

Completion Deliverable

Boggess 9H



Limited En	try Calculator Inputs:
e	ehd: 0.42"
(Cd: 0.70
I	njection rate: 85 bpm
1	Net stress: 1200 psi (regional estimate)
9	Shots per cluster: 8
(Clusters per stage: 5
Results Su	mmary:
9	Stages analyzed: 3-56
F	Pred avg stage cluster efficiency: 60%
F	Pred max stage cluser efficiency: 60%
F	Pred min stage cluster efficiency: 60%
Ţ	Total clusters analyzed: 270
٦	Total clusters effectively stimulated (predicted): 162
Problem st	tage indicators:
9	Stress variability (scaled 0-300 psi)
l	Layering (scaled 25-40% layered)



Perforation Efficiency and Problem Stage Identifier Fracture ID



The following slides show graphical images of the completion's **predicted perforation** efficiency by stage and potentially difficult stages. Predicted perforation efficiency is calculated by determining if the design's perforation friction is sufficient to overcome the measured stress variability. Then, the percent flow is computed using plain strain.

Based on Fracture ID's experience, the following measurements can indicate **potentially** difficult stages:

Layering: High layering can indicate higher clay content and/or more ductile rock. Thus, in highly layered stages initiating and maintaining a fracture may be more difficult. Intervals with High Layering have a higher likelihood of "screenout" events.

Stress Variability: Stages with the highest Stress Variation may have lower perforation efficiency because of the additional perforation friction required to effectively distribute fluid and proppant to all clusters. Low perforation efficiency can result in increased treating pressures and proppant bridging.

Geometric Completion: All Lateral Data

E_EFFICIENCY 1.	Stage Cluster Ef	iciency			
Completions_Geo:STAG 0. <a a="" brokening<=""> <a a="" brokening<="">	Plugs				
Completions_Geo:PERCFLOW 0 0.75 Completions_Geo:PLUGS 1	Open clusters				
CLUSTER 4 D Stages Geo	888888888888888888888888888888888888888	8 8 8 8 8 8 8 8	8 8 8 8 8	21 21 21 21 21 21	11 11 00 00 V F
DEPTH (FT) FID_SNR 0 1	10000 11000 12000	13000 14000	15000 16000	17000	18000 19000
FED_SH_MIN_VT1 6500. ——— 8000.		un werd have a stand werd and the stand of the			
FID_MQ_VARIABILI 00.01 Variable 0-300 psi		trouble			
FID_MO_LAVERING 00.01 Layered 2540%		Potential stage ind			
Stages Geo	8 8 7 9 9 9 8 9 9 9 9 9 9 9 9 9 9 9	8 8 6 8 8 8 8 8 8 8 8 8		19 15 15 13 13 13 13	11 11 12 13 13 14 16 16 16 16 16 16 16 16 16 16 16 16 16

Geometric Completion: Stages 3-20

STG	LAYERED	VARIABILITY	STRESS		STG	CONTRIBUTION	CSTR EFF%	
Stag	FID_MQ_LAYERIN 0 0.01	FID_MQ_VARIABIL 00.01	FID_SH_MIN_VTI 65008000.	DEPTH (FT)	CLUSTER	Completions_Geo: PERCFLOW 0.75	Completions_Geo:STAGE_EFFICIE 0.	ENCY 1.
es Geo	Layered	Variable			Stages G	0 Completions_Geo: PLUGS 1	<50% - 75%	
	2540%	0—300 psi			ieo		<75%	
			why		11			
20			Write/Ia	1620	20			
			WW	00	11			
			h da		11			
19			al de la	16400	19			
			hrty/w)				
;			4m)	16				
18			ł	5600	8 1			
			M/					
1			ww	1				
h			WW	5800	11			
			\/\/ *					
			t M	1				
16			M	7000	16			
			1 M	D	•			
			hu					
15			M	1720	15 -			
			let h	00				
			ll.		1			
14			MupM	174	14			
			4	00				
			hawk					
ţ			and the	17	ţ			
1			MM	7600	1			
			Verent Martin					
Ş			₩ł	1				
7			wył	7800	I I			
			,,,,,	D	1			
			, MA					
11			vtum	180	11			
			May	00				
			M		1			
10			1	182	61			
			wm	200				
			M		1			
0			AN AN	1	0			
1			Ŵ	8400	2			
			wh		1			
			1	:				
×			W	1860	0			
			Mm		1			
r			4wyA	1	,			
			M	.880(\ \			
			hm	D				
			414					
9			****	1900	9			
			Nyw	0	1			
			hunn M					
'n			m	192	S.			
			NHYN	:00				
			hulu					
4			Marty	194	4			
			Ŵ	00				
ont					T			
m			Yww.	196	m			
tia			1	00	T			

Geometric Completion: Stages 21-38

STG	LAYERED	VARIABILITY	STRESS		STG	CONTRIBUTION	CSTR EFF%	
Staç	FID_MO_LAYERIN 00.01	FID_MQ_VARIABIL 00.01	FID_SH_MIN_VTI 6500 8000.	DEPTH (FT		Completions_Geo:PERCFLOW 0.75	Completions_Geo:STAGE_Ef 0.	FFICIENCY 1.
ges Geo	Layered	Variable			Stages	0 Completions_Geo: PLUGS 1	<50%	
	2540%	0—300 psi			Geo		50%-75% <75%	
			M					
85			la da	1260	8			
8			h M	0	2			
			Ŵĸţ	1	1			
37			n wh	2800	37			
			hum		11			
			1	130	11			
36			Ŵ	000	8			
			M-M					
			, wh	132				
35			1	00	ж I			
			W	Τ				
			N.	134				
34			hum	400	*			
			1		1			
			,My	130				
R			Ψ¶ŧ	500	8			
					1			
			Ŵ	13				
32			W M	800	32			
			M					
			'₩ ^t	1				
31			t.	4000	31			
			M)				
			Mp	1				
30			M	420	R			
			J.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		11			
			Ŵ		1			
29			441	1440	8			
			M	00				
			M					
ac			/h//t	146	۴			
97			ml	500	। । १			
			M					
			Ŵ	14	1			
27			rW	800	z –			
			νťγψ		'			
			ła/IV	15				
26			Y.	000	26			
			Maya					
			wł	15				
25			N.	5200	25			
			A.					
			M	1				
24			N/M	5400	24			
			1M					
			th y vt	1				
23			wM	5600	2			
			all ^a)				
			'wk(
22			myn	1580	22			
			WWW	0				
			M		1			
21			W	1600	21			
0.51			ph-	00				
			Å					

Geometric Completion: Stages 39-56

Stages Geo 🧐 🖌	FID_MQ_LAYERIN 0011 Layered2540%	FID_MO_VARLABIL 0	FID_SH_MIN_VTI 6500. — 8000.		Stages G	Completions_Geo:PERCFLOW 0.75 Completions_Geo:PLUG5 1	Completions_Geo:STAGE 0<50%	11.
Geo S S	Layered 2540%	Variable 0-300 psi		0	itages G	1	<50%	
8 8 5					eo		50%-75% <75%	
22 22			Ń					
5			M		35			
5			WW	9200				
1			n Minana		55			
2			MW	940				
ž			Mann	00	2			
				€				
23			Munik	500	8			
			MM.					
			M.	9800				
52			W. (m. 4)		22			
			M	:				
			M₩M	10000				
5			11-1)	5			
			W		1			
			h	10200				
20			M	0	2 2			
			MM		1			
			A	1040	11			
49			W	00	49			
			w	106				
48			1	00	8			
			44m/4					
			Mmy	10	1			
47			hw	800	47			
			hth		1			
			l ng Ul	1				
46			W	1000	4			
			m		1			
			Why	1	1			
ł			M	.1200	1			
1			h.	D	₽ 			
			hw	1				
			l.N	1140	:			
F			d W	D	ţ			
			٧w	:	1			
43			wh.	1600	4			
			M					
			L _ M	11	1			
42			M	.800	42			
			M					
			M	12	1			
41			w	2000	41			
			M					
			t Ma	1				
40			WA.	220	4			
2			M,	0	7			
			han		1			
			hry.	124				
39				00	ا ا			
			al Mark					
			habt	126	Π			
8			W	600	8			

Geometric Stage Summary

Stage	Layering	Stress Variability (psi)	Cluster Efficiency	Stage	Layering	Stress Variability (psi)
3	37%	120	60%	27	35%	130
4	33%	109	60%	28	33%	136
5	35%	98	60%	29	34%	145
6	35%	115	60%	30	41%	191
7	39%	133	60%	31	34%	138
8	39%	147	60%	32	44%	258
9	50%	224	60%	33	45%	244
10	38%	149	60%	34	34%	131
11	33%	135	60%	35	37%	213
12	31%	136	60%	36	30%	113
13	31%	112	60%	37	32%	135
14	34%	135	60%	38	32%	158
15	32%	149	60%	39	34%	138
16	29%	150	60%	40	37%	173
17	30%	121	60%	41	33%	131
18	33%	181	60%	42	31%	154
19	33%	148	60%	43	35%	183
20	31%	148	60%	44	32%	143
21	34%	198	60%	45	30%	123
22	35%	126	60%	46	32%	129
23	37%	135	60%	47	33%	159
24	34%	190	60%	48	30%	191
25	37%	172	60%	49	35%	167
26	33%	101	60%	50	32%	162

Stage	Layering	Stress Variability (psi)	Cluster Efficiency
52	34%	174	60%
53	35%	174	60%
54	31%	178	60%
55	28%	112	60%
56	34%	157	60%
57*			

*Stage 57 is in the curve section

Cluster Efficiency 60% 60% 60% 60% 60%

60%

60% 60% 60% 60% 60% 60% 60% 60% 60% 60% 60% 60% 60% 60% 60% 60% Fracture ID data did not cover Stages 1 and 2



Minimum Horizontal Stress Calculation and Assumptions Fracture ID



$$\sigma_{h,min} = \frac{v_{13}}{(1-v_{12})} \big(\sigma_{obg} - \alpha \cdot P_{ppg} \big) + P_{ppg}$$

- v_{13} = Fracture ID Horizontal-Vertical Poisson's Ratio, unitless
- v_{12} = Fracture ID Horizontal-Horizontal Poisson's Ratio, unitless
- σ_{obg} = Overburden Gradient, psi/ft
- P_{ppg} = Pore Pressure Gradient, psi/ft
- α = Biot's Poroelastic Constant, unitless
- TVD = True Vertical Depth, ft
- Overburden Gradient (psi/ft):1.166Pore Pressure Gradient (psi/ft):0.68Biot's Poroelastic Constant:0.9