2016
PROPPANT MARKET REPORT

CONFIDENTIAL

Published March 1, 2017

Table of Contents

- **FORWARD** 3
  - Methodology 5
- **MARKET DYNAMICS** 6
- The Year in Review: 2016 7
  - Chart: Proppant Consumption by Year 8
  - Chart: Proppant Consumption by Type 9
  - Key Factors Impacting Proppant Demand 10
  - Proppant Demand Fundamentals 12
  - Chart: Natural Gas Price Trends 13
  - Chart: Oil Price Trends 14
  - Chart: Oil vs Gas Price Dependent 15
  - Chart: US Oil and Gas Drilling Activity-All Wells 17
  - Chart: US Oil and Gas Drilling Activity-Trajectory 19
  - Chart: US Horizontal Drilling-Oil vs. Gas 20
  - Chart: Canadian Horizontal Drilling-Oil vs. Gas 21
  - Chart: Drilled, Completed, and DUC Inventory 24
  - Chart: Rig Effciency and Proppant Intensity 25
  - Chart: U.S. Oil Production vs. Major Imports 31
  - Chart: U.S. Dry Gas Production vs. Imports 32
  - Chart: Key Factors Impacting Proppant Supply 33
  - Proppant Supply Fundamentals 34
- **FRAC SAND** 39
- The Frac Sand Industry 40
  - Chart: Frac Sand Consumption 1991-2016 42
  - Chart: Basic Frac Sand Types 43
  - Chart: Basic Frac Sand Properties 44
  - Chart: Sand Performance Consideration 45
  - The Rise of Regional Sands 46
  - Select Sand Operating Hours by State 47
  - Table: Frac Sand Suppliers 51
  - Table: Frac Sand Suppliers (International) 62
  - Table: Pending Frac Sand Suppliers 63
  - Chart: Frac Sand Capacity By Grade and Type 64
  - Chart/Table: Capacity by Company 65
  - Chart/Table: Capacity by State/Region 66
- **CERAMIC PROPPANTS** 67
- The Ceramic Proppant Industry 68
  - Chart: Ceramic Consumption 1980-2016 70
  - Chart: Basic Ceramic Proppant Types 71
  - Chart: Basic Ceramic Proppant Properties 72
  - Table: Ceramic Proppant Suppliers (Western) 73
  - Table: Ceramic Proppant Suppliers (Eastern) 74
  - Table: Ceramic Proppant Suppliers (Other) 78
  - Chart: Estimated Ceramic Proppant Capacity 79
- **RESIN COAT** 80
- The Resin Coat Industry 81
  - Chart: Resin Coat Consumption 1988-2016 83
  - Chart: Basic Resin Coat Properties 84
  - Table: Active Resin Coat Suppliers 85
  - Table: Select International Suppliers 87
  - Chart: Estimated Resin Coat Capacity 88
- **SUPPLY CHAIN** 89
  - North American Trends 90
  - Logistics Outlook 2017 92
- **SUMMARY** 93
  - Summary 2016 94

Forward

Recently there has been considerable discussion concerning regional, fit-for-purpose sand. I credit the popularization of "fit-for-purpose" sand to industry veterans at BJ Services and PropTester nearly a decade ago (see SPE 116054 "Using Industry Standards as a Way to Predict Sand Performance and Approve Sand Deposits: Is There A Catch 22?", Brannon, et al). The study correctly addressed that natural frac sands can fail one or more industry qualifying standards and still meet select reservoir flow capacity needs. The fact is, regional sands of various qualities have been an important supply source since the inception of commercial hydraulic fracturing in 1949. Regional sources included niche operations such as those Doug Olmen (my dad) established in Colorado and England in the 1970s and 1980s to more present-day, high-capacity operations today involving significant private and public funding.

The use of non-traditional frac sand (specifically sands that readily do not meet all API/ISO standards) is often impacted by Tier 1 supply availability and industry economics. Generally, weak oil and natural gas prices result in a higher acceptance and use of lower-cost, lower-quality proppants to minimize completion costs, only to revert to more conductive, higher-cost proppants as economics improve. Conversely, non-traditional proppants sometimes must be used during strained supply for no other reason than to ensure timely well completions.

The present "just pump more sand" movement is not new, but the degree at which it is being applied in completion practices is challenging conventional thinking. Higher intensity loadings of all types of smaller mesh sands are showing promise in unconventional oil and gas wells in Canada, the US and even Saudi Arabia (see SPE 184823 "From the Backyard Sand Dune to Fracturing a Highly Tectonically Complex Formation in Saudi Arabia," Bartko, et al).

PropTester Inc.

KELRIK

Considering sources of very high quality, Tier 1 sand are not prevalent outside of the United States, if at all, this trend may bode very well for unconventional resource development outside of North America. Long-term proppant conductivity is still important, but so are maximizing reservoir contact, avoiding early screen-out, and curtailing completion costs, among other things.

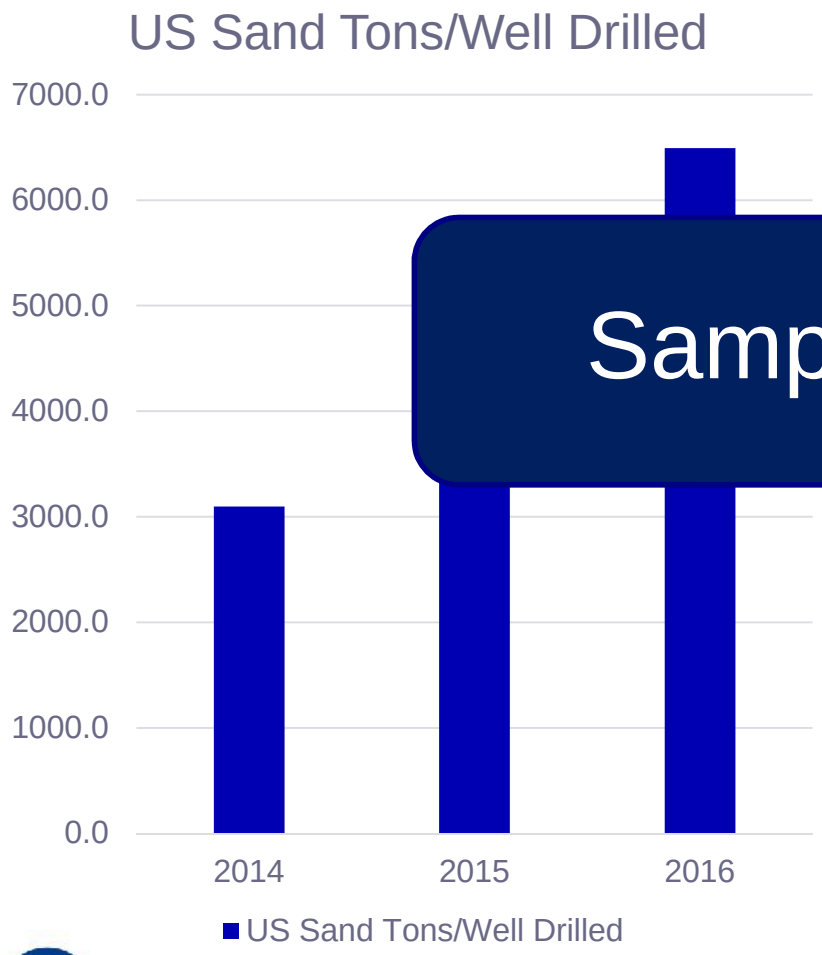
In January I had the pleasure of revisiting with Ralph Veatch, the 2017 recipient of the Legends of Hydraulic Fracturing award. He may have summed it up best when he questioned, “What is the cost of not knowing what we need to know to maximize economic returns?” In other words, there is a cost of ignorance in our industry. It was not a derogatory question, but rather an understanding over a long career that our industry will, and must continue to, challenge completion practices.

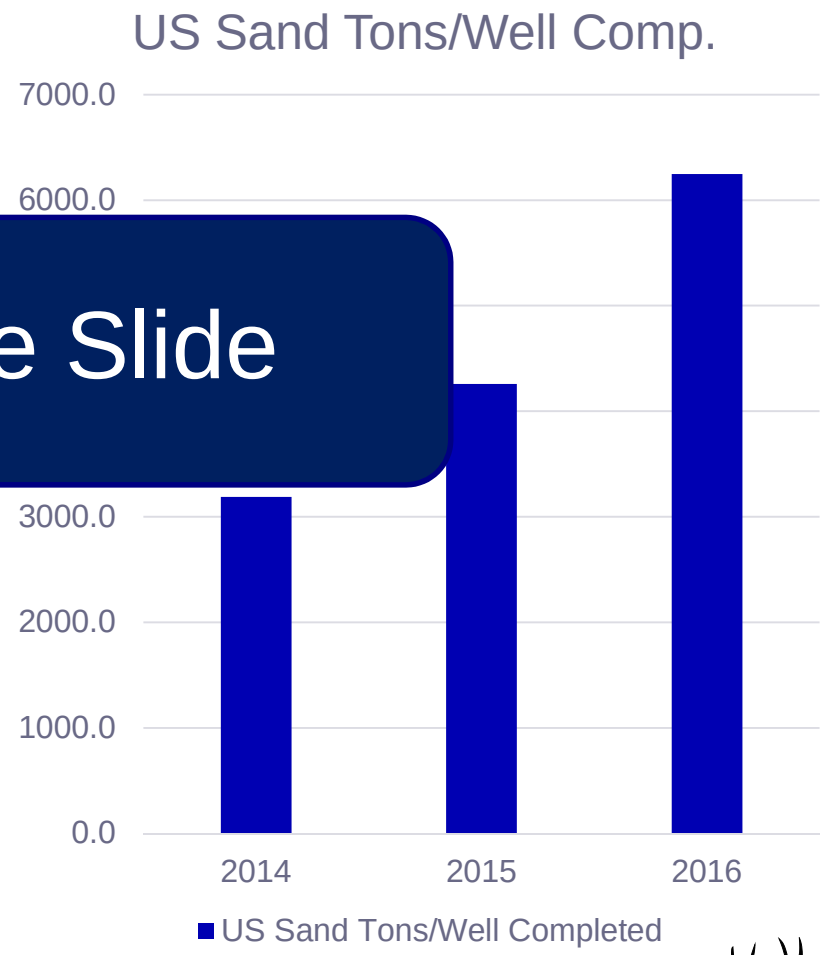
In his words, there are steep learning curves involved going from millidarcy to microdarcy to nanodarcy formations, and eventually we must evolve from “bigger is better” to “smarter is better” to achieve higher economic returns. Expenditures (even though they may be relatively large) to enhance our knowledge of essential information has a high probability of dramatically increasing economic returns, especially with the high dollar costs of current operations.

We agree. Until then, we will revert, and caution others, from making absolute statements about what future proppant trends and volumes will be.

Brian D. Olmen, KELRIK LLC

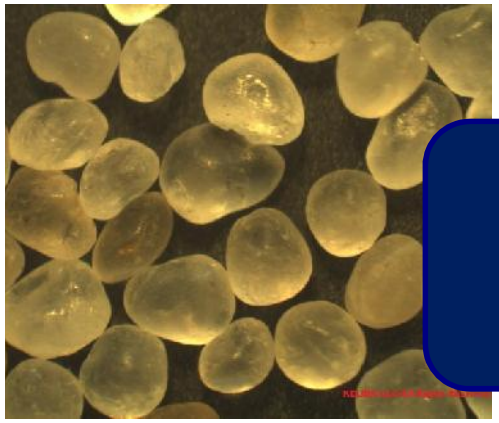
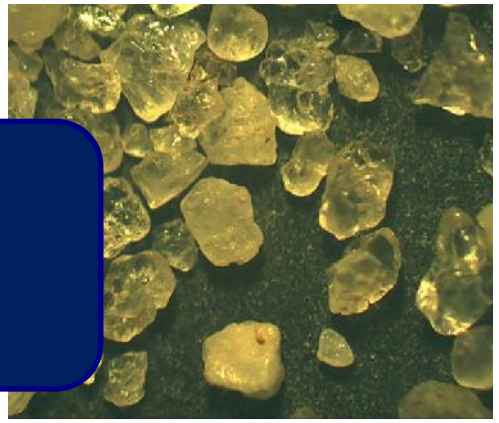
Rig Efficiency and Proppant Intensity



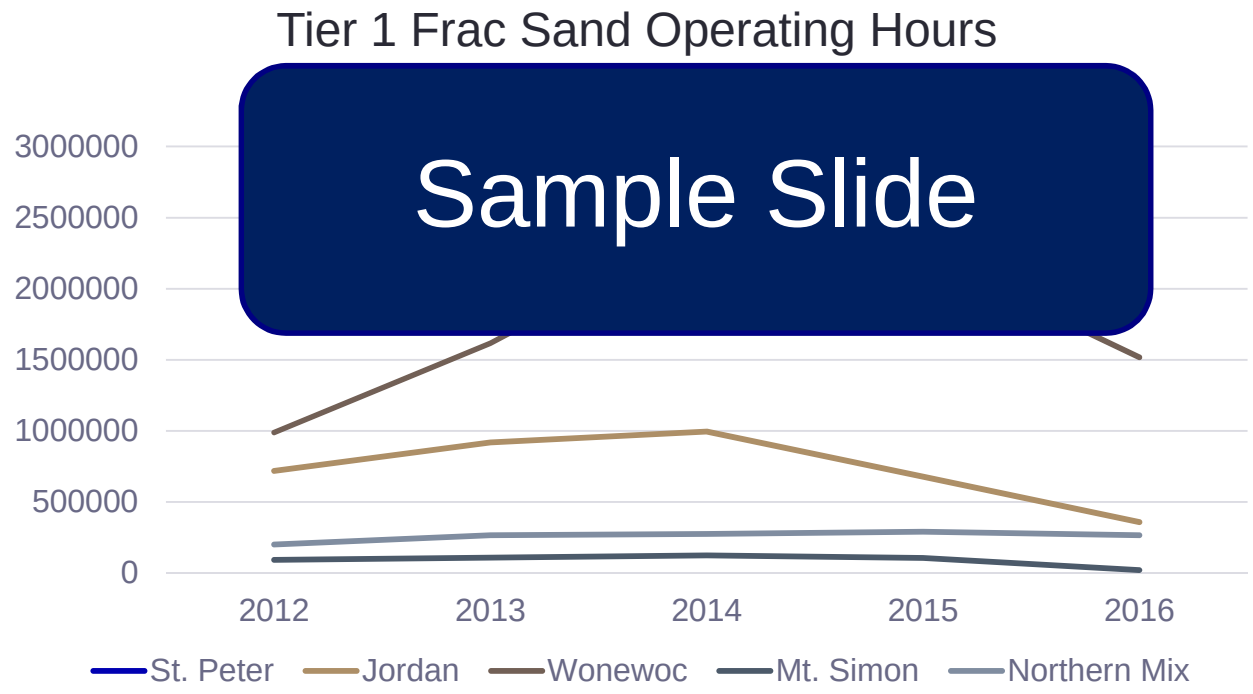


Sample Slide

Basic Frac Sand Types

Tier 1	Tier 2	Tier 3
		
Premium	Good	Marginal
"Northern White"	"Brady Type"	"Fit-for-Purpose"

Further review of the data reveals other trends. Sand grain distribution can vary significantly within deposits. The primary source deposits for Tier 1 sands consist of St. Peter, Jordan, Wonewoc, and Mt. Simon formations, and select Wisconsin deposits which we generically refer to as Northern Mix that contain an alluvial blend of one or more of the named sources. Our Tier 1 classification includes nearly all Illinois, Iowa, Minnesota and Missouri deposits, and a select few Arkansas and Oklahoma operations that have either St. Peter or equivalent deposits. Coarse sand supply (i.e., 20/40 and coarser) is limited in St. Peter sandstone deposits and essentially non-existent south of Illinois. Considering the propensity to pump finer mesh sands the past year, it should come as no surprise that St. Peter sources faired better than their coarser kin.



Company	Plant Locations	Source Material	Direct Access	Estimated Realistic Frac Capacity and Noteworthy Events
Capital Sand Proppants, LLC **www.capitalsandproppants.com**	Cape Girardeau, MO	St. Peter	Truck Barge	**Capacity: 4.000 billion (2,000,000 tons)** **Grades: 30/50 thru 100 M/200 M** Established in 1973, Capital Sand, Inc., a subsidiary of Farmer Holding Company, commenced supplying frac sand after constructing a new 2.0 Million ton frac sand processing plant in April 2015. Known as Capital Sand Proppants, LLC, the new barge and truck-to-rail facility produces 30/50 thru 100 mesh from the St. Peter sandstone in Missouri. The company also supplies silica flour.
Mississippi Sand, LLC **www.Mississippi-sand.com**	Festus, MO Arcadia, WI	St. Peter Jordan	Truck/Barge	**Capacity: 3.800 billion lbs (1,900,000 tons)** **Grades: 20/40 thru 100 M** Mississippi Sand maintains primary production facilities in Missouri, it's flagship facility, and Arcadia, Wisconsin. The Festus operation has both barge and truck-to-rail capabilities. The previously pending Ottawa, Il mine was sold to US Silica. Capacity has increased marginally from prior year, and we expect Arcadia will
American Silica LLC **www.americansilica.com**	Black Rock, *(NEW 201*			**ns)** illion, BNSF-served processing facility near initial product shipments January 2017. ave City, AR and is a St. Peter sandstone
Sargent Sand **www.sargentsand.com**	Ludington, M			**ons)** **Grades: 30/50 thru 40/70** Sargent Sand completed a new, 1 Million tpy dry screen facility in Ludington, Michigan in 2012 (fully operational in 2013). The truck-to-rail based facililty was expanded in mid 2014 to a current capacity of 1.4 Million tpy. Predominantly a 40/70 deposit, the company will install equipment to commence making limited 100 mesh in 2017.
Sierra Frac Sand, LLC **www.sierrafracsand.com**	Tatum, TX Gonzales, TX	Northern /other Northern	BNSF/UPRR	**Capacity: 2.700 billion lbs (1,350,000 tons)** **Grades: 8/16 thru 100 M** Sierra Silica initially produced Northern White sands sourced from the upper Midwest deposits at its Texas processing facilities. More recently, the company has focused on producing regional sources of sand from both Texas and Louisiana. The company continues to look into new regional sources of sand, as well as expanding its dust containment business.

Sample Slide