

Scooping Out the Bluffs

\$and Dollars — Mining Frac Sand in the River Valley

By Reggie McLeod

Sand has become a source of friction in several rivertowns recently, as sand mines gear up to meet the rapidly growing demand for very old, very pure sand. The demand for the sand and the debate will likely continue to grow, at least in the near future.

Much of the sand in the sandstone layers of the bluffs along the Mississippi River is very very old. It started out as much bigger quartz rocks that eroded into ever smaller rocks, and finally sand. That sand formed a layer in an ancient ocean that was slowly squeezed into a layer of sandstone. Over millions of years the sandstone eroded into separate grains again, then again became sandstone, then sand, then sandstone, and so on, numerous times over hundreds of millions of years. Each cycle rubbed the grains of sand rounder and smoother, and the bed of sand became purer, as softer materials got ground up and washed away.

For many years this purer sand was prized for making glass, but lately it has found a new use and a new name. A new method of drilling for oil and natural gas injects a slurry of water, chemicals and this special sand under very high pressure into shale deep underground. The high pressure shock cracks the shale and the sand holds those cracks open so that natural gas or oil can flow through the shale to the oil well and to the surface. Some of the best sand for this “frac-

ture drilling” or “fracking” is found in the exposed rocky bluffs along the Upper Mississippi. This so-called “frac sand” is in great demand. As a result, some established local sand-mining operations are expanding and

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mining companies from other parts of the country are looking for opportunities here.

Most of the sand found in the Upper Midwest is silica, which is the same thing as quartz or silicon dioxide. Silica sand has probably been mined for hundreds of years for a variety of purposes. Glass is mostly silica. Sand is also used for casting metals, as an ingredient in concrete and mortar, and as fill used to prepare construction sites. Potters sometimes add it to their clay.

The best frac sand is almost pure silica with very round, large grains of a uniform size. Ideally this sand is found near a railroad or a site with water shipping, because shipping makes up a large part of the cost of supplying sand to gas and oil drilling sites, according to Tony Runkel, adjunct professor at the University of

Minnesota and chief geologist of the Minnesota Geological Society.

Two sandstone formations that you can see in many of the rocky river bluffs fit these requirements: Jordan sandstone and St. Peter sandstone. St. Peter is younger and sits above the Prairie du Chien dolomite formation. (Dolomite is much harder than sandstone, and sometimes incorrectly called limestone.) Jordan is 500 million years old and lies just below the Prairie du Chien formation. The grains of sand in Jordan sandstone are usually larger than grains of St. Peter, which makes it more valuable as frac sand, said Runkel.

“If you have a bucket full of billiard balls and another bucket packed with fine sand, you can see how a liquid would travel faster through the billiard balls,” he explained.

Rock formations are usually named after a city where they are prominent. Jordan and St. Peter are named after cities on the Minnesota River in Minnesota. Prairie du Chien is named after the Wisconsin city on the Mississippi.

Though rock formations are layered in a given succession, bedrock rises, sinks and folds over hundreds of millions of years, moving formations to different depths in different places. In some places Jordan or St. Peter sandstone is mined from a pit on the surface. There are places in the river valley where it’s easier to cut a mine into the bluff, following the formation



A pile of frac sand sits on a bluff overlooking the Mississippi downriver from Clayton, Iowa. One of three entrances to the Pattison Sand Company's mine is in the lower right, in this 2010 photo. Bagley, Wis., sits at the base of the bluff across the river. (Robert J. Hurt)

horizontally underground.

St. Peter sandstone is at about the level of the Mississippi in the Twin Cities. When it was first built, the Ford Motor factory on the bluff above the river in St. Paul mined St. Peter sandstone from the bluff to use to make windshields for its cars. The Jordan formation is below the water level there and is the formation that many wells in the state draw water from.

In the Winona, Minn., area the Prairie du Chien dolomite formation caps the bluff, and Jordan sandstone is the orange sandstone just below that cap, several hundred feet above the river. Iron gives it a rusty color locally.

Both Jordan and St. Peter sandstones are very soft, making it easy to mine and crush into sand. Miners use a small explosive charge to dislodge the rock. Then it's scooped out and crushed. Some operations use water cannons to break up the rock and move it out of the mine in a slurry.

Clayton, Iowa

Since 1878, a succession of owners have mined sand just downriver from Clayton, Iowa. Sand from here was used to make glass at the Rock Island Glass Company in Illinois, and as coring sand for metal casting, for sand-blasting and an ingredient in plaster. In the 1920s a nearby company used it to make brick and tile. The site is now owned and operated by Pattison Sand Company, explained Beth Regan, permit and environmental coordinator for Pattison Sand.

The company is locally owned and employs 165 workers in shifts that run around the clock every day of the year. They mine and process about 5,000 tons of St. Peter sandstone a day to fill 250 railroad cars per week. Most of the cars are filled at the mine, but some sand is trucked to Prairie du Chien and loaded on railroad cars. About 80 percent of the sand heads south and 20 percent east. Most is used as frac sand.

The underground mine cuts back into the bluff in a checkerboard pattern of excavated chambers and large intact pillars of sandstone, with 30-foot high, 30-foot wide roads running straight through them. Two mine entrances face the river, and one enters from the other side of the bluff. The mine is about 1,500-feet wide and more than a mile north to south. The sandstone is broken up with small explosions, scooped out and loaded into trucks that take it to be wetted and crushed. The slurry of sand and water is pumped out of the mine to another processing site, where it is sifted into four size categories. Then it's dried.

Wetting the sand keeps the dust down, making it safer to work with.

"We have a closed water system. All of the water is recycled," explained Regan.

Pattison also mines St. Peter sandstone from pit mines. When they are finished mining an area, it has to be reclaimed by restoring a cover of top-

soil and grading it.

"We stabilize all the slopes, and, in areas where it's appropriate, we plant trees," said Regan.

Regan works with an array of agencies. The Iowa Department of Natural Resources (DNR) oversees stormwater and air quality permits and activity in the floodplain. The Iowa Department of Agriculture and Land Stewardship licenses aggregate mines. The state fire marshal and the U.S. Department of Alcohol, Tobacco and Firearms oversees the use of explosives. Clayton County officials keep tabs on driveways and wells. And Regan occasionally needs to work with the Army Corps of Engineers.

Bay City & Maiden Rock, Wis.

Upriver, frac sand mining activity is heating up. On the shores of Lake Pepin, in Maiden Rock, Wis., Wisconsin Industrial Sand Company, a subsidiary of Chardon, Ohio-based Fairmount Minerals, operates a frac sand mine in the downstream end of the village of 117. Last fall the company applied for permits to expand its

The sandstone is often exposed in the ridges, which are easily dug away, taking the tops off hills and leveling the landscape.

operations in the village and adjoining township, according to Mike Michaud, a village resident for 32 years.

Opponents of the expansion formed the Maiden Rock Concerned Citizens to campaign against the conditional use permit applications to Pierce County and the village of Maiden Rock. In January, the county approved the permit that allows it to expand in the township, but the village could not, for technical reasons. In April, voters elected a new village president, who was more sympathetic to the Concerned Citizens and who appointed three new members to the village planning commission, explained Michaud, who is a member of the Concerned Citizens.



A string of open railroad cars full of sand wait on a siding in Winona, Minn. (Pamela Eyden)

However, Michaud is not satisfied with limiting the mine's expansion.

"Really, I'd just like to see them go away," he said. "It's a big nuisance."

The mine in Maiden Rock and Wisconsin Industrial Sand's mine outside the nearby rivertown of Bay City, Wis., (pop. 480) and its processing facility in Hager City, Wis., put a lot of trucks on the Great River Road and put a lot of silica dust into the air. Trucks are supposed to cover their loads of sand, but often the covers are not secured, and dust is evident in and around the frac sand operations, according to Michaud.

Blasting in the mine rattles windows in the village. The Maiden Rock mine uses 1.2 million gallons of water a day, he added.

The Wisconsin Industrial Sand Company in Maiden Rock did not return calls.

Red Wing & Winona, Minn.

Windsor Permian, part of Oklahoma-based Windsor Energy, owns 155 acres of land near Red Wing, Minn., which locals believe it intends to mine for frac sand, according to *The [Red Wing] Republican Eagle*, 5-29-11.

A group of area residents there want the Goodhue County Board to wait at least a year before acting on any permit applications for the site,

to ensure there is enough time to consider possible effects of frac sand mining on public health and water tables in the area.

Sixty miles downriver, in Winona, Minn., the city planning commission approved a site plan for for a facility on the upstream end of the city that will dry sand and load it onto railroad cars, despite written protests from neighbors.

One health concern is from the effects of very small sand particles, which can cause "chronic or ordinary silicosis," which "... can occur after many years of exposure to relatively low concentrations of airborne respirable crystalline silica dust." according to the Material Safety Data Sheet for silica from the Wisconsin Industrial Sand website. The effects may be disabling or fatal, according to the data sheet.

"Individuals with silicosis are at increased risk to develop pulmonary tuberculosis, if exposed to persons with tuberculosis," according to the data sheet. Breathing silica may also cause cancer, autoimmune diseases and kidney disease.

There is, of course, more potential danger to workers, but mines and processors are required to follow safety

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measures to protect workers. However, people who live near mines and processors are concerned about long-term, low-level exposure, especially with operations around the clock and trucks and railroad cars being loaded and unloaded.

People are also concerned about the appearance that mining companies are being secretive and rushing local officials to issue permits without sufficient time to investigate possible hazards and other concerns. On the other hand, mining companies counter that they are trying to quickly satisfy a rapidly growing demand for frac sand in a very competitive market.

Public officials and people living near frac sand operations often have an attitude that "it's only sand," but some opponents point out that there are several important differences between the frac sand mining that's taking place now and traditional sand-and-gravel operations. The biggest difference is the scale. Frac sand mines have quickly increased the mining and shipping of massive amounts of sand, worrying some that problems might arise that were not apparent when less sand was being mined.

Chippewa Falls, Wis.

Up on the Wisconsin's Chippewa River, in the Chippewa Falls area, Patricia Popple and others have been challenging frac sand mining activities for the last three years. The Jordan sandstone there is near or at the surface.

"They're the sandstone bluffs, ridges and hills," she said.

The sandstone is often exposed in the ridges, which are easily dug away, taking the tops off hills and leveling the landscape. Mining is also done in pits. Opponents to the mining organized as Save the Hills Alliance.

Popple says that mining techniques vary from company to company. Some farmers sell sandstone deposits to "wildcatters," sometimes just a guy with a truck, who digs it out, pays the farmer and carries it away uncovered. Uncovered train loads of sand roll right through the city of Chippewa Falls.

The sand itself is not a problem.

The microscopic silica crystals that cement the sand grains together create a nearly invisible dust that can settle deep in the lungs. She fears a future like that of Libby, Mont., where decades of asbestos mining gradually lead to widespread cases of asbestosis in the town, she said.

Many of the counties and small towns and cities do not have the resources necessary to research, monitor and enforce rules that would ensure the safety of their residents, so they rely on the mining companies. When people have reported problems to the Wisconsin DNR, the department complains of budget problems, she said.

EOG Resources, Inc., formerly Enron Oil & Gas Company, is building a processing facility in Chippewa Falls. EOG also does drilling, so sand will be shipped to its own drilling sites, according to Popple.

A former teacher and principal, Popple sees her role as an educator. She wants people to know that the issues extend beyond the sandstone hills of Chippewa County and the Mississippi River Valley. Frac drilling in the East, South and West may be causing massive environmental damage to aquifers and air. Opponents claim that when frac drilling fractures shale formations, much of the natural gas is released into aquifers lying above it. They also point out that much of the slurry of water, chemicals and frac sand that is injected into the shale to fracture it is not recovered, leaving it to find its way into aquifers. The 2010 documentary film "Gasland" has been a rallying point for opponents. In it director Josh Fox films several people who live near drilling fields who can actually light the water coming from their taps, apparently because it contains natural gas.

Bruce A. Brown, senior geologist for the Wisconsin Geological Survey, has been getting a lot of phone calls about sand mining lately. Wisconsin is the second largest producer of sand in the nation, after Illinois. However, it doesn't have any regulations for "non-



A thick layer of soft Jordan sandstone is exposed by the road cut near the top of the bluff overlooking Winona, Minn. (Reggie McLeod)

metallic" mining other than requirements that the land be reclaimed when the mining is done. Local zoning applies and local governments issue conditional use permits for mines. The DNR is responsible for monitoring and enforcing air- and water-quality requirements.

He said nearly all frac sand is processed wet, in order to control dust, and that the processing at Maiden Rock is done inside the mine. Most soil in the area naturally contains a lot of fine silica, so dust from farm fields may present more of a threat of silicosis than mining operations.

Some farmers in the Chippewa Falls area have gained cropland by having the sandstone mined off the top of a hill, then farming the reclaimed, flattened hilltop, he said.

Besides the St. Peter and Jordan formations, Wisconsin has a couple additional sources of frac sand. The Wonewoc formation is older and, thus, deeper than the other two, and is mined in Menomonie, Taylor and Portage. And in a new twist, a company is buying glacial sand cleaned out of cranberry bogs in the Tomah area, then processing it to get frac sand, avoiding the mining process and regulations, Brown said.

There is a lot of incentive for creativity. The sand and drilling industries keep prices private, but rumor has it that frac sand sells for more than \$100 a ton, when the demand is good. Sand for making glass, on the other hand, goes for around \$20, and construction grade sand for just a few dollars a ton. 🌱