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Everything Has Changed, Part 3 - The Frac Sand Revolution

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A primary focus of E&Ps during the Shale Era has been driving down the cost of drilling and completing wells — doing so lowers producers' break-even costs and increases their profitability. With the volumes of frac sand being used in the Permian and many other plays having grown dramatically in the past five years, a big push is on not only to minimize the cost of the sand itself, but to maximize the efficiency of sand delivery and sand management at the well site. All this has been spurring E&Ps to assume responsibility from oilfield service companies for the frac sand supply chain — anything from directly sourcing the sand to managing "last-mile" logistics. Today, we continue our series on the rapidly changing frac-sand world, this time concentrating on producers' growing involvement in sand procurement and management.

This is Part 3 of this series. In Part 1, we proclaimed that the Frac Sand Revolution has arrived. Generally speaking, this new era is characterized by long lateral drilling lengths (7,500 to 10,000 feet, and sometimes thousands of feet longer than that) and an intense use of sand (2,500 pounds per linear foot of lateral is now common in the Permian), which together have resulted in the need for large volumes of frac sand. In fact, demand for the sand used in hydraulic fracturing has more than doubled over the past three years, to more than 100 million tons per annum (MMtpa). To help reduce the delivered cost of sand, dozens of new "local" sand mines have been developed, and frac sand prices have fallen sharply from their 2017 highs. We also zeroed in on the local sand sources in the Permian, which now has about 20 sand mines with a combined nameplate capacity of more than 70 MMtpa — considerably more than the play's current sand demand of about 50 MMtpa. In Part 2, we continued our look at local sand mines, this time discussing the Eagle Ford, SCOOP/STACK and Haynesville plays, each of which appears to be well on its way toward becoming largely self-sufficient from a sand supply perspective. It's important to note that while the use of local sand has risen to the fore in these plays, some volumes of Northern White Sand are still being railed in from the Upper Midwest. Also, Northern White remains the dominant frac sand in many other production areas, including the Marcellus/Utica, Bakken, Niobrara's Denver-Julesburg (D-J), and Powder River basins.

Today, we turn our attention to the E&P sector's evolving view of how deeply producers should become involved in the frac sand supply chain, which begins at the sand mine and continues through the well site (see Figure 1). Traditionally, responsibility for ensuring that sand is procured, transported to well sites, and stored — ready to use in well completions — has fallen to the integrated oilfield services (OFS) companies or pressure-pumping specialists that E&Ps contract with to do their drilling and pressure pumping. Generally speaking, the pressure pumpers would manage the sand supply chain themselves by buying from frac sand companies, arranging the rail transportation, utilizing their own or independent sand transload facilities in the plays, managing the last-mile trucking to the site and "pushing" the sand at the well site. That approach to sand supply oversight has been challenged in the past two or three years, however, as the amount of frac sand being used — and the cost of sand, especially during the 2017 price spike — led at least some E&Ps to consider alternatives that would give them more control.

Figure 1. Frac Sand Supply Chain. Source: PLG Consulting

Remember that producers since the beginning of the Shale Era have been striving continuously to whittle down their drilling and completion costs — that, combined with focusing on their best, most productive acreage, has enabled E&Ps in many production areas to thrive when hydrocarbon prices are strong and do well even when prices are only middling. Just as producers were making progress on other fronts — lower drilling costs per linear foot, for example, and the use of multi-well pads — their sand needs and costs were rising, however, and many E&Ps started to examine how best to rein them in.

There are, of course, many degrees of potential E&P involvement in the sand supply chain. These include anything from directly procuring a small fraction of the sand they need to buying most or all of their sand requirements — and managing the delivery of sand to the well site and its storage there. Producers also have the option of turning to sand-mining companies or sand logistics specialists to do part or all of the above for them. A lot of this has been happening; our understanding is that about half of the frac sand to be supplied this year will be directly procured by E&Ps, with the rest of the supply still being bought by OFS companies/pressure pumpers. We should point out that just a couple of years ago only a handful of E&Ps direct-sourced their sand and managed their sand logistics. The trend toward self-sourcing sand and direct involvement in sand logistics is a real one and, given the overall positive experience of producers who have turned to it, it's a trend that's likely to continue.

Frac Sand Plant. Source: PLG Consulting

A very small number of E&Ps have been self-sourcing their frac sand for years — both to ensure supply and to reduce sand costs. For example, Pioneer Natural Resources, whose primary focus is the Permian, back in 2012 acquired an industrial sand company with a big mine in Brady, TX (midway between Abilene and Austin) to help meet its growing need for frac sand. More recently, in September 2018, Pioneer entered into a 15-year sand supply agreement with U.S. Silica's new 6-million-ton/year Lamesa sand mine, which is located about 60 miles north of Midland, TX — and close to Pioneer's acreage in the Permian's Midland Basin. According to Pioneer, the delivered cost of sand from the Lamesa mine is about half that of the company's previous supply. Pioneer expects to receive an average of 1.4 million tons of sand from the mine in 2019, ramping up to 2 million tons/year in 2020 and beyond. (The Brady plant, whose frac sand is no longer local enough to be economic, is being shut down.)

Up in the Marcellus production area, natural gas-focused E&P Antero Resources has indicated that it expects to offset most — and possibly all — of 2019's forecasted cost-escalation for new wells in the play by renegotiating its pressure-pumping contracts, improving its well-completion efficiencies, and transitioning to the 100% self-sourcing of its sand needs. As Figure 2 shows, the cost of drilling and completing a Marcellus well with a 12,000-foot lateral averaged $950,000 per thousand feet, or $950/foot, in 2018 (dark-green bar to far left), and inflation was expected to add $60/foot to that cost in 2019 (red bar).

Contract renegotiation, partial sand self-sourcing and improved completion efficiencies now are seen as trimming costs by at least $40/foot (two light-green bars to left), and a switch to 100% self-sourcing plus other efficiencies could save as much as another $40/foot (three light-green bars to right), reducing per-well costs to $930/foot (dark-green bar to far right).

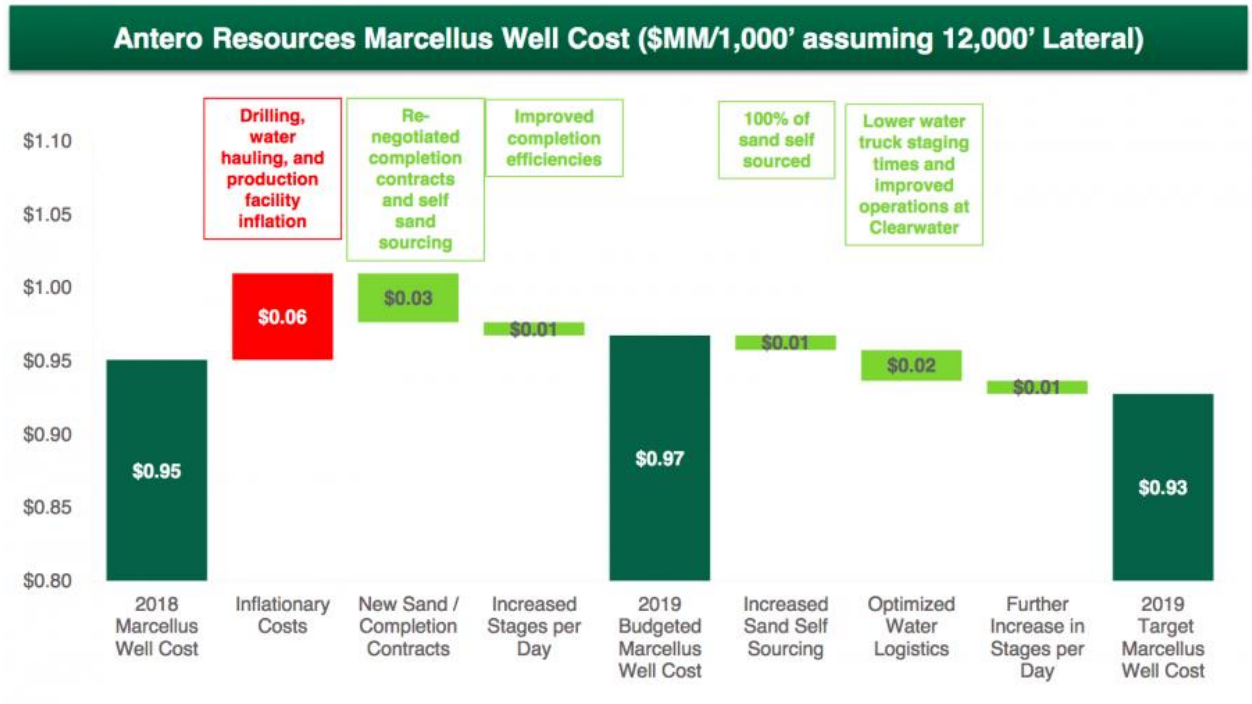

Figure 2. Source: Antero Resources, March 2019 Presentation

Then there's WPX Energy, which for the past couple of years has been directly procuring frac sand and making other efforts to manage the supply and delivery of its Permian frac sand (and water) needs, in part to hold down costs and in part to ensure that the commodities and services it needs to complete wells will be there. The approach has been helping to reverse what had been a run-up in well drilling and completion costs. Using a 1-mile lateral in the Stateline area (near the West Texas/New Mexico border) as a proxy, WPX said during its February 2019 earnings call that those costs averaged between $5 million and $5.5 million in 2016, peaked at $8 million in 2018, and are expected to average about $7 million this year — and $8.5 million for a 1.5-mile lateral and $10 million for a 2-mile lateral.

These are only a few examples of the increasingly hands-on approach that many E&Ps are taking to sand procurement and sand logistics, either by assuming these responsibilities themselves or by working closely with sand mining or sand logistics companies to do the work for them. In the next and final blog in this series, we'll look at the efforts being made to optimize the efficiency — and minimize the cost — of last-mile sand logistics.

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Everything Has Changed, Part 4 - The Frac Sand Revolution

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Nowadays, the hydraulic fracturing of a typical Permian well with a 10,000-foot lateral requires about 12,500 tons of frac sand — enough sand to fill more than 500 large sand trucks. That sand needs to be at the ready — delivered, offloaded, stored, and set for blending and use. If it's not, the well completion and the start of production would be delayed or the hydraulic fracturing process would be shut down after starting — a mortal sin in the shale world. With reliable, seamless access to frac sand at the well site being so critical, E&Ps and their pressure pumpers are understandably doing all they can to optimize their "last-mile" sand logistics. This involves everything from minimizing truck-delivery congestion to maximizing the speed at which sand is transferred from truck to storage, as well as the type of storage used. It's all much more high-tech than you might think. Today, we conclude our series with a look at the latest in last-mile logistics, which can account for as much as one-third of the total delivered cost of sand.

This series' aim is to provide an up-to-the-minute look at the frac sand part of the U.S. hydrocarbon production machine. Things have been changing fast. As we said in Part 1, the Frac Sand Revolution we're now in the midst of is characterized by longer lateral drilling lengths and a more intense use of sand per linear foot of lateral, which together have resulted in the need for larger volumes of frac sand. Sand use for U.S. hydraulic fracturing has more than doubled over the past three years, to more than 100 million tons per annum (MMtpa). To help meet that demand — and to offer sand at a much lower price than railed-in Northern White Sand from the Upper Midwest — a number of new "local" sand mines have been developed in the Permian (discussed in Part 1), and in the Eagle Ford, SCOOP/STACK and Haynesville (discussed in Part 2), to the point that the vast majority of the frac sand used in each of these plays is now locally sourced. In Part 3, we turned our attention to the increasingly hands-on role that a number of E&Ps have been taking in managing their frac sand supply chain. Traditionally, responsibility for ensuring that sand is procured, transported to well sites, and stored — ready to use in well completions — has fallen to the integrated oilfield services companies or pressure-pumping specialists that E&Ps contract with to provide completion-related services. That approach to sand supply oversight has been challenged in the past two or three years, however, as the drive to enhance reliability, maximize efficiency and minimize costs led at least some E&Ps to consider alternatives that would give them more control.

These same goals — reliability, efficiency and cost — also have been pushing E&Ps, sand-mining companies, pressure pumpers and others to examine every aspect of their last-mile logistics to see what can be tweaked (or, in some cases, entirely reworked) to improve productivity, save money, and further reduce the risk that frac sand won't be at hand when it's needed. Today, we'll focus on two of the most important elements of sand management in this new era: (1) the delivery of sand by truck from the local sand mine or rail-transload facility, and (2) the selection of the equipment for handling and storing sand at the well site. We're starting with the trucking side of things, though, because as we'll get to, the type of truck used ties in to some degree with the sand handling and storage equipment that is employed.

Trucking

Virtually every grain of frac sand used is delivered to the well site by trucks. Trucks pick up their loads at the local mine or transload facility and drive anywhere from 10 to 100 miles or more to the well site, where the sand is offloaded. As the volume of frac sand used in major U.S. shale plays has increased, so has the number of trucks needed to deliver that sand. Take the Permian, where frac sand consumption in calendar 2019 is likely to top 50 million tons. A typical pneumatic frac-sand truck trailer can transport up to 24 tons of sand; bottom-dump trailers (which have been gaining in popularity) can move up to 27 tons. That means that some 2 million truckloads of sand will need to be delivered to

well sites in West Texas and southeastern New Mexico this year — that's nearly 6,000 truckloads a day (plus return trips to the sand mine or transload facility).

While the Permian may seem like wide-open country, the vast majority of these sand-laden trucks are fanning out from only 20 or so local mines located between the Permian's Midland and Delaware basins (or from rail transload/storage terminals spread throughout both areas), and there are only a very limited number of highways in place to take trucks to the big concentrations of new wells. That means far more traffic congestion — and potential sand-delivery delays — than you might expect in such a remote area, including along U.S. Highway 285 both north and south of Orla, TX, which is the heart of the southern Delaware. (According to the Texas Department of Transportation, more than $100 million in road improvements are under construction along this stretch of U.S. 285, which should help to improve traffic flow in the long-term but may make this worse until the work is done late next year.)

Managing a steady flow of frac-sand deliveries to multiple well sites in the Permian and the other shale plays is akin to air traffic control at O'Hare or George Bush International. The goals are to minimize both driving time and waiting time — either at the sand mine (when picking up sand) or at the lease, where long queues can leave drivers waiting for hours if the pace of deliveries is not properly managed. To make sand drop-offs as efficient as possible, the people managing the trucking side of last-mile logistics have been taking a number of measures, including increasing the payload of each delivery. It may not seem like much to switch from pneumatic trucks that can carry 24 tons of sand each to trucks that can move 27 tons, but doing so reduces the number of trucks — and drivers — by more than 10%. And if companies had been using box systems (more on these in a moment), that improvement in payload is amplified as most flatbeds (which are used to transport the sand-filled boxes) can carry only a maximum of 22 tons of sand per load. Also, unloading times can be minimized in part by carefully scheduling and timing the delivery of trucks. If sand-laden trucks arrive at regular intervals tied to the pace of truck-unloading, drivers' wait-times can be held to a minimum, reducing costly demurrage fees. Several software providers are developing systems that will better manage the frac sand last-mile supply chain and minimize the number of people required to oversee this complex network utilizing the latest technology.

Sand Handling and Storage

At the well site, the primary goals on the sand front are to minimize the time it takes to transfer sand from the truck to storage, and to maximize the efficiency of transferring sand of various grades (100-mesh, 40/70-mesh, etc.) to blenders for staged use in hydraulic fracturing. During the first half of this decade, it was common practice to use pneumatic trailers to deliver sand to the lease, where air pumps were used to blow sand into SandKing-type storage systems, which had minimal capacity (leading to frequent stock-outs). Also, the "sandstorms" created by blowing the sand (see photo below) posed a hazardous situation for well-site personnel.

Frac Sand Deliveries With Pneumatic Trucks. Source: NIOSH

Since 2015-16, though, there's been a big shift away from SandKing-type storage systems to the use of either box or silo systems that enable larger volumes of sand to be stored at the well site. Our understanding is that the market share of these alternative systems has soared to more than 90% from only 5% five years ago. A number of companies have developed various box and silo systems. Generally speaking, box systems involve — no surprise here — box-like containers that are loaded onto flatbed trailers, driven to the sand mine or transload facility, filled with sand, then returned to the lease, where the sand-filled boxes are offloaded by large forklifts. The offloading is quick: typically, about 5 minutes per box (a primary benefit of box systems). Silo systems, in turn, involve (you guessed it) rows of vertical, silo-like containers that are set up at the well-site to receive sand via either pneumatic or bottom-dump trailers. Sand typically is either air-pumped to the tops of the silos from pneumatic trucks or transported from underneath bottom-dump trucks to the silo tops by fast-moving conveyor belts. A pneumatic trailer takes about 40 minutes to unload (multiple trailers can be unloaded concurrently), while a bottom-dump trailer takes only 5 to 10 minutes. We should note that the bottom-dump approach could be a game-changer — the trailers can carry up to 27 tons, and efforts are under way to improve conveyor systems and reduce offloading times to as little as 5 minutes.

It's that kind of optimization — maximizing payloads and minimizing offloading times — that will characterize frac sand management efforts in the Permian and other major plays in the next year or two as E&Ps strive to fine-tune their assembly-line-style production activities, increase their well-site productivity, and rein in their frac sand costs. And the industry is hopeful that technology will offer additional efficiency breakthroughs in the last-mile supply chain.