Results of 3 Layer Reservoir Simulation Study – Schaben Field, Ness County, Kansas

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Open File Report – 2000-78
Kansas Geological Survey

Results of 3 Layer Reservoir Simulation Study – Schaben Field, Ness County, Kansas

The Schaben field is located in Ness County, Kansas. A detailed reservoir characterization and simulation study was carried out in the northern part of the field under a project funded by DOE's Class 2 program (under contract DE-FC22-93BC14987). The Schaben demonstration site consists of 1720 contiguous acres within the Schaben field and spreads over Sections 19, 29, 30, 31 and 32 in Range 21W/Township 19S and over Sections 23, 24, 25, 26, 35 and 36 in Range 22W/Township 19S (Figure A1, Appendix A). The objective of this study was to improve reservoir performance of mature oil fields, located in shallow shelf carbonate reservoirs of the Midcontinent, by demonstrating the application of cost-effective tools and techniques to characterize and simulate the reservoir.

The initial study included analyses and integration of geologic data, production data, and petrophysical log and core data to develop a reservoir geomodel. This geomodel formed the basis for a two-layer reservoir simulation study using DOE's BOAST3 simulator. Results of this study available over the Internet at http://www.kgs.ukans.edu/Class2/index.html and http://www.kgs.ukans.edu/DPA/Schaben/schabenMain.html. This initial study was followed by second simulation study (using DOE's BOAST4 simulator) where the reservoir was described by two layers with an underlying bottom aquifer forming the third layer.

Background of the simulation study

A sedimentologic and diagenetic study[1], using cores from the Schaben field, revealed that the reservoir-strata were deposited on a ramp. The basal stratum (MO) consists of normal to somewhat restricted marine strata. The MO stratum has an abundance of echinoderm-rich facies with a diverse fauna. The upper strata (M1) was mainly made up of sponge spicule-rich facies that contained silicified original evaporite minerals. An internal unconformity, a subaerial exposure event, separates MO strata from M1. The post Mississippian unconformity caps the entire sequence. The best reservoir was found to be the sponge spicule-rich wackestone/packstone facies (SWP) with replaced evaporites. Echinoderm-rich wacke-packstones (EWPG) were also found to form locally important reservoir facies. However, EWPG facies that are dominant in the MO unit are not likely to result in favorable reservoirs because processes associated with M1 unit lead to the occlusion of its porosity.

The reservoir volume constructed for the simulation study was therefore made up of two layers, layer 1 conforming to M1 strata and layer 2 conforming to the MO strata. Within the simulation input-data, the major difference in petrophysical properties for layers 1 and 2 was in their respective net to gross ratio. The ratio-value assigned to layer 1 was 0.8 while that for layer 2 was 0.5. During the course of history matching, the net to gross

ratio for some of the wells had to be changed from this initial assumption to obtain a reasonable match with the production/pressure history.

Input data

Figure A1 shows the study-area (Schaben field) that was simulated in BOAST4 along with the location of the wells. The grid cell dimensions used was 220 ft by 220 ft. Table 1 shows the cell addresses related to each well within the study area and also the corresponding name given for each well to display the output results from the simulation.

Appendix A contains plots showing the distribution of various gridded parameters that were used in this simulation study. Figures A1 and A2 show the gross isopachs maps of layer 1 and layer 2. Figures A3 and A4 show the final net isopach maps obtained at the end of the history matching. In the absence of additional data, the effective porosity for both M1 and MO was assumed to be the same (Figure A5). The distribution of horizontal permeability-feet for layers M1 and MO is shown in Figures A6 and A7, while the vertical permeability for these two layers are displayed in Figures A8 and A9. The distribution of initial reservoir pressure (1963) is shown in Figure A10. Initial oil saturation (1963) within the effective porosity of M1 and MO is shown in Figures A11.

The PVT data, relative permeability and capillary pressure data and the well data entered into the input file were the same as used in the two layer simulation study[2] in BOAST3.

Results of history matching

Appendix B shows the results of the history match that was obtained at each well. The oil production at each well was entered into the simulator for the first 11 years and the simulator calculated the corresponding water production during this time and also calculated the corresponding bottom hole pressure. This calculated bottom hole pressure, at the end of the 11^{th} year, was input for each well for the simulator to calculate both the oil and water production during the remaining period of the production life of each well (till December 1995). Current fluid level data was available for most wells and was used to calculate the current bottom hole pressure. In the absence of a recorded history of pressure measurements, the bottom pressure was varied between that at the end of the 11^{th} year and the current pressure to attaining a history match at each well.

Appendix C consists of maps showing the distribution of remaining potential in Schaben field as of 1995. Figures C1 and C2 show the residual oil saturation (December 1995), obtained from the simulation output after the history match at the well level, in M1 and MO. Figure C3 maps the remaining areas with the best potential, as of December 1995, for infill drilling in the Schaben field. The areas shown in color on the map have remaining oil saturation of at least 40% and a net pay greater than 20 feet. Based on the remaining potential map, the various operators of the Schaben field drilled 22 infill wells between 1996 and 1998.

Results of performance prediction of infill wells

Appendix C compares the performance, as predicted by the simulation model, of the infill wells with the production data recorded at each of the infill well during the first few months of their lives.

References:

1) Improved Oil Recover in Mississippian Carbonate Reservoirs of Kansas – Near Term – Class 2. DOE/BC/14987-12. Annual Report – January 1, 1998 to December 31, 1998 by Carr. T.R., Green, D.W., and Willhite, G.P.
2) Improved Oil Recover in Mississippian Carbonate Reservoirs of Kansas – Near Term – Class 2. DOE/BC/14987-10. Annual Report – September 18, 1994 to March 15, 1997 by Carr. T.R., Green, D.W., and Willhite, G.P.

Table 1				
Name code	**Well name**	**Well No**	**Cell Address - X**	**Cell Address - Y**
'19-41'	Witman 2	26	40	10
'19-42'	Witman 1	28	46	10
'19-43'	Gneich 1	20	52	10
'19R41'	Wittman 4	66	42	12
'19R42'	Wittman 5	67	44	12
'19R43'	Gneich P1 Twin	65	50	12
'19S41'	Wittman 6 (add correction reqd)	70	39	12
'23-44'	Gillig A2	37	10	10
'24-41'	Gillig B1	33	16	10
'24-42'	Gillig 1-24	44	20	12
'25-11'	Borger 4	35	16	16
'25-12'	Borger A2	19	22	17
'25-13'	Borger 2	13	28	16
'25-14'	Borger 2	18	34	16
'25-21'	Borger 1 & 3	31	16	22
'25-22'	Borger A1	8	22	22
'25-23'	Borger 1	9	28	22
'25-24'	Borger 1	17	34	22
'25-31'	Wagner 4	46	17	28
'25-32'	Dora Wagner 1	6	22	28
'25-33'	Humburg 1	5	28	28
'25-34'	Humburg A1	10	33	28
'25-41'	Wagner 5	47	17	33
'25-42'	Dora Wagner 3	11	22	34
'25-43'	Humburg 2	7	28	34
'25-44'	Humburg 2A	14	34	34
'25R11'	Borger 2	42	16	19
'25R13'	Borger 4	59	29	19
'25R14'	Borger 3 (one up)	55	32	18
'25R21'	Borger 3	48	17	24
'25R23'	Borger 3	62	29	24
'25R33'	Humburg 4	54	29	27
'25R34'	Humburg 1-X	43	34	28
'25R43'	Humburg 3	45	28	36
'25R44'	Humburg AP 3	53	32	32
'25S14'	Borger 4	63	35	20
'25S34'	Humburg 2X	64	32	27
'26-24'	Robert B Lent 1	38	10	22
'26-34'	Gillig 1	40	10	28
'26R34'	Gillig 1-26	68	11	26
'29-11'	Rein A4	36	64	16
'29-22'	Rein A5	39	69	22
'29-31'	Rein A1	4	64	28
'29-41'	Rein A2	23	65	36
'29R31'	Rein AP 7	56	62	31
'30-11'	Moore D2	21	39	17
'30-12'	Moore D3	22	45	17
'30-13'	Moore B4	25	51	16
'30-14'	Moore B6	34	57	16
'30-21'	Moore D1	15	39	23
'30-22'	Moore D4	27	45	22
'30-23'	Moore B5	29	51	22
'30-24'	Moore 3-30	60	56	21
'30-31'	Moore C2	16	39	28
'30-32'	Moore C3	41	45	28
'30-33'	Moore B2	3	51	28
'30-34'	Moore B3	51	59	30
'30-41'	Moore 1-30	61	38	33
'30-42'	Moore C1	2	45	34
'30-44'	Moore B1	1	57	34
'30R11'	Moore DP 6	52	42	15
'30R12'	Moore DP 5	57	46	15
'30R13'	Moore BP Twin - to right	49	51	16
'30S32'	Moore CP 4	58	43	26
'31-14'	Lyle Schaben 2P	50	59	39
'36-11'	Anna Williams 3	32	16	40
'36-12'	Anna Williams 1	24	22	40
'36-13'	HL Williams Est 1	12	28	40
'36-21'	Anna Williams 2	30	16	46
'36R12'	William 6	69	23	38

Appendix A

Results of 3 Layer Reservoir Simulation Study – Schaben Field, Ness County, Kansas

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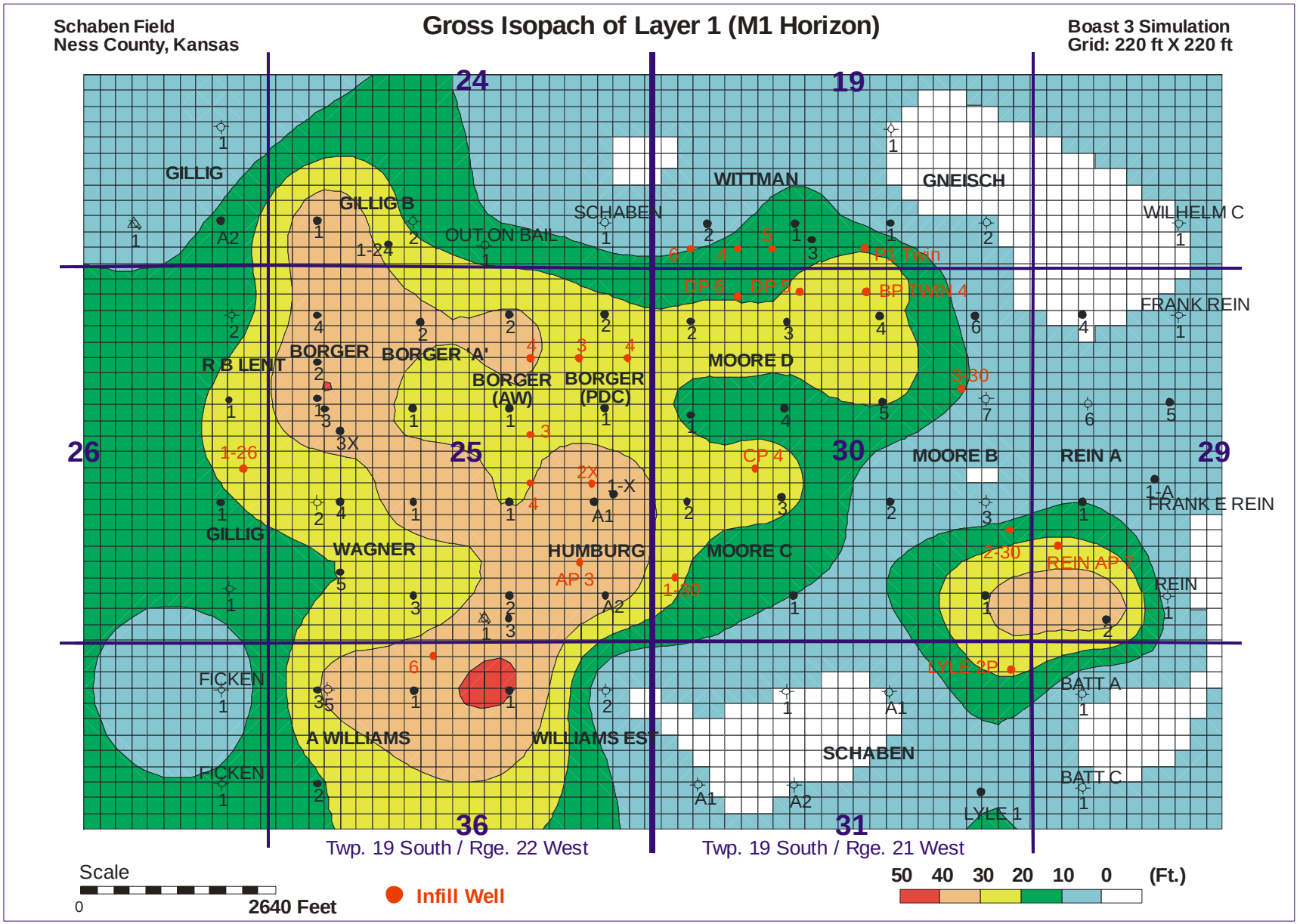
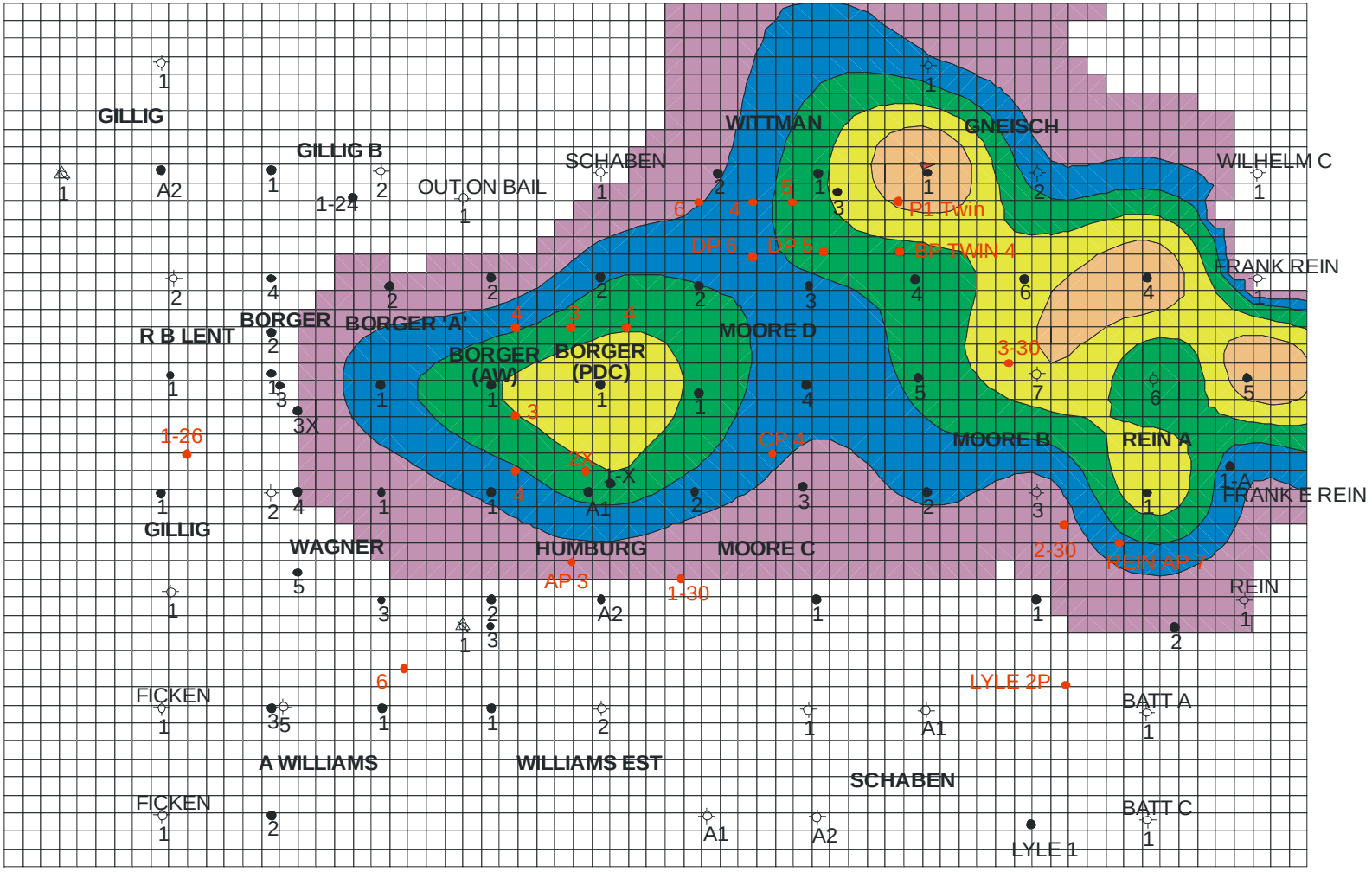

Schaben Field
Ness County, Kansas
Gross Isopach of Layer 1 (M1 Horizon)
Boast 3 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
OUT ON BAIL
SCHABEN
WITTMAN
GNEISCH
WILHELM C
FRANK REIN
R B LENT
BORGER
BORGER 'A'
BORGER (AW)
BORGER (PDC)
MOORE D
MOORE B
REIN A
FRANK E REIN
REIN
GILLIG
WAGNER
HUMBURG
MOORE C
REIN AP 7
FICKEN
A WILLIAMS
WILLIAMS EST
SCHABEN
BATT A
BATT C
LYLE 2P
LYLE 1
1-24
1-26
3X
2X
1-X
AP 3
1-30
2-30
3-30
CP 4
DP 6
DP 5
BP TWIN 4
P1 Twin
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
Infill Well
50 40 30 20 10 0 (Ft.)

Figure A1

Schaben Field
Ness County, Kansas

Gross Isopach of Layer 2 (M0 Horizon)

Boast 4 Simulation
Grid: 220 ft X 220 ft



Scale
0 2640 Feet

Infill Well

35 30 25 20 15 10 5 0 (Ft.)

Figure: A2

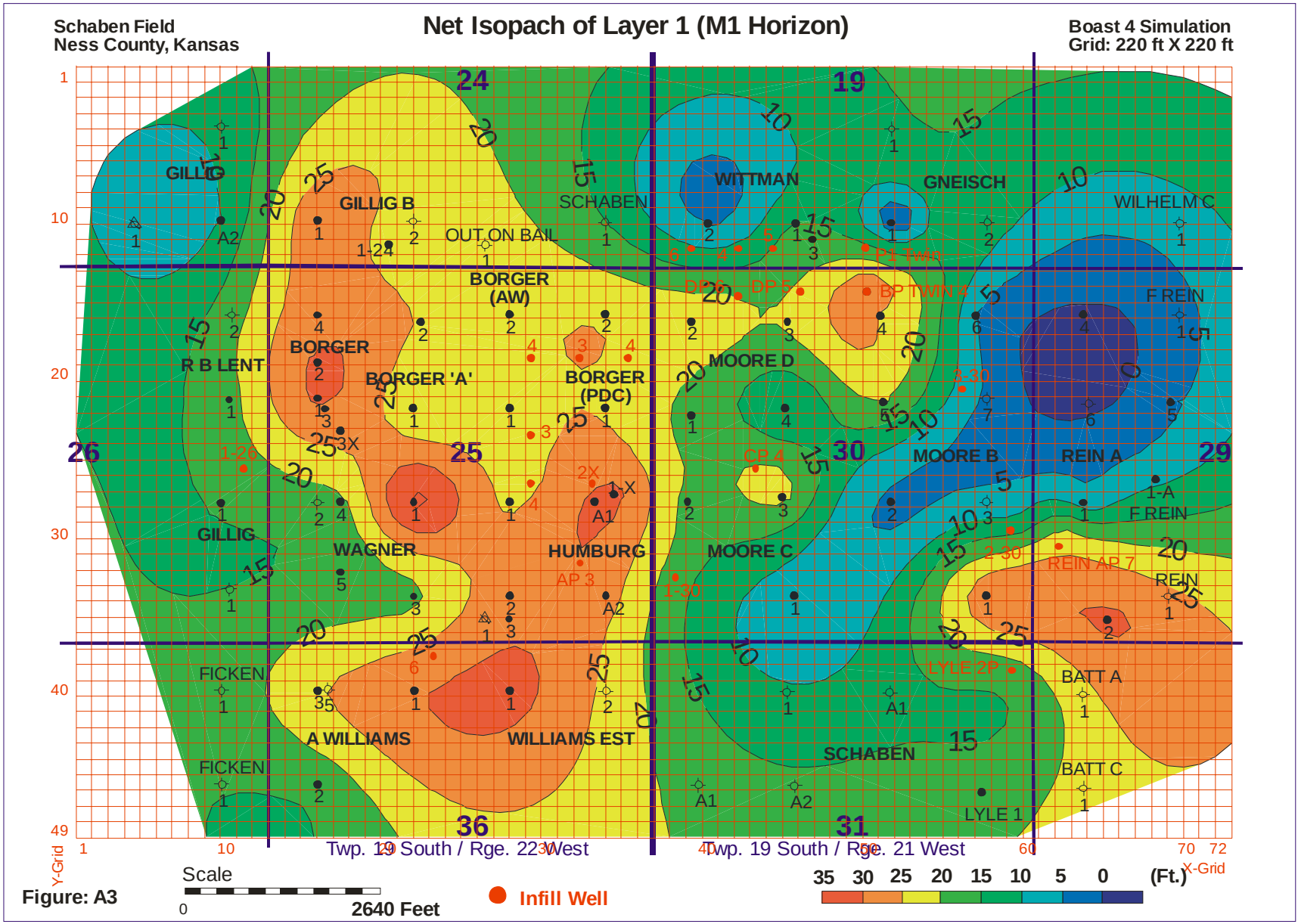

Schaben Field
Ness County, Kansas
Net Isopach of Layer 1 (M1 Horizon)
Boast 4 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
OUT ON BAIL
SCHABEN
WITTMAN
GNEISCH
WILHELM C
BORGER (AW)
BORGER
R B LENT
BORGER 'A'
BORGER (PDC)
MOORE D
F REIN
MOORE B
REIN A
1-A F REIN
GILLIG
WAGNER
HUMBURG
MOORE C
REIN
FICKEN
A WILLIAMS
WILLIAMS EST
SCHABEN
BATT A
BATT C
FICKEN
LYLE 1
1-24
1-26
1-30
3-30
2-30
REIN AP 7
LYLE 2P
DP 5
BP TWIN 4
CP 4
AP 3
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Y-Grid
X-Grid
Scale
0
2640 Feet
Infill Well
35 30 25 20 15 10 5 0 (Ft.)

Figure: A3

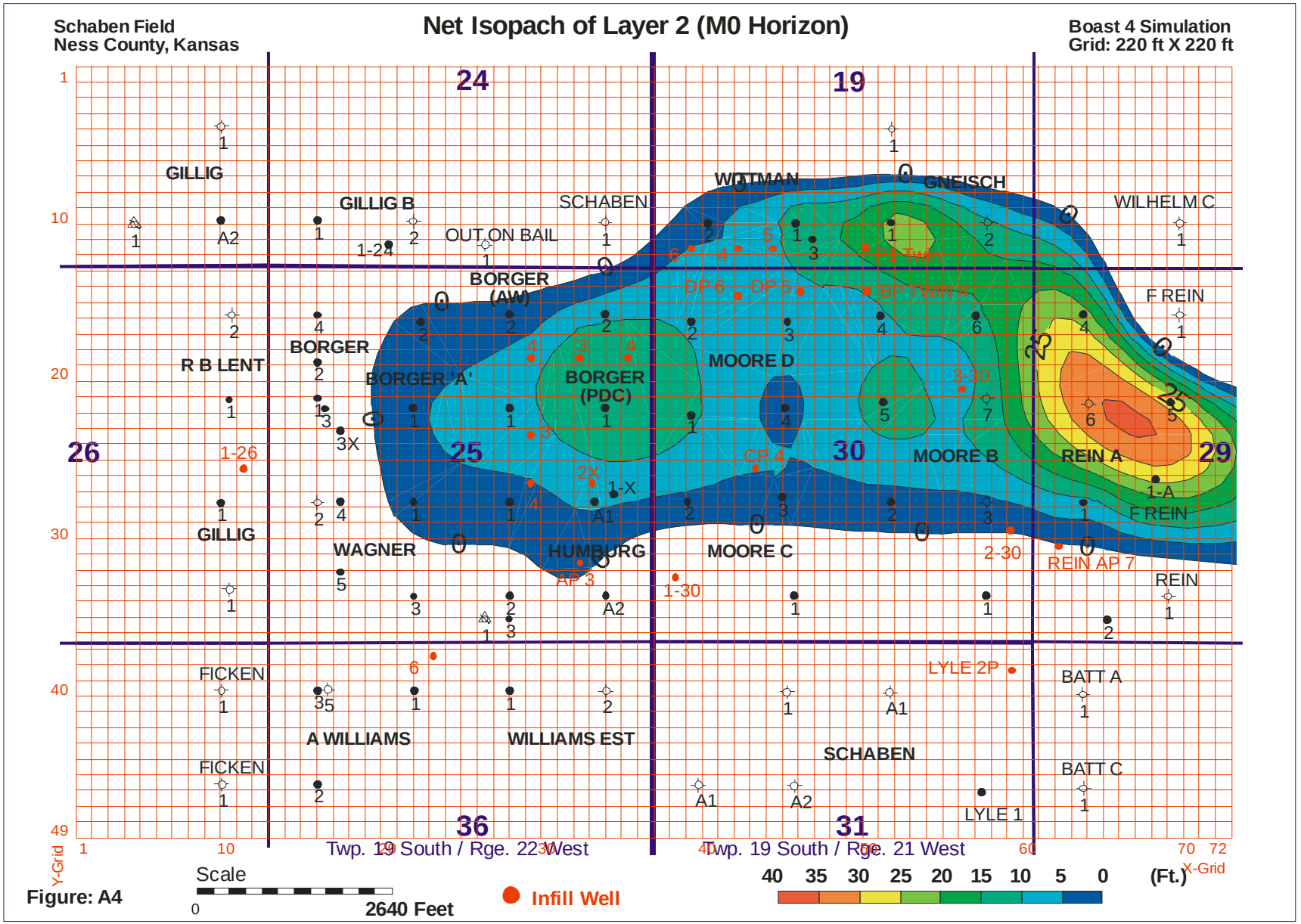

Schaben Field
Ness County, Kansas
Net Isopach of Layer 2 (M0 Horizon)
Boast 4 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
SCHABEN
WATMAN
GNEISCH
WILHELM C
OUT ON BAIL
1-24
BORGER (AW)
F REIN
R B LENT
BORGER
BORGER 'A'
BORGER (PDC)
MOORE D
1-26
3X
MOORE B
REIN A
1-A
F REIN
GILLIG
WAGNER
HUMBURG
MOORE C
2-30
REIN AP 7
REIN
1-30
FICKEN
LYLE 2P
BATT A
A WILLIAMS
WILLIAMS EST
SCHABEN
FICKEN
BATT C
LYLE 1
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Y-Grid
X-Grid
Scale
0
2640 Feet
Infill Well
40 35 30 25 20 15 10 5 0 (Ft.)

Figure: A4

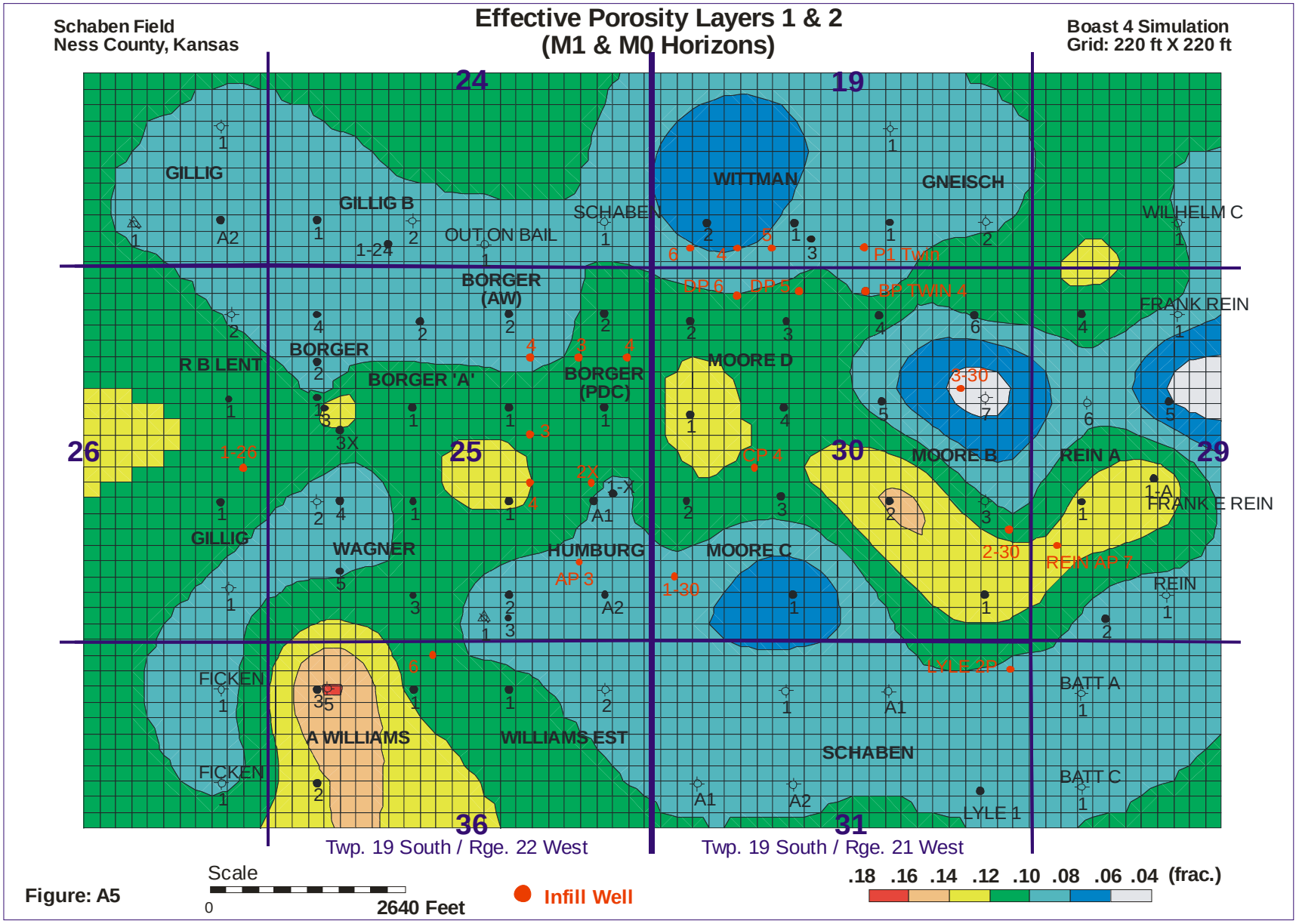

Schaben Field
Ness County, Kansas
Effective Porosity Layers 1 & 2
(M1 & M0 Horizons)
Boast 4 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
WITTMAN
GNEISCH
WILHELM C
SCHABEN
OUT ON BAIL
1-24
BORGER
(AW)
DP 6
DP 5
DP TWIN 4
FRANK REIN
R B LENT
BORGER
BORGER 'A'
BORGER
(PDC)
MOORE D
3-30
1-26
CP 4
MOORE B
REIN A
1A
FRANK E REIN
2X
1-X
A1
GILLIG
WAGNER
HUMBURG
AP 3
MOORE C
2-30
REIN AP 7
1-30
A2
REIN
LYLE 2P
FICKEN
BATT A
A WILLIAMS
WILLIAMS EST
SCHABEN
FICKEN
BATT C
LYLE 1
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
Infill Well
.18 .16 .14 .12 .10 .08 .06 .04 (frac.)

Figure: A5

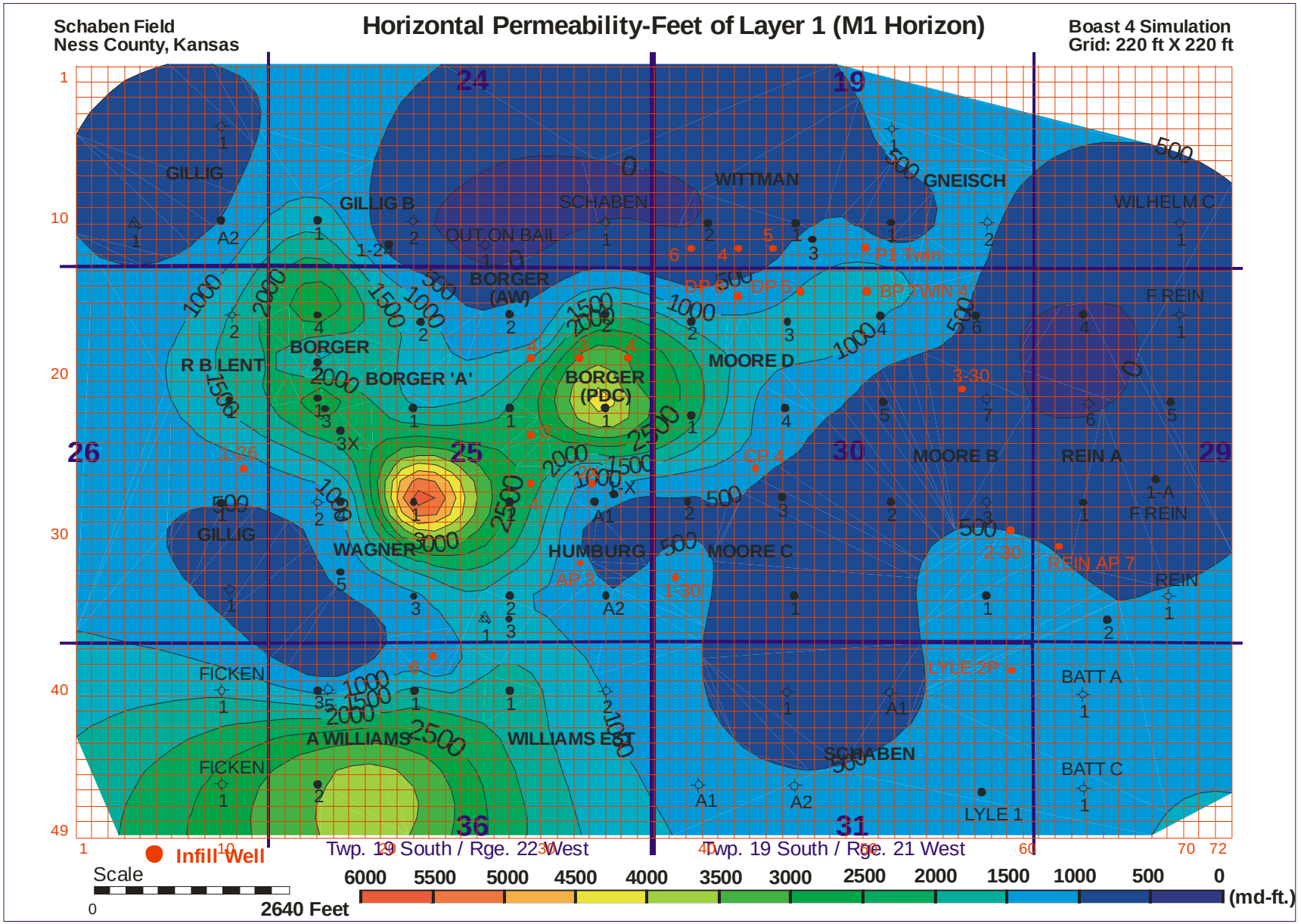

Schaben Field
Ness County, Kansas
Horizontal Permeability-Feet of Layer 1 (M1 Horizon)
Boast 4 Simulation
Grid: 220 ft X 220 ft
GILLIG
GILLIG B
WITTMAN
GNEISCH
WILHELM C
SCHABEN
OUT ON BAIL
BORGER (AW)
DP 6
DP 5
BP TWIN 4
P1 Twin
F REIN
BORGER
R B LENT
BORGER 'A'
BORGER (PDC)
MOORE D
3-30
MOORE B
REIN A
CP 4
1-A F REIN
GILLIG
WAGNER
HUMBURG
AP 3
MOORE C
2-30
REIN AP 7
REIN
1-30
LYLE 2P
BATT A
FICKEN
A WILLIAMS
WILLIAMS EST
SCHABEN
BATT C
LYLE 1
24
19
26
25
30
29
36
31
Infill Well
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
6000 5500 5000 4500 4000 3500 3000 2500 2000 1500 1000 500 0
(md-ft.)

Figure: A6

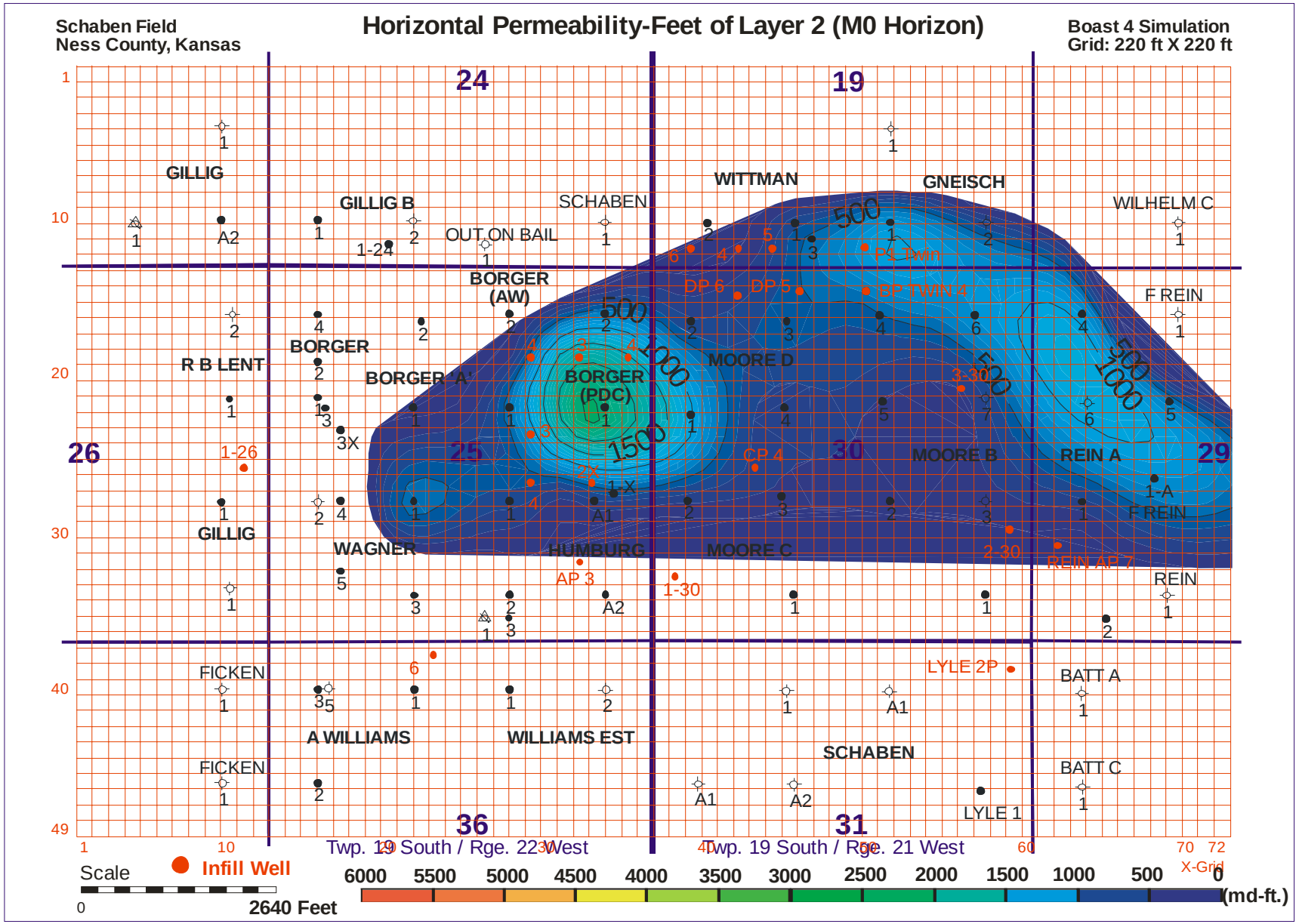

Schaben Field
Ness County, Kansas
Horizontal Permeability-Feet of Layer 2 (M0 Horizon)
Boast 4 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
SCHABEN
WITTMAN
GNEISCH
WILHELM C
OUT ON BAIL
BORGER (AW)
F REIN
BORGER
R B LENT
BORGER A'
BORGER (PDC)
MOORE D
MOORE B
REIN A
1-A
F REIN
WAGNER
HUMBURG
MOORE C
REIN
FICKEN
LYLE 2P
BATT A
A WILLIAMS
WILLIAMS EST
SCHABEN
BATT C
LYLE 1
1-24
1-26
1-30
2-30
3-30
3X
1-X
AP 3
CP 4
DP 6
DP 5
BP TWIN 4
P1 TWIN
REIN AP 7
500
1000
1500
2000
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
Infill Well
0
2640 Feet
6000 5500 5000 4500 4000 3500 3000 2500 2000 1500 1000 500 0
(md-ft.)
X-Grid

Figure: A7

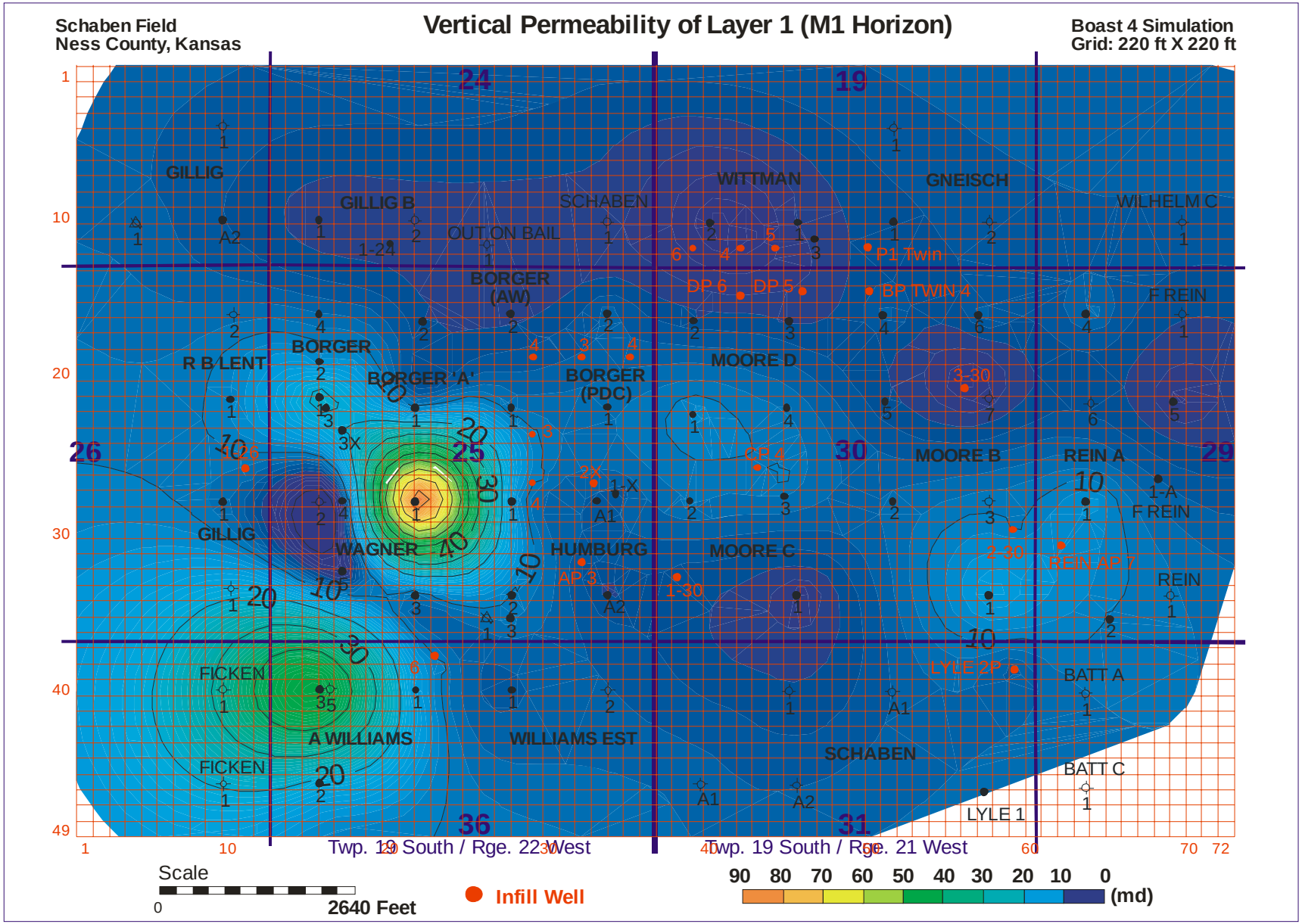

Schaben Field
Ness County, Kansas
Vertical Permeability of Layer 1 (M1 Horizon)
Boast 4 Simulation
Grid: 220 ft X 220 ft
GILLIG
GILLIG B
OUT ON BAIL
SCHABEN
WITTMAN
GNEISCH
WILHELM C
BORGER (AW)
P1 Twin
DP 6
DP 5
BP TWIN 4
F REIN
BORGER
R B LENT
BORGER 'A'
BORGER (PDC)
MOORE D
3-30
MOORE B
REIN A
1-A F REIN
CP 4
GILLIG
WAGNER
HUMBURG
AP 3
MOORE C
1-30
2-30
REIN AP 7
REIN
LYLE 2P
BATT A
FICKEN
A WILLIAMS
WILLIAMS EST
SCHABEN
BATT C
LYLE 1
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
Infill Well
90 80 70 60 50 40 30 20 10 0
(md)

Figure: A8

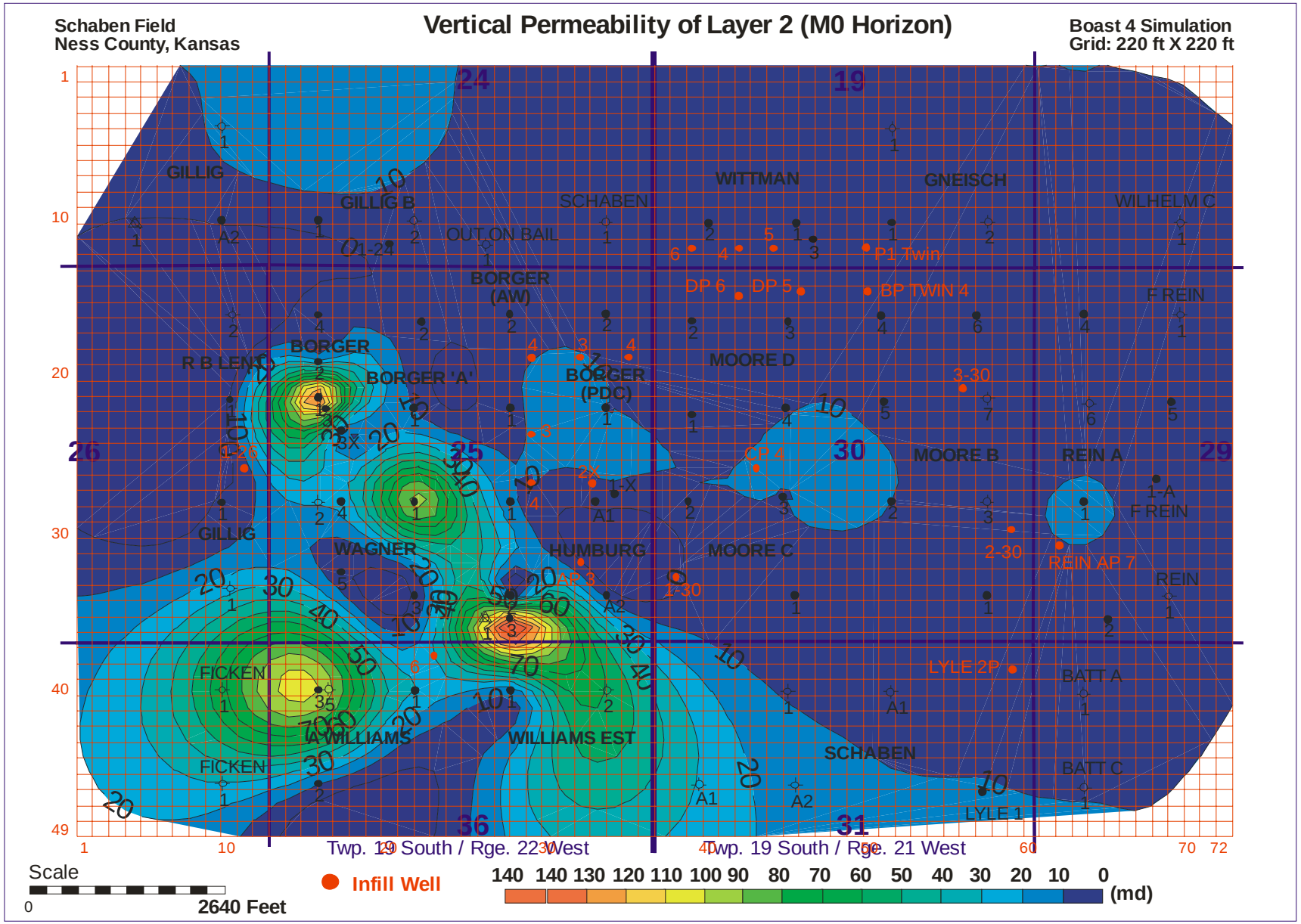

Schaben Field
Ness County, Kansas
Vertical Permeability of Layer 2 (M0 Horizon)
Boast 4 Simulation
Grid: 220 ft X 220 ft
GILLIG
GILLIG B
OUT ON BAIL
SCHABEN
WITTMAN
GNEISCH
WILHELM C
BORGER (AW)
P1 Twin
DP 6
DP 5
BP TWIN 4
F REIN
BORGER
R B LENO
BORGER 'A'
BORGER (PDC)
MOORE D
3-30
MOORE B
REIN A
CP 4
1-A F REIN
GILLIG
WAGNER
HUMBURG
MOORE C
2-30
REIN AP 7
REIN
LYLE 2P
BATT A
FICKEN
A WILLIAMS
WILLIAMS EST
SCHABEN
BATT C
LYLE 1
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
Infill Well
140 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
(md)

Figure: A9

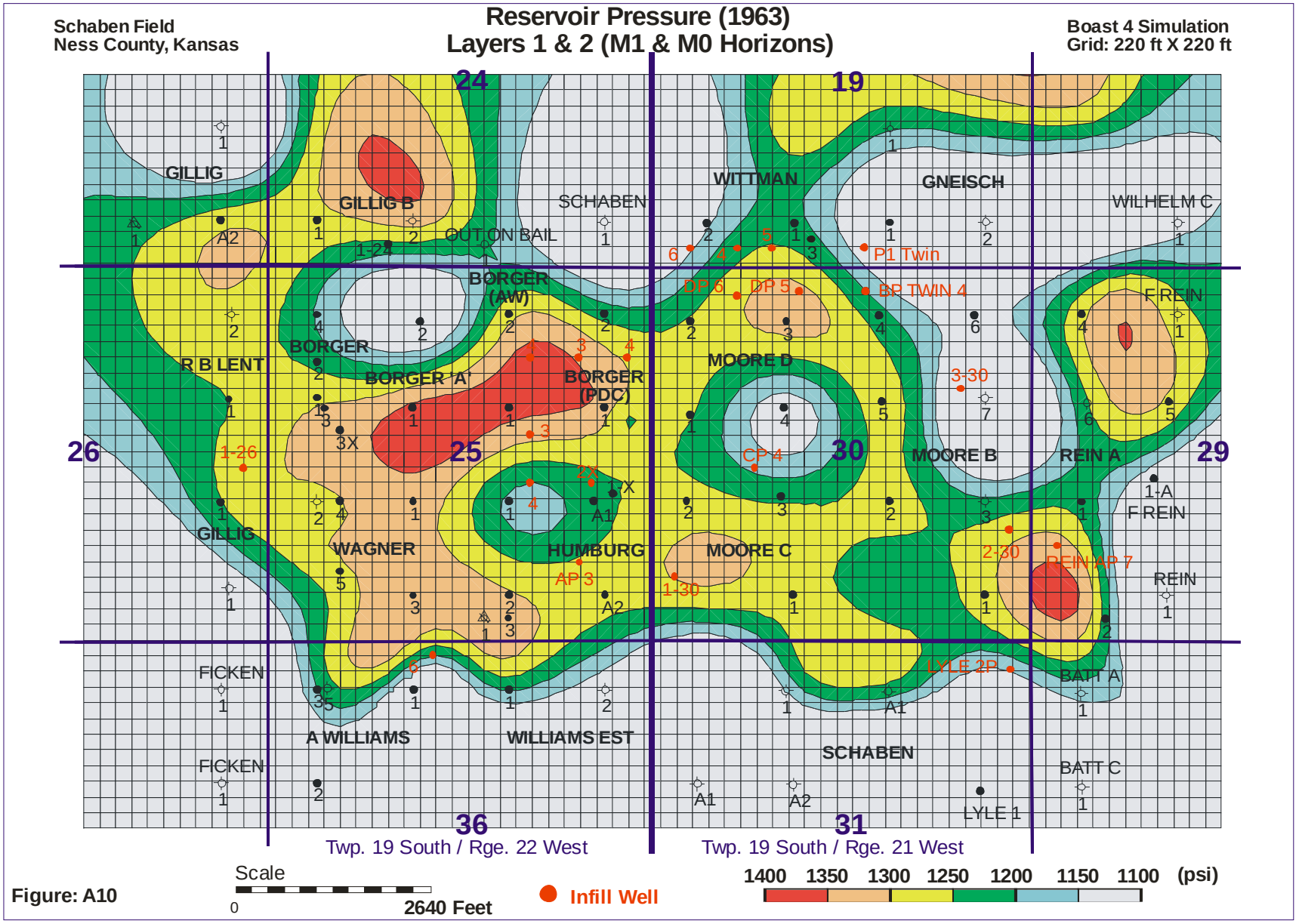
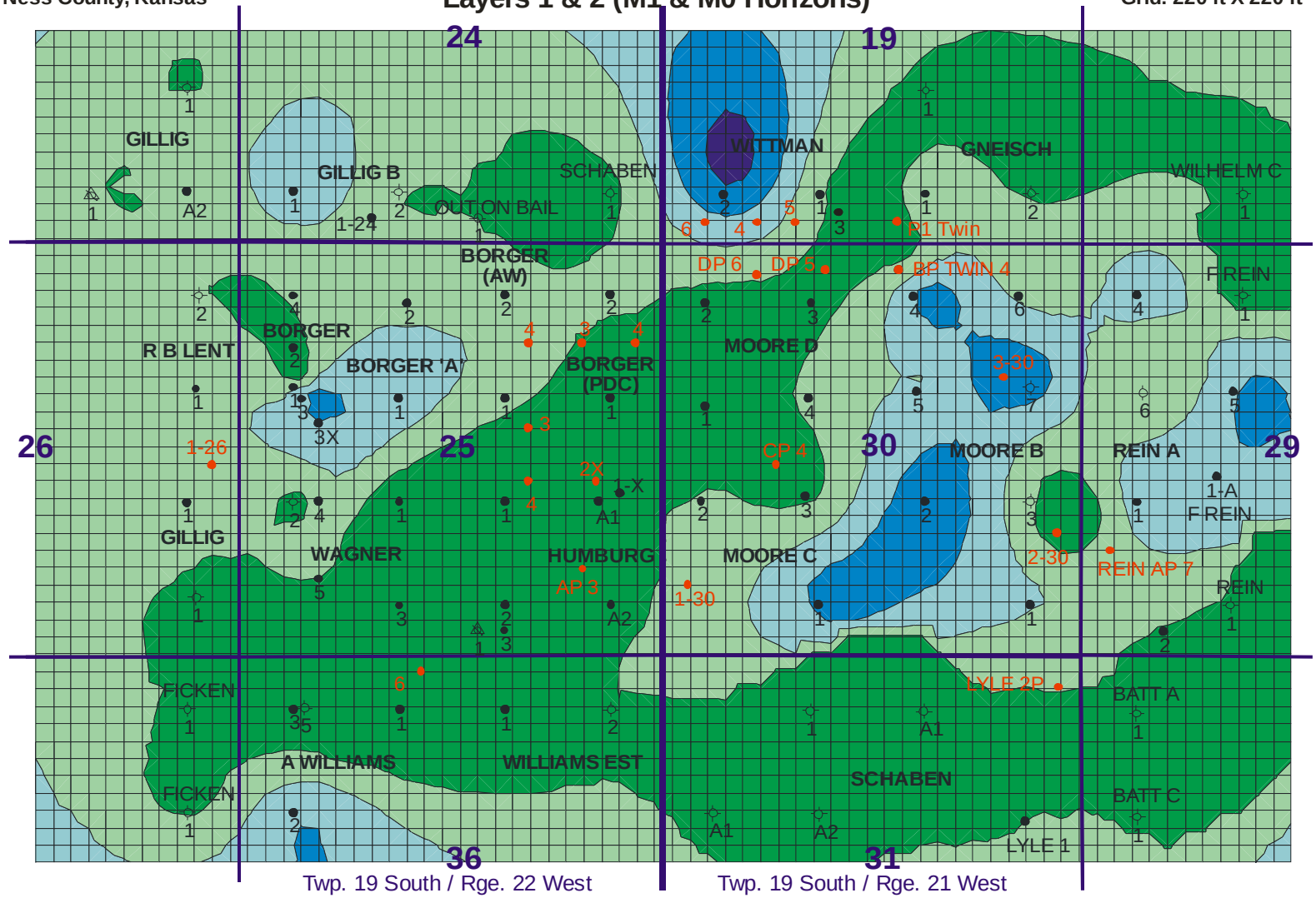

Schaben Field
Ness County, Kansas
Reservoir Pressure (1963)
Layers 1 & 2 (M1 & M0 Horizons)
Boast 4 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
SCHABEN
WITTMAN
GNEISCH
WILHELM C
OUT ON BAIL
1-24
BORGER (AW)
P1 Twin
DP 6
DP 5
BP TWIN 4
F REIN
BORGER
R B LENT
BORGER "A"
BORGER (PDC)
MOORE D
3-30
1-26
CP 4
MOORE B
REIN A
1-A F REIN
GILLIG
WAGNER
HUMBURG
MOORE C
2-30
REIN AP 7
AP 3
1-30
REIN
FICKEN
LYLE 2P
BATT A
A WILLIAMS
WILLIAMS EST
SCHABEN
FICKEN
BATT C
LYLE 1
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
Infill Well
1400 1350 1300 1250 1200 1150 1100 (psi)

Figure: A10

Schaben Field
Ness County, Kansas

Oil Saturation in Effective Porosity (1963)
Layers 1 & 2 (M1 & M0 Horizons)

Boast 4 Simulation
Grid: 220 ft X 220 ft



Scale
0 — 2640 Feet

● Infill Well

80 72 68 62 56 50 (%)

Figure: A11

Appendix B

Results of 3 Layer Reservoir Simulation Study – Schaben Field, Ness County, Kansas

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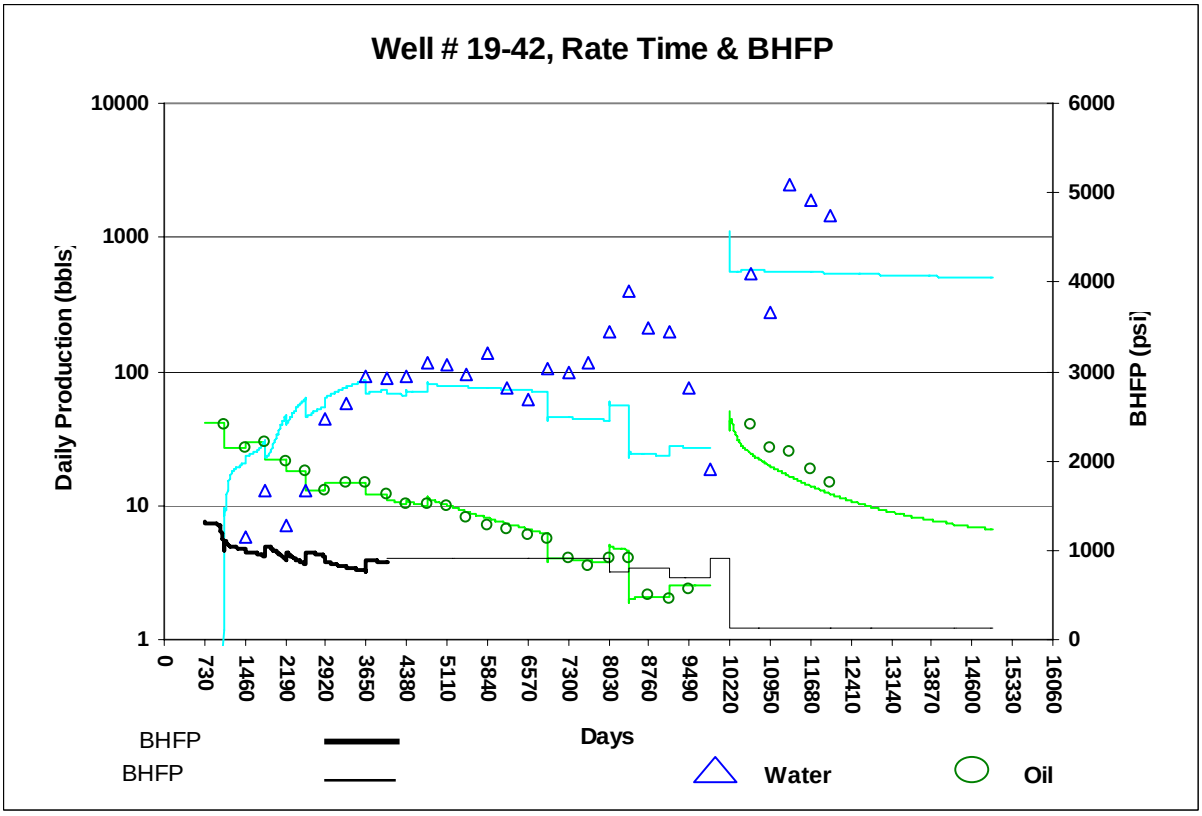
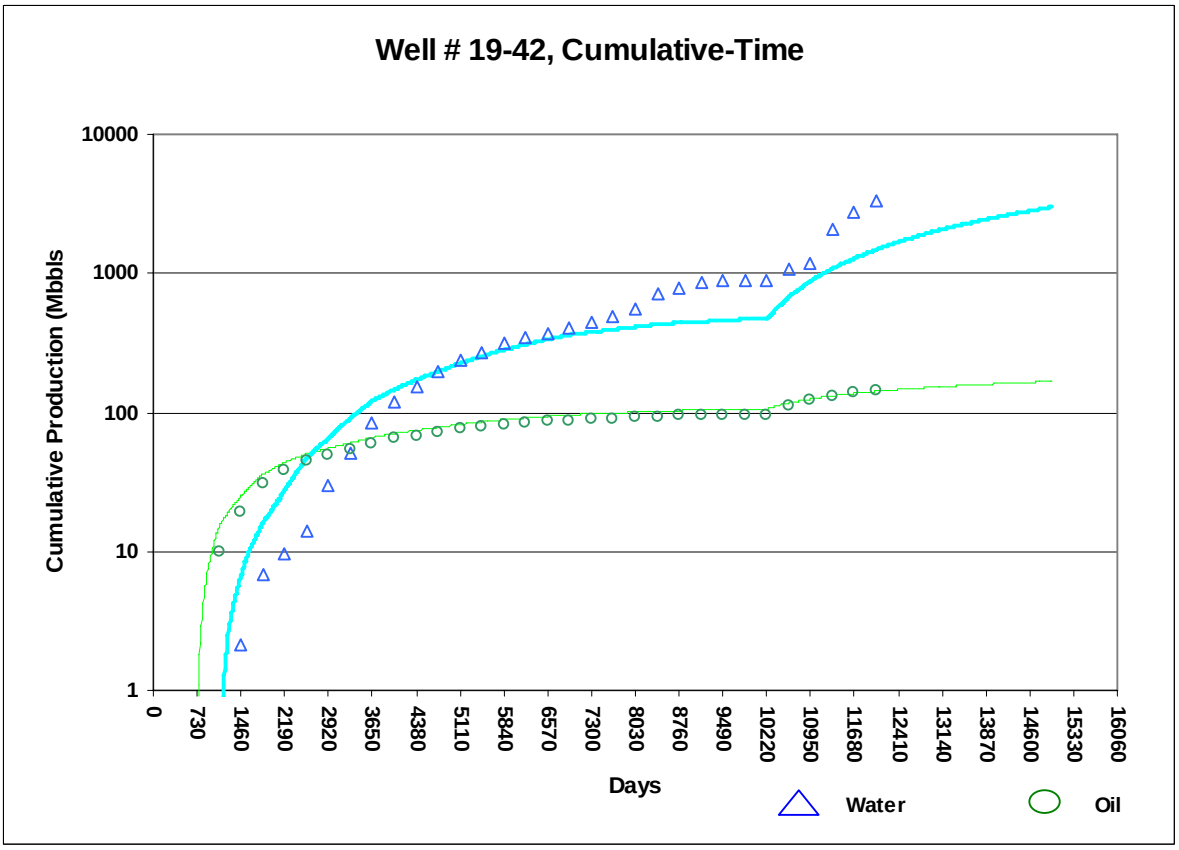
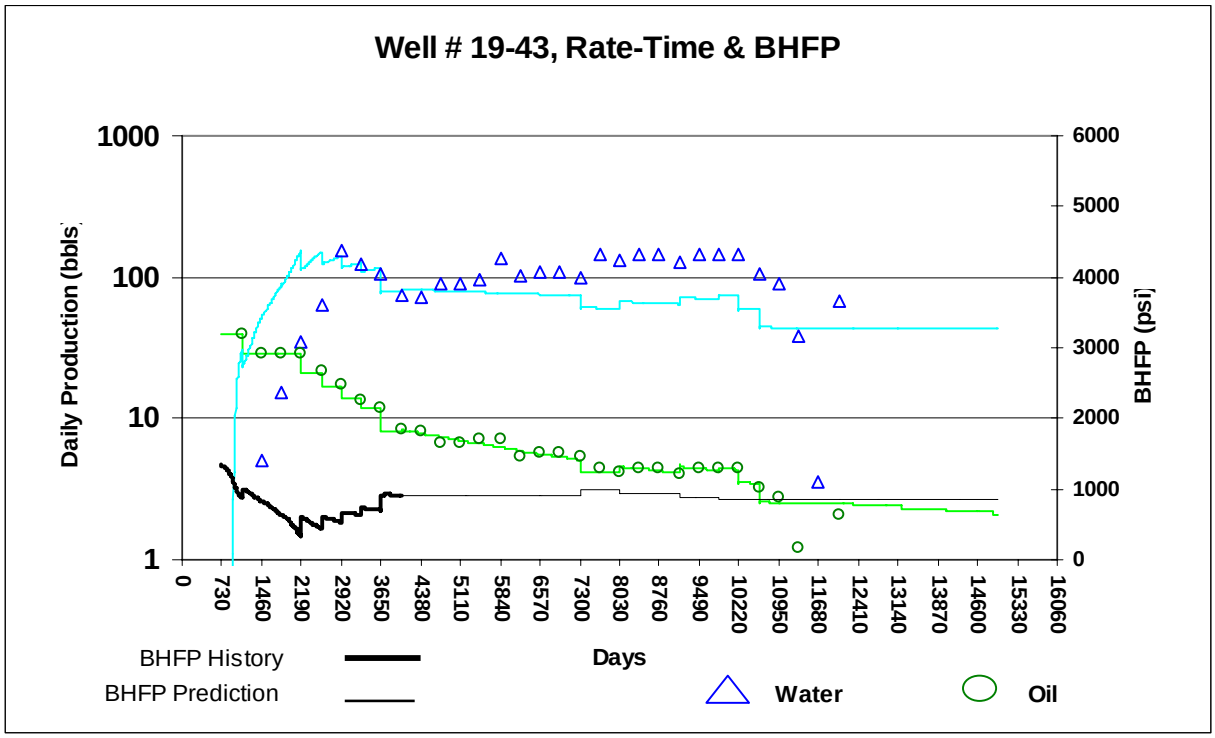
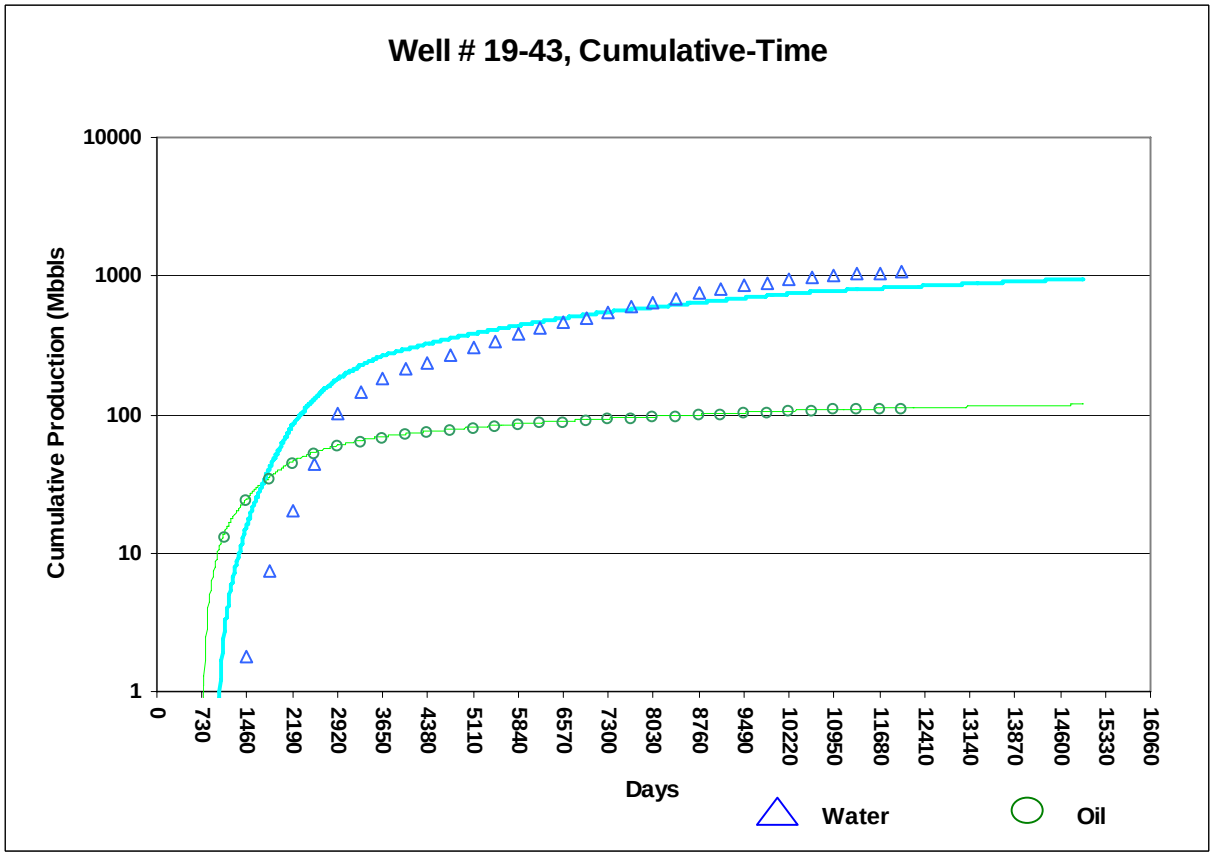
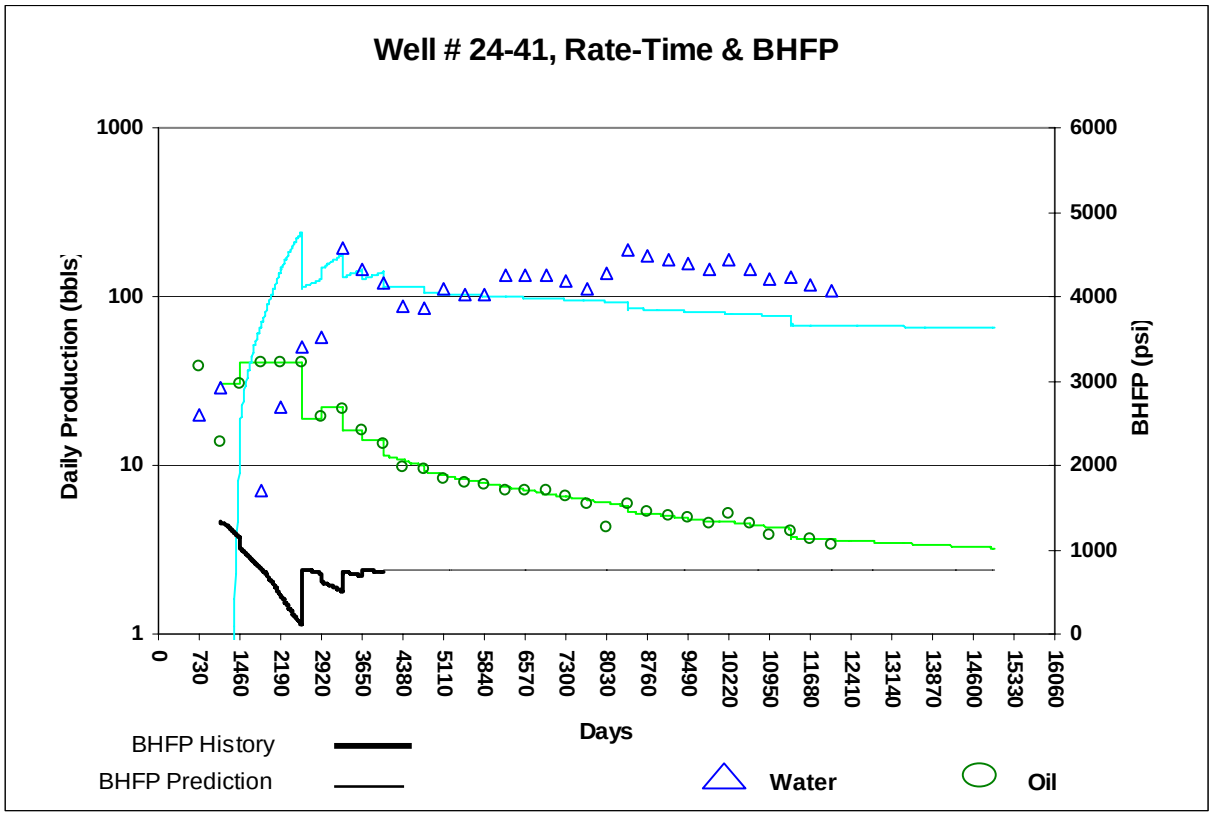
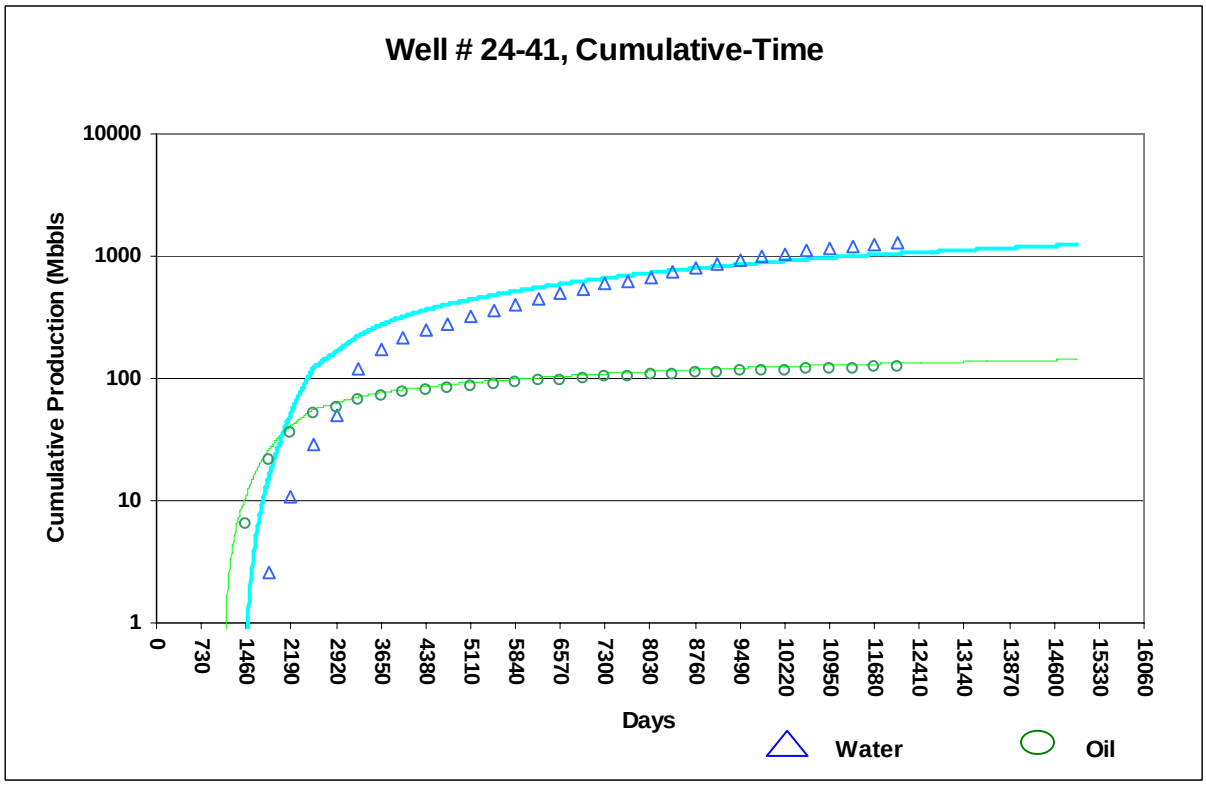

Well # 19-42, Rate Time & BHFP
Daily Production (bbls)
BHFP (psi)
10000
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP
BHFP
Water
Oil

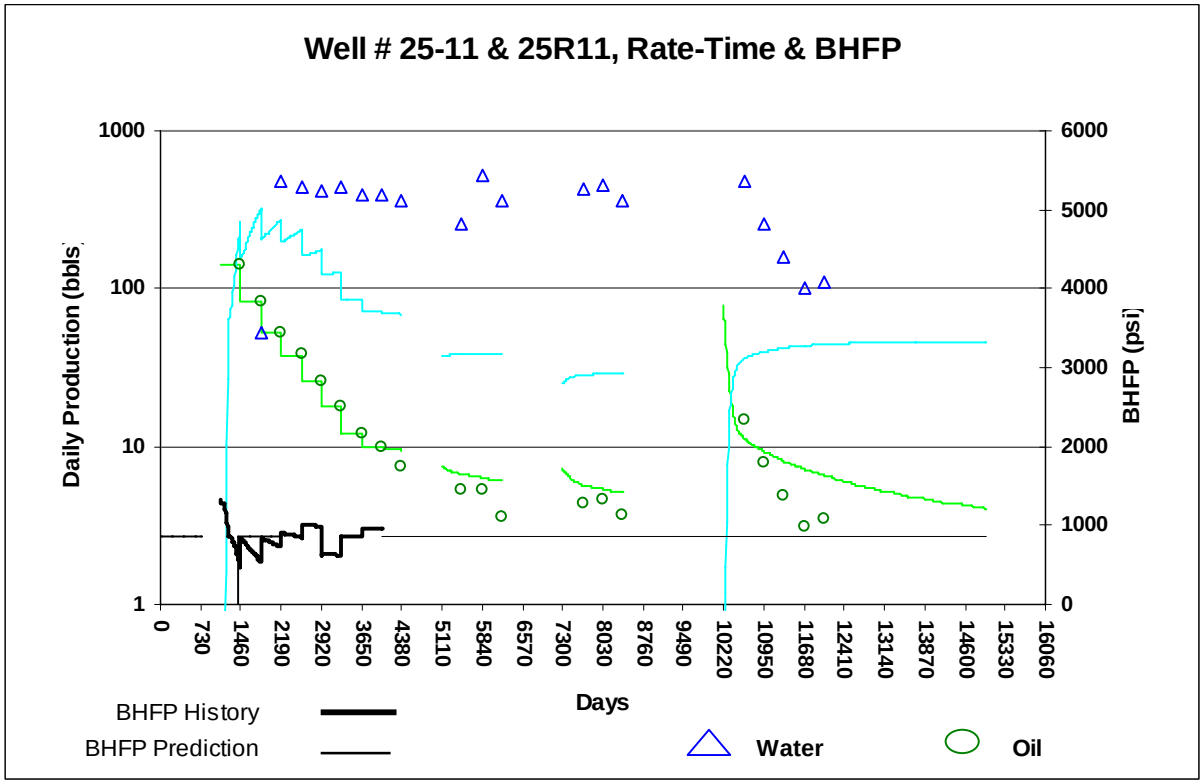

Well # 19-42, Cumulative-Time
Cumulative Production (Mbbls
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

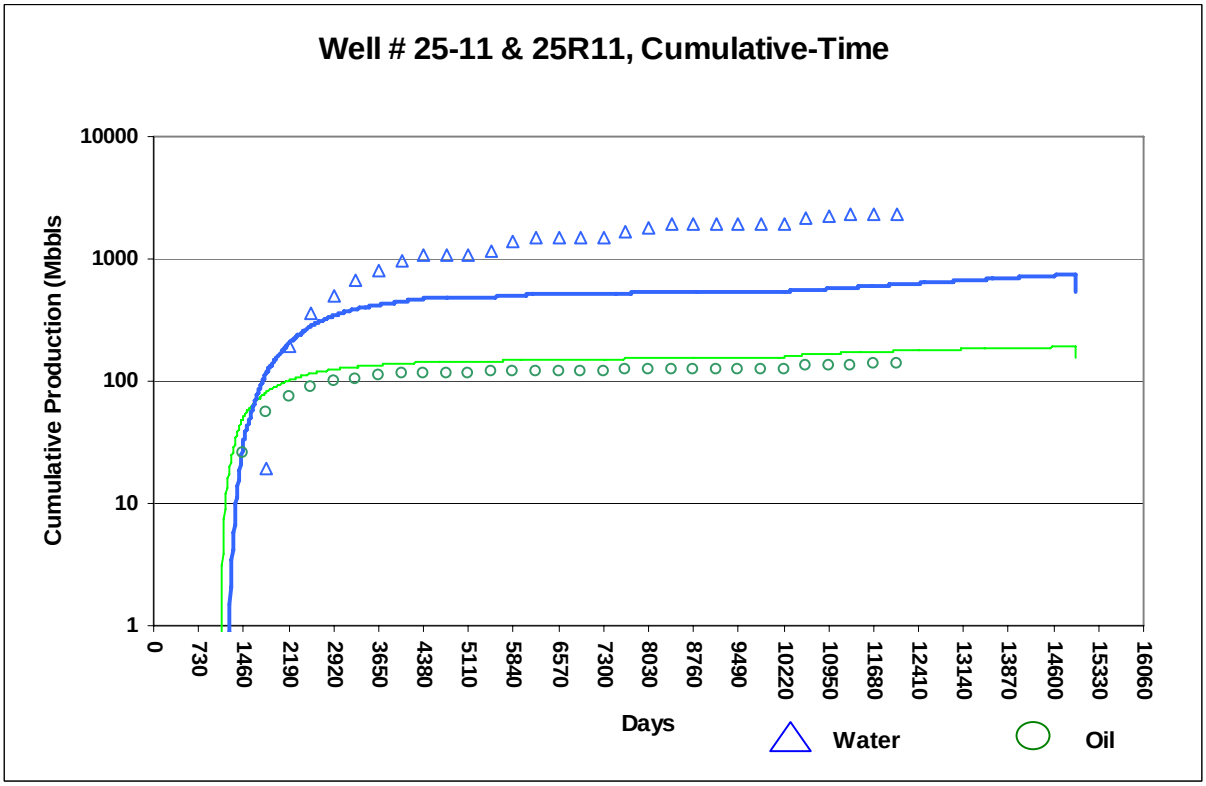

Well # 19-43, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

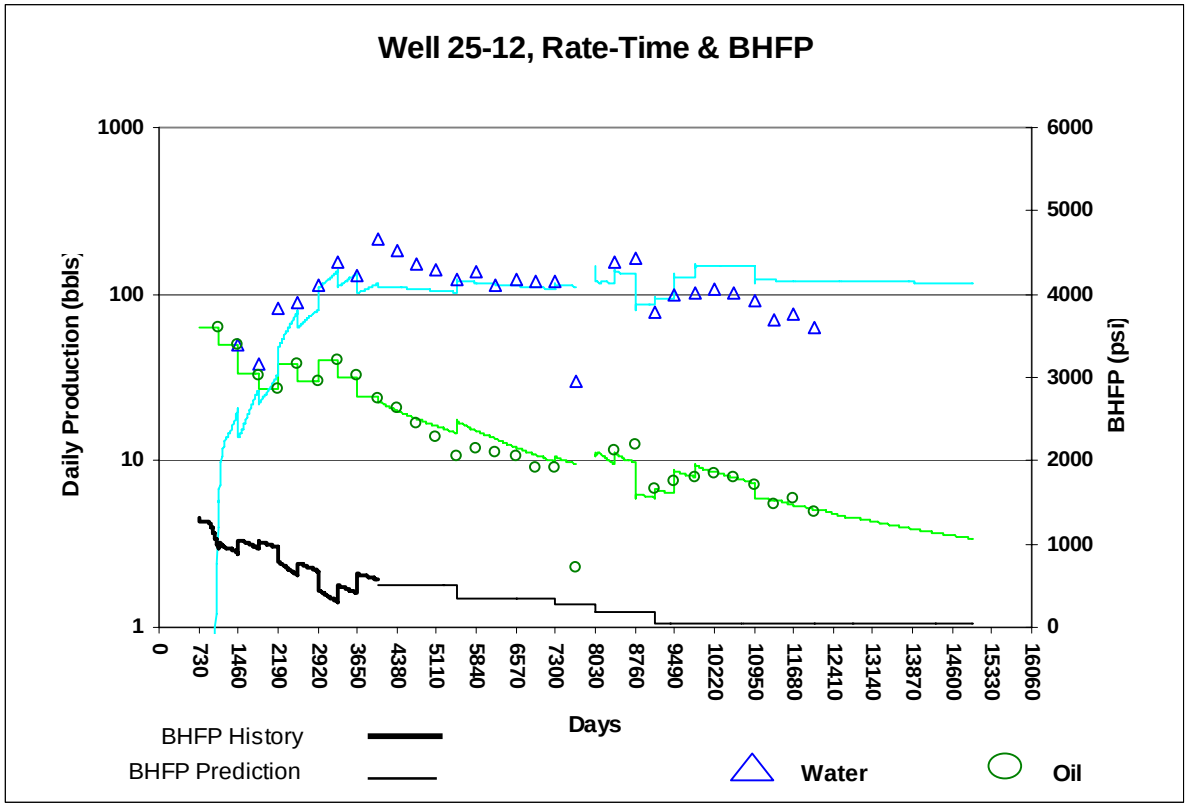

Well # 19-43, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

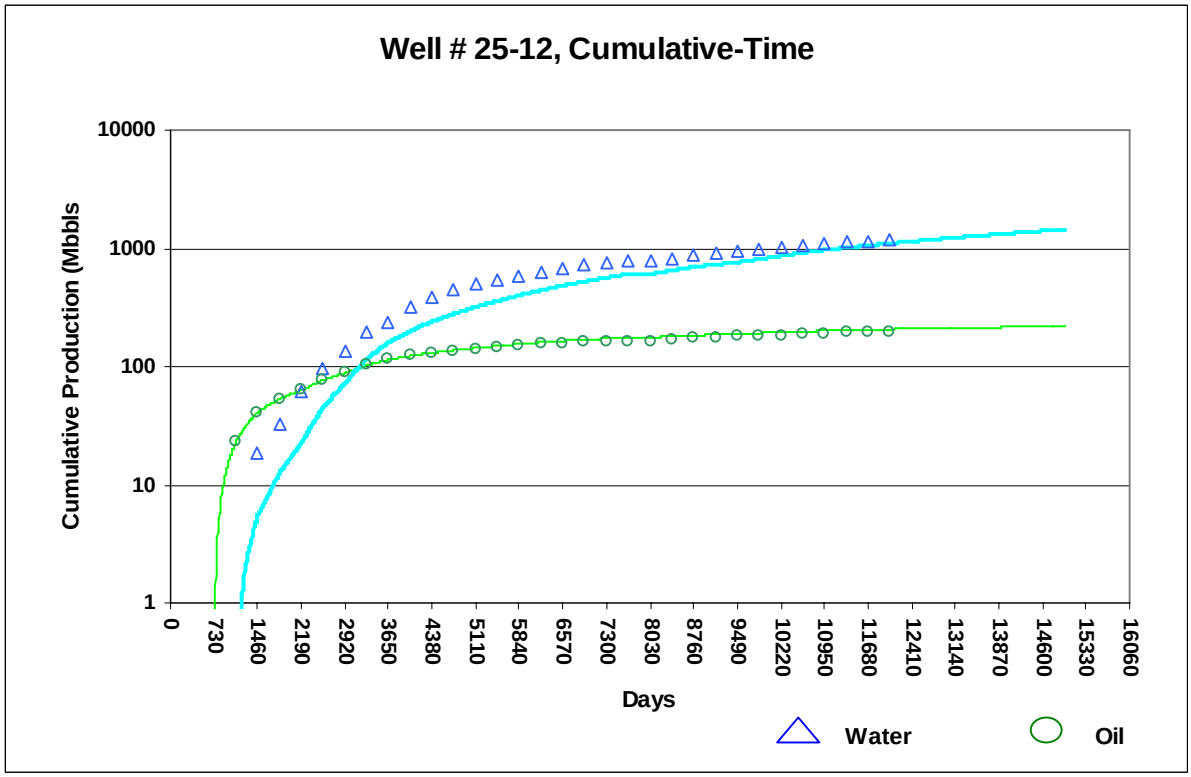

Well # 24-41, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

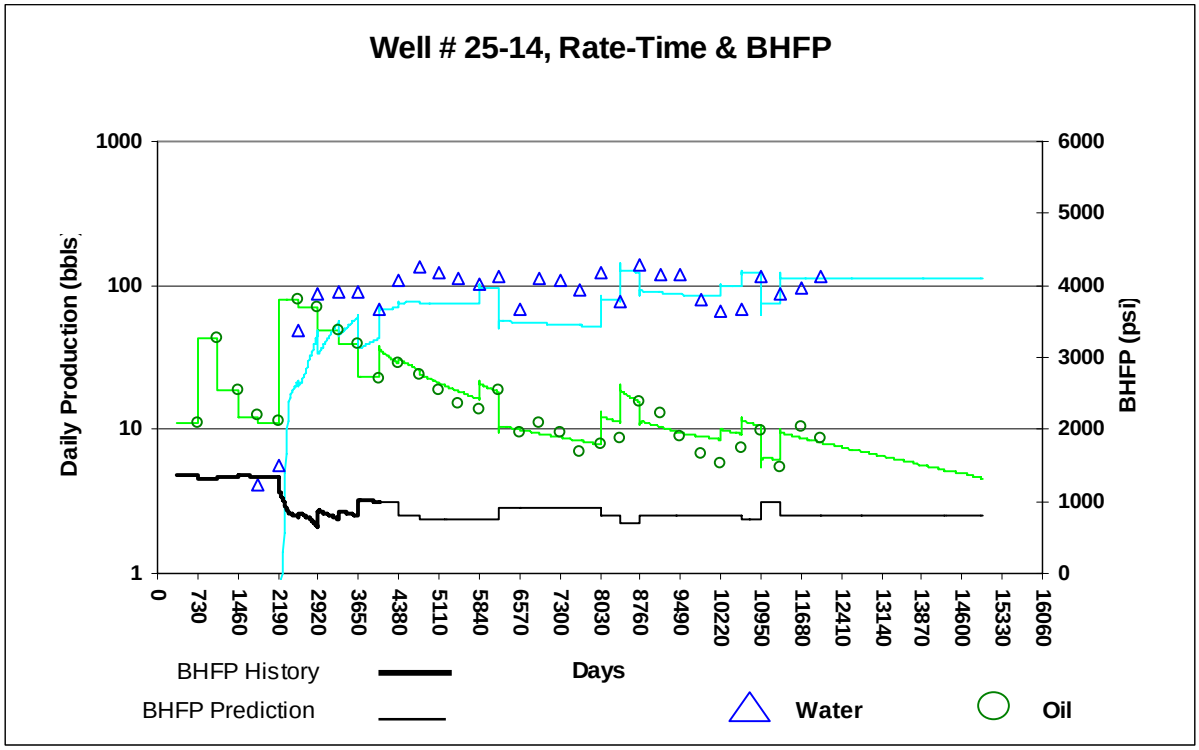

Well # 24-41, Cumulative-Time
Cumulative Production (Mbbls
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

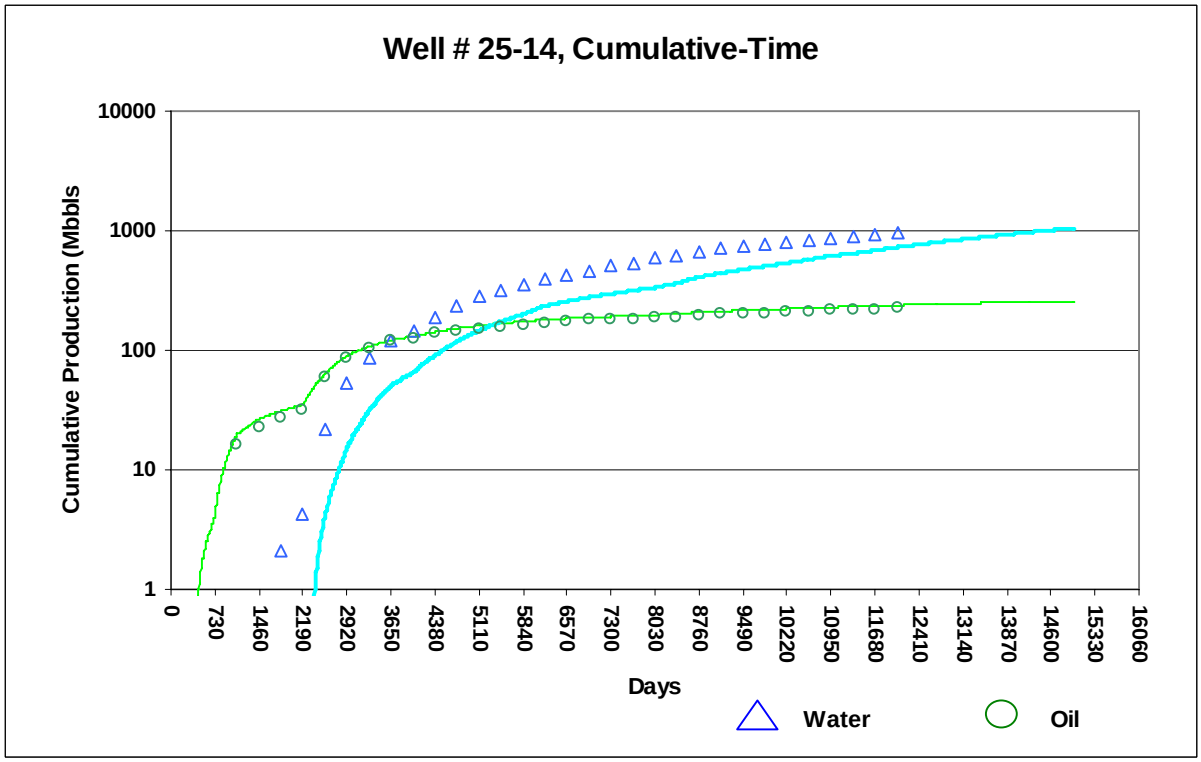

Well # 25-11 & 25R11, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

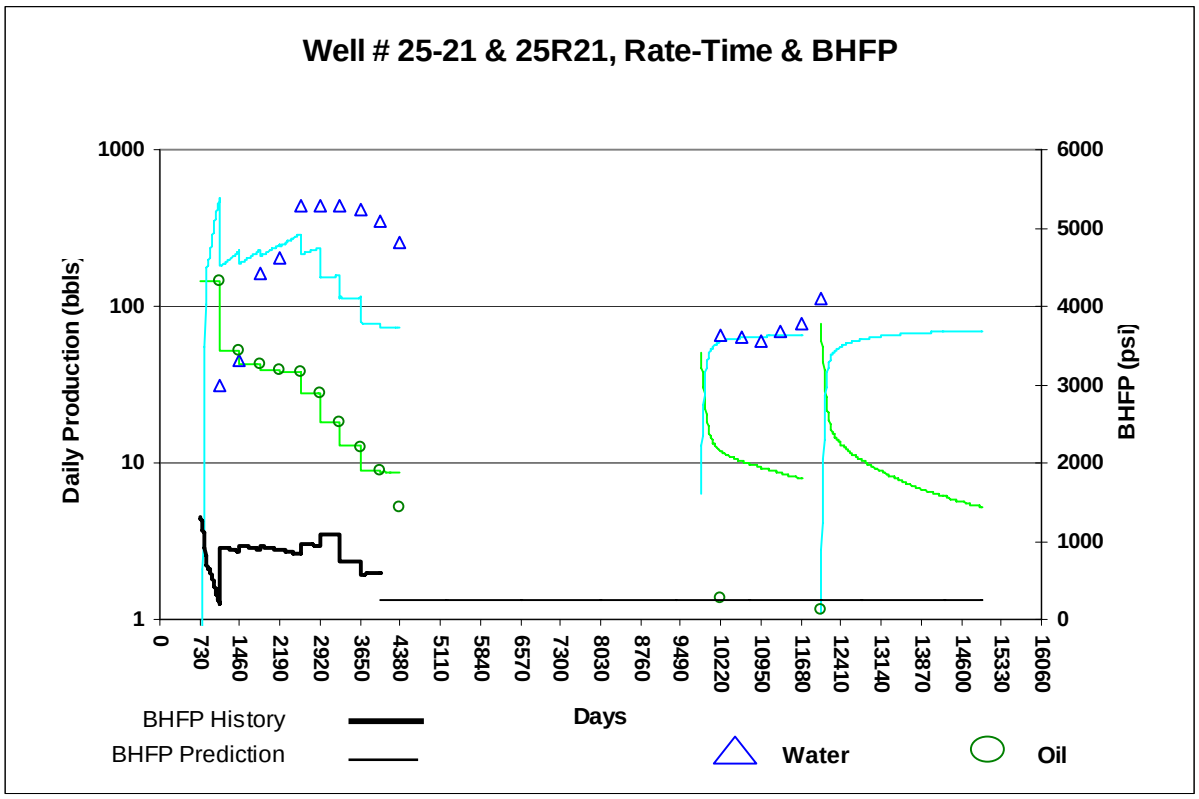

Well # 25-11 & 25R11, Cumulative-Time
Cumulative Production (Mbbls
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

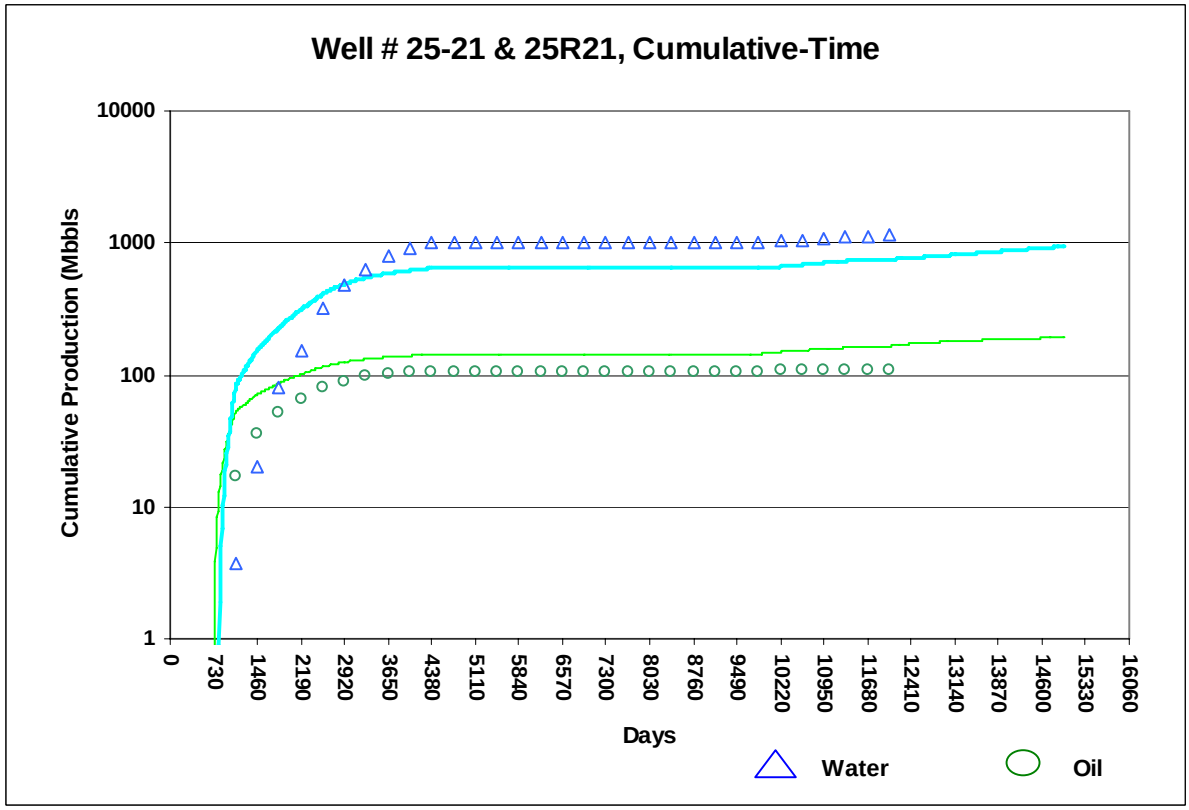

Well 25-12, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
Days
BHFP History
BHFP Prediction
Water
Oil

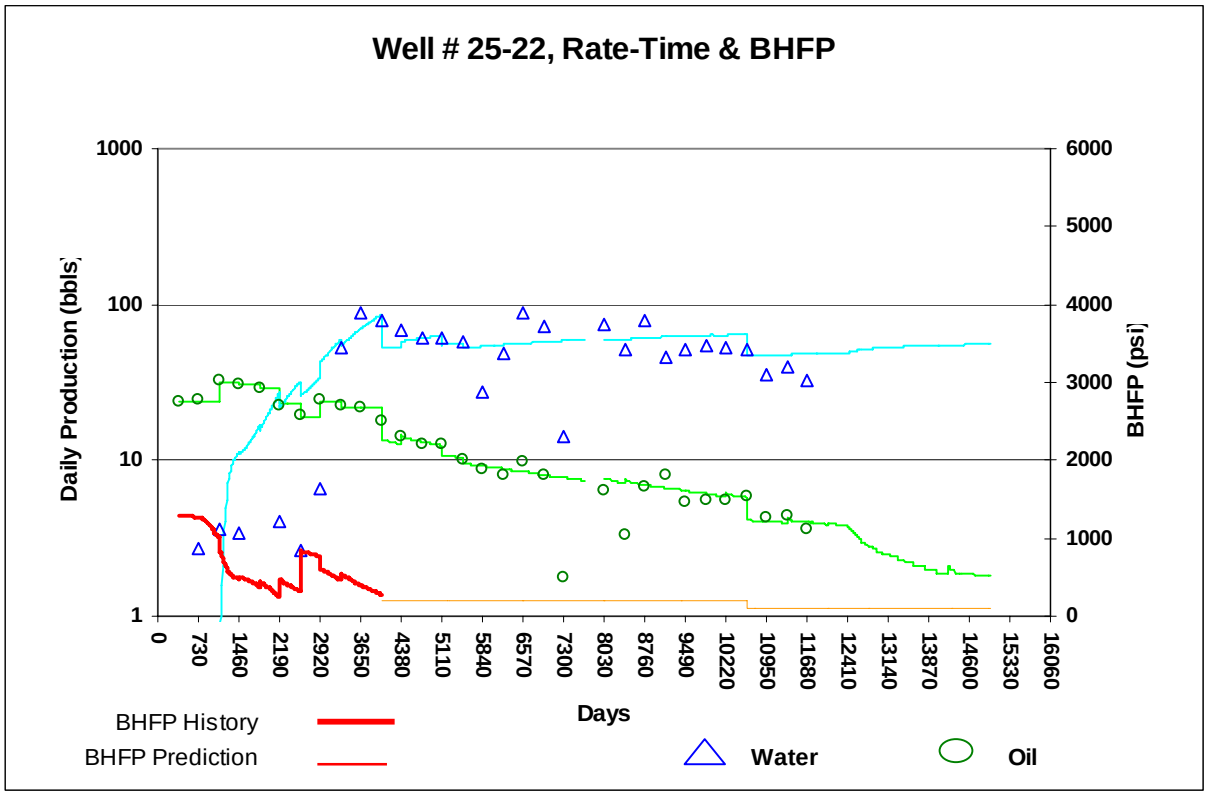

Well # 25-12, Cumulative-Time
Cumulative Production (Mbbls
Days
Water
Oil

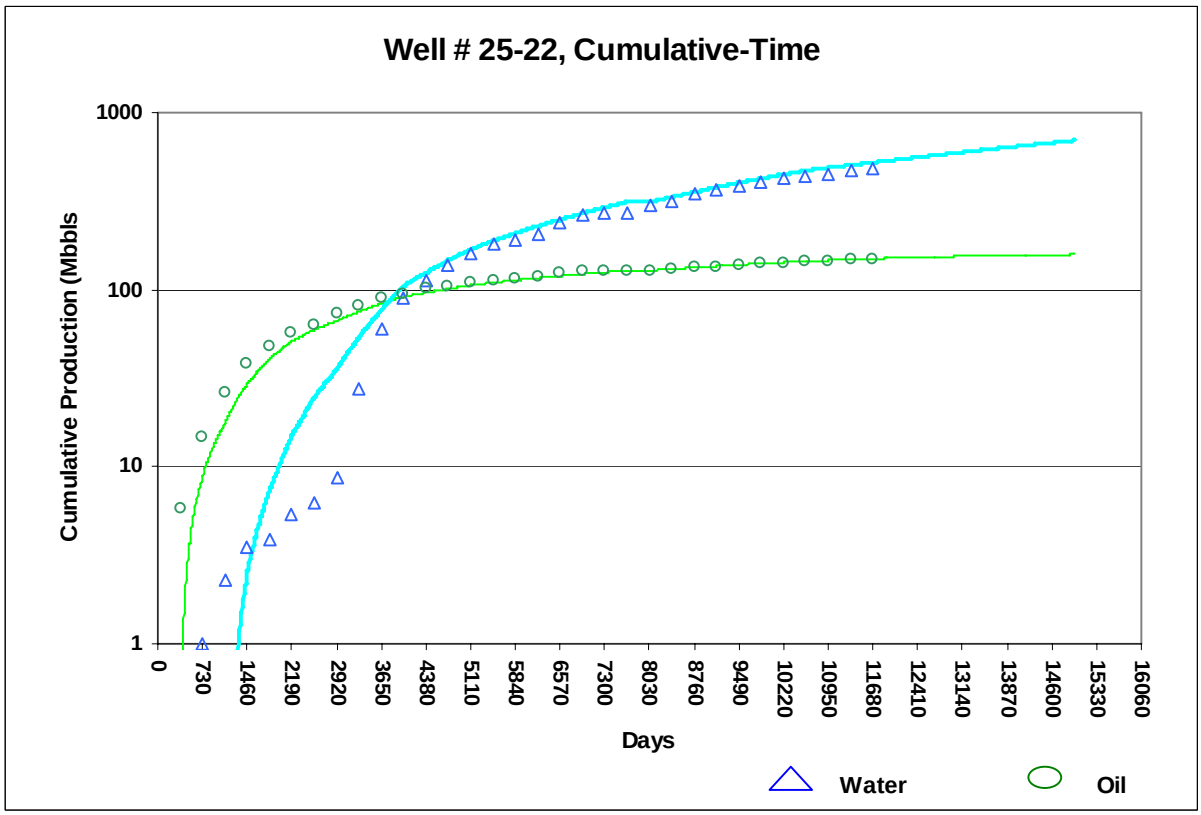

Well # 25-14, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

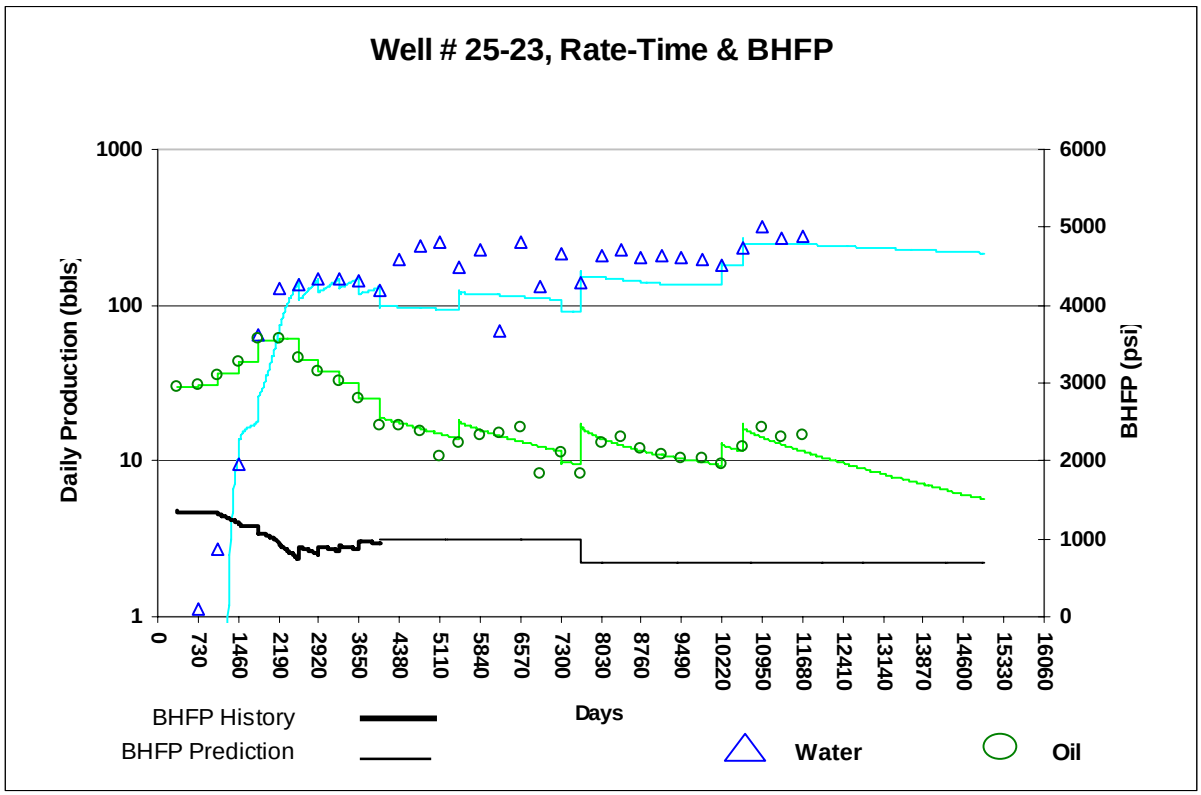

Well # 25-14, Cumulative-Time
Cumulative Production (Mbbls
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

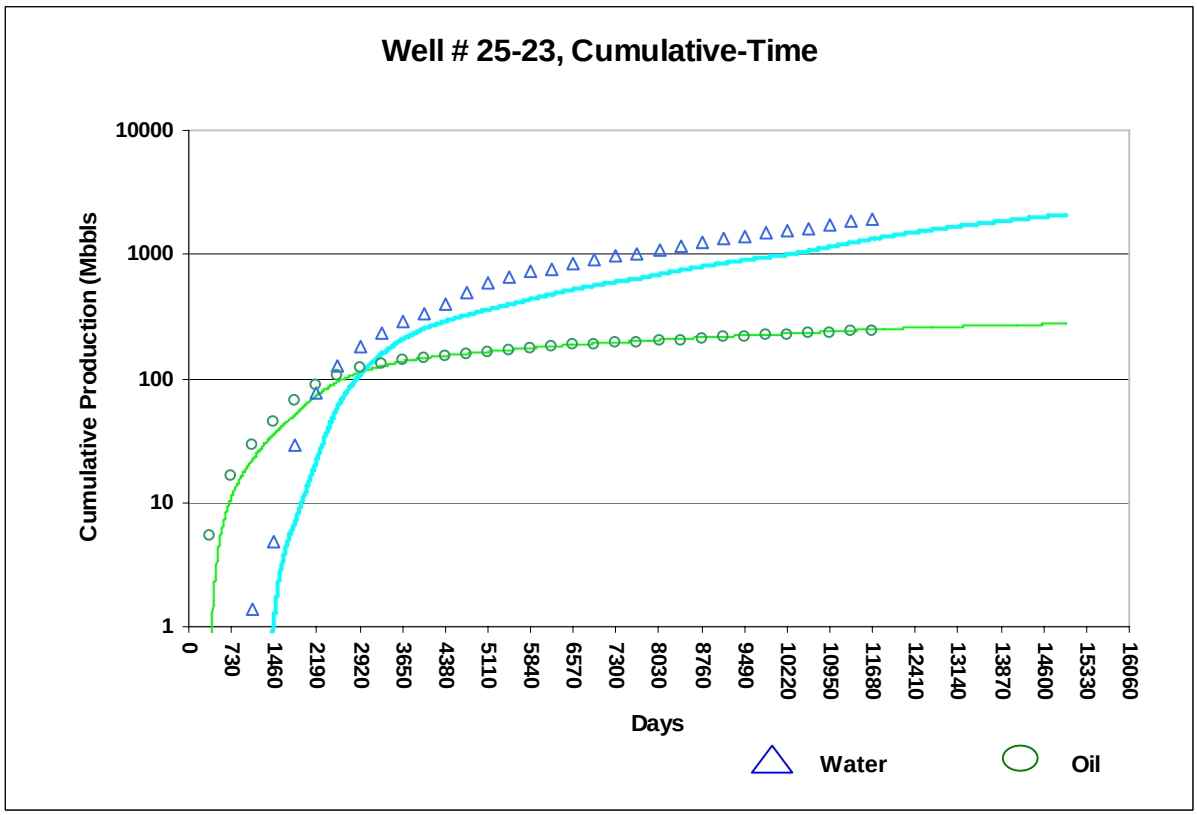

Well # 25-21 & 25R21, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

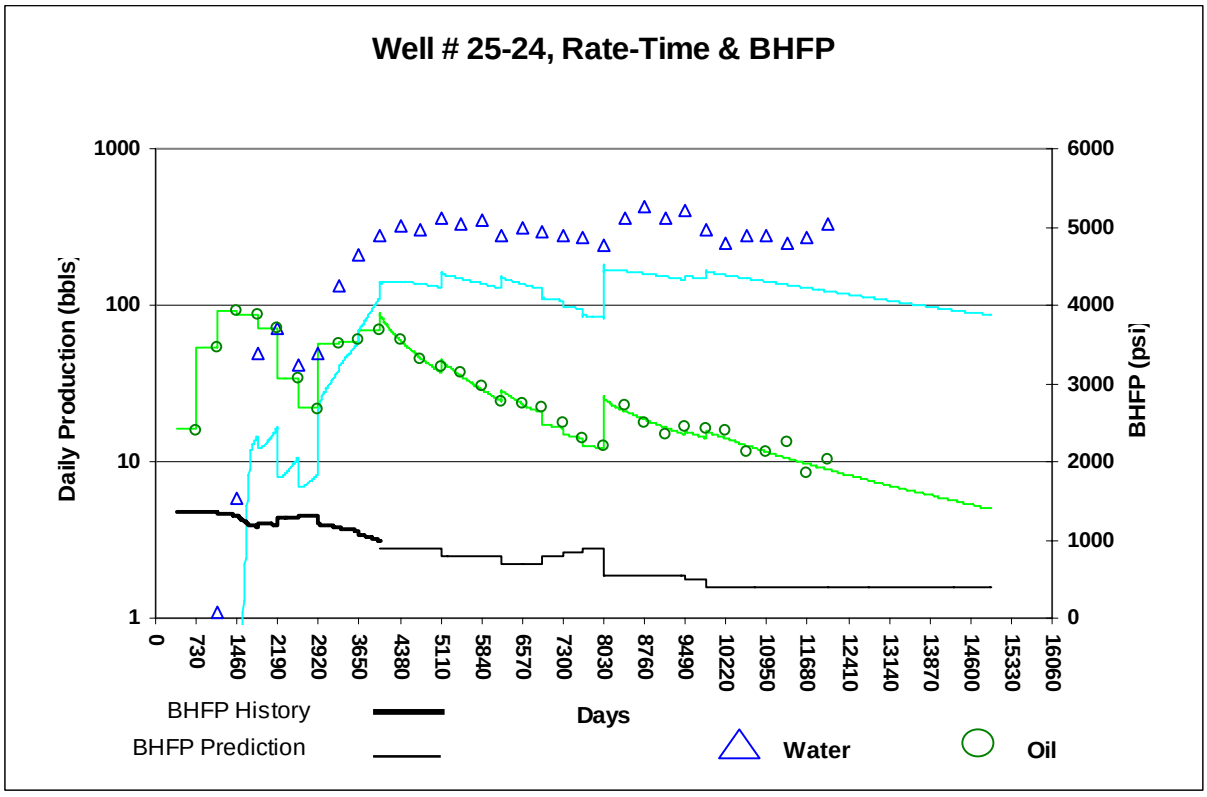

Well # 25-21 & 25R21, Cumulative-Time
Cumulative Production (Mbbls
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

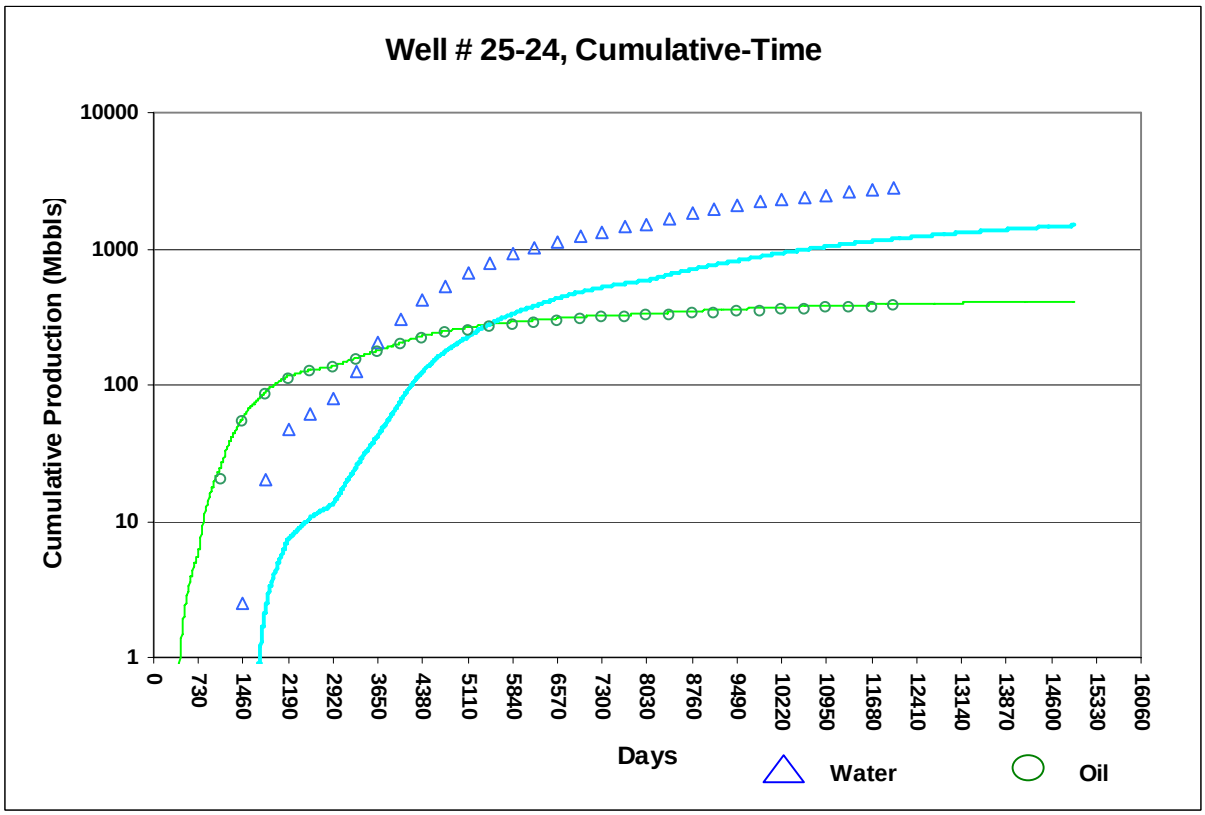

Well # 25-22, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

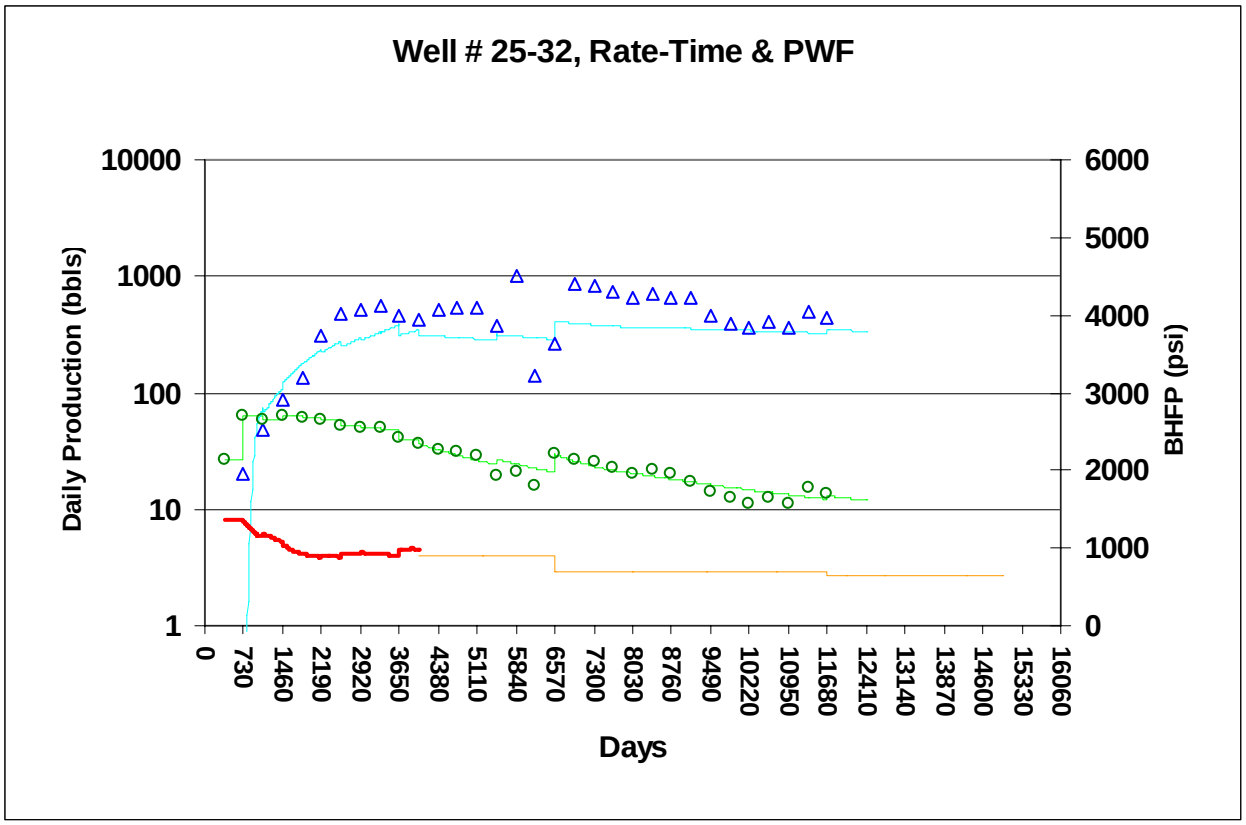

Well # 25-22, Cumulative-Time
Cumulative Production (Mbbls
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

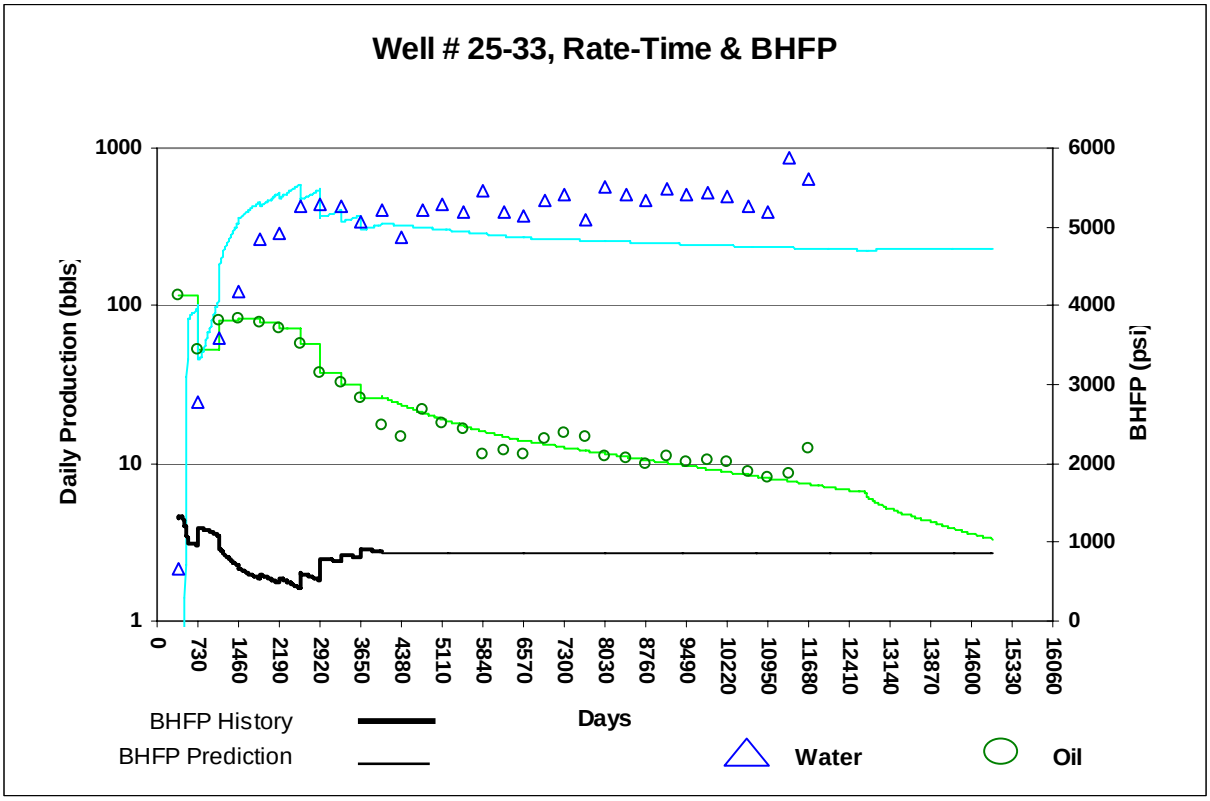

Well # 25-23, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

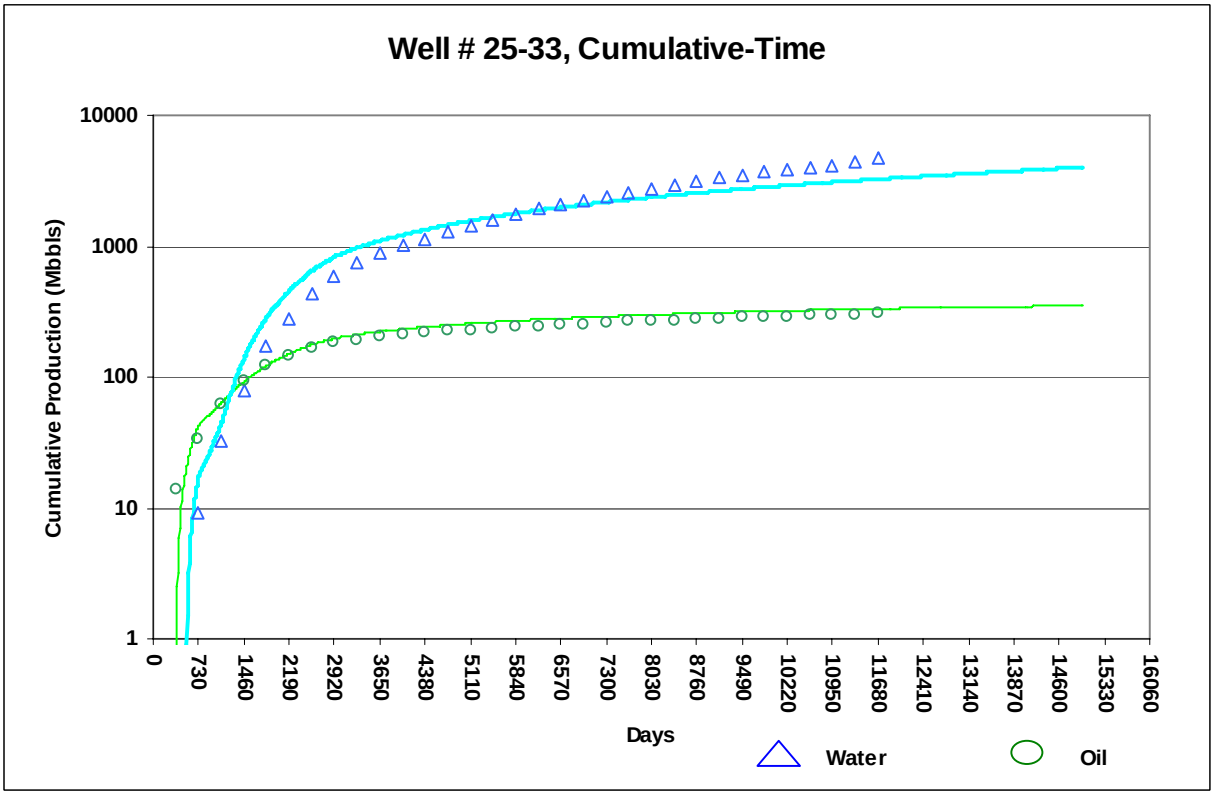

Well # 25-23, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

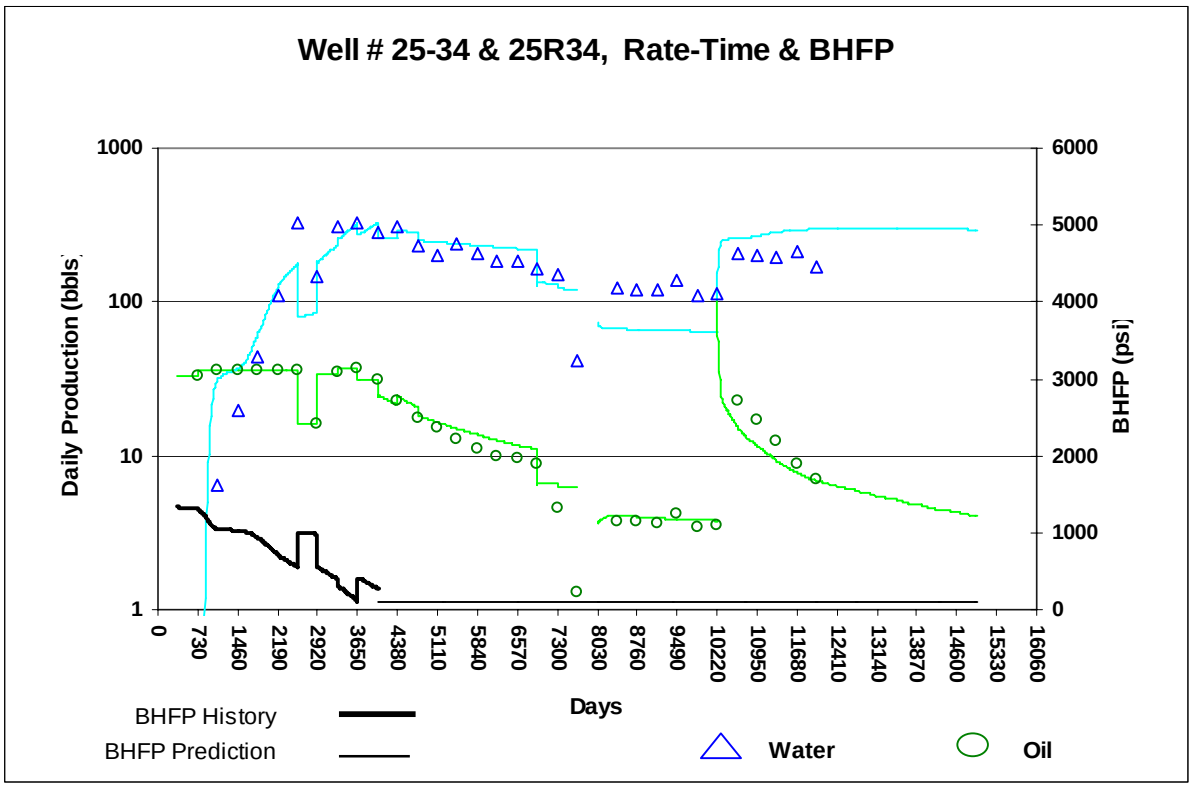

Well # 25-24, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

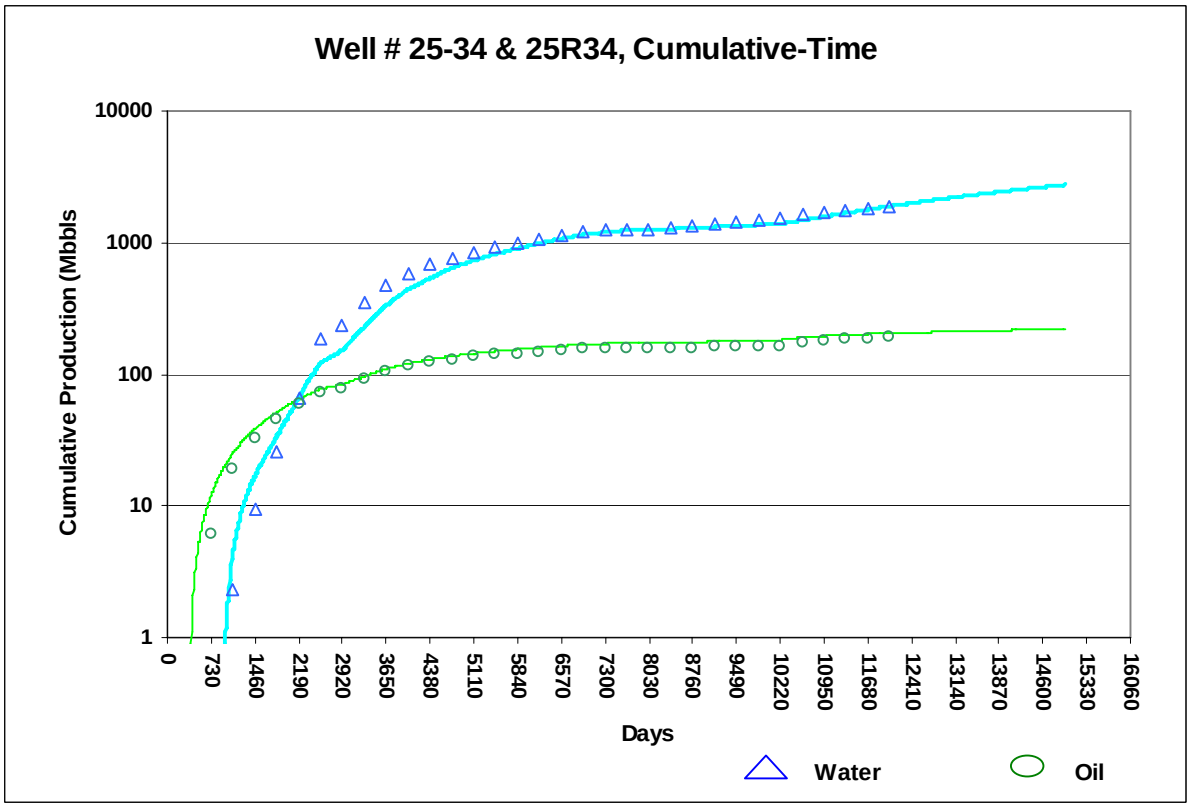

Well # 25-24, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

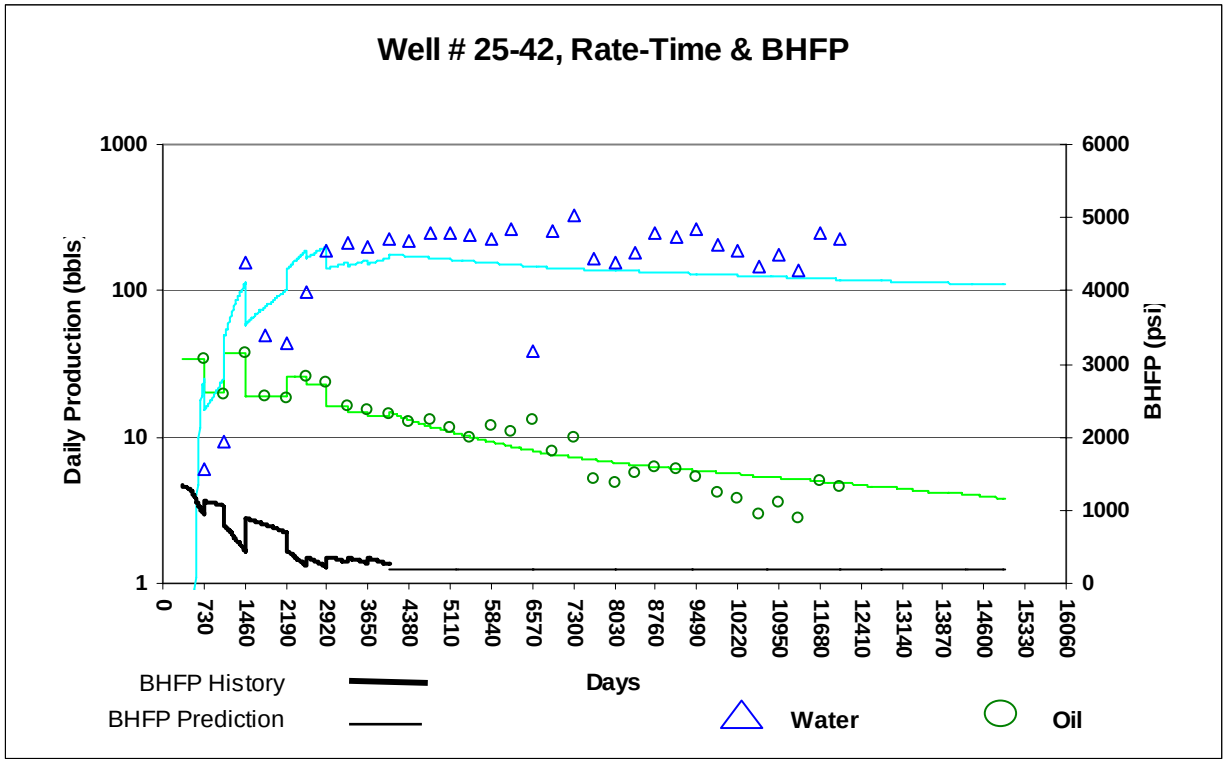

Well # 25-32, Rate-Time & PWF
Daily Production (bbls)
BHFP (psi)
Days
10000
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060

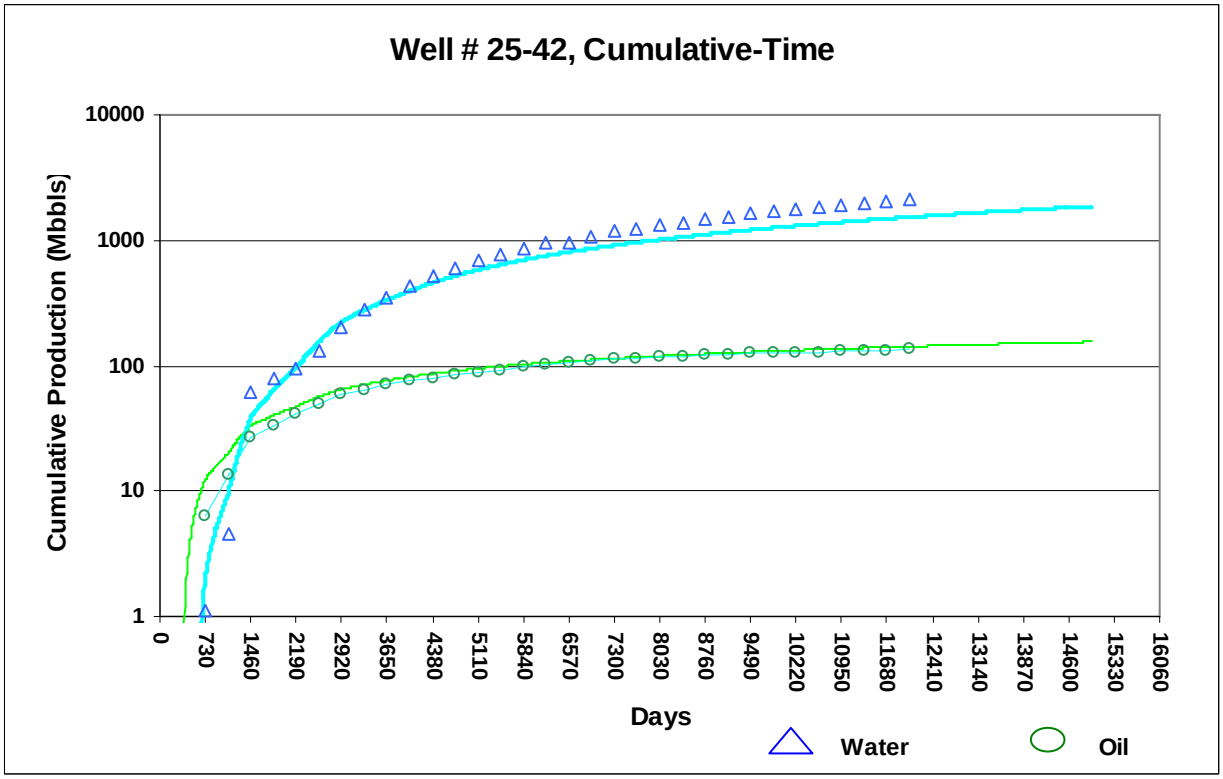

Well # 25-33, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

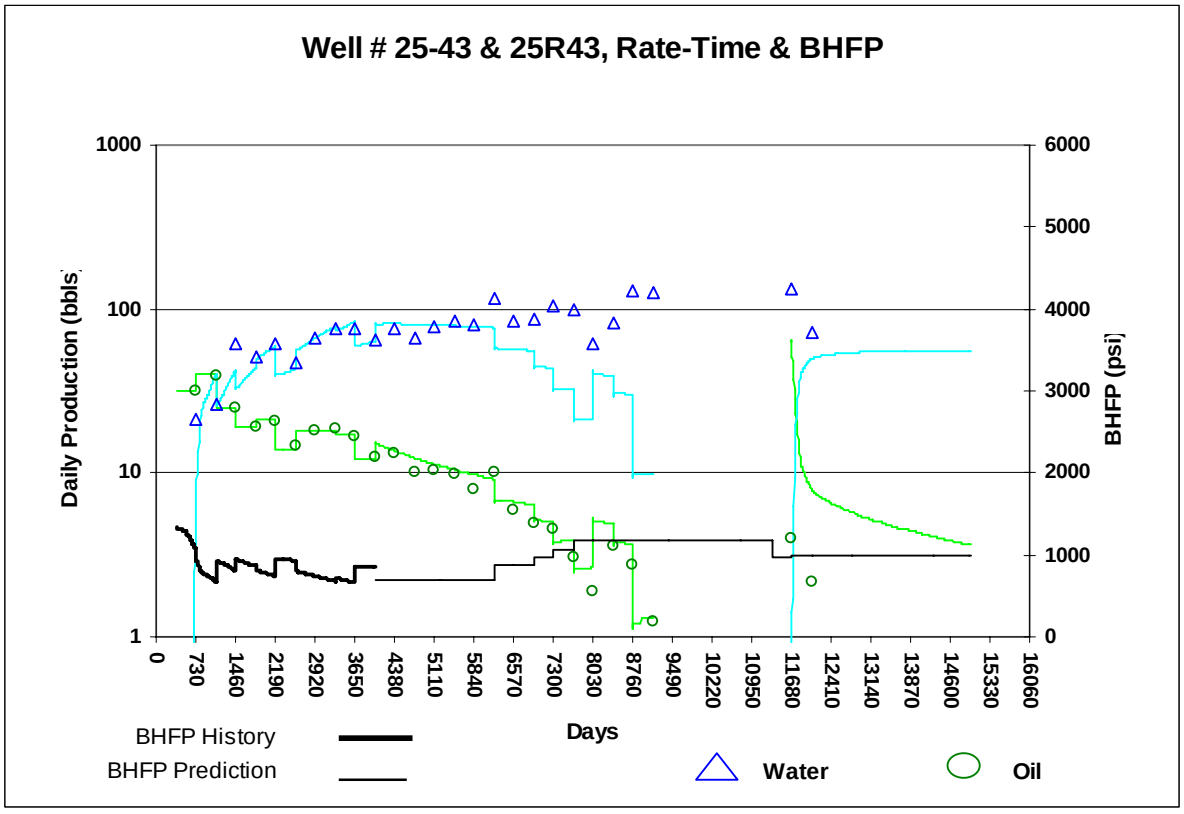

Well # 25-33, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

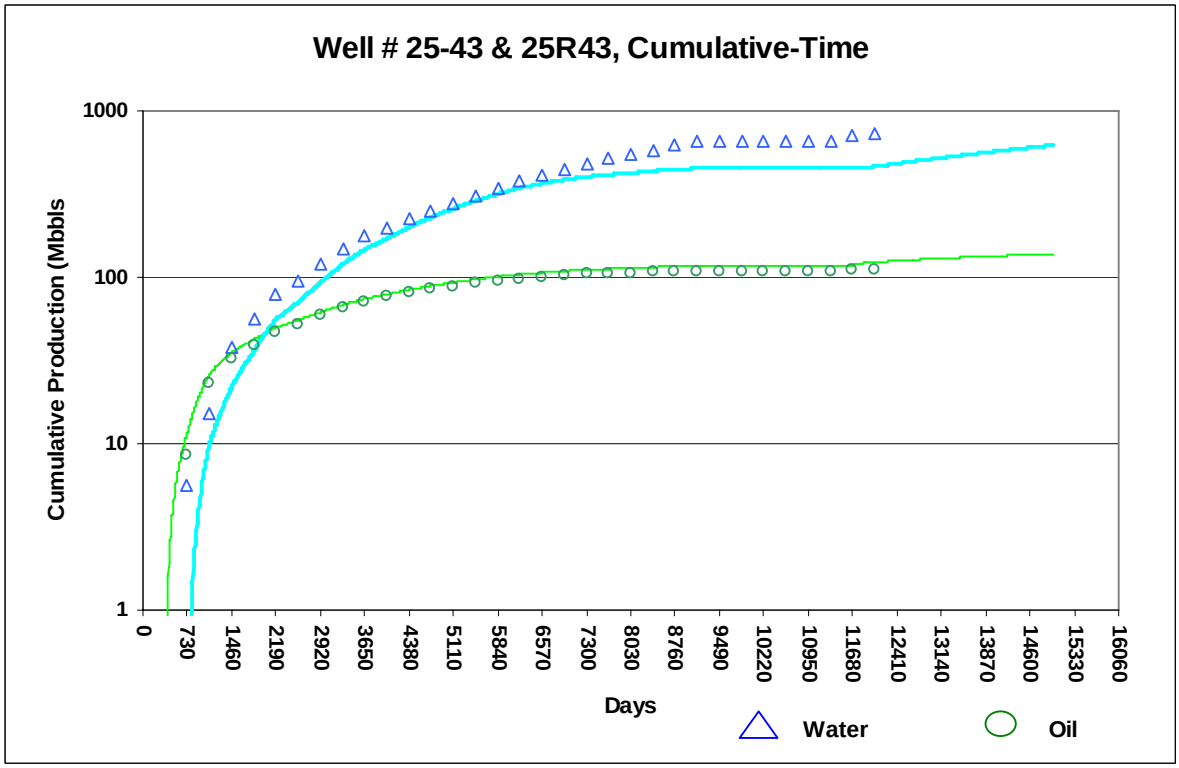

Well # 25-34 & 25R34, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

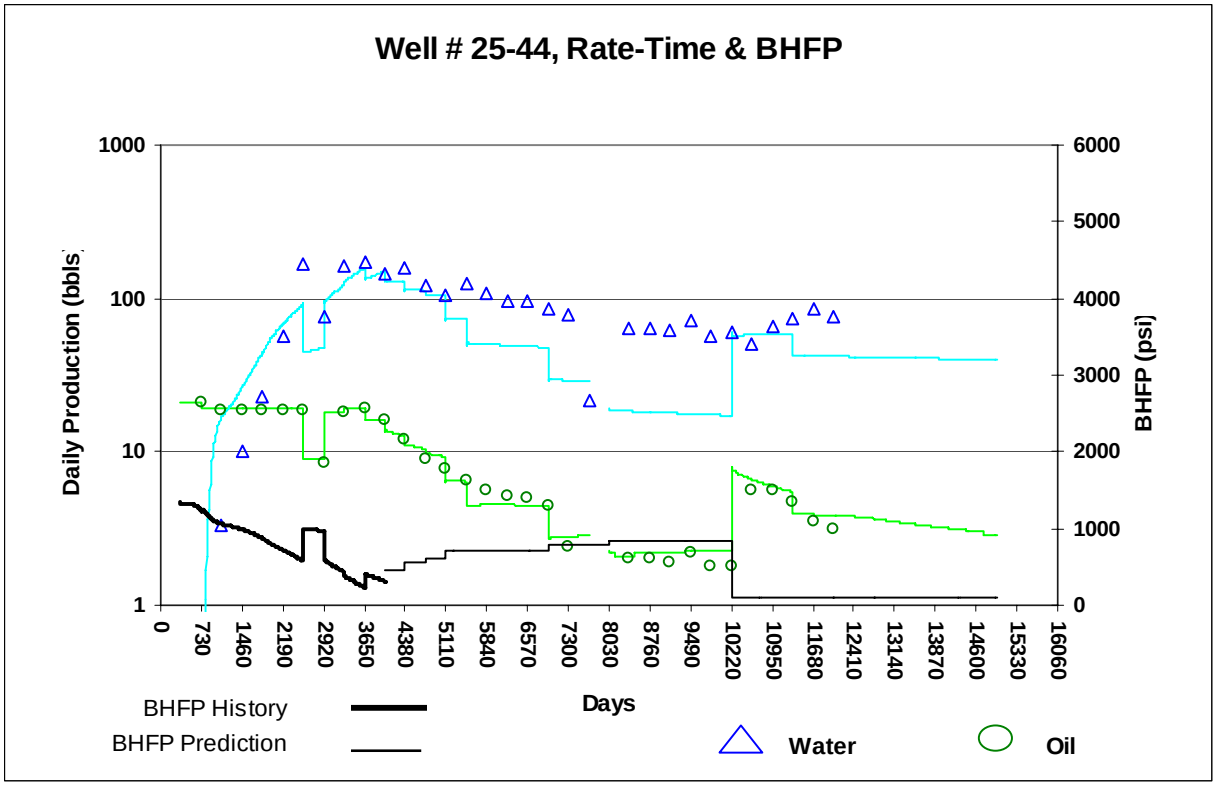

Well # 25-34 & 25R34, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

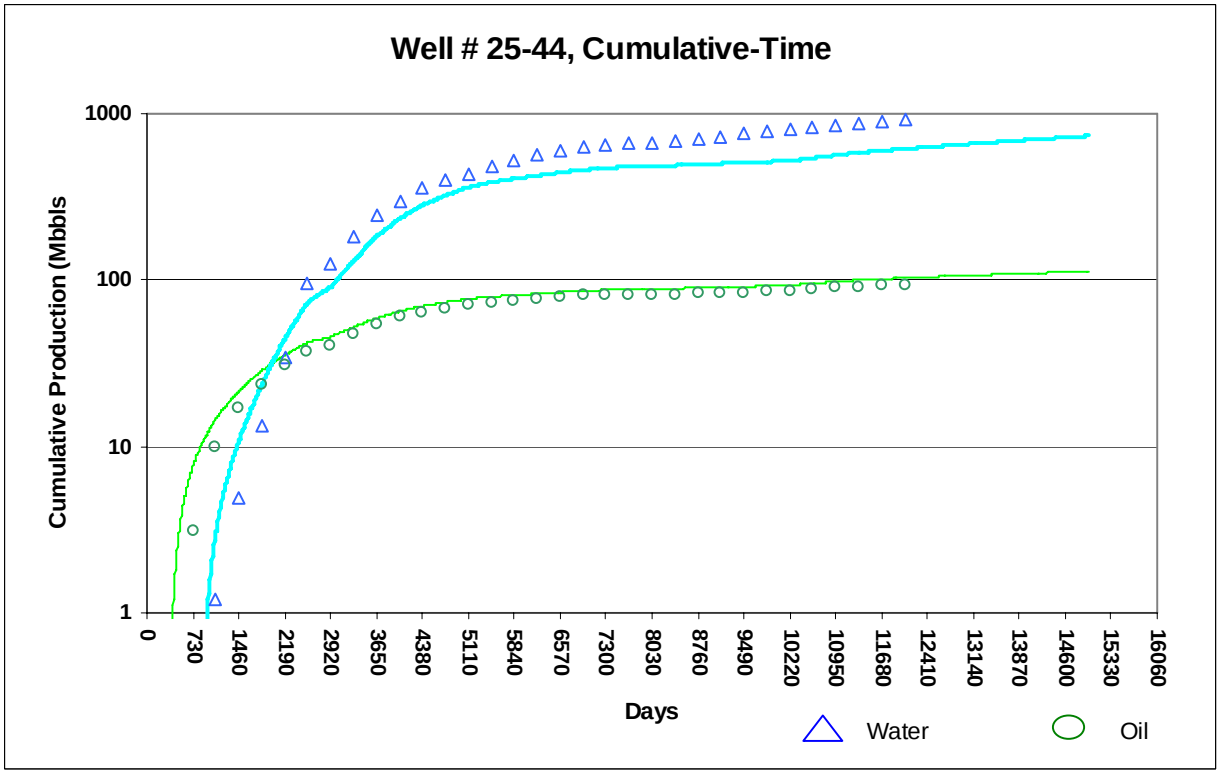

Well # 25-42, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

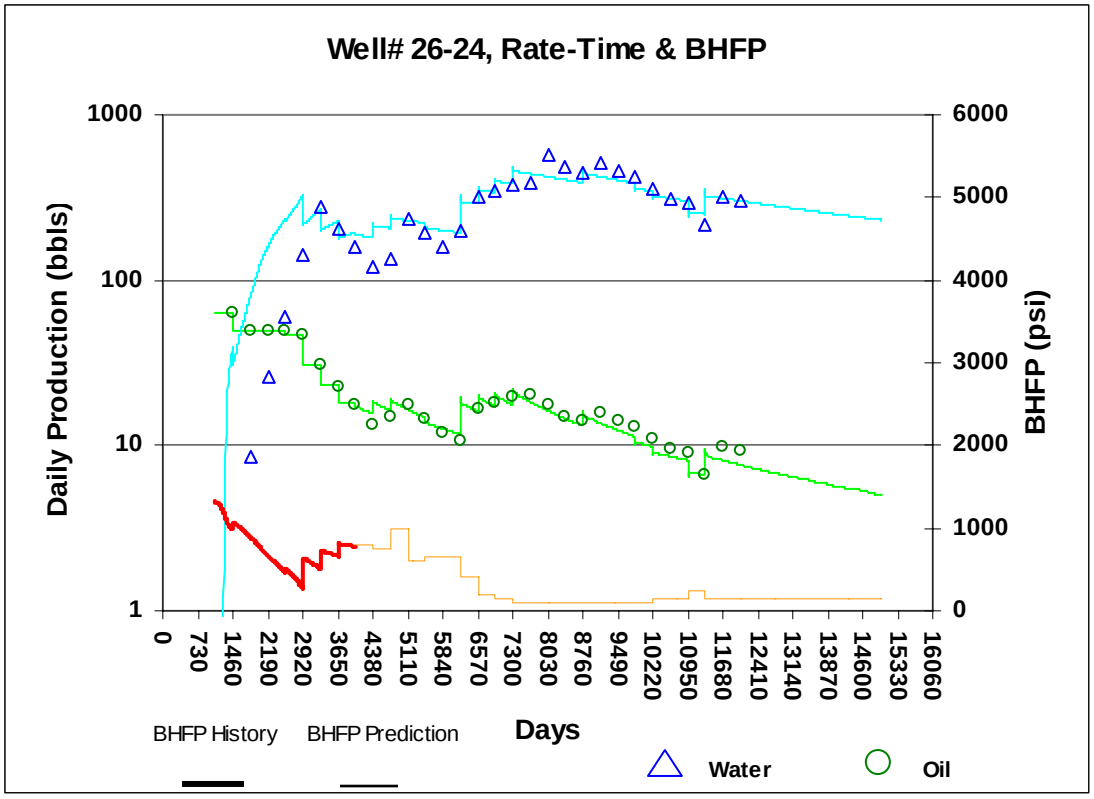

Well # 25-42, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

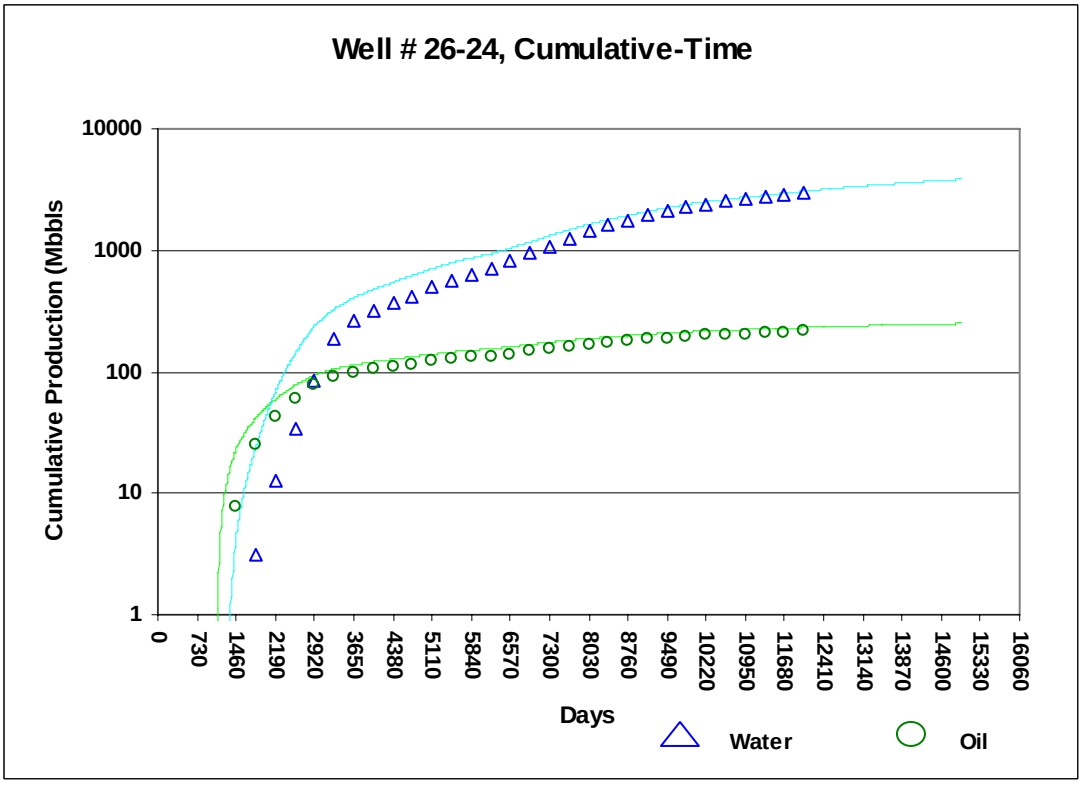

Well # 25-43 & 25R43, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

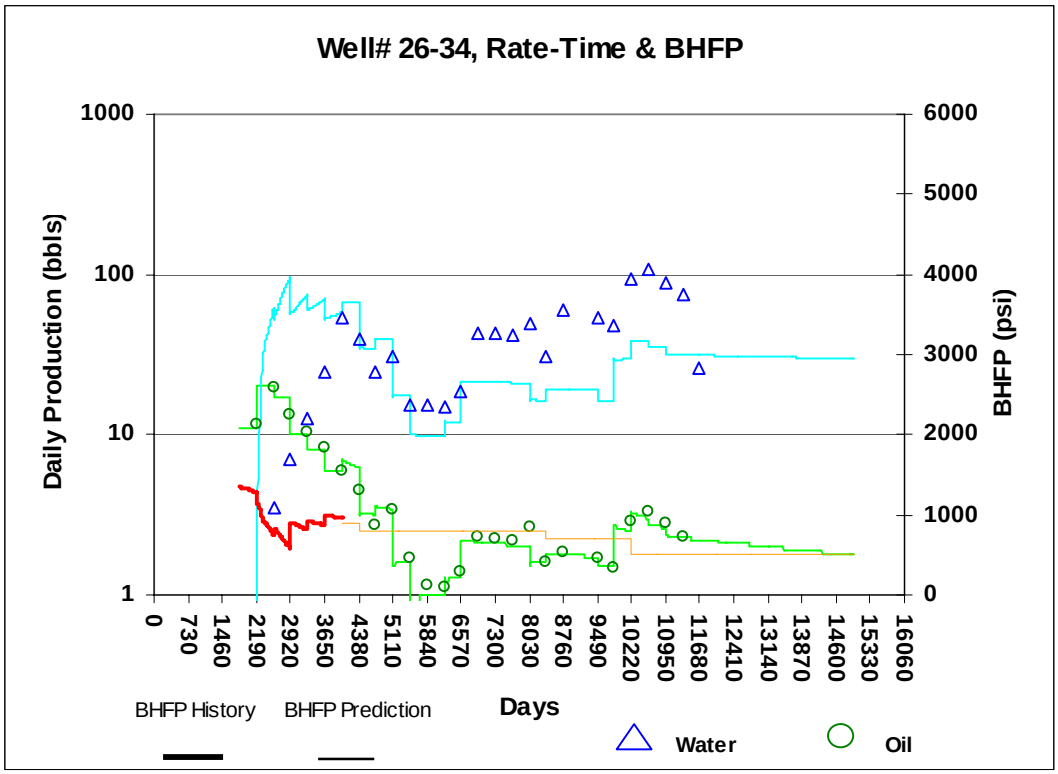

Well # 25-43 & 25R43, Cumulative-Time
Cumulative Production (Mbbls
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

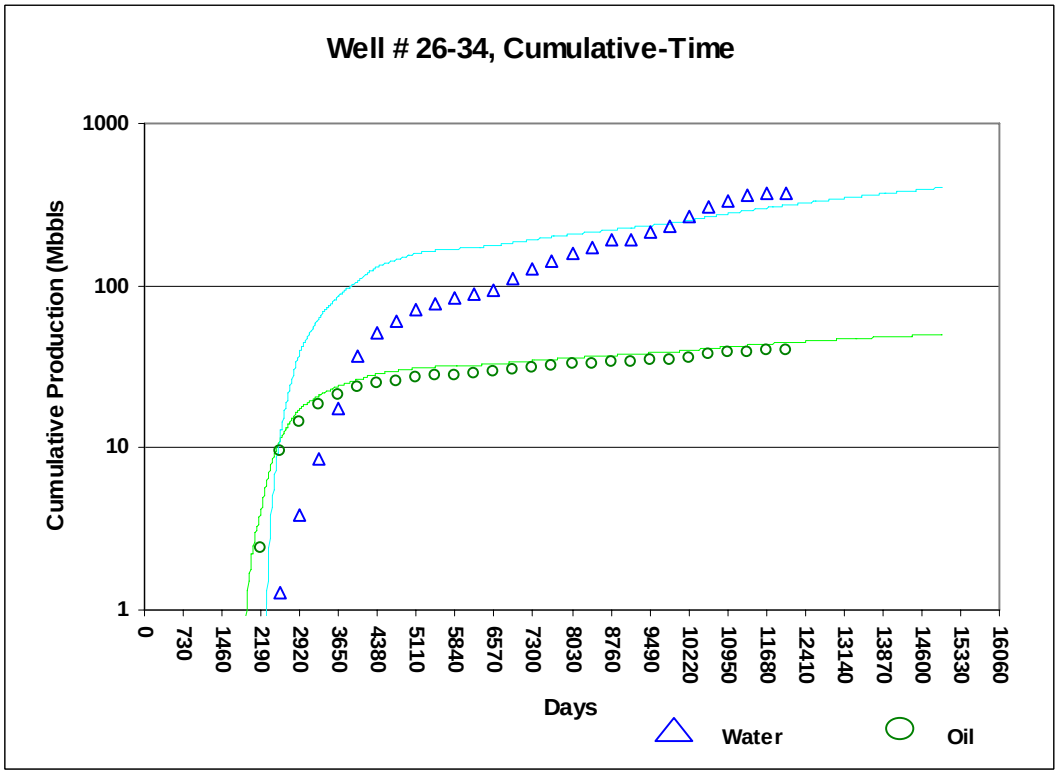

Well # 25-44, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

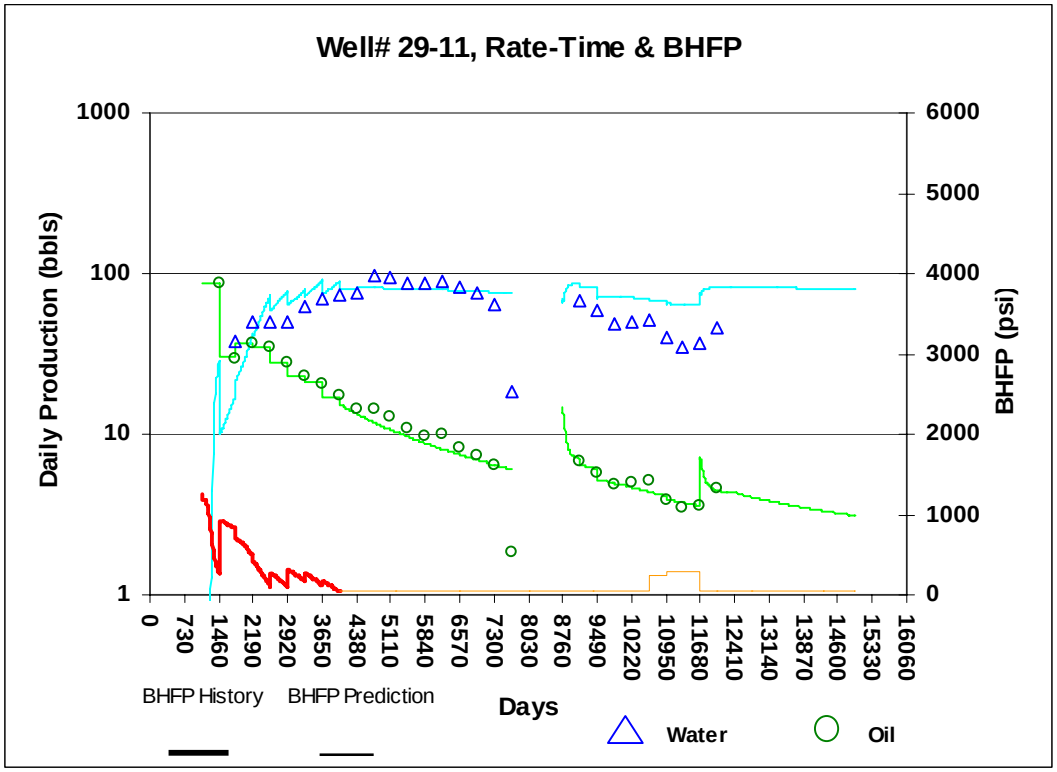

Well # 25-44, Cumulative-Time
Cumulative Production (Mbbls)
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

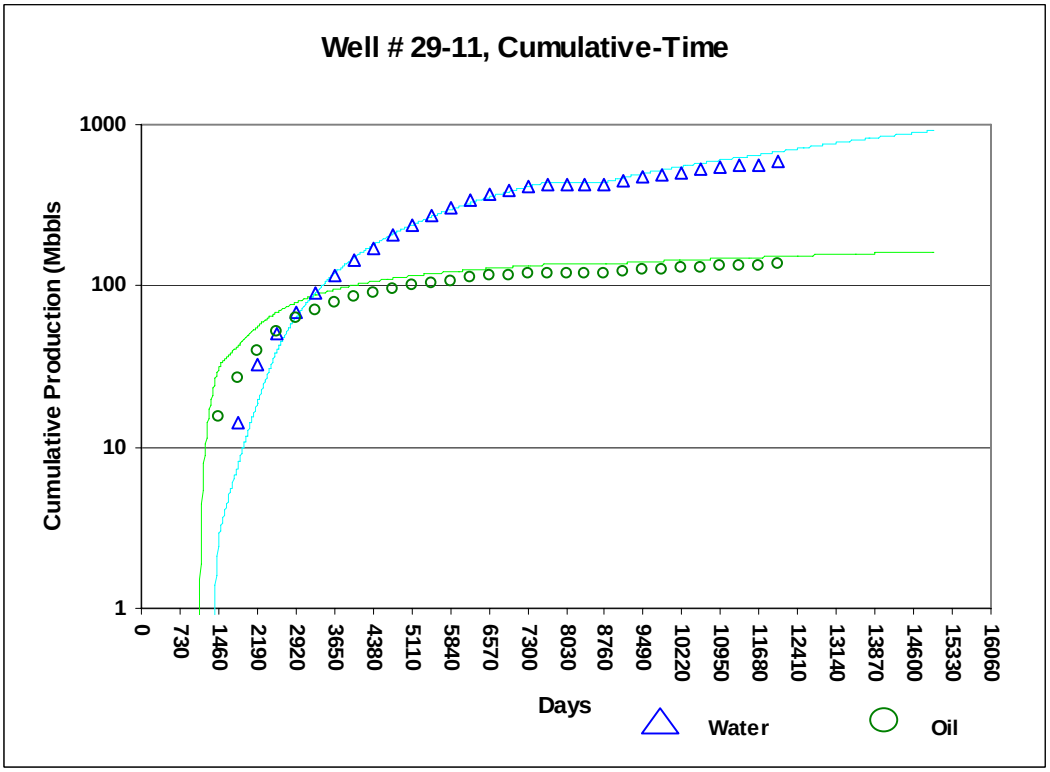

Well# 26-24, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

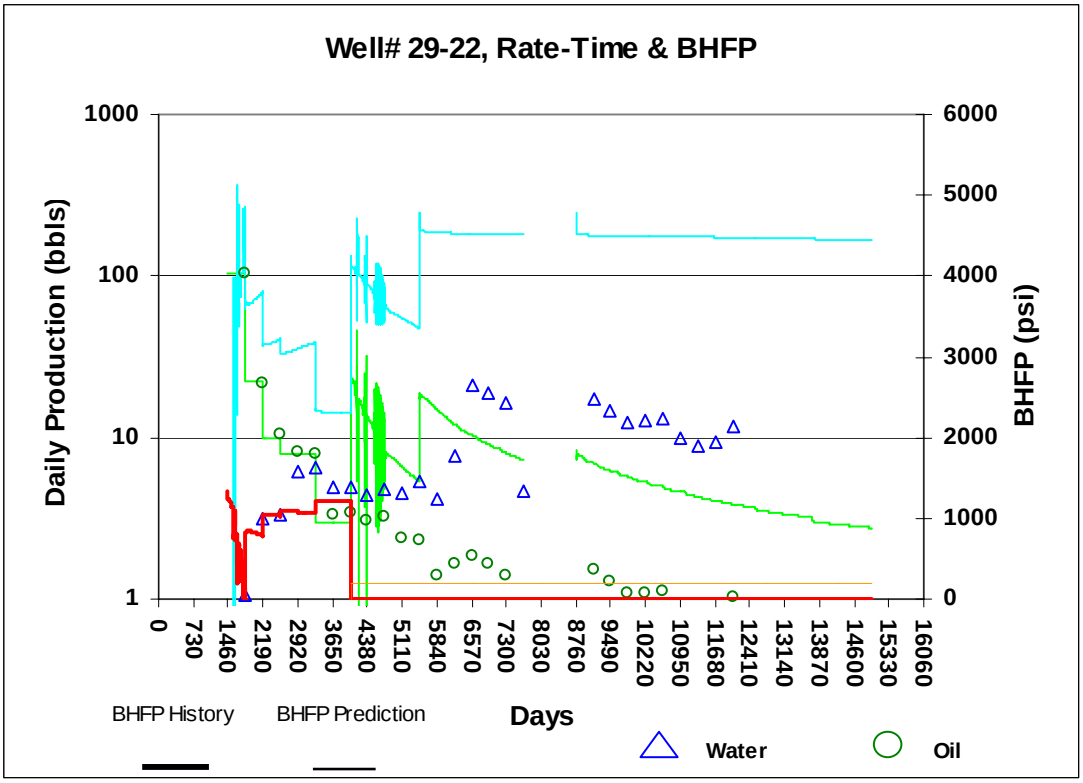

Well # 26-24, Cumulative-Time
Cumulative Production (Mbbls
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

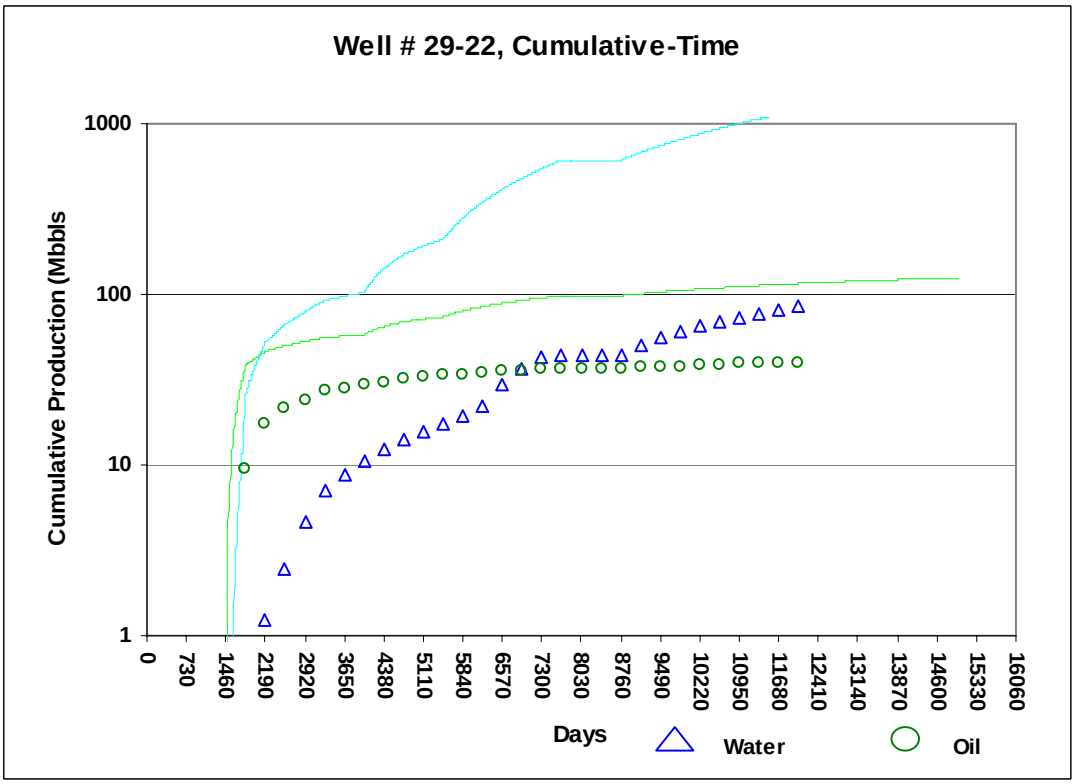

Well# 26-34, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

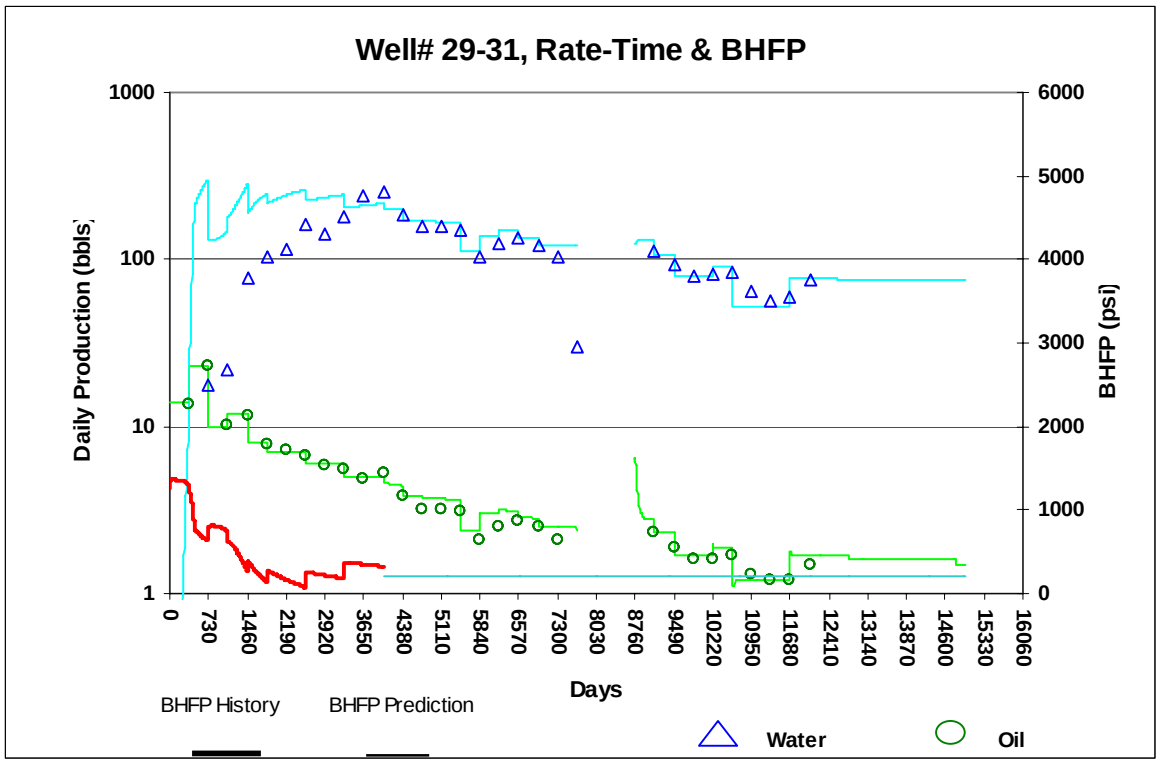

Well # 26-34, Cumulative-Time
Cumulative Production (Mbbls
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

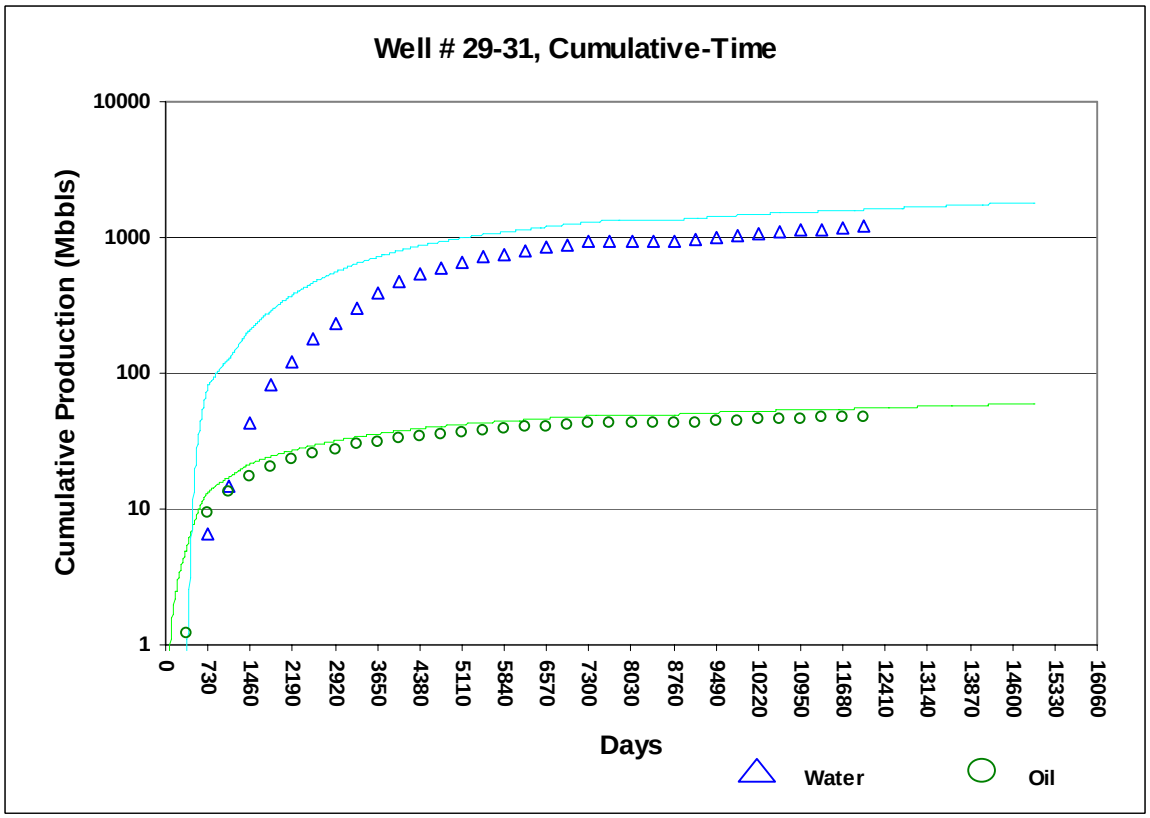

Well# 29-11, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

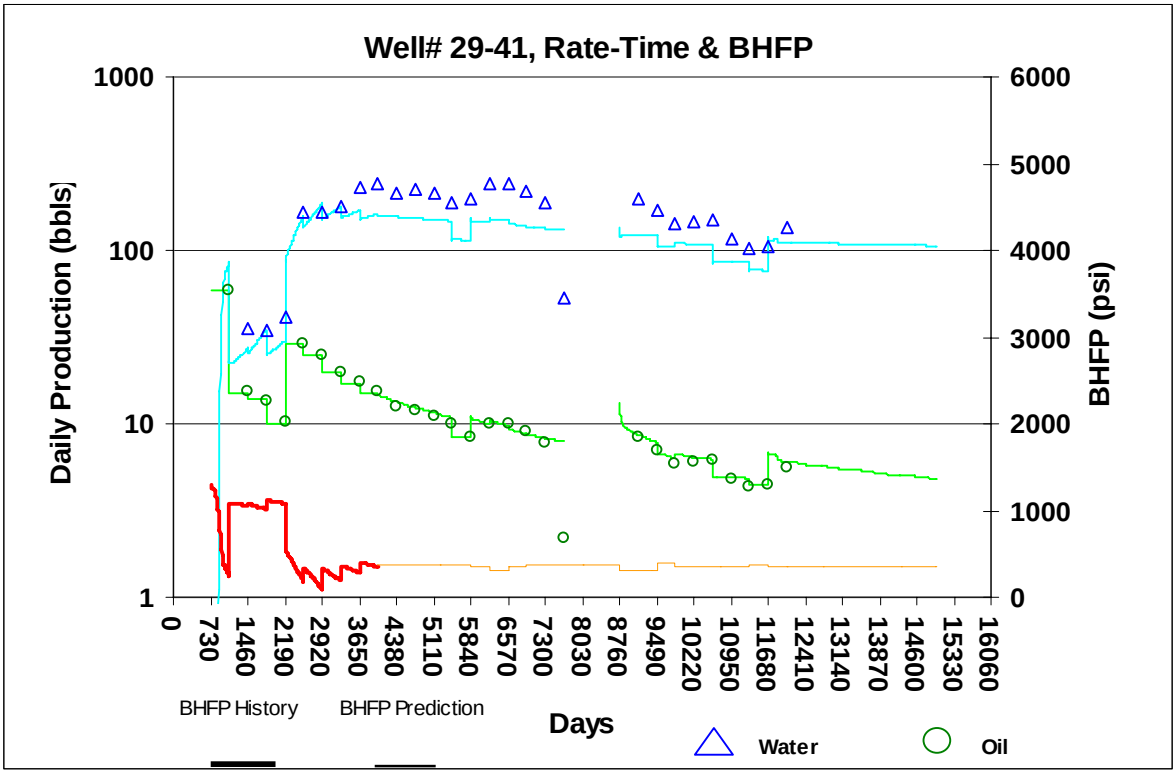

Well # 29-11, Cumulative-Time
Cumulative Production (Mbbls
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

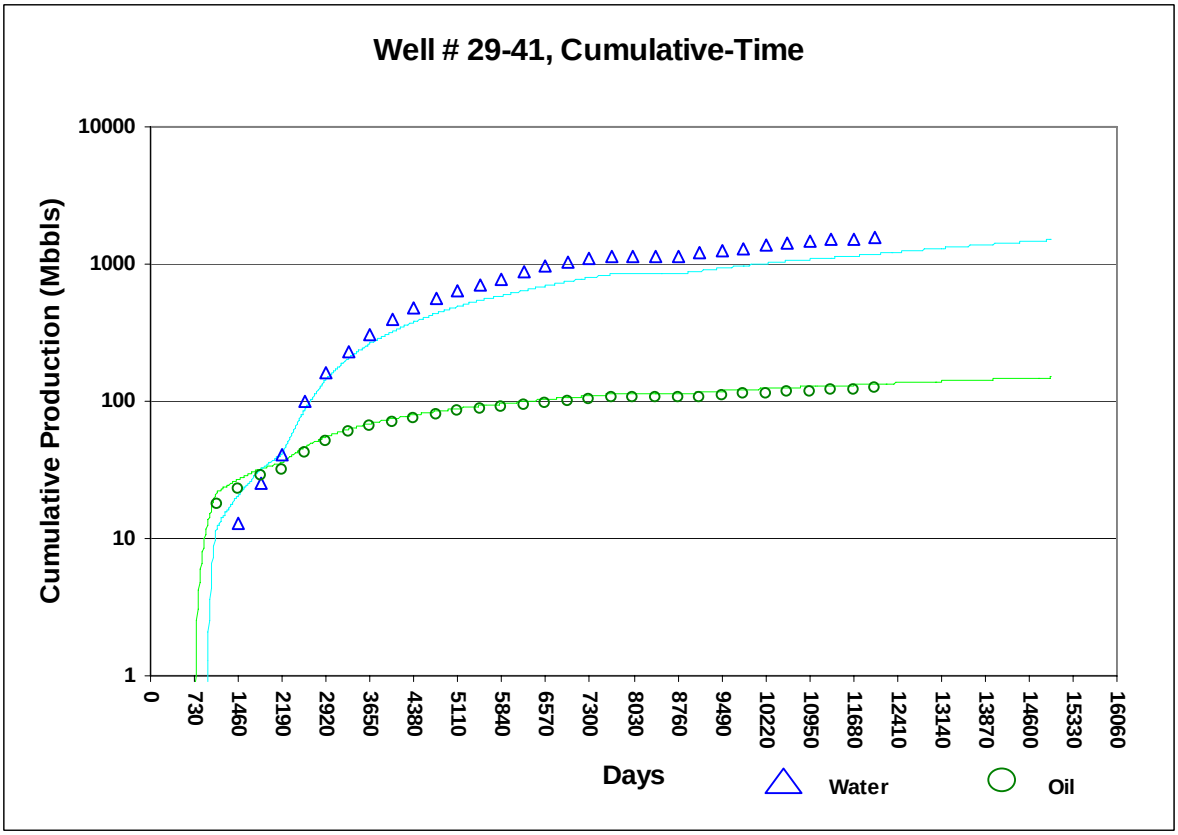

Well# 29-22, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

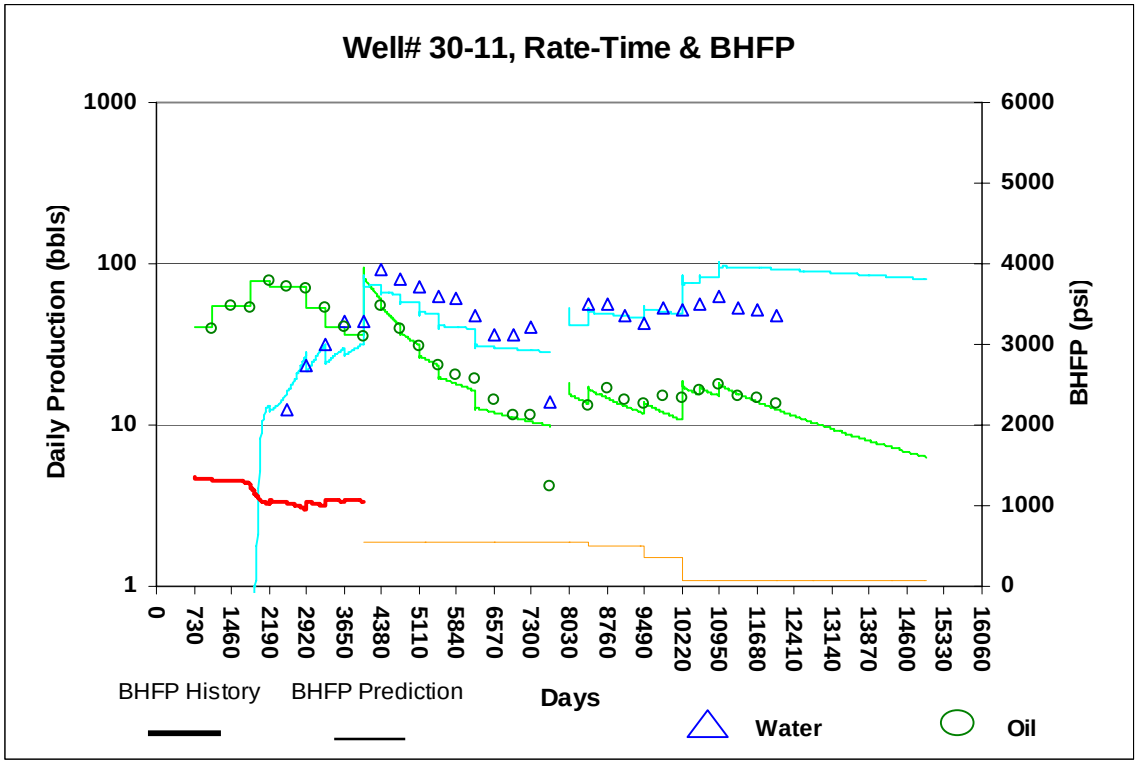

Well # 29-22, Cumulative-Time
Cumulative Production (Mbbls
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

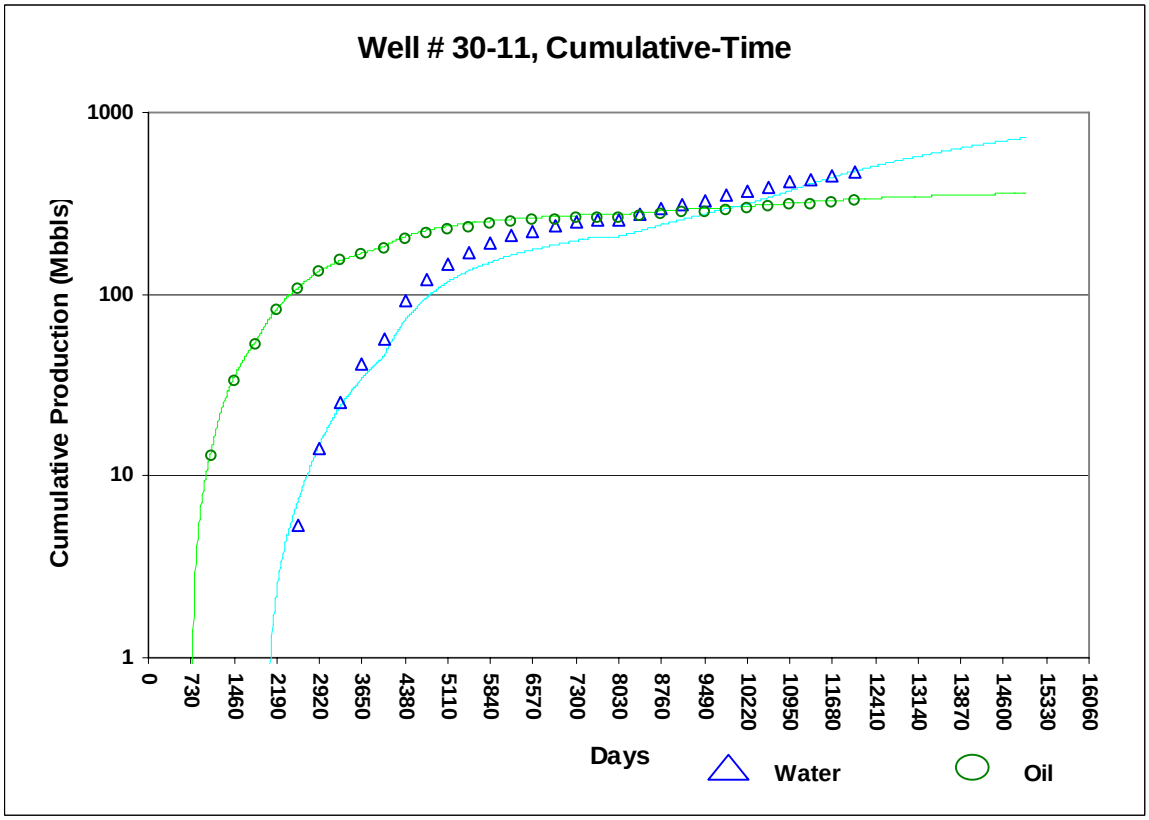

Well# 29-31, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

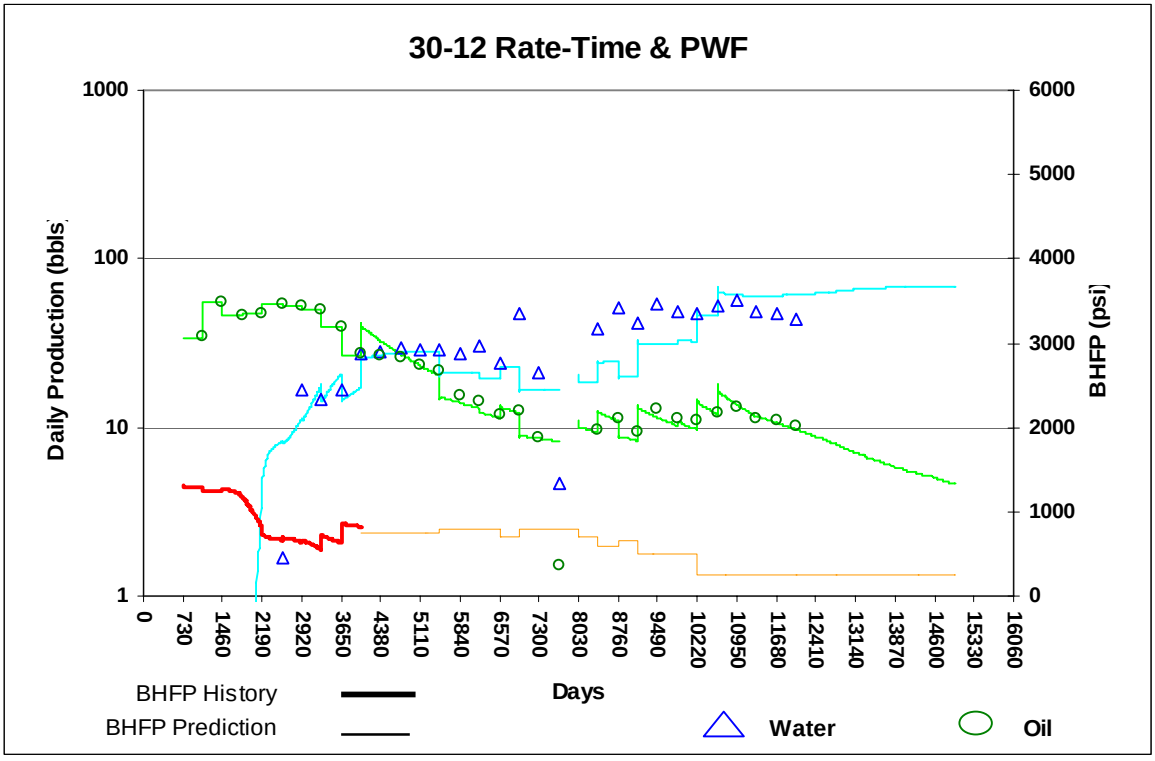

Well # 29-31, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

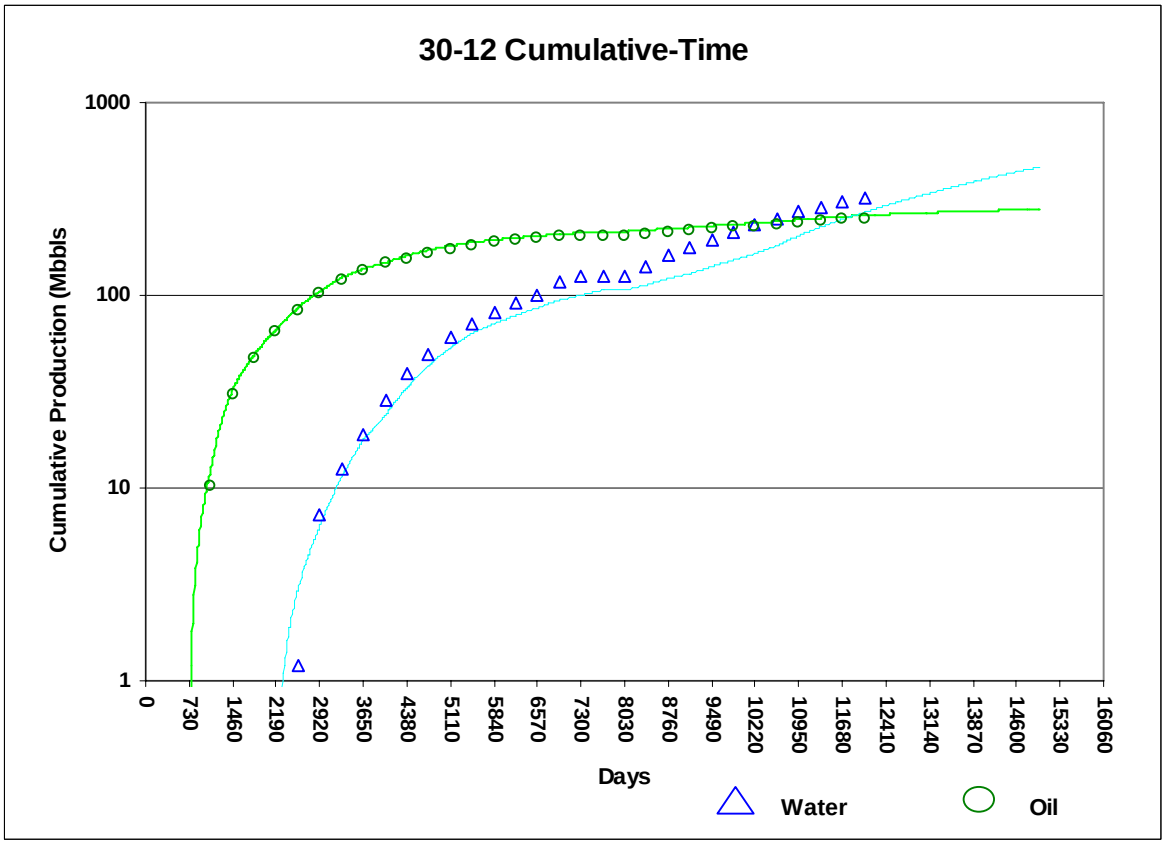

Well# 29-41, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

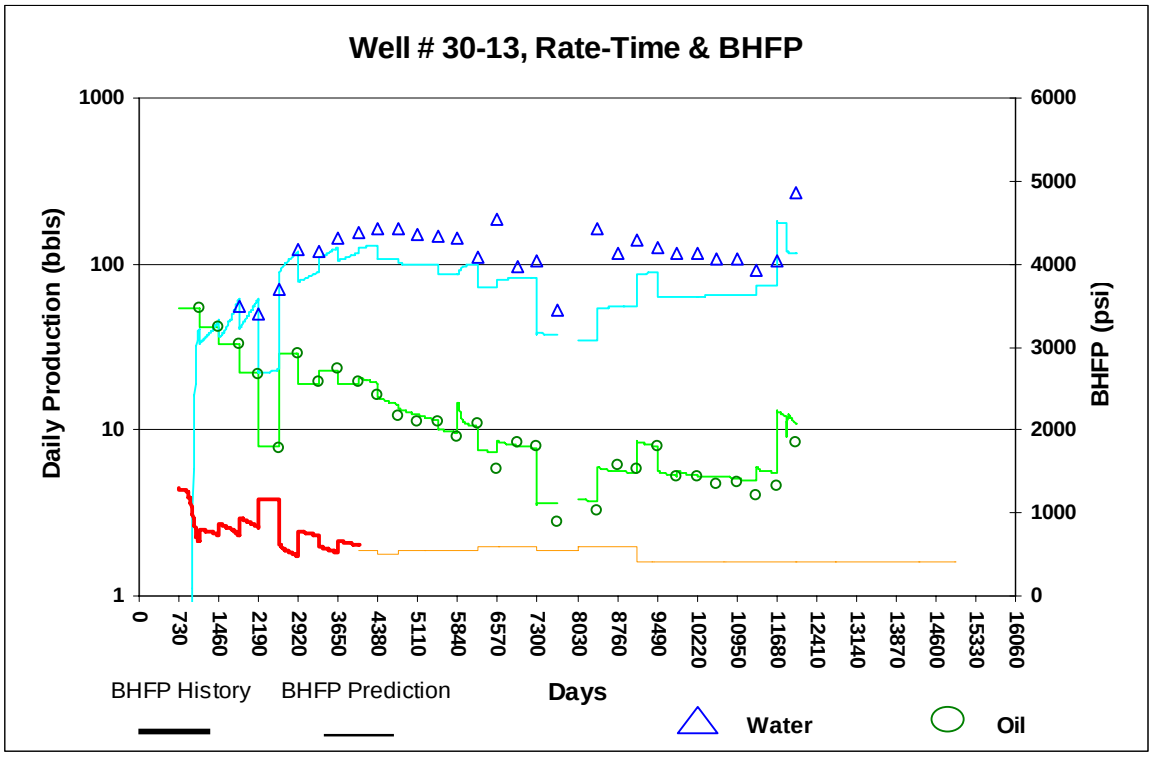

Well # 29-41, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

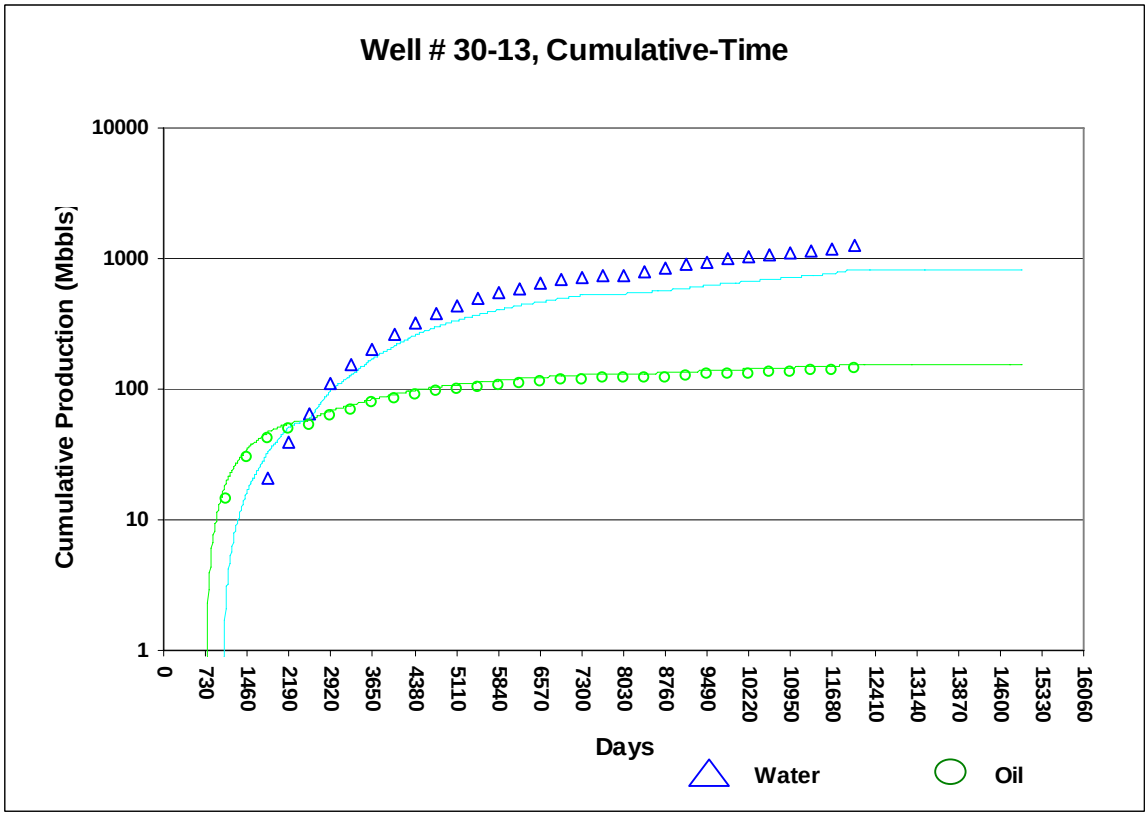

Well# 30-11, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

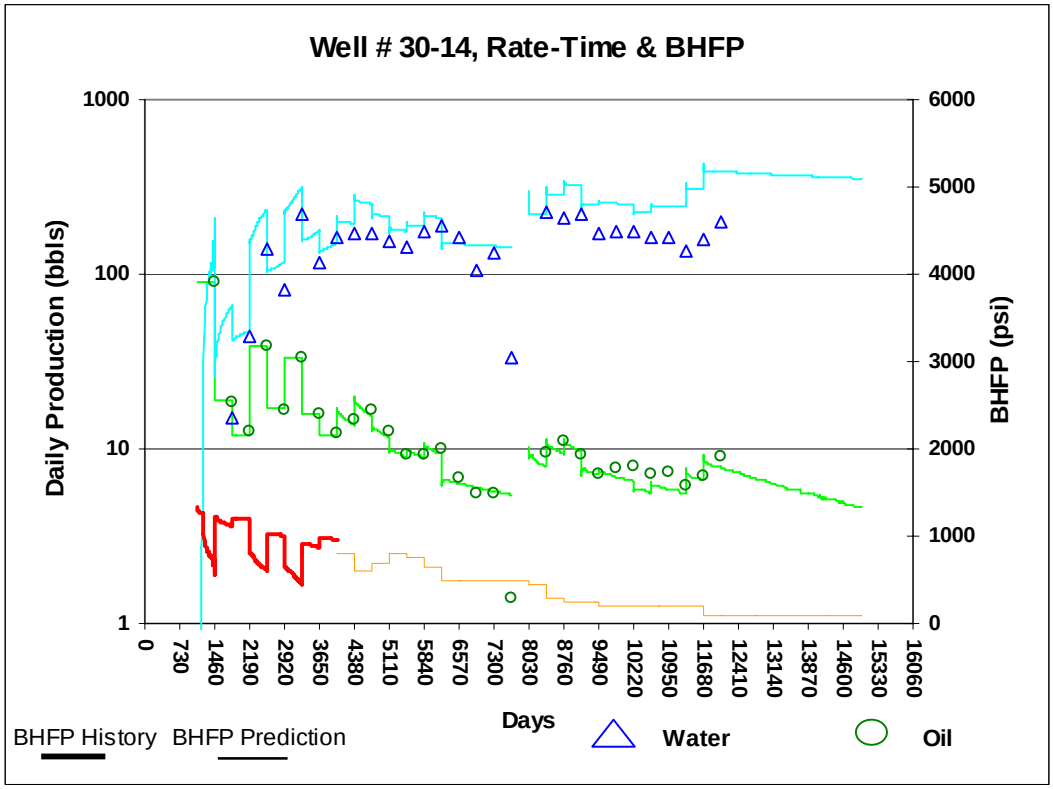

Well # 30-11, Cumulative-Time
Cumulative Production (Mbbls)
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

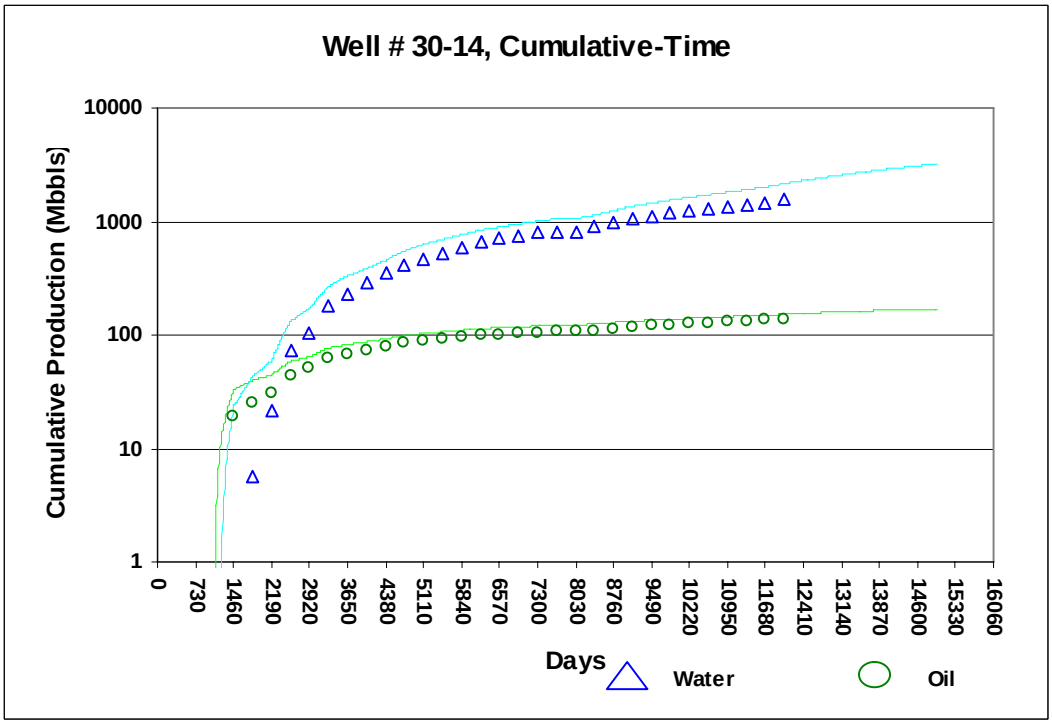

30-12 Rate-Time & PWF
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

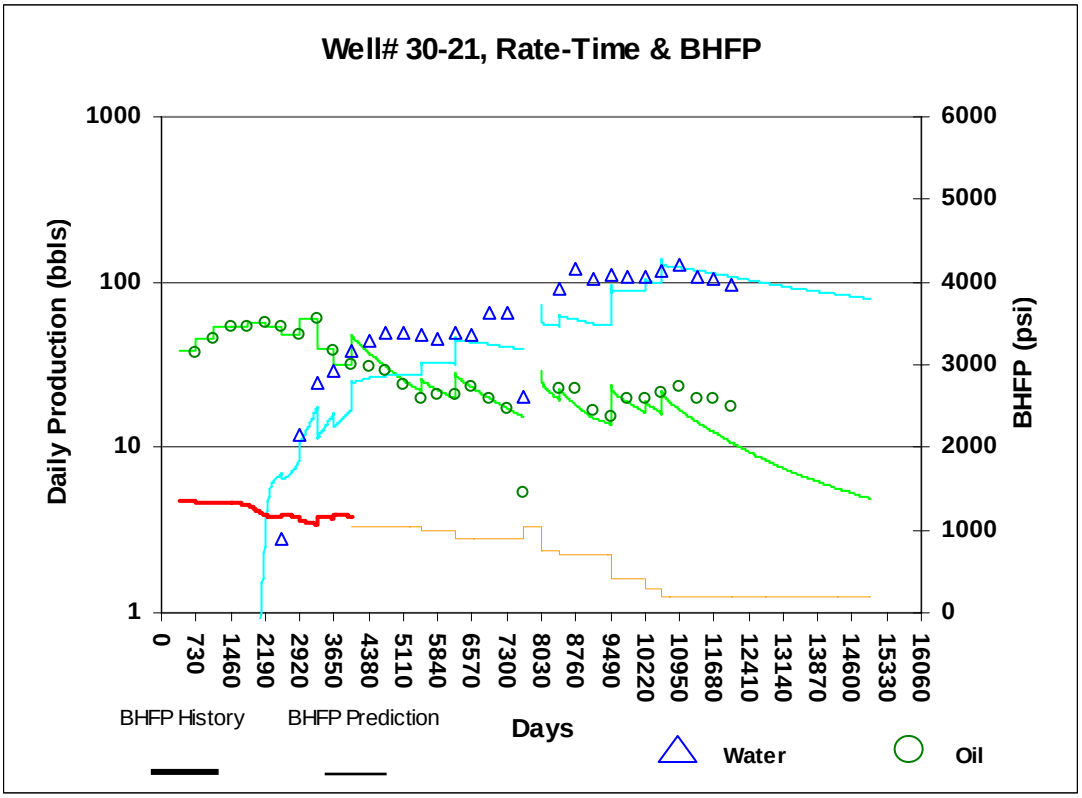

30-12 Cumulative-Time
Cumulative Production (Mbbls
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

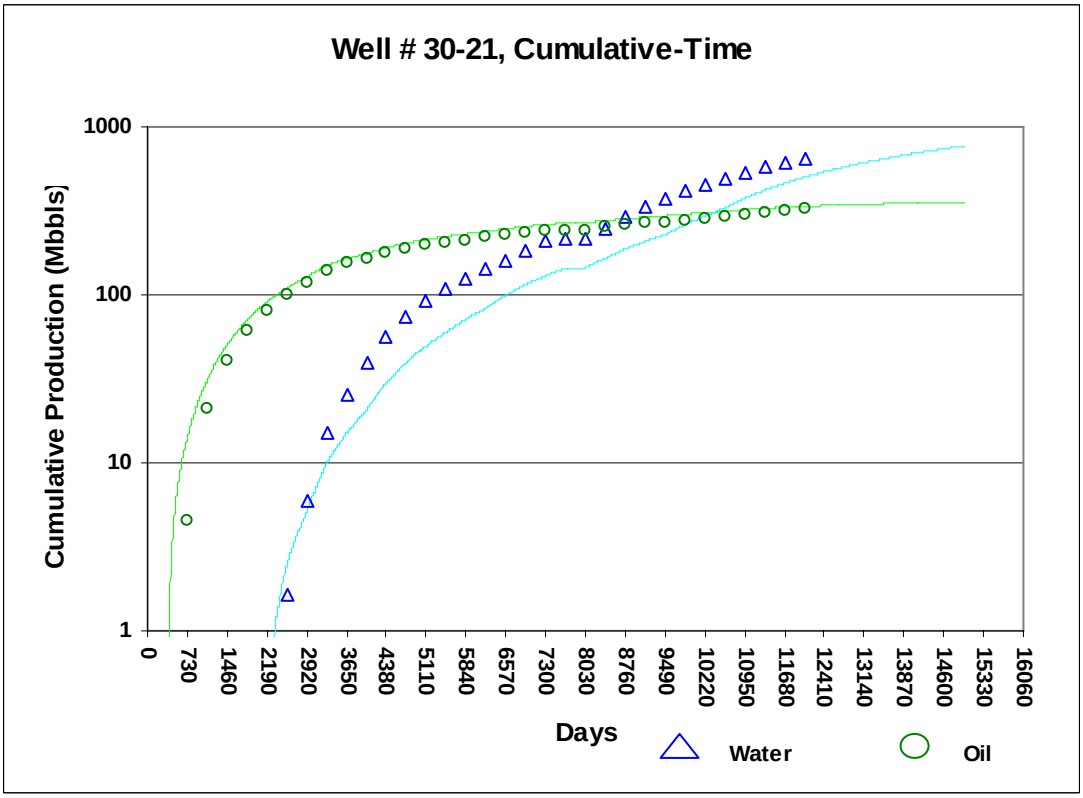

Well # 30-13, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

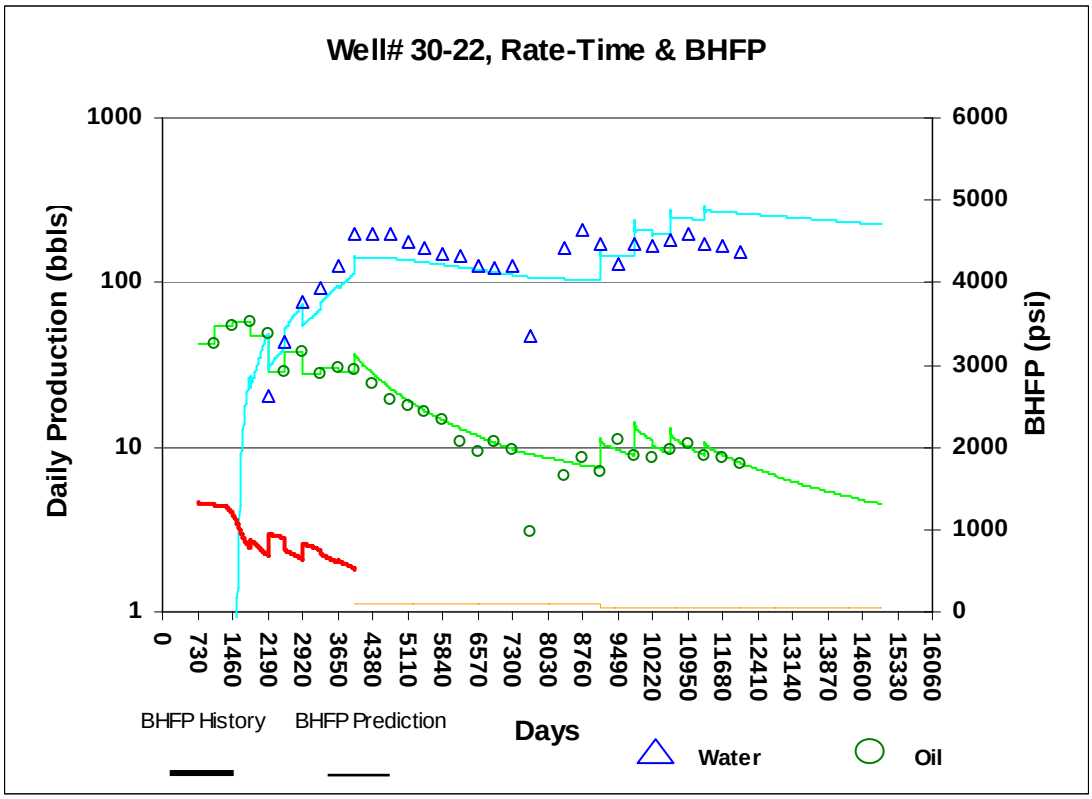

Well # 30-13, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

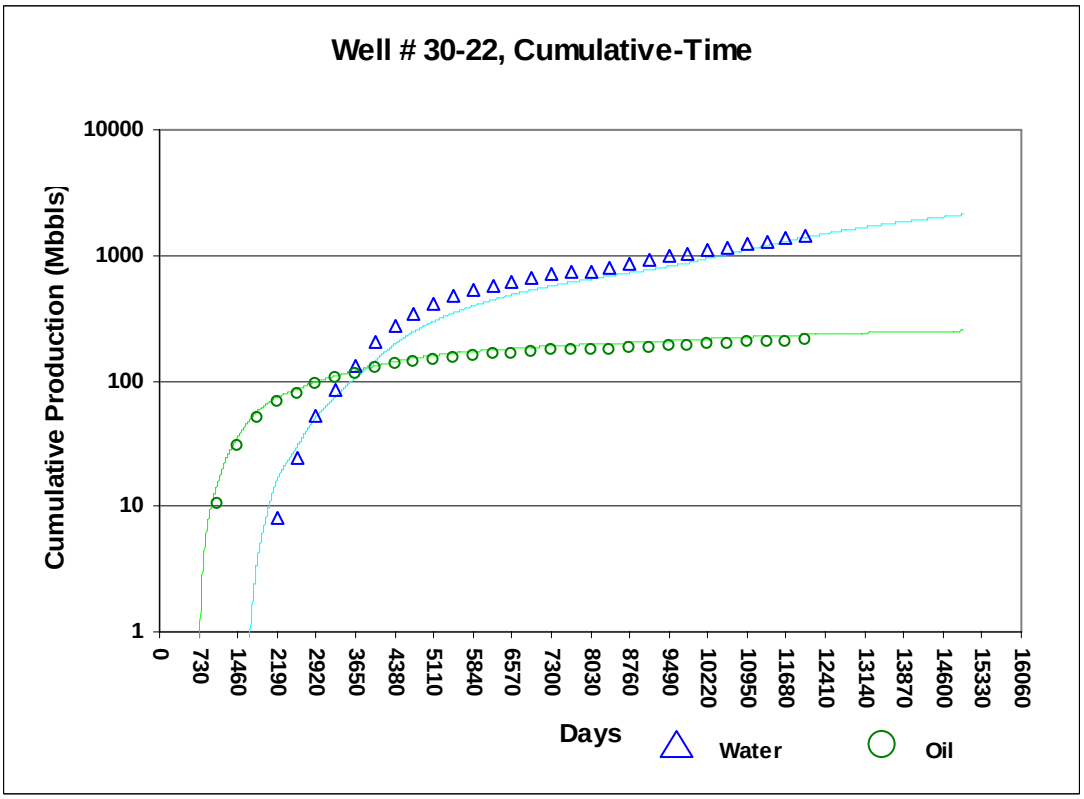

Well # 30-14, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

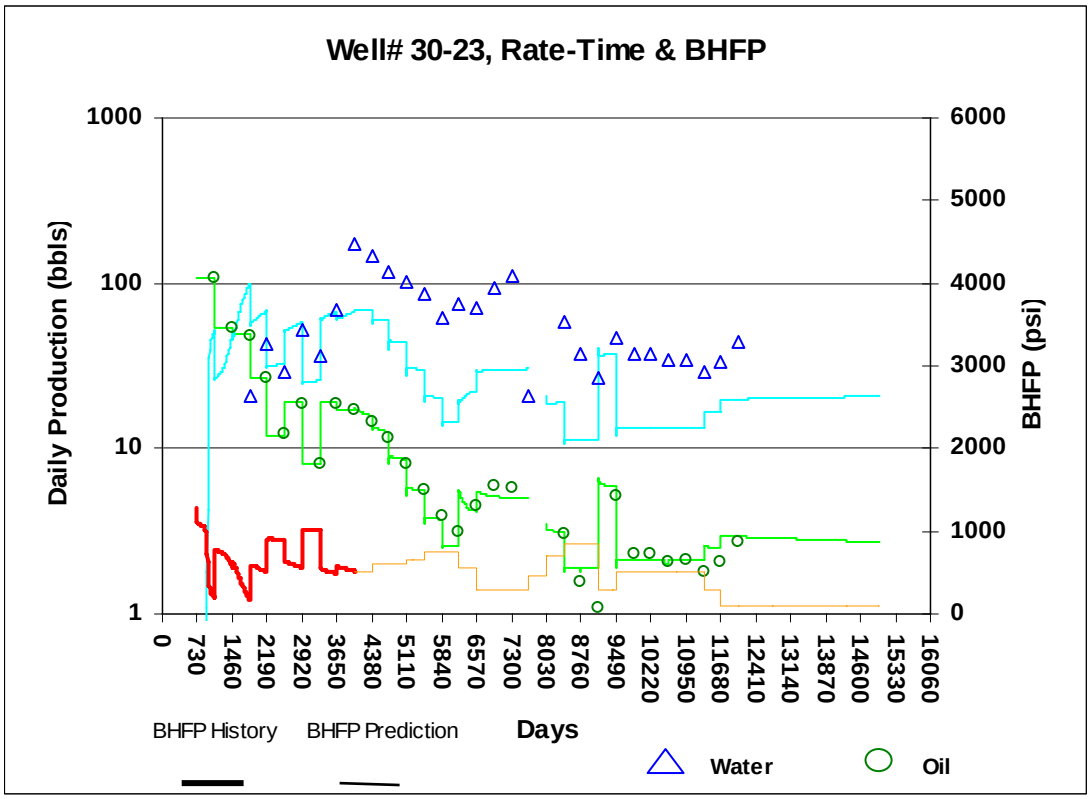

Well # 30-14, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

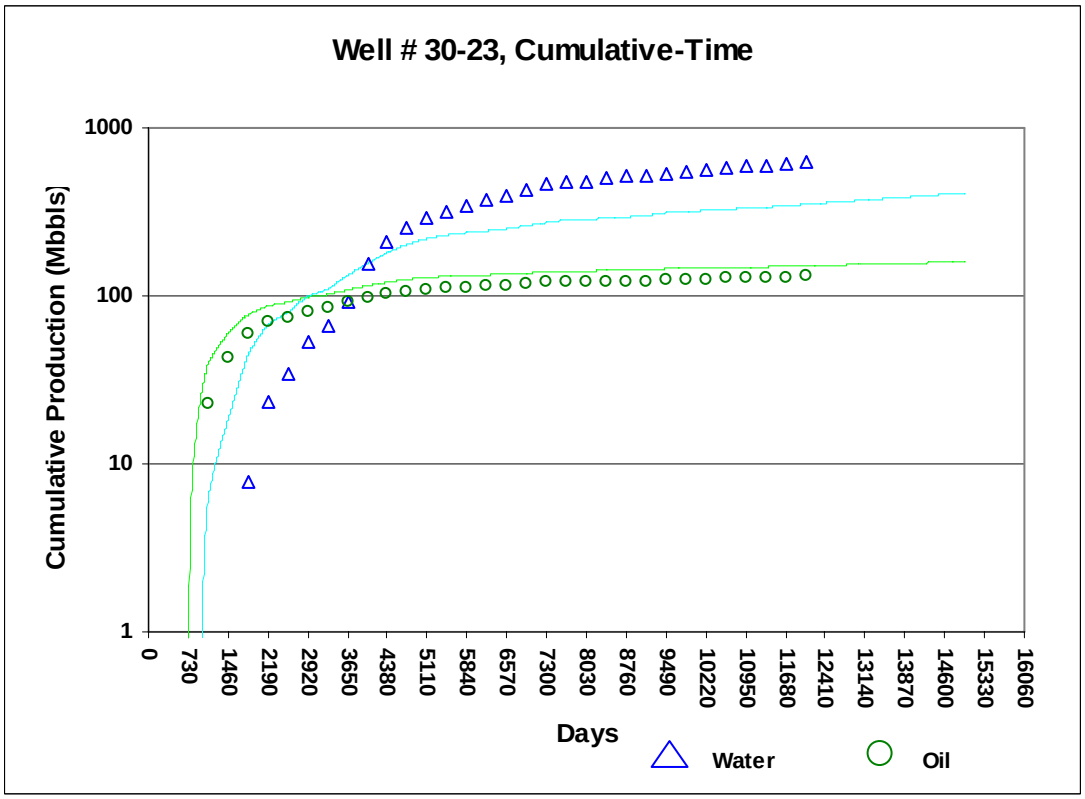

Well# 30-21, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

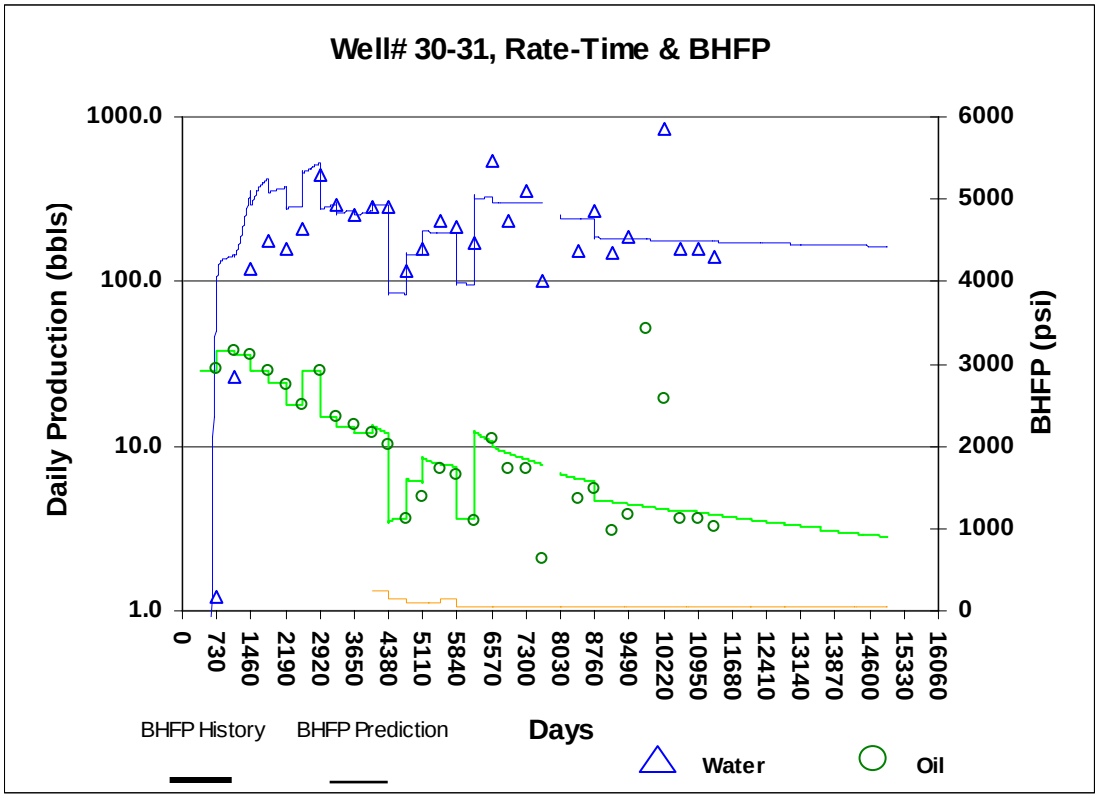

Well # 30-21, Cumulative-Time
Cumulative Production (Mbbls)
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

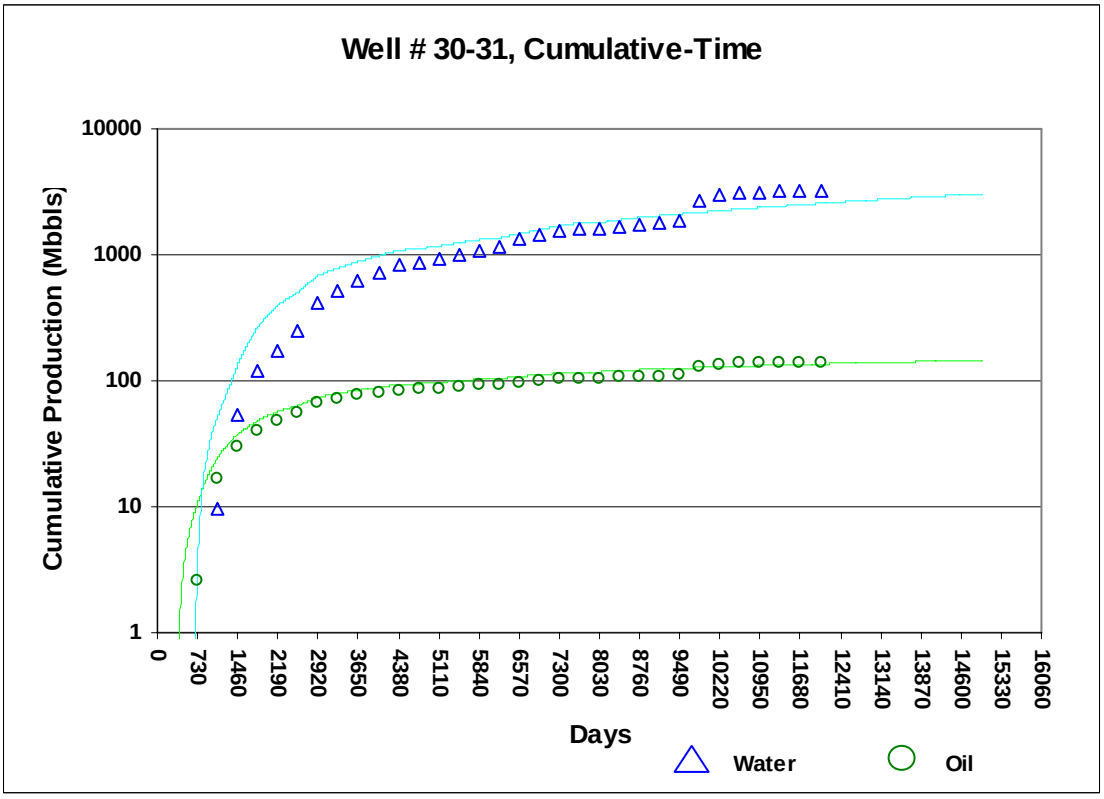

Well# 30-22, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

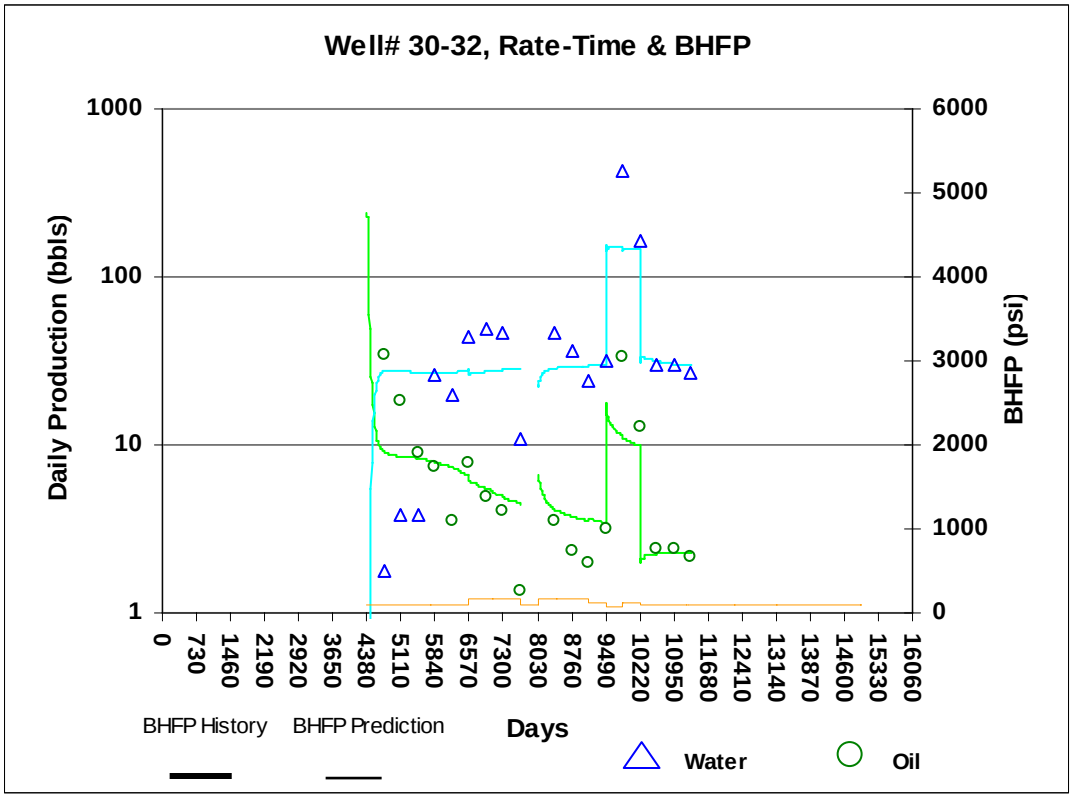

Well # 30-22, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

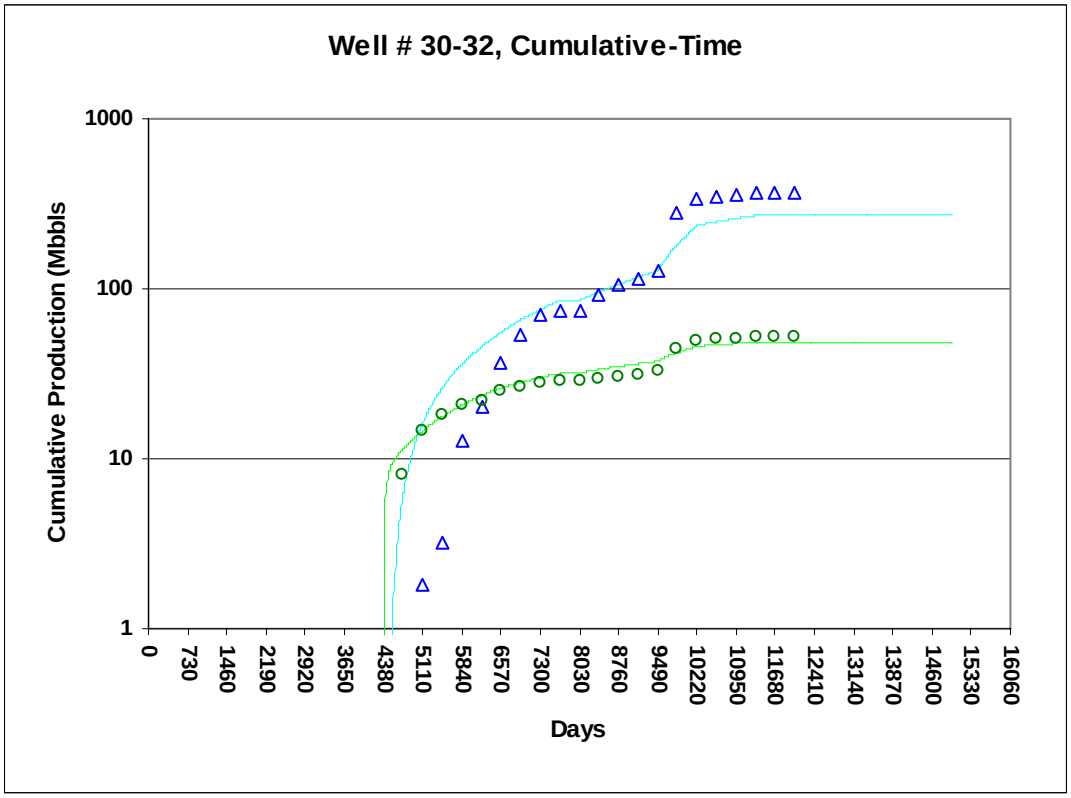

Well# 30-23, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

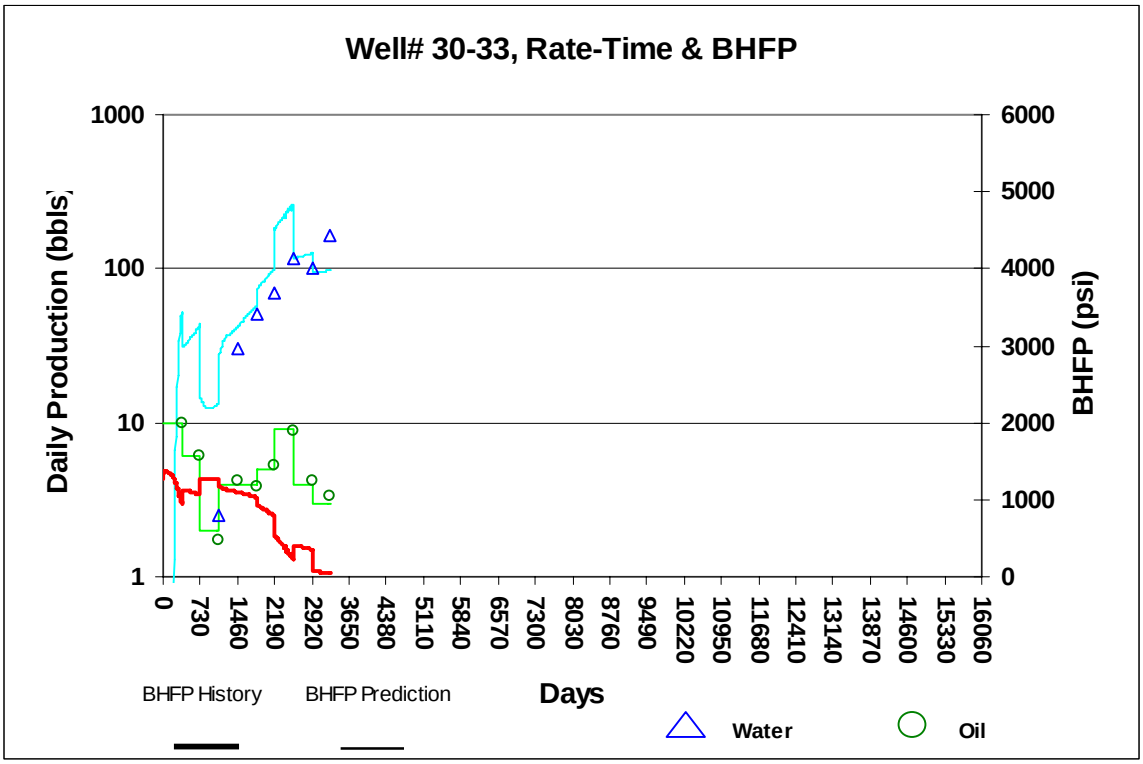

Well # 30-23, Cumulative-Time
Cumulative Production (Mbbls)
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

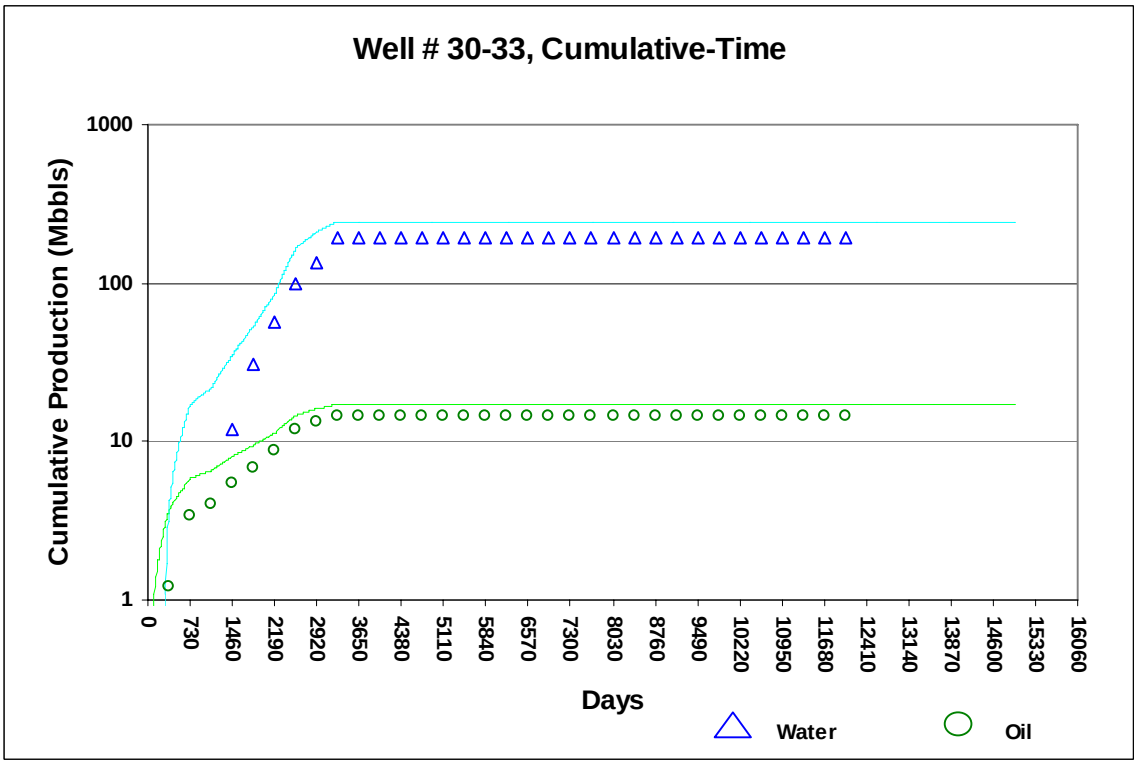

Well# 30-31, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000.0
100.0
10.0
1.0
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

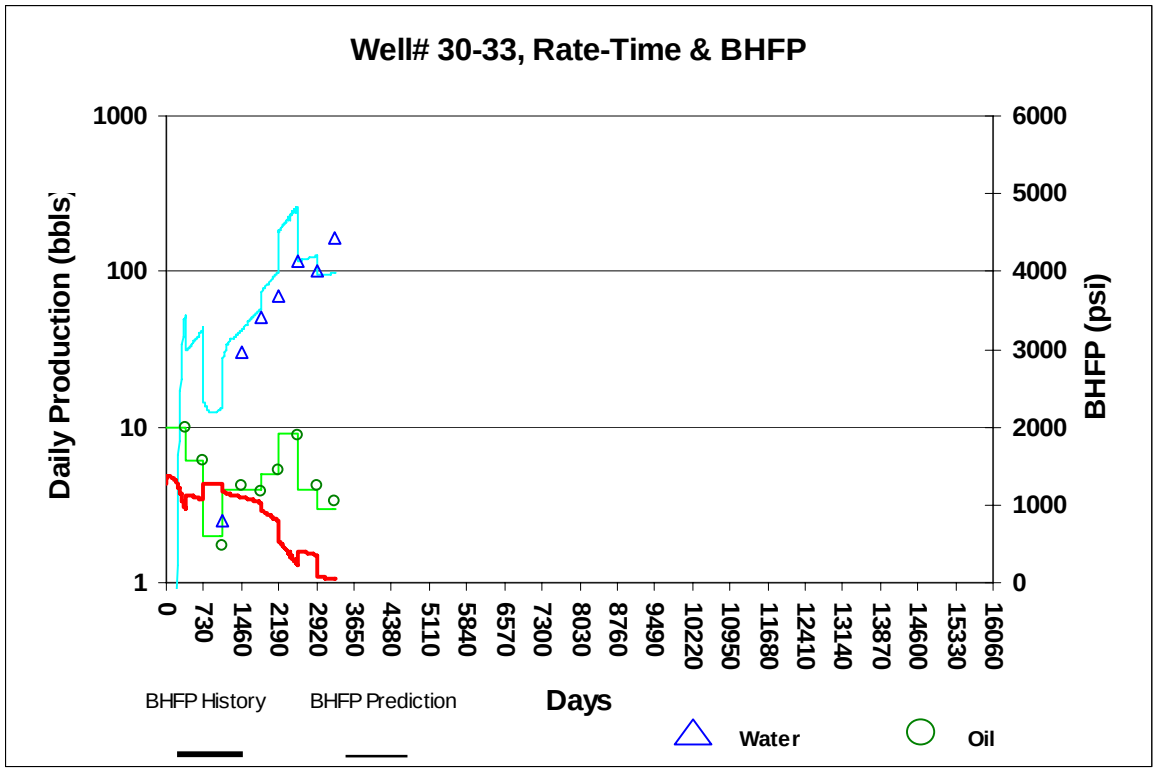

Well # 30-31, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

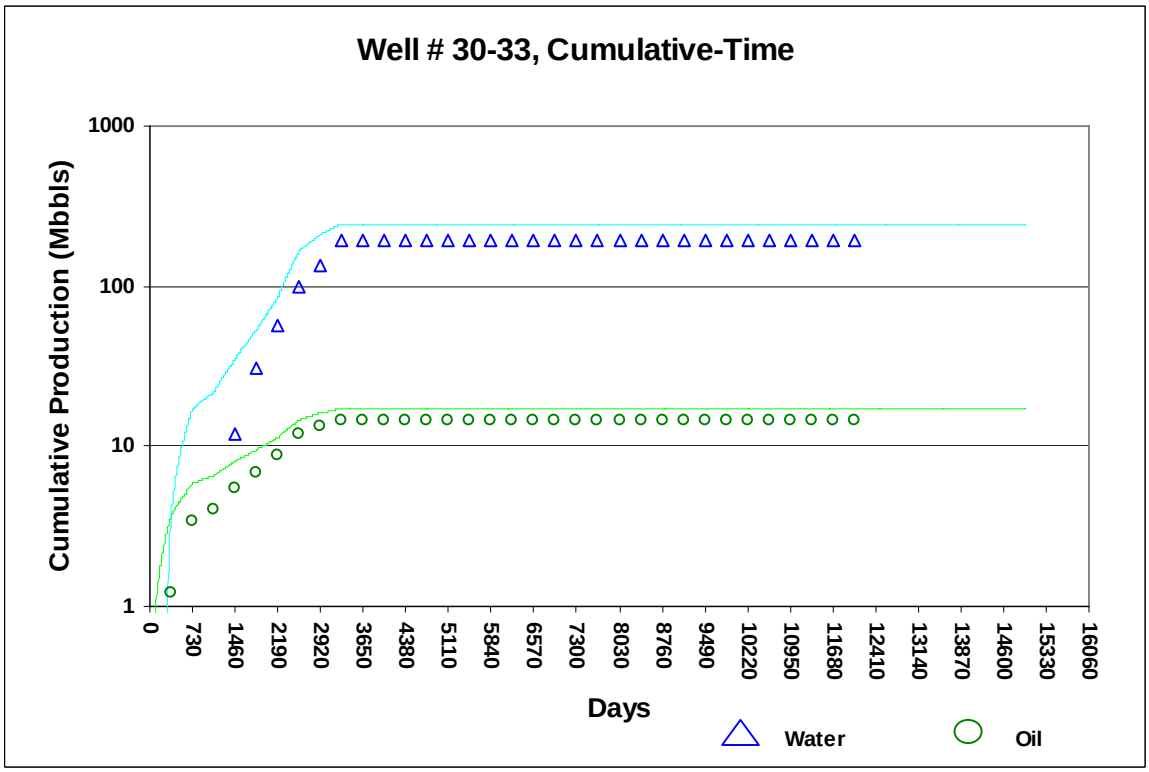

Well# 30-32, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

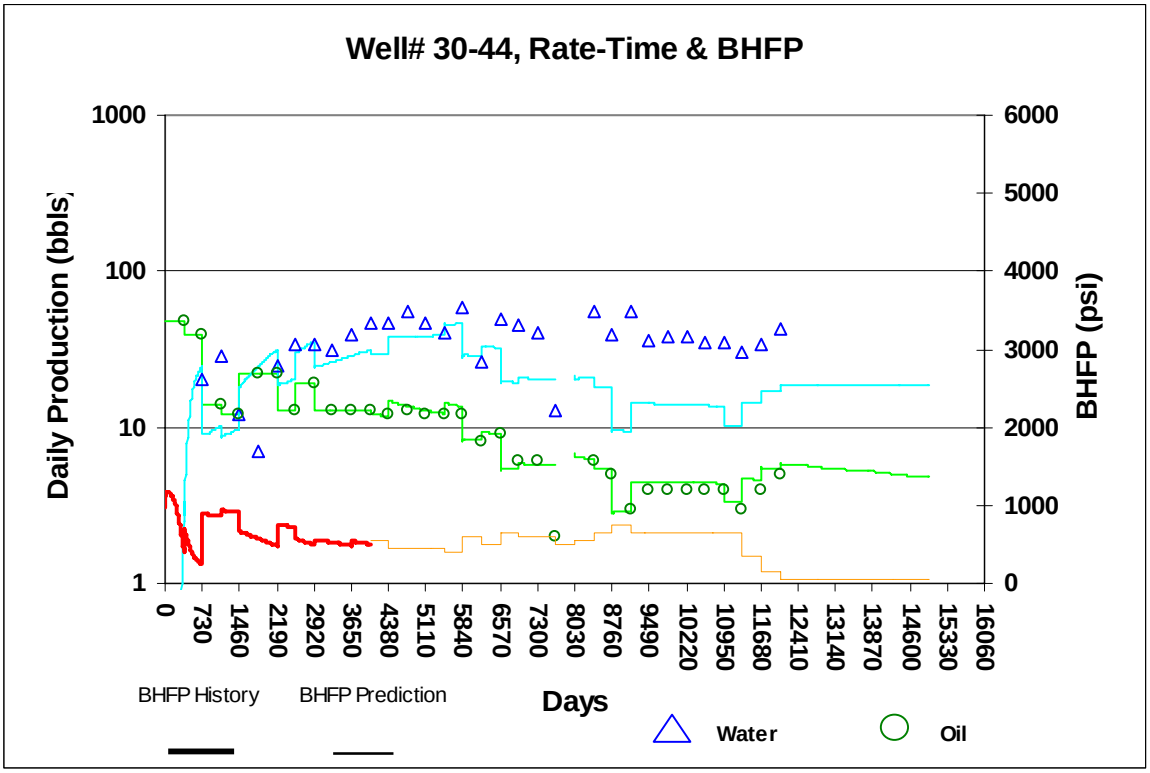

Well # 30-32, Cumulative-Time
Cumulative Production (Mbbls
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days

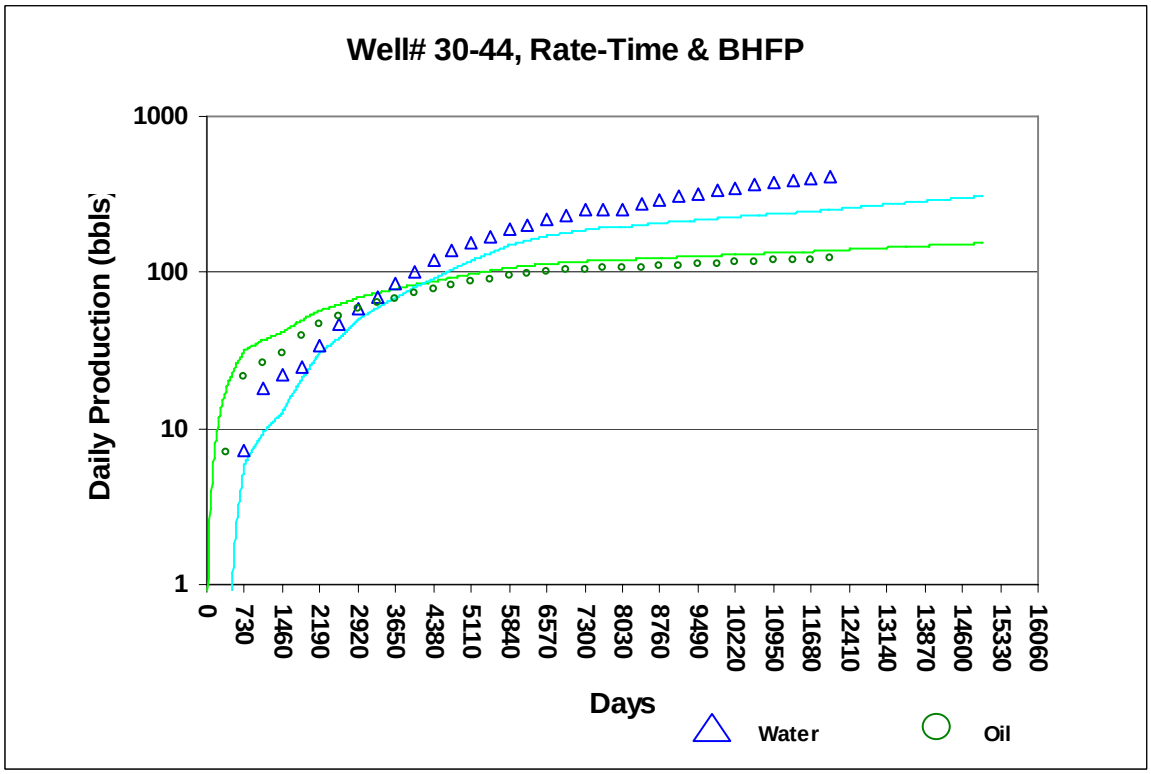

Well# 30-33, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

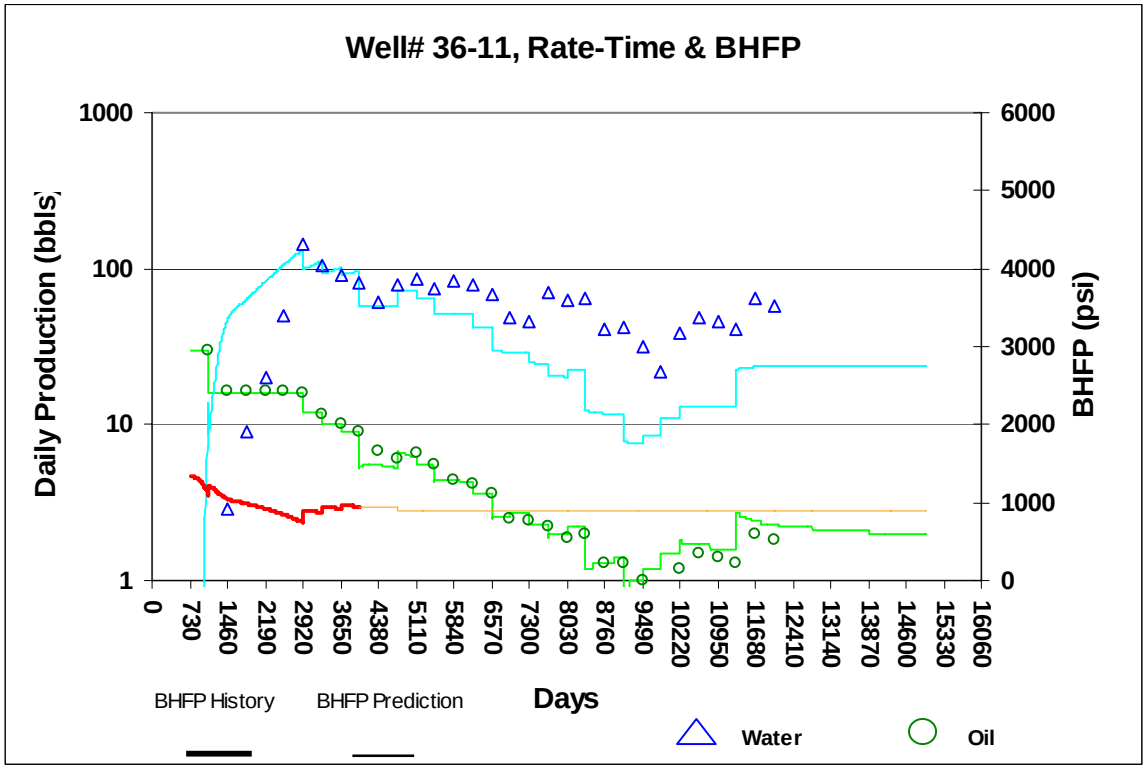

Well # 30-33, Cumulative-Time
Cumulative Production (Mbbls)
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

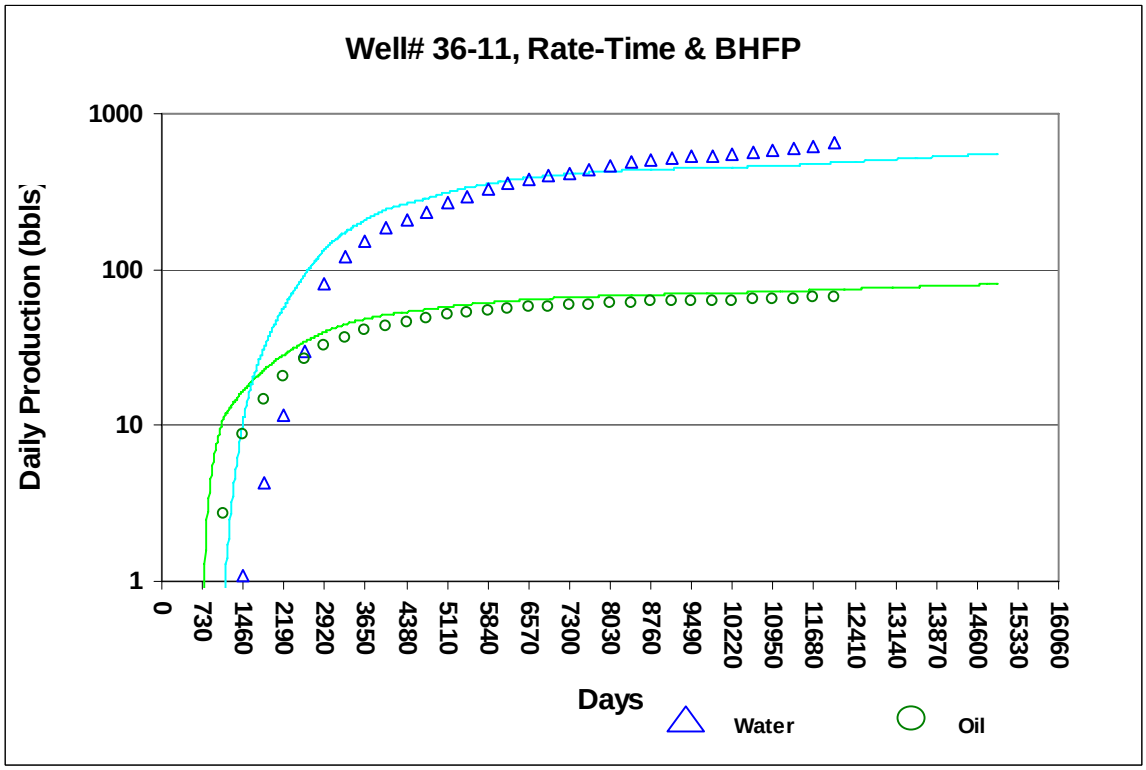

Well# 30-33, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

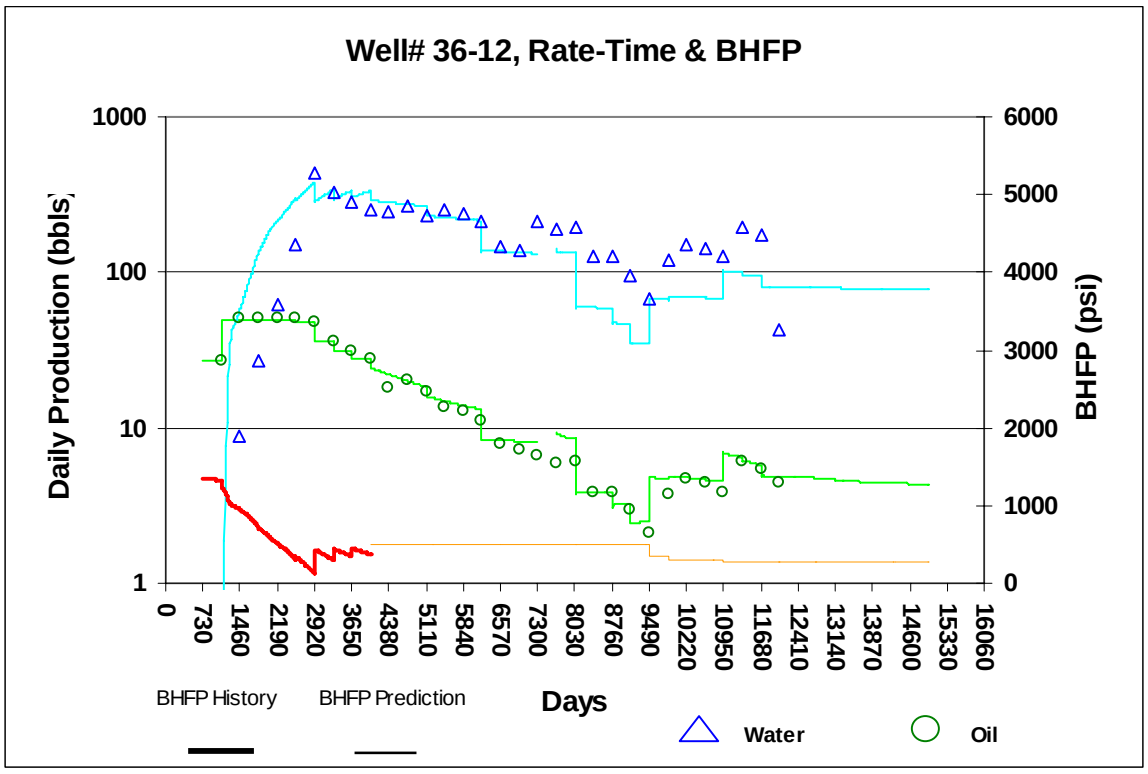

Well # 30-33, Cumulative-Time
Cumulative Production (Mbbls)
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

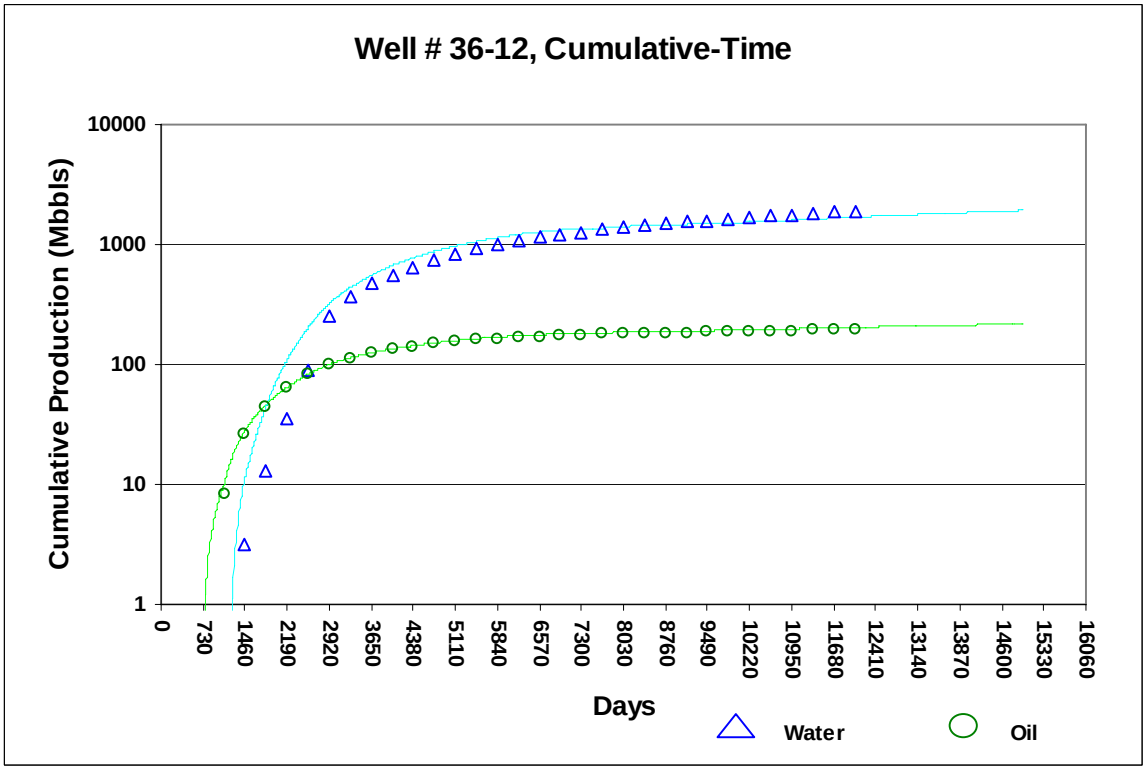

Well# 30-44, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil

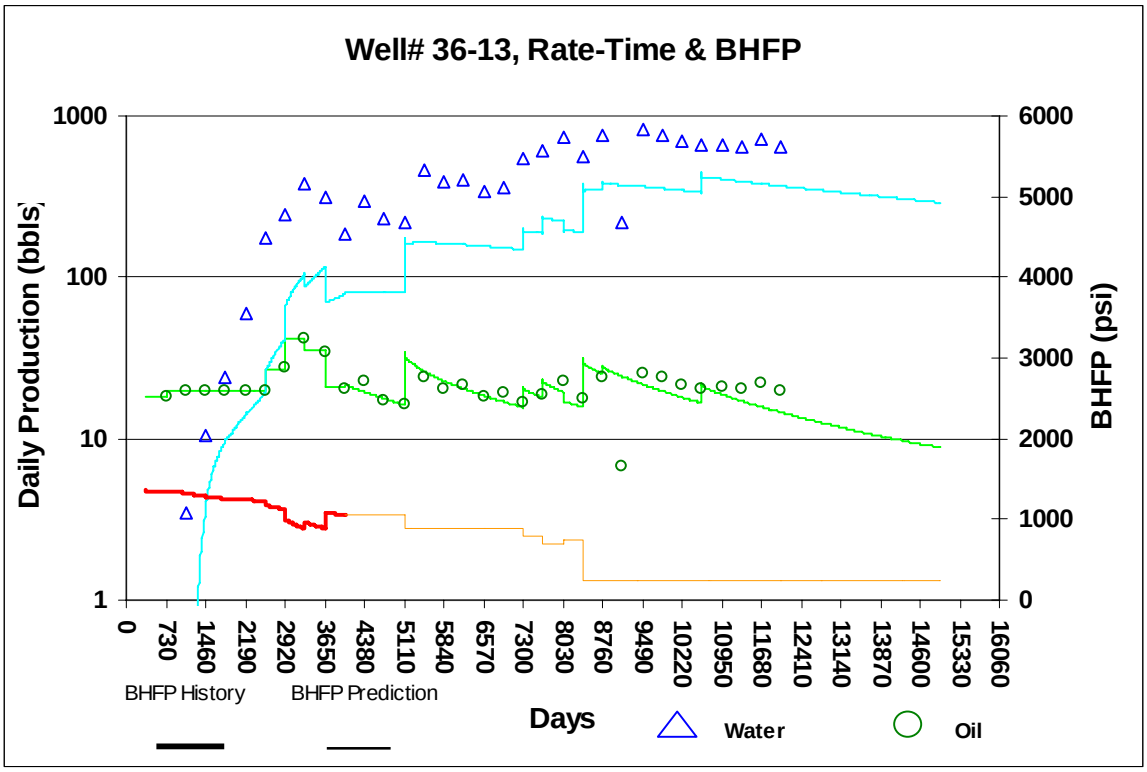

Well# 30-44, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

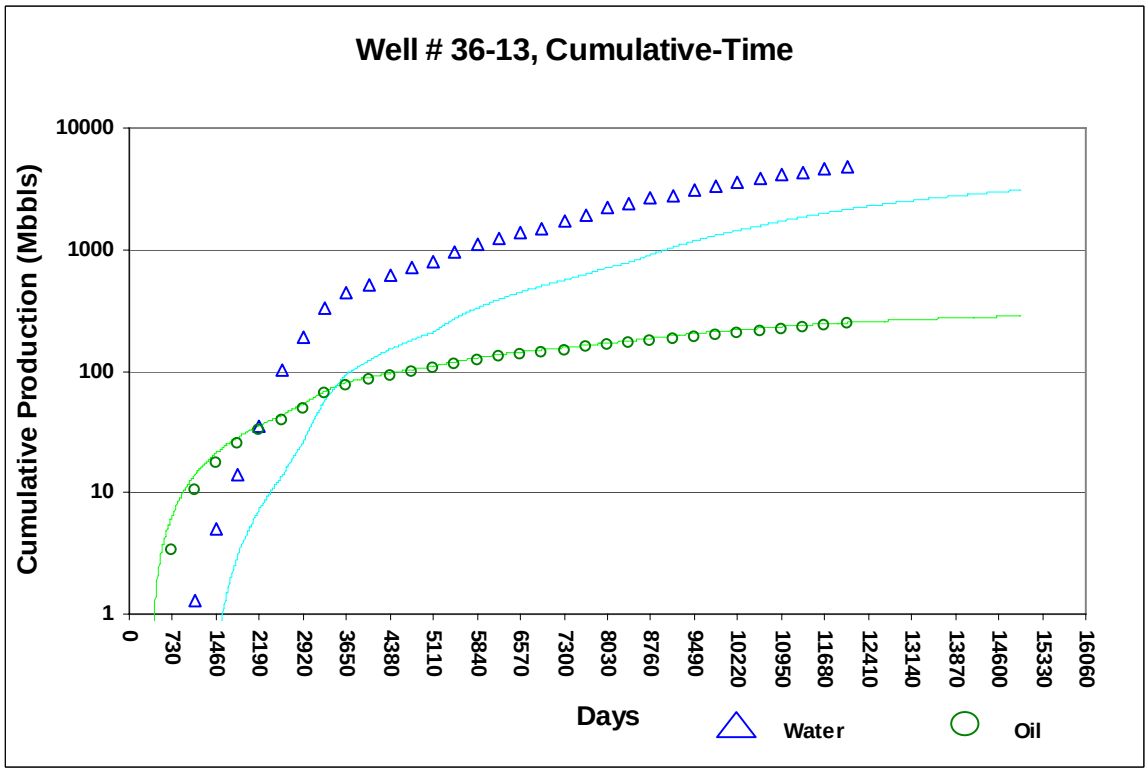

Well# 36-11, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil

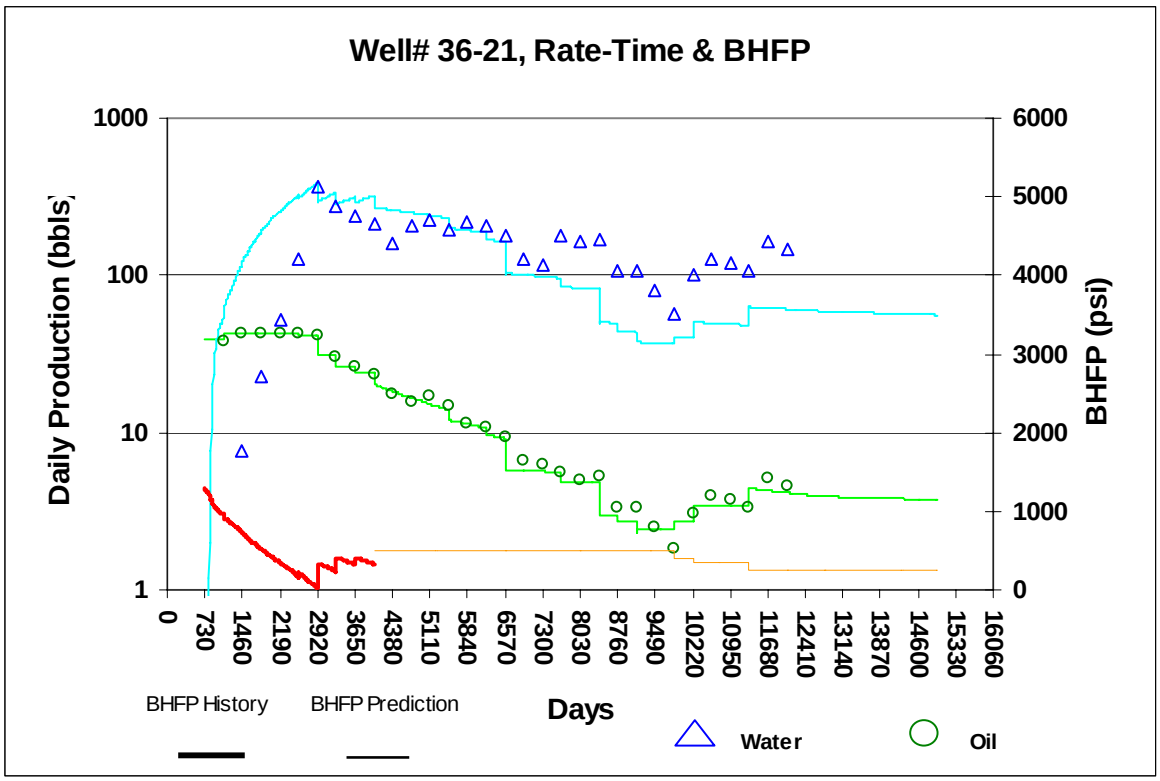

Well# 36-11, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

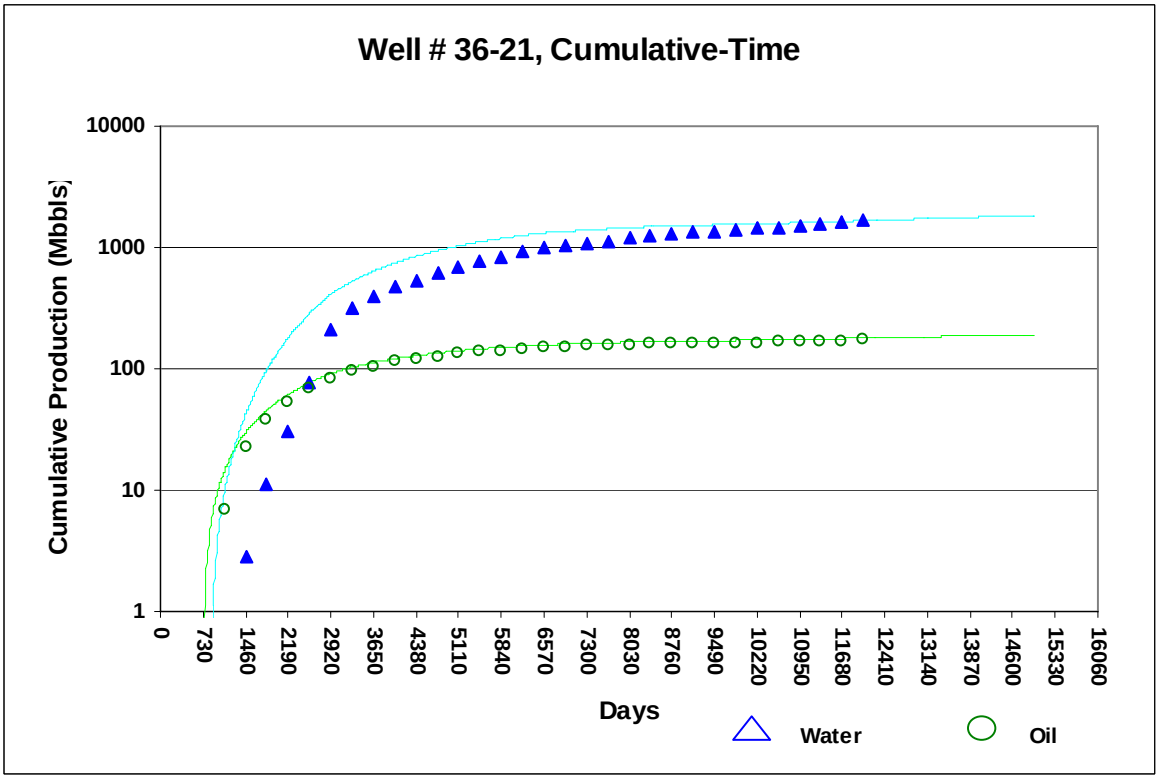

Well# 36-12, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
BHFP History
BHFP Prediction
Water
Oil


Well # 36-12, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

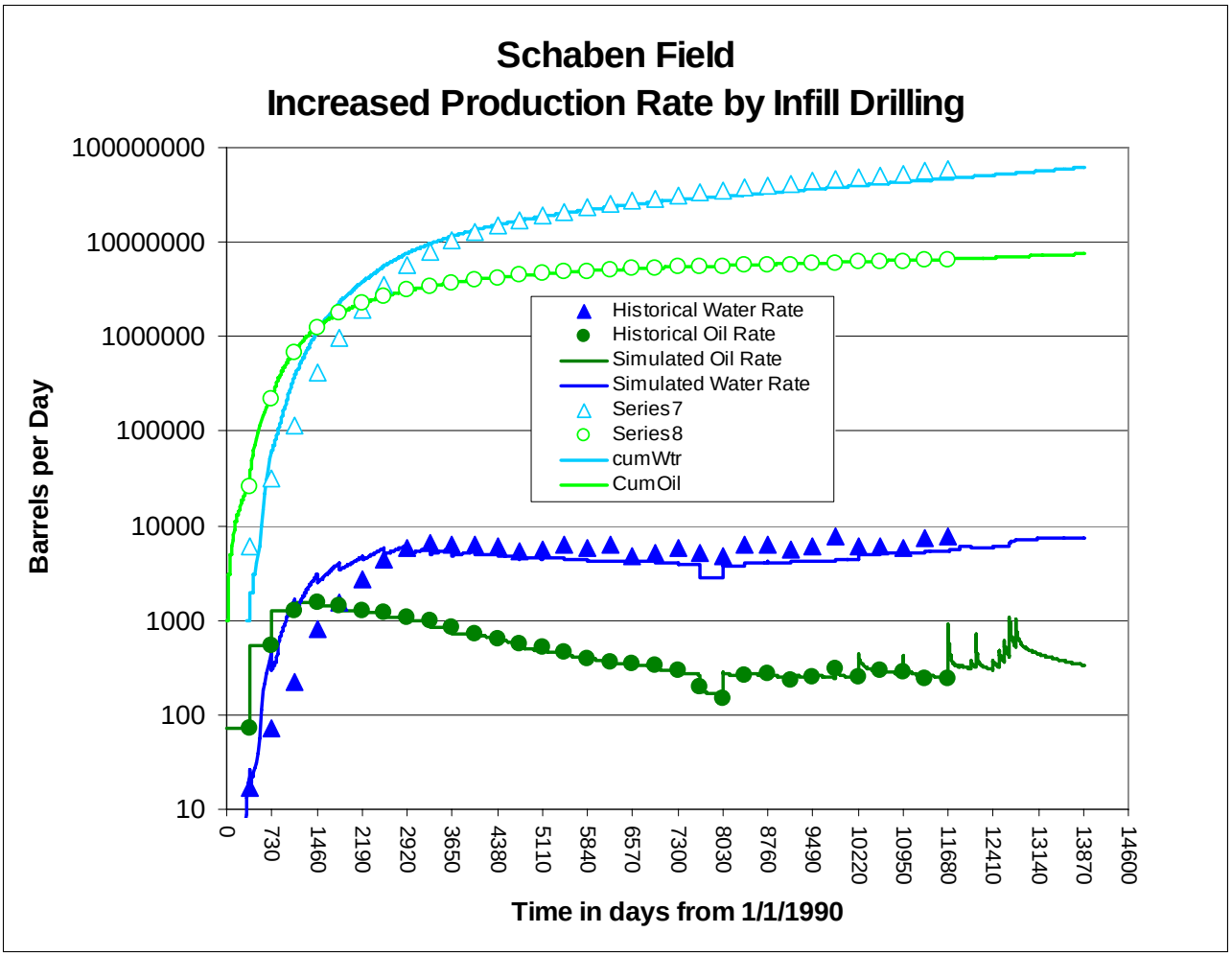

Well# 36-13, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil


Well # 36-13, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil


Well# 36-21, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
BHFP History
BHFP Prediction
Days
Water
Oil


Well # 36-21, Cumulative-Time
Cumulative Production (Mbbls)
10000
1000
100
10
1
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days
Water
Oil

Full field match and production increase from infill drilling



Appendix C

Results of 3 Layer Reservoir Simulation Study – Schaben Field, Ness County, Kansas

Open File Report – 2000-78

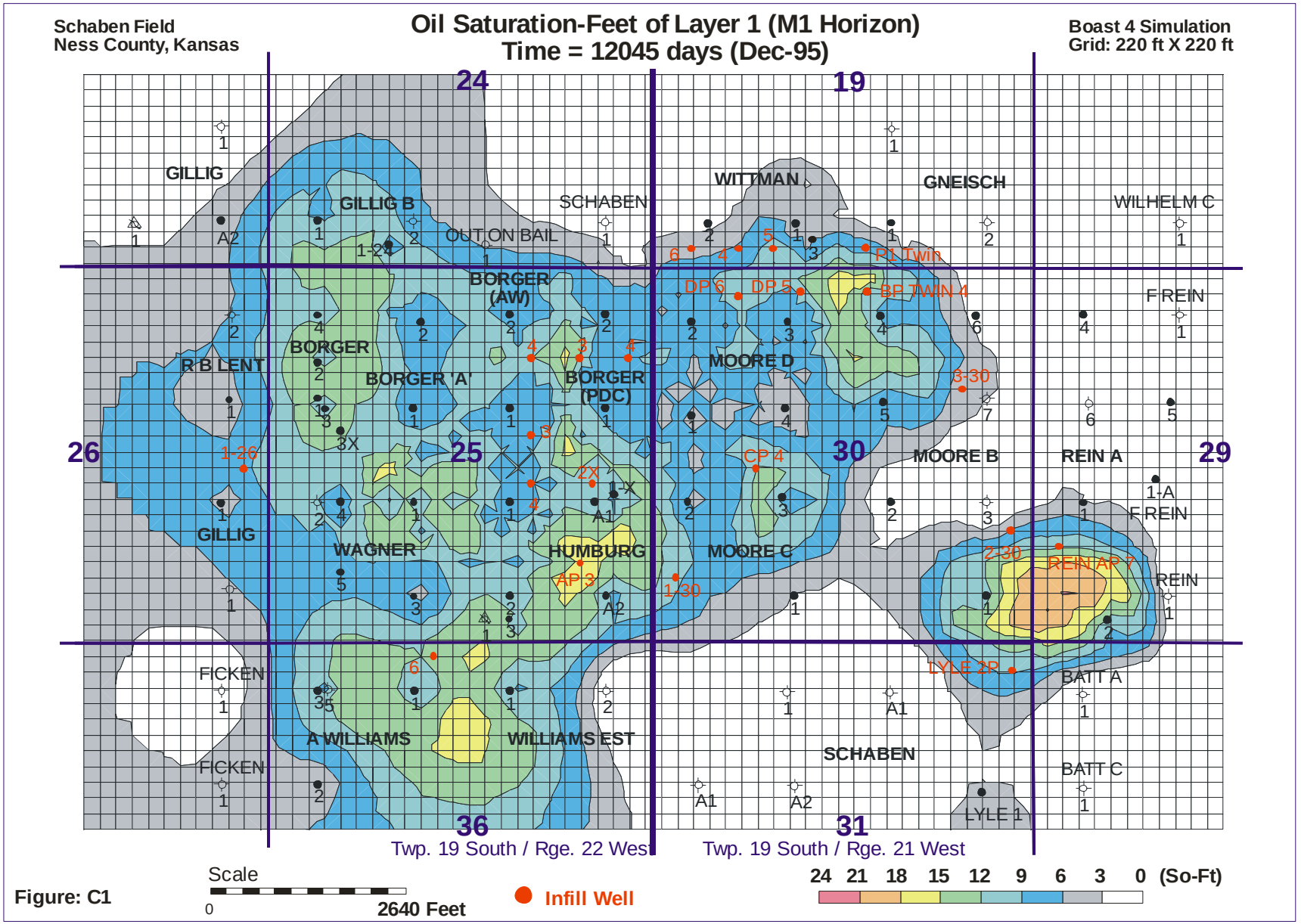

Schaben Field
Ness County, Kansas
Oil Saturation-Feet of Layer 1 (M1 Horizon)
Time = 12045 days (Dec-95)
Boast 4 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
SCHABEN
WITTMAN
GNEISCH
WILHELM C
OUT ON BAIL
BORGER (AW)
F REIN
BORGER
R B LENT
BORGER 'A'
BORGER (PDC)
MOORE D
MOORE B
REIN A
1-A F REIN
REIN AP 7
REIN
GILLIG
WAGNER
HUMBURG
MOORE C
FICKEN
A WILLIAMS
WILLIAMS EST
SCHABEN
BATT A
BATT C
LYLE 1
P1 Twin
DP 6
DP 5
BP TWIN 4
3-30
CP 4
2-30
LYLE 2P
1-30
AP 3
1-26
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
Infill Well
24 21 18 15 12 9 6 3 0 (So-Ft)

Figure: C1

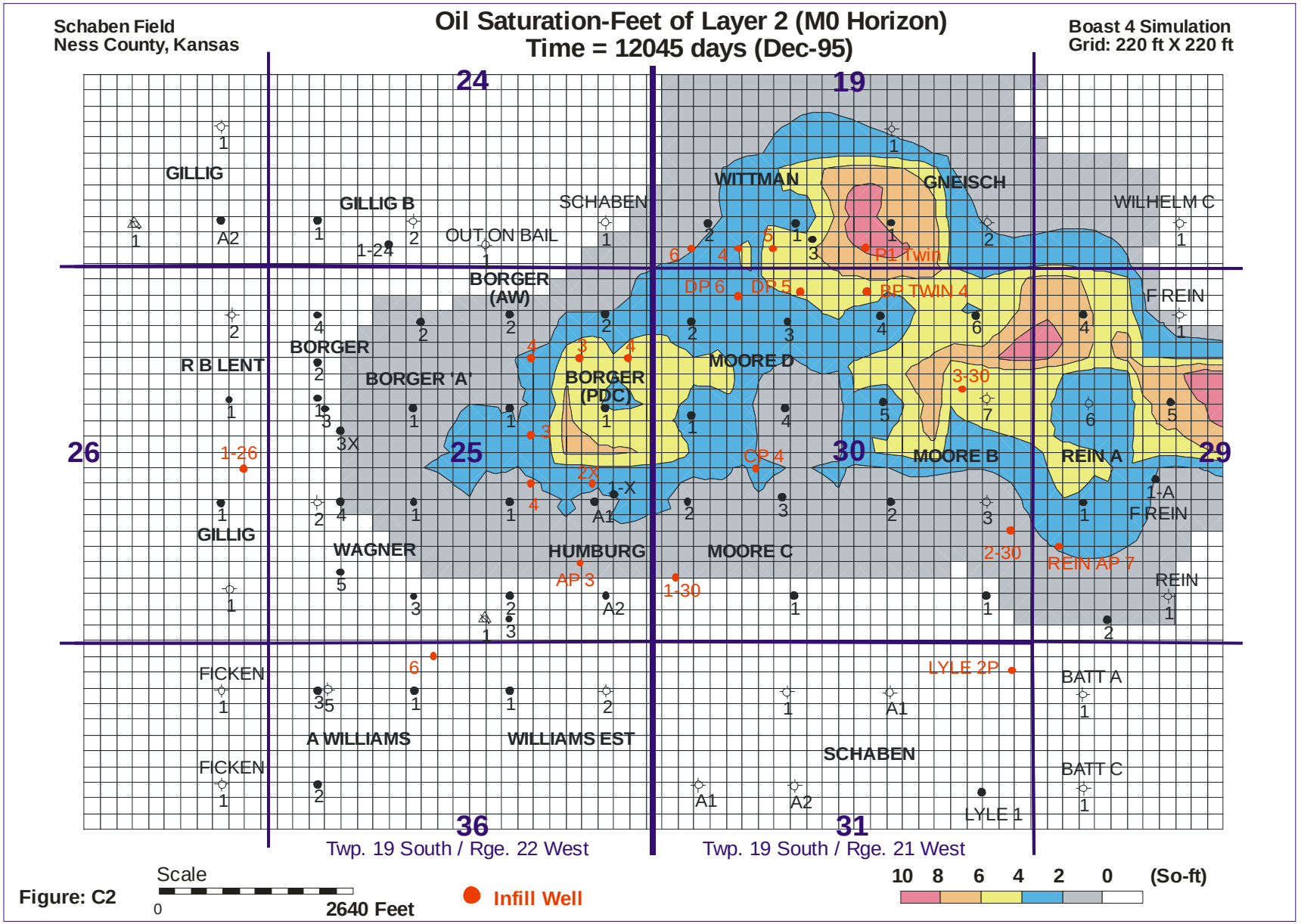

Schaben Field
Ness County, Kansas
Oil Saturation-Feet of Layer 2 (M0 Horizon)
Time = 12045 days (Dec-95)
Boast 4 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
SCHABEN
WITTMAN
GNEISCH
WILHELM C
OUT ON BAIL
1-24
BORGER (AW)
DP 6
DP 5
BP TWIN 4
P1 Twin
F REIN
BORGER
R B LENT
BORGER 'A'
BORGER (PDC)
MOORE D
3-30
1-26
3X
CP 4
MOORE B
REIN A
2X
1-X
1-A
F REIN
GILLIG
WAGNER
HUMBURG
MOORE C
2-30
REIN AP 7
AP 3
1-30
REIN
LYLE 2P
BATT A
FICKEN
A WILLIAMS
WILLIAMS EST
SCHABEN
BATT C
FICKEN
LYLE 1
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
Infill Well
10 8 6 4 2 0 (So-ft)

Figure: C2

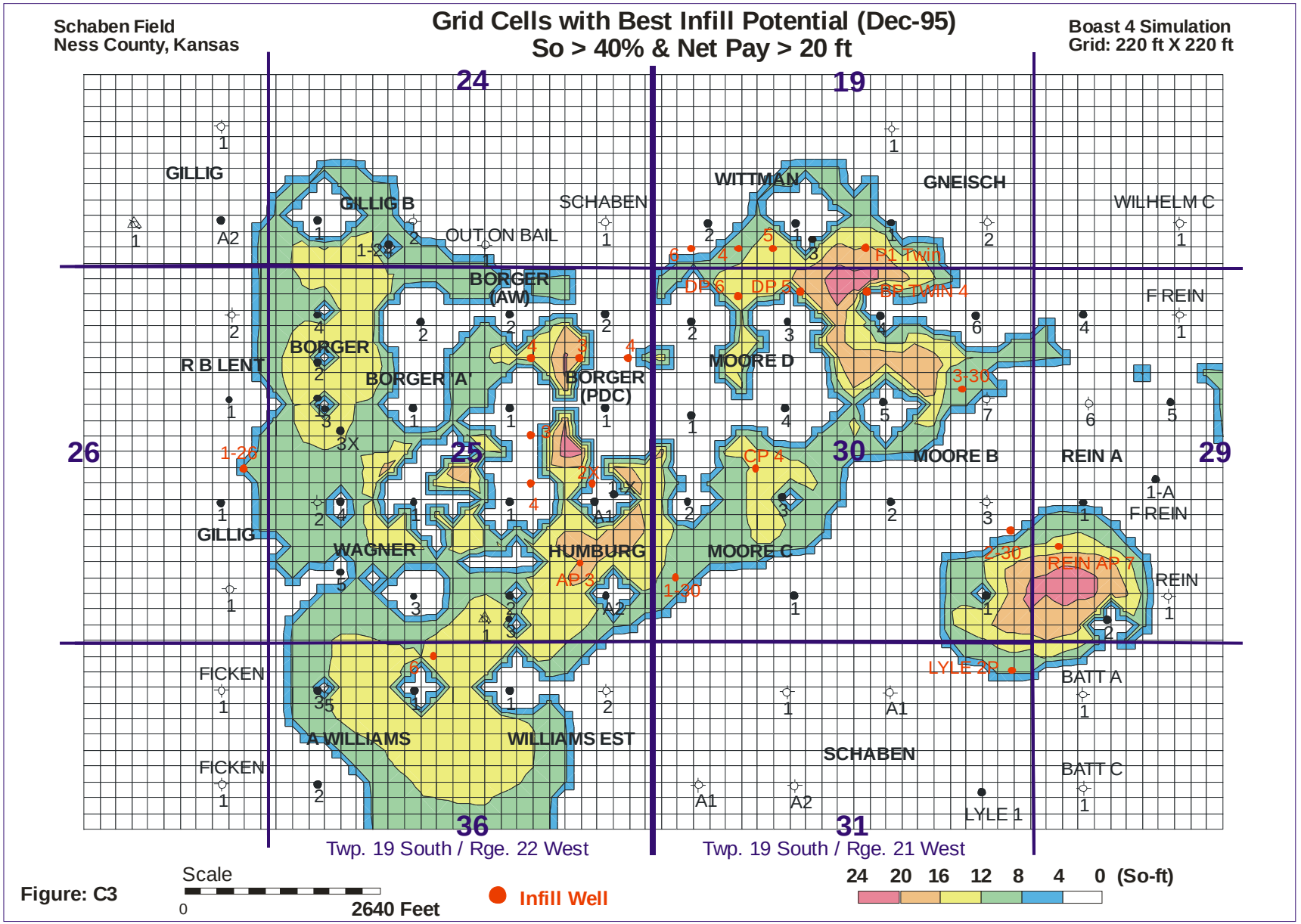
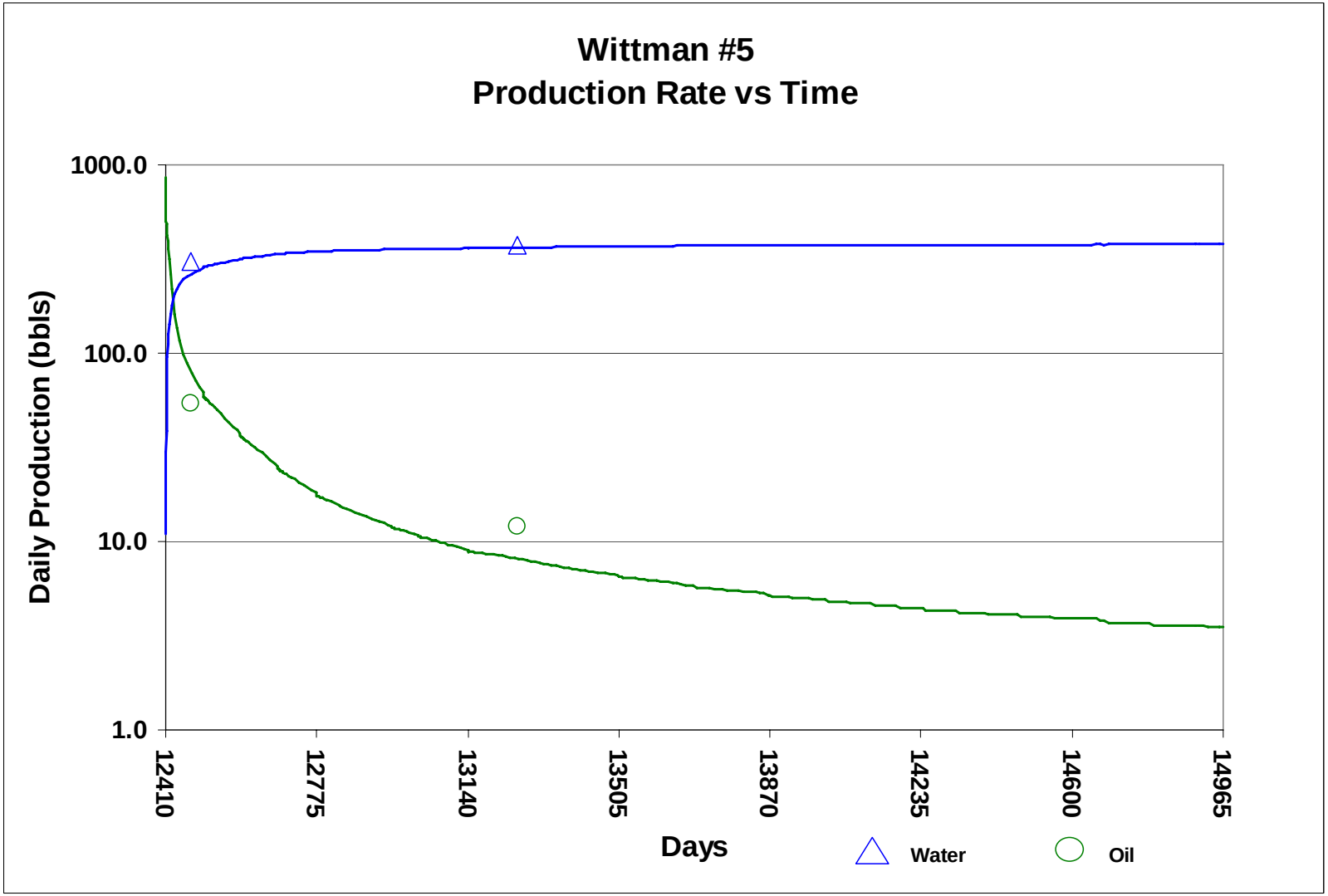

Schaben Field
Ness County, Kansas
Grid Cells with Best Infill Potential (Dec-95)
So > 40% & Net Pay > 20 ft
Boast 4 Simulation
Grid: 220 ft X 220 ft
24
19
26
25
30
29
36
31
GILLIG
GILLIG B
SCHABEN
WITTMAN
GNEISCH
WILHELM C
OUT ON BAIL
BORGER (AW)
F REIN
BORGER
R B LENT
BORGER 'A'
BORGER (PDC)
MOORE D
MOORE B
REIN A
1-A F REIN
GILLIG
WAGNER
HUMBURG
MOORE C
REIN
FICKEN
A-WILLIAMS
WILLIAMS EST
SCHABEN
BATT A
BATT C
FICKEN
LYLE 1
1-28
AP 3
1-30
2-30
REIN AP 7
LYLE 2R
P1 Twin
DP 6
DP 5
BR Twin 4
3-30
CP 4
Twp. 19 South / Rge. 22 West
Twp. 19 South / Rge. 21 West
Scale
0
2640 Feet
Infill Well
24 20 16 12 8 4 0 (So-ft)

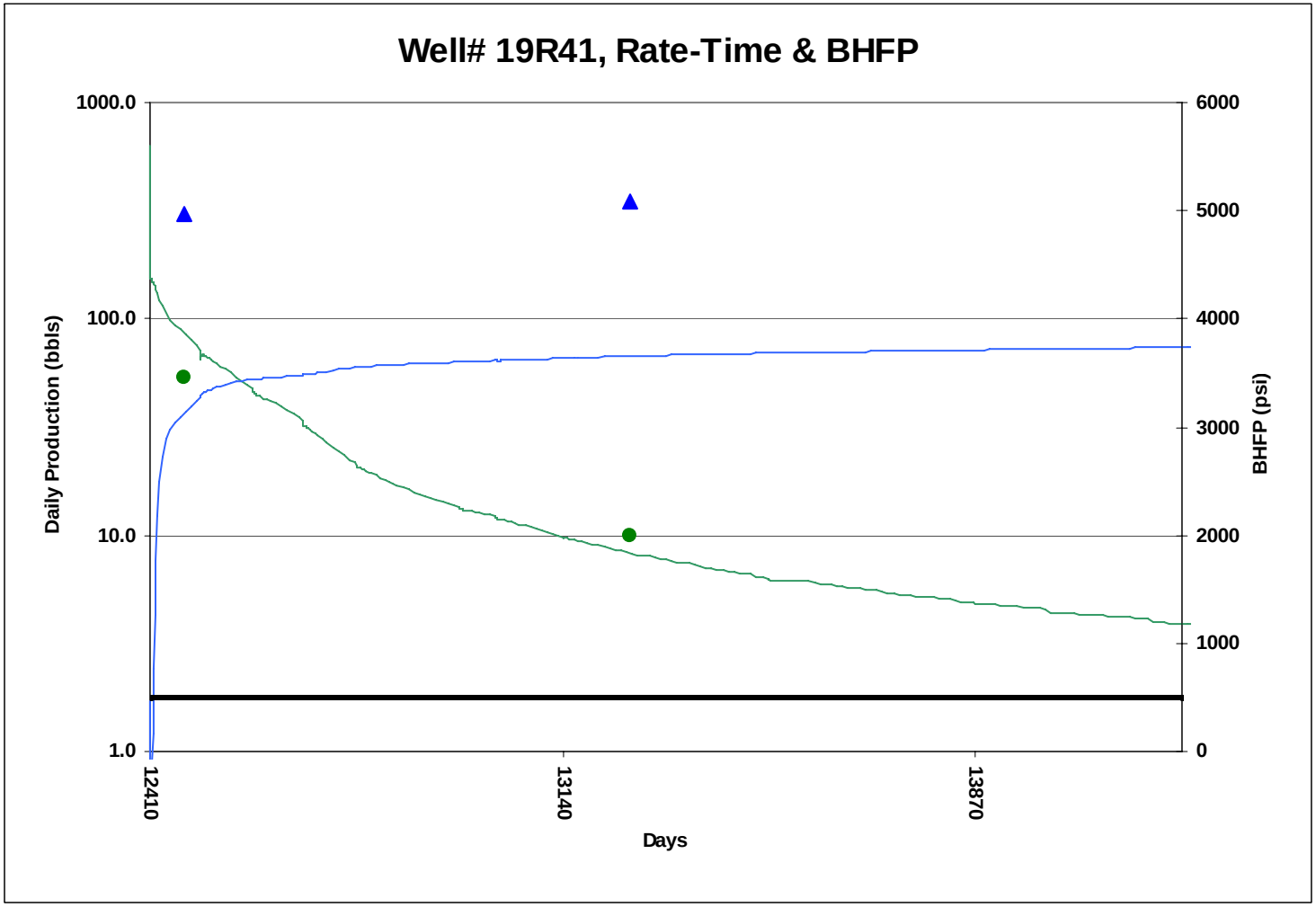
Figure: C3

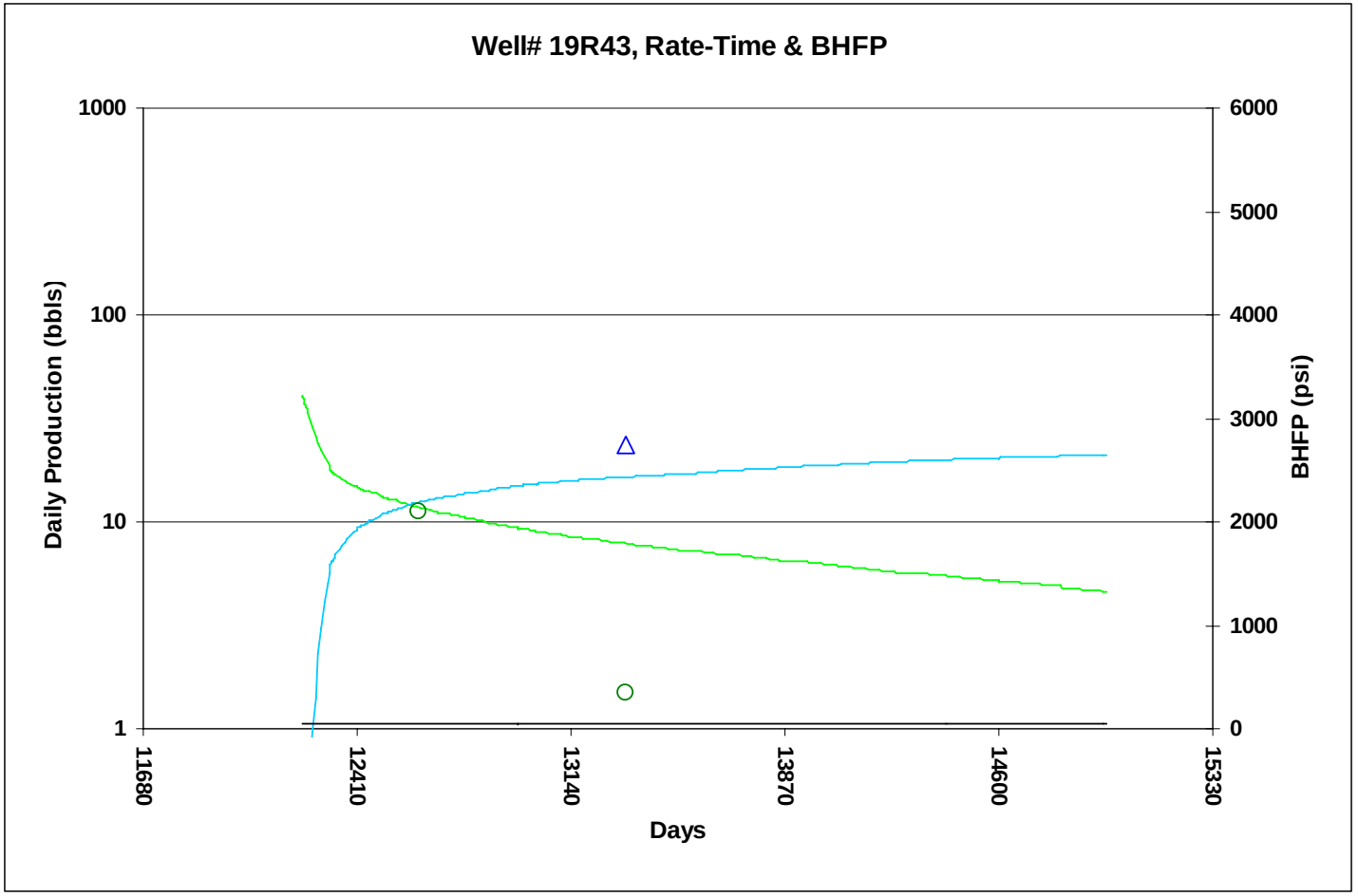
Appendix D

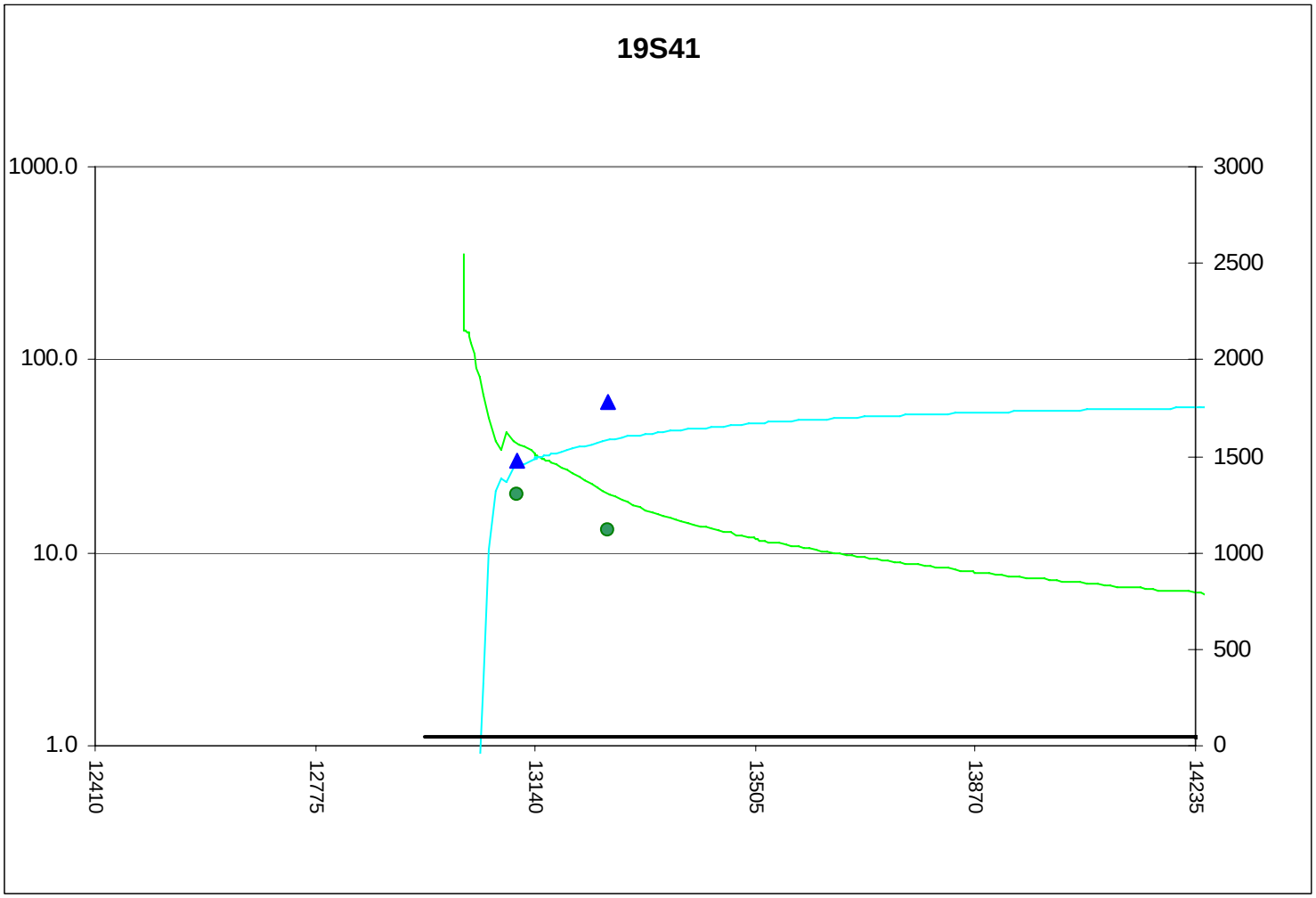
Results of 3 Layer Reservoir Simulation Study – Schaben Field, Ness County, Kansas

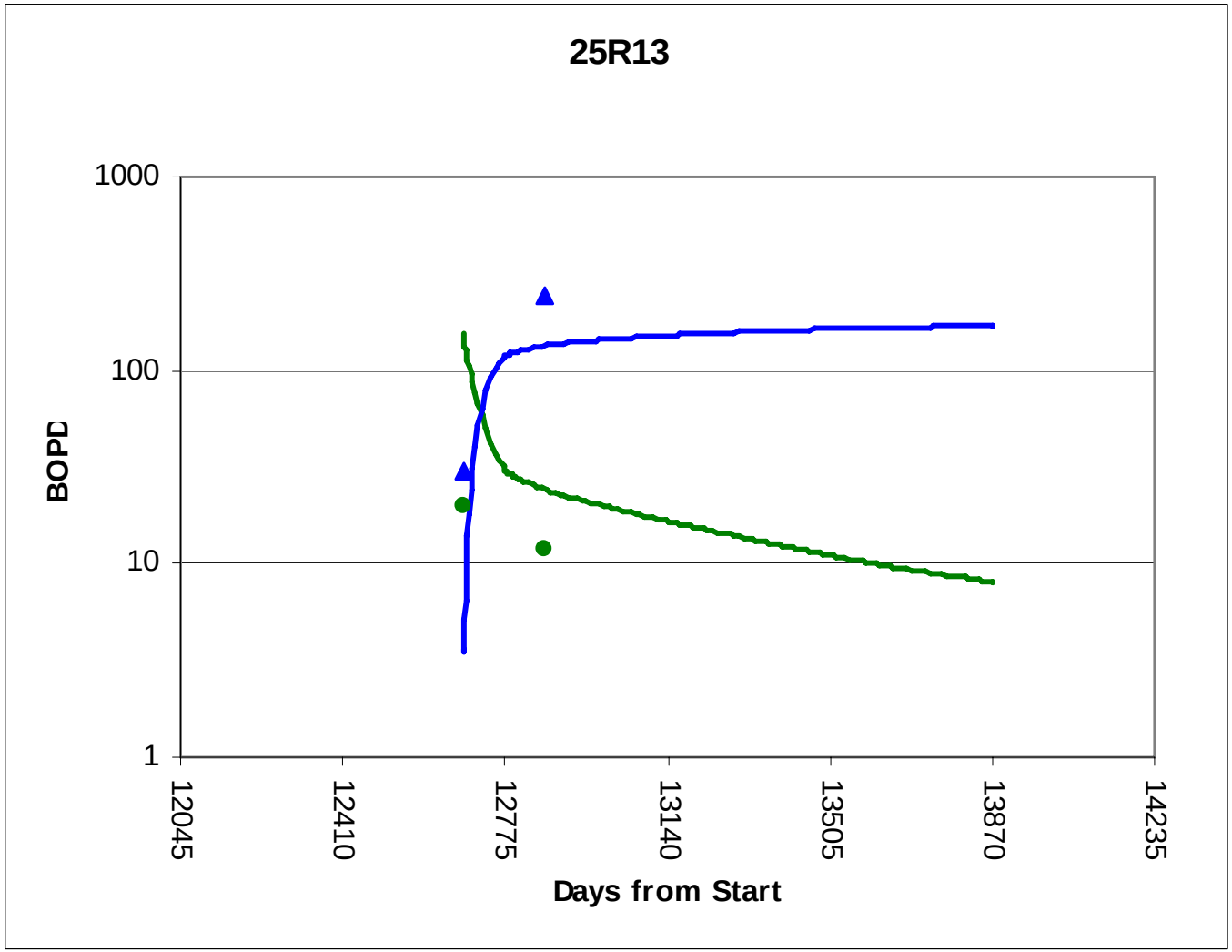
Open File Report – 2000-78

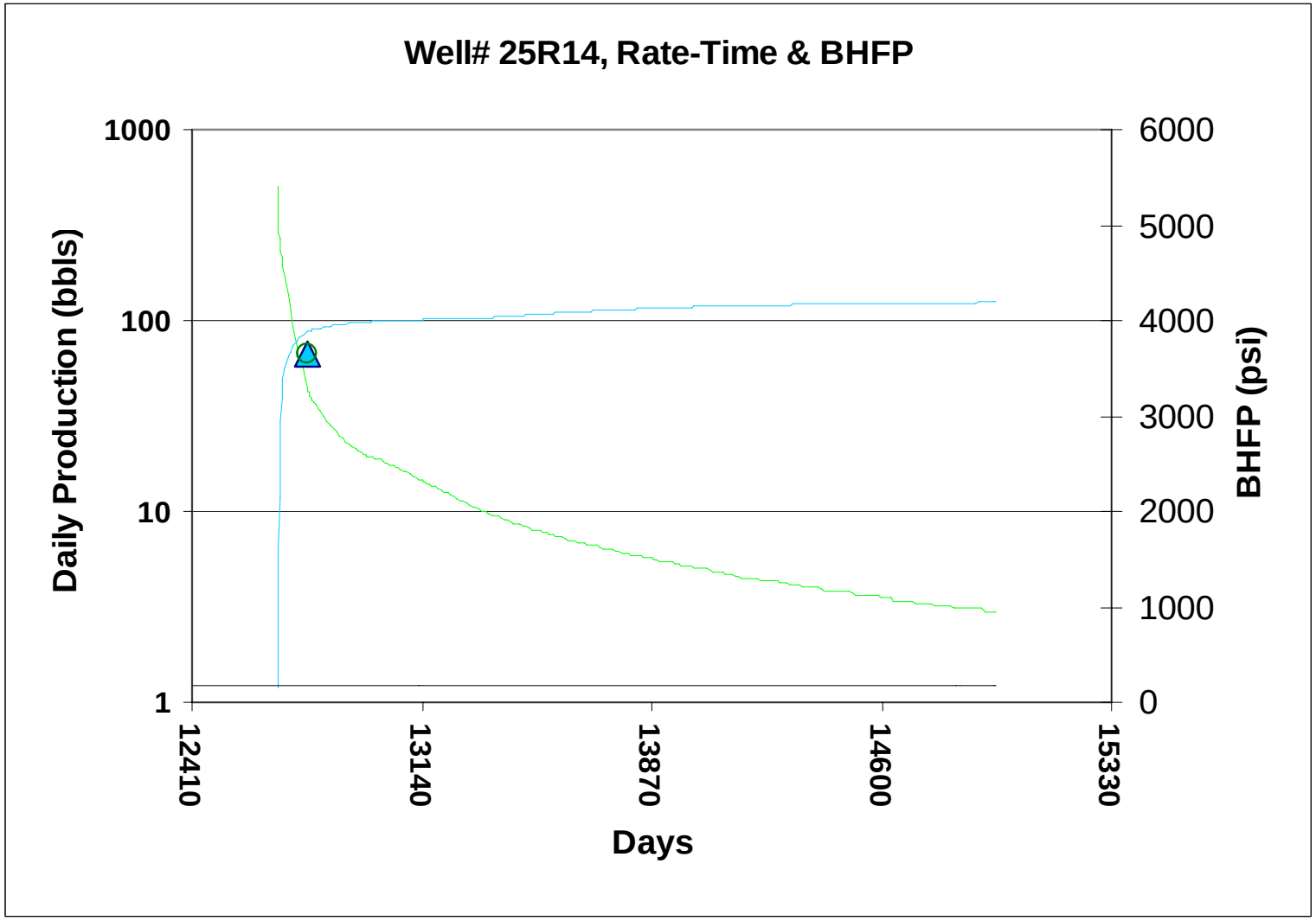

Wittman #5
Production Rate vs Time
Daily Production (bbls)
1000.0
100.0
10.0
1.0
12410
12775
13140
13505
13870
14235
14600
14965
Days
Water
Oil

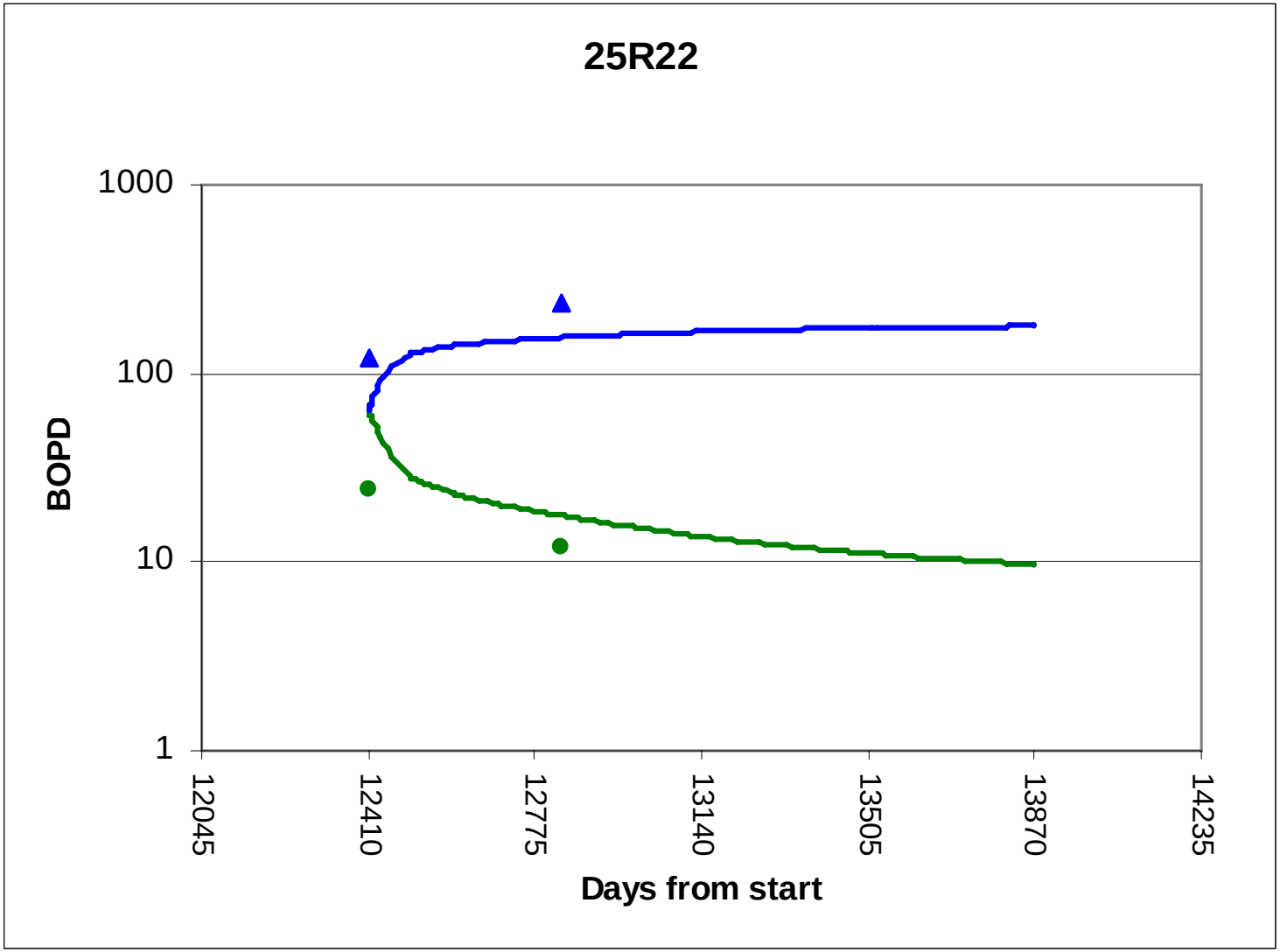

Well# 19R41, Rate-Time & BHFP
1000.0
100.0
10.0
1.0
Daily Production (bbls)
6000
5000
4000
3000
2000
1000
0
BHFP (psi)
12410
13140
13870
Days

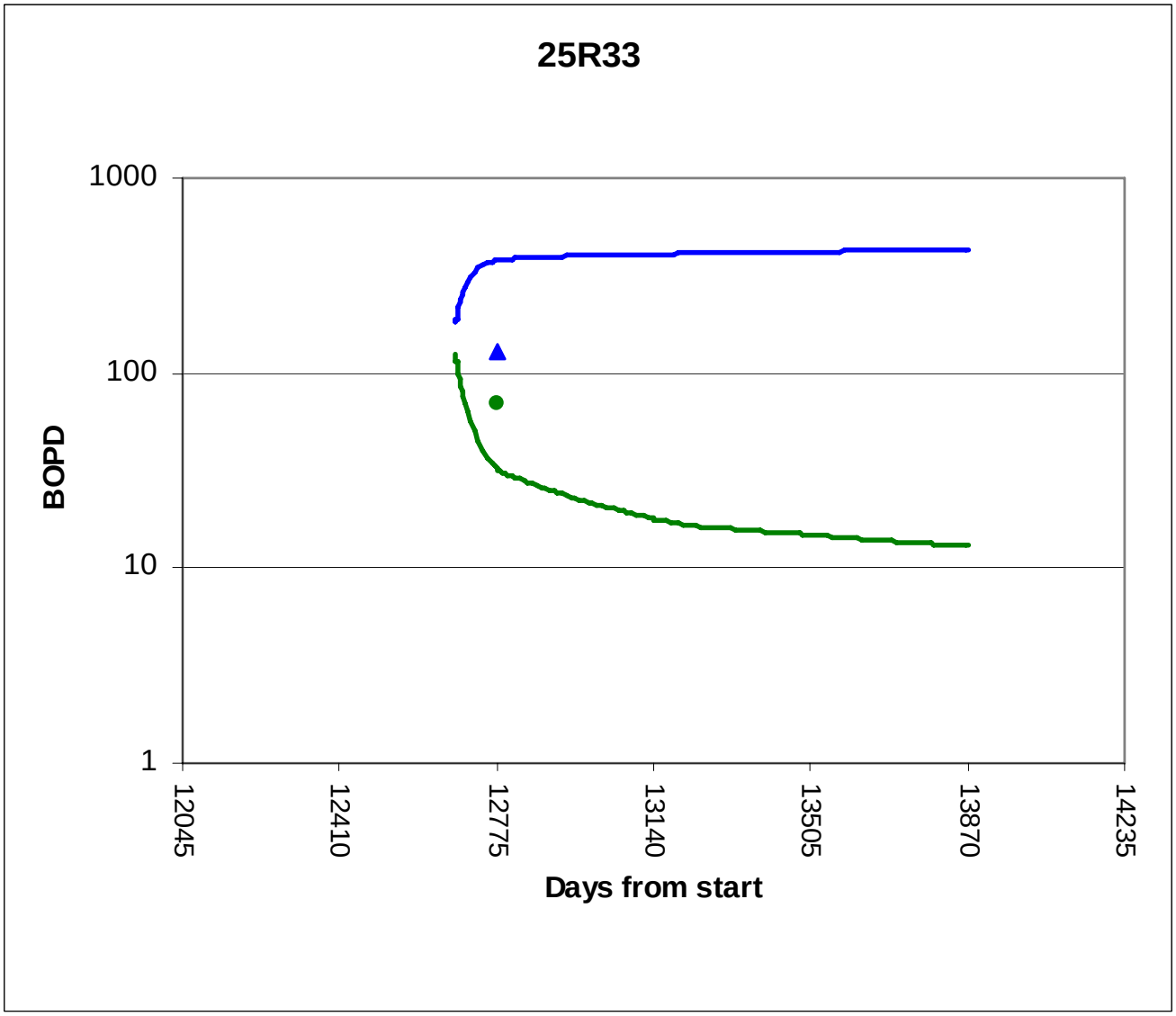

Well# 19R43, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
11680
12410
13140
13870
14600
15330
Days

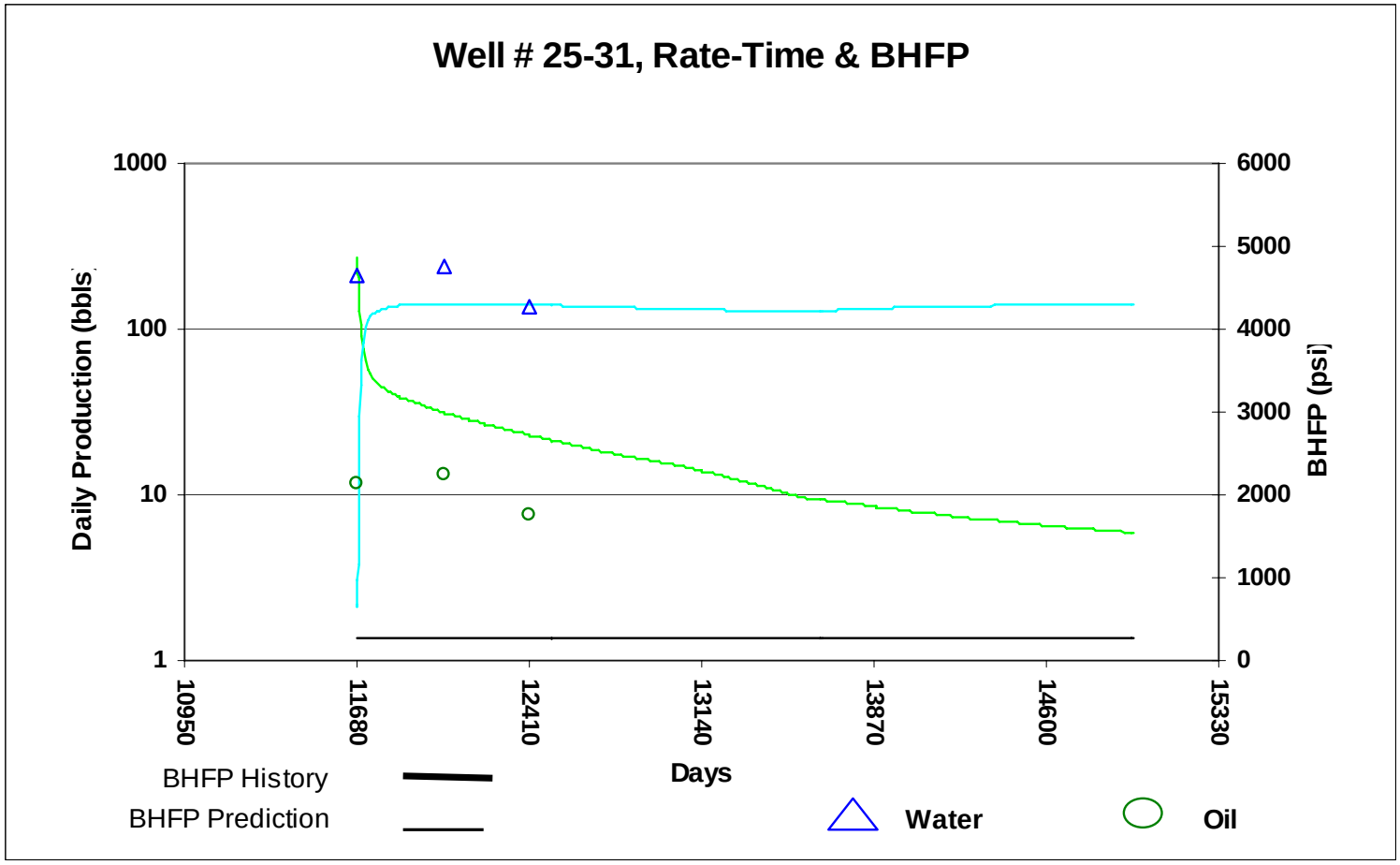

19S41
1000.0
100.0
10.0
1.0
3000
2500
2000
1500
1000
500
0
12410
12775
13140
13505
13870
14235

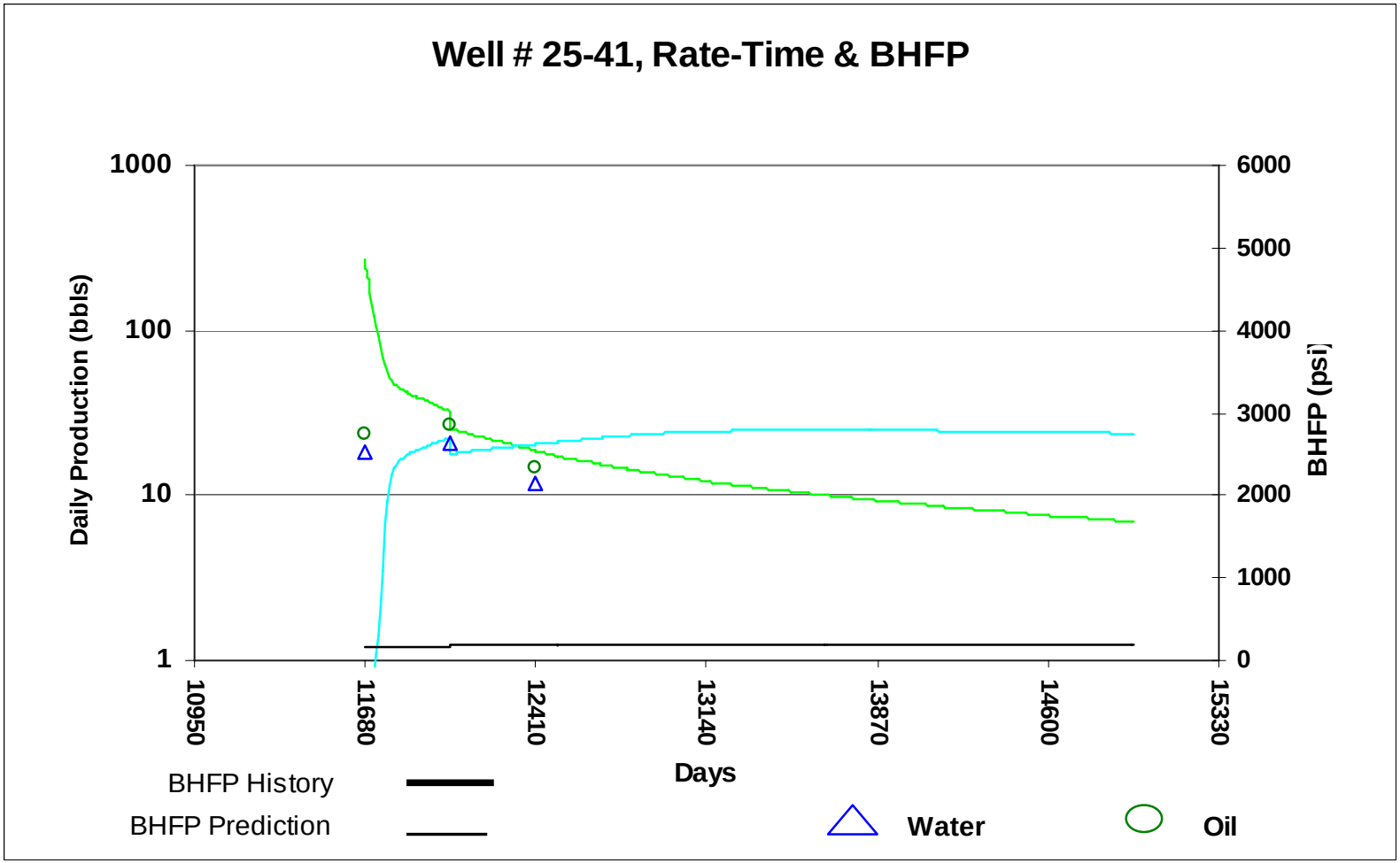

25R13
1000
100
10
1
BOPD
12045
12410
12775
13140
13505
13870
14235
Days from Start

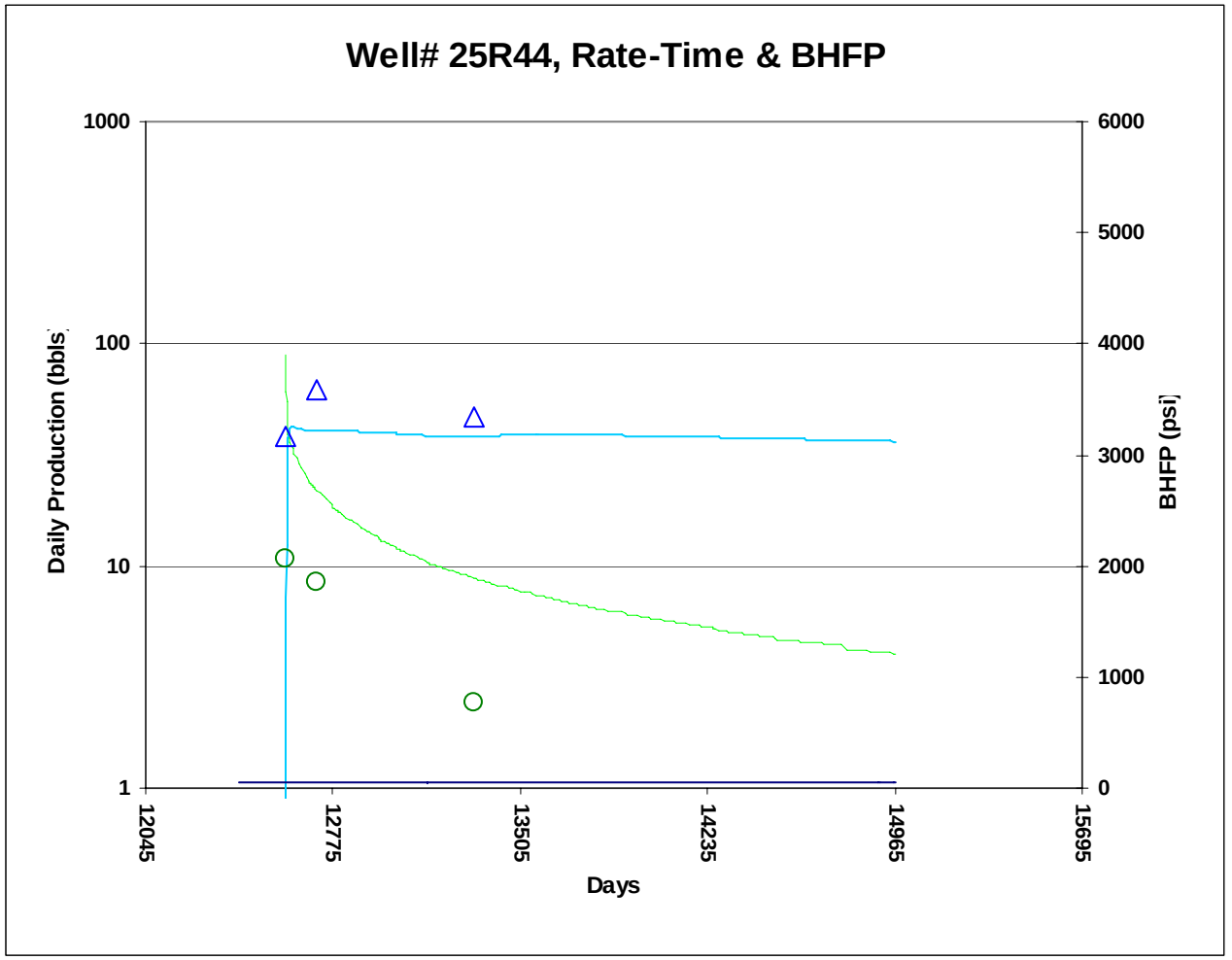

Well# 25R14, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
BHFP (psi)
12410
13140
13870
14600
15330
Days

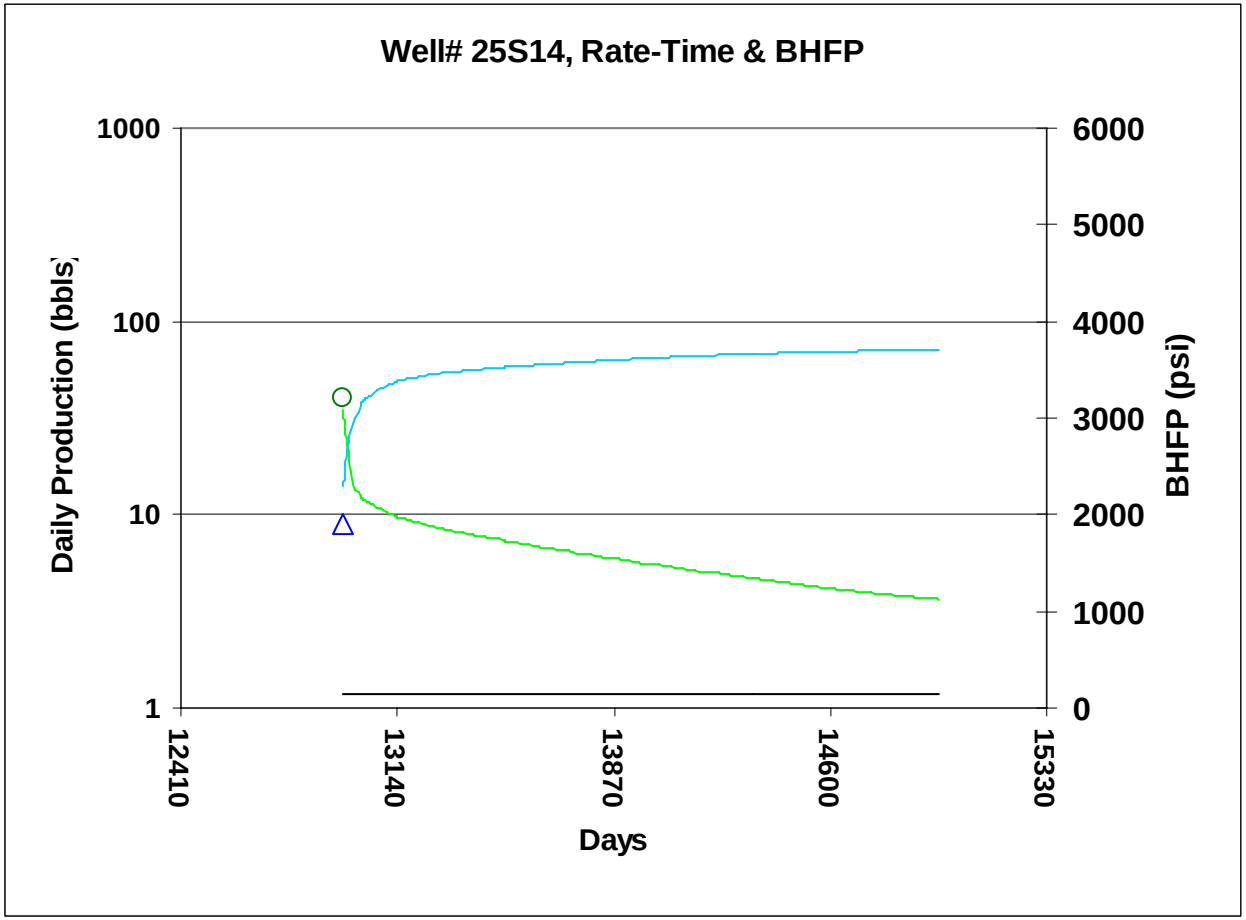

25R22
1000
100
10
1
BOPD
12045
12410
12775
13140
13505
13870
14235
Days from start

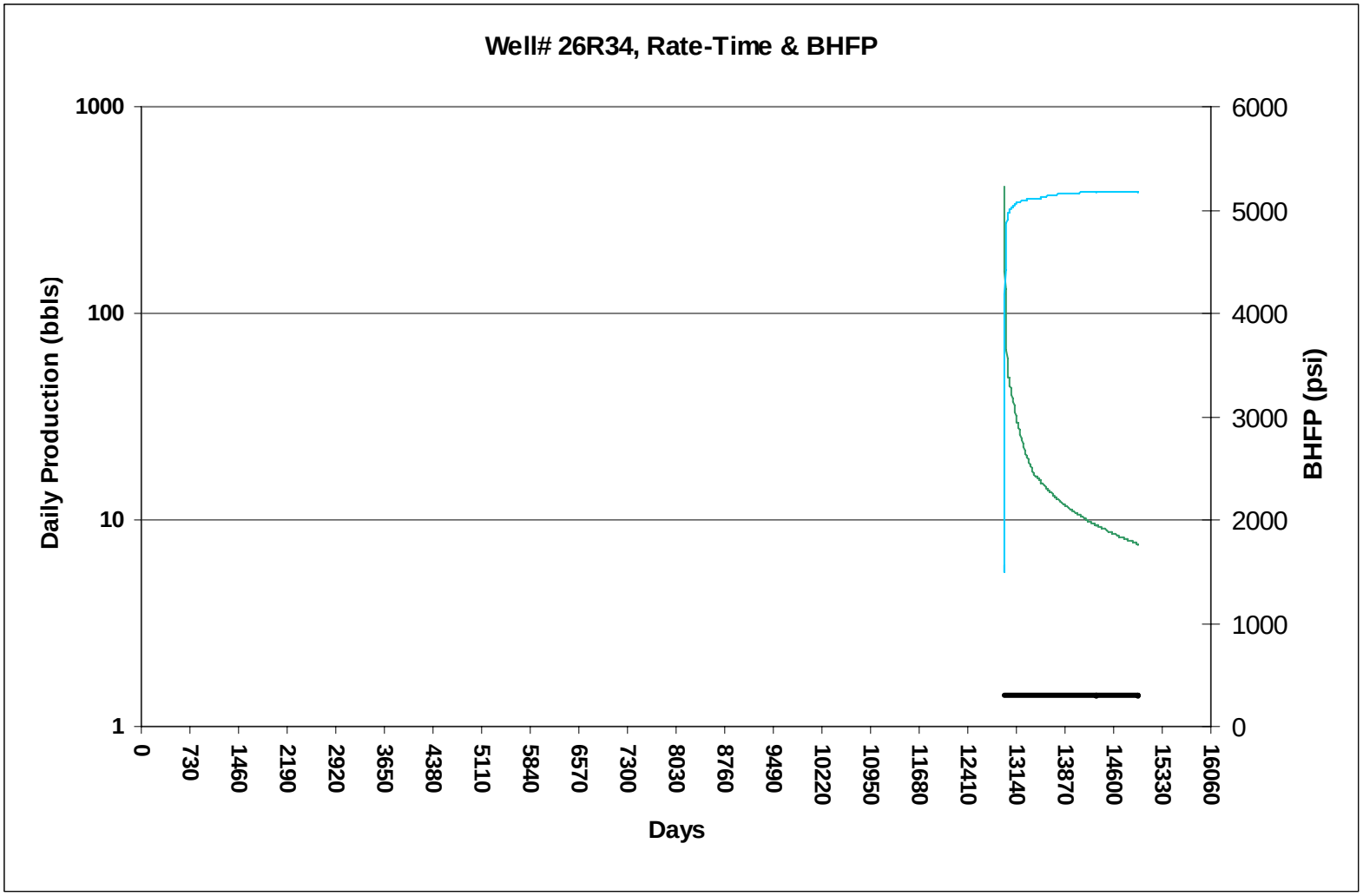

25R33
1000
100
10
1
BOPD
12045
12410
12775
13140
13505
13870
14235
Days from start

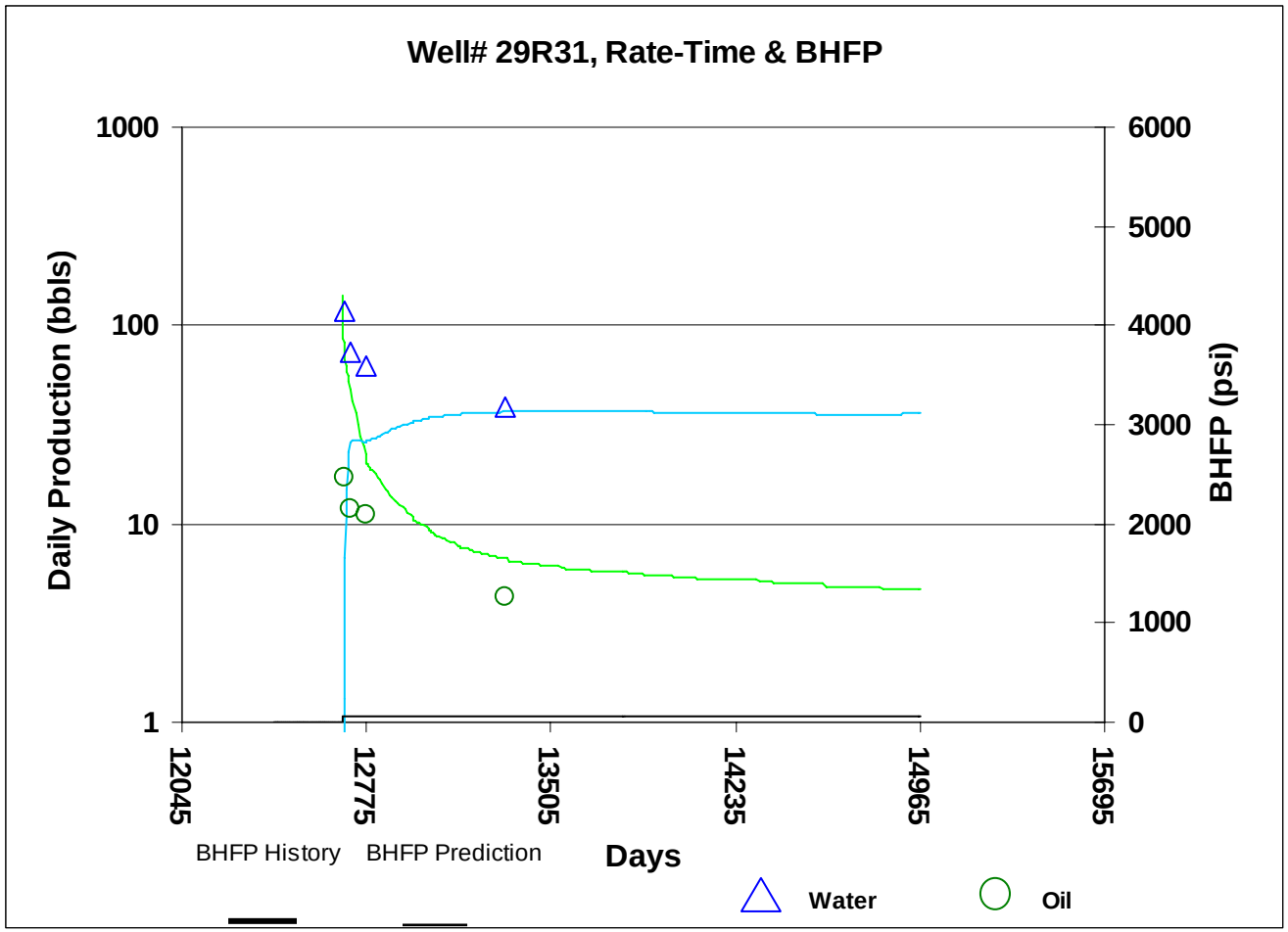

Well # 25-31, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
BHFP (psi)
10950
11680
12410
13140
13870
14600
15330
Days
BHFP History
BHFP Prediction
Water
Oil

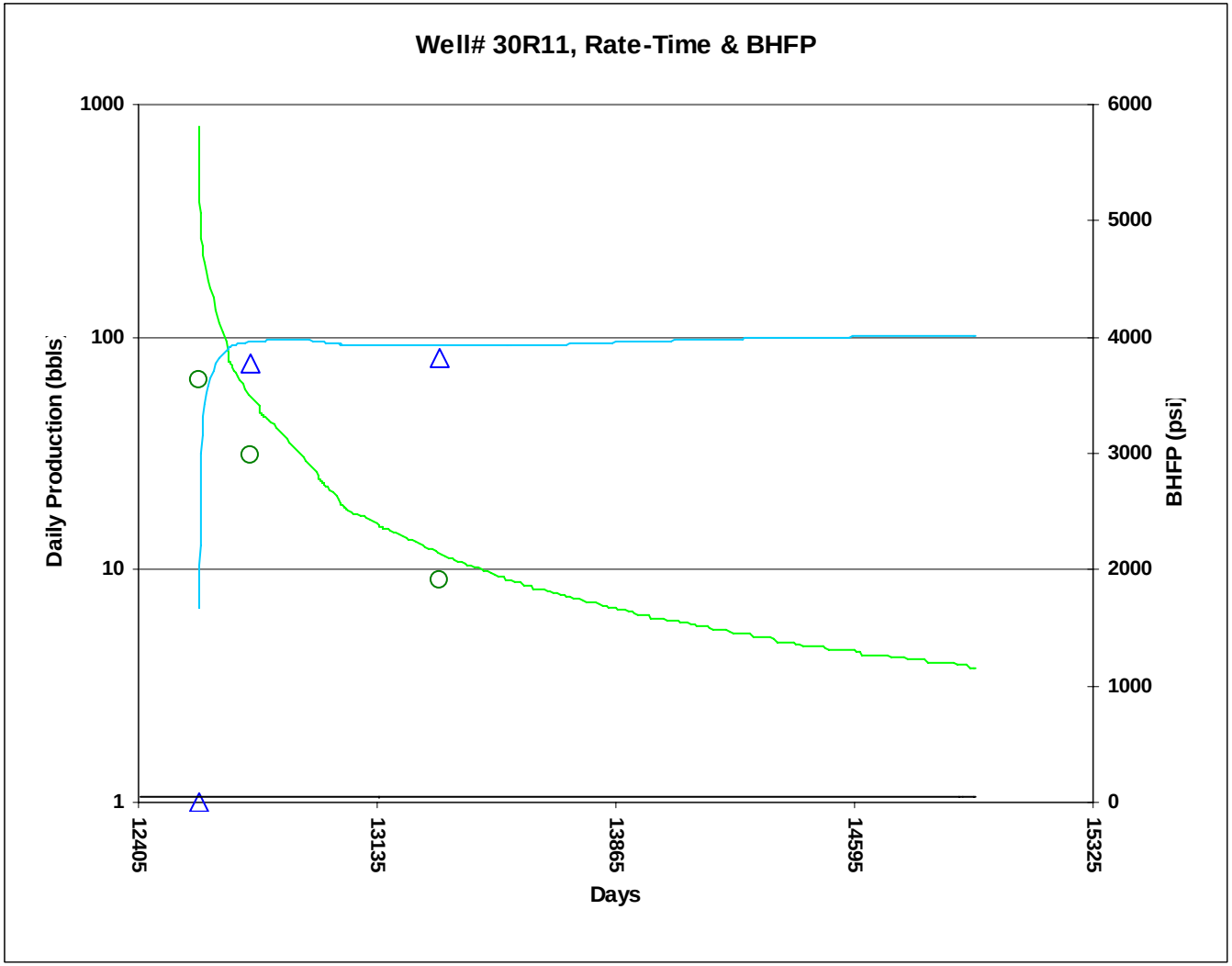

Well # 25-41, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
BHFP (psi)
6000
5000
4000
3000
2000
1000
0
10950
11680
12410
13140
13870
14600
15330
Days
BHFP History
BHFP Prediction
Water
Oil

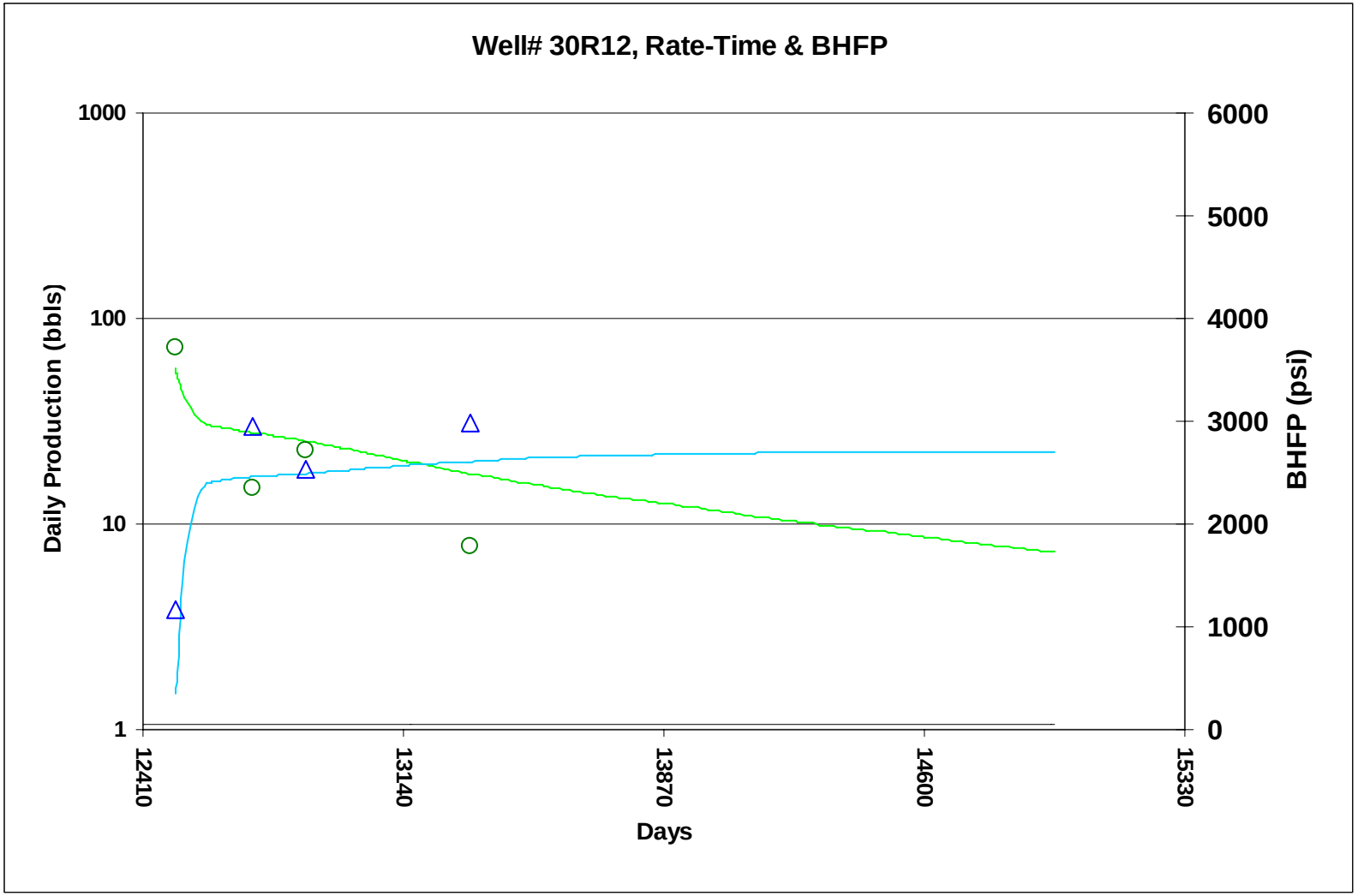

Well# 25R44, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
12045
12775
13505
14235
14965
15695
Days

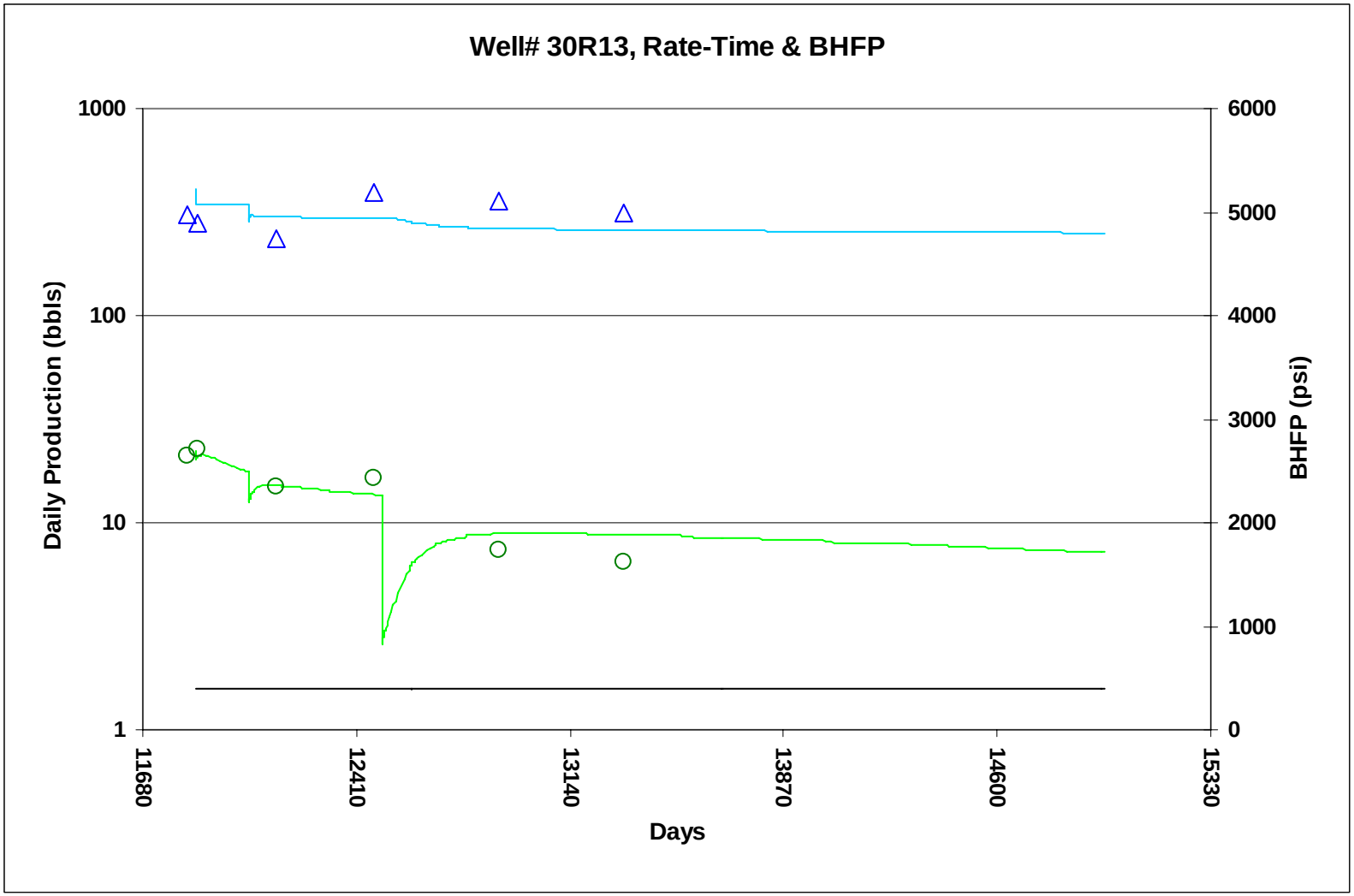

Well# 25S14, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
12410
13140
13870
14600
15330
Days

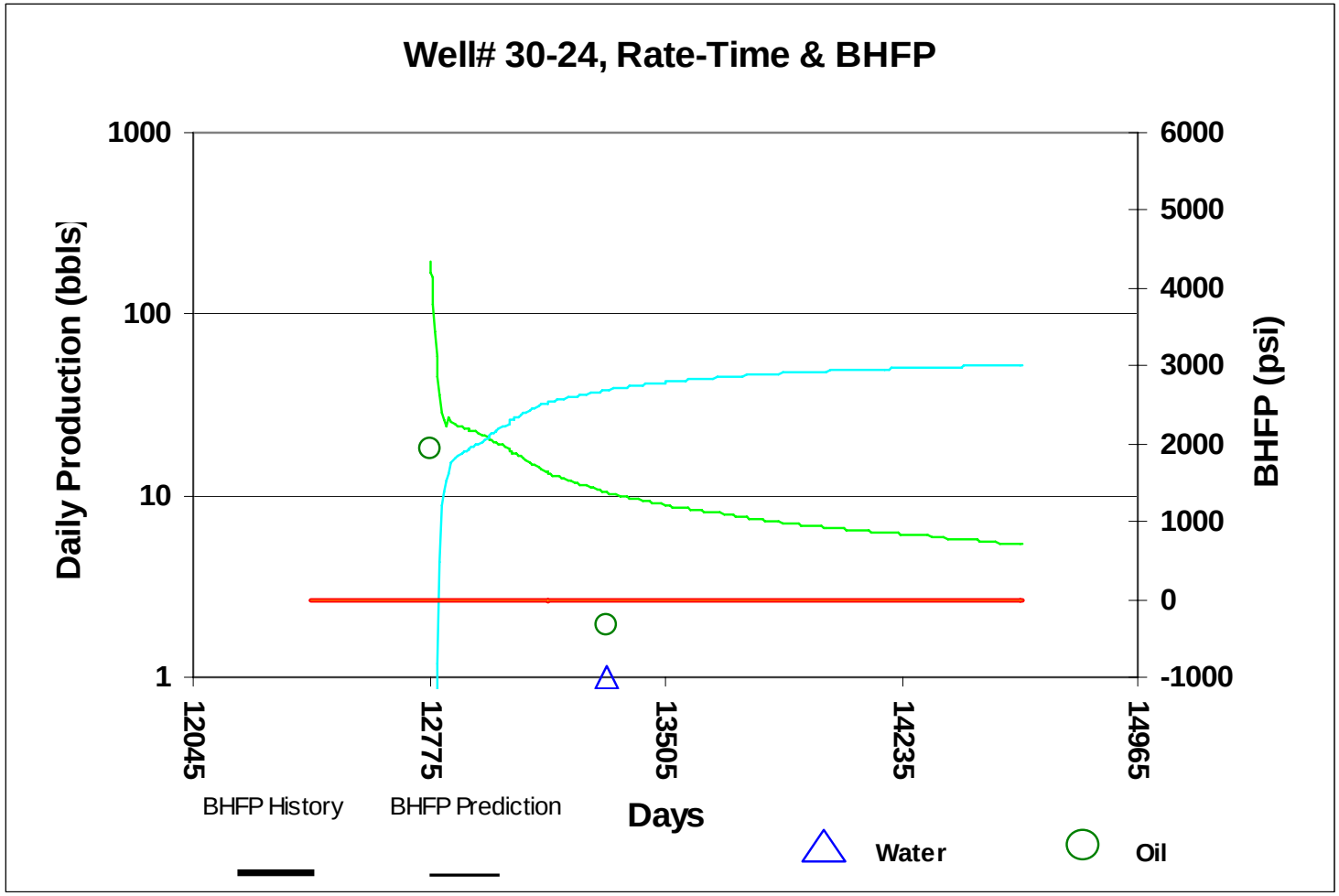

Well# 26R34, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
BHFP (psi)
6000
5000
4000
3000
2000
1000
0
0
730
1460
2190
2920
3650
4380
5110
5840
6570
7300
8030
8760
9490
10220
10950
11680
12410
13140
13870
14600
15330
16060
Days

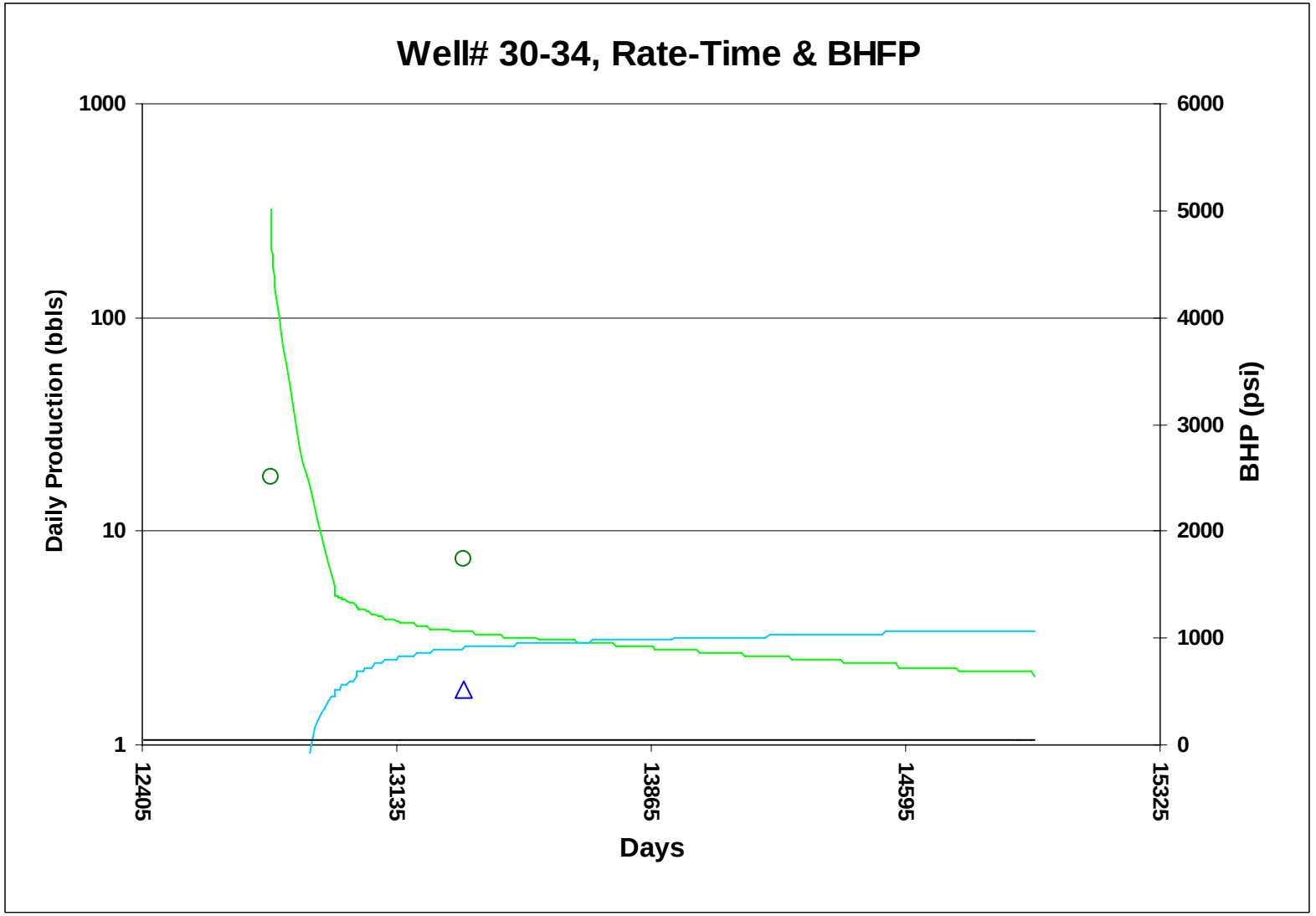

Well# 29R31, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
BHFP (psi)
6000
5000
4000
3000
2000
1000
0
12045
12775
13505
14235
14965
15695
Days
BHFP History
BHFP Prediction
Water
Oil

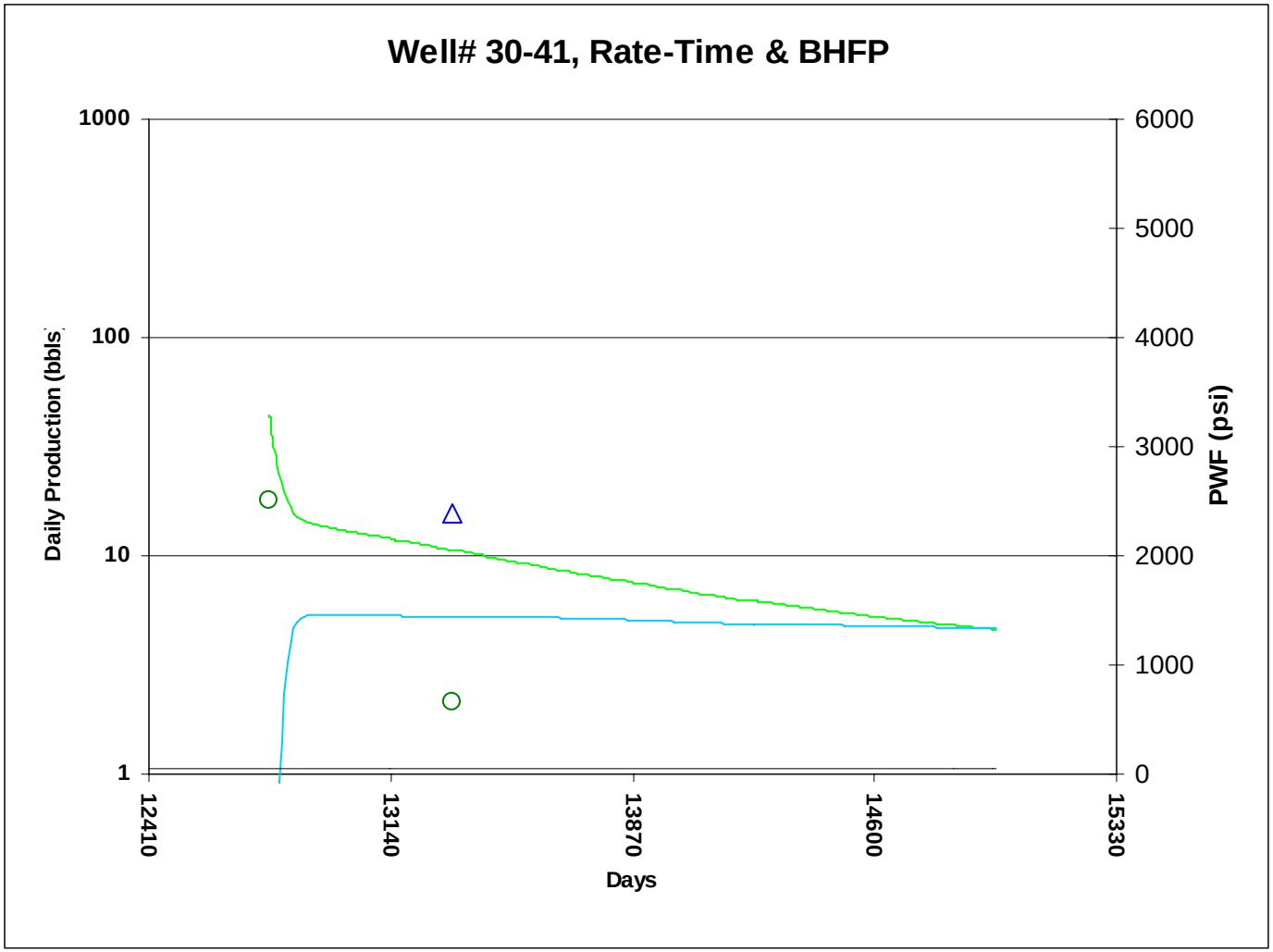

Well# 30R11, Rate-Time & BHFP
Daily Production (bbls)
BHFP (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
12405
13135
13865
14595
15325
Days

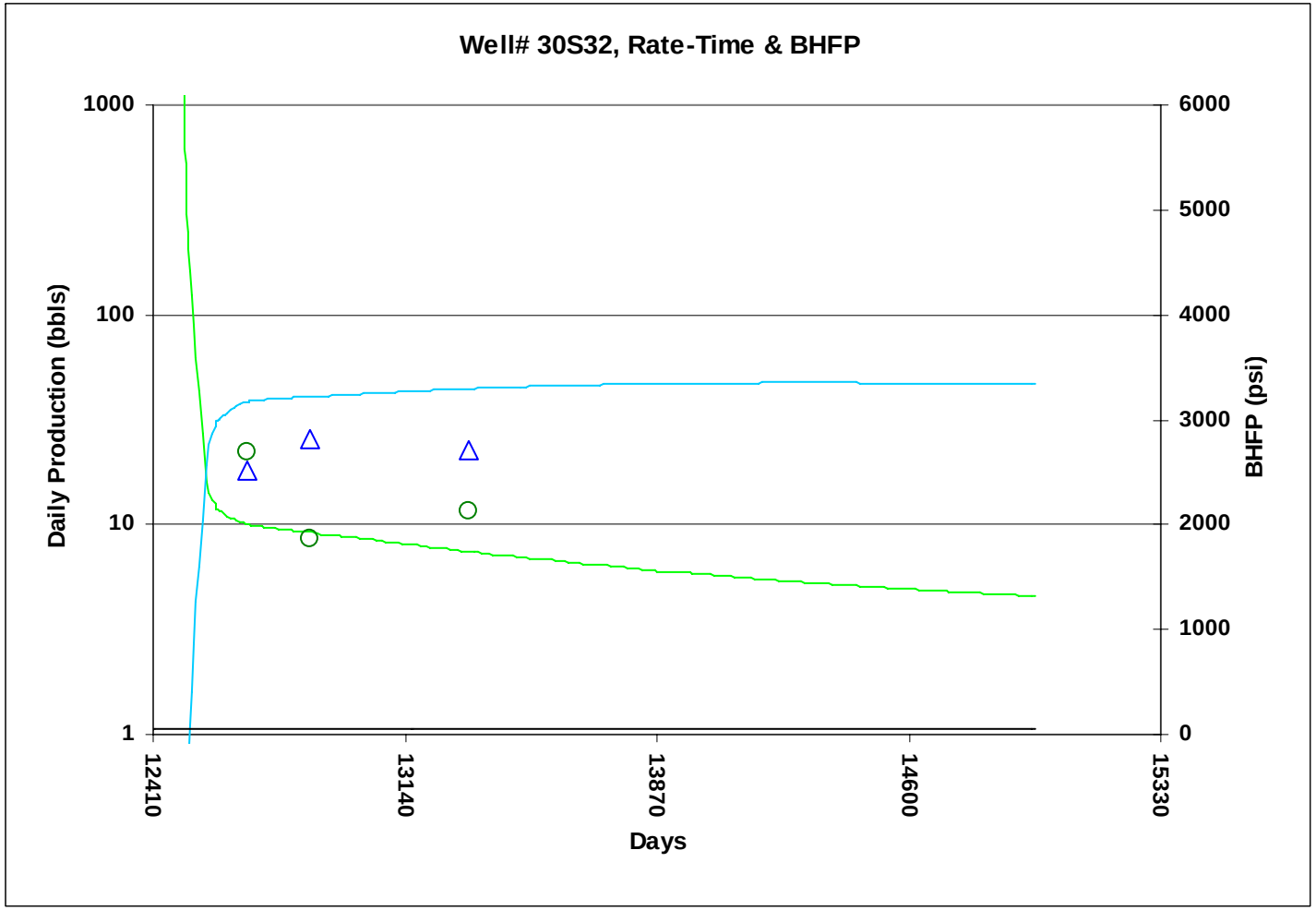

Well# 30R12, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
BHFP (psi)
6000
5000
4000
3000
2000
1000
0
12410
13140
13870
14600
15330
Days

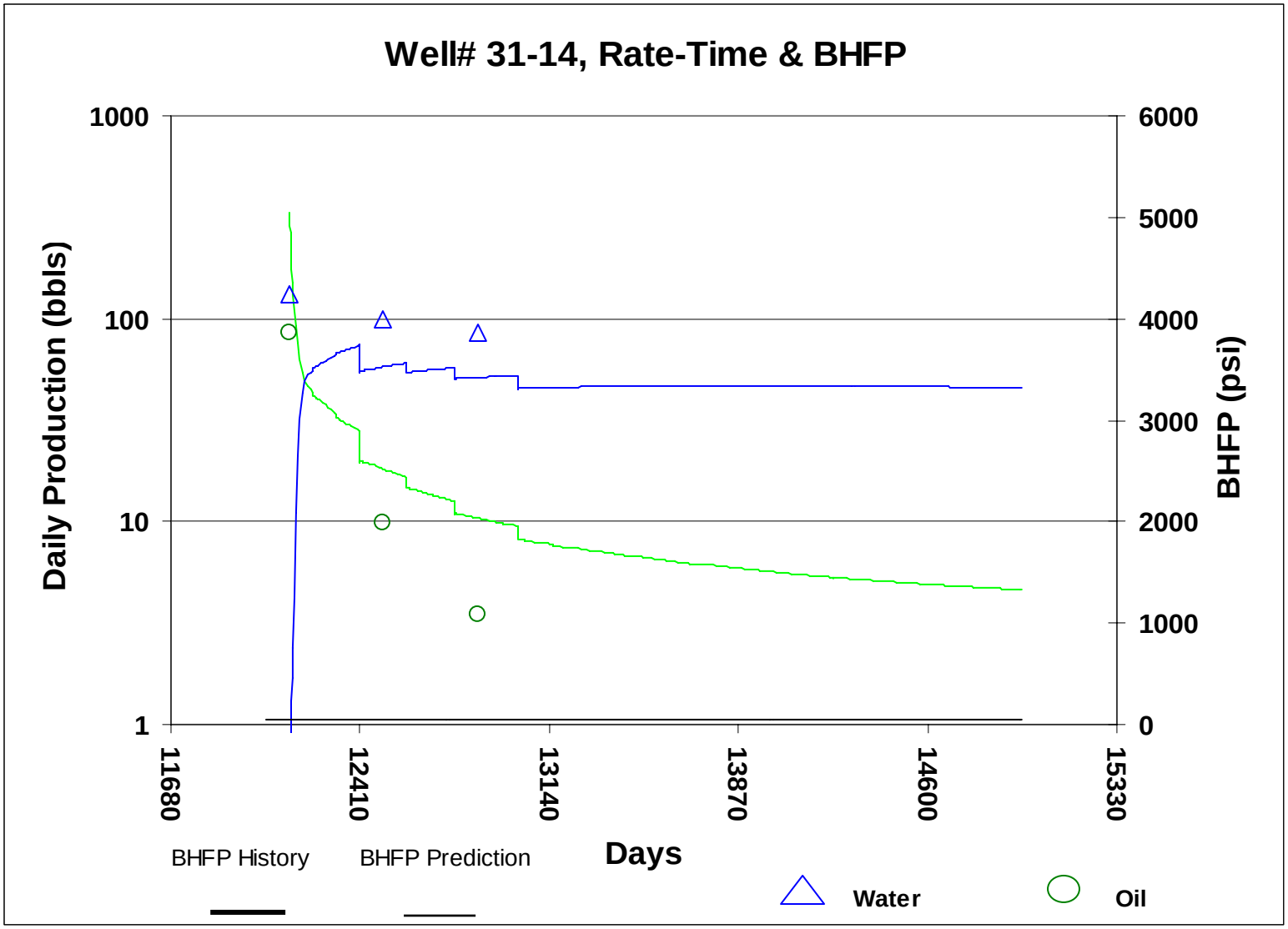

Well# 30R13, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
BHFP (psi)
6000
5000
4000
3000
2000
1000
0
11680
12410
13140
13870
14600
15330
Days

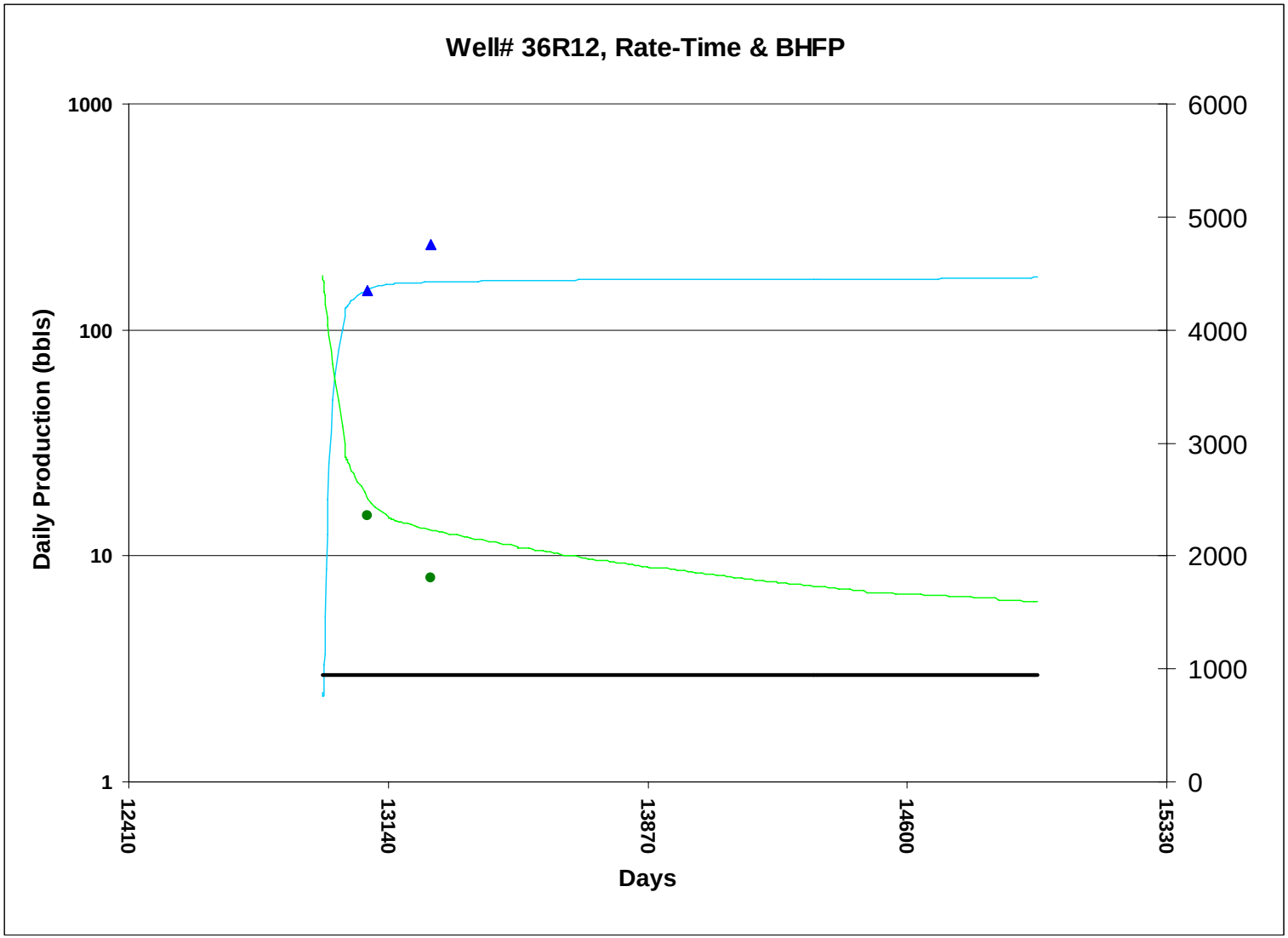

Well# 30-24, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
-1000
BHFP (psi)
12045
12775
13505
14235
14965
Days
BHFP History
BHFP Prediction
Water
Oil


Well# 30-34, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
BHP (psi)
6000
5000
4000
3000
2000
1000
0
12405
13135
13865
14595
15325
Days


Well# 30-41, Rate-Time & BHFP
Daily Production (bbls)
PWF (psi)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
12410
13140
13870
14600
15330
Days


Well# 30S32, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
BHFP (psi)
6000
5000
4000
3000
2000
1000
0
12410
13140
13870
14600
15330
Days


Well# 31-14, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
BHFP (psi)
6000
5000
4000
3000
2000
1000
0
11680
12410
13140
13870
14600
15330
Days
BHFP History
BHFP Prediction
Water
Oil


Well# 36R12, Rate-Time & BHFP
Daily Production (bbls)
1000
100
10
1
6000
5000
4000
3000
2000
1000
0
12410
13140
13870
14600
15330
Days