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Transportation Impacts of Frac Sand Mining in the MAFC Region: Chippewa County Case Study

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TABLE OF CONTENTS

INTRODUCTION

The boom in oil and gas production using hydraulic fracturing (fracking) technology to extract oil and gas from shale has created thriving industries all along its supply chain. The increased production of the supplies needed for drilling—sand, water, chemicals, pipe, and rigs—all with different transportation characteristics, have also strained the transportation system at the source of production, processing, and distribution.

Plentiful and easily accessible deposits of sand suitable for fracking (frac sand) exist in the Midwest, especially in Wisconsin. Here, private industry investment levels are indicative of a 20 to 30 year life span for the emerging frac sand industry, correlating with the life span estimates of recoverable oil in shale formations (Stark, 2012). These investments include the purchase or leasing of land for sand mines, construction of mines and sand processing plants, and rail and road infrastructure improvements. At full build-out the frac sand mining industry will be characterized by mining twenty-four hours a day, five days a week, heavy truck moves over rural roads, and unit or manifest trains moving approximately 40 million tons of sand a year out of Wisconsin (Wisconsin Department of Transportation NW Region Planning Staff, 2012).

Road damage over local roads is a concern for many communities. County governments have used a number of mechanisms to recover the costs of road damage both for drilling areas and sand mining areas. Chippewa County, Wisconsin serves as a model of how local government is using road use or road upgrade maintenance agreements (RUMA) to recover road damages, fund maintenance, and grade crossing improvements. This white paper examines Chippewa's road use agreements and discusses the emerging transportation impacts and implications for neighboring counties, state-level policy, and the need for a regional approach when assessing transportation impacts.

The current federal surface transportation legislation, Moving Ahead for Progress in the 21st Century (MAP-21), recognizes the importance of energy corridors and encourages the identification of routes serving energy production sites. States are also encouraged to develop freight plans and include a description of improvements that may be required to reduce or impede the deterioration of routes on which travel by heavy vehicles (including mining, agricultural, energy cargo or equipment, and timber vehicles) is projected to substantially deteriorate the condition of roadways.

There are new terminologies to describe the landscape of oil and gas production. Historically, hydrocarbons—oil, natural gas and condensate—have been produced using the conventional method of pumping. In conventional reservoirs, the "pay" consists of free-flowing oil or natural gas. For the last few decades, offshore drilling has used technology to reach deeper reservoirs. The global supply of oil in these conventional reservoirs has peaked and now production levels are on a terminal decline. New technology is allowing unconventional oil—oil that is not free flowing—to be produced to meet U.S. and world demand.

The term unconventional oil refers to any oil that must be heated or diluted before it can be pumped. This category includes oil sands, new heavy oils, deepwater oil, and oil shale.

Tight oil does not have to be heated; it is extracted using a method called hydraulic fracturing. Although the recovery rates (amount recovered from a reservoir) for unconventional oil are much lower than for conventional reservoirs, it is expected that unconventional oils will close the gap for demand until alternative technologies are adopted or carbon policies are enacted (Gorden, 2012).

THE SHALE BOOM

The United States is experiencing a boom in domestic oil and gas production from shale rock in a number of areas across the country. Figure 1 shows the geography of shale formations (U.S. Energy Information Administration, 2012).

The shale formations or energy production sites that affect the transportation and economy of the states of the Mid-America Freight Coalition (MAFC) include: the Bakken and Three Forks formation spanning parts of North Dakota and Canada, the Marcellus and Utica shale formation located in Ohio and Pennsylvania, and the Eagle Ford and Barnett formation located in Texas and Oklahoma.

Key gas plays in the United States are the Marcellus, Barnett, Eagle Ford, Haynesville, Fayetteville, Granite Wash and Woodford. The Bakken, Utica, and Eagle Ford are primarily oil plays, or areas with prospective oil formations. Gas, however can be extracted from oil plays as well.

Drivers to the boom include technological advances in horizontal drilling and hydraulic fracturing combined with price of a barrel of oil. Oil priced at $70 a barrel is profitable for some drilling companies. Enormous profits can made be when prices reach $100 a barrel despite expensive initial investments. Exploration for natural gas has recently waned as new production has outstripped current demand and storage facilities around the country are at capacity in 2012. Low natural gas prices are, however, serving as a catalyst for the adoption of natural gas as an alternative fuel, and the conversion of many coal-fired power plants to natural gas (Stark, 2012).

Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.
Updated: May 9, 2011

FIGURE 1 North American oil and gas shale plays

Hydraulic Fracturing: the Technology Behind the Boom

Hydraulic fracturing (also called hydrofracking or fracking) is a technique that can be traced back to the 1860s, when liquid nitroglycerin was used to stimulate shallow, hard rock wells in Pennsylvania, New

York, Kentucky, and West Virginia. Hydraulic fracturing has been used for vertical wells since the 1940s. The technique was combined with horizontal drilling technology in the early 1990s and the technique was widely adopted starting in 2003/2004. Different elements of the process, including the use of water are constantly being refined (Stark, 2012).

Figure 2 illustrates the technique that begins with wells being drilled vertically to a depth of approximately 8,000 to 10,000 feet below the surface depending on the formation. Once the desired depth is reached, the drill bit can be turned horizontally and drilling continues to approximately 5,000 – 10,000 feet. Several seamless steel pipes are cemented in during the drilling. Small-scale explosives puncture the pipe, allowing the hydraulic fluids to reach the shale. The fracking process begins with a liquid mixture consisting of water, chemicals, and sand being injected into the horizontal well under very high pressure, often 8000-12000 psi or higher. The fluid pressure cracks the shale and the sand flows into the cracks and props open the fissures allowing gas or oil to escape.

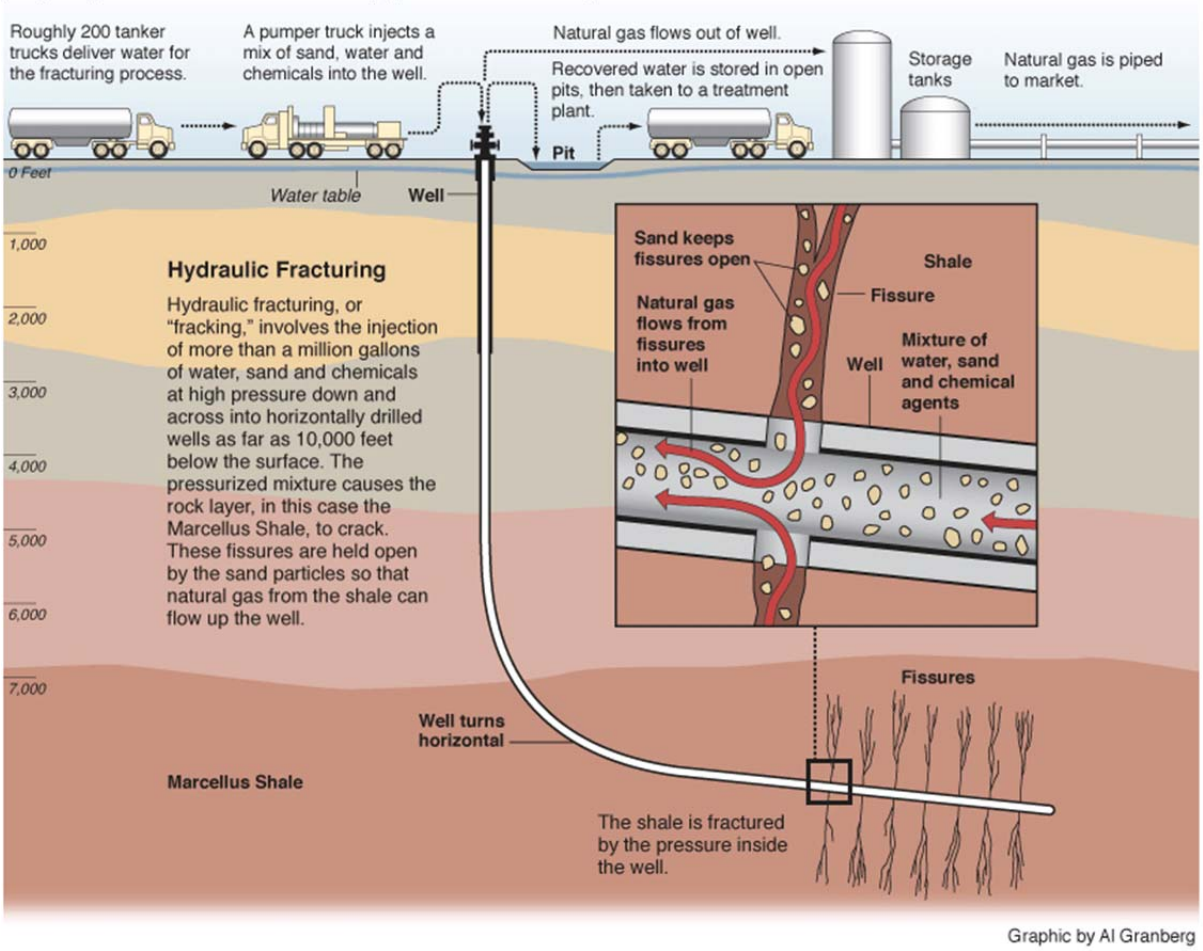

FIGURE 2 Hydraulic fracturing technique (ProPublica, n.d.)

There are constant innovations in this technique. One advancement is multi-stage fracking, which fractures in contiguous sections instead of the entire lateral leg which greatly improves recovery rates but also requires more water, sand, and chemicals. Where different shale formations are in proximity, wells can be drilled to access both formations and then fracked in multi-stages (Neset, 2012).

Truck Transportation Requirements of Hydraulic Fracturing Technology

Hydraulic fracturing is a resource-intensive process using water, sand, chemicals, and drilling equipment. Since the drilling sites are located in rural areas, nearly everything must be trucked in. For well construction, cement, steel pipes, rig infrastructure, as well as mobile offices are needed. A conservative

estimate of truck moves associated with a single well consists of 1,340 one-way truck trips to establish the well, or 2,680 round-trip truck movements. Additionally, because of lower recovery rates for tight oil, an operating well may be fractured up to 18 times to maintain its production. If multi-stage fracking is performed then the one well could undergo approximate 30 fracturings (Brisben, 2012)(NYSDEC, 2011).

The following assumptions are used in determining truckloads for the hydraulic fracturing process: maximum allowed truck weight is 80,000 pounds and an empty truck weighs 30,000 pounds (i.e., a maximum cargo load is 25 tons). Tank trucks can hold 5,465 gallons of water. Permitted flatbed trucks are allowed 120,000 pounds gross vehicle weight.

Table 1 provides low and high estimates of truckloads required for the construction and development of a well and for hydraulic fracturing (NYSDEC, 2011). These ranges reflect various vertical and horizontal drilling extents. In some cases drilling can extend one mile, in other formations drilling can extend two miles. It is possible to drill several wells on a single drill pad, which reduces the need for transportation. The entire process for well completion or to install a well to be ready for production may take 30 to 40 days (Neset, 2012).

TABLE 1 Low and High Estimates of Typical Number of Truck Loads

Activity	**# Truckloads**	
Rig Mobilization, Site Prep, Demobilization	**Low**	**High**
Drill Pad and Road Construction Equipment	10	45
Drilling Rig	25	30
Drilling Fluid and Materials	25	50
Drilling Equipment (casing, drill pipe, etc.)	25	50
Completion Rig Mob/Demobilization	10	15
Total for Overall Drilling and Mobilization	**95**	**190**
Well Completion	**Low**	**High**
Completion Fluid and Materials	10	20
Completion Equipment (pipe, wellhead)	3	4
Hydraulic Fracture Equipment (pump trucks, tanks)	150	200
Hydraulic Fracture Water	440	1,429
Hydraulic Fracture Sand	60	80
Flow Back Water Removal	40	495
Well Production Equipment	5	10
Total for 1 Fracturing	**707**	**2,237**
Total (One Way)	**802**	**2,427**
Total (To/From Trips)	**1,604**	**4,854**

Source: (NYSDEC, 2011)

Besides heavy truck requirements for frac sand, flowback water removal requires a large number of trucks. Technological advances are making it possible to recycle flowback water. As technological breakthroughs are widely adopted, it is expected that by early 2013 there will be some reduction in the truck travel related to water (Stark, 2012). Other technologies such as the use of natural gas gels may entirely eliminate the need for trucking water to well sites (NYSDEC, 2011).

Trucking is not the only mode that has a role in transporting supplies. Rail plays a large role, especially in the movement of sand. Concerns regarding length of trains, safety at grade crossings, school bus routes, and elevated noise levels have been noted at the local level. However, truck traffic is the greatest concern for state, county, and local governments as roads built for rural, low-freight economies

must now accommodate high volumes of heavy trucks. The magnitude of the truck requirements increases when several well sites use the same roads. On a national scale, the lack of pipeline infrastructure from the oil/gas sites to refineries means that extracted oil and gas must move by truck or rail until enough pipelines are constructed near national energy production sites (Neset, 2012) (Colvin, 2012) ("Rail Time Indicators, A Review of Key Economic Trends Shaping Demand for Rail Transportation," 2012)(Szakonyi, 2012).

ACTIVITY IN THE MID-AMERICA FREIGHT COALITION REGION

Shale Drilling

Oil and gas production has been, for many decades, an important industry for states like Michigan, Kansas, and Kentucky. The use of hydraulic fracturing in vertical wells has been prevalent in other formations besides shale.

Shale gas drilling is most concentrated in Ohio, which is also the most impacted in terms of road damage and high volumes of truck traffic. In Ohio's Utica formation, there have been 375 permits issued since 2009 and 134 wells drilled. In Ohio's Marcellus formation, 16 permits have been issued with 7 drilled (Ohio DNR Division of Mineral Resources Management, n.d.). The technique of hydraulic fracturing is being used in other states of the MAFC (Figure 3):

- The first vertical well fractured in the United States was in Kansas in 1947. There are thousands of conventional, producing wells in Kansas. Current horizontal drilling in Kansas is targeting the Mississippian Lime Play, which is not a shale play but a porous limestone formation that encompasses areas of northern Oklahoma, and southern and western Kansas. Horizontal drilling and hydraulic fracturing are starting to revive this region that was considered tapped out by vertical drilling decades ago. The counties highlighted in Figure 3 indicate horizontal well activity as of August 1, 2012 ("Horizontal Well Activity in Kansas," n.d.).
- In Michigan, more than 12,000 wells have been hydraulically fractured (vertical) since the 1960s. There has been some deep shale horizontal drilling in the Utica and Collingwood formations ("Questions and Answers about Hydraulic Fracturing in Michigan," Undated).
- Indiana has a long history of oil and gas production, as well as a national pipeline network and numerous gas storage areas. Hydraulic fracturing is prevalent in vertical wells. Horizontal hydraulic fracturing of the New Albany Shale has not met productivity or economic expectations, perhaps due to the shallow depth of the formation. The New Albany Shale extends to Kentucky (Indiana Division of Oil and Gas, n.d.).
- Shale in Kentucky has more clay, which discourages hydraulic fracturing because water makes clay formations swell, inhibiting the release of gas. Liquid nitrogen is used instead of water in fractured wells in Kentucky (KY Division of Oil and Gas, Undated).

Frac Sand Mining

Many counties and states have placed moratoriums to take time to review the impacts of drilling or sand mining and to pass laws and ordinances to protect public health, water supplies, improve safety and to upgrade transportation infrastructure.

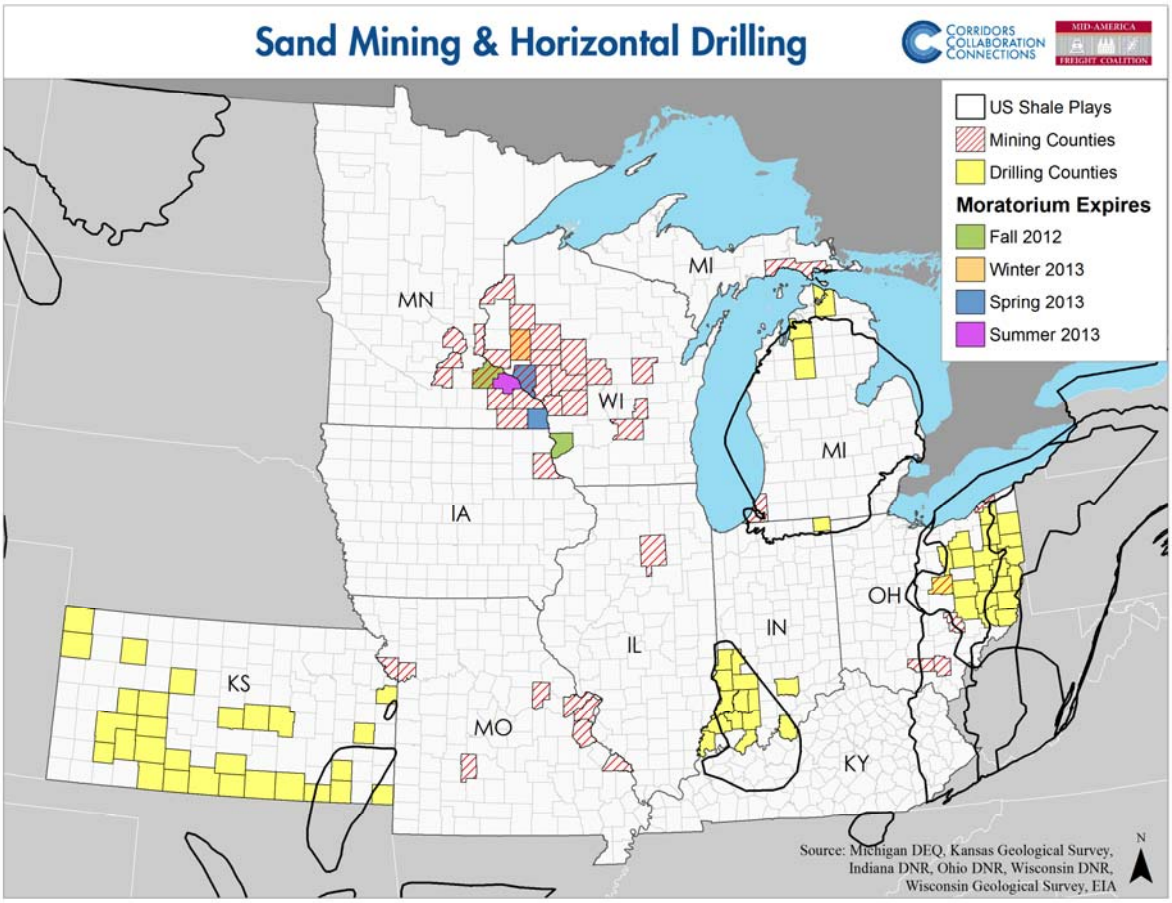

FIGURE 3 Horizontal drilling and frac sand mining as of August 1, 2012

The states with most frac sand mining activity are Wisconsin and Minnesota, followed by Missouri, Iowa, and Illinois. As of July 2012, there were more than 100 mines either in place or in the permitting stage in Wisconsin (Prengaman, 2012). Nine mines are in production or in the permitting stage in Minnesota. It is difficult to monitor activity in other states of the MAFC, as there is no distinction between a sand operator mining sand for foundry use or for frac sand. In some states, mining regulations require a sand mine operator to declare that mined sand will be used for hydraulic fracturing. Some are not required to disclose this information.

Once the sand leaves the Midwest by rail, it will travel to an energy production site in Ohio, Canada, Texas, Colorado, Louisiana, or North Dakota. The final leg will consist of the delivery of the sand from the rail line to the well site, typically by truck. A network of sand storage facilities is being developed at various rail junction points in the shale states for improved staging of supplies. Depending on where the storage facility is located, the sand may be moved more than once before it reaches the well site.

In the United States, the American Petroleum Institute (API) sets operating and equipment standards for the oil and gas industry. Specifications for frac sand are contained in API *RP-56: 1995 Recommended Practices for Testing Sand Used in Hydraulic Fracturing Operations*, 2nd edition.
A related standard was developed by the International Organization for Standardization, *ISO 13503-2: 2006 Petroleum and natural gas industries – Completion fluids and materials - Part 2: Measurement of properties of proppants used in hydraulic fracturing and gravel-packing operations*, 1st edition.

FRAC SAND MINING

Frac sand possesses certain characteristics and properties such as purity, size, shape, and strength. Grains that are round, uniform in size, and have high silica/quartz content are preferable due to their compressive strength and their ability to withstand high pressure and temperatures inside the wells. The compressive strength for frac sand ranges between 6,000 and 14,000 psi (Zdunczyk, 2007).

Ideal sand for fracking comes from specific sandstone formations: St. Peter (Ottawa Sand in commercial use), Wonewoc, and Jordan (both known as Northern White Sand). The sands in these deposits are older and have been worn down to a round shape by an ancient inland sea without sacrificing their strength. These formations are prevalent in eastern Minnesota and central and western Wisconsin and are relatively easily reachable (Brown, 2011). Figure 4 depicts the areas where sand is most accessible in red.

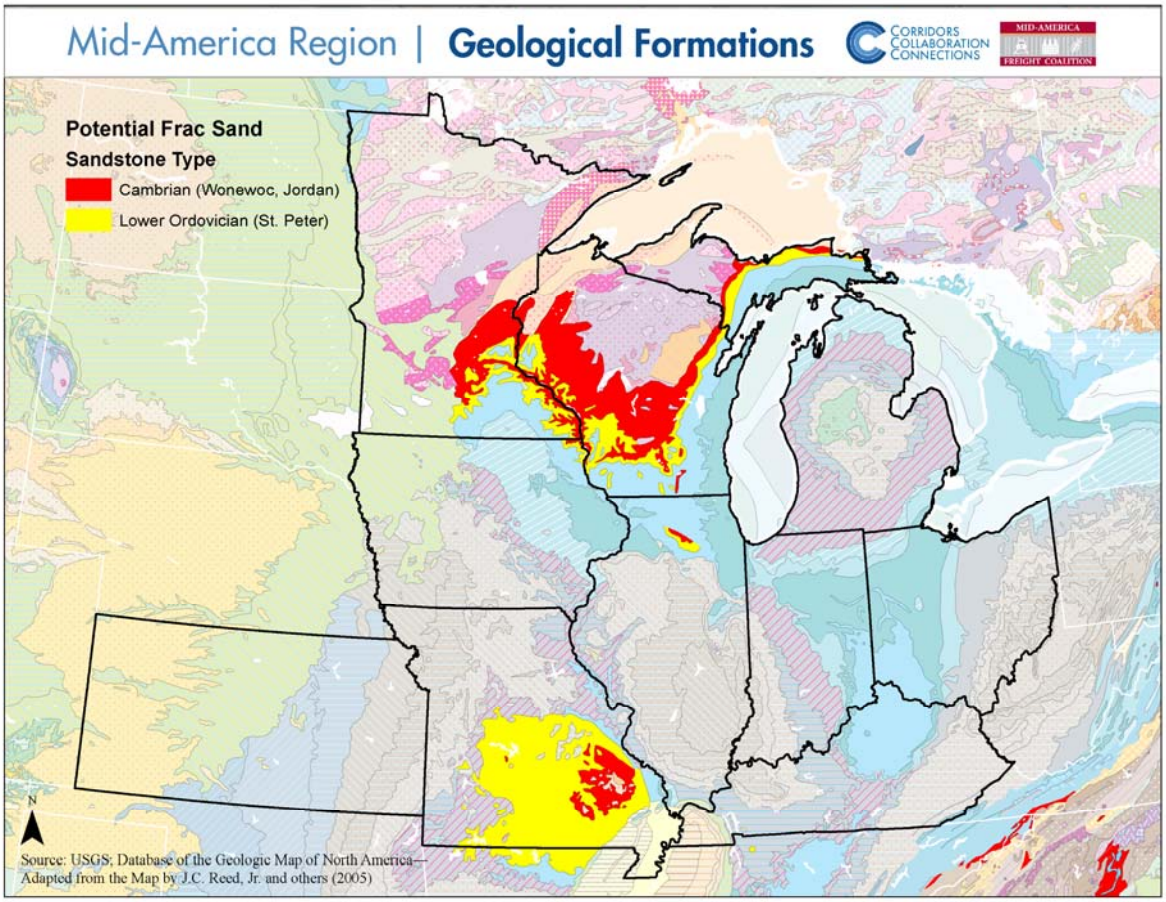

FIGURE 4 Geology of frac sand in MAFC region

Sand Processing

Sand processing consists of moving sand though a series of steps to sift it into size groups for market. Sand is washed to remove pieces of gravel and non-sand particles such as silt and soil in a "wet plant." A "dry plant" not only removes moisture remaining from the wet process but also mechanically sifts the sand. The mesh used for separation determines several sand sizes. The mesh size indicates the number of openings per inch. A larger number indicates a smaller grain size. Coarser sand is used for oil, and finer sand like 40/70 is used for natural gas. A single sand mine may produce several products for different markets across the country. Product differentiation requires separate trucks or rail cars and different final destinations (Wisconsin Department of Natural Resources, 2012).

Business Characteristics

Sand is considered a commodity; its business characteristics include:

- Value chain structure - Sand is worth between $100 and $400 per ton once it reaches the drilling site. Much of that value is created in the processing, transportation, and outbound logistics.
- On the supply side, as more industrial sand mines are permitted and become operational, sand prices will decrease and stabilize. On the distribution side, sand storage facilities are being sited at new, strategically placed transload facilities. New costs for storage may also impact the final cost for frac sand. An analysis by Professional Logistics Group in June 2012 showed that the logistics costs of transporting sand from the source to the well site accounted for 58 percent of the final worth (Brisben, 2012). Figure 5 offers a breakdown of costs.
- Revenue generation/margins - Sand is sold by weight or by car in either short-term or long-term contracts.
- Position in the value network - Due to the lucrative nature of the energy business, there are many competitors at all levels of the value-adding process.
- Competitive strategy.
    - Vertical integration has been a characteristic of the oil industry for decades. Oil companies control the process from exploration, production, refinement, and distribution of products such as gasoline and diesel. Energy companies that are also mining sand are realizing additional savings per well. It is expected that vertical integration will become the norm in the mid- to long-term. It is also expected that large industrial sand mining companies will outlast any market downturns as opposed to smaller operations.
    - Although historically there has been some demand for frac sand in international markets, Midwest frac sand will meet the demand in the United States and Canada.
    - Sand processing operations sited adjacent to a railroad have the advantage of lower transportation costs.

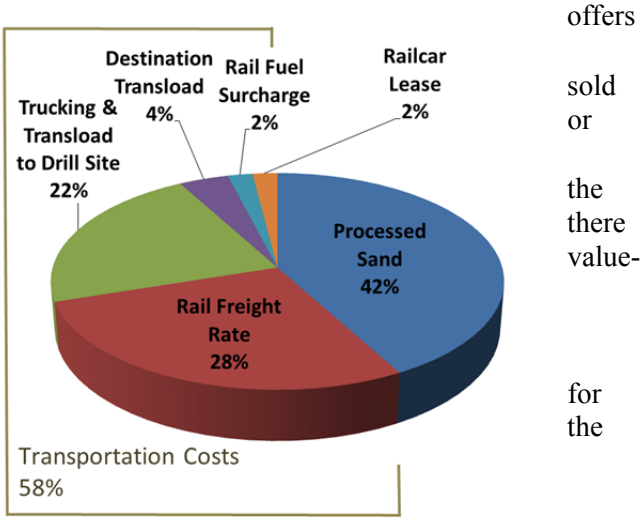

Figure 5 Representative Logistics Cost for Example Frac Sand Price of $180/ton (Brisben, 2012)

Site selection and transportation costs

A first criterion in site selection is the availability and accessibility of sand. The second consideration is the availability of water for processing. This will influence whether processing can occur at the mine. A

third consideration is the access to rail or barge for the long haul portion of the trip to energy production sites. Inherent in this consideration is whether access to a shortline or Class I railroad is more advantageous financially or operationally; perhaps in order to have a more flexible schedule for assembling trains or less costs associated with being on a main line. Access to rail is secured by long-term contracts between mine operators and railroads. Only then will a railroad make additional capacity improvements such as building spurs and sidings. Sand operators may or may not have a secured contract with drilling companies depending on whether they are an established mining corporation, a small company new to mining, or a speculative company.

Table 2 summarizes different ways operators configure their sand operations and the transportation costs and impacts associated with each type. There are a few sites in Wisconsin where all mining, processing, and load-out to rail happen in one location. More generally some processing is done at the mine, or the processing plant is co-located with access to rail.

There may be other configurations and other impacts depending on the haul route. The degree of use of the road system depends on location of the mine in relation to where the sand is processed and where it is loaded to the national rail network for distribution. This has been referred to in Wisconsin as the "triad." However, in addition to loaded truck trips from the mine, empty truck trips and loaded truck trips of rejected sand materials back to the mine must be considered in road impacts (see Table 2).

In some situations, not all components of the mining process may be operational at the same time. A mine may begin extraction and stockpile sand until a processing plant is constructed, sometimes due to a separate permit process for the processing plant. Some mines are only permitted to operate at certain times of the year. Also, weather must be considered, as sub-freezing temperatures affect wet sand processing.

An operator's business model and ultimately the demand for the product will fluctuate depending on the market and seasonality. Therefore, the impact on transportation may vary as truck traffic may be more cyclical than constant.

TABLE 2 Types of Sand Mining Operations and Transportation Impacts

Type	Description	Type of Truck Movements	Type of Impact	Transportation Costs	Comments
Inclusive co-location	Mining processing and access to rail at one location.	Loaded trucks only within mine.	Grade crossings in vicinity of mine. Delay at grade crossings from spur to main line.	Trucking costs within mine. Rail car lease.	Sand company distributes to national location. Provide great savings to operator.
Processing plant co-located with rail access	Mine separate from processing plant Processing plant located adjacent to rail.	Loaded trucks travel from mine to processing plant. Empty trucks return to mine. Some trucks loaded with reject sand are returned to mine to be used for reclamation.	Road damage, safety.	Construction or reconstruction costs: depends on road type, intersection type, and length of haul route. Rail spur construction. Grade crossing protection.	Thaw time allowance, rail access on shortline versus Class I railroad
Mine co-located with processing plant	Mine and processing plant are on the same site.	Truck movement within mine. Loaded trucks with dry sand to rail load out or barge location. Reject material transported within mine.	Road damage, safety, noise, dust.	Rail car lease, cost of transloading sand to covered hopper at load out.	Rail yard must be large enough to accommodate hoppers.
Distributed	Mine, processing plant, and transload facility are geographically separated.	Loaded trucks with raw sand (wet). Loaded trucks with dry sand from processing plant.	Road damage to two haul routes.	Transportation costs higher for additional truck moves. Possible congestion costs for road and rail. Distance hauled may be higher. Rail car lease.	Different companies could own mine and processing plant. A town may not have jurisdiction over the haul route. Load out facility may be shared. Transportation may be by conveyor.

Characteristics of Boom Industries

Recent booms that have stressed the transportation system in a variety of ways include ethanol production (2003-2007), activity associated with establishing a wind turbine industry (2005-2008) and now shale development 2009-present (Brisben, 2012). There are three phases that have characterized these recent energy booms: 1) new market, 2) consolidation, and 3) full build out.

The first phase, new market, is characterized as an initial rush to gain market share. Activities witnessed during the frac sand boom included exploration, land rights or real estate purchase negotiations, an influx of established, companies with expertise or newcomers to the industry seeking permits, infrastructure developments such as mine and processing plant construction as well as rail construction. Construction costs for processing plants range from $40 million to $100 million depending on the capabilities of the plant; more so if resin coating is desired. Most processing plant facilities have an intended lifespan of 30 years. Construction jobs peak in this phase as well as a short-lived induced effect for retail establishments. The frac sand industry also witnessed a backlog in manufacturing rail cars for transporting sand. Because of high demand and shorter supply of frac sand and rail cars, this phase is profitable for early investors. This phase duration may last anywhere from 1.5-3 years (Economic Modeling Specialists, Inc., 2012).

From an economic impact perspective, a second phase would be characterized as when mining and processing plants are fully operational but may include additional expansion (Economic Modeling Specialists, Inc., 2012). In prior energy booms, a second phase was characterized as a consolidation of players (Brisben, 2012). In Wisconsin we may see a combination of these characteristics. Many plants are operational, but the level of production in some operations has already met target production goals for the year and will now sit idle until next year. This is due to a drop in demand in natural gas production and the lack of a nationwide storage facility network. As a national storage facility network is built out, the sand production season will extend longer into the year. The level of activity in the number of permits has stabilized. Because of the high logistics cost associated with moving frac sand, it is uncertain whether all currently permitted sand facilities will ever be built. Smaller mining operators that have completed the permitting stage and or may be operational may be taken over by larger operators if deemed economically feasible. Wildcat operations, those that may not have processing plant capabilities may not survive.

The third phase will be a full, built out sand mining and processing industry. Jobs are considered permanent with direct and induced economic benefits. Larger, better-capitalized operators may be the norm. Transportation methods, practices and procurement are standardized both by operators and within government levels. In this phase margins will be highly dependent on cost-effective logistics strategies. Operators sited most efficiently will be at a competitive advantage (Economic Modeling Specialists, Inc., 2012).

Because frac sand mining is a component of the hydraulic fracturing technique, demand will follow those exploration patterns. Historically oil and gas exploration follows a boom/bust cycle due to global marketplace forces. However, the simultaneous development of new markets for natural gas, the conversion of coal plants to natural gas, and a long-range utility such as the building of port terminals to export liquefied natural gas (LNG) will impact the demand and hence the need to transport frac sand out of Wisconsin.

Assessment of Transportation in Wisconsin

Wisconsin is well positioned for the movement of bulk commodities by rail to some of the major energy production areas of the country. There are four Class I railroads in the state. Burlington Northern-Santa Fe (BNSF) runs coal along the Mississippi River and has an extensive network in the western part of the country, including the Bakken and the Texas formations. Canadian Pacific Railway (CP) line extends southward from Canada to the Bakken and the Marcellus. Canadian National (CN) runs from Prince Rupert, Canada to the Gulf Coast. Union Pacific Railroad's (UP) network, also a western railroad, has access to the Texas shale formation. Two shortline railroads, Progressive Rail, Inc. (PGR), and Wisconsin and Southern Railroad (WSOR) are also shipping frac sand to connections to Class I's within Wisconsin.

Capacity along a rail network for a heavy commodity like sand can be constrained by the actual structure of the rail (ballast, ties, and rail weight), by the type of signaling system (Manual, Automatic Block Signaling, Centralized Traffic Control, Positive Train Control), if a line is single or double-tracked and the lack of passing sidings (Cambridge Systematics, 2007). Bridges can also be a limiting factor for transporting sand if the bridge is not rated for the 286,000 pound car weight, which is one standard used by the rail industry.

For other modes, such as barge, there are some limitations in terms of land available for loading sand due to the unique geography of the Upper Midwest (See Figure 6). The Upper Mississippi River flows through a valley separating Wisconsin from Minnesota, with limestone bluffs hugging the waterway. A large portion of the land is protected by the states of Wisconsin, Minnesota, and the federal government. In Wisconsin, for example, the Lower Wisconsin State Riverway, established in 1989, can issue nonmetallic mining permits. However any activity cannot be visible from the river when deciduous trees are in leaf, hence eliminating barge loading (Wis. Stat. 30.44(3e)). Another limiting factor to barge movement is frozen waterways during winter months. Weather is also a factor in the processing as most wash plants are shut down during winter months.

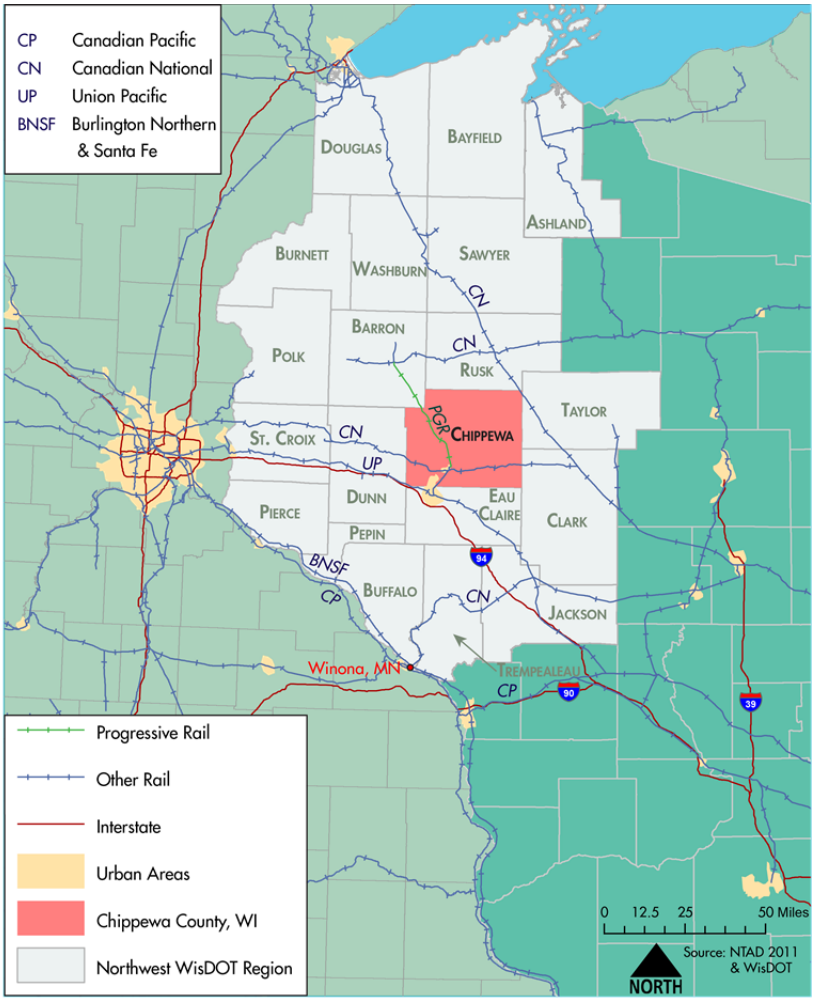

FIGURE 6 Western Wisconsin rail network

Currently sand can be loaded onto barge at the Port Authority Dock in downtown Winona, Minnesota. Access to Winona from Wisconsin is by bridge on Wisconsin Hwy 54/Minnesota Hwy 43. However, sand also moves over the bridge to connect to load-outs on the Burlington Northern-Santa Fe in Winona. Currently 700 trucks are allowed to cross the bridge per day. The two-lane bridge needs rehabilitation. A new two-lane bridge will be constructed in 2015 while the older bridge is rehabilitated at a later date. This will double capacity, but not for several years (Buss, 2012).

Transportation by barge through the Great Lakes is another possibility but is considered economically unfeasible at this time. The added cost of transloading the sand from rail to barge increases transportation costs. Another factor is that any port terminal would need to have enough yard capacity to handle unit trains.

There are some sand operations in Wisconsin that are moving towards a complete conveyor system to minimize trucking costs within a mine. Conveyors or pipe slurry are also being used in some situations to move sand to a processing facility also removing truck movements out of the plant logistics.

CASE STUDY: FRAC SAND MINING IN CHIPPEWA COUNTY, WISCONSIN

Chippewa County Facts
Acreage: 1,041 square miles
2011 Population/Density: 62,610/ 60 persons per square mile
Demographics: Predominately white
23.6% under 18
7.5% 18 to 24
6.5% 25 to 29
12.3% 30 to 39
14.8% 40 to 49
15% 50 to 59
10.1 60 to 69
10% 70 and older
Top Employers (250-999 employees): TTM Advanced Circuits, Inc., Chippewa Falls Public School, St. Joseph's Hospital, Department of Corrections, Chippewa Valley Music Festivals, Inc., County of Chippewa, Wal-Mart, Precision Pipeline, LLC, Mason Companies, Inc., Bloomer Memorial Medical Center, Inc., Cray, Inc.
Industrial parks with rail access: Seymour Cray Sr. (Chippewa Falls), Bloomer, Stanley
Rail freight dependent businesses (prior to 2011): Bloomer Plastics, Jennie-O-Turkey (Barron), Glacier State Distribution, PMI
Type of Government: County Administrator
Recreational/Tourism revenue: $96 million (2010)
Water Bodies: 449 lakes over 20,000 acres including Lake Wissota, Chippewa River
Sources: Wisconsin Department of Administration, Chippewa County Economic Profile 2011 – Chippewa Falls Chamber of Commerce, West Central Regional Planning Commission

The purpose of this case study is to understand how local governments, in this case, Chippewa County are using road use and maintenance agreements (RUMA)[1] to fund road repairs to frac sand haul routes. The agreements presented highlight the variability in the length and condition of haul routes and the financial solutions that were negotiated. Background information on the county is presented along with a statutory context for the RUMAs and an overview of the permits needed to establish a sand mine in Wisconsin. Transportation implications as well as other impacts are outlined.

The case study information was sourced through interviews with county officials, private enterprises, trade associations, government representatives, railroad representatives, and logistics representatives. Most of the interviewees requested anonymity. Researchers toured Chippewa County's frac sand mining operations and the industrial sand freight network.

County Overview

Chippewa County is located in West Central Wisconsin, with parts of the county falling in the Eau Claire metropolitan region. Chippewa County is a member county of the Western Central Wisconsin Regional Planning Commission.

Computer and electronic manufacturing, food services, educational services, nursing and residential care facilities, and specialty trade contractors are the top Chippewa County industries by employment.

About a half million acres are currently being farmed in the county. The county has 11 industrial parks some of which have access to rail and water.

Chippewa County businesses generated 1.4 million tons that were transported by truck in comparison to 989,000 inbound tons. Another 33,800 tons moved within the county by truck. On the rail side, 137,700 tons originated in Chippewa County, and 383,800 terminated ("Transearch Data for Wisconsin 2007").

Thirty-one percent of Chippewa County residents work in the City of Chippewa Falls, another 21 percent travel to the City of Eau Claire, Dunn County for work, and 32 percent work elsewhere in Chippewa County. Demographic patterns mirror the United States in terms of age distribution. Forty three percent of the population is under 18 or over 60 years old. Median salary for this county at $13.16 per hour or $27,368 a year (U.S. Census Bureau, n.d.) (Demographic Services Center, Wisconsin Department of Administration, n.d.).

Chippewa County currently has a County Administrator form of government ("Forms of County Government, n.d.). Nearly two decades ago, the county switched its government type, and previously elected office positions became merit-based, allowing department commissioners sole authority, equivalent to a board. This important fact has helped to streamline road negotiation efforts in Chippewa County as the Highway Commissioner can work directly with sand operators.

[1] Road upgrade or roadway use and maintenance agreements (RUMA) are used interchangeably in this report.

TABLE 3 Local officials in Wisconsin

Activity	County	City	Village	Town
Executive	County Executive or County Administrator or Administrative Coordinator	Mayor or City Manager	President or Village Manager	Town Board Chair
Legislative	County Board	City Council	Village Board	Town Board

Source: Paddock, Wisconsin Blue Book, 1997-1998

Most townships within Chippewa County do not have town zoning ordinances, but some have adopted county zoning ordinances. All villages and cities have zoning ordinances.

County Transportation System

U.S. Highway (USH) 53 (see Figure 7), which traverses the county from the southeast to the northwest is the one of the county's busiest arterials with average traffic rates of 12,000-14,000 vehicles per day north of Chippewa Falls and 8,000-10,000 north of Bloomer (Wisconsin DOT Travel Counts, 2008). State Trunk Highways (STH) 40 and 64 are frac sand haul routes. Both had about 900-1,900 vehicles per day in each direction outside of Bloomer as of 2008. Another major freight route in the county is STH 29 with daily (2008) traffic counts ranging from 10,000 – 19,000.

There are three railroads with a total of 70 miles of track that serve Chippewa County. Canadian National (CN) and the Union Pacific Railroad (UP) are both Class I railroads. The third, Progressive Rail, Inc., is a shortline railroad (Figure 7).

CN is Canada's largest railroad and offers access to various energy production sites: the Tar Sands in Alberta, Canada and the Canadian Bakken Shale. Portions of CN are currently out of service north of Chippewa County from Barron to Ladysmith. CN will be reinstating service over 39 miles in December 2012 once frac sand shipper contract guarantees are in place and the track is upgraded. CN will invest $35 million in this project. Sand is not moving over the CN in Chippewa County at this time.

Progressive Rail, Inc. (PGR) leases portions of its track from UP and another portion from the Wisconsin Central Ltd., a division of CN. The portion that was leased from CN will revert back to CN in the Fall of 2012. The rail line spans Barron and Chippewa Counties. In Barron County the portion of the track from Almena to Barron is out of service. West of Almena the rail corridor is currently being used as a trail and is preserved for future transportation use under the Federal Rails to Trails Act. The line to the north ends at Rice Lake abutting a trail. Progressive Rail's line runs from Rice Lake in the north to Norma where it connects with UP's tracks.

Progressive Rail has, in the past, moved thirty-car trains two to three times per week to connect with the UP. With current levels of sand production, unit trains – where all cars are headed to a single destination carrying a single good – are being assembled of 80-100 cars. Each car is not fully loaded to the 286,000-pound capacity because of weight limitations over the bridge located in the Flats area of Chippewa Falls. Although track has been upgraded, trains are operated at no more than 10 miles per hour in this corridor since the run is not very long to the UP connection.

Frac sand in Chippewa County that is initially loaded on to Progressive Rail connects to the national system via the Union Pacific (UP) railroad. Union Pacific has an extensive network spanning the western part of the United States with connections to Texas' Eagle Ford formation and the Permian Basin, Colorado and Wyoming. Unit trains are assembled south of Chippewa Falls, in Norma, Wisconsin and run several times per week at night.

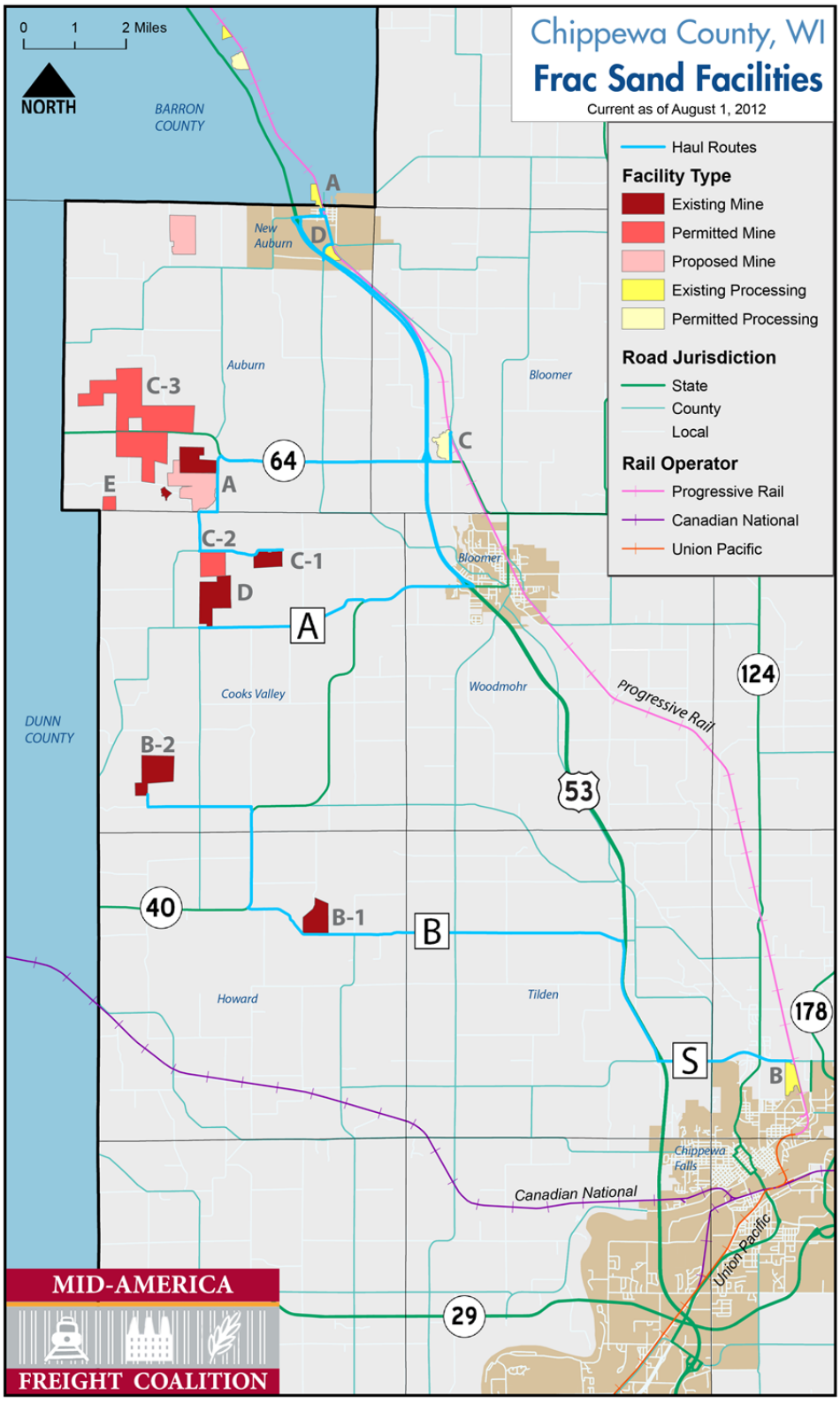

FIGURE 7 Chippewa County frac sand mines and routes

Tools for managing roadway impacts

In Wisconsin, state statutes found under Chapter 348 are related to weight limitations and Chapter 349 outlines state and local authority to restrict traffic. Of particular interest is Wis. Stat. 349.16(1)(c) which authorizes reimbursement for road damage. Every Chippewa County RUMA includes the following recital.

> Whereas Wis. Stat. 349.16(1)(c) authorizes the County highway commissioner to enter into and agreement on behalf of County with any owner or operator of any vehicle being operated on a highway maintained by County that provides that the County will be reimbursed for any damage done to the highway.

Wisconsin Department of Transportation's (WisDOT) Facility Development Manual (FDM) provides policy, procedural requirements, and guidance encompassing the development process of all types of highway improvements on the state trunk highway system, other street/highway systems for which federal-aid highway funds may be utilized, state facilities road systems funded with state funds administered by the department, and other highways and roads for which the department may act as an administrative agent ("Facilities Development Manual," ongoing)

Links to Referenced Wisconsin Statutes, Tools, Permits
Chapter 82 -Town Roads
Chapter 86 - Misc. Highway Provisions
Chapter 348 - Vehicles - Size, Weight and Load
Chapter 349 - State and Local Powers
WisDOT FDM -Traffic Impact Analyses
Wisconsin Administrative Code – Reclamation permit: NR135

The FDM's Procedure 7-35-10, Traffic Impact Analyses (TIAs) consists of an engineering study that compares before and after traffic conditions on a roadway network due to a proposed land change. A TIA is triggered when new driveways (access points) are needed for the construction of a traffic-generating enterprise or industry. WisDOT approaches a TIA from a safety and operational standpoint and the outcome is a list of roadway changes and the costs of engineering, real estate, and construction and assigns those costs to a project's scope. WisDOT has offered technical support in reviewing site plans for counties. Not all counties in Wisconsin have taken advantage of this resource which reflects how strongly locals governments work to solve their own problems (Wisconsin Department of Transportation NW Region Planning Staff, 2012).

Other state statutes that refer to miscellaneous highway provisions and railroad crossing maintenance that may be referenced in road damage agreements are located in Chapter 86. Statutes governing town roads can be found in Chapter 82.

State roads, under the jurisdiction of the Wisconsin Department of Transportation (WisDOT), do not have statutory recourse for road damage. Therefore maintenance and improvement costs are borne by the department. In the case of new or emerging commodity traffic, higher levels traffic will affect the life of the road.

Permitting a sand mine in Wisconsin

There are a number of permits required for the siting of a nonmetallic mine and its associated processing plant. The mining permit application process, which varies by state, involves many regulatory agencies. At the federal level, the Department of Labor's Mine Safety and Health Administration (MSHA) enforces safety and health procedures and policies.

In Wisconsin, the Department of Natural Resources (WisDNR) uses permits to regulate air quality to control silica and fugitive dust, water permits for stormwater, high capacity wells, and wetlands/surface waters (where applicable). Finally, a reclamation plan must be finalized for after the completion of the mining process using Wisconsin Administrative Code NR135. Potential land uses include green spaces, wildlife habitats, agriculture, or lakes and ponds (Haines, 2012).

Local and county governments ultimately have the most control over regulation. Zoning provides the simplest method. Depending on the zoning category, the local city or township can prevent mining or at

least impose specific regulations such as hours of operation, truck routes and speeds, and road repair liabilities. Some counties have imposed fixed-length moratoriums on mining, despite questionable legality. The moratoriums have not been challenged in courts, likely due to the time to trial and costs outweighing any short-term benefits.

Table 4 provides a summary of permits that may be required. There may be more tools available at the local level than provided here as local governments may be organized differently.

TABLE 4 Permitting sand mines in Wisconsin

		Extraction	Processing	Transportation
Fed	U.S. Department of Labor	Occupational Health and Safety		
		Mine Safety and Health		
State	Department of Natural Resources	Air Quality Permit		
		Storm Water Permit		
		High Capacity Well Permit		
		Wetlands/Surface Water Permit		
	Department of Transportation			Access Permits on State Highways
	Department of Safety and Professional Services	Blasting Permit		
	Register of Deeds	Registration of Mineral Deposit		
		Statement of Mineral Claim		
Local	County Planning Department	Conditional Use Permit		
	County Zoning Department	Zoning Permit		
	County Land Conservation Dept.	Reclamation Permit		
	County Highway Dept.			Road Use Agreement, Over Size-Over Weight Permit
	Town Board/Village	Developer's Agreement, Road Upgrade Permit, Right of Way Permit, RUMA		

Road Upgrade and Maintenance Agreements

Once environmental requirements are satisfied, if the proposed haul routes are over county or local roads, the conditional use permit is then reviewed by the county highway commissioner who in turn negotiates a road upgrade and maintenance use agreement (RUMA) on behalf of the county. The commissioner has also negotiated on behalf of a town in Chippewa County. If proposed mine haul routes are over state roads then the county is not involved.

The outcome of the negotiations will vary from operator to operator based on the condition of the haul route, the operator's business model, and their payment schedule preferences. It is in the interest of operators to negotiate with the county as counties have the ability to post weight limit restrictions on their roads and can therefore affect the operator's level of production. The negotiation process in Chippewa County has helped build relationships between county staff and the operators.

Chippewa County hired a consultant to evaluate a number of possible routes to determine road conditions for projected truck traffic (AET, Inc., 2011). The following tests were conducted: subsurface exploration, nondestructive pavement testing using a deflectometer, and geotechnical and pavement engineering analysis for approximately 43 lane miles. A digital video log captured pavement surface conditions. To measure pavement thickness and to identify thin pavement locations, ground-penetrating radar was used at one-foot intervals in both traveling directions.

For the pavement condition survey, the potential truck haul routes were rated using the PASER system from 1-10 with 1 being a complete reconstruction (Walker, 2002). The results showed that the majority of roads were in good condition for current and historical traffic counts. The MN/DOT TONN method was used to calculate load capacity and required overlay for the test segments (Stelzner, 2012) ("Estimated Spring Load Carrying Capacity TONN Method," n.d.).

Table 5 summarizes the consultant findings in regard to the overlay thickness required to accommodate projected truck levels for the next ten years. The table shows the needs for current traffic versus sand hauling traffic, with and without spring weight limits. A structural asphalt overlay would be required ranging in depths of .9 to 6.0 inches.

Funding mechanisms in other states

RUMA

Roadway use and maintenance agreements (RUMAs) have been standardized in Ohio for both local governments and the involved operators. Local officials were perpetually concerned about being notified prior to drilling activity and the effects on the township and county road systems.

The process for the development of the RUMA in Ohio included a cross section of county engineers, politicians, oil company and railroad representatives. This process resulted in coordination with the Ohio Department of Natural Resources to change legislation to require that an active RUMA is a checklist item for an Oil and Gas Horizontal Drilling Permit. RUMAs include the following components: a defined route, a bonding requirement (except in cases where the road can handle additional traffic, or operator agrees to pay/upgrade route, bond already exists), route maintenance during drilling activity, notifying the rail industry when crossings are involved, a comprehensive engineering report, specific local requirements, and an emergency repair contact list. A RUMA does not permit the development of the drilling infrastructure itself, specific non-negotiable bonding ranges, contract expiration dates, or release from over-size, over-weight permits (CEA-OH, n.d.). A model RUMA for Ohio can be found in Appendix B.

Impact Fees

Impact fees are typically imposed on commercial vehicles on specific routes. There may or may not be different rates based on the commercial or business type. Other jurisdictions post weight limits on roads of concern and require permits if a vehicle exceeds the limit. Impact fees were originally used to help pay for infrastructure in new developments, but recently, they have been used in Pennsylvania to handle vehicle weights related to fracking. Drillers in the Marcellus Shale pay a fee of $40,000 to $60,000 per well (U.S. Energy Information Administration, 2010).

Aggregate Tax

The last alternative municipalities have used to recover road damage costs is an aggregate tax. Operators pay a constant rate per unit of sand hauled on a county's roads. The resulting local revenues would be explicitly used for road maintenance. Winona County, MN could realistically implement this system, because an aggregate removal tax already exists (Juhl, 2012).

TABLE 5 Overlay Thickness Required for Next 10 Year Traffic (inches)

Section	Roadway	From	To	Current Traffic		With Sand Hauling	
				Without Limits	With Limits	Without Limits	With Limits
1	186th Ave	50th St.	CTH DD	0.9	0.0	4.6	4.1
2	190th Ave	CTH DD	22nd St.	1.4	0.5	5.0	4.5
3	22nd St.	195th Ave	STH 64	1.2	0.3	6.0	4.3
4	CTH DD	STH 64	CTH A	0.9	0.0	4.0	3.4
5	135th Ave	CTH DD	20th St.	1.8	1.0	5.9	5.5
6	20th St.	135th Ave	End AC	0.0	0.0	3.1	2.4
8	135th Ave	20th St.	County Line	3.0	0.6	6.0	4.6
9	CTH B	90th St.	55th St.	4.0	1.7	4.9	4.4

Section	Roadway	From	To	Current Traffic		With Sand Hauling	
11	CTH B	End Construction	STH 40	5.5	2.4	5.5	4.8
12	CTH A	CTH DD	40th St.	0.8	0.0	3.0	2.3
13	CTH A	CTH DD	50th St.	0.8	0.0	3.3	2.6
14	CTH A	50th St.	60th St.	1.3	0.0	4.9	3.2
15	CTH Q	USH 53	CTH SS	0.0	0.0	2.8	2.0
16	CTH SS	CTH Q	CTH M	0.0	0.0	0.9	0.0
17	CTH M	CTH SS	PC	0.0	0.0	2.0	1.2
18	CTH M	PC	USH 53	0.0	0.0	1.8	0.9

Source: AET 2011, p 17

Note: Segments 7 and 10 had a gravel surface or a granular base.

Evaluations made through the WisDOT TIA process helped to identify other design engineering needs such as pavement width, land acquisition needs for right of way, and turning movement considerations at access points. Routes were selected based on the report and negotiations were finalized.

None of the agreements restrict traffic along the haul routes. It should also be mentioned that in the financial particulars for all agreements, there are provisions that allow Chippewa County to bill operators for additional costs they incur beyond those explicitly mentioned in the agreements.

Elements of a Road Use Agreement
A good agreement will:

- Include recitals
- Identify terms and conditions
- Identify the roadway routes to be used
- Identify the owner and authorized representatives
- Identify the local government and authorized representatives
- Contain terms for payments of both roadway improvements and long term roadway maintenance
- Indicate cooperation and potential emergency actions
- Contain provisions for insurances, remedies and enforcement
- Contain severability clauses
- Discuss assignability
- Contain processes for modifications, and
- Contain the process for termination (Stelzner, 2012).

Prior to 2010, there were less than a dozen sandstone quarries, all relatively small operations employing fewer than 20 people in Chippewa County. The first conditional use permit for an industrial sand mine was submitted in 2009. As of August 2012, five frac sand mines and three processing plants are in operation. Three additional mines were permitted between May and July and others are currently proposed. Figure 7 shows the mine locations, processing plants, and the haul routes in the Chippewa County area ("Non Metallic Mining & Reclamation Permit Applications : Chippewa County, WI," n.d.). Table 6 provides a summary of the agreements. A sample Chippewa County RUMA can be found in Appendix A.

The RUMAs are the source for the following industrial sand mine descriptions:

Each road use agreement states that any and all monies paid to the county must be exclusively used for the operator's haul routes. Roads are built to design standards in the WisDOT Facilities Development Manual, Section 11-40. The agreement ends when the mining reclamation permit expires.

Operator A

The Operator A mine is located within the town of Auburn on CTH DD near STH 64. According to the road use agreement dated May 2011, Operator A would reimburse the county $311,510 in a single payment to reconstruct the 0.2 miles of CTH DD between the mine entrance and STH 64. The operator owns a processing plant on the Barron County side of New Auburn along the Progressive Railroad line. The haul route from the mine to the plant is CTH DD to STH 64 to USH 53 to CTH M and then over local streets in New Auburn for an approximate total

distance of 10.9 miles. The haul route includes 9.9 miles of state roads, 0.8 miles of county roads, and 0.2 miles of village roads.

Further maintenance is not expected on CTH DD as it has been built for a 30-year lifespan. Parties however agreed that the county could invoice the operator for exceptional maintenance. CTH M, a short section of urban county road located within the village is in relatively good condition, however agreements with both Operators A and D who share this route, were left open for future discussions for upkeep or improvements. It is most likely that these operators will need to share in the expense for the future upkeep/improvement on this section of roadway. Operator A's mine, which has a wet plant, was initially permitted for 135 acres. The permit was recently expanded to include 334 more acres for a total of 469 acres.

Operator B

Operator B has two mines that supply sand to a processing plant in Chippewa Falls. One is located at 5312 CTH B in Howard (B-1 mine). Due to conditions set by the town, sand cannot be extracted, blasted or hauled from the mine site between May 1 and October 15. The acreage for this mine is 185 acres. A second mine, located at 20th Street in Cooks Valley (B-2 mine), was developed in part due to the imposed restrictions on the B-1 mine. Mining can take place year round at the Cooks Valley location. The acreage for this mine is 234 acres. The two mines share a haul route for approximately 11 miles.

The haul route for the B-2 mine, which is located farthest from the processing plant, begins at the mine entrance on 20th Street and continues on 135th Avenue then to STH 40, CTH B, USH 53, and CTH S, which is 17.7 miles one-way. The Town of Cooks Valley negotiated, with the assistance of the county commissioner, a road upgrade and right of way permit. The permit covers the town roads starting at the mine entrance on 20th Street to 135th Avenue to its intersection with STH 40, a distance of 3.3 miles. Operator B agreed to bear all costs of rebuilding the road to WisDOT FDM standards needed for sand hauling. However no dollar amounts were specified in the permit. The town also negotiated a town road maintenance agreement where the operator agreed to cover all exceptional maintenance –work above normal public maintenance such as increased snow plowing or more frequent pavement repairs that may be required for commercial trucks ("Town of Cooks Valley Road Haul Agreements," n.d.).

County Highway B Reconstruction May 2012

The 11-mile one-way haul route for the B-1 mine starts on CTH B near 55th St. and then follows the same B-2 mine route, that is CTH B to USH 53 to CTH S. The RUMA however, includes a section of CTH B running west of the mine entrance, to the intersection of CTH B and STH 40. The RUMA called for three equal payments to reflect a phased reconstruction of 7.45 miles at a total cost of $2,888,089. Four segments were identified:

1) STH 40 to S&S Mine entrance (1.5 miles),
2) Mine entrance to 90th Street (3.5 miles)
3) CTH B from 90th to 110th Street (2.25 miles)
4) CTH B 110th to USH 53 (.2 miles).

Segment 3, CTH B from 90th Street to 110th although identified here, had already been redesigned in 2010, and was already scheduled for construction in 2011. Cost estimates for Segments 1, 2, and 4 were based on the Segment 3 project that was paid for by federal aid and county funds. The cost per mile for the Segment 3 project was $548,671. Estimates were derived by multiplying the per mile costs by the

length of segments 1, 2, and 4 for a total of $2,853,089.22. An additional $35,000 was budgeted for a cattle crossing.

Initial payment occurred at the execution of the agreement and subsequent payments will be due at the beginning of each construction phase. The operator will be responsible if costs exceed estimates. Likewise, if payments exceed actual costs, the county will refund monies to the operator.

In terms of impacts, the haul route for the B-2 mine impacts 3.3 miles of town roads, 4.5 miles of state roads, which include USH 53, and 9.9 miles of county roads. The B-1 mine when it is operating hauls over 2.5 miles of state roads and 8.5 miles of county roads.

Operator C

Operator C has been permitted to operate three mines in Chippewa County however; only one is in production at this time. This mine is located near 4430 186th Avenue in Cooks Valley (225 acres) and according to the reclamation permit, has a wash plant. A processing plant has been permitted in the Town of Bloomer near the intersection of STH 64/CTH SS but construction has not started. Access to the proposed processing plant may be along 85th Street, which may need to be upgraded. Operator C's haul route begins at 186th Avenue to CTH DD to STH 64 for a total of 8.4 miles. Like other haul routes, town (1.6 miles), county (2.2 miles), and state roads (4.5 miles), comprise the haul route. Therefore, two road use agreements were negotiated at the town and county level.

The town RUMA covered 1.6 miles from the mine entrance to CTH DD. The particulars in regard to funding a construction and setting up a maintenance account were practically identical to the County RUMA except that improvement to 186th Avenue would require a 5.5-inch hot-mix asphalt (HMA) overlay.

The county RUMA acknowledged that the county would be reimbursed for improvements and required Operator C to fund a construction account in the amount of $500,000. The county would improve CTH DD from 186th Avenue to STH 64, a length of 2.2 miles by adding approximately a 3.5-inch HMA overlay, shouldering and other incidentals. The work was to be completed within 60 days of the agreement execution. Remaining funds from this work would be used to design, construct and make initial geometric improvements to the intersection of CTH DD and 186th Avenue with actual construction scheduled for 2012. If costs exceed $500,000 the operator would be billed for the difference. If the costs come in under budget, the remaining funds would transfer to a county maintenance account reserved solely for this haul route. The account would be funded through a monthly payment of 5 cents per ton of sand hauled from the mine. Operator is required to submit production records for the prior month's production with each monthly payment to confirm payment amount. The operator would be allowed to suspend payment once the account balance reached $500,000 and restart payment when the balance fell below $100,000.

Because the processing plant has not been constructed, the sand is trucked more than 80 miles one-way to the operator's processing plant in Woodbury, Minnesota mostly over state roads and the interstate. Given the required traveling distance, it is particularly important for Operator C to have the purest sand possible prior to leaving the mine. Operator C has two other mines that were recently permitted in May 2012. One mine, 160 acres, is located on 186th Avenue and shares the negotiated haul route. The other mine, which is a 1,224-acre site, will have direct access to STH 64. Each location will have a wash plant but construction has not begun on either site. Should the remaining sand mines and the processing plant become operational, STH 64 will become a heavy truck corridor.

Operator D

Operator D's mine entrance is located on CTH A near the intersection with CTH DD and its processing plant is in the village of New Auburn on the Progressive Railroad line. The 15-mile haul route includes CTH A to STH 40 to USH 53 to CTH M to CTH SS to CTH Q.

The February 2012 agreement identified 2.97 miles on CTH A that needed to be upgraded. Estimates were based on the rehabilitation work done on CTH B in 2011. A unit cost of $599,209 per mile was used as a baseline estimate. A 9.5-inch of hot-mix asphalt (HMA) overlay was also required to accommodate

truck traffic for twenty years. The estimated cost of the HMA was $721,659. (The AET report reported overlay depths for 10 years.) In addition geometric improvements at the mine entrance ($250,761) and to the processing plant entrance on CTH Q ($199,825) were included. A total estimate of $3,7999,843 also included costs such as safety edge and an inflation factor of 5 percent.

In the RUMA, the operator agreed to pay $3,800,000 million upfront. If the costs were to exceed the estimates, the operator would pay the difference. The RUMA also stipulated that unused funds would transfer to a maintenance account that would cover all exceptional maintenance costs. A $35,000 annual payment would initially fund the maintenance account. Payments would be suspended when the account reaches a balance of $500,000 and resume again when the balance falls under $100,000. If, for some reason, other roads are used by mistake or with the consent of the county, the operator would be responsible for road damage and the county would use maintenance account funds to pay for exceptional maintenance.

The parties also agreed that the operator would pay for grade crossing improvements at CTH Q near CTH SS in addition to the above listed amounts. The mine size is 176 acres. In terms of impacts, the haul route consists of 8.4 miles of state roads and 6.6 miles of county roads.

Operator E

The forty-three acre mine was permitted at 19249 17th Street, Bloomer in August of 2012. Activities at the site will include excavation, screening, crushing, stockpiling and loading. Trucks will be used to transport raw sand to an offsite processing facility. It is projected that 70 percent of mineable sand will become product and 30 percent of the mineable sand will be reject material that is returned to the mine site for use in reclamation.

Development Agreements
A development agreement is a consensual, binding contract between two or more parties, typically between a land owner/land developer and a government agency. Although the State of Wisconsin does not expressly authorize local governments to enter into development agreements, many communities regularly use them ("Development Agreement Checklist," n.d.).

A developer's mining agreement was negotiated between the Town of Auburn and Operator E. The developer's agreement contained RUMA stipulations. A road use agreement was not negotiated with the county as the indicated haul route includes only town and state roads.

According to the agreement, sand will be hauled over Town of Auburn roads for 1.8 miles. The route would begin at 17th Street to 195 Street to 22nd Street to STH 64. In the developer's mining agreement, Operator E will video tape the truck route to serve as a baseline for needed repairs, and for the condition the road must be in at the end of the agreement (10 years). The operator will determine an escrow amount based on the cost of road repair per mile times the total number of miles of town roads. To determine the cost of road repair, the town board will obtain bids from at least three contractors within 60 days the agreement becomes effective. The bids will be based on an estimate of the cost per mile for a replacing a class B town road of 20 feet in width, with broader reinforced corners, 12 inches of base materials, and 4 inches of asphalt. The bids will not include the cost of reconfiguring the road or expanding the road surface beyond 20 feet. Bids will be averaged to determine the cost of road repair.

Any remaining funds after repair will fund an escrow account on a monthly basis at a rate of $0.20 cents per ton of sand hauled. Payment can be suspended when the escrow account reaches the escrow amount. This operator will be required to maintain records of haul miles for each truck each day and submit records and payment on a monthly basis. The town may adjust the escrow rate to reflect costs of road construction. The operator will be responsible for additional payments if the escrow account balance is insufficient.

Click here to access an interactive map of frac sand mining in Chippewa County. Chippewa County Frac Sands

The agreement also satisfies financial responsibilities required under the town's Mine and Weight Limit Ordinance. As of September 2012, this operator was reviewing different business models to determine where processing would occur and where sand would be loaded to the rail network.

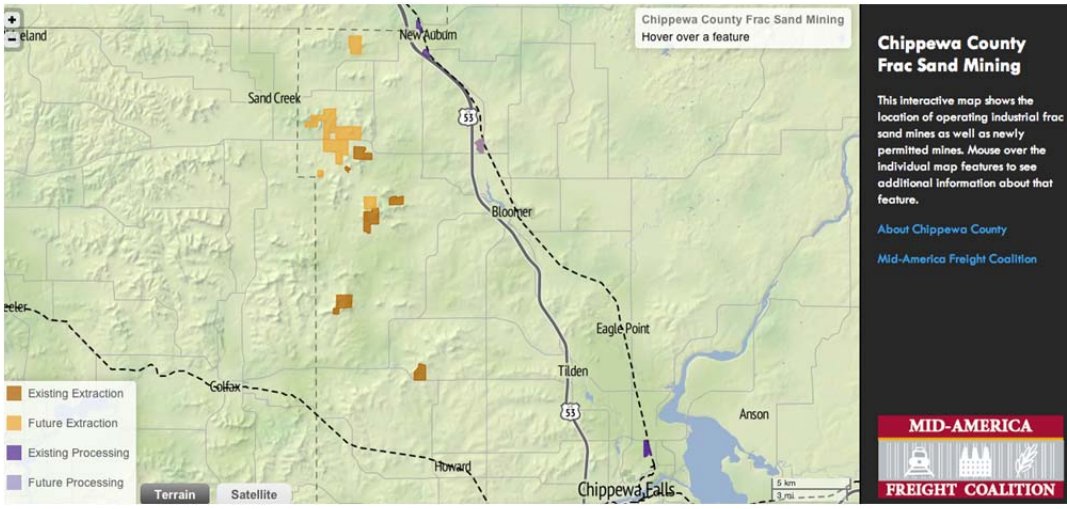

TABLE 6 Chippewa County Road Upgrade and Maintenance Agreements as of August 1, 2012

Operator	RUMA Jurisdiction	Permit Issue Date	RUMA Date	Construction Initial Acct Deposit	Maintenance Account	One-Way Haul Route Length (mi)	State Roads (mi)	Total County Roads (mi)	County/Town Roads in RUMA	County Roads - No upgrades needed	Comment
A	Chippewa County	5/6/11	5/19/11	$311,510	Single payment	10.9	9.9	.8	0.2	0.6	Haul route also includes .2 miles over village roads. Roads used by other Operators: CTH DD, STH 64, USH 53, CTH M
B-1	Chippewa County	4/29/09	9/2/11	$2,888,089	Three equal payments	11 12.45*	2.5	9.9	5.2*	4.75	*RUMA extends beyond mine entrance. RUMA begins at STH 40/CTH B
B-2	Town of Cooks Valley	10/14/11	12/20/11	To be determined	-	17.7	4.5	9.9	3.3 (Town)	9.9	Shares 11 miles with S&S Mine route. * Includes 5.2 miles under other RUMA.
C-1	Chippewa County	6/8/11	NA	$500,000	5 cents/ton until balance reaches $500,000	8.3 (80)*	4.5 (3.3)	2.2 (2.2)	2.2 (2.2)	-	*Processing plant not yet constructed. Temporary haul route 80 miles one-way. Chippewa mileage in ().
	Town of Cooks Valley	NA	2011	$498,772	*		-	-	1.6 (Town)		
D	Chippewa County	5/10/11	2/16/12	$3,800,000	$35,000/year until balance reaches $500,000	15.0	8.4	6.6	3.0	3.6	Grade crossing improvements to be paid by operator.
Total mileage mines in production August 1 (one-way)						**134.60**	**28.6**	**29.4**	**10.6/4.9**	**18.9**	
Permitted Mines yet to be constructed											
C-2	*NA*	*5/25/12*	*No RUMA*	-	-	*7.1*	*4.4*	*2.2*	*2.2*	*2.7*	*Permitted mine, no construction yet. Route already has RUMA.*
C-3	*NA*	*5/25/12*	*No RUMA*	-	-	*6.4*	*6.4*	*NA*	*NA*	*NA*	*Permitted mine, no construction yet.*
E	*Town of Auburn*	*7/30/12*	*8/8/12*	-	-	*TBD*	*TBD*	*NA*	*1.8*	*TBD*	*Operator still to determine processing location and transportation.*
Potential mileage full build out (one-way)						***76.4***	***39.4***	***31.6***	***14.6/4.9***	***21.6***	

Sand Production Estimates

Data on sand production indicates three mines in Chippewa County have an estimated annual production of 1-1.5 million tons while a fourth has a production range of 1.5-2.5 million tons of sand annually. Data on a fifth location was not available (AET Inc., 2011). Two more mines have been recently permitted; one mine site is 1,200 acres will have 400 acres for extraction.

One million tons of frac sand equates to approximately 40,000 trucks if each truck can carry 25 tons of sand. Forty thousand trucks per year equates to 110 daily one-way trucks. Not all mine sites, even if they are permitted for 24/7 operations move sand every day. Many of the conditional use permits had language restricting trucks on routes during school bus routing times and some mining is restricted during certain times of the year. Trucks configurations also vary from operator to operator. Modern trucks, like many rail cars, may be constructed of lighter materials allowing for greater payloads.

Transportation Implications of Sand Mining in Chippewa County

In a full build out scenario, Chippewa County could see approximately five million to over seven million tons of sand transported via truck and rail out of the county (Wisconsin Department of Transportation Northwest Region Planning Staff, 2012).This is in sharp contrast to the 137,000 rail tons that originated in the county in 2008 ("Transearch Data for Wisconsin 2007," n.d.)

In terms of truck traffic, five million tons of sand equates to 200,000 one-way truck movements and seven million would equate to 280,000 truck moves at 25 tons per truck. Sand is hauled in hopper car and capacity will vary; newer railcars are lighter weight and hence can accommodate more sand before it reaches the observed limit in Chippewa County of 266,000 pounds (including rail car). Assuming that each hopper car holds 100 tons of sand, five million tons would equate to 50,000 hopper cars or 500 unit trains (100 cars) of sand. Seven million tons of sand production would result in 700 trains a year. To measure the total impact, one should consider the return trip to the mine as well as the return of unit/manifest trains with empty cars.

Haul Routes by Jurisdiction

As of August 1, a total of 134.6 (one-way) miles of roadway are being used to transport sand within and from Chippewa County to the respective processing plants. This high number is due to Operator C-1's temporary haul route, an 80-mile one-way route over mainly state roads in Chippewa County, Dunn County, and then I-94. Of the 80 miles, only 5.5 are in Chippewa County. When Operator C-1's processing plant is constructed, the total frac sand haul route miles will total 76 miles.

Table 6 also shows the miles of county/town road miles negotiated under a RUMA which add up to 10.6 miles for county government versus 4.9 miles for town governments. These are roads that at he onset of mine construction were unable to withstand predicted truck traffic volume. A larger number of county road miles (18.6) did not need upgrades at this time. State trunk highways are the most impacted. Preliminary calculations by Wisconsin DOT region staff indicate that 430 miles of state roads are being used in the northwest region of the state as industrial sand hauling routes (Wisconsin Department of Transportation NW Region Planning Staff, 2012).

Grade Crossing Funded Upgrades

In one road use maintenance agreement, Chippewa County negotiated sand mine operator-funded upgrades to the grade crossing at CTH Q and SS, which currently has crossbucks as a protection level. Normally improvements to grade crossings are ordered by the Office of Commissioner of Railroads. Funding and needs analysis is respectively administered and performed by WisDOT. By including this

stipulation in the RUMA, the County has essentially secured funding and bypassed some of the procedural policy currently in place. Because crossing upgrades cannot be approved until ordered by the Office of the Commissioner of Railroads, there will be a need for improved communication.

The county commissioner realized that grade crossings should have been a stipulation from the start and future RUMAs with grade crossings will contain such language.

Costs for grade crossings vary depending on the site. For example, an upgrade to flashing lights can range from $140,000-$220,000 (WisDOT, 2012). The next level of upgrade is flashing lights and the following level is flashing lights with gates. The highest level of protection is a grade separated crossing where an overpass is built to go over the railroad tracks or a bridge is built for a train to go over the highway. Grade separations are costly and are justified when exposure levels impact safety.

At a greater scale, there will be a need for coordination between all parties, including railroads, to strategically upgrade crossings. The state's rail crossing database needs to be kept up-to-date to ensure that train frequencies are recorded as this data offers a starting point for state planners to prioritization updates. The state's database automatically updates to the national inventory and the Quiet Zone calculator allowing for communities to apply for Quiet Zones, something that may be interest to communities along the rail line.

In Ohio, RUMAs were developed in coordination with rail representatives. Issues such as blocked crossings or delays at grade crossings were addressed head on in Ohio. In Wisconsin they may arise as the industry builds out.

Rail Safety and Increased Train Frequencies

At full build out (all permitted mines in full production), Chippewa County could at a minimum be generating a 120-carload unit train a day. This does not include traffic that will be generated from Barron County, although most of that traffic will be routed to the CN railroad. Safety is always a concern at any time that a railroad interacts with a highway, more so when train frequencies quadruple.

At this time, many of the frac sand unit or manifest trains are traveling at night when a lower level of traffic is on the roadway and there is less conflict of passenger vehicles and trains. Before the number of trains increase and trains run more often during the day, educational campaigns on train safety will need to be in place. Another impact of increased frequency of trains is whistle blowing. Trains running at night are disruptive. Upgrading crossings to flashing lights and gates would allow communities to enforce a 24-hour or partial whistle ban.

Although vehicular traffic is low on many roads in Chippewa County, more trains increase the time and frequency that motorists and pedestrians must wait for them to pass. Delay and congestion should be monitored to establish a baseline. In some cases, railroads may block a crossing which is a concern for emergency response vehicles. Communities that experience blocked crossings will need to work with the railroads to improve operations.

Safety is a top consideration for the county and the state. Regional Wisconsin DOT staff is monitoring train frequencies and are actively recruiting volunteers for Operation Lifesaver, an educational outreach effort on train safety. The growth in train traffic has gone from 2-3 trains per week to 9-10 trains per week and some are unit trains while others are manifest trains going to multiple destinations.

Community and Economic Impacts

It is important to remember that the investment the private sector has made in the frac sand industry covers a 20 to 30-year horizon. The economic impacts as a result of frac sand mining are significant. The Wisconsin Industrial Sands plant located in nearby Menomonie estimates its economic impact at $2.4 million per year. The initial benefit of jobs and new wages is largest as a result of the construction. Wood County, Wisconsin economic impact study projected that $86 million in capital investment upfront would create more than 900 jobs and $49.9 million in new revenue in the first 18 months of the project (Economic Modeling Specialists, Inc., 2012).

Several industries have benefited from the frac sand boom, including trucking, heavy equipment/machinery, railroads and railcar (manufacturing and leasing), and utilities. The processing plants use large amounts of energy in the drying process as well as in running conveyors. Indirect effects include school and hospital expansions, as well as businesses renovations and additions by gas stations and banquet facilities. Rental apartment units are essentially unavailable in some areas, and the service industry has seen notable upticks, including airport usage. One plant in Chippewa Falls was recently assessed at $65.8 million dollars generating $1.4 million in revenue for the City of Chippewa Falls.

Not all economic impacts are positive. Studies have shown that nearby real estate can be adversely impacted in a measurable way. Home values within one third of a mile from the mine decrease by 30 percent. Those within one, two, and three miles have decreased 14.5 percent, 8.9 percent, and 4.9 percent, respectively (Erickcek, 2006) ("The Potential Financial Impacts of the Proposed Rockfort Quarry," 2009).

Business to Business Impacts

Other businesses, especially manufacturing, can be affected by the influx of the frac sand industry, particularly in siting processing facilities. In Bloomer, a sand processing plant was to be sited 1,200 feet from Bloomer Plastics, a manufacturer of film. The company considered moving its operation because the fine particles would damage their products. The City of Bloomer decided to enact a policy regarding the minimum distance a plant could be sited. The plant is now sited one mile from Bloomer Plastics, but has yet to be constructed. Other impacts for other manufacturers may include the level of vibration if operations are located along the rail line.

Operations

Truck driver shortages, a nationwide concern before the recession, continue to be a challenge. New federal safety rules for truck drivers put additional pressure on trucking companies as they strive to recruit and maintain a workforce while moving sand safely. Operationally, some trucking companies are using real-time tracking to ensure drivers comply with speed restrictions and to ensure that trucks maintain optimal speeds for greatest fuel efficiency ("Frac Sand, The Valley's New Gold Rush," 2012). A boom will impact other businesses that compete for truck drivers.

Economic Development

From an economic development perspective, planners should encourage freight clustering where related businesses are in close proximity. The clustering of mines as can be seen in Figure 7; perhaps Chippewa County can encourage further mine development in this area. A concept of a mining district, something that is used in Michigan, may be an administrative way to facilitate further mining or to minimize transportation impacts.

Historically rail traffic in Wisconsin has been characterized as pass through traffic, especially for Class I railroads. Railroad companies have, over the last two years, upgraded their track, increased the number of places where cars can be loaded on to the network and built long sidings to accommodate unit trains along side intermodal trains. Much of this has happened on railroad right-of-way, which does not fall under any zoning restrictions. Railroads have also closed many crossings across the state. This new added infrastructure poses new opportunities for rural shippers or for new manufacturers looking to use rail as they may be able to piggyback on manifest sand trains especially during slowdowns in energy production. Like wise, new enterprises may be able to take advantage of the expanded natural gas infrastructure for their enterprises.

Issues on the Horizon

As with other boom industries or emerging commodities, issues are uncovered. This happened with the movement of wind turbines through communities in Wisconsin, which uncovered a number of issues on industry efficiency, permitting, and gaps in policy at the Wisconsin DOT and the role the department should play in facilitating industry. WisDOT evaluated routes to determine congestion that may conflict

with turbine moves and determined routing suitable from a number of ports. The coordination requires a point person in WisDOT to handle special over-size, over-weight permitting. Established policy and performance measures and a one-stop contact in the department now exists.

A survey of different counties in Wisconsin and in Minnesota reveals different ideologies in how road impacts are assessed. The road use agreements are varied within this county. Counties and towns will need to develop procedures for managing maintenance accounts as well as dedicating staff to this new industry. Chippewa County has used a data driven approach to make baseline evaluations of their roads. The road use agreements have served as an opportunity to foster relationships between the mining operators and the county staff. Financial responsibilities will also be proportioned if other mines use already established Sand Truck Haul Routes per a negotiated RUMA. The Chippewa Country Commissioner has stressed that by evaluating truck traffic associated with the sand industry as any other traffic generating enterprise, that all industries are treated fairly. This requires that counties must have data-driven long-established policies for evaluating road impacts of commercial activity (Stelzner, 2012).

Frac sand is plentiful along the Mississippi River Bluff area exactly where, from a logistics perspective, it makes sense to locate transload/barge facilities. Some communities have held fast to environmental and aesthetic priorities and refused siting of processing plants along the Mississippi River. This may result in a need for inland ports. However any effort needs to be regional to include all counties impacted.

Differences in the experience level of county boards with industry are varied as well. Much effort has been made to offer training and educate peers with best practices. It is unknown whether all counties are negotiating terms that are data-driven or are adequate for their needs. A formally adopted RUMA would be a step in standardization. The lack of standardization from the local level has pushed the sand industry to move to self-regulate by the creation of a Wisconsin Frac Sand Association.

Federal Legislation and Freight Data

MAP-21 recognizes the centers of energy production and the need to fund roads in those areas. A review of activity of the states with oil and gas drilling shows that while some production is concentrated in the so-called new shale areas, hydraulic fracturing is more pervasive. It will be necessary for the federal government to further define the market for hydraulic fracturing by establishing thresholds of production recognizing that these roads would be subject to market demands.

MAP-21 also encourages states to develop freight plans and to list heavy truck routes that are used in mining, which can include frac sand. Other funding at the federal level, specifically Projects of National and Regional Significance (PNRS), could be used for regional bottlenecks such as upgrading highway bridges important for regional truck hauls, upgrading bridges for railroads, or building more barge terminals along the Mississippi River.

Federal freight data modeling efforts, such as the Freight Analysis Framework, will also need to be revised to approximate new market supply chains.

CONCLUSION

The U.S. shale boom, in combination with an oversupply and low prices for natural gas, has spawned a "new energy economy" that is impacting the states of the MAFC. The supply chains associated with this boom have also resulted in new, different freight lanes in mostly rural areas –areas that have historically seen little freight. The demand for frac sand in Wisconsin is impacting and altering rail, local, and state roads networks. Projected sand production of 40 million tons will make frac sand the commodity with the highest tonnage originating out of Wisconsin. Farm products, currently the highest commodity group, originated 31 million tons in 2007 (WisDOT, 2012 and Transearch, 2007). Road condition directly impacts industry metrics of sand truck travel time and fuel efficiency.

Road upgrade and maintenance use agreements negotiated in Chippewa County revealed important information about the sand haul routes and local decision-making. These include: not all local roads for a given truck haul route are in need of upgrades; upgrading a road to service sand trucks is prohibitive by local governments; and, a larger proportion of sand truck haul route miles are not under local government jurisdiction but under state jurisdiction. RUMAs are an effective mechanism for truck haul routes under a single jurisdiction. At different scales, where a sand haul route may include two jurisdictions, two counties or two states, differences in impact assessment become complex and they create administrative loads both for locals and industry as RUMAS must be negotiated for every jurisdiction. Tools and guidance for negotiating RUMAs at various scales are needed.

While this case study looked at Chippewa County in isolation, sand truck haul routes often span more than one county, and sometimes more than one state. It is difficult to assess the cumulative impacts over more than one jurisdiction without a regional approach or a multimodal approach.

The boom in frac sand mining needs to be viewed as a catalyst to economic development but could also be catalyst for developing a framework for freight dialogue in the state as all modes are impacted. A frac sand plan would help to identify a vision for the sand mining region that aligns with economic goals and aesthetic qualities of the region as well as environmental concerns. Details about RUMA and industry practices may drive a regional plan. An example would include grade crossing improvements that were negotiated under a RUMA yet neither industry nor state rail representatives were informed so timely implementation may be impacted. Another example may be the industry decision not to use trucks in sand plant design. A plan would also generate baseline truck and rail counts, identifying highway capacity needs, simulating rail movements, prioritizing improvements, creating alternative transportation solutions and adopting new technologies such as the use of sensors for monitoring infrastructure. Local officials who have negotiated RUMAs have developed good relationships with frac sand operators, a required first step in freight planning.

Next Steps

Further research in this area might examine policies for state DOTs related to emerging commodities, funding for maintenance and upgrade of state highways that are tied to the energy sector, and the development of a statewide energy office that that provide real-time data for industries that support the oil and gas industry.

Other topics include regional policies and freight funding for bottleneck improvements at state borders, the use of alternative fuels in trucking, as well as considerations of jurisdictional transfers for some roads that become truck routes. A formal review of access points on state truck highways that are primarily truck routes and the use of conveyors in highway right-of-ways, and grade crossing impact studies are other areas of research. Bridge condition in the region was not an initial infrastructure concern. This is perhaps because weight limits were observed on roads and rail hoppers were not filled to capacity. However many states have bridge policies. In light of heavier use, those policies should be revisited. A final topic could examine the impacts to the tourism industry specifically on Scenic Byway roads.

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APPENDIX A: SAMPLE NEGOTIATED RUMA-CHIPPEWA COUNTY

COUNTY ROAD UPGRADE AND MAINTENANCE AGREEMENT

This COUNTY ROAD UPGRADE AND MAINTENANCE AGREEMENT (this "Agreement") is made and entered into this __th day of _____by and between Chippewa County (the "County"), and _____(the "Operator"). Each of the Operator and the County are sometimes referred to herein individually as a "Party" and collectively as the "Parties". The term "Operator's Representatives" shall include Operator's contractors, sub-contractors, agents, employees, suppliers and designees.

RECITALS

WHEREAS, Operator is in the business of mining and production of silica sand, and is in the process of constructing, developing, operating, maintaining and reclaiming a non-metallic mining facility (the "Project") in Chippewa County, Wisconsin, and has submitted an application for a Non-metallic Mining Reclamation Permit for the Project with the Chippewa County Land Conservation and Forest Management Department in accordance with the Non-metallic Mining Reclamation Ordinance of Chippewa County, and

WHEREAS, in connection with the construction, development, operation, maintenance and reclamation of the Project, the Parties desire to address certain issues relating to the roads owned, operated and maintained by the County (collectively, the "County Roads") over which it will be necessary for Operator and Operator's Representatives to, among other things, transport heavy equipment and certain locally sourced materials, including, but not limited to, silica sand, over certain County Roads, which may in certain cases be in excess of the design limits of the County Roads; and both parties acknowledge that certain of the County Roads may not be constructed to withstand the frequency and weight of shipments necessary for the Operator to transport its products and equipment.

WHEREAS, Wis. Stat. §349.16(1)(c) authorizes the County highway commissioner to enter into an agreement on behalf of County with any owner or operator of any vehicle being operated on a highway maintained by County that provides that the County will be reimbursed for any damage done to the highway, and

WHEREAS, Operator has provided to County a site layout plan for the Project that shows the access road entrances, a copy of which is attached as Exhibit A (the "Plan"), and

WHEREAS, Operator and County wish to set forth their understanding and agreement as to the road issues relating to the construction, development, operation, maintenance and reclamation of the Project, and

WHEREAS, this Agreement shall apply to those County Roads listed on the attached Exhibit B and, subject to Section 4.B. herein, any other County Road(s) used by Operator or Operator's Representatives in direct support of the construction, development, operation, maintenance and reclamation of the Project.

AGREEMENT

NOW, THEREFORE, in consideration of the mutual promises and covenants herein set forth, the parties, intending to be legally bound, agree as follows:

Section 1. Term of Agreement.

This Agreement shall commence upon the date indicated above (the "Effective Date") and shall continue in full force and effect until Operator's Non-metallic Mining Reclamation Permit has expired, has been terminated, or until Operator has fully discontinued its construction, development, operation, maintenance and reclamation of the Project and any and all transportation activities related thereto on the County Roads listed on Exhibit B, whichever occurs later.

Section 2. Operator, in respect of the Project constructed, developed, operated, maintained and reclaimed by it, acknowledges and agrees the Project may require County to undertake the following activities in order to preserve County Roads and that the Operator shall be financially responsible for the costs of said activities to the extent provided for under the terms of this Agreement:

A. Upgrading Pavement Sections on County Roads to a design standard as directed by the WIDOT, Facilities Development Manual, Section 11-40, to withstand the hauling of products and equipment that are necessary for the Project.

B. Upgrading the geometric design of the County Roads to a standard as directed by the WIDOT, Facilities Development Manual, Section 11-40, that will safely and efficiently accommodate the traffic that Operator has indicated the Project will generate; including improvements at entrances, intersections and to the typical cross-section. Geometric improvements shall also include any improvements to Structures and Culverts necessary to accommodate the increased traffic from the Project.

C. Providing Engineering Plans for all improvements needed under Sections 2.A. and 2.B. above, including any Right-of-Way needed.

D. Operator shall be responsible for all exceptional maintenance costs, above normal maintenance requirements, that are attributable to damage to County Roads from the hauling of products and equipment related to the Project. Said maintenance cost may occur either before or after any of the improvements to County Roads indicated in Sections 2.A., 2.B. and 2.C. above are made. County shall inform Operator if it has a good faith basis to believe any exceptional maintenance costs become necessary and provide a good faith estimate of costs to Operator prior to commencing work.

County will invoice the Operator for exceptional maintenance costs incurred as the work is completed. Operator shall have thirty (30) days from the date of invoicing to make payment to County.

E. In order to compensate County for repairs needed as a result of Operator's use and to accomplish the work indicated in Sections 2.A., 2.B. and 2.C. above, Operator shall make a payment to County of Three Hundred Eleven Thousand Five Hundred Ten Dollars ($311,510.00) at the time of execution of this Agreement. Based on the construction plans provided by the Operator and cost

estimate agreed upon by both parties, the payment amount should be sufficient for County to make needed improvements to the Haul Route.

Notwithstanding the above, Operator acknowledges that conditions may be encountered or additional requirements imposed by the WIDOT or other regulatory agency that require additional work by the County and that the cost of all additional work is the responsibility of the Operator. When improvements are complete the County will invoice the Operator for any additional costs incurred. Operator shall have thirty (30) days from the date of invoicing to make payment to County.

After construction of the improvements is complete any remaining funds will be returned to Operator within thirty (30) days of project audit by County.

Section 3. County, in accordance with the terms of this Agreement, agrees to:

A. Review for approval all access points to the County Road system by giving consideration to sight distances, drainage and proximity to other entrances, in a reasonable manner, and in accordance with accepted engineering practices;

B. Review for approval permits for all utility encroachments on County rights-of-way in a reasonable manner, and in accordance with accepted engineering practices;

C. Coordinate with Operator and Operator's Representatives so as to minimize the impact of their use of the County Road system;

D. Perform all maintenance and construction of all improvements pursuant to this Agreement on the County Roads used for the construction, development, operation, maintenance and reclamation of the Project.

E. Keep those County Roads listed on the attached Exhibit B of this Agreement open to Operator to haul products and equipment related to the Project for the entire term of this Agreement without further restrictions, other than those indicated in this Agreement, for all vehicles meeting statutory requirements for weight, width, height and length. County shall retain the right and its authority to establish and set traffic speed limits in accordance with generally accepted highway standards and safety practices.

Section 4. Road Inventory.

A. Routing and Access Approval.

This Agreement applies only to the County Roads listed on the attached Exhibit B of this Agreement. If conditions or circumstances change and Operator desires to change haul routes, it must first request authorization from

the County. All expenses for additional haul routes are not part of this Agreement and shall be negotiated by the Operator and County in a separate agreement in the event any changes are requested.

B. Incidental Use

The Parties recognize that the Project traffic may, either through mistake or with the consent of County, use County Roads other than those listed on Exhibit B of this Agreement. Repairs for damage caused by Operator or Operator's Representatives during such mistaken or permitted use shall be treated as exceptional maintenance under Section 2.D. above.

Section 5. Construction Cooperation.

A. Operator.

Operator shall submit to County a schedule with planned activities that affect the County Roads. Said Schedule shall reasonably indicate the estimated number of trucks that will be hauling products and equipment and daily hours of operation. Operator shall submit the Schedule to County within two (2) weeks of execution of this Agreement. Operator shall further provide County with an updated Schedule within two (2) weeks of any material changes being made with the Project. Operator understands that County Road construction and maintenance activities will be on-going while Project hauling is occurring, and that while County Roads will be open to traffic, Operator acknowledges that these activities may slow hauling operations.

B. County:

During the term of this Agreement, County and Operator shall meet as needed to discuss Project activities and County Road construction and maintenance schedules. County agrees to keep those County Roads specified in Exhibit B open to Project traffic during County Road construction and maintenance activities, except that County may temporarily close any of the County Roads specified in Exhibit B for replacement of a culvert, structure or due to an emergency. County will provide a temporary alternate haul route when reasonably practicable. Annual seasonal weight limitations shall apply to all haul routes in Exhibit B and to any alternate routes approved by County.

County agrees to exclusively use any payments received from Operator as part of 2(E) of this Agreement on County Roads used as haul routes by the Operator.

C. Emergency Actions.

Notwithstanding the foregoing, in the event Operator or Operator's Representatives have caused damage to County Roads of a magnitude

sufficiently great to create a hazard to the motoring public, which in County's opinion warrants an immediate repair or County Road closing, County may unilaterally close those County Road(s) affected and make or authorize repair, with the reasonable, documented costs thereof paid for by Operator.

Both Parties acknowledge that while County is the Jurisdictional Authority for those County Roads listed in Exhibit B, certain emergency situations may arise that fall under law enforcement, fire district or emergency management control. In such situations the road may be closed to traffic, including traffic from the Project, outside the control of County. County shall not be responsible for any harm to Operator, Operator's Representatives or the Project that may result from County Road closings that occur due to such emergencies.

Section 6. Indemnification/Hold Harmless and Liability Insurance Provisions.

A. Indemnification by Operator. Operator hereby releases and agrees to indemnify and hold harmless County and its respective officers, employees, elected or appointed officials, and agents, and their respective heirs, executors, administrators, successors and assigns (hereinafter collectively "County Releasees") from any and all third party actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands against County Releasees arising out of or relating to the performance by Operator of its obligations under this Agreement. More particularly, but without in any way limiting the foregoing, Operator hereby releases County Releasees and agrees to indemnify and hold harmless County Releasees from any and all third party actions, causes of action, suits, claims, expenses (including reasonable attorney's fees) and demands arising directly or indirectly from any personal injury, death or property damage arising out of the use by Operator or Operator's Representatives of any County Road subject to this Agreement.

1. Limitations of Liability. In no event shall County or any of their Board, officers, elected or appointed officials, agents, investors, principals, shareholders, members or employees be liable (in contract or in tort, involving negligence, strict liability, or otherwise) to any other party or their contractors, suppliers, employees, members and shareholders for indirect, incidental, consequential or punitive damages resulting from the performance, non-performance or delay in performance under this Agreement.

2. Required Insurance. Operator shall at all times throughout the term of this Agreement maintain in full force and effect commercial general liability insurance, naming County, its Board, officers, elected or appointed officials, agents and employees as an additional insured, in the aggregate amount equal to Ten Million Dollars ($10,000,000). Operator may utilize any combination of primary and/or excess insurance to satisfy this requirement.

Section 7. Remedies and Enforcement.

Each of the Parties hereto covenant and agree that in the event of default of any of the terms, provisions or conditions of this Agreement by any party (the "Defaulting Party"), which default is not caused by the party seeking to enforce said provisions (the "Non-Defaulting Party") and after notice and reasonable opportunity to cure has been provided to the Defaulting Party, then in such an event, the Non-Defaulting Party shall have the right of specific performance. The remedy of specific performance and injunctive relief shall not be exclusive of any other remedy available at law or in equity.

Section 8. Due Authorization.

Operator hereby represents and warrants that this Agreement has been duly authorized, executed and delivered on behalf of Operator. County hereby represents and warrants that this Agreement has been duly authorized, executed and delivered on behalf of County.

Section 9. Savings/Severability.

It is mutually agreed by the Parties that in the event any provision of this Agreement is determined by any court of law of competent jurisdiction to be unconstitutional, invalid, illegal or unenforceable in any respect, it is the intention of the parties that such unconstitutionality, invalidity, illegality or unenforceability shall not affect the other provisions, and the Agreement shall be construed as if such unconstitutional, invalid, illegal or unenforceable provision had never been contained in this Agreement.

Section 10. Entire Agreement.

This Agreement and the exhibits attached thereto constitute the entire agreement among the Parties hereto with respect to the subject matter hereof, and supersede any prior understandings or written or oral agreements between the parties with respect to the subject matter of this Agreement. No amendment, modification, cancellation or alteration of the terms of this Agreement shall be binding on any party hereto unless the same is in writing, dated subsequent to the date hereof and is duly authorized and executed by the Parties hereto.

Section 11. Designated Representative.

Operator designates _____ as Agent with primary responsibility for the performance of this Agreement. In the event this Agent is replaced by another for any reason, Operator will designate another Agent within seven (7) calendar days and provide notice to County of replacement pursuant to the procedure set forth in Section 14, Notices.

Section 12. Notices.

All notices to be given under the terms of this Agreement shall be in writing and signed by the person serving the notice and shall be sent via registered or

certified mail, return receipt requested, postage prepaid, or hand delivered to the addresses of the parties listed below. Notice shall be deemed to have been received on the date of receipt as shown on the return receipt or other written evidence of receipt.

FOR COUNTY: Bruce Stelzner
Chippewa County Highway Commissioner
801 East Grand Avenue
Chippewa Falls, WI 54729

FOR OPERATOR: _____

_____
_____
_____

Section 13. Assignability/Consent.

This Agreement shall be binding on the Parties hereto, their respective heirs, devisees and successors. Except as otherwise provided herein, or except as may be hereafter determined by the Parties, Operator may not sell, assign or transfer its interest in this Agreement, or any of its rights, duties or obligations hereunder, without the prior written consent of County. Whenever the consent or the approval of County is required herein, County shall not unreasonably withhold, delay or deny such consent or approval.

Section 14. Force Majeure.

The performance of this Agreement shall be subject to events of force majeure. Events of force majeure shall mean any contingency or cause beyond the reasonable control of a Party including, without limitation, acts of God or the public enemy, war, riot, civil commotion, insurrection, government or de facto government action (unless caused by acts of omissions of the party), fires, explosions, rain or other weather delays, floods, strikes, slowdowns or work stoppages.

Section 15. Modification

No modification of this Agreement or of any covenant, condition or limitation herein contained shall be valid unless in writing and duly executed by the party to be charged therewith. No evidence of any modification shall be offered or received in evidence in any proceeding arising between the Parties hereto out of or affecting this Agreement, or the rights or obligations of the Parties hereunder, unless such modification is in writing and duly executed. The parties further agree that the provisions of this Section 15 will not be waived unless herein set forth.

Section 16. Counterparts.

This Agreement may be executed in any number of counterparts, each of which shall be deemed an original, with the same effect as if the signatures thereto and hereto were upon the instrument. Delivery of an executed counterpart of a signature page to this Agreement by telecopier shall be as effective as delivery of a manually signed counterpart to this Agreement.

Section 17. Choice of Law and Forum Selection.

This Agreement shall be governed by, and construed, interpreted and enforced in accordance with the laws of the State of Wisconsin. The Parties agree, for any claim or suit or other dispute relating to this Agreement that cannot be mutually resolved, the venue shall be in the Circuit Court of Chippewa County, a court of competent jurisdiction within the State of Wisconsin, and the parties further agree to submit themselves to the jurisdiction of said court, to the exclusion of any other judicial district that may have jurisdiction over such a dispute according to any law.

Section 18. Default Termination.

In the event Operator shall default in any of the covenants, agreements, commitments, conditions or obligations herein contained, and any such default shall continue unremedied for a period of ten (10) calendar days after written notice thereof to Operator, County may, at its option and in addition to all other rights and remedies which it may have at law or in equity against Operator, including expressly the specific enforcement hereof, forthwith have the cumulative right to immediately terminate this Agreement and all rights of Operator under this Agreement.

Section 19. Waiver of Terms and Conditions.

The failure of County to enforce or insist upon compliance with any of the terms or conditions of this Agreement shall not constitute a general waiver or relinquishment of any such terms or conditions, but the same shall be and remain at all times in full force and effect.

Section 20. Compliance with Applicable Laws.

Operator shall become familiar with, and shall at all times comply with and observe all federal, state and local laws, ordinances and regulations which in any manner affect the conduct or performance of Operator and its agents and employees of the terms and obligations under this Agreement.

Section 21. Captions.

The captions contained in this Agreement are for informational purposes only and shall not in any way affect the substantive terms or conditions of this Agreement.

Section 22. Cooperation.

The Parties agree to cooperate with each other in addressing any unforeseen or extraordinary events caused by Operator's activity that would result in significant impacts to the County Roads. The parties further agree to cooperate with each other in addressing any unforeseen impact to Operator's ability to utilize the haul route or any alternative route provided for in this Agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement the day and year first written above.

OPERATOR:
XXXX.

_____
By: XXX
Its Director of Operations

COUNTY:
Chippewa County, a municipal corporation

_____
By: Bruce G. Stelzner
Chippewa County Highway Commissioner

EXHIBIT B

Haul Routes

1.) CTH DD, from STH 64 south to _____ permitted mine entrance.

APPENDIX B: MODEL RUMA-OHIO

MODEL ROADWAY USE AND MAINTENANCE AGREEMENT FOR HORIZONTAL DRILLING PROJECTS AND INFRASTRUCTURE

THIS AGREEMENT is entered into at _____, Ohio, by and between COUNTY / TOWNSHIP , a political subdivision, whose mailing address is (hereafter "Authority"), and_____ , whose address is _____ (Hereafter "Operator"), and shall be as follows:

RECITALS

WHEREAS, Authority has control of the several county/township roads within Township, in _____ County, Ohio and is required by law to keep such roads in good repair; and

WHEREAS, Operator is the operator of certain oil and gas leasehold, and intends to develop and operate the [DEVELOPMENT SITE NAME], including the equipment, facilities, impoundments, and pipelines necessary for the operation of the [DEVELOPMENT SITE NAME] (hereafter collectively referred to as "oil and gas development site") located in _____ Township, in _____ County, Ohio; and

WHEREAS, Operator intends to commence use of miles of CR/TR ( ) and miles of CR/TR ( ) for the purpose of ingress to and egress from the [DEVELOPMENT SITE NAME], for traffic necessary for the purpose of constructing sites and drilling horizontal oil and gas wells, and completion operations at the [DEVELOPMENT SITE NAME] (hereinafter referred to collectively as "Drilling Activity"); and

WHEREAS, Authority and Operator desire to enter into an agreement, providing for the repair and maintenance of said roads and bridges thereon as a result of such Drilling Activity; and

WHEREAS, if any county or township roads contemplated herein contain any railroad crossings, Section 4 below shall apply;

NOW THEREFORE, in consideration of the good faith performance by each party of the mutual covenants hereinafter set forth, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Operator agrees to the maintenance and repair of said roads and bridges, to their pre-Drilling Activity condition or as modified pursuant to Appendix A, thereon for any damages thereto, as a result of Drilling Activity related to such sites.

FURTHER, Operator shall also provide for the strengthening and upgrading of the roads and bridges if mutually agreed to be necessary, prior to or during any Drilling Activity. The areas and structures required to be strengthened and/or upgraded shall be determined by an engineer provided by the Operator with the approval of the County Engineer to be provided within thirty (30) days of a written request submitted by the Operator. Operator's engineer shall provide a written report to the County detailing the condition of the roads and appurtenances covered under this Agreement along with any recommendations, if necessary.

BOTH PARTIES FURTHER AGREE to the following additional terms and conditions:

1. The portion of CR_, to be utilized by Operator hereunder, is that exclusive portion beginning at *(route description here ending at the intersection of CR/TR)* . It is understood and agreed that the Operator shall not utilize any of the remainder of CR/TR ( ) for any of its Drilling Activities hereunder.

2. The portion of CR/TR ( ), to be utilized by Operator hereunder, is that exclusive portion beginning at *(the intersection of CR/TR ending at the oil and gas development site)* wherein Operator's site are to be constructed herein. It is understood and agreed that the Operator shall not utilize any of the remainder of CR/TR ( ) for any of its Drilling Activities hereunder.

3. Those portions of said roads and bridges and their appurtenances to be used by Operator hereunder and mutually agreed to require necessary strengthening and/or upgrading by the Operator's Engineer in conjunction with the County Engineer, shall be strengthened and/or upgraded to a condition sufficient and adequate to sustain the anticipated Drilling Activity by Operator, at Operator's sole expense, and with the advice and approval of the County Engineer as detailed in Appendix A. Thereafter, such roads shall be maintained by Operator for damages caused by Operator's Drilling Activity, at Operator's sole expense, throughout the term of this Agreement, to a level consistent with the condition of such roads at the commencement of its use by the Operator hereunder or as modified pursuant to Appendix A, as determined by the Operator's engineer and the County Engineer. The maintenance of aforementioned roads includes the use of a commercially recognized dust palliative to control the airborne dust created and/or contributed to by the Operator or the Operator's contractors and or agents.

4. The Operator shall give notice to the railroad at least thirty (30) days prior to any known Drilling Activity utilizing a railroad crossing so that a joint inspection can determine the condition of the crossing. Additionally, the Operator shall coordinate all work needing to be performed at a railroad crossing with the railroad company at least thirty (30) days prior to starting work on a railroad crossing. If the railroad company fails to respond to the Operator's notice of work needing to be performed at a railroad crossing within thirty (30) days of receipt of such notice, then the railroad waives all rights it has under this agreement with respect to the work specified in the notice. Work performed at a railroad crossing may include a separate agreement at the railroad's discretion. The Authority shall not be liable for any incidents arising out of or related to work performed at any railroad crossing pursuant to this Agreement or any separate Agreement between the Operator and the railroad company, or lack of notification by Operator.

5. Either the Operator or the Authority may terminate this Agreement with just cause following at least thirty (30) days written notice to the other of its intent to terminate. As soon as possible after receipt of such notice, the Authority and the Operator shall inspect said roads and bridges and their appurtenances. Following final inspection, the parties shall meet, and all restoration resulting from Operator's Drilling Activity shall be identified and thereafter completed by the Operator, at Operator's sole expense. Following completion of all restoration work, this Agreement shall be terminated and of no further force or effect.

6. Unless excepted for the reasons provided below, prior to the Drilling Activity on the Route, Operator shall post a bond or other surety in a form satisfactory to the Authority to cover the costs of any damage caused by the Drilling Activity on the Route by Operator. The amount of the bond or surety shall be in an amount no greater than _____ & 00/100 DOLLARS ($_____.00) per mile. However, no such bond or surety shall be required of Operator, if any of the following conditions are satisfied:

   a. A geotechnical analysis of the Route provided by the Operator and mutually accepted by the Authority and Operator exhibits that the Route's condition is sufficient for the expected traffic necessary for the development of the oil and gas development site.
   b. The Operator provides a geotechnical analysis of the Route, mutually accepted by the Authority and Operator, and based on that analysis, an Operator and Authority-approved maintenance plan for the Route or an Operator and Authority-approved preventative repair plan of the Route is attached to the Agreement as an addendum.

c. The Operator has provided a sufficient bond or surety, mutually accepted by the Authority and Operator, in favor of the Authority for road usage by the Operator within the Authority's oversight.

7. All motor vehicles to be utilized by Operator hereunder, whether owned by Operator or others, shall comply with all legal size, load and weight limits in accordance with State Law, and all non-conforming vehicles shall require the proper local permit.

8. Operator shall furnish the Authority with a written Letter of Authority, setting forth all necessary contact information, including a twenty four (24) hour emergency contact number, for the authorized local representative of the Operator, and such information shall be maintained and kept current at all times concerned hereunder.

9. If Authority determines that any additional traffic signage is needed, or desired, as a result of this Agreement and in the interests of safety, then Operator shall provide for such signage at Operator's sole expense. In the event that any other safety concerns should arise during the course of this Agreement, Operator and Authority agree that they will mutually discuss such concerns and reach a resolution satisfactory to all concerned.

10. Operator shall protect, save, indemnify, and hold the Authority, its officials and employees harmless from any liability, claims, damages, penalties, charges, or costs which may arise or be claimed as a result of any violations of any laws or ordinances, or any loss, damage or expense, including injury or death to any person, from any cause or causes from Drilling Activity whatsoever.

11. Operator assumes all liability for subcontractors and or agents working on Operator's behalf.

12. This Agreement shall be binding upon Operator and Authority, and their respective successors and assigns.

13. In any event that any clause, provision or remedy in this Agreement shall, for any reason, be deemed invalid or unenforceable, the remaining clauses and provisions shall not be affected, impaired or invalidated and shall remain in full force and effect.

14. Agreement shall be governed by the laws of the State of Ohio.

15. This Agreement shall be in effect on , 201___.

Executed in duplicate on the dates set forth below.

Authority	**Operator**
By: _____	By: _____
Commissioner/Trustee	
By: _____	Printed name: _____
Commissioner/Trustee	
By: _____	Company Name: _____
Commissioner/Trustee	

By: _____ Title: _____

County Engineer

Dated: _____ Dated: _____

Approved as to Form: _____

County Prosecutor

SAMPLE

Appendix C.1

Operator shall be required to:

1) Provide for videotaping of the road prior to Drilling Activity.
2) Provide an engineering report detailing pavement thickness and composition, base thickness and composition, and subgrade composition, as and if reasonably determinable. Engineering report to also provide an analysis of conditions along with a recommendation, if mutually agreed to be necessary, for upgrading roadway to handle anticipated Drilling Activity.
3) Upgrade CR/TR in accordance with the attached plans and/or county standards, dated 10/10/11.
4) Maintain CR/TR during Drilling Activities for those damages caused by said Drilling Activities.
5) Reimburse the Authority for minor maintenance of the road during the hauling period (or provide for a contractor to perform minor maintenance on 24 hour notice) for damages caused by Drilling Activities.

Authority shall:

1) Provide for minor maintenance of the road during the Drilling Activity for damages not caused by said Drilling Activity. For any work that is to be reimbursed by the Operator to the Authority, Authority agrees to give 24 hour prior notice to the Operator (or agrees to notify Operator when maintenance is needed).
2) Provide for maintenance of the roadway and bridges for damages not caused by the Drilling Activity at the Authority's cost and expense, including snow/ice control, mowing, etc.

The intent of this Appendix A is to include anything agreed to by the parties –If the Authority wants plans prior to construction, then include – etc., etc. If the Authority doesn't want anything in Appendix A, then that is their option.

The parties could also address the scenario where more than one Operator is involved on the same Route in this appendix.