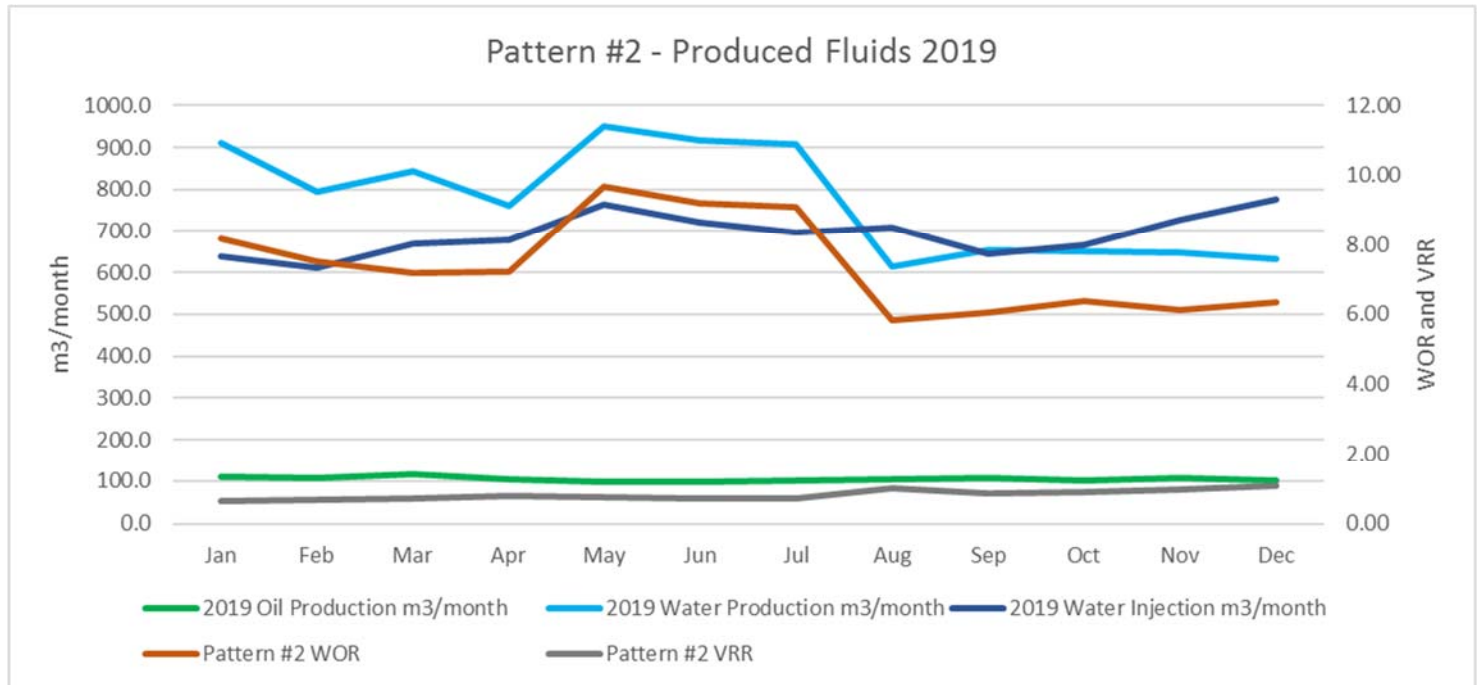


Sinclair Unit #4 Produced Fluids: Pattern #1 Sec 14-7-29W1M

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oil Production m3/month	84.70	75.70	91.90	78.80	87.80	72.00	74.60	73.30	84.30	84.00	81.60	81.20
Water Production m3/month	299.40	230.90	286.30	243.40	302.90	235.50	278.70	244.00	204.10	178.60	174.30	172.80
Water Injection m3/month	735.20	655.30	676.20	663.60	661.60	647.80	682.80	680.40	669.20	643.10	418.20	407.80
Pattern #1 WOR	3.53	3.05	3.12	3.09	3.45	3.27	3.74	3.33	2.42	2.13	2.14	2.13
Pattern #1 VRR	1.91	2.14	1.79	2.06	1.69	2.11	1.93	2.14	2.32	2.45	1.63	1.61



ATTACHMENT 3: PRODUCED FLUIDS FOR PATTERN #2 OF THE WATERFLOOD PROJECT (TABULAR AND GRAPHICAL)

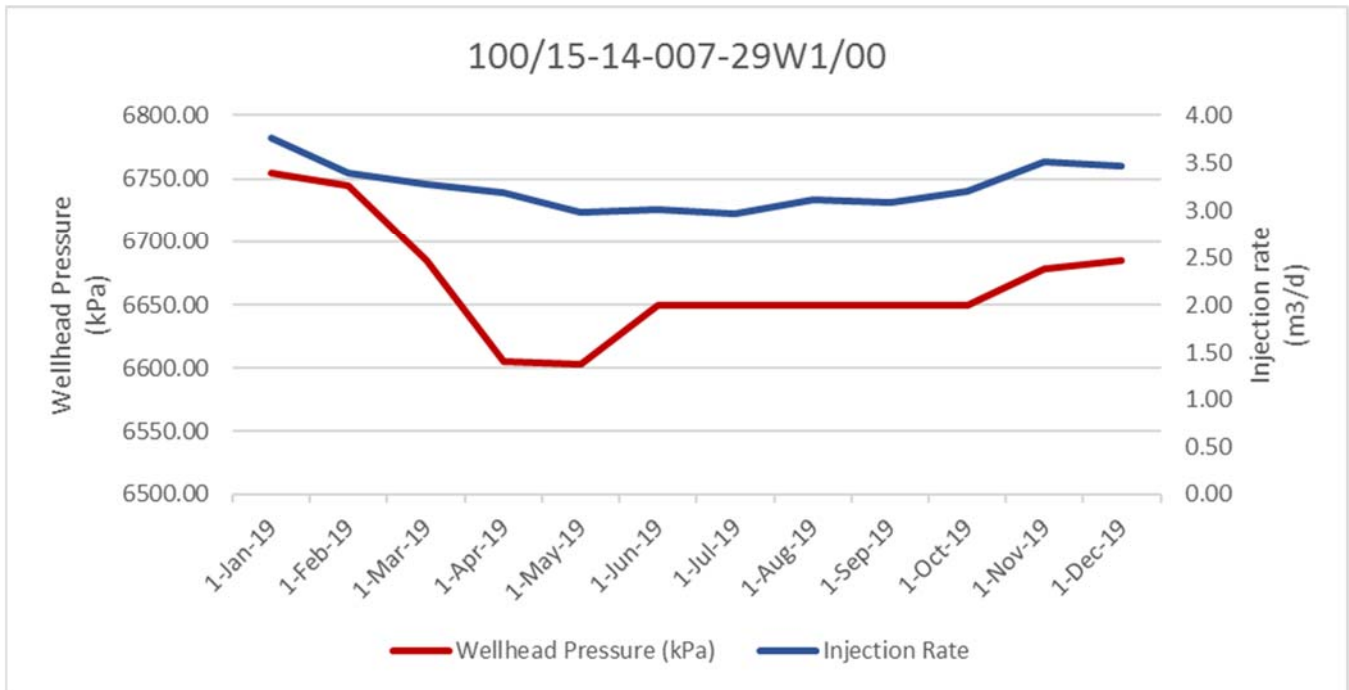
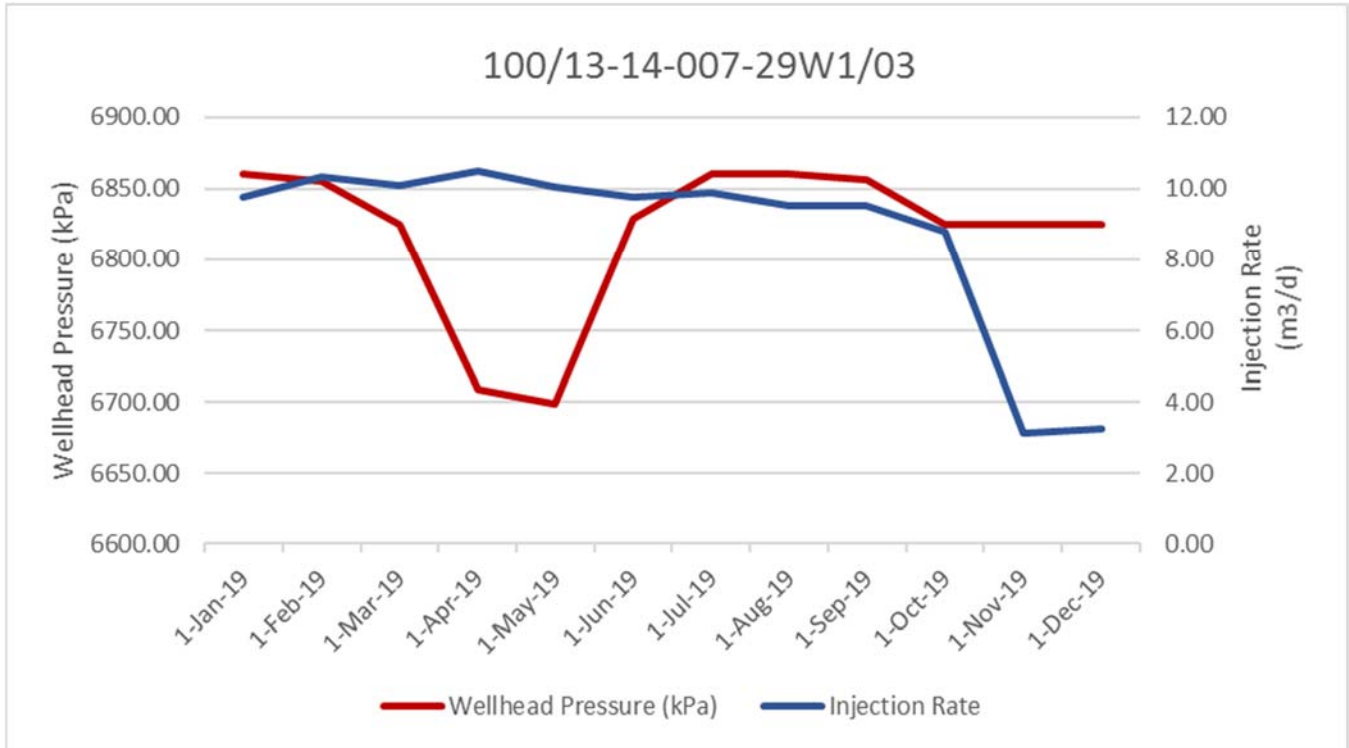


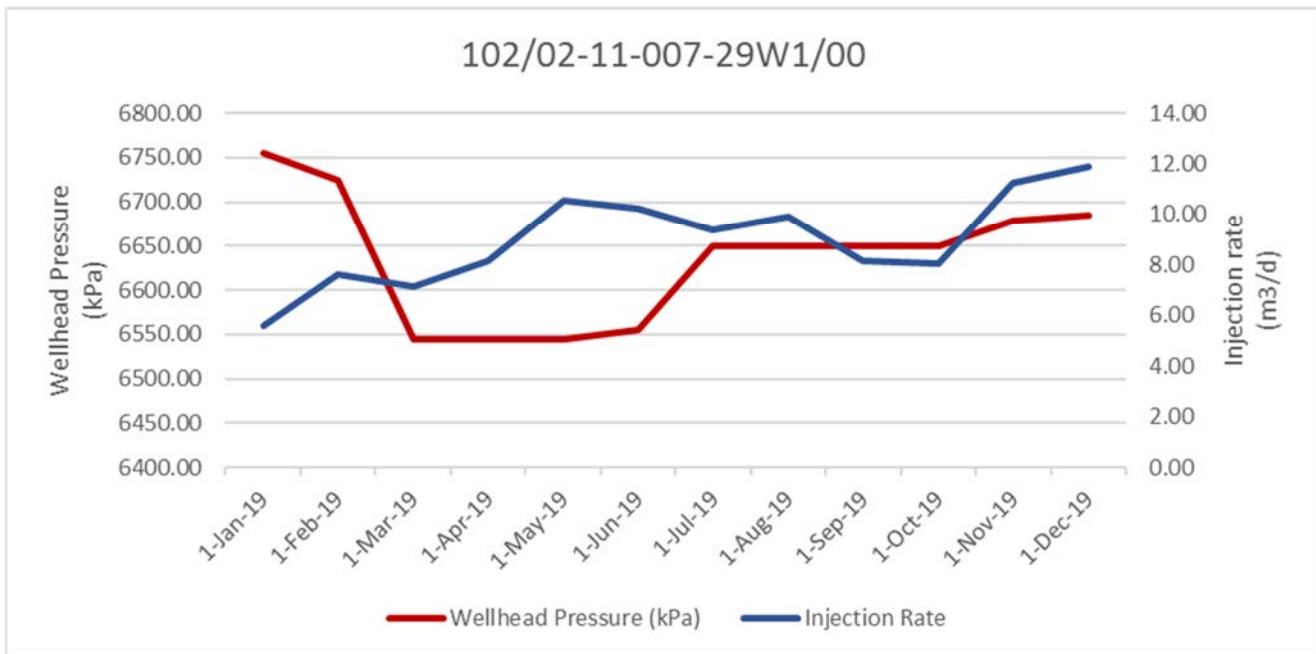
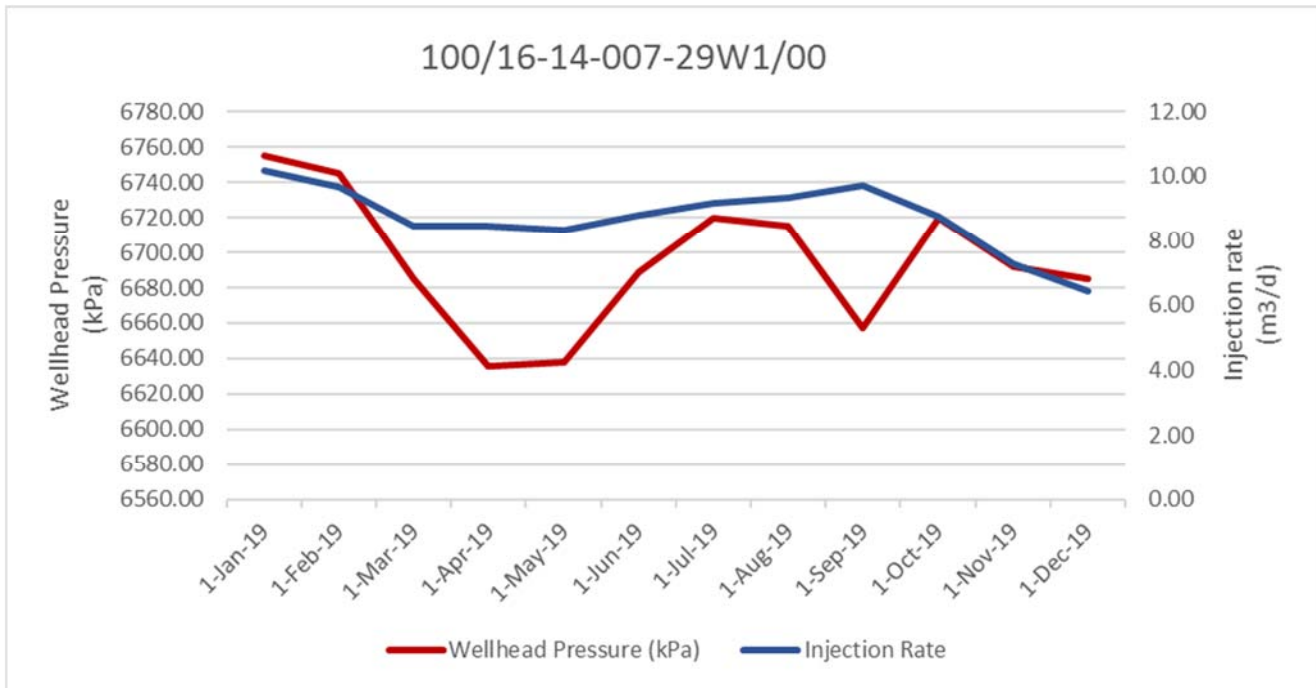
Sinclair Unit #4 Produced Fluids: Pattern #2 Sec 11-7-29W1M

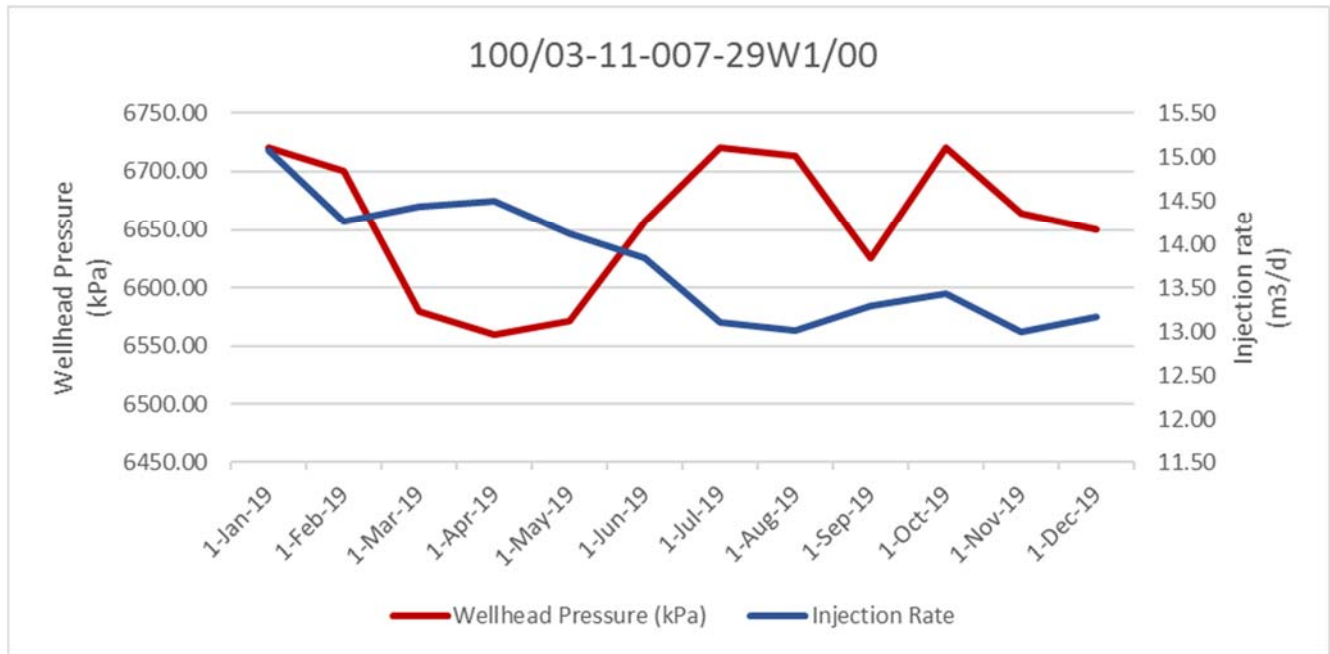
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019 Oil Production m3/month	111.1	105.8	117.1	105.4	98.3	99.5	99.8	105.4	107.7	102.3	106.0	99.8
2019 Water Production m3/mont	910.6	793.9	843.9	761.7	951.9	916.2	906.2	614.8	653.5	651.7	647.9	631.7
2019 Water Injection m3/month	639.6	612.8	669.3	679.2	765.0	722.1	696.2	710.4	644.0	665.7	726.6	777.1
Pattern #2 WOR	8.20	7.50	7.21	7.23	9.68	9.21	9.08	5.83	6.07	6.37	6.11	6.33
Pattern #2 VRR	0.63	0.68	0.70	0.78	0.73	0.71	0.69	0.99	0.85	0.88	0.96	1.06



ATTACHMENT 4: INJECTION RATE VS PRESSURE FOR INJECTION WELLS







ATTACHMENT 5: MONTHLY AVERAGE RATE AND PRESSURE DATA

Sinclair Unit #4 Monthly Average Injection Data

Pattern #1 Monthly Averages	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
00/13-14 Injection Rate (m3/d)	3.77	3.40	3.27	3.18	2.98	3.01	2.96	3.11	3.08	3.20	3.51	3.47
00/13-14 Injection Pressure (kPa)	6754.93	6745.01	6683.02	6605.66	6602.56	6630.00	6630.00	6630.00	6630.00	6630.00	6677.99	6685.09
00/16-14 Injection Rate (m3/d)	10.19	9.66	8.47	8.44	8.33	8.80	9.17	9.32	9.70	8.74	7.30	6.43
00/16-14 Injection Pressure (kPa)	6755.00	6744.94	6683.02	6636.00	6637.59	6688.47	6719.98	6715.43	6637.03	6719.98	6692.05	6684.95
00/13-14 Injection Rate (m3/d)	10.19	9.66	8.47	8.44	8.33	8.80	9.17	9.32	9.70	8.74	7.30	6.43
00/13-14 Injection Pressure (kPa)	6860.01	6854.98	6824.99	6708.81	6699.02	6828.50	6860.01	6860.01	6856.49	6824.99	6824.99	6824.99

Pattern #2 Monthly Averages	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
02/2-11 Injection Rate (m3/d)	5.56	7.63	7.16	8.15	10.55	10.23	9.36	9.90	8.17	8.05	11.23	11.91
02/2-11 Injection Pressure (kPa)	6755.00	6724.94	6544.99	6544.99	6544.99	6555.47	6630.00	6630.00	6630.00	6630.00	6677.99	6685.02
00/3-11 Injection Rate (m3/d)	15.07	14.25	14.43	14.49	14.13	13.84	13.10	13.01	13.30	13.43	12.99	13.16
00/3-11 Injection Pressure (kPa)	6719.98	6699.98	6580.01	6559.88	6571.88	6637.03	6719.98	6713.22	6625.52	6719.98	6663.99	6630.00

