

WESTERN WISCONSIN SAND MINING

By: Ayres Associates

Lori Rosemore, PG

Mike Stoffel, PE

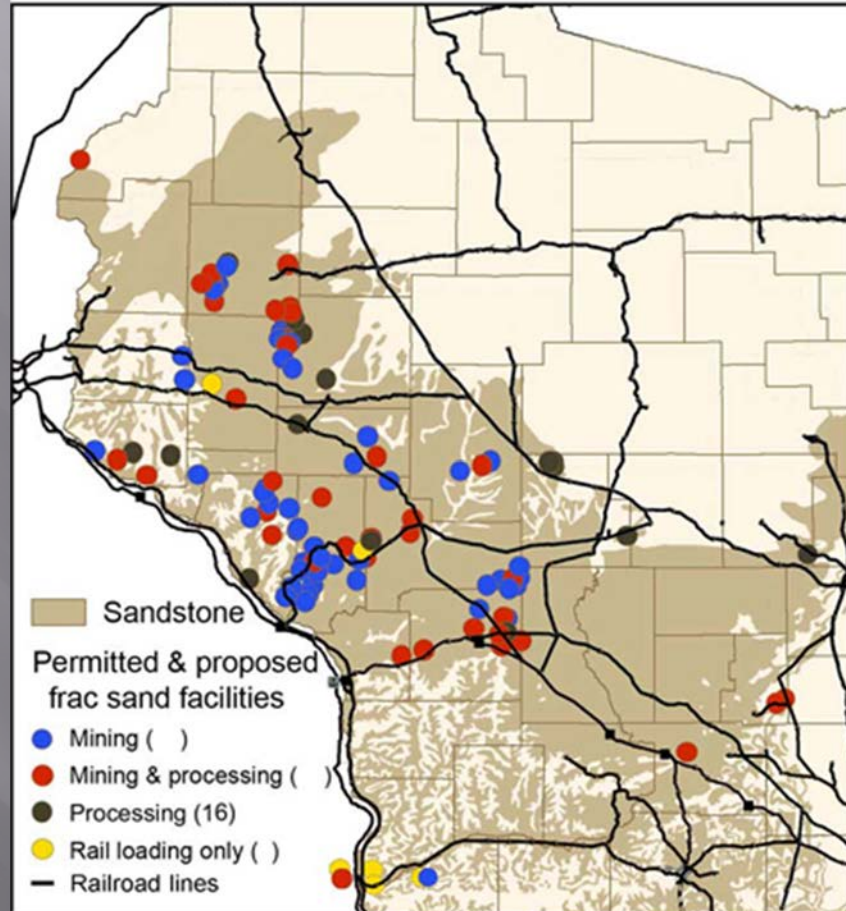
Sand Type

- ▣ API fracture sand specifications, considerations include:
 - ▣ Size, sphericity, roundness, mineralogy, crush resistance
- ▣ Sand of interest is super strong, almost pure quartz (>90%) (SiO_4)
- ▣ Sand size +140
 - Larger size more valuable +70
 - Size sought (20-40, 40-70, 70-140)
- ▣ Contaminants reduce strength (glauconite, iron, manganese, etc.)



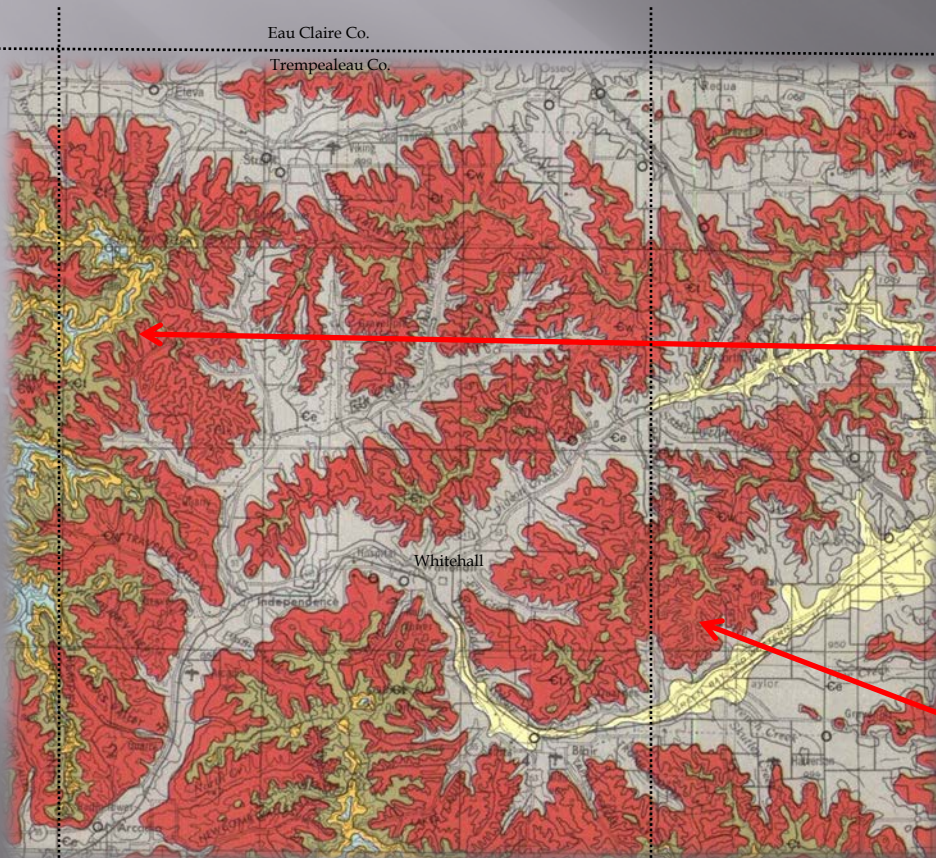
Where Is the Sand?

**Frac Sand Mining and Processing Facilities
in Wisconsin, July 2012**



Source: Crawford Stewardship Project combined maps from Sandstone, U.S. Geological Survey; Mine Sites, WCIJ reporting and Wisconsin Department of Transportation.

West Central Sand Formations



DESCRIPTION OF MAP UNITS

- Os **Platteville Formation.** Dolomite, light brown, beds less than 1 m thick, fractured; about 4 m maximum thickness in this area.
- Oa **Ancell Group.** Sandstone, quartzose, white to pale yellow, fine grained, rounded, moderately sorted; 25 m thick.
- Op **Prairie du Chien Group.** Dolomite and sandy dolomite. Consists of three recognizable units, from top to bottom: **Shakopee Formation, Willow River Member**-dolomite, gray to brown, medium grained, thin-bedded; contains rounded flat pebbles of buff, fine-grained dolomite; 15 to 18 m thick. **Shakopee Formation, New Richmond Member**-sandstone and siltstone, brown to gray, fine grained, dolomitic, lenticular-bedded; contains coarse rounded and frosted quartz grains; 2 to 5 m thick. **Oneota Dolomite**-dolomite, gray, thick-bedded, crystalline; with much chert in discrete beds or in irregular masses throughout; with white to light gray oolite beds up to 60 cm thick in lower part; 27 m thick.
- Cj **Jordan and St. Lawrence Formations.** Sandstone, quartzose, sandy dolomite, dolomite, and siltstone. Consists of four recognizable units, from top to bottom: **Jordan Formation, Coon Valley Member**-dolomite, yellow to tan or brown, sandy; 6 to 14 m thick. **Jordan Formation, Van Oser Member**-sandstone, quartzose, white to brown to yellow or orange, fine to medium grained, poorly sorted, medium- to thin-bedded, cross-bedded; with calcite-cemented nodules, iron-cemented in places; may be locally interbedded with underlying unit; 9 to 15 m thick. **Jordan Formation, Norwalk Member**-sandstone, quartzose, white, fine grained, rounded, and moderately sorted quartz sand grains, medium-bedded; trace of garnet; 15 to 18 m thick. **St. Lawrence Formation, Lodi Member**-siltstone, light brown to blue-brown, and very fine-grained dolomite, thick-bedded; less than 3 m thick.
- Ct **Tunnel City Group.** Sandstone, 30 to 56 m thick. Consists of five recognizable, interbedded units: **Mazomanie Formation, lithology 1**-sandstone, quartzose, yellow to white, fine grained, well sorted, cross-bedded; less than 5 percent glauconite. **Mazomanie Formation, lithology 2**-sandstone, quartzose, mica-bearing, light gray to yellow, fine to very fine grained, thin-bedded; similar to Tomah Member but containing no shale; **Lone Rock Formation, Reno Member**-sandstone, quartzose, glauconite-bearing, fine and very fine grained; small-scale cross-bedding. **Lone Rock Formation, Tomah Member**-sandstone, quartzose, mica-bearing, light gray to yellow, very fine grained, thin-bedded; beds separated by laminae and partings of gray-green siltstone. **Lone Rock Formation, Birkmose Member**-sandstone, quartzose, glauconite-bearing, green, fine grained, commonly cross-bedded; includes burrowed beds and flat-pebble conglomerate.
- Cw **Wonewoc Formation.** Sandstone. Consists of two recognizable units, from top to bottom: **Ironton Member**-sandstone, quartzose, white to brown with iron staining, medium to coarse grained, subrounded, poorly sorted, wavy-bedded, vertical burrows present; calcite-cemented; 5 to 18 m thick; individual bedding units 1 to 2 m thick with thin, intervening claystone beds. **Galesville Member**-sandstone, quartzose, white, fine to medium grained, rounded to subrounded, well sorted, thick-bedded, cross-bedded, poorly cemented; 5 to 18 m thick; individual bedding units 3 to 5 m thick.

Buffalo Co.

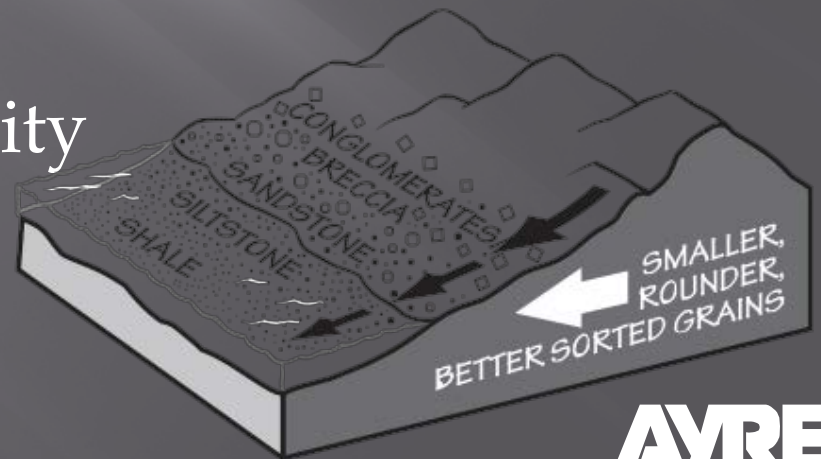
Trempealeau Co.

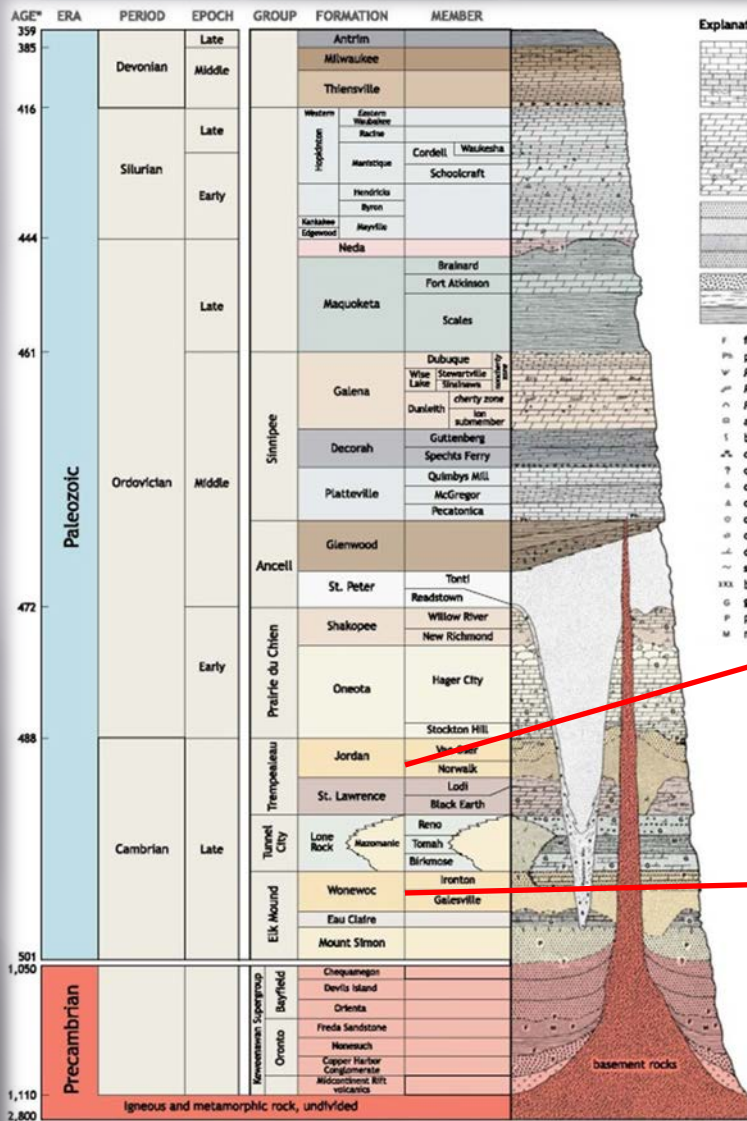
Jackson Co.

Source: UWEX WGNHS

Why Is the Sand Here?

- ▣ Cambrian Period inland sea
- ▣ Transgressive/regressive deposition
- ▣ Sandstone layers - deposition during high energy (shallow sea)
- ▣ Limestone layers - deposition during low energy (deep sea)
- ▣ Exposed by glacial activity





- Explanation**
- [Symbol] limestone
 - [Symbol] dolomitic
 - [Symbol] sandy
 - [Symbol] shaly
 - [Symbol] dolomite
 - [Symbol] calcitic
 - [Symbol] sandy
 - [Symbol] shaly
 - [Symbol] massive
 - [Symbol] sandstone, coarse
 - [Symbol] medium
 - [Symbol] fine
 - [Symbol] coarse, medium
 - [Symbol] conglomerate
 - [Symbol] siltstone
 - [Symbol] shale
 - f feldspar
 - ph phosphate pellets
 - P Pentamerus
 - R Receptaculites
 - Pr Prasopora
 - a algae
 - b burrows
 - c conglomerate
 - q questionable relation
 - ch chert
 - o oolitic chert
 - o oolites
 - o openings (vugs, etc.)
 - ~ dolomitic
 - ~ silty
 - xxx bentonite
 - G glauconite
 - P pyrite
 - M mica

Ancell	Glenwood	
	St. Peter	Tonti
Prairie du Chien	Shakopee	Willow River
		New Richmond
	Oneota	Hager City
		Stockton Hill
Trempealeau	Jordan	Van Oser
		Norwalk
	St. Lawrence	Lodi
Tunnel City		Reno
		Tomah
		Birkmose
Elk Mound	Wonewoc	Ironton
	Eau Claire	Galesville
	Mount Simon	



Lone rock



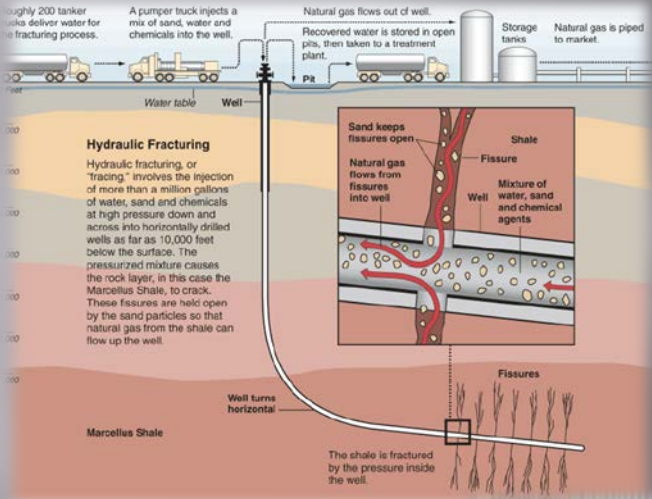
* Absolute age dates in million years are based on the Geological Society of America Geologic Time Scale, 2009.



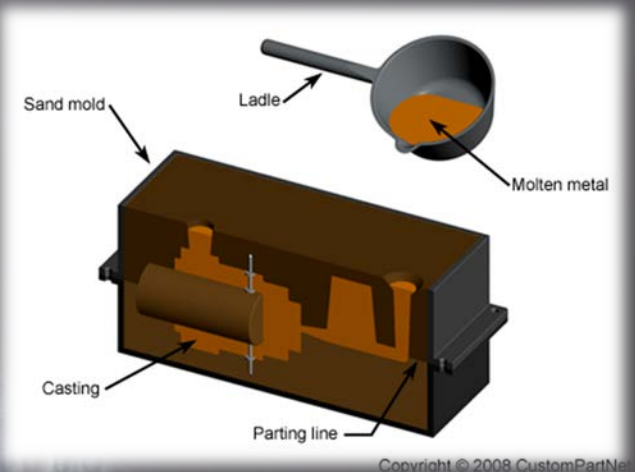
Source: UWEX WGNHS



What Is the Sand Used For?



Hydro-fracking



Sand Casting (foundry sand)

- Pool Filtration
- Play Sand
- Golf Courses
- Water Filtration
- Hot Mix Asphalt
- Glass



Sand Blasting

Sand Mining (Deposit Selection)

- ▣ Literature research to find possible sources
- ▣ Outcrop samples
- ▣ Soil borings
- ▣ Grain size and crush test



Sand Mining (Mine Selection)

- ❑ Deposit thickness and depth
- ❑ Contiguous property size
- ❑ Groundwater elevation
- ❑ Surface water and wetland proximity
- ❑ Residential proximity
- ❑ Governmental climate
- ❑ Processing and shipping facility proximity



Image Source: Google Earth

Processes at the Mine

- ▣ Site preparation
- ▣ Sand excavation
 - Mechanical only or mechanical w/ blasting
- ▣ Stormwater controls
- ▣ Stockpiles (conveyors, equipment, scalping screen)
- ▣ Crushing (mine specific) (3" minus)
- ▣ Washing (mine specific)
- ▣ Hauling



Processes at the Mine



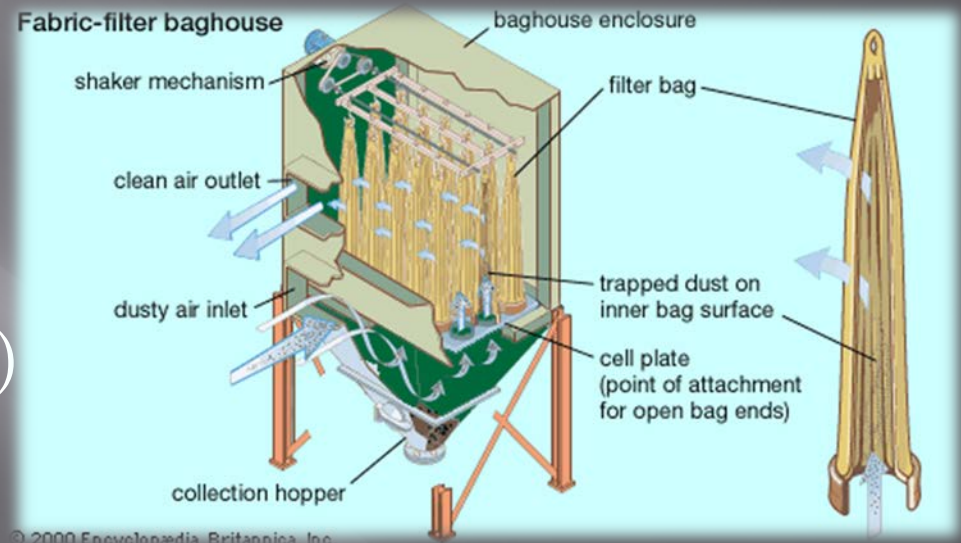
Sand Mining (Plant Selection)

- ▣ Rail access
- ▣ Water supply
- ▣ Roadway access
- ▣ Fuel supply
- ▣ Sand supply
- ▣ Governmental climate



Processes at the Sand Plant

- ▣ Raw stockpiling
- ▣ Crushing
- ▣ Washing
 - Wet stockpile
 - Clarifier (flocculants)
 - 6,000-10,000 gpm
- ▣ Drying
 - 200-400 tph
- ▣ Screening
- ▣ On-site storage
- ▣ Shipping
- ▣ Dust control



Sand Processing Plants



Mine & Plant Permitting

- ▣ Reclamation plan permitting
- ▣ Stormwater permitting
- ▣ Surface water/wetland impact permitting
- ▣ Air permitting
- ▣ Industrial byproduct permitting
- ▣ High capacity well permitting
- ▣ Driveway permitting
- ▣ Building code permitting



Monitoring & Enforcement



Monitoring Well



Stormwater Monitoring



Air Monitoring Station



Water Supply Well

Industry Regulations

- ▣ Local regulation (county and/or municipality)
 - Reclamation, zoning, land use, licensing, conditional use permits, shoreland, driveway, road use, sanitary, building
- ▣ State regulations (WDNR, WDOT)
 - Water supply, air, stormwater, wetlands, surface water, archaeological, historical, endangered resources, highway access
- ▣ Federal regulations (EPA, MSHA, FAA, USACE, CWA, NIOSH)



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Industry Regulations

- ▣ WDNR – Air emissions standards
 - Fugitive dust control plan
 - Air monitoring plan
 - Malfunction prevention & abatement plan
 - Stack compliance testing
- ▣ NIOSH – Occupational safety
 - Occupational silica dust exposure limits
 - ▣ TWA₁₀ exposure limit 0.05 mg/m³
- ▣ MSHA – Workplace safety
 - Miner noise exposure limits
 - ▣ “Action level” – TWA₈ sound level 85 dBA
 - ▣ “Dual hearing protection level” – TWA₈ sound level 105 dBA

Decibel Chart

Commercial	Industrial	Residential	dB Level
Threshold For Hearing			0
Good Recording Studio		Breathing	10
		Rustling Leaves	15
		Whisper, Mosquito	20
Library		Living / Dining Room	30
Refrigerator Hum		Kitchen / Bathroom	40
Quiet Office	Power Lawn Mower	Home Office	50
		Birds at 10'	55
Conversational Speech			60
Piano Practice		Electric Shaver	60
Business Office		Piano Practice	65
Noisy Restaurant	Inplant Office	Street Traffic	70
Chamber Music		Barking Dog	75
Classroom		Alarm Clock	75
		Television / Dishwasher	75
Airplane at 1 mile	Manual Machines	Vacuum Cleaner	80
Reception / Lobby Area	Handsaw	Garbage Disposal	85
Motor Bus		Telephone Dial Tone	85
Applause in Auditorium		Lawn Mower	85

Decibel Chart (cont.)

OSHA Required Hearing Protection in Factory			85
Teleconference Room		Train at 100'	90
Subway	Farm Tractor	Teenage Stereo	90
Sustained Exposure May Cause Hearing Loss			90
Music Practice Room	Electric Drill	Walkman at 5/10	94
French Horn	Average Factory Noise	Blender	100
Orchestra	Diesel Truck	Motorecycle	105
Computer Room	Printing Press	Train	105
Bass Drum	Heavy Truck	Power Saw	110
Dog Kennel	Power Mower	Baby Crying	110
Symphony Orchestra	Punch Press	Squeaky Toy to Ear	110
Pain Begins			120
Disco	Sandblasting	Shot Gun	120
Cymbal Crash	Pneumatic Clipper	Air Raid Siren	130
Draggear Racing	Military Jet	Shotgun	140
Rock Concert	Aircraft Carrier Deck	Jet Takeoff	140
Chest Wall Begins to Vibrate			150
Ear Drum Breaks Instantly			160
Death of Hearing Tissue			180
Loudest Possible Sound			194

Local Concerns

- ▣ State statute enforcement
- ▣ Zoning impacts (traffic, noise, light, vibration, etc.)
- ▣ Rail crossings
- ▣ Air impacts
- ▣ Groundwater impacts
 - Direct – Mining below water table
 - Indirect – Industrial byproducts
- ▣ Surface water/wetland impacts
- ▣ Aesthetics

Questions?

Michael C. Stoffel, PE
715.834.3161

StoffelM@AyresAssociates.com
www.AyresAssociates.com



Lori A. Rosemore, PG
715.834.3161

RosemoreL@AyresAssociates.com
www.AyresAssociates.com



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