

Overview of Horizontal Well Fracturing & Sand Requirements

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Outline

- Introduction
- What is Fracturing?
- Actual Execution of Fracturing Operations
 - Key Equipment Utilized
 - Location Layouts and Photographs
- Sand (Proppants) - Purpose/Specifications/Types/Amounts
- Sand – How to Evaluate/Qualify
- Questions?

Introduction

- Frank R. Leeper – 21yr. industry veteran, 16 yrs. with SLB in various technical, sales, management roles in the US (9 yrs. in the Appalachian Basin) and world-wide. 4 yrs. with Superior Well Services, joined PSC in March 2011.
- PSC – 100% Employee Owned Pressure Pumping Company located in Zanesville, Ohio since 1981.
- Studies show only ONE item is remembered from any presentation.....

• **FRAC** NOT FRACK!

What is Fracturing?

- Fracturing, simply put, is the cracking of oil & gas bearing rock (Utica/Marcellus Shale) deep below the earth's surface via pumping fluid at high pressures and rates
- Chesapeake Video OR Explanation of the Process

Equipment – Command Center

Full acquisition of all job data, remote transmission anywhere in the world, satellite phones, internet, television!



Equipment – 120 BPM Blending Unit



“Heart” of operation – Mixes sand with water and additives – Sends mixture to high pressure pumps

Equipment – Bulk Sand Handling



Typically 3-7 per wellsite, can hold approx.. 250,000 lbs.. sand/proppant each

Equipment – High Pressure Manifold



Typically rated to 10K or 15k
psi with ports to hook up 10
to 14 pumps

Equipment – 2250 Frac Pump

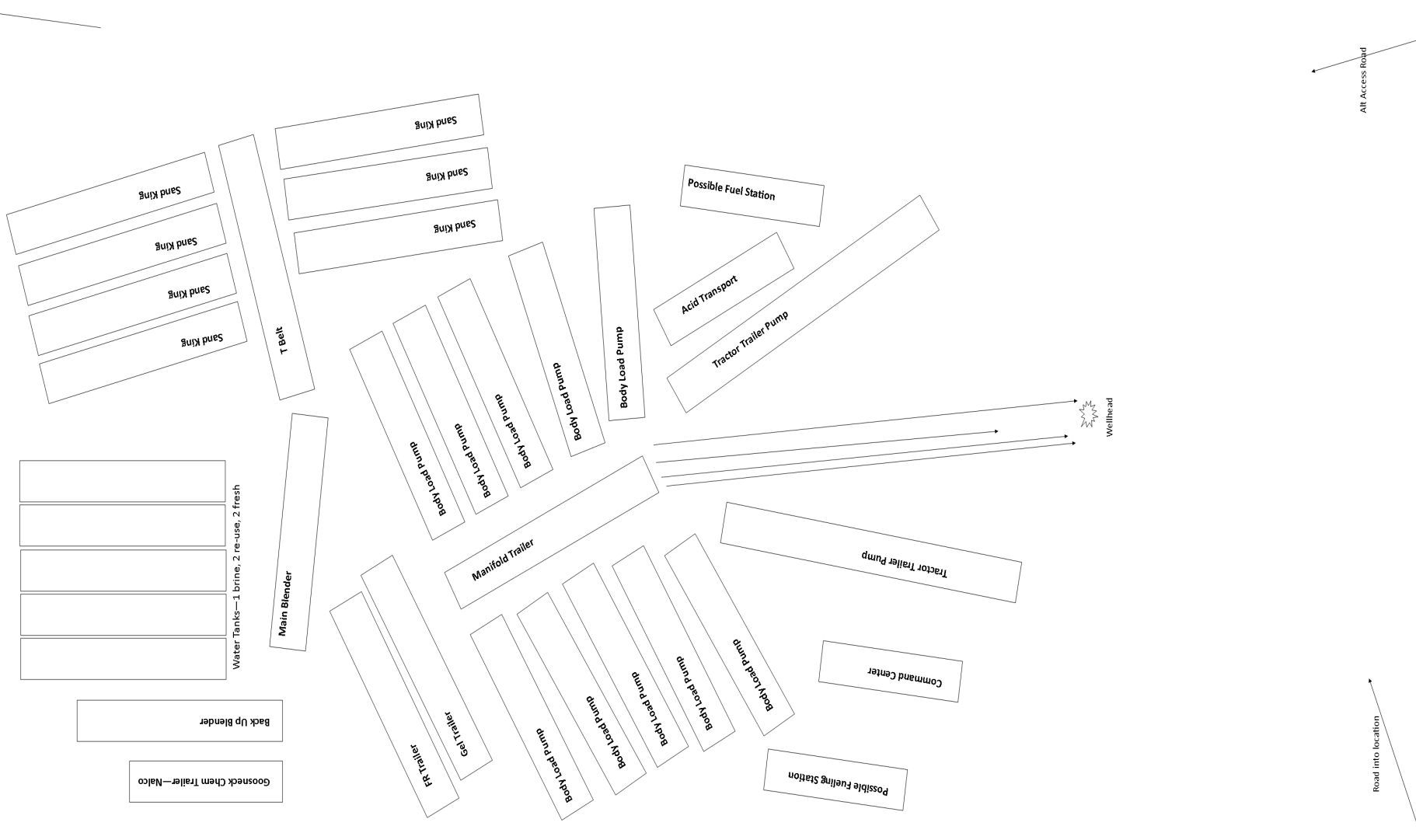


Typical 10-14 per job,
pump fluid ends
determine pressure
ratings – pump
sand/water mixture
down well



Typical Location Layout

Chesapeake Gary Kestner 3H Location Frac Layout Design—To Scale—Location is 190' Wide x 360' Long



Well Site – Marcellus Pad Frac



Well Site – Marcellus Pad Frac



Well Site – Marcellus Pad Frac



Well Site – Marcellus Pad Frac



Sand (Proppants)

- Frac Sand (Proppant) is the other largest material pumped into a typical well (water + sand = 99+% of total volume)
- Typical Horizontal Well = approx. 4-8 MM lbs. Frac Sand
- Purpose – to “Prop” open the rock after pumping is done
- Specification – vast majority of Frac Sand meets API (American Petroleum Institute RP 56 Standard) specifications
 - Grain Size (100, 40/70, 30/50, 20/40) 90% of grains must fall into range
 - Sphericity and Roundness – older deposits typically better
 - Crush Resistance – determines grade “brown vs. white”
 - Acid Solubility – less than 2% weight loss
 - Turbidity – clay and silt – typically can be removed

Sand (Proppants)

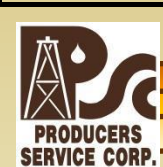
- Types of Sand (Proppants)
 - Natural (Sand – typical “brown” = 4000 PSI crush, typical “white” = 6000 psi crush)
 - Coated Natural Sands – increased crush resistance and “flowback” control
 - Man Made Products (Ceramics/Bauxite) – higher crush resistance, roundness and resistance to deterioration over life of well

Examples (Pump Schedules - Volumes)

Operator Name: xxxx
 Well Name: Dry Gas
 Formation: Marcellus
 Fluid Type: Fresh Water

PUMP SCHEDULE

STAGE DESCRIPTION	Stage Time (min)	Rate (bpm)	Clean (gals)	Clean (bbls)	Dirty (bbls)	Cum (bbls)	Begin Conc (ppg)	End Conc (ppg)	Stg (lbs)	Cum (lbs)	Sand Type	Sand Rate [lbs/min]
Acid 7.5%	2	15	999.6	24	24	24	0	0	0	0		0
Pad FR	25	80	84000	2000	2000	2024	0	0	0	0		0
0.25# 100 Mesh FR	5	80	16800	400	405	2428	0.25	0.25	4200	4200	100 Mesh	840
0.5# 100 Mesh FR	5	80	16800	400	409	2837	0.5	0.5	8400	12600	100 Mesh	1680
0.75# 100 Mesh FR	5	80	16800	400	414	3251	0.75	0.75	12600	25200	100 Mesh	2520
1.0# 100 Mesh FR	5	80	16800	400	418	3669	1	1	16800	42000	100 Mesh	3360
Pad - 10# Gel	1	80	4200	100	100	3769	0	0	0	42000	100 Mesh	0
0.50# 40/70 White 10# Gel	5	80	16800	400	409	4179	0.5	0.5	8400	50400	40/70 White	1680
1.0# 40/70 White 10# Gel	8	80	25200	600	627	4806	1	1	25200	75600	40/70 White	3360
1.50# 40/70 White 10# Gel	9	80	29400	700	748	5554	1.5	1.5	44100	119700	40/70 White	5040
2.0# 40/70 White 10# Gel	16	80	50400	1200	1309	6863	2	2	100800	220500	40/70 White	6720
2.50# 40/70 White 10# Gel	11	80	33600	800	891	7754	2.5	2.5	84000	304500	40/70 White	8400
3.0# 40/70 White 10# Gel	7	80	21000	500	568	8323	3	3	63000	367500	40/70 White	10080
Flush 1st 100 BBL 10# Gel, then FR	4	80	14700	350	350	8673	0	0	0	367500		0
DESIGN TOTALS	110		347500	8274	8673					367500		
42,000# 100 Mesh & 325,500# 40/70 White Per Stage - 21 Total Stages												

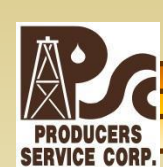


Examples (Pump Schedules - Volumes)

Operator Name: xxxxx
 Well Name: Wet Gas
 Formation: Marcellus
 Fluid Type: Fresh Water
 Location: Ohio County, WV

PUMP SCHEDULE (First Stage)
Other Stages 2500 gal 15% HCL

STAGE DESCRIPTION	Stage Time (min)	Rate (bpm)	Clean (gals)	Clean (bbls)	Dirty (bbls)	Cum (bbls)	Begin Conc (ppg)	End Conc (ppg)	Stg (lbs)	Cum (lbs)	Sand Type	Sand Rate [lbs/min]
Acid 15%	8	15	5000	119	119	119	0	0	0	0		0
Pad FR	15	85	55000	1310	1310	1429	0	0	0	0		0
0.25# 100 Mesh FR	15	85	53000	1262	1276	2705	0.25	0.25	13250	13250	100 Mesh	892.5
0.5# 100 Mesh FR	15	85	53000	1262	1291	3996	0.5	0.5	26500	39750	100 Mesh	1785
0.75# 100 Mesh FR	17	85	58000	1381	1428	5424	0.75	0.75	43500	83250	100 Mesh	2677.5
1.0# 100 Mesh FR	17	85	58000	1381	1444	6868	1	1	58000	141250	100 Mesh	3570
1.25# 100 Mesh FR	17	85	58000	1381	1460	8327	1.25	1.25	72500	213750	100 Mesh	4462.5
1.50# 40/70 White FR	8	85	26000	619	661	8989	1.5	1.5	39000	252750	40/70 White	5355
1.75# 40/70 White FR	8	85	28000	667	720	9709	1.75	1.75	49000	301750	40/70 White	6247.5
2.0# 40/70 White FR	8	85	27500	655	714	10423	2	2	55000	356750	40/70 White	7140
2.25# 40/70 White FR w/20# gel	9	85	30000	714	788	11211	2.25	2.25	67500	424250	40/70 White	8032.5
2.50# 40/70 White FR w/20# gel	9	85	30000	714	796	12006	2.5	2.5	75000	499250	40/70 White	8925
2.75# 40/70 White FR w/20# gel	11	85	35000	833	938	12944	2.75	2.75	96250	595500	40/70 White	9817.5
3.0# 40/70 White FR w/20# gel	12	85	39000	929	1056	14000	3	3	117000	712500	40/70 White	10710
Flush FR	0	85	0	0	0	12944	0	0	0	712500		0
DESIGN TOTALS	171		555500	13226	14000					712500		



Sand (Proppants)

- How to Qualify? What do I Have?
 - Samples must be tested
 - Many companies specialize in initial and ongoing QA/QC testing
 - PropTesters, FracTAL, Anderson Engineering etc...
- Frac Sand is NOT “dirt” or “beach” sand...it is very specialized and specific BUT if the right deposit exists, can be very valuable – especially close to market!
- Estimated approx.. 15 Million Metric Tons worth over \$1 Billion pumped in 2011!

QUESTIONS?