Environmental Quality Board

Tools to Assist Local Governments in Planning for and Regulating Silica Sand Projects

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December 13, 2013

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I. INTRODUCTION

A. Background

In May 2013 the Minnesota Legislature adopted Laws 2013, chapter 114, commonly referred to as HF 976, now codified in Minnesota Statutes chapter 116C. Minnesota Statute 116C.99, sub division 2 requires the Environmental Quality Board (EQB) to develop model standards and criteria that may be used by local units of government (LGUs) in developing local ordinances regarding the mining, processing, and transporting of silica sand. This *Tools to Assist Local Governments* document fulfills this legislative requirement.

Authority to plan for and regulate land use activities rests primarily with local government. The EQB supports good local planning that articulates the future vision of a community. This should be supported with the adoption of sound local ordinances as the means to implement the planning. This document provides information that may be useful for LGUs when discussing issues related to silica sand.

The EQB strongly encourages each individual local unit of government to seek the advice of legal counsel in connection with the use of this document and its contents. The recommendations, standards, criteria, and considerations included in this document are not substitutes for local government planning and the contents of this document are not a substitute for legal advice.

The document is organized by topic. Each topic section or subsection discusses potential impacts from silica sand activities. Considerations for addressing potential impacts are discussed and then suggestions are provided on how to address the impacts.

This document is essentially a box of tools available for consideration by local governments. In some situations, there are several tools that may be chosen or used in conjunction with other tools to address a particular concern. The toolbox also includes instructions on how to use the tools themselves. As with any box of tools, the user should decide what is to be built before selecting a tool.

Two regions of the state were the focus of the statute: the Minnesota River Valley and southeastern Minnesota. These two regions are the areas most likely to experience the greatest effects of silica sand operations because they are where most of the sand exists. However, the toolbox can be applied to other areas of the state, where an LGU could compare its own circumstances to the geology, hydrology, and other characteristics discussed in this document.

This document is the work of staff from the Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, Minnesota Department of Transportation, Minnesota Department of Health, Minnesota Department of Agriculture, and the EQB itself.

Local units of governments are not required to adopt any elements of this document and Minn. Stat. 116C.99 does not authorize the EQB or any other state agency to impose or enforce anything on local governments. The EQB and its member agencies are not enforcing or attempting to enforce the suggestions in this document as if they are duly adopted state rules.

It also is important to note that this document does not represent legal advice or legal opinions. The EQB assumes and recommends that an LGU will obtain appropriate legal advice before making any decisions to adopt or amend its official controls.

For reference, Minn. Stat. 116C.99 is included below in its entirety.

116C.99 SILICA SAND MINING MODEL STANDARDS AND CRITERIA.

Subdivision 1. **Definitions.** The definitions in this subdivision apply to sections 116C.99 to 116C.992.

(a) "Local unit of government" means a county, statutory or home rule charter city, or town.

(b) "Mining" means excavating silica sand by any process, including digging, excavating, drilling, blasting, tunneling, dredging, stripping, or by shaft.

(c) "Processing" means washing, cleaning, screening, crushing, filtering, sorting, processing, stockpiling, and storing silica sand, either at the mining site or at any other site.

(d) "Silica sand" means well-rounded, sand-sized grains of quartz (silicon dioxide), with very little impurities in terms of other minerals. Specifically, the silica sand for the purposes of this section is commercially valuable for use in the hydraulic fracturing of shale to obtain oil and natural gas. Silica sand does not include common rock, stone, aggregate, gravel, sand with a low quartz level, or silica compounds recovered as a by-product of metallic mining.

(e) "Silica sand project" means the excavation and mining and processing of silica sand; the washing, cleaning, screening, crushing, filtering, drying, sorting, stockpiling, and storing of silica sand, either at the mining site or at any other site; the hauling and transporting of silica sand; or a facility for transporting silica sand to destinations by rail, barge, truck, or other means of transportation.

(f) "Temporary storage" means the storage of stock piles of silica sand that have been transported and await further transport.

(g) "Transporting" means hauling and transporting silica sand, by any carrier:

(1) from the mining site to a processing or transfer site; or

(2) from a processing or storage site to a rail, barge, or transfer site for transporting to destinations.

Subd. 2. **Standards and criteria.** (a) By October 1, 2013, the Environmental Quality Board, in consultation with local units of government, shall develop model standards and criteria for mining, processing, and transporting silica sand. These standards and criteria may be used by local units of government in developing local ordinances. The standards and criteria shall be different for different geographic areas of the state. The unique karst conditions and landforms of southeastern Minnesota shall be considered unique when compared with the flat scoured river terraces and uniform hydrology of the Minnesota Valley. The standards and criteria developed shall reflect those differences in varying regions of the state. The standards and criteria must include:

(1) recommendations for setbacks or buffers for mining operation and processing, including:
  (i) any residence or residential zoning district boundary
  (ii) any property line or right-of-way line of any existing or proposed street or highway
  (iii) ordinary high water levels of public waters
  (iv) bluffs
  (v) designated trout streams, Class 2A water as designated in the rules of the Pollution Control Agency, or any perennially flowing tributary of a designated trout stream or Class 2A water
  (vi) calcareous fens
  (vii) wellhead protection areas as defined in section 103I.005
  (viii) critical natural habitat acquired by the commissioner of natural resources under section 84.944
  (ix) a natural resource easement paid wholly or in part by public funds

(2) standards for hours of operation

(3) groundwater and surface water quality and quantity monitoring and mitigation plan requirements, including:
  (i) applicable groundwater and surface water appropriation permit requirements
  (ii) well sealing requirements
  (iii) annual submission of monitoring well data
  (iv) storm water runoff rate limits not to exceed two-, ten-, and 100-year storm events

(4) air monitoring and data submission requirements

(5) dust control requirements

(6) noise testing and mitigation plan requirements

(7) blast monitoring plan requirements

(8) lighting requirements

(9) inspection requirements

(10) containment requirements for silica sand in temporary storage to protect air and water quality

(11) containment requirements for chemicals used in processing

(12) financial assurance requirements

(13) road and bridge impacts and requirements

(14) reclamation plan requirements as required under the rules adopted by the commissioner of natural resources

Subd. 3. **Silica sand technical assistance team.** By October 1, 2013, the Environmental Quality Board shall assemble a silica sand technical assistance team to provide local units of government, at their request, with assistance with ordinance development, zoning, environmental review and permitting, monitoring, or other issues arising from silica sand mining and processing operations. The technical assistance team may be chosen from representatives of the following entities: the Department of Natural Resources, the Pollution Control Agency, the Board of Water and Soil Resources, the Department of Health, the Department of Transportation, the University of Minnesota, the Minnesota State Colleges and Universities, and federal agencies. A majority of the members must be from a state agency and all members must have expertise in one or more of the following areas: silica sand mining, hydrology, air quality, water quality, land use, or other areas related to silica sand mining.

Subd. 4. **Consideration of technical assistance team recommendations.** (a)When the technical assistance team, at the request of the local unit of government, assembles findings or makes a recommendation related to a proposed silica sand project for the protection of human health and the environment, a local government unit must consider the findings or recommendations of the technical assistance team in its approval or denial of a silica sand project. If the local government unit does not agree with the technical assistance team's findings and recommendations, the detailed reasons for the disagreement must be part of the local government unit's record of decision.

(b) Silica sand project proposers must cooperate in providing local government unit staff, and members of the technical assistance team with information regarding the project.

(c) When a local unit of government requests assistance from the silica sand technical assistance team for environmental review or permitting of a silica sand project the local unit of government may assess the project proposer for reasonable costs of the assistance and use the funds received to reimburse the entity providing that assistance.

EFFECTIVE DATE. This section is effective the day following final enactment.

B. Different Geographic Areas of the State: Paleozoic Plateau/Driftless Area and the Minnesota River Valley

The geographic distribution of silica sand resources in Minnesota are generally found in two regions: the Minnesota River Valley and the Paleozoic Plateau. The geographic attributes of the two regions differ significantly in terms of geology, hydrology, mining techniques, infrastructure, biodiversity and cultural resources.

Geology

The term "Paleozoic Plateau" is an ecological classification used to describe the bedrock dominated landscape of southeastern Minnesota. The bedrock consists of mostly flat lying layers of dolostones, limestones, sandstones, and shales deposited in an the Paleozoic era of geologic time 365 to 540 million years ago. The landscape of the Paleozoic Plateau is noted for its unique geology of rugged bluffs and valleys, buttes, and karst features such as caves, sinkholes, and springs. Home to approximately 156 Species of Greatest Conservation Need (SGCN), which includes state and federally-listed species, this area is also known for its unique ecological habitats. The Paleozoic Plateau is commonly known as the Driftless Area and may also be referred to as "southeastern Minnesota" within this document.

Paleozoic sandstones are sought after because they are a premiere source of industrial silica sand. Among other uses, this silica sand is a highly desired resource because it is used to hydraulically fracture oil bearing rock formations and to extract oil and gas from beneath the earth's surface. The silica sand, commonly referred to as "frac sand," mined from Paleozoic sandstones are able meet the stringent specifications required for hydraulic fracturing purposes.

Traveling westward from the Mississippi River to the Minnesota River Valley the topography changes from bluffs, to rolling hills, to flat expanses of land. The change marks the boundary between an older, erosional landscape to one that has been recently glaciated (~14,000 years ago). The underlying Paleozoic-aged bedrock extends to Mankato but is buried deeply by glacial sediment.

Near surface occurrences of silica sand are limited to a section of the Minnesota River Valley stretching from Mankato area to the Twin Cities. The mile-wide valley was carved by Glacial River Warren, one of the largest glacial meltwater channels in Minnesota. As it drained Glacial Lake Agassiz, River Warren's fast moving water scoured the valley removing thick sequences of glacial sediment and bedrock. As a result, silica sand resources are relatively accessible beneath the old river terrace deposits that lay between the modern day Minnesota River floodplain alluvium and the bluffs composed of glacial materials. The Minnesota River Valley and portions of Twin Cities metropolitan area have historically and continue to host large-scale silica sand mining.

Hydrology and Hydrogeology

While the two geographic regions have some similarities, as a whole they are markedly different in surface and groundwater hydrology. Both regions are underlain by bedrock of Paleozoic age. However, Southeast Minnesota contains a greater thickness of rock and a greater number of rock formations supporting a larger number of discernible bedrock aquifers. The movement of groundwater through the dolostone, limestone, and sandstone aquifers provides water to domestic wells, municipal wells, trout streams, calcareous fens, springs, seeps, wetlands, lakes and rivers. The aquifers are separated by shale layers that act to confine or semi-confine the water bearing rocks. The alternating rock types along with fractures and conduits in the rock facilitate the emergence of springs and seeps, some of which have groundwater and environmental conditions that support and sustain rare calcareous fen wetlands.

Streams in Southeast Minnesota tend to rise and fall quickly following a rain storm because of the mature, dendritic drainage patterns in the steep valleys of the Paleozoic Plateau. Regional groundwater flow is generally to the Mississippi River but many of the deeply incised valleys intercept groundwater which then discharges from springs and seeps. During dry periods, the base flows in trout streams are kept cold and clear by groundwater inputs.

The Paleozoic Plateau is a mature karst landscape with many surface and subsurface features. The dissolution of dolostone and limestone has resulted in the widening of fractures, bedding planes and voids over tens of millions of years. The solution-widened vertical fractures and horizontal bedding planes and fractures form enhanced permeability zones within the rock that are labeled conduits. These conduits are characterized by turbulent, high velocity groundwater flow which is a fundamental component of karst systems. Recent investigations show that vertical fractures are found throughout all rock formations. Rocks near the surface and near valley walls tend to have a greater number, higher density and wider vertical fractures.

Essentially karst is a three-dimensional transport system moving water and material through the landscape via solution enhanced channels.

Surface karst features, such as sinkholes, are expressed in the Paleozoic Plateau because of the relatively thin layer of weathered soils or very old glacial deposits on top of the bedrock surface. Sinkholes are found in those areas with less than 50 ft. of unconsolidated material over the karst bedrock. The surface expression of karst features come and go as weathering processes, hydrology, hydrogeology, land cover and land use changes. Karst surface features such as sinkholes, coupled with conduit flow conditions, make this geographic region highly vulnerable to pollutants entering the aquifers with very limited filtering or biological treatment. Changes in surface hydrology or groundwater levels can induce the expression of karst features at the surface. There is a high potential for spills or pollutants associated with land use activities to travel great distances underground to domestic wells and water dependent resources such as trout streams and fish hatcheries. The groundwater flow direction and divides typically do not correspond to surface watersheds making it difficult to use surface topography to predict groundwater flow directions. Dye tracing is used to delineate subsurface groundwater springsheds and calculate flow velocities which are often on the order of miles per day. The technique is labor intensive and only a small portion of the Paleozoic Plateau has been mapped. Predicting where and when a karst surface feature will be expressed in the future is very difficult if not impossible to do. Karst surface features can sometimes be successfully sealed using engineering techniques involving the placement of fill and the diversion of surface water.

In contrast, relatively few rock formations and unconsolidated sediment deposits play a role in the hydrology and hydrogeology of the Minnesota River Valley. Typically within the old river terraces, where silica sand mining has occurred to date, the lower section of the Paleozoic Oneota Dolomite is present above the Jordan Sandstone. On top of the Oneota is a relatively thin terrace deposit composed of cobble, gravel, and sand. Below the Jordan Sandstone and extending under the Minnesota River valley is the St. Lawrence Formation that acts as a regional confining layer.

Groundwater flow is generally towards the Minnesota River Valley. There are relatively fewer trout streams designated in the region. A large number of calcareous fens are found at the base of the floodplain escarpment where the Jordan Sandstone outcrops or is buried by a thin layer of weathered rock, alluvium and fen peat. Karst features are sometimes found in the Oneota Dolomite, but for the most part it is a thickly bedded deposit with tight vertical fractures and serves as a semi-confining layer above the Jordan Sandstone. In some areas, siltstone and shale layers in the base of the Oneota, such as the Blue Earth Siltstone in the Mankato area, act as local confining layers. Karst surface features are generally not expressed in the thick glacial materials located to the east of the terrace deposits.

Mining Sites and Techniques

Mining techniques used to access silica sand are determined by the geologic and hydrologic conditions of each region. Within the Paleozoic Plateau, mining silica sand resources can vary depending on the slope of the landform being mined. Currently, the resource is being mined

along hill slopes, within ridges, or by excavating flat-topped buttes. In areas with greater slopes and vertical topographic relief, bench or underground mining could be employed to access silica sand. While this form of mining is possible and potentially speculated, it is important to note that a mine plan implementing bench or underground mining have yet to be formally proposed for environmental review in Minnesota. In the Paleozoic Plateau, mine sites tend to be above the water table.

Within the Minnesota River Valley, mining occurs along the flats of the river valley terraces or adjacent to the valley walls. Quarries in the Minnesota River Valley typically are developed as excavations below the existing grade of the landscape and below the water table, which is commonly referred to as "wet mining." Some silica sand mines in this region pump groundwater from a sump to dewater the active mine cell in order employ "dry mining" techniques which lowers the water level in the mine, thereby reducing the depth below the water surface where mining occurs. To gain access to the Jordan Sandstone, geologic material, such as terrace deposits and Oneota Dolomite, must first be removed. Blasting may or may not be employed at a mine in either geographic area. The use of blasting depends on the nature of the overburden (if it is rock or glacial sediment) and the degree to which the sandstone is cemented together.

Infrastructure

Access to transportation infrastructure also plays a critical role in siting silica sand mines and the development of the industry. Mines located within the Minnesota River Valley generally have better access to railroad spurs at or near the mine site. As a result, silica sand companies within the Valley tend to mine, process, and transload the material at a single, contained site. In contrast, silica sand operations in the Paleozoic Plateau have developed a hub and spoke model of operations that involves multiple modes of transportation. For example, sand can be mined at one site, transported by truck to be processed or stored at a second site, transported again to a transload facility at a third site before it is finally hauled to market by either rail or barge. Consequently, ports and rail terminals along the Mississippi have developed within town and city limits which funnel haul trucks onto designated truck routes and interstate highways that intersect residential and commercial areas.

Biodiversity

Within the Paleozoic Plateau, four major river systems, the Root, Whitewater, Zumbro, and Cannon, dominate the landscape and ultimately drain into the Mississippi River through the course of steep bluffs and valleys. The river systems provide a well-used "roadway" for migrating birds, including high numbers of rare birds and are highly regarded by bird watching enthusiasts. Forest cover in this region is primarily restricted to steep slopes and narrow valleys. Native plant communities grade from predominantly maple-basswood forest along the upper valley slopes and small streams on north facing slopes, to drier oak forest and occasional bluff prairies on south facing slopes and bluff tops. Lowland hardwood forest occurs in valley bottoms, with occasional small black ash swamps. Several rare and fragile plant communities found in this area are dependent on "algific" (cold producing) talus slopes and "maderate cliffs"

(algific slope lacking talus). The communities associated with cold-air slopes are found only in the Paleozoic Plateau, which hosts some of the highest concentrations of rare animal and plant species in Minnesota. On top of the bluffs, historic native plant communities were largely prairie and oak savanna. However, most of the native vegetation has been converted to row crop.

The Minnesota River Valley once grew tall grass prairie dominated by big bluestem, little bluestem, switch grass, and Indian grass with many large patches of wet prairie. Near the Mankato area and north, the vegetation changed to the Big Woods complex that included oak, maple, basswood and hickory. Although now greatly altered by agricultural activities, recent work by ecologists indicates that the river valley and its immediate environs support the majority of the remaining native plant communities and rare species. This is particularly true near the Twin Cities metropolitan area.

The valley consists of floodplain forests and marshes, wet meadows, trout streams, fens and lakes. Most of the wetlands are dependent on the river and by the spring-fed streams draining from the base of the bluffs. These features attract thousands of song birds and waterfowl each year making this area well known for bird watching and waterfowl hunting. The river and trout streams also make the area well known for fishing opportunities.

Cultural Resources

The distinct region of the Paleozoic Plateau has been occupied by Native Americans for nearly 12,000 years and contains a number of archaeological site types. Due to exposed and easily erodible bedrock, it is the region of Minnesota that contains the most potential for rock shelters and caves used as prehistoric habitation sites. Bedrock faces also have the potential to contain rock art either painted or engraved. The bedrock of southeastern Minnesota is known to contain chert cobbles suitable for stone tool manufacture and many quarry and workshop sites have been mapped throughout the region. Southeastern Minnesota has more prehistoric burial mounds than any other region of Minnesota which are found on bluff tops or high terraces along the river valleys, especially the Mississippi River Valley. Both prehistoric and early historic Indian camp sites and villages are also found on river terraces and alluvial fans, especially near major river junctions.

With regard to historic period cultural resources, southeastern Minnesota was one of the first regions settled by Euro-American immigrants. Property types associated with this period include archaeological remnants of forts, fur posts, ghost towns, and early farmsteads, as well as Indian villages. Graves, cemeteries, and burial grounds may be associated with these sites. There are also numerous non-archaeological historic resources in the region including buildings, structures, cultural landscapes, and traditional cultural properties (TCPs) such as sacred sites.

The Minnesota River and its associated valley were also important natural features attractive to past human populations. The riparian environment served as an excellent source of aquatic plants and animals valuable for human subsistence. The trees lining the valley were a critical human resource, providing wood for constructing shelters and building fires. The river itself was an important transportation corridor. Over the last 12,000 years, Native Americans had villages and

campsites on the terraces and alluvial fans lining the river valley, some of which have been deeply buried by colluvium and alluvium sediment. On the high terraces, burial mounds were built.

Euro-American settlers also found the Minnesota River Valley attractive for a variety of reasons. Steamboats could navigate much of the river as far as New Ulm. Roads and railroads were built along the river terraces linking towns in the valley. As with southeastern Minnesota, historic period cultural resources can include archaeological sites as well as architectural, landscape, and TCP properties, some with associated graves, burial grounds, and cemeteries.

Distinctions based on Geographic Regions

Since there are notable differences in geography and natural resources between the Paleozoic Plateau and the Minnesota River Valley, the Minnesota State Legislature required that the silica sand model standards and criteria for silica sand projects be differentiated by region (M.S 116C.99 Subd. 2). Where appropriate, the recommendations, standards, criteria, and tools in the following sections reflect “those differences in varying regions of the state.”

II. TOOLS TO ASSIST LOCAL GOVERNMENTS

A. Air Quality

A.1. Air monitoring and Data Requirements

a. Description of Silica Sand Project Concerns

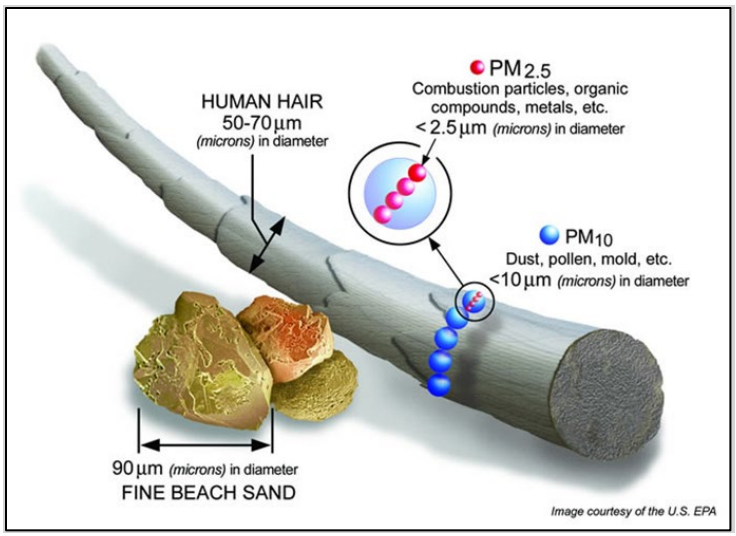
Particle pollution is regulated by particle size. A particle's size has implications for how the particle can enter the body and affect human health. The air pollutants of most concern from silica sand operations include particulates of various size fractions and chemical compositions.

b. Narrative Description, Background Information, Potential Impacts

In response to community concern regarding the potential air quality impacts resulting from increased mining, processing, and transport of silica sand in Minnesota, this section was written to help facilitate air quality assessments in impacted communities. The MPCA routinely collects air monitoring data for broad geographic areas, but also has required some silica sand facilities to collect property line monitoring data. The MPCA has made this air quality monitoring data available on its website.

The air pollutants of most concern from silica sand mining operations and transport include particulates of various size fractions and chemical compositions. This section will address methods for assessing air concentrations of the following air pollutants:

- Total suspended particles (TSP)
- Inhalable particles (PM_{10})
- Fine particles ($PM_{2.5}$)
- Crystalline silica as PM_{10} or PM_4
- Diesel exhaust



Particle pollution is regulated by particle size. A particle's size is determined by measuring the particle's aerodynamic diameter, which has implications for how the particle can enter the body and affect human health.
Human health research has shown that the smallest particles are of greatest concern for public health. Silica sand mining operations have the potential to emit particles across all size ranges including TSP, PM_{10}, PM_4 (not pictured), and $PM_{2.5}$.

Air pollution assessment methods

There are two methods for assessing air pollution concentrations associated with pollutant emissions from silica sand mining operations: ambient air monitoring and air dispersion computer modeling. Ambient air monitoring provides direct measurements of pollutant concentration at a specific location and period of time. Air dispersion modeling estimates air pollution concentrations across a broader area utilizing computer models which incorporate total air emissions from nearby sources and local meteorology. This document will focus primarily on options for conducting ambient air quality monitoring to assess the community level air quality impacts of silica sand mining. It is expected that this document could inform the plan for a site-specific air monitoring study. A silica sand facility or an LGU may initiate the planning and monitoring process. Regardless of who initiates the planning and implementation, the MPCA should be involved early on in the process. The MPCA has, and will continue to do the following: (1) provide technical assistance to LGUs regarding air monitoring issues, (2) review and approve an air monitoring plan, (3) review the data, (4) host the data through its website, and (5) perform audits of monitoring equipment.

Planning an air monitoring study

In choosing locations for an air monitoring site, particular attention should be paid to the goals of the air monitoring study. A community interested in assessing the air quality impacts of silica sand mining operations should consider the following monitoring objectives:

> **Source-oriented monitoring:** An air monitoring site is located at the property line of an air pollution emissions source in the area of expected maximum pollution concentration. An upwind (non-impacted) and downwind (impacted) monitoring site may be established to measure the air quality impact of the emissions source.

Hot-spot monitoring: Similar to source-oriented monitoring, air pollution hot-spot monitors are located in the area of expected maximum pollution concentration. An air pollution hot-spot may be the result of a single emission source, or multiple emission sources concentrated in a small area, such as a heavily trafficked roadway.

Area background monitoring: Area background monitors are located to measure "typical" air pollution concentrations in a community. These monitors are located in areas that are not directly impacted by distinct emission sources; rather they are sited to measure the cumulative impact of air pollution emissions in a community. Area background monitoring provides a baseline for air pollution concentrations in a community, which can be used to measure the relative air pollution impact of air pollution sources assessed through source-oriented or hot spot monitors.

In addition to meeting the objectives of the air monitoring study, an air monitoring site should meet all siting criteria established by the U.S. Environmental Protection Agency (EPA) which are described in 40 Code of Federal Regulations Part 58 Appendix E. Important factors to consider when establishing an ambient monitoring site include:

Measuring ambient air: To compare air monitoring results with air quality standards, the air monitoring site must be measuring ambient air. According to 40 CFR 50.1 (e), ambient air is defined as the portion of the atmosphere, external to buildings, to which the general public has access. Air monitoring sites located within a facility's property line are not considered ambient if a fence or other physical obstruction prevents public access. However, if no such obstruction exists, air quality monitors located within a facility's property boundary may be considered ambient.

Horizontal and vertical placement: The objectives of the monitoring study will determine the criteria for placement of air monitoring probes or sample inlets. In most cases, air monitoring probes and inlets must be located between 2 and 7 meters above ground level. As a result, monitoring sites located at ground level typically require the installation of an elevated platform or shelter. Air monitoring sites may also be located on the roof of a building which is no higher than two-stories.

Spacing from emission sources: The proximity of the air monitor to air pollution emission sources is dependent on the objectives of the monitoring study. For source-oriented or hot-spot monitoring, air monitors should be located as close to the area of expected maximum air pollution concentration as safely possible. If the monitoring objective is to assess air pollution concentrations representative of a wider area, such as the average air pollution concentration across a community, air monitors should be located further away from emission sources.

Spacing from obstructions: Buildings and other obstacles can impact air monitoring results by scavenging pollutants and restricting airflow to the monitor, resulting in inaccurate air concentration measurements. In general, if an obstruction is located near an air monitoring site, the distance of the air monitor from the obstruction must be two-

times the height of the obstruction.

Cost of establishing an air monitoring site

The costs associated with establishing an air monitoring site will vary depending on the physical characteristics of the chosen monitoring location, the type of monitoring platform chosen (e.g. ground-level platform, shelter/trailer, rooftop), pollutants measured and existing infrastructure. The following section will describe the estimated costs associated with establishing a new air monitoring site in 2013. These cost estimates have been developed assuming all site infrastructure and equipment will be purchased and may not reflect the costs associated with establishing a temporary air monitoring site through a contractor.

Site Infrastructure

Capital costs for site infrastructure at ground-level sites - $10,000

- Land clearing and grading to access the site and meet siting criteria Utility drop and electrical connections to power instrument platforms
- Building permits
- Materials to construct elevated monitoring platforms
- Security fence and gate to enclose the monitoring site -

Capital cost considerations for alternative site configurations

- Ground level shelter/trailer and associated infrastructure -$32,000
- Rooftop installation and associated infrastructure - $6,000

Supporting Equipment (equipment needs will depend on pollutants measured at the site)

- Data logger and wireless telemetry for continuous monitoring instruments - $9,000
- Meteorological equipment and tripod - $3,500
- Laptop and uninterruptable power supply - $4,500
- Certified meters and devices to calibrate and perform quality control checks- $2,500
- Dynamic Dilution Calibrator with gas phase titration chamber (GPT) - $21,000
- NO2 Calibration gas cylinder and regulators - $1,000

Recurring annual site operation costs - $31,000

- Weekly site operation and maintenance - $20,000
- Project administration, contract management, site construction, procurement, QA/QC audits, data management, analysis and reporting - $10,000

- Consumable field supplies and miscellaneous hardware - $1,000

The following sections provide additional information about the pollutants of concern from silica sand mining operations including information on health effects, relevant air quality standards, and available air monitoring equipment and associated costs.


Example air monitoring sites: rooftop monitoring (left); ground-level monitoring including a shelter (right).

Total suspended particles (TSP)

Total suspended particles (TSP) are small airborne particles or aerosols that are less than 100 micrometers in diameter. Common components of TSP include soot, dust, fumes, and sea mist. In contrast to smaller size particulates (such as fine particles), the human body effectively blocks TSP, reducing the adverse health effects associated with exposure. Nearly all inhaled TSP is either directly exhaled or trapped in the upper areas of the respiratory system and expelled. If TSP enters the windpipe or lungs, it becomes trapped in protective mucous and is removed through coughing. While TSP pollutants are not expected to cause serious health effects in humans, high levels of TSP can be a nuisance, cause property damage, and reduce visibility.

In Minnesota, TSP is regulated by two Minnesota Ambient Air Quality Standards (MAAQS), including a daily (24-hour) and annual standard. To meet the daily standard, the 2nd maximum 24-hour average TSP concentration in an area must not exceed 150 micrograms per cubic meter (µg/m^3). An area meets the annual standard if the annual average TSP concentration does not exceed 60 µg/m^3.

Total suspended particulate monitoring is conducted by collecting a 24-hour mass sample on a glass fiber filter. The fiber filter is weighed in a laboratory pre and post sample collection. The mass difference is used to calculate the total TSP concentration in a volume of air. The standard annual operating schedule for TSP monitoring is a midnight to midnight 24-hour mass sample collected once every six days.

Total suspended particulate monitors should be sited to meet the goals of the specific monitoring project. To measure TSP concentrations associated with silica sand mining, TSP monitors should be located directly downwind of the TSP emission source of concern. When establishing a TSP monitoring site additional factors which must be considered include, maintaining unobstructed airflow in all directions of the air monitor, placing the sample inlet between 2-15 meters above ground level, and removing public access to the monitor through fencing or locating the monitor on the roof of a building.

High-volume TSP Sampler

On average, the cost of an EPA certified TSP monitor is $8,000. For regulatory comparisons with ambient air quality standards, all TSP monitoring networks must meet applicable quality assurance and quality control requirements, including a 10% monitor collocation requirement. For community level monitoring projects, the collocation requirement means that at least one monitoring site must have two TSP monitors operating at the same time. An additional collocated monitor is required for every 10 monitoring sites.

Operational costs associated with TSP monitoring include sample media purchase, preparation, and post sample analysis; weekly visits by a site operator and quarterly visits by a QA officer; motor replacement and/or brush repair; and power.

TSP Summary Information

Equipment Cost: $8,000/monitor
O&M Cost: $5,000/monitor

Operational Considerations:
Collocated monitor required at one sampling site

Regulatory Standards

Daily MAAQS: Annual 2nd high 24-hour TSP concentration does not exceed 150 µg/m^3

Annual MAAQS: Annual average TSP concentration does not exceed 60 µg/m^3

Inhalable particulate (PM_{10})

High-volume PM_{10} monitor (top); semi-continuous PM_{10} monitor (bottom)

Inhalable particles (PM_{10}) are very small particles less than 10 micrometers in diameter. Sources of PM_{10} include crushing and grinding operations, natural (crustal) and road dust, and biological sources. Scientific studies have linked short term exposure to elevated PM_{10} concentrations to decreased lung function, increased respiratory symptoms in children, increased doctor's visits and hospital admissions, and premature death in people with heart or lung disease.

In Minnesota, PM_{10} is regulated through national and state ambient air quality standards including a daily (24-hour) and annual standard. To meet the daily PM_{10} National Ambient Air Quality Standard (NAAQS) the 3-year average of the annual count of 24-hour PM_{10} concentrations greater than 150 $\mu g/m^3$ site must be less than or equal to 1. To meet the annual PM_{10} MAAQS, the annual average PM_{10} concentration must not exceed 50 $\mu g/m^3$.

The Code of Federal regulations requires that any monitor operated for the purpose of comparison of NAAQS must have a Federal Reference or Equivalent Method Designation, except as otherwise provided in Appendix C of 40 Code of Federal Regulations 40, Part 58. A complete list of acceptable monitors can be found in the 40 CFR, Part 53, Sections 53.2 and 53.3.

There are several PM_{10} monitoring methods included among the EPA certified monitors. The three most common monitoring methods used for measuring PM_{10} concentrations include high volume and low volume monitors that collect a 24-hour mass sample on a filter and semi-continuous monitors that collect hourly PM_{10} measurements on an auto-advancing filter tape. There are advantages and disadvantages for each of these monitor types. Choosing the best monitor for the monitoring study will depend on the monitoring objective.

To assess the PM_{10} impacts of silica sand mining operations in a community, the MPCA recommends utilizing a semi-continuous PM_{10} monitor. When paired with hourly meteorological or site activity data, hourly PM_{10} concentration data can be used to identify PM_{10} sources. Additionally, the semi-continuous monitor requires less frequent site operator visits than the high-volume sampler. The average cost of a semi-continuous PM_{10} monitor, including the monitor enclosure is $30,000. Because the semi-continuous PM_{10} monitors do not collect the PM_{10} sample on a retrievable filter, crystalline silica analysis cannot be performed with this collection method.

PM_{10} Summary Information

Equipment Cost:
High-volume filter: $10,000
Low-volume filter: $12,500
Semi-continuous: $28,000

O&M Cost: $5,000/monitor

Regulatory Standards

Daily NAAQS: 3-year average of the annual count of 24-hour PM_{10} concentrations greater than 150 µg/m^3 must be less than or equal to 1

Annual MAAQS: Annual average PM_{10} concentration does not exceed 50 µg/m^3

Fine particles ($PM_{2.5}$)

Fine particles such as those found in smoke and haze are 2.5 micrometers in diameter and smaller. Fine particles can be emitted directly from combustion activities or the can form in the air when other pollutant gases react in the air. Fine particles are created through most combustion activities, but the most common sources of fine particle pollution includes power plants, industries, automobiles, and fires.

Due to their very small size, fine particles can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked fine particle exposure to respiratory discomfort, decreased lung function, aggravated asthma, irregular heartbeat and heart attacks, increased doctor's visits and hospitalizations, and premature death in people with heart or lung disease.

Low-volume $PM_{2.5}$ filter monitor

Fine particle pollution is regulated through two national ambient air quality standards including a daily (24-hour) and annual standard. To meet the daily $PM_{2.5}$ standard, the 3-year average of the annual 98th percentile 24-hour $PM_{2.5}$ concentration must not exceed 35.4 µg/m^3. To meet the annual $PM_{2.5}$ standard, the 3-year average of the annual average $PM_{2.5}$ concentration must not exceed 12.0 µg/m^3.

The Code of Federal regulations requires that any monitor operated for the purpose of comparison of NAAQS must have a Federal Reference or Equivalent Method Designation. Except as otherwise provided in 40 CFR, Part 58, Appendix C. A complete list of acceptable monitors can be found in the 40 CFR, Part 53, Sections 53.2 and 53.3.

Several $PM_{2.5}$ monitoring methods are included among the EPA certified monitors. The most common monitoring methods used for measuring $PM_{2.5}$ concentrations include low-volume monitors that collect a 24-hour mass sample on a filter and semi-continuous monitors that collect hourly $PM_{2.5}$ measurements on an auto-advancing filter tape. There are advantages and

disadvantages for each of these monitor types. Choosing the best monitor for the monitoring study will depend on the monitoring objective.

To assess PM2.5 impacts of silica sand mining operation in a community the MPCA recommends utilizing a semi-continuous PM2.5 monitor. When paired with hourly meteorological or site activity data, hourly $PM_{2.5}$ concentration data can be used to identify $PM_{2.5}$ sources. Additionally, the semi-continuous monitor requires less frequent site operator visits than the filter based sampler. The average cost of a semi-continuous $PM_{2.5}$ monitor, including the monitor enclosure is $30,000.

$PM_{2.5}$ Summary Information	**Regulatory Standards**
Equipment Cost: **Low-volume filter:** $12,500 **Semi-continuous:** $30,000	**Daily NAAQS:** 3-year average of the annual 98th percentile 24-hour $PM_{2.5}$ concentration does not exceed 35.4 µg/m^3
O&M Cost: $5,000/monitor	**Annual NAAQS**: 3-year average of the annual average $PM_{2.5}$ concentration does not exceed 12.0 µg/m^3
Operational Considerations: Collocated monitor required at one sampling site	

Crystalline silica

Respirable crystalline silica is a dust-sized particle invisible to the naked eye that when inhaled is deposited deep within the lungs. Crystalline silica is a very common component of soil and well-known occupational hazard in certain trades. Activities such as mining for crystalline silica and other natural resources, as well as construction activities related to cutting and sawing of common materials such as concrete, create respirable crystalline silica particles.. People who work in the hydraulic fracturing or frac sand mining industries are most at risk for exposure to elevated levels of respirable crystalline silica, but people living downwind of silica sand mining, processing, or hauling operations could also be exposed to respirable crystalline silica. Due to the greater risk for exposure in the occupational environment, respirable crystalline silica is routinely measured in the workplace. However, levels of respirable crystalline silica in ambient (outdoor) air are rarely determined. Diseases associated with chronic exposure to respirable crystalline silica over many years include: silicosis, emphysema, chronic obstructive pulmonary disease, tuberculosis, lung cancer, and immune system diseases.

There are no federal or state standards for respirable crystalline silica in ambient air. However, the MPCA uses a risk guideline value developed by the MDH to assess the risk of adverse health effects from exposure to measured levels of respirable crystalline silica in the air. In July 2013, the MDH established a chronic Health Based Value for respirable crystalline silica of 3 µg/m^3 in ambient air for non-occupational exposures occurring in the general population. The MPCA compares annual average monitoring results to the chronic health based value to assess the health

risk associated with respirable crystalline silica concentrations in the air. Quantitative health based guidance for shorter duration exposures to respirable crystalline silica were not developed because data are lacking and the extremely high levels of respirable crystalline silica required to cause short-term health effects in occupationally-exposed individuals are far beyond the scope of ambient exposure scenarios the general public would be expected to encounter. The Minnesota Department of Health's chronic Health Based Value for respirable crystalline silica of 3 µg/m^3 is very conservative and highly protective guidance. Short-term increases in ambient levels of respirable crystalline silica in excess of the chronic Health Based Value do not necessitate an immediate cause for concern. Therefore measured 24-hour average concentrations of respirable crystalline silica in ambient air will be used to calculate the 95% upper confidence limit of an annual mean concentration and compared to the chronic Health Based Value of 3 µg/m^3
The EPA has not established a standard method for measuring crystalline silica in ambient air. The MPCA recommends utilizing a modified low-volume particulate sampler to collect 24-hour mass samples of PM_4 on a 47 mm mixed ester sample filter. Following sample collection, the loaded filter should be sent to a certified laboratory for crystalline silica analysis using the National Institute for Occupation Safety and Health (NIOSH) Method 7500 or NIOSH Method 7602. The average cost of the low-volume particulate sampler is $12,500. The estimated annual cost of analysis of 60 crystalline silica samples from a certified laboratory is $25,000.

Respirable Crystalline Silica Summary Information

Equipment Cost:	**No regulatory standard**
$12,500/monitor	**Chronic health based value:** 3.0 µg/m^3
O&M Cost:	See MDH Silica Health Based Value Summary at:
$25,000/monitor	http://www.health.state.mn.us/divs/eh/risk/guidance/air/silicasumm.pdf

Diesel exhaust

The exhaust from diesel engines contains a complex mixture of air pollutants including gases and particles. Major chemical components of diesel exhaust include carbon dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, particles (coarse, fine, and ultra-fine), black carbon, and sulfur dioxide. Diesel exhaust also contains air toxic pollutants such as acrolein, benzene, formaldehyde and polycyclic aromatic hydrocarbons (PAHs).

The majority of scientific studies conducted to measure the health risks associated with exposure to diesel exhaust focus on the particle components of the exhaust. Similar to the health effects associated with fine particle pollution, exposure to diesel particles can cause adverse respiratory and cardiovascular health effects including decreased lung function, aggravated asthma, irregular heartbeat and heart attacks, increased doctor's visits and hospitalizations, and premature death in people with heart or lung disease. The U.S. EPA has also classified diesel exhaust as a likely carcinogen due to increased risk for lung cancer resulting from long term exposure.

There is no ambient air standard for diesel exhaust. The MPCA uses a health based value to assess the risk of adverse health effects from exposure to diesel particulate. The chronic non-cancer health risk value for diesel particulate is 5 $\mu g/m^3$.

Methods do not currently exist to measure the amount of diesel exhaust in ambient air directly. Instead, researchers typically monitor other pollutants that may be signatures of diesel exhaust. These pollutants include fine particles, ultra-fine particles (particle diameter less than 1 micrometer), elemental carbon, and nitrogen oxides. Utilizing surrogate pollutants to assess the amount of diesel exhaust in the air has significant limitations, as the relationship between the surrogate pollutant and the amount of diesel exhaust in the air varies geographically and by the characteristics of the emissions source.

If surrogate monitoring is conducted to assess diesel exhaust concentrations, the MPCA recommends establishing an upwind (non-impacted) and downwind (impacted) monitoring site. Comparing the result from these monitors may help identify the relative impact of increased diesel exhaust emissions if other pollutant emissions are relatively uniform between the two monitors. While either hourly $PM_{2.5}$ or nitrogen oxides can be used as a surrogate for diesel exhaust, the MPCA recommends utilizing hourly measurements of $PM_{2.5}$.

Due to the difficulties associated with measuring diesel exhaust through air monitoring, the MPCA assesses the health risks associated with diesel exhaust emissions through air dispersion modeling. Air dispersion models integrate information on emission sources and local geography and meteorology to estimate pollution concentrations in the air. To assess the increased health risks associated with diesel exhaust emissions from silica sand mining operations, information on diesel emission sources should be gathered. This may include information on the engine type, size, and age; fuel type; and in the case of on-road diesel engines, the number of vehicles and miles traveled on a roadway.

Diesel Exhaust Summary Information

No direct monitoring methods

Surrogate measurements:
Fine particles: $30,000
Nitrogen dioxide: $12,000

O&M Cost: $5,000/monitor

No regulatory standard

Chronic non-cancer health based value: 5 $\mu g/m^3$ diesel particulate

Summary of estimated air monitoring site capital and annual operation costs in 2013 dollars

All monitoring sites must meet the guidelines described in 40 CFR Part 58 Appendix E.

Site infrastructure		
	Rooftop site	$6,000
	Ground-level site (no shelter)	$10,000
	Shelter/trailer site (with HVAC)	$32,000
Pollutant monitors		
	Semi-continuous $PM_{2.5}$ (with environmental shelter, but without HVAC)	$30,000
	Semi-continuous PM_{10} ((with environmental shelter, but without HVAC)	$28,000
	High-volume TSP	$8,000
	Low-volume PM_4	$12,500
	Nitrogen oxides	$12,000
Supporting equipment		
	Data logger/wireless telemetry	$9,000
	Meteorological sensors and tripod	$3,500
	Laptop and uninterruptable power supply	$4,500
	Certified meters and devices for calibration and QA/QC	$2,500
	Dynamic Dilution Calibrator with gas phase titration chamber (GPT)	$21,000
	NO2 Calibration gas cylinder and regulators	$1,000
Sample analysis		
	TSP sample prep and post-weigh analysis	$5,000/year
	Low-volume PM_4 sample silica analysis (60 samples)	$25,000/year
	Data processing and analysis for $PM_{2.5}$, PM_{10}, and nitrogen oxides	$5,000/year
Operations and maintenance		
	Weekly site operations and maintenance	$20,000/year
	Project administration, contract management, site construction, procurement, QA/QC audits, data management, analysis and reporting	$10,000/year
	Consumable field supplies and hardware	$1,000/year

Estimated one-time capital expenses per monitoring site*: $19,000 - $142,000**

Estimated annual expenses per monitoring site*: $12,000*- $56,000

*Post-construction upwind/downwind monitoring will require at least two monitoring sites

**Low-end of range based on a single rooftop monitoring site measuring TSP and meteorological parameters only.

c. Recommendations, Standards, Criteria, Considerations

The proposed standards, criteria, and considerations are informed by both the processes within the proposed silica sand project and the geographic location of the project.. The monitoring plan for a silica sand project should include the following:

What to monitor:

- Every silica sand project involving a mine of any size should conduct monitoring for Total Suspended Particulate, PM_4-silica, and meteorological data.
- Every silica sand project involving processing should monitor for PM_{10}, PM_4-silica, and meteorological data; the term 'processing' means washing, cleaning, screening, crushing, filtering, sorting, stockpiling, and storing silica sand.
- Every silica sand project involving over-the-road transportation should monitor for $PM_{2.5}$, PM_4-silica, and meteorological data at each site where silica sand is either loaded or unloaded from a transportation carrier (e.g. truck, rail, barge).

Note that if a silica sand project involves one or more of the above activities, then the monitoring plan should reflect all of the indicated monitors (e.g. a project that encompasses a mine, processing facility, and over-the-road transportation should monitor for TSP, PM_{10}, $PM_{2.5}$, and PM_4-silica).

When to monitor:

- All silica sand projects should conduct ambient monitoring prior to startup of the project. The pre-construction monitoring period should continue until at least one year of valid data is collected.
- All silica sand projects should conduct ambient monitoring after startup of the project. The post-construction monitoring period should continue until at least three (3) years of valid data are collected.

How often to monitor:

- Each TSP sampler should run for a 24-hour midnight-to-midnight period once every six days on the schedule found here: http://www.epa.gov/ttnamti1/calendar.html
- Each PM_{10} analyzer should run on a semi continuous (hourly) basis
- Each $PM_{2.5}$ analyzer should run on a semi continuous (hourly) basis
- Each PM_4 sampler should run for a 24-hour midnight-to-midnight period once every six days on the schedule found here: http://www.epa.gov/ttnamti1/calendar.html

Which monitor and test method should be used:

- Each TSP, PM_{10}, and $PM_{2.5}$ monitor should be one that has been designated as a Federal Reference Method (FRM) or as a Federal Equivalent Method (FEM); an electronic list of monitors that hold this designation is available at http://www.epa.gov/ttnamti1/files/ambient/criteria/reference-equivalent-methods-list.pdf
- Each PM_4 monitor should be approved by the MPCA on a case-by-case basis. The silica test method should be NIOSH 7500.

Monitor Siting

- Historical wind patterns (direction, intensity) from nearby meteorological stations and the on-site meteorological station should be compiled to inform the siting conditions in order to construct 'upwind / downwind' monitor placement. The monitors should be placed as close to the facility as possible while remaining in ambient air. This is typically the fence line of the facility.
- Monitor sites should meet criteria laid out at 40 CFR pt. 58, Appendix E. This appendix contains information such as vertical and horizontal placement, spacing, distance from obstructions, and more.

Data Reporting

- All data should be sent to the MPCA and the LGU
- TSP, PM_{10}, $PM_{2.5}$, and Crystalline Silica data should be reported on a quarterly basis no later than one month following the end of each quarter.
- Data may be provided in a written report but most also be provided in an electronic format that can be directly read into a spreadsheet or database
- For parameters that are measured hourly or sub-hourly, electronic data submissions should include hourly averaged data
- The silica sand project proposer should notify both the MPCA and the LGU within 24 hours of receiving sample results exceeding ambient standards. The notification should include the date of the exceedance, the concentration of the sample, and a summary of the measures taken by the proposer to reduce emissions at the silica sand project.

A.2. Dust Control & Containment of Sand

a. Description of Silica Sand Project Concerns

Virtually all stages of silica sand mining, processing, and transportation may emit particulate matter, which is commonly known as dust. The control strategies share a common feature: they are designed to minimize the interaction between wind and silica sand. In general, all processes after the mining process should be enclosed. Those portions of the process that cannot be enclosed (i.e. roads) should utilize alternative methods such as watering and sweeping in order to suppress the movement of particulate matter.

b. Recommendations, Standards, Criteria, Considerations

The recommendations, standards, criteria, and considerations are informed by the processes within the proposed silica sand project. If the LGU is interested in methods that could be used to reduce the particulate emissions from a silica sand facility, then the LGU could implement dust control measures within their local permit. The dust control strategy for the proposed silica sand project could include the following measures:

Mine Haul Roads within a Silica Sand Facility

Emissions from mine haul roads that are within the property line of the silica sand facility should be suppressed by the daily application of water. Water should be applied at a rate of 0.10 gallons per square foot per day, unless the one of the following events occurs:

- The facility receives rainfall of 0.16 inches during the previous 24 hour period, or
- the ambient air temperature will be less than 35 degrees, or
- the weather conditions, in combination with the application of water, could create hazardous driving conditions. If water is not applied for this reason, watering should resume once the hazardous conditions have abated.

On a daily basis, the facility owner should keep records of the water applications, including the following:

- The roads watered, the amount of water applied, the time watered, and the method of application. If water was not applied because there was a 0.16 inch or greater rainfall in the previous 24 hours, or because the temperature or other weather conditions that would result in unsafe driving conditions, it must be noted in the record along with the source of the measurement (i.e. on-site rain gauge or thermometer).
- Records of watering equipment breakdowns and repairs, and records of contingency efforts undertaken.

Processing

After the sandstone has been mined, all subsequent processing steps should be enclosed. Processing encompasses the following activities: washing, cleaning, crushing, filtering, drying, sorting, and stockpiling of silica sand. All emissions from the enclosed processes should be ducted to control equipment designed to mitigate particulate matter emissions. There are numerous control technologies that are capable of controlling particulate matter, such as a cyclone, an electrostatic precipitator, a wet scrubber, a fabric filter, and a high efficiency particulate air (HEPA) filter. While the more efficient devices include fabric filters and HEPA filters, the other control technologies can be arranged in series in order to meet or exceed the efficiency of filter-based technologies. Cyclones rely on inertial separation and are typically less efficient at controlling PM_{10} sized particles. Cyclones can be used as a first stage in a series of control devices in order to control emissions of larger sized particles. Electrostatic precipitators rely on the ability to apply an electrostatic charge to particulate matter. Silica does not readily accept an electric charge, and therefore will not be well controlled by an electrostatic

precipitator. Wet scrubbers are typically more efficient than cyclones at controlling PM_{10}-sized material, but not as efficient as a fabric filter. Wet scrubbers rely on a liquid spray to knock particulate matter out of the gas stream, but create a liquid process stream that must be addressed. Fabric filters are typically woven into the shape of a cylindrical bag, which are then arranged within a structure called a 'baghouse.' Process air is ducted such that it must pass through the fabric filter in order to exit to the atmosphere. Over time, a cake of dust will accumulate on each bag. This dust is periodically cleaned from the bag and collected in an enclosed hopper. Another similar control technology is called a high efficiency particulate air (HEPA) filter. When compared to a baghouse fabric filter, a HEPA filter has finer fibers that have a higher packing density. HEPA filters usually take the form of a cartridge that must be periodically replaced. The use of a baghouse does not preclude the use of a HEPA filter, and a HEPA filter could be added at a later date should the need arise. A baghouse can routinely achieve greater than 99% control of all particulate matter, and 93% of all particulate matter sized smaller than PM_{10}. A HEPA filter can remove 99.98% of all particulate matter, and 99.98% of all particulate matter sized smaller than PM_{10}. When arranged in series, this control strategy can achieve control greater than 99.99% of all particulate matter, and greater than 99.99% of all particulate matter sized smaller than PM_{10}. Each of these devices are typically guaranteed by their respective manufacturer to achieve a certain level of control, provided that they are operated within certain operating parameter ranges. One such operating parameter is called 'pressure drop.' Pressure drop is a measure of the resistance to flow through the control device. The control device manufacturer will indicate the proper operating range. The pressure drop across each control device should be regularly monitored in order to verify that the device is working properly. All particulate matter that has been collected by the baghouse should be stored in an enclosed location until the material is either used in mine reclamation or transported off-site. The suggested dust mitigation strategy for processing activities includes:

- Capture Strategy: Enclose all processes and vent all emissions through a particulate matter control device. Keep all doors and windows closed, and maintain negative gauge pressure within the building.
- Control Strategy: Operate and maintain one or more filter-based particulate matter control devices arranged in series. (for example: first the process air is ducted to a baghouse, then the air exiting the baghouse is routed to the HEPA filter, which is then exhausted to atmosphere).
- Periodic Monitoring and Recordkeeping: On each day of operation, record the operating time and material throughput for each air emission unit. Utilize a continuous parameter monitoring system to monitor and record pressure drop across each control device every fifteen minutes. Store each data point for at least five years. Conduct maintenance and inspections on the following schedule:

  A. maintain an inventory of spare parts that are subject to frequent replacement, as required by the manufacturing specification or documented in records under items H and I;

  B. train staff on the operation and monitoring of control equipment and troubleshooting, and train and require staff to respond to indications of malfunctioning equipment, including alarms and other indicators of abnormal operation;

C. thoroughly inspect all control equipment at least annually, or as required by the manufacturing specification (this often requires shutting down temporarily);
D. inspect monthly, or as required by the manufacturing specification, components that are subject to wear or plugging, for example: bearings, belts, hoses, fans, nozzles, orifices, and ducts;
E. inspect quarterly, or as required by the manufacturing specification, components that are not subject to wear including structural components, housings, and ducts;
F. check daily, or as required by the manufacturing specification, monitoring equipment, for example: pressure gauges, chart recorders, and recorders;
G. calibrate annually, or as required by the manufacturing specification, all monitoring equipment;
H. maintain a record of activities conducted in items A to G consisting of the activity completed, the date the activity was completed, and any corrective action taken; and
I. maintain a record of parts replaced, repaired, or modified for the previous five years.

- Corrective Actions: If the recorded pressure drop range or component of the control device need repair corrective action should be taken as soon as possible. Corrective action should return the pressure drop to the manufacturer's indicated range and/or include completion of necessary repairs identified during the inspection.

Transportation

The following recommendations are intended to minimize particulate matter emissions that are associated with transportation of silica sand, but these recommendations could also be used for other bulk-transport industries. If the LGU is interested in reducing the effects of particulate matter from transportation-related processes, then the following suggestions could form the basis for LGU permit requirements. The drop height at each material transfer point should be minimized by using telescopic chutes and skirting. Trucks and railcars that receive silica sand should do so via a telescoping loading spout that meets the design requirements described in the reference book *Industrial Ventilation Handbook—A Manual of Recommended Practice for Design*, currently in the 26th edition. Trucks that unload should do so within an enclosed structure. The doors that allow the truck to enter and exit the unloading station should be closed prior to the unloading procedure. The drop height from truck bed to the surface or receiving hopper should not exceed eight inches of open drop. Airborne material should be ducted to particulate control equipment meeting the same efficiencies described in the preceding silica sand processing section. Bottom dump trucks with dump gate skirts should be used for all over-the-road transportation. The skirting should have a maximum vehicle-to-ground clearance of six inches (air gap). As described by Minn. Stat. Section 169.81, subd. 5b(b), all trucks in silica sand service should be covered. All railcars in silica sand service should be covered hoppers. All trucks that leave the facility should be processed by a vehicle wheel wash station. The silica sand facility should keep and maintain the following records for the trucks in silica sand service:

1. The number of trucks used on each operating day,
2. The number of hours that each truck was operated each day,
3. The haul route or routes used on each operating day,

4. The rated capacity of each truck's engine,
5. The vehicle identification number (VIN) for each truck,
6. The amount of fuel used and fuel economy as averaged over a month,
7. The percent of time on idle,
8. The federal emission standards that each truck engine is subject to, and
9. The tailpipe emission control technology used by each truck, such as:

    ,
    a. diesel oxidation catalyst,
    b. diesel particulate filter, or
    c. selective catalytic reduction.

The on-road truck fleet should meet the following criteria:

- All diesel trucks used in the sand mining operation should be Model Year 2007 or newer,
- All trucks should follow an anti-idling plan that minimizes excessive idling, but accounts for traffic, temperatures in excess of 90 degrees and less than zero degrees Fahrenheit, and inclement weather. The plan should be developed by the LGU and the silica sand facility. Examples of anti-idling regulations can be found at the following:
    - The City of Minneapolis an anti-idling ordinance http://www.minneapolismn.gov/environment/air/airquality_antiidling_home
    - American Transportation Research Institute http://www.atri-online.org/research/idling/ATRI_Idling_Compendium
    - US EPA http://epamap10.epa.gov/website/StateIdlingLaws.pdf
- All trucks should pass a state highway safety inspection.

The non-road vehicle fleet should meet the following criteria:

- At least 50% of the diesel-powered equipment used in sand mining operations should have a EPA certified Tier-3 or better engine, and
- the remaining equipment should be certified to Tier-2andAll trucks should follow an anti-idling plan that minimizes excessive idling, but accounts for traffic, temperatures in excess of 90 degrees and less than zero degrees Fahrenheit, and inclement weather. The plan should be developed by the LGU and the silica sand facility.

All roads at a silica sand facility, other than mine haul roads, should be paved. Paved surfaces should be vacuum swept on a daily basis. The facility owner should maintain records of the following:

1. The roads swept, the time the roads were swept, and the method of sweeping.
2. Records of sweeping equipment breakdown and repairs, and records of contingency efforts undertaken.

Temporary Storage

Temporary storage is defined to be the storage of stockpiles of silica sand that have been transported and await further transport. Storage piles that are intended to be used at the facility on a recurring basis are not considered temporary storage; rather, these piles should be enclosed and controlled in the manner described in the 'processing' section above. In situations where silica sand is to be stored on a temporary basis and the material cannot be enclosed, then the sand should be checked for moisture content and watered until the moisture content of the pile exceeds the amount indicated below. After the temporary pile has been removed, the area should be swept as soon as possible. Suggested requirements for open-air storage piles include:

- Moisture content: Greater than or equal to 2.9%
- Test method / compliance assessment: American Society for Testing and Materials (ASTM) method D 2216-92 or D 4643-93 (or equivalent). These test methods involve weighing a wet sample, heating it, and then weighing it again.
- Test frequency: once per day, within 2 hours of 12 noon. Testing is not recommended if any of the following three items are true:
    - The facility receives rainfall of 0.16 inches during the previous 24 hour period, or
    - the ambient air temperature will be less than 35 degrees, or
    - the weather conditions, in combination with the application of water, could create a hazard near the storage pile.
- Corrective action: If the test result is below the suggested moisture content requirement, then the operator should apply water to all exposed surfaces until subsequent moisture content testing demonstrates that the moisture content is at or above the suggested percentage.
- Recordkeeping: keep on-site records of each moisture content test summarizing the method used, results, time, date, temperature, and person performing the test
- Temporary stockpiles or stripping/overburden stored outside the pit should have sediment control mechanisms in place until the material is completely removed. Materials should not be placed in surface water or stormwater conveyances such as curb and gutter systems, or conduits and ditches.

A.3. Noise Monitoring and Testing

a. Narrative Description and Background Information

Noise is a pollutant. While its physical and emotional effects are difficult to define quantitatively, the noise level itself can be measured.

The MPCA is empowered to enforce the state of Minnesota noise rules; however, the noise rules apply to all persons in the state, with municipalities having some responsibility for compliance with the rules. All sources of noise must comply with the noise level standards, unless specifically exempted or a variance has been granted.

The MPCA has established standards for noise limits for residential and other areas in Minnesota Rules Chapter 7030. These standards are set by "noise area classification," (NAC) based on the land use at the location of the receiver (person hearing the noise). Noise is measured with sound meters for a period of one hour, and compared to state noise standards. Two measurements are used – the L10 and the L50. The L10 standard is the noise level (in A- weighted decibels) that cannot be exceeded for more than 10%, or 6, minutes of the hour. "A-weighted" means a specific weighting of the sound pressure level for the purpose of determining the human response to sound. The specific weighting characteristics and tolerances are those given in American National Standards Institute S1.4-1983, section 5.1. The L50 standard is the noise level that cannot be exceeded for more than 50%, or 30 minutes, of the hour. Noise limits are most stringent in NAC 1, which includes residential areas, and least stringent in NAC 3, which includes industrial facilities.

The noise standards itemized in the table below describe the limiting levels of sound established on the basis of present knowledge for the preservation of public health and welfare. These standards are consistent with speech, sleep, annoyance, and hearing conservation requirements for receivers within areas grouped according to land activities by the noise area classification (NAC) system established in part 7030.0050. However, these standards do not, by themselves, identify the limiting levels of impulsive noise needed for the preservation of public health and welfare. Noise standards in the table below apply to all sources.

Noise Area Classification	Daytime		Nighttime	
	L50	L10	L50	L10
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

Compliance with Noise Standards

Unless specifically exempted under Minnesota Statute 116.07, Subdivision 2a, all sources of noise must comply with the state standards. Local governments have the authority to enforce state noise standards, and may choose to adopt their own local ordinances regarding noise, though they may not set standards describing maximum levels of sound pressure more stringent than those set by the MPCA. In effect, local ordinances addressing outdoor sound level standards may set levels identical to the MPCA rules, and/or may address noise in ways not included in the MPCA rule (for example, limiting permissible operating hours of noisy lawn equipment).

The MPCA assists LGUs in ensuring compliance with state noise standards by providing advice, monitoring equipment to assist LGUs to measure noise levels, and reviewing projects for noise issues through the environmental project review process. The MPCA also works to ensure compliance at facilities for which it has issued an air emissions permit.

A NIOSH study entitled "Snapshot of Noise and Worker Exposures in Sand and Gravel Operations" by E.R. Bauer and E.R. Spencer indicates that plant operations can emit noise of up to 97 db(A) in plant areas; these measurements were made 1 to 2 meters from the equipment. Sound pressure is reduced by 6 dB for every doubling of distance. If the most stringent noise standard in Minnesota is 50 dB, then the distance required in order to achieve a noise reduction from 97 dB to 50 dB is equal to [2 meters * 2^(47/6) = 456 meters], or about 1500 feet.

b. Recommendations, Standards, Criteria, Considerations

The most effective means of avoiding noise pollution is proper land use planning and implementation of planning through land-use regulation; these regulations should be designed to ensure that land uses with more stringent noise standards are located away from land uses with less stringent noise requirements. Municipalities with the authority to regulate land use must take all reasonable measures to ensure that the establishment of a particular land use activity will not result in immediate violation of the state noise standards. Distance between noise sources and receptors (people) is the most useful method for reducing sound levels.

Physical barriers can help to further reduce noise levels, but such methods do require consideration of necessary barrier heights, location, materials, cost, and durability. Shrubbery is not typically an effective sound barrier, though it may change the perception of disturbances. In general, a 100-foot deep barrier of dense, tall, evergreen vegetation would have the effect of reducing noise by 5 dB. A solid, wooden privacy fence will typically have a greater noise mitigation impact than landscaping. Buffers may also be used to create separation; buffers are described later in this document in Section E.

A noise survey could be used to verify that the noise impacts from a silica sand facility have been reviewed. The noise survey could include the following: any silica sand project should conduct a pre-construction noise monitoring at every residence within 1500 feet. This distance should be measured from the property line of the silica sand facility to the property line of the residence. The monitoring should include both a daytime and a nighttime monitoring period, and should comport with the measurement methodology prescribed by the Minnesota Noise Rules at 7030.0060. The road surfaces within the site should be constructed to maximize the use of traffic circles. This will, in turn, minimize the need for vehicles to use their back-up alarm. After construction and startup of the silica sand project, then the facility should conduct post-construction monitoring at the same locations and time periods. Any exceedance of the noise standards should be mitigated by raising berm heights and adding landscaping until subsequent testing shows compliance with the noise standards. If railcars are used, then they should be coupled and uncoupled only during daytime hours.

B. Water Standards

B.1. Water Quantity Standards

a. Description of Silica Sand Project Concerns

Silica sand activities such as mining, mine dewatering, slurry pipeline transportation and wet processing have the potential to impact groundwater and surface water resources. Mining at or below the water table often requires the removal of large volumes of groundwater to dewater the mine to facilitate dry mining operations. Washing of sand to remove fine-grained particles, dust control and the transportation of sand from the mine to the wet processing facility may also require large volumes of water.

A cone of depression forms within the water table aquifer near any well or mine sump that is pumping groundwater. Depending on sump depth, well construction, pumping regime, and local geology, the degree and lateral extent of the water table drawdown will vary. Dewatering of a mine has the potential to impact water availability in nearby domestic wells, municipal production wells and water dependent resources. Dewatering of a silica sand mine, or other large appropriations of groundwater, can reduce discharge to surface water resources such as calcareous fens, wetlands, ponds, lakes, trout streams, springs, seeps, and watercourses leading to potential degradation of fish and wildlife habitat.

b. Narrative Description and Background Information

The Commissioner of the DNR administers the use, allocation and control of all waters of the state. This includes both surface water and groundwater. The DNR is required to manage water resources to ensure an adequate supply to meet Minnesota’s long-term needs. The Water Appropriation Permit Program exists to balance competing management objectives that include both development and protection of Minnesota's water resources.

A water use permit (appropriation permit) from DNR Ecological and Waters Resources Division is required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year. In accordance with Minnesota Rule 6115, an application must be submitted for each surface or ground water source from which water is proposed to be appropriated. The applicant must provide written evidence of ownership, or control of, or a license to use, the land overlying the groundwater source or abutting the surface water source from which water will be appropriated. The DNR commissioner is authorized to grant permits, with or without conditions, or deny them.

The Legislature has set the following water allocation priorities for Minnesota:

1. Domestic water supply

2. Consumptive use less than 10,000 gallons of water per day
3. Agricultural irrigation and processing
4. Power production
5. Other consumptive uses in excess of 10,000 gallons per day, and
6. Nonessential Uses

Silica sand mining related activities are considered a fifth or sixth water allocation priority depending on specific details of the operation.

An appropriation permit application for a silica sand mine should consist of the following submittals:

1. Permit Application Form - completed with all background information
2. Mining Plan - for the duration of the mine operations
3. Reclamation Plan - including final disposition of the land or land use
4. Comprehensive Domestic Well Inventory - for the potentially impacted area
5. Wetland Delineation - for the potentially impacted area
6. Hydrogeologic Investigation Report - including a resource impact analysis, water well and boring records, information on the subsurface geologic formations penetrated by the well, geological formation or aquifer that will serve as the water source, and geologic information from test holes drilled to locate the site of the production well, the maximum daily, seasonal, and annual pumpage rates and volumes being requested, information on groundwater quality and the articulation of a groundwater conceptual model for the area.
7. Aquifer Test Report - with quantified aquifer properties
8. Groundwater Computer Model - developed in coordination with DNR that is parameterized using aquifer test results, calibrated, verified and used to run simulations of future possible mining and reclamation scenarios
9. Calcareous Fen Management Plan - (if a calcareous fen is potentially impacted)
10. Proposed Monitoring Plan - for groundwater and surface water resources
11. Proposed Mitigation Plan - for water use and water resource impacts including a proactive domestic well interference remediation policy.

Upon receipt, the DNR Area Hydrologist distributes the permit application and coordinates a request for comments with the LGUs and DNR Divisions of Fisheries, Wildlife and Ecological and Water Resources staff. Groundwater technical review will be completed by the DNR Regional Groundwater Specialist as the required reports and plans are submitted to the DNR Area Hydrologist. Groundwater technical review will often include a domestic well risk analysis, interpretation of the data, comments on any technical deficiencies and recommendations for additional technical work, water monitoring or permit condition language. All water appropriation installations must be equipped with a flow meter to measure the quantity of water used. The methods used for measuring water use are based on the quantity of water appropriated, the source of water, and the method of appropriating or using water. Records of the amount of water appropriated must be kept for each installation. The readings and the total amount of water appropriated must be reported annually to the DNR along with payment of the water use fees on or before February 15 of the following year.

The installation of monitoring equipment to detect potential impacts from permitted appropriators is generally required for large users of water. Monitoring installations are to be equipped with devices capable of accurately measuring water levels, flows, or conditions. DNR staff will determine the type, frequency and duration of measurements based on the quantity of water appropriated or used, the source of water, potential connections to other water resources, the method of appropriating or using water, seasonal and long-term changes in water levels, and any other facts supplied to the Area Hydrologist. Permit conditions generally require quarterly electronic reporting of monitoring data in a standard DNR format. The permittee is responsible for all costs related to establishing and maintaining monitoring installations, measuring and reporting data.

If the total withdrawals and uses of ground or surface waters exceeds the available supply based on established resource protection limits, including protection elevations and protected flows for surface water and safe yields for groundwater, resulting in a water use conflict among proposed users and existing users, a plan must be developed that includes proposals for allocating the water.

In a recent survey of LGUs,14 of 16 respondents reported that they defer to State requirements for addressing any non-metallic mining water quantity concerns. Of the participating LGUs, 93% (14 of 15 respondants) said they defer any drinking water quantity and quality concerns for domestic wells and public water supply wells to the State agencies. In addition, 37% (6 of 16 respondents) of the participating LGUs developed or negotiated water monitoring plans with permittees. The LGU monitoring plans included groundwater static water level measurements (2 of 7 responses), groundwater quality sampling (2 of 7 responses), stream water quality sampling (1/ 7 responses), spring or seep water quality sampling (1 of 7 responses and other types of monitoring (4 of 7). Not included were stream gaging, lake or wetland depths, and spring or seep discharge measurements. For mitigation plans, 88% (14 of 16 responses) of the participating LGUs defer to State Wetland Conservation Act or Public Waters requirements.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both the Minnesota River Valley and the Paleozoic Plateau.

- Reduced water availability in domestic wells
- Reduced water availability in municipal production wells
- Reduced discharge to water dependent resources including calcareous fens, wetlands, ponds, lakes, trout streams, springs, seeps, and watercourses
- Degradation of fish and wildlife habitat
- Impacts to state protected species
- Well interference complaints
- Water use conflicts

d. Recommendations, Standards, Criteria, Considerations

In order to protect surface water, groundwater and water dependent resources from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities, Paleozoic Plateau and Minnesota River Valley LGUs could consider the following actions be required of applicants:

i. Surface Water and Groundwater Appropriation Requirements

1. Permit Application Comments - Provide technical comments and policy concerns on appropriation permit applications when requested by DNR Area Hydrologist.

ii. Monitoring and Annual Submission of Monitoring Data Requirements

1. Develop a comprehensive and detailed monitoring plan that requires the type, frequency and duration of measurements necessary to adequately monitor site conditions. Measurements could include groundwater static water levels, stream stages and discharges, pond and wetland stages, spring and seep discharges, specified water quality parameters, wetland communities, listed species and other data that satisfies the monitoring needs of state agency and LGU permits.
2. Monitoring Data Submittals - Data submittals should be reported quarterly in a standardized electronic format to the LGU and state agency designated contact.
3. Annual Monitoring Report - An Annual Monitoring Report due by February 15th of each year should be required that compiles, summarizes, analyzes and interprets the data for the year as well as over the entire period of record. Based on the Report, LGUs and state agencies may require changes in the monitoring plan, amendment of permits or changes in operations.

iii. Mitigation Plan Requirements

1. Well Interference – a proactive well interference response plan should be submitted, approved and made a condition of all permits. If the permittee fails to respond adequately, DNR has a well interference complaint investigation authority and process in place to determine if the well interference report is related to an appropriation permit and will take action to restore water to the complainants if warranted.
2. Water Use Conflicts – If the DNR anticipates or determines that there is a limited volume of available water to one or more existing or proposed large water appropriator with the same level of water allocation priority (i.e. two competing silica sand operations), the DNR will invite the LGU to participate in a water use conflict resolution process to develop an allocation plan in accordance with Minnesota Rules.
3. Calcareous Fen Impacts – If based on the hydrogeologic investigation report and monitoring data, there is a potential for impacts to a nearby calcareous fen, the approval of a Calcareous Fen Management Plan by the DNR Commissioner will be required prior to the commencement of the silica sand mining activity. The review and coordination of any proposed Calcareous Fen Management Plan will be coordinated with the LGU

through the Wetland Conservation Act (WCA) Technical Evaluation Team (TEP). See the Calcareous Fen subsection for more details.

4. Impacts to other Wetland Dependent Resources - If based on the hydrogeologic investigation report and monitoring data that there is an impact to a water dependent resource, the DNR and LGU should enter into discussions with the permit applicant to identifying appropriate actions or changes to operations to avoid, mitigate or compensate for the impact and amend permit conditions accordingly.
5. Trout Stream Setback Permit Requirement in Paleozoic Plateau - In the Paleozoic Plateau area of southeast Minnesota, all new silica sand mining operations within a mile of a designated trout stream are required to apply for and obtain a trout stream setback permit from the DNR prior to operation of the mine. See the Trout Stream and Class 2A Waters subsection for more details.

References

Minnesota Statute:

103G.255 ALLOCATION AND CONTROL OF WATERS OF THE STATE
103G.261 WATER ALLOCATION PRIORITIES
103G.281 WATER USE PROHIBITED WITHOUT MEASURING QUANTITIES
103G.282 MONITORING TO EVALUATE IMPACTS FROM APPROPRIATIONS.
103G.287 GROUNDWATER APPROPRIATIONS

Minnesota Rules:

6115.0710 ADDITIONAL REQUIREMENTS AND CONDITIONS FOR DEWATERING
6115.0730 WELL INTERFERENCE PROBLEMS INVOLVING APPROPRIATIONS
6115.0740 WATER USE CONFLICTS.
6115.0750 PROVISIONS AND CONDITIONS OF WATER APPROPRIATION PERMITS

DNR web page:
http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/index.html

LCMR Study of the Hydraulic Impacts of Limestone Quarries
files.dnr.state.mn.us/publications/waters/Quarries_Impacts_Section_2_Outcomes.pdf

B.2. Water Quality Standards

B.2.a. Well sealing

a. Description of Silica Sand Project Concerns

Silica sand operations require the use of groundwater wells for a variety of reasons. Wells are installed for monitoring purposes or when groundwater is needed for uses such as dewatering, industrial processes, and drinking water. Wells that are no longer in use can become buried and forgotten; if they have not been properly sealed, they may then act as a drain for surface runoff, debris, and other contaminants to groundwater supplies. Therefore, when wells are no longer in use or needed, to help ensure that groundwater is protected to the fullest extent possible, proper well sealing procedures should be implemented to help eliminate accelerated pathways for surface contaminants to reach the groundwater.

Pre-existing wells within the footprint of the mine site may also pose a risk to groundwater if damaged or altered during mining operations. Such wells, if still in use, require adequate protection to prevent damage. If they are not in use, they should be properly sealed or completely removed.

b. Narrative Description and Background Information

Minnesota Statute 103I.241 requires that any well or boring that threatens groundwater quality, or otherwise poses a threat to health or safety, or is not in use (unless the property owner has a maintenance permit), must be sealed by a licensed contractor. Once a well is sealed, the contractor must submit a well and boring sealing record to MDH. An existing well within the mine site footprint that is damaged and threatens groundwater, or any well installed during mine operations that is no longer needed, must be properly sealed to prevent potential contamination of the groundwater.

c. List of Silica Sand Project Potential Concerns

Potential impacts are applicable to both the Minnesota River Valley and the Paleozoic Plateau

- Potential for contaminants to discharge to and contaminate groundwater through unused, unsealed and/or abandoned wells. Different responses by silica sand operations regarding the sealing of wells are not expected in the two major regions where silica sand mining occurs.

d. Recommendations, Standards, Criteria, Considerations

For both the Minnesota River Valley and the Paleozoic Plateau, LGUs could consider the following:

In order to prevent contamination of groundwater through abandoned wells or wells previously used in silica sand operations, requirements should be put in place at the silica sand site for procedures and notifications on the closing of wells when they are no longer in use. Therefore, any unused, unsealed wells should be brought back into use or sealed in accordance with Minnesota Statutes, Chapter 103I, and Minn. R. 4725. A licensed contractor should be hired by the applicant to perform the sealing. The applicant should be required to submit notification to the LGU when well sealing has occurred.

In addition, if the applicant constructs any boreholes for the purpose of exploration, the boreholes should be properly sealed to prevent adverse impacts on groundwater sources. Documentation supporting proper borehole sealing should be submitted to the LGU.

Furthermore, prior to construction of any new silica sand operations, a study should be done by the applicant to identify all wells including any potential pre-existing unused or abandoned wells on the property and on property surrounding within a one mile radius of boundaries. Documentation showing the results of this well search and inventory should be submitted to the LGU.

Additional information on the construction of wells can be found at http://www.health.state.mn.us/divs/eh/wells/construction/; further information on sealing of wells can be found at http://www.health.state.mn.us/divs/eh/wells/sealing/ .

B.2.b. Monitoring and mitigation plan requirements, including

i. Groundwater quality monitoring and mitigation plan requirements with annual submittal

a. Description of Silica Sand Project Concerns

All mining operations pose a potential risk to groundwater as a result of the removal of protective geological materials that help to filter contaminants from water infiltrating from the surface or prevent their migration into lower aquifers. Proper site planning, careful site management during mine operations, and appropriate site reclamation following completion of mining activities can help to minimize or eliminate risks to the groundwater, but this should be verified with monitoring.

Silica sand mining operations that infiltrate process wastewaters (meaning any discharge not comprised entirely of stormwater), mine pit dewatering (meaning any water that is impounded or that collects in the mine and is pumped, drained or otherwise removed from the mine through the efforts of the mine operator), or stormwater (means stormwater runoff, snow melt runoff, and surface runoff and drainage) should be required to conduct groundwater monitoring to assure that aquifers have not been adversely affected by site operations. Surface water monitoring may also be required if contaminated groundwater discharges to surface waters.

In addition to generating wastewater that requires proper management, mine excavation below the water table and subsequent dewatering, may create new pathways for shallow groundwater contaminants to migrate to deeper aquifers. This is of particular concern in the Minnesota River Valley Region, where accessing the Jordan Sandstone often requires the removal of confining layers near the base of the Prairie du Chien Group. Dewatering of the upper Jordan may create a localized "cone of depression" that can draw any shallow groundwater contaminants downward into the deeper aquifer.

A related concern is that mines requiring dewatering may also require engineered infiltration galleries (meaning a pond, trench, or other structure through which water is infiltrated to control the potentiometric surface of groundwater in order to mitigate the effects of dewatering on nearby wells or natural features, such as wetlands and surface water bodies) to prevent drawdown impacts to nearby wells or surface water features. Infiltration galleries in limestone or dolomite formations may potentially create conditions conducive to the formation of karst features, such as sinkholes and solution cavities, which can accelerate the migration of surface contaminants to groundwater.

b. Narrative Description and Background Information

The type of mine operation, hydrogeologic setting, and presence of groundwater users and contaminant sources will determine the specific groundwater monitoring and mitigation requirements for a given mine site. Thorough site characterization is critical to the development of appropriate groundwater monitoring and mitigation plans. Issues to consider include:

- The amount and type of geologic materials to be removed and the potential for this to increase the vulnerability of groundwater to contamination;
- The type of wastewater (e.g., from sand processing, dewatering, or stormwater) stored in ponds or reinfiltrated at the site;
- The proximity of the site to surface water features and the potential for those surface waters to enter the mine site during periods of flooding;
- The type and volumes of chemicals used at the site and their potential to reach the groundwater;
- The use of dewatering at the mine, its potential to alter local groundwater flow systems and aquifer characteristics, and the possibility of capturing any nearby groundwater contaminant plumes;

- The potential for infiltration galleries and similar structures, used to manage dewatering drawdown impacts, to alter aquifer characteristics and increase the potential for contaminants to reach the groundwater; and
    - The location and proximity of groundwater users (especially public or private drinking water wells) and sensitive surface waters that may be negatively impacted by any changes to groundwater quality or chemistry.

Groundwater in the Paleozoic Plateau of SE Minnesota is particularly vulnerable to contamination, due to karst development from the dissolution of carbonate bedrock. Karst features such as sinkholes, caverns, and solution-enlarged fractures allow infiltrating surface water and any contaminants it contains to rapidly enter the groundwater system and move large distances.

Sinkholes and other karst features tend to align along large bedrock joints that allow vertical migration of infiltrating water through otherwise massive, low permeability limestone and dolomite to occur. In SE MN, these joints are often present in subparallel, intersecting sets and sinkholes are particularly apt to form where two joints intersect. Investigations in SE MN have determined that sinkholes and other karst features are particularly likely to occur in areas where the contact zone between the Shakopee and Oneota members of the Prairie du Chien formation is at or near the surface of the bedrock beneath a thin (<50 feet) layer of overlying sedimentary deposits and/or when this zone is near the water table (Dalgleish and Alexander, 1984; Alexander and Maki, 1988; Alexander, et al., 2013). Also, activities that alter surface drainage to sinkholes may result in new sinkholes opening nearby (Alexander and Lively, 1995). Sinkholes are also known to form in the basal St. Peter Sandstone, often due to the upward propagation of karst features from the underlying carbonate formations.

Because of the greater risk to groundwater in the Paleozoic Plateau, the hydrogeologic evaluation of proposed mine sites in SE Minnesota should include an assessment of on-site and nearby karst features, including an evaluation of the alignments of mapped karst features within a one mile radius of the proposed mine to determine possible locations of intersecting joint sets. New remote sensing tools, such as LiDAR (Light Ranging and Detection), provide imagery that reveals surface and near surface structures better than aerial photography and should be used to located currently unmapped karst features. In areas mapped as having a high probability of karst formation (or where the contact of the Shakopee and Oneota members of the Prairie du Chien group is less than 50 ft. below the ground surface and/or at or near the water table), geophysical surveys may be required to evaluate the subsurface below the proposed mine for karst features. This investigation could be used to consider establishing, on a case by case basis, mining setbacks from any sinkholes, disappearing streams and blind valleys that may be of concern.

Mining activities in areas of SE Minnesota designated by the Minnesota Department of Natural Resources, in Part B of the County Geologic Atlases, as having a “moderate to high probability of karst development” should be analyzed carefully. Removal of sand-bearing formations below the elevation of the surrounding land surface could lead to the creation of a depression in the bedrock surface that might act as a focal point for water infiltration that may accelerate karst formation. In addition, it should be noted that the very act of removing the overlying sandstone

may increase the probability of karst development, causing an area designated as low or moderate probably to having a moderate or high probability.

c. List of Silica Sand Project Potential Impacts

Two distinct geologic settings exist where silica sand is mined in Minnesota and each area requires different responses by the silica sand operation in regards to groundwater monitoring. If silica sand mining and/or operations occur in an area outside of the two regions indicated below, then whichever geology and hydrology most closely matches that at the proposed site should be the set of recommendations followed. It is recommended that, if needed, the LGU hire a consultant to assist with the recommendations below and charge the fee to the applicant; different consulting firms should be used by the LGU and applicant.

Minnesota River Valley

- Potential for process wastewater, dewatering and stormwater constituents to contaminate groundwater;
- Potential for dewatering to capture nearby contaminant plumes;
- Potential for contaminated groundwater to discharge to surface waters and cause contamination;
- Potential for re-infiltrated waters to change aquifer characteristics; and
- Potential for removal of confining layers above Jordan Sandstone and increased potential for shallow groundwater contamination being drawn downward due to mine pit dewatering.

Paleozoic Plateau

- Potential for process wastewater, dewatering and stormwater constituents to contaminate groundwater;
- Potential for dewatering to capture nearby contaminant plumes;
- Potential for contaminated groundwater to discharge to surface waters and cause contamination;
- Potential for re-infiltrated waters to change aquifer characteristics; and
- Potential for complex hydrogeology, high groundwater flow velocities and sensitivity to contamination.

d. Groundwater monitoring and mitigation plan requirements and model standards:

i. Groundwater Monitoring Plan

1. Site Characterization:
    a. Review of all available geologic and hydrogeologic information for the site and provide:
        i. Assessment of and map indicating groundwater elevation, hydrologic gradient, and groundwater flow direction for the project area.

ii. Cross-section showing pre-mining overburden and deposit thickness, geologic composition, and the approximate groundwater elevation as determined by hydrogeological investigations.

iii. Cross-section showing post-mining topography of project site and thicknesses of remaining geologic formations

1. *Paleozoic Plateau*: indicate if the contact of the Shakopee and Oneota members of the Prairie du Chien group will be less than 50 feet below the ground surface, as this is a predictor of increased potential for sinkhole formation (Dalgleish and Alexander, 1984; Alexander and Maki, 1988; Alexander, et al., 2013).

iv. Assessment of groundwater vulnerability before, during, and after mine operations.

v. *Paleozoic Plateau:*

1. Review all available on-line databases, aerial photos and LiDAR images to identify any karst features within one mile of the project site, including possible intersections of joint sets.
2. Identify any structural bedrock features such as anticlines, synclines, monoclines and domes, as such features are often associated with higher densities of bedrock fracturing.
3. Conduct a site reconnaissance to identify any karst features on and within 500 feet of the project site.
    a. Karst features include: open and filled sinkholes, sinkhole drainage areas, depressions, known caves, resurgent springs, seeps, disappearing streams, karst windows, blind or dry valleys, and open fractures and joints.
    b. In agricultural areas, drain tile systems should be examined since such systems routinely drain to kart features or to surface waters.
4. Provide a map showing the location of any karst features within 500 feet of the project site.
5. Due to the complexity of groundwater flow in this region, the water table configuration should be carefully evaluated:
    a. The study area should be sufficiently large to determine the potentiometric surface in all directions from the site until *either* the water table is established by measurements to be consistently higher than at the vicinity of the site *or* a definite discharge boundary (such as a large perennial stream) is reached.
    b. After groundwater flow direction has been determined and all discharge points identified, a final groundwater/surface water monitoring plan can be established.

b. Groundwater receptor survey that identifies all groundwater users (especially drinking water wells) within a one-mile radius of the site. Note that a simple review of the County Well Index is not sufficient; all residential properties should be assumed to have a drinking water well unless specific information indicates otherwise.

i. Prior to construction of any silica sand operation, the applicant should evaluate the potential increase in vulnerability of public drinking water supplies due to the removal of geologic materials. The Minnesota Department of Health is available to provide information or guidance in this area for the applicant.

c. Identification of any contaminant sources near the site and review of any available information regarding known groundwater contamination within 1 mile of the site. This should include any nearby surface waters that may encroach on the mine site during periods of flooding.

d. Identification of all chemicals to be used at the site, including known residual contaminants of those chemicals and all known breakdown products.

e. Identification of all areas on the project site where wastewater (e.g., from sand processing, dewatering, or surface water runoff) will be stored or infiltrated.

2. Monitoring Well Network

a. The groundwater monitoring well network should be configured to provide sufficient information to evaluate water quality upgradient and downgradient of the project site.

i. The number, location and depth of the wells will depend on such factors as the complexity of the local hydrogeology, size of the project site, depth of the mine, the number and location of wastewater storage/infiltration areas, whether dewatering is occurring, etc.

ii. Additional wells may be needed over time if site monitoring indicates groundwater flow directions differ significantly than those used in planning the monitoring well network.

iii. In areas where dewatering or infiltration is occurring, or vertical flow of groundwater is otherwise indicated, the monitoring well network should include nested wells to detect vertical movement of groundwater and contaminants.

b. The network must include monitoring wells located between the project site and any downgradient groundwater receptors, such as public or private drinking water wells.

i. The depth of such monitoring wells should be appropriate for detecting any site-related contaminants migrating toward the drinking water well.

c. At mines where dewatering occurs, monitoring wells should be placed between the project site and any off-site contaminants that may be drawn toward the project site.

d. Minnesota River Valley Region

i. Regional groundwater flow for mines in this area will generally be toward the Minnesota River, but the potential influence of bedrock structures such as buried bedrock valleys and upwelling from deeper aquifers near the river should be considered in planning monitoring well networks for this region.

e. Paleozoic Plateau

i. The complexity of the hydrogeology of this region requires careful tailoring of monitoring well networks to site-specific conditions and should account for and intercept:

1. significant fluctuations in water table elevations typical of karsted aquifers, and
2. the presence of high permeability zones along bedding planes
    a. If no such zones are identified in the site characterization, wells should be cased to the depth where competent rock is encountered and left open below that for a minimum interval of ten (10) feet.

ii. Natural monitoring points, such as springs, cave streams, and seeps identified as being potential discharge points for groundwater from the facility must be incorporated into the groundwater monitoring network.

iii. Dye tracer studies can also be employed to determine flow regimes.

f. All monitoring well construction shall follow MDH requirements in Minn R. Chapter 4725. Any silica sand operation should be consistent with wellhead protection (WHP) plans as outlined in MN Rules 4720 and the Wellhead Protection Issues Related to Mining Activities document created by the Minnesota Department of Health in August 2009; this document can be found at: http://www.health.state.mn.us/divs/eh/water/swp/mining.pdf

3. Sample Collection and Analysis
    a. Prior to mining operations at the site, groundwater samples should be collected from monitoring wells and nearby drinking water wells to evaluate "background" groundwater quality. This important step could be accomplished by sampling from any or all of the following:
        i. Monitoring wells
        ii. Nearby drinking water wells
        iii. Natural monitoring points, such as springs, cave streams, and seeps identified as being potential discharge points for groundwater from the facility.
    b. The hydraulic conductivity of the potentially affected aquifer(s) should be determined to help set an appropriate sampling frequency.
    c. The frequency of groundwater monitoring well sampling once mining begins will vary depending on the hydrogeologic setting and site operations, however, a typical monitoring plan initially requires quarterly monitoring. The frequency of sampling may change in response to such things as:
        i. Sampling results over time that support either more or less frequent sample collection;
        ii. Potential contamination events, such as chemical releases within the project site or flood waters from a nearby surface water entering the mine pit or infiltration areas;
        iii. Detection of site-related contaminants or changes in groundwater chemistry.
    d. The chemicals analyzed will vary depending on the hydrogeologic setting and site operations, however a typical analyte list includes:
        i. pH
        ii. specific conductivity
        iii. temperature
        iv. total coliform bacteria

v. nitrite + nitrate-nitrogen
vi. naturally occurring metals, such as iron, manganese, and arsenic, that may be mobilized as a result of changing groundwater chemistry
vii. petroleum hydrocarbons or volatile organic compounds (VOCs) to detect any leakage from vehicles or other equipment used at the site.

e. In addition to the above, monitor on an annual basis (at least initially) for:
   i. Hardness
   ii. Aluminum (dissolved and total), antimony, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, magnesium, molybdenum, nickel, selenium, silver, thallium, total tin, and zinc.

f. The frequency of drinking water well monitoring near the site should be based on aquifer hydraulic conductivity and distance and direction of the well from the project site, but initially should be at least annual.
   i. Detection in monitoring wells of site-related contaminants, bacteria, or changes in groundwater chemistry should result in sampling of downgradient private wells.
   ii. As a precaution, if flood waters enter the mine pit or site infiltration areas, downgradient drinking water wells should be sampled for bacteria and any other relevant contaminants.

g. At sites where flocculants will be used, the following chemicals should be included in the groundwater monitoring (both before and after mining begins):
   i. Polyacrylamide-based flocculants:
      1. Acrylamide
      2. Total Kjeldahl nitrogen (EPA method 351.2)
      3. Nitrate + nitrite (EPA method 353.2)
   ii. Poly-diallyldimethylammonium chloride (p-DADMAC) based flocculants:
      1. p-DADMAC, if an analytical method is available
      2. Diallyldimenthylammonium chloride (DADMAC), if an analytical method is available.

h. At minimum, all sampling and monitoring results should be submitted to the LGU on an annual basis. Any monitoring and sampling that shows potential of contamination should be subject to additional monitoring and to mitigation by the applicant as requested by the LGU following their review of the previous year's results.

i. Groundwater monitoring should continue for some period of time following the cessation of mining activities to monitor for contaminant migration over time and to ensure the adequacy of site reclamation. The duration and frequency of sampling will vary depending on the hydrogeologic setting, previous sampling results, site operation history (i.e. any record of chemical spills or flooding), etc., but should continue for no less than 5 years following final site reclamation.

j. Minnesota River Valley Region
   i. Many areas of this region have naturally occurring elevated concentrations of manganese in the groundwater. Monitoring of this metal, both before, during, and after mining operations should be required to determine if changes in water chemistry at or near the project site affect these already high concentrations.

k. Paleozoic Plateau

i. The inherent variability of karst settings should be evaluated by sampling during three major recharge events (i.e. large rainfall event or snowmelt) prior to the start of mining operations to characterize groundwater flow. This should include measurement of:

1. hydraulic head, temperature and specific conductance at nearby wells, and
2. discharge volume, temperature, and specific conductance at natural discharge points such as springs.

ii. These same parameters should also be measured at these points during all other routine site monitoring events.

ii. Groundwater Mitigation Plan

a. The applicant shall provide a plan for responding to detections of site-related contaminants or alterations in groundwater chemistry. This plan must specify:
   i. Response actions to be taken for detections in monitoring wells; and
   ii. Response actions to be taken for detections in drinking water wells.

ii. Surface water quality monitoring and mitigation plan requirements with annual submittal

a. Description of Silica Sand Project Concerns

Silica sand mining operations that have process wastewaters (meaning any discharge not comprised entirely of stormwater), mine pit dewatering (meaning any water that is impounded or that collects in the mine and is pumped, drained or otherwise removed from the mine through the efforts of the mine operator), or stormwater (means stormwater runoff, snow melt runoff, and surface runoff and drainage) have the potential to impact surface waters (meaning all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private). Silica sand mining operations that have process wastewaters, dewatering and/or stormwater discharges to surface waters are required per Minn. R. 7001.0150 to conduct wastewater and surface water monitoring to assure that waters of the state (meaning all streams, lakes, ponds, marshes, wetlands, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion therefore) have not been adversely affected by site operations.

b. Narrative Description and Background Information

Differences in surface water monitoring and mitigation plan requirements for site wastewater management and direct runoff to surface waters are not expected for the different regions of the state (MN River Valley and Paleozoic Plateau). However, the potential for rapid movement of groundwater to surface water without benefit of filtration by aquifer materials, which is typical in karsted areas such as the Paleozoic Plateau, means surface waters in that region may be more vulnerable to contamination from silica sand mining. Surface water sampling plans should reflect the possibility of groundwater discharge to surface waters in this region. Groundwater discharge points to surface waters identified during site characterization should be monitored for site-related contaminants and changes to water chemistry, Groundwater Monitoring and Mitigation Planssubsection. Additional sampling of the receiving surface waters should be based on these results. If silica sand mining and/or operations occur in an area outside of the two regions indicated below, then whichever geology and hydrology most closely matches that at the proposed site should be the set of recommendations followed. It is recommended that, if needed, the LGU hire a consultant to assist with the recommendations below and charge the fee to the applicant; different consulting firms should be used by the LGU and applicant.

c. List of Silica Sand Project Potential Concerns

<u>Minnesota River Valley Region</u>

- Potential for process wastewater, mine pit dewatering and stormwater constituents to discharge to surface waters and cause contamination.
- As most of the mine dewatering activities are likely to happen in in this region, some additional focus on possible impacts of dewatering wastewater management may be necessary for mines along the Minnesota River Valley.

<u>Paleozoic Plateau</u>

- Potential for process wastewater, mine pit dewatering and stormwater constituents to discharge to surface waters and cause contamination.
  - Karst features, such as sinkholes, caves, and solution enlarged fractures, can accelerate movement of site-related contaminants from groundwater to surface waters. Additional surface water monitoring may be needed, based on the site characterization, to evaluate whether site-related contaminants are impacting nearby surface waters.
  - Additional precautions should be required if wastewater pond construction will occur in karst regions due to the potential for sinkhole development beneath such structures.

d. Recommendations, Standards, Criteria, Considerations

As mentioned above, there are three potential types of surface water discharges from silica sand mining and processing operations: process wastewaters (e.g., wash water), dewatering, and stormwater discharges. Each type of discharge has the potential to enter and have an impact on groundwater and/or surface waters. Silica sand mining and processing operations can capture all

process wastewater, dewatering and stormwater discharges on site. This water can then be used as recycled process wastewater (e.g., recycled wash water) and if any remains and is infiltrated on-site then proper infiltration techniques, good engineering, and best management practices need to be in place to protect groundwater from potential contamination.

Therefore, to ensure that these discharges to not pose a risk to surface and groundwater contamination, the following requirements are recommended:

i. Surface Water Monitoring Plan

1. Process wastewater: Process wastewaters (e.g., wash water) that occur at silica sand operations are often treated through the use of settling ponds. If chemical additives, such as flocculants, are used to treat process wastewaters at silica sand mines then additional precautions are needed. Flocculants are a chemical additive commonly used by silica sand operations to speed up the settling rate of very fine particles present in the wastewater. If chemical additives, such as flocculants, are proposed for use by the applicant, then:
    a. Lining of all settling ponds should be required so that a closed-loop system with no discharges to waters of the state (groundwater and/or surface water) is obtained. Lining of settling ponds should be in compliance with state requirements; more information on pond lining can be found at http://www.pca.state.mn.us/index.php/water/water-types-and-programs/wastewater/wastewater-technical-assistance/wastewater-engineering/technical-information.html
        i. If wastewater ponds are lined and a closed-loop system is in place so that no discharges to waters of the state are occurring (i.e., no discharge to surface waters or groundwater), then process wastewater monitoring for the parameters listed below is likely not needed, but is at the discretion of the LGU.
    b. If wastewater ponds are not lined and a close-loop system is not in place, and discharges to waters of the state will occur, in addition to any required state NPDES/SDS permit, then the following monitoring of process wastewater should be required:
        i. For process wastewater discharges to groundwater, follow the Sample Collection and Analysis recommendations found in the Groundwater Monitoring Plan section above.
        ii. For process wastewater which will discharge to a surface water(s), monitor, at a minimum, on a quarterly basis for:
            a. Total suspended solids (TSS)
            b. pH
            c. Temperature
            d. Specific conductivity
            e. Flow
            f. Oil & grease and surfactants
            g. Chemical additives

a. If polyacrylamide flocculants are used, then ***monthly*** monitoring of acrylamide, total Kjeldahl nitrogen (EPA Method 351.2), and nitrate+nitrite (EPA Method 353.2) in the process wastewater and any *waste or water-sediment slurry* should be required initially (reduced sampling frequency may be considered after two years of monitoring has occurred). In addition a dosage rate of polyacrylamide flocculant should be limited to 1 ppm with no more than 0.05% residual monomer, by weight, present in the flocculant so that that the concentration of residual acrylamide monomer does not exceed 0.5 ppb, the National Primary Drinking Water Regulation (NPDWR) established by the US Environmental Protection Agency (EPA) for acrylamide, or any future health based value determined by Minnesota Department of Health, in the wastewater, groundwater, and/or slurry.

b. If poly-diallyldimenthylammonium chloride (pDADMAC) flocculants are used, then ***monthly*** monitoring of pDADMAC and diallydimethylammonium chloride (DADMAC) in the process wastewater, groundwater, and any *waste or water-sediment slurry* should be required if an analytical method is available. Reduced sampling frequency may be considered after two years of monitoring has occurred.

iii. In addition to the parameters listed above, monitor, at a minimum, on an annual basis for:
   1. Hardness
   2. Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc.
   3. Aluminum, barium boron, cobalt, iron, magnesium, manganese, molybdenum, total tin, and total aluminum.

   Additional parameters may be needed based on site specific conditions.

iv. It is recommended that applicants monitor any *water-sediment slurries used as backfill* for all parameters as listed above.

v. It is also recommended that the applicant monitor any nearby surface waters that could receive discharges from the silica sand operation (within 1 mile radius of the site property boundaries) for all parameters listed above pre-construction to establish a baseline for natural background conditions.

vi. All parameters above should be monitored for following the completion of all post-construction and reclamation activities to ensure that any potential negative impact to nearby surface waters is not occurring. Considerations used in the Groundwater Monitoring Sample Collection and Analysis part could be applied here (see section B.2.b.i.d.3.i.).

vii. At minimum, all sampling and monitoring results should be submitted to the LGU on an annual basis.

c. Regardless of whether a closed or open loop system is utilized for wastewater treatment at silica sand operation, proper wastewater basin construction is vital to protect against potential overflow and other issues associated with improper basin design that could lead to contamination of waters of the state. The LGU should require submittal of all engineering specifications for the design and construction of all wastewater basins to ensure appropriate wastewater basin design standards have been met. At minimum, the wastewater basins should be designed to hold all precipitation and wastewater and should be managed to maintain the design capacity of the system. In addition, wastewater basins should be designed with a minimum of three feet freeboard as a factor of safety. Wastewater pond design criteria can be found in the Recommended Pond Design Criteria manual located at http://www.pca.state.mn.us/index.php/view-document.html?gid=11503 .

d. *Paleozoic Plateau:* In addition to the requirements listed above in a. through c., for wastewater pond construction within karst regions of the state, the pond site should not be located on sites which show evidence of karstification (i.e. sink holes or solution channeling generally occurring in areas underlain by limestone or dolomite). Proposed pond sites as well as existing pond sites which are being upgraded should be subject to intensive hydrogeologic site evaluation before approval can be given if they exist in a known or suspected Karst region. This evaluation should include not only an assessment of the current potential for karst feature development, but also whether the mining activities will alter the bedrock topography in ways that may increase the potential for karst feature development (including post-reclamation). Before a pond site to be located in karst area can be approved, the applicant may be required to utilize additional lining materials beyond normal sealing requirements. An intensive hydrogeological site evaluation in karst areas would be required and include seismic and resistivity studies of the site.

e. Any monitoring and sampling that shows potential of contamination should be subject to additional monitoring and to mitigation by the applicant as requested by the LGU following their review of the previous year's results.

2. Mine Pit Dewatering: Dewatering discharges present at silica sand operations typically consist completely of groundwater and stormwater (no process wastewaters). Dewatering discharges consisting solely of uncontaminated groundwater and stormwater, with no chemical additives, typically pose low risk to the environment. Therefore, discharge to surface waters and groundwater, with appropriate state permits, is usually acceptable. *If the dewatering discharge contains chemical additives, then it should be treated as a process wastewater and recommendations listed above for Process Wastewater should be followed.*

   For dewatering discharges (consisting solely of uncontaminated groundwater and stormwater) to surface waters and groundwater, monitoring of the following parameters and conditions are recommended:

a. For dewatering discharges to groundwater, follow the Sample Collection and Analysis recommendations found in the Groundwater Monitoring Plan section above.
b. For dewatering discharges which will discharge to a surface water(s), monitor, at a minimum, on a quarterly basis for:
    1. Total suspended solids (TSS)
    2. pH
    3. Temperature
    4. Specific conductivity
    5. Flow
c. In addition to the above, monitor, at a minimum, on an annual basis for:
    a. Hardness
    b. Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc.
    c. Aluminum, barium boron, cobalt, iron, magnesium, manganese, molybdenum, total tin, and total aluminum.

    Additional parameters may be needed based on site specific conditions, particularly if there are known areas of groundwater contamination or sources of potential groundwater contaminants located within the capture zone of the dewatering system.
d. Where dewatering wastewater is re-infiltrated in constructed galleries above or in limestone or dolomite bedrock formations, the water chemistry of both the formation and the re-infiltrated water should be monitored for calcium as dissolved $CaCO_3$ (EPA method 200.7) to evaluate the potential of the re-infiltrated water to cause dissolution of the formation that may lead to development of karst features such as sinkholes and solution cavities.
e. It is also recommended that the applicant monitor any nearby surface waters that could receive dewatering discharges from the silica sand operation (within 1 mile radius of the site property boundaries) for all parameters listed above, pre-construction, to establish a baseline for natural background conditions.
f. All parameters above should be monitored for following the completion of all post-construction and reclamation activities to ensure that any potential negative impact to nearby surface waters is not occurring. Considerations used in the Groundwater Monitoring Sample Collection and Analysis part could be applied here (see section B.2.b.i.d.3.i.).
g. In addition to the monitoring requirements listed above, the following conditions should be in place at silica sand operations if dewatering will occur:
    1. Any outlet pipe, culvert or hose outlets for the discharge should all be located on the ground. The silica sand operation should install and maintain outlet protection measures such as properly sized riprap, splash pads, or gabions at the discharge stations to prevent erosion.
    2. All water from dewatering or basin draining activities should discharge in a manner that does not cause nuisance conditions, erosion in receiving channels or on downslope properties, or inundation in wetland causing significant adverse impact to the wetland.

h. At minimum, all sampling and monitoring results should be submitted to the LGU on an annual basis. Any monitoring and sampling that shows potential of contamination should be subject to additional monitoring and to mitigation by the applicant as requested by the LGU following their review of the previous year's results.

3. Stormwater: Stormwater present at silica sand operations can become contaminated when runoff comingles with industrial activities, processes, and/or significant materials (significant materials includes, but is not limited to: raw materials; materials such as solvents, degreasers, detergents, fuels, and lubricants; fertilizers and pesticides; finished materials such as nonmetallic products; and waste products such as slurry that have the potential to be released with stormwater discharges. When determining whether a material is significant, the physical and chemical characteristics of the material should be considered (e.g., the material's solubility, transportability, and toxicity characteristics) to determine the material's pollution potential. In addition to monitoring, appropriate stormwater controls, as discussed in the next section, C. Stormwater management, should be implemented to protect stormwater runoff from contamination.

For stormwater discharges to waters of the state, monitoring of the following parameters and conditions is recommended:

a. For stormwater runoff discharges to groundwater, follow the Sample Collection and Analysis recommendations found in the Groundwater Monitoring Plan section above.
b. Stormwater runoff leaving silica sand operations site property boundaries should be no different than pre-project rates (more on this in C. Stormwater management section). For any stormwater runoff that is discharging to surface waters, in addition to any required state NPDES/SDS permits, the following monitoring requirements should be in place:
c. Monitor, at a minimum, on a quarterly basis for:
    a. Total suspended solids (TSS)
    b. pH
    c. Temperature
    d. Specific conductivity
d. In addition to the above, monitor, at a minimum, on an annual basis for:
    a. Hardness
    b. Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc.
    c. Aluminum, barium boron, cobalt, iron, magnesium, manganese, molybdenum, total tin, and total aluminum.
e. Additional parameters may be needed based on site specific conditions.
f. It is also recommended that the silica sand operation monitor stormwater runoff that has not come into contact with any industrial activity, processes, or significant materials for all parameters listed above to obtain natural background conditions for comparison.
g. All parameters above should be monitored for following the completion of all post-construction and reclamation activities to ensure that any potential negative impact to nearby surface waters and groundwater is not occurring.

h. At minimum, all sampling and monitoring results should be submitted to the LGU on an annual basis. Any monitoring and sampling that shows potential of contamination should be subject to additional monitoring and to mitigation by the applicant as requested by the LGU following their review of the previous year's results.

ii. Surface Water Mitigation Plan

a. Any monitoring and sampling that shows potential of contamination to surface waters should be subject to mitigation by the applicant as requested by the LGU.
    i. The applicant should provide a plan for responding to detections of site-related contaminates or alterations in surface water quality. The plan should specify
        1. Response action to be taken for detections in surface waters.

B.2.c. Stormwater management

i. Stormwater management plan elements

a. Description of Silica Sand Project Concerns

Silica sand mining operations that have stormwater (means stormwater runoff, snow melt runoff, and surface runoff and drainage) have the potential to impact surface waters (meaning all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private) and groundwater. Stormwater runoff can come into contact with silica sand mining processes and significant materials (i.e, materials with potential to contaminate stormwater). Stormwater runoff that is contaminated by industrial activities and significant materials may lead to contamination of receiving surface water and groundwater. Therefore, stormwater controls and best management practices (BMP) should be implemented to protect surface and groundwater from contamination.

Stormwater runoff can become contaminated through contact with significant materials such as storage piles, process equipment, and dust emitted during processing. Stormwater can be discharged two ways: through groundwater or surface water. The site should enclose all significant materials to the extent possible and contain all stormwater on-site to prevent contamination of nearby surface waters. Evapotranspiration or proper infiltration methods should be used to treat stormwater prior to discharge to groundwater.

In areas prone to sinkhole development, alterations of sinkhole drainage areas may result in formation of new sinkholes nearby, with the potential for unanticipated impacts to groundwater and surface water. The stormwater management plan should identify and avoid, or minimize and mitigate, any changes to surface drainage to nearby sinkholes.

b. Narrative Description and Background Information

Pollutants conveyed in stormwater discharges from active and inactive mineral mining and processing facilities will vary. A number of factors influence to what extent industrial activities and significant materials can affect stormwater discharges and water quality:

- Mineralogy of the extracted resource and the surrounding rock
- How the mineral was extracted (e.g., quarrying/open face, dredging, solution, or underground mining operations)
- Type of ground cover (e.g., vegetation, crushed stone, or dirt)
- Outdoor activities (e.g., material storage, loading/unloading, vehicle maintenance)
- Size of the operation
- Type, duration, and intensity of precipitation events
- Inadequate BMPs

These factors should be taken into consideration so that stormwater control and BMPs utilized on site are effective in preventing contamination of waters of the state from impacted stormwater.

c. List of Silica Sand Project Potential Impacts

Potential impacts are applicable to both the Minnesota River Valley and the Paleozoic Plateau.

- Potential for stormwater constituents to discharge to waters of the state and cause contamination exists in both regions.

d. Recommendations, Standards, Criteria, Considerations

For both the Minnesota River Valley and the Paleozoic Plateau, LGUs can consider the following:

To the extent possible, all significant materials and processes should be enclosed so that no contact with stormwater is made. In addition, as described in the Air Quality Standards A.2. Dust Control and Containment of Sand 'Processing' section above section above, after the sandstone has been mined, all subsequent processing steps should be enclosed. Processing encompasses the following activities: washing, cleaning, crushing, filtering, drying, sorting, and stockpiling of silica sand.

The main method of treatment utilized to control stormwater involves a variety of best management practices (BMPs). BMPs are applicable to eliminate or minimize the presence of pollutants discharges from mineral mining and processing facilities. A combination or suite of BMPs will likely be needed to address stormwater and process wastewater contained on-site and/or discharging from the facility.

The first consideration should be for pollution prevention BMPs such as enclosure (designed to prevent or minimize pollutants from entering stormwater runoff and/or reduce the volume of stormwater requiring management), followed by treatment BMPs (engineered structures, intended to treat stormwater runoff and/or mitigate the effects of increased stormwater runoff peak rate, volume, and velocity). The former includes regular cleanup and spill control, and the latter includes infiltration devices and sediment ponds. Finally, source reduction BMPs are methods by which discharges of contaminants are controlled with little or no required maintenance, and include diversion dikes, vegetative covers, and berms.

Mining facilities often operate only seasonally or intermittently, yet year-round controls remain important because significant materials remain exposed when reclamation is not completed. These characteristics make a combination of source reduction and treatment BMPs the most desirable controls. Source reduction BMPs are typically low in cost and relatively easy to implement, while more intensive treatment BMPs, including sedimentation ponds and infiltration devices, may also be necessary.

To ensure appropriate BMPs have been put into place at a site, the development and submittal of a Stormwater Management Plan to the LGU (commonly referred to as a Stormwater Pollution Prevention Plan (SWPPP) or Pollution Prevention Plan (PPP)) should be required which documents consideration and implementation of, at a minimum, the following:

- Description of BMPs in place and any enclosure
- Infiltration device and/or stormwater pond design, construction, and management
- Erosion and sediment control practices
- Vehicle tracking control of sediment
- Good housekeeping
- Maintenance of BMPs in place
- Management of spills and leaks
- All methods used to control stormwater runoff rate and volume so that pre and post-construction runoff is not different for a 100-year 24-hour storm event
- Inspections
- Management of surface drainage and nearby sinkholes

Again, enclosure of significant materials and a combination of BMPs is expected to yield the most effective wastewater and stormwater management for minimizing the offsite discharge of pollutants. All BMPs require regular maintenance to function as intended. BMPs must be regularly inspected to ensure they are operating properly, including during runoff events. As soon as a problem is found, action to resolve it should be initiated immediately. Documentation of inspections and any problems encountered and how they were resolved should be included in the required Stormwater Management Plan submittal as well. Further guidance on stormwater control and management can be found in the Minnesota Stormwater Manual located at http://stormwater.pca.state.mn.us/index.php/Main_Page.

In sinkhole-prone areas, especially in the Paleozoic Plateau, Stormwater Management Plans should identify and avoid, or minimize and mitigate, any changes to surface drainage to nearby sinkholes.

ii. Rate and volume control

a. Description of Silica Sand Project Concerns

Silica sand mining operations can change the pre-existing natural landscape and topography. Changes to landscape and topography impact stormwater (means stormwater runoff, snow melt runoff, and surface runoff and drainage) and have the potential to impact surface waters (meaning all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private), groundwater, and neighboring properties. Therefore, in addition to stormwater controls and best management practices (BMP), stormwater rate and volume should be controlled.

b. Narrative Description and Background Information

Two distinct geologic settings exist where silica sand is mined in Minnesota; however, different responses by the silica sand operation a regarding stormwater rate and volume control is not expected. It is recommended that, if needed, the LGU hire a consultant to assist with the recommendations below and charge the fee to the applicant; different consulting firms should be used for the LGU and applicant.

c. List of Silica Sand Project Potential Impacts

Potential impacts are applicable to both the Minnesota River Valley and the Paleozoic Plateau.

- Potential for an increase in stormwater rates and volumes which can impact surface water, groundwater, and neighboring properties exists in both regions.

d. Recommendations, Standards, Criteria, Considerations

For both the Minnesota River Valley and the Paleozoic Plateau, LGUs should consider the following:

To help eliminate the concern of stormwater runoff contaminating waters of the state and nearby properties, sites should be designed to minimize the rate of stormwater runoff. This can be achieved by minimizing new impervious surfaces; minimizing the discharge from connected impervious surfaces by discharging to vegetated areas, or grass swales, and through use of other non-structural controls. In addition, sites should be designed with capabilities to control and contain stormwater on-site so that the pre and post-project runoff rates and volume from a 100-year 24-hour precipitation event are not different. The most recent version of NOAA Atlas 14 should be used for precipitation frequency estimates. Further guidance regarding stormwater rate

and volume control can be found in the Minnesota Stormwater Manual located at http://stormwater.pca.state.mn.us/index.php/Main_Page.

iii. Pond design

a. Description of Silica Sand Project Concerns

Stormwater runoff that is contaminated by industrial activities and significant materials may lead to contamination of receiving surface water. Therefore, in addition to stormwater management and stormwater rate and volume controls, stormwater should be contained on site. To contain stormwater runoff on site, ponds will likely be needed so that pre and post project runoff rates are not different for a 100-year 24-hour storm event. Proper pond design, construction, and management should be required to aide in prevention of unintended discharges which can lead to contamination of waters of the state and nuisance conditions on neighboring properties.

As noted in the discussion of mine pit dewatering, infiltration galleries constructed above or in limestone or dolomite bedrock formations may create conditions for development of karst features. This should be carefully evaluated when such systems are proposed for managing stormwater.

b. Narrative Description and Background Information

Two distinct geologic settings exist where silica sand is mined in Minnesota; different responses by operators regarding pond design is expected. If silica sand mining and/or operations occur in an area outside of the two regions indicated below, then whichever geology and hydrology most closely matches that at the proposed site should be the set of recommendations followed.

c. List of Silica Sand Project Potential Impacts

Minnesota River Valley Region

- Potential for improper construction of stormwater ponds which can lead to discharges to waters of the state and potentially cause contamination.
- Potential for improper construction of stormwater ponds which can lead to discharges causing nuisance conditions on nearby properties.

Paleozoic Plateau

- Potential for improper construction of stormwater ponds which can lead to discharges to waters of the state and potentially cause contamination.
- Potential for improper construction of stormwater ponds which can lead to discharges causing nuisance conditions on nearby properties.
- Extra caution and consideration is needed if constructing ponds in karst prone areas of the state.

d. Recommendations, Standards, Criteria, Considerations

Minnesota River Valley Region

To help eliminate the concern of stormwater runoff contaminating waters of the state, sites should be designed to contain stormwater runoff on site.

To contain stormwater on site, containment basins such as industrial stormwater ponds, sedimentation basins and/or infiltration devices should be constructed to allow for infiltration of stormwater; be constructed to allow for maximum separation distance from groundwater with a minimum of three feet of separation distance from the bottom of the infiltration system to the elevation of the seasonally saturated soils or the top of bedrock; should not be constructed in areas with standing water; and designed with capacity to hold up to a 100-year 24-hour storm event if need be. In addition, a minimum of three feet of freeboard should be in place as a factor of safety.

Much of the poor performance exhibited by ponds employed in the sand and gravel mining industry is due to the lack of understating the settling techniques. This is demonstrated by the construction of ponds without prior determination settling rate and detention time. The chief problems associated with settling ponds are rapid fill-up, insufficient retention time and the closely related short circuiting. This can be avoided by proper sizing, construction, and management. Therefore, it is recommended to request documentation of engineering specification and management to insure ponds are properly sized and maintained. Further information regarding pond design criteria, good engineering practices and proper settling techniques can be found at: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/wastewater/wastewater-technical-assistance/wastewater-engineering/technical-information.html

Paleozoic Plateau

In addition to the requirements listed above, for pond construction within karst regions of the state, the pond site should not be located on sites which show evidence of karstification (i.e. sink holes or solution channeling generally occurring in areas underlain by limestone or dolomite). Proposed pond sites as well as existing pond sites which are being upgraded should be subject to intensive hydrogeologic site evaluation before approval can be given if they exist in a known or suspected karst region. An intensive hydro-geological site evaluation in karst areas would be required and include seismic and resistivity studies of the site. This evaluation should be included with the Site Characterization as recommended in the Groundwater Monitoring Plan section above.

Also, for stormwater management basins within karst regions of the state, an appropriate combination of measures such as shading, filtered bottom withdrawal, vegetated swale discharges or constructed wetland treatment cells that will limit temperature increases and protect groundwater from any potential contamination should be considered. However, based on results of the hydro-geological site evaluation and the likelihood of infiltration accelerating karst formation, lining of stormwater ponds may be necessary with additional lining materials beyond normal lining requirements. More information on pond lining can be found at

http://www.pca.state.mn.us/index.php/water/water-types-and-programs/wastewater/wastewater-technical-assistance/wastewater-engineering/technical-information.html

B.2.d. Containment Requirements for Chemicals Used in Processing

a. Description of Silica Sand Project Concerns

Silica sand mining operations utilize chemicals that could contaminate surface waters and groundwater if exposed. Therefore, any chemicals used in silica sand operations should be managed carefully.

b. Narrative Description and Background Information

Two distinct geologic settings exist where silica sand is mined in Minnesota; different responses by silica sand operations regarding chemical containment and management is not expected. It is recommended that, if needed, the LGU hire a consultant to assist with the recommendations below and charge the fee to the applicant; different consulting firms should be used for the LGU and applicant.

c. List of Silica Sand Project Potential Impacts

Potential Impacts are applicable to both the Minnesota River Valley and the Paleozoic Plateau.

- Potential for chemicals to discharge to waters of the state and cause contamination exists in both regions.

d. Recommendations, Standards, Criteria, Considerations

For both the Minnesota River Valley and the Paleozoic Plateau, LGUs should considering the following:

In order to prevent contamination of waters of the state from chemicals used in silica sand operations, limits and controls should be put in place at the site for use of materials at the facility that may cause exceedances of surface or groundwater standards specified in Minnesota Rules, ch. 7050 and 7060. These materials include, but are not limited to, detergents and cleaning agents, solvents, chemical dust suppressants, lubricants, fuels, hydraulic fluids, drilling fluids, oils, fertilizers, explosives and blasting agents. These materials must be properly stored, including secondary containment, to prevent spills, leaks or other discharge. Storage and disposal of any hazardous waste should be in compliance with applicable solids and hazardous waste management rules; any necessary state permits for hazardous waste and/or above ground

storage tanks should be obtained. These materials should not be discharged to surface waters or groundwater of the state.

In addition, the applicant should eliminate or minimize contact of stormwater with significant materials that may result in pollution of the runoff. *Therefore, measures to prevent or minimize stormwater contact with any storage piles of materials containing chemicals (e.g., slurry or waste containing polyacrylamide or poly-diallyldimenthylammonium chloride (pDADMAC)) should be implemented*. Also, measures to prevent or minimize stormwater contact with fuel areas should be utilized. The applicant should consider covering the fueling area, using spill and overflow protection and cleanup equipment, minimizing run-on/run-off of storm water to the fueling area, using dry cleaning methods, collecting the storm water runoff and providing treatment or recycling or other equivalent measures.

Furthermore, materials management practices should be evaluated to determine whether inventories of exposed materials can be reduced or eliminated. This can include clean-up of equipment yards, periodic checking of dust control equipment to ensure minimal accumulation of dust in the area of control equipment, consolidation of materials from multiple areas into one area, and training employees regarding proper handling and disposal of materials. Significant materials (i.e, materials with potential to contaminate stormwater) may also be moved indoors or covered with a tarp or structure to eliminate contact with precipitation.

B.2.e. Containment requirements for silica sand in temporary storage to protect water quality

a. Description of Silica Sand Project Concerns

Silica sand operations commonly handle raw, intermediate, and final product that are considered significant materials (i.e, materials with potential to contaminate stormwater). Significant materials are stored indoors and/or outdoors on site for temporary or extended durations. As described in the Stormwater Management section, outdoor storage of raw, intermediate and final grade silica sand should be contained in a manner that eliminates or reduces exposure of the significant materials to stormwater (means stormwater runoff, snow melt runoff, and surface runoff and drainage) so that waters of the state (ie., groundwater and surface waters) are protected.

b. Narrative Description and Background Information

Inadequate best management practices (BMPs), poor housekeeping and failing to reduce and/ or minimize exposure of temporary storage piles and other significant materials to stormwater can potentially contaminate waters of the state that receive stormwater discharges associated with an industrial activity.

c. List of Silica Sand Project Potential Impacts

Potential impacts are applicable to both the Minnesota River Valley and the Paleozoic Plateau.

- Potential for temporary stockpiles and storage of other significant materials to contaminate waters of the state exist in both regions.

d. Recommendations, Standards, Criteria, Considerations

As described in the Air Quality Standards, Dust Control and Containment of Sand 'Temporary Storage' section, temporary storage is defined to be the storage of stockpiles of silica sand that have been transported and await further transport. Storage piles that are intended to be used at the facility on a recurring basis are not considered temporary storage; rather, these piles should be enclosed and controlled in the manner described in the Air Quality Standards Dust Control and Containment of Sand 'Processing' section above.

In situations where silica sand is to be stored on a temporary basis and the material cannot be enclosed, then the following requirements should be in place to ultimately protect waters of the state from contamination:

1. Temporary stockpiles or stripping/overburden stored outside the pit should have sediment control mechanisms in place until the material is completely removed. Materials should not be placed in surface water or stormwater conveyances such as curb and gutter systems, or conduits and ditches.
2. After the temporary pile has been removed, the area should be swept as soon as possible to prevent contamination of stormwater.
3. Temporary stockpiles of materials containing chemicals such as flocculants (e.*g.*, *polyacrylamide or poly-diallyldimenthylammonium chloride (pDADMAC*)) should be managed so that stormwater contact is prevented or minimized and discharges of contaminated stormwater to groundwater and surface waters does not occur.
4. Silica sand should be checked for moisture content and watered until the moisture content of the pile exceeds the amount indicated in the Air Quality Standards, Dust Control and Containment of Sand 'Temporary Storage' section.
5. All other requirements for open-air storage piles included in Air Quality Standards, Dust Control and Containment of Sand 'Temporary Storage' section should be followed to ultimately help protect water quality.

References

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C. Transportation: Road and Bridge Impacts

Overview

Silica sand is a common bulk material that falls into the freight transportation category of a low value, high volume, heavy and dense undifferentiated commodity. Silica sand mined and processed for use as a proppant in oil field hydraulic fracturing operations represents a new and large scale use of this commodity. Because of the geographic locations of the end use of this product, virtually all of the material is transported to consumers distant from the main sources of high grade commercial "frac" sand in Wisconsin, Illinois, and Minnesota. Mine sites for silica sand with the required physical properties are relatively dispersed, while processing plants and transload sites to access rail and barge common carriers are more concentrated and naturally benefit from economies of scale and access to long distance, low cost transportation.

A large percentage of mine-generated traffic will be in heavy commercial trucks operating over the public road network, which by law and ownership is open without discrimination to all users. Despite that right to transport persons and property on public roads, the applicants and the local government units are equally cognizant of the previously unforeseen impacts on road structure, safety, and the environment that these new large scale and highly concentrated traffic patterns place on the infrastructure, and that specially conditioned and contractual arrangements may need to be made to maintain ongoing viable transportation operations. In addition, the long distance nature of this transportation chain automatically involves interstate movements and the federal government in its role as regulator of national commerce, a further complicating factor for LGU's consideration. The tension between local and national interests is an ongoing issue but comprehensively addressed in federal legislation, rules, and case law.

The following recommendations, standards, criteria, and considerations specifically address those impacts and issues that are in the purview of state and local government officials and can effectively be monitored and mitigated through local ordinances and conditional use permits negotiated with applicants for silica sand facilities.

Reference: www.dot.state.mn.us/frac/; Use of Public Roads
www.dot.state.mn.us/frac/; Land Use and Federal Pre-emption for Railroads and Waterways (Albemarle County, VA, brief)

C.1. Weight Limits: Truck Loadings and Legal Compliance

a. Description of Silica Sand Project Concerns

Adherence to road and bridge weight limits by silica sand truck transporter.

b. Narrative Description and Background Information

Road wear from traffic use is strongly correlated with the use of heavy commercial trucks running at or near the legal weight limit and axle loadings. This is particularly true on local light duty roads and bridges designed for lower traffic levels and lighter axle loadings, with less heavy commercial traffic expected. On a designated silica sand haul route from mine to process plant or transload facility, heavy commercial trucks and the associated wear is concentrated and continuous, unlike the dispersed truck traffic patterns created by other uses such as sand and gravel quarries, distribution centers, ethanol plants and grain elevators. Although history and practice in the silica sand industry show that most routine truck operations are legal in truck size, configuration, and axle loading, significantly accelerated wear rates and even pavement and structural failures on the route can result from overloading. In addition, distinct postings of roads and bridges for lighter weights, and seasonal road down-postings such as spring thaw restrictions should be recognized and adhered to in order to minimize excess wear. Much of this can be assured by strategically placed scales, solid state scale devices on loading equipment, conveyors, and trucks, and regular communications between the applicant and the road personnel at the LGU, the County, and MnDOT.

c. List of Silica Sand Project Potential Impacts

- Accelerated wear and road or bridge damage caused by truck overloads
- Unsafe operation exacerbated by overloaded trucks or deteriorated road surfaces
- Severe road damage caused by ignoring condition-based or seasonal road weight down-postings

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. The applicant and its contractors and operators will adhere to all legal weight limits, axle loadings and truck configuration regulations without exception. Special postings and seasonal conditions will be observed in all cases.

2. The applicant will demonstrate to LGU the installation and operation of weight measuring equipment sufficient to control the loading of all trucks within specified load limits.

3. The applicant will consult as necessary and appropriate with local, county, and state road officials about operational matters and regulatory compliance, but not less than on an annual basis.

C.2 Designated Truck Routes

a. Description of Silica Sand Project Concerns

Designating a mutually acceptable silica sand haul route for regular use by applicant's trucks from mine to processing plant and transload sites.

b. Narrative Description and Background Information

Silica sand mining is a very high volume and concentrated activity. A mine may generate from 50 to 250 truckloads per day of raw silica sand. While some silica sand operations are self-contained with mining, processing and rail loading all on a single property or adjacent properties, others rely on truck hauling from an active mine site to an associated but distant processing plant and transload site for rail or barge loading. This entails a high level of truck traffic on a single highway route by vehicles loaded to the 80,000 pound maximum gross vehicle weight (GVW) legal limit in Minnesota. Recognizing that high purity silica sand is a very common, non-hazardous transportation commodity that has been handled in regular commerce for over a century in Minnesota, and is subject to effective EPA and OSHA regulation for dust exposure and occupational hazards, it is the traffic impacts on road structures, the safety of the applicant's transportation employees and the traveling public on these roads, and disturbance of residents and businesses immediately adjacent to the route that are arguably the most significant and wide-ranging effects of large scale silica sand mining and processing.

The applicant will normally desire uninhibited use of the shortest heavy-duty network of roads that is possible, in good condition and allowing safe operation. This is a critical concern of the applicant due to safety issues and the cost of operation, both of which directly determine the viability and competitiveness of the company. The local government units along the route will have concerns in several areas. These include accelerated wear on local roads and bridges on the route that may have a light duty design, safety of other local road users including passenger vehicle, farm implements, recreational users, and non-motorized vehicles, and traffic impacts on residents and businesses adjacent to the route that may see increased levels of traffic, dust, and noise. Other local government units on the route but not directly authorized to permit the sand facilities will have similar concerns but reduced authority to control the impacts. State highway officials will have an interest in the route's use of state and federal roads and bridges, not necessarily for accelerated wear but certainly for safety and connectivity issues.

The designation of the preferred haul route should be mutually acceptable to all parties, including all units of government having responsibility for each road segment along the route.

Under current law, the request to participate by other impacted LGU's in permitting negotiations is solely at the pleasure of the permitting LGU, and represents the only opportunity for impacted LGU's to have a say in the preferred routing, traffic impact studies, and any road use compensation agreements. The impacted non-permitting LGU's have no other recourse to request consideration under current state law. The Minnesota Department of Transportation recommends this cooperative approach and also may need to be represented among the impacted governmental units particularly in District 6 (Southeast Minnesota). The designation of the primary route may also be accompanied by an intentional designation of preferred detours in the case of required road maintenance, traffic issues, or emergencies. The route designation should be determined with the routine and maximum truck volumes in mind. The route designation allows the performance of a targeted Traffic Impact Study for the entire route, and identification of needed rehabilitation, corrective design and construction, and refined maintenance schedules.

c. List of Silica Sand Project Potential Impacts

- Accelerated wear and failure of light-duty roads and bridges from intensive use, and disruption of transportation for both silica sand operator and existing road users
- Unsafe travel conditions for all users in areas of substandard road condition or design due to increased heavy truck traffic
- Environmental and life style impacts for residents and businesses immediately adjacent to designated route, particularly in small towns and other settled areas
- Reduction or elimination of recreational and non-motorized uses on some road segments, impacting tourism and, recreational businesses and culturally distinct local religious and farming communities

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. Within the permitting process, a trip origin and destination will be specified for each expected or preferred haul route. Multiple origins or destinations will require a distinct route designation for each Origin/Destination pair. Designated routes will include identification of all roads regardless of road class or jurisdiction, including local, county, state, and federal roads. At least one secondary route must be specified for each primary designated route. A significant route change during or after the permitting process will trigger a permit review. Each government unit responsible for a highway segment will be involved in any discussion of routing and the impacts caused by specified routings, with resolution of any unresolved issues the prerogative of the permitting LGU.

2. A maximum permitted daily trip volume and an expected routine daily trip volume will be specified on each designated route. In the case of multiple mines and routes converging on a common destination represented by one processing or transload site, a consolidated maximum and routine trip volume will be produced, with sub-segment volumes individually designated.

3. Each designated primary route and secondary route will be subject to a Traffic Impact Study prior to the issuance of any permit, at the expense of the applicant. The Traffic Impact Study will involve the entire length of the designated route regardless of class and governmental ownership of the public road. The Traffic Impact Study will address traffic impacts at current and projected traffic levels and comment on safety and alternative road uses, including recreational use and culturally distinct communities and the presence of non-motorized vehicles.

C.3. Compensation for Identified Road Wear on Designated Route

a. Description of Silica Sand Project Concerns

Determining reasonable and necessary compensation for identified road wear on Designated Route segments, including establishment of Road Use and Maintenance Agreements between the applicant and impacted local governing units.

b. Narrative Description and Background Information

Heavy commercial truck traffic concentrated on a single designated route with fully loaded and frequent truck trips will notably accelerate the wear and reduce the expected life of certain highway segments of the designated silica sand truck route. The impacted segments may in particular be local lightly designed and constructed roads, and in the instance of certain state roads in District 6 (southeast Minnesota), unpaved or lightly constructed state highways. Almost all responsible local government units in central and southeast Minnesota have insufficient financial resources to maintain the local road segments under this heavy use, resulting in failure of the road surface and structure for all users including the silica sand producers. The precedent exists in numerous other neighboring states to negotiate a level of compensation specifically for maintenance and upgrade of the designated road segments that are determined to be deficient through engineering analysis and traffic projections. In principal, the sand industry recognizes this need to maintain the infrastructure that will be subject to unusual wear, at the expense of the applicant responsible for the wear, determined by professional assessment of the wear, costs, and mitigation, and subject to informed negotiation of compensation with the LGU on a case-by-case basis.

A current Aggregate Material Removal Tax, Minnesota Statute 298.75, subd. 2a, b, and d, is available to counties to offset road wear caused by sand and gravel hauling, and the resulting revenue may be distributed to local cities and townships. The tax can be no more than 15 cents per ton of material either transported, sold, or imported into the county. Research done by Mankato State University under commission from the Local Road Research Board (LRRB) on road wear specified in Equivalent Single Axle Loadings (ESAL's) noted that intensive use of a road by commercial trucks loaded to the maximum legal vehicle weight limits may significantly

shorten a road's design life, and incur a direct maintenance or replacement cost of up to 22 cents per ton per mile of sub-standard roads subjected to intensive heavy commercial use. Depending on the length of the sub-standard road segment and other relevant conditions, the Aggregate Tax may be inadequate by a factor of 10 or more to provide adequate revenue. A further complicating factor is 298.75, subd. d, prohibiting collection of "additional host community fees" if the aggregate tax is being collected. This prohibition could be interpreted as preventing a negotiated road use fee included in a CUP.

The agreement to cooperate on road maintenance and upgrades may be included in a Road Use and Maintenance Agreement (RUMA) linked to the conditional use permit process. RUMA's have been widely employed in similar circumstances in several states, including Ohio, Pennsylvania, and Wisconsin. The National Center for Freight and Infrastructure Research and Education (CFIRE) describes this tool in a whitepaper on Wisconsin sand mining, noted in the references. A RUMA may employ any of a number of financing schemes for the necessary work. The Minnesota County Engineers Association, the Local Road Research Board, Mankato State University, and MnDOT have cooperated in developing a road wear calculator, available at www.dot.stat.mn.us that in part identifies a fee of up to 22 cents per ton-mile applied to the length of the deficient highway segments under concentrated loads, based on ESAL and design life considerations. The consensus on fair and appropriate application of this fee is that it will apply until such time as the necessary repairs and upgrades are accomplished to put the road segment into a heavy-duty category in a good state of repair. Other negotiated alternatives may include a lump sum payment to the road authority to complete upgrades before mine start up, an annual stipend to assist accelerated repair schedules, and contracting for supplemental road crews by the applicant, in coordination with local government activities. The RUMA should also detail any necessary sub-agreements covering financial assurances, funds transfers, cooperative construction projects, safety accommodations, and other impact mitigation conditional to the CUP.

References:

www.dot.state.mn.us/frac/; Findings from Winona County Task Force
www.dot.state.mn.us/frac/; CFIRE Whitepaper: Chippewa County Sand Mining

c. List of Silica Sand Project Potential Impacts

- Rapid deterioration of road pavement under increased heavy commercial traffic
- Deterioration and failure of bridges and drainage systems along the designated route
- Collapse of road edges and shoulders under load
- Unsafe operating conditions for all users
- Depletion of financial resources of local government unit
- Loss of access to mine sites and other users of the deteriorated road segment

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. The permitting LGU and adjacent governmental units with roads directly impacted by the haul route will assess the existing condition of roads and bridges, and remaining design life. Assessment will be at cost to the applicant. Assessment will include an estimate of any pre-start up remediation deemed necessary for safe and efficient operation without immediate damage to road structure, and other geometric or safety improvements engendered by the intensive operation of commercial trucks in the employ of the applicant, particularly as reported by the Traffic Impact Study.

2. Upon identification of light-duty or deficient roadways, the haul distance will be specified for each segment of light-duty road needing ongoing maintenance and improvement. The ton-miles hauled over these segments will be subject to a negotiated road use and maintenance fee specified in a Road Use and Maintenance Agreement (RUMA), with each impacted government unit along the route party to the RUMA. The ton-mile fee is not to exceed 22 cents per ton-mile on the identified mileage until such time as road structure including bridges is brought up to full ten-ton, heavy duty condition. A lump-sum remediation amount may be negotiated as part of the RUMA, as well as periodic payments above and beyond the ton-mile fee to be used toward accelerated road maintenance as agreed or needed. Each governmental unit involved in haul route impacts will receive a corresponding share of the remittances. The RUMA will include sub-agreements addressing the detailed operating and financial arrangements.

C.4 Safety Issues and Mitigation

a. Description of Silica Sand Project Concerns

Identifying safety issues specific to road locale and traffic levels, and implement mitigation measures to restore road to safe condition for all users.

b. Narrative Description and Background Information

As part of a comprehensive Traffic Impact Study, the applicant in cooperation with the local governing units affected along the route will study and identify specific safety issues that arise from a significant increase in heavy commercial vehicle traffic. Safety issues are a particular concern in certain areas of southeast Minnesota. The area is heavily dependent on a thriving tourism business hinging in part on hiking and bicycling in rural areas of the region. They are particularly frequent users of local roads during summer months. A second consideration unique to the southeast is the presence of Amish and Mennonite colonies in the area. Their culture and religious beliefs eschew modern conveniences including cars and trucks. As a result, they employ horse drawn buggies, wagons, and farm implements in their normal daily activities. Their horse and buggies are a constant presence year round, operating at slow speeds and using light vehicles that leave riders extremely vulnerable in traffic collisions. Many of the two-lane

rural roads they frequently use are potential connectors to proposed mine sites. The current roads generally do not have wide shoulders or any other accommodation for use by widely different vehicle traffic. The Traffic Impact Study is expected to address these concerns in the southeast, and lead to agreements that will correct safety deficiencies that are the result of heavy commercial truck traffic. These responses to the identified safety problems may include employee, community, and public education efforts to improve the visibility of the issues of threatened users.

MnDOT supports the adoption of appropriate road design improvements to address these safety conflicts. Turning and climbing lanes may be specified at specific sites. Areas along the preferred haul route that host non-motorized vehicle traffic should be a candidate for installation of 10 foot wide graded, partially paved, shoulders for the complete distance of the identified conflict. Locally acceptable alternatives including bypasses and dedicated trails may also be adopted as part of the CUP.

c. List of Silica Sand Project Potential Impacts

- Safety threats to established recreational and non-motorized road uses by implementation of heavy haul routes on certain road segments.
- Increased risk to health and life of culturally distinct community members in the southeast
- Economic damage to the area due to degradation of tourism and recreational uses
- General safety risks and conflicts for all road users on designated routes

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. The Traffic Impact Study will identify traffic safety impacts specifically involving the common use of roadways along the designated haul route with recreational uses, including pedestrian (hiking and running) and biking activities, and non-motorized vehicle uses, in particular horse-drawn buggies, wagons, and farm implements. The Traffic Impact Study will further identify the origin or sources of these conflicting uses, including trails, resorts, and culturally distinct religious communities including Amish and Mennonite communities and colonies. (may be specific to southeast region, but applicable statewide)

2. Safety conflicts or potential hazards will be mitigated through mutually agreeable improvements, including but not limited to road widening, shoulder widening and surfacing, surface use designation and signage, warning signs, both commercial driver and general public education, speed limits, correction of limited lines-of-sight, and other recognized effective design and operational measures. These may be at cost to applicant.

C.5. Transportation Related Communications

a. Description of Silica Sand Project Concerns

Establish formal contacts and regular communications to monitor and coordinate transportation activities related to silica sand transportation.

b. Narrative Description and Background Information

Successful ongoing operation of silica sand facilities and transportation under the Conditional Use Permit and RUMA terms will depend on a regular and professional communication regimen. Operating officials at the Applicant Company and counterparts at the local government level should be in routine contact to monitor and address emerging issues around the transportation agreements and the implementation of mitigation measures. The designated contacts should be authorized to act for their respective organizations in order to effectively and promptly respond to problems. Best practices in other regions suggest at least monthly face-to-face meetings and regular phone or electronic communications as needed.

c. List of Silica Sand Project Potential Impacts

- Effects of emerging problems or deteriorating infrastructure conditions may reach critical proportions without regular monitoring and response
- Information on company operations and community complaints lost for responsible officials
- Lack of responsiveness to changes in volumes, operations, or routes if not monitored
- Local conflicts for employees and residents an ongoing issue

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. The applicant and each governmental unit party to the Road Use and Maintenance Agreement (RUMA) will specify an authorized and responsible staff contact. The RUMA will include a requirement to maintain regular professional communications between all contacts at least monthly and more often as needed in order to monitor operations, road conditions, construction, routing, and maintenance as necessary.

D. OPERATIONS

The experience level regulating operational activities of surface mines is highly varied between different LGUs. For many issues that are specified in the operational section, the experience in regulating aggregate mines can be applied to regulating silica sand mines. There are some exceptions that have been noted in other sections of this document. One, the use of flocculants is infrequently used to process aggregates, but is more commonly employed in silica sand processing. And two, the length of transport and the potential number of time/places the material is handled are greater than the aggregate industry.

Setting operational standards and criteria is one method to control potential impacts and adverse effects of mining, processing, and transportation of silica sand projects; protect the safety and health of the public; and mitigate nuisance issues. Using operational standards in combination with other mitigating strategies, such as screening with vegetation (buffers), berms, setbacks, and general land use planning (see Setbacks and Buffers for further discussion) is a best management practice that is commonly used by LGUs.

In this section, six operational standards and criteria related to silica sand mining, processing, transload, and transportation (referred to collectively as silica sand projects) are addressed: lighting, hours of operation, reclamation, financial assurances, blasting, and inspection. Within this section, there are a range of tools offered to LGUs that are interested in regulating silica sand activities. The tools include language that could be included in ordinance, standards and criteria, and general considerations for decision making. Where appropriate, special considerations for geographic regions are addressed.

D.1. Lighting

a. Description of Silica Sand Project Concerns

Silica sand mining and related projects have the potential for producing light emission and contributing to ambient light pollution. Although this is a regional environmental problem with many contributing sources, the concern is that bright lights produced at a silica sand project site would further degrade the “night sky” and impact the circadian rhythm of humans and wildlife. Setting lighting requirements are best addressed in ordinance. Model ordinances created by the International Dark-Sky Association (IDA) and the Illumination Engineering Society (EIS) are available for LGUs to consider and adopt. In lieu of existing lighting ordinances, lighting requirements can then be addressed during the issuance of a local permit. The permitting process can require Photometric Plans for proposed projects with specified performance standards.

b. Narrative Description and Background Information

Dark starry nights, like natural landscapes, forests, clean water, wildlife, and unpolluted air are valued by residents and communities. Ambient light pollution by man-made light is one of the most rapidly increasing alterations to the natural environment (Cinzano *et al*., 2001). The first World Atlas of artificial night sky brightness (seen in figure 1) produced by Cinzano *et al* indicates that all of southern Minnesota is impacted by ambient, night-time light levels.

Ecologists are beginning to research and better understand some of the impacts of artificial night lighting. Impacts, such as the deaths of migratory birds around tall lighted structures, are better known (Evans-Ogden, 1996). While other more subtle influences of light pollution, such as the influence on behavior and impacts to community of ecology of species, are less well recognized (Longcore and Rich, 2004 and Buchanan, 1993). Medical research is just starting to link health impacts to the disruption of circadian rhythms and sleep deprivation (Stevens *et. al*, 2004,).

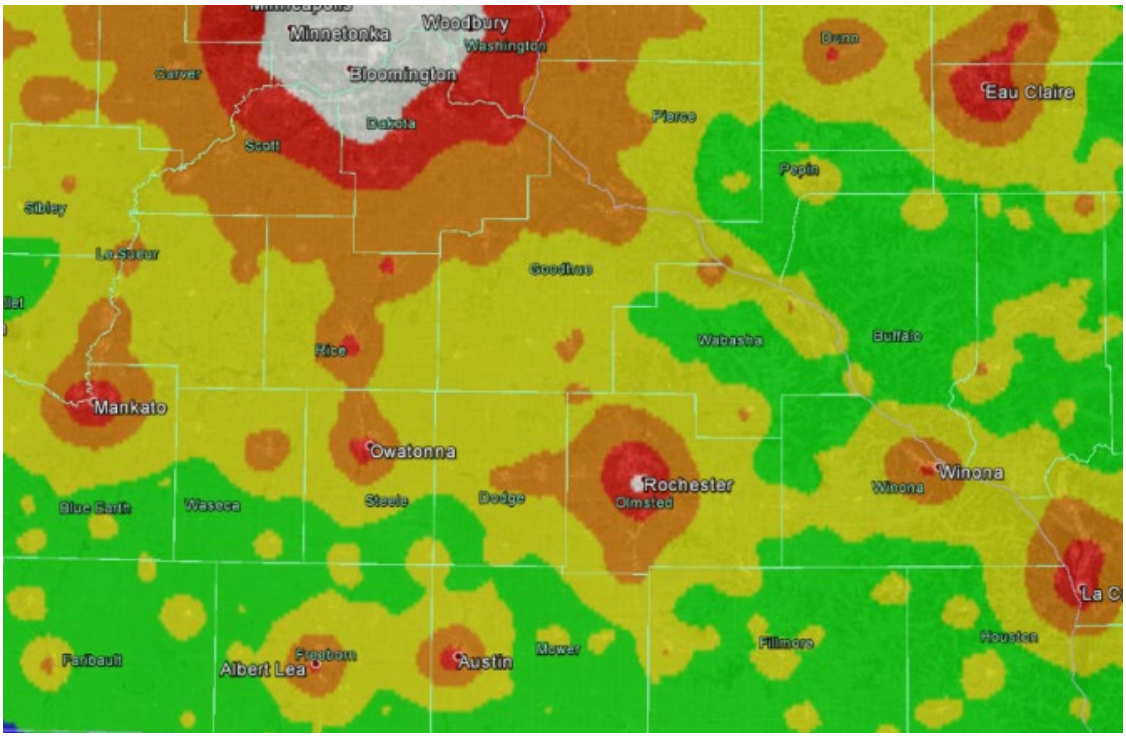

Figure 1: Artificial Night Sky Brightness of Southern Minnesota, 2001. Based on the data from Cinzano, et. al., 2001. Overlay of model brightness on Google Maps, downloaded 11/14/2013.

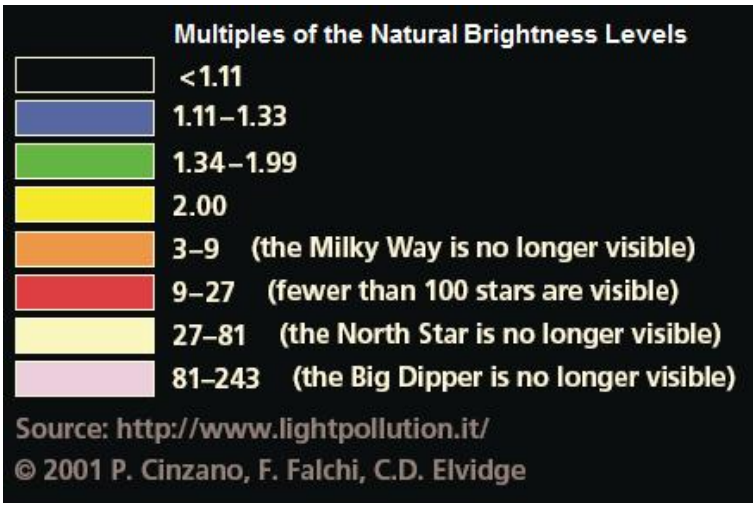

Figure 2: Scale of brightness.

Lighting requirements of silica sand projects are partially regulated by State and Federal Governments. The Occupational Safety and Health Administration (OSHA) sets standards and guidelines for lighting requirements within the workplace. Mining Health and Safety Administration (MSHA) regulates the health and safety of workers within a mine. The Minnesota Department of Labor and Industry also specifies minimum levels of illumination in Minnesota Rule 5205. While proper lighting is considered a safety precaution, light emissions from a mine or a facility can significantly alter the local night time landscape. Even though federal and state standards and guidelines must be met for silica sand projects, an LGU can stipulate outdoor lighting emissions and specifications of a mine site or facility.

A collective issue like night sky brightness requires a collective approach to improve the overall quality of a night sky. Please refer to "Additional Resources" near the end of this section for internet links to Model Lighting Ordinances (MLO) and more information about state resources that are available to communities.

c. Potential Impacts as it Relates to Lighting

The use of outdoor lighting is often necessary for adequate nighttime safety and utility, but common lighting practices can also interfere with other legitimate public concerns which include:

- The increase of sky glow or the brightening of the night sky due to the accumulation of lights.
- Light trespassing onto neighboring properties.
- Wasted light emissions where it is not needed or intended.
- Excessive brightness, or glare, which causes visual discomfort and decreased visibility.

- Unnecessary consumption of energy and resources in the production of wasted light.
- The impact of visible light emissions within the wavelength 500 nanometer or less (blue to violet light in the spectrum of visible light) on wildlife and human health.
    - Wildlife impacts include species becoming distracted or attracted to artificial light; species being exposed to higher levels of predation; species navigational abilities can be disrupted; and species can be induced into early breeding due to long artificial days.
    - Human health impacts including disruption of hormone production (melatonin) which is linked to insomnia, depression, and cancer (Chespesiuk, 2009).
- While unfiltered LED lighting is energy efficient, it produces more blue-rich light than metal halide lights.

Figure 3: Glaring lights can distress the eyes. (Photo Source: International Dark-Sky Association)

d. Recommendations, Standards, Criteria, Considerations

For creating lighting ordinances:

- It is recommended that a community establishes lighting ordinances that can be used to determine performance standards for all sources of ambient night-time light.
    - A recommended guide to establish lighting overlay districts is the "Model Lighting Ordinance" (MLO) jointly produced by the Illuminating Engineering Society (IES) and the International Dark-Sky Association (IDA) in 2011.
    - Lighting Zones defined by the MLO range from
        - LZ0 – A recommended default zone for wilderness areas, parks, preserves, and undeveloped rural areas to

- § LZ4 – This pertains to areas of very high ambient lighting levels and may be used for extremely unusual installations such as high density entertainment districts and heavy industrial uses.

· Any new development, including silica sand projects, would have to comply with lighting performance standards prescribed by Lighting Zones. A majority of silica sand projects would fall into LZ1-LZ3.

Lighting Zone	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Allowed Lumens Per SF	0.5	1.25	2.5	5.0	7.5
Allowed Base Lumens Per Site	0	3,500	7,000	14,000	21,000

For permitting individual silica sand projects, an LGU may want to consider:

· Requiring Photometric Plans as a condition of a local permit, which could include:
  - o Pre-construction analysis to assess baseline night sky conditions.
  - o Future assessment of light impacts from a silica sand project and consideration of impacts from additional sources of light not associated with the project site.
  - o Once the plan is approved, any additional new or temporary outdoor lighting with exception to emergency lighting must submit a new outdoor lighting plan to LGU(s) and receive approval prior to implementation of the revised plan.
  - o Plan should include location and limits of outdoor lights and a photometric diagram showing predicted maintained lighting levels of proposed lighting fixtures.

Standards and criteria for consideration:

· Requiring outdoor lighting with color temperature specifications no greater than 3000K.
· Requiring full-cutoff outdoor lighting fixtures.
· Specifying zero percent uplight emissions above 90 degrees for area lighting.
· Requiring outdoor lighting fixtures that must be aimed, located, and maintained to prevent glare.
· Specifying zero percent “property-line” backlight emissions to prevent light trespass onto adjacent properties.
· Stipulating adaptive lighting controls to dim or extinguish lighting when not needed that would reduce wasted light.
· Encourage use of high-pressure sodium lamps and narrow-spectrum Light Emitting Diode (LED) lighting systems when color rendering light is not needed.
· As with any aspect of permitting, an LGU may need to hire an engineer or lighting professional to review and approve projects at the cost of the applicant.

Additional Resources

To download the Joint IDA-IES Model Lighting Ordinance (MLO), go to the Illuminating Engineering Society website:
http://www.ies.org/PDF/MLO/MLO_FINAL_June2011.pdf

For additional State support in developing efficient outdoor lighting, contact the MPCA GreenStep Cities Program:

Website: www.mngreenstep.org
Phone: 651/757-2594 or 800/657-3864

For more information on the impacts of light pollution, sample ordinances, and approved "Dark-Sky" lighting, go to the International Dark-Sky Association website: http://www.darksky.org/

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Florida Atlantic University Astronomical Observatory:
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Flagstaff Arizona Lighting Regulations:
http://www.flagstaff.az.gov/DocumentCenter/Home/View/14707

D.2. Hours of Operation

a. Description of Silica Sand Project Concerns

Hours of operation for silica sand projects are best determined on a project by project basis to address specific issues of an individual project. Operational hours can also be set in ordinance with the option of modifying them as needed within the permitting process.

Setting the hours of operations is one means to mitigate noise impacts, light pollution, and traffic issues originating from a project site. Hours of operations could be broken out and specified by activity or be all inclusive (all activity is to occur during a specified interval). Typically, for mines or facilities with longer operational life-spans and multiple phases of activity, addressing hours by activity may make sense. Additionally, LGUs could also adjust hours of operation seasonally to compensate for changes in daylight hours and the potential loss of vegetated buffers during leaf-off conditions.

b. Narrative Description and Background Information

Determining a the hours of operation of a mine, processing, or transload facility is a function of many different parameters of a given site: proximity to residences and residential districts, residential density, adjacent land use and activities, the placement of processing equipment within the mine, width of buffers, height of berms, school bus routes and schedules, type of back-up alarms, etc. For projects undergoing environmental review, some of the this information needed to make decisions about hours of operations would be addressed in noise and traffic impact studies. An LGU could require these studies be performed regardless of whether a project meets the thresholds for a formal environmental review, especially if a concern exists with proximity of a project to non-conforming land uses.

Additional activities that may be associated with silica sand projects include independently operated truck terminals and maintenance facilities. Independent trucking facilities may be established to support silica sand transport from mine site to processing facility and/or transload sites. These truck facilities may include routinely regulated activities such as equipment fueling, lubrication, and washing. A silica sand truck fleet may consist of ten to fifty dedicated trucks. The hours of operation will tend to begin before sand facility start-up, and end after specified sand facility hours of operations end. This may constitute an extension of specified hours of operation that will impact residences and businesses in immediately adjoining areas and on travel

routes. Ordinances and conditional use permit terms may be designed to limit this extension of operating hours.

Specified conditions and ordinances must be specific to link this limitation of operations to the intensive operations of the sand mining and processing activities, due to risk of overlap of these controls onto other commercial operations and businesses that may be supported by the same truck terminal. This would constitute an unintended and unapproved restriction on trade to unassociated business activities if the truck terminal is operated by an independent or contracted operator, which would in turn be subject to a valid challenge by the impacted parties.

c. List of Silica Sand Project Potential Impacts

When determining the hours of operation for silica sand projects and related activities, a number of factors should be considered:

- Potential impacts of silica sand projects and independent trucking facilities may include:
  - Noise and vibration from engines, wheels and brakes, horns, back-up alarms, and communication systems.
  - Light pollution from yard lights in terminal and headlights of trucks.
  - Extension of truck transportation related noise, vibration, and traffic impacts beyond plant hours of operation.
  - Route and terminal specific impacts to immediately adjacent residences and businesses.
- Compatibility to adjacent land uses.
- Results of the Noise Impact Study and Traffic Study.
- Best and appropriate time for a specific activity associated with the project and life span of a project.
- Special cultural or community characteristics of an area.
- It is also important to weigh the possible benefits and impacts of concentrating mining, processing, or transporting activities to a given timeframe. For example,
  - Limiting hours of operations has the benefits of restricting noise and traffic impacts to daylight hours and to times when a percentage of people are presumed not to be home.
  - However, restricting hours of production may result in:
    - A larger mine footprint to maintain production rates,
    - A longer lifespan of the mine,
    - A higher density of truck traffic during peak traffic hours, and/or
    - Additional equipment being operated on-site and increased noise.

d. Recommendations, Standards, Criteria, Considerations

When hours of operations are stipulated within local permitting process, site-specific issues and concerns can be better addressed.

Recommendations

- Based on the location and scope of the project and results of various impact studies, examples of hours of operations include:
  - Restricted hours (EXAMPLE: 7:00 A.M. to 6:00 P.M., no weekends or federal holidays) could be considered when a project is near higher densities of population or non-conforming land uses, such as tourist attractions, parks, etc.
  - Non-restricted hours (24 hours/7 days a week) could be considered when mines are located near compatible land uses, large distances from residential dwellings, etc.
- A LGU may consider further limitations on specific activities that generate additional nuisance impacts. Examples of such activities include:
  - BLASTING: For safety considerations, blasting could be limited to daylight hours. Another option it to specify hours in which this activity is allowed within the permit to mine. Language used in the LeSueur County CUP (#29000) of UNIMIN South Mine, Kasota Township and Scott County IUP of Great Plains Sands (May 1, 2012):
    All blasting shall be conducted between the hours of 10 AM and 6 PM, Monday through Saturday. Every effort possible should be made to limit blasts between the hours of 10 AM and 3 PM. No blasting on weekends or holidays (holidays should be designated/identified – i.e. federal holidays) without County Board prior approval.
  - REMOVAL OF OVERBURDEN: For some mining operations, this activity can generate additional noise from heavy equipment. A LGU may want to consider restricting the removal of overburden to specified hours within a local permit: i.e. *conducted between the hours of 7:00 A.M. and 6:00 P.M., except on Sundays and federal holidays. Any modification would require prior approval from LGU*.
  - BERM CONSTRUCTION: Since this activity occurs near the property line, a more restrictive timeframe is recommended: i.e. *conducted between the hours of 8:00 A.M. and 4:30 P.M., except on Sundays and holidays. Any modification would require prior approval from LGU*.
  - PROCESSING: If processing is not enclosed within a structure, an LGU may want to limit hours of processing depending on the location of the facility.
  - TRUCKING RATES/LIMITATIONS: Depending on the location of the mine and the rate of trucks leaving, an LGU may want to specify in the local permit limitations on truck activity:
    - During hours of school transportation.
    - During high traffic levels
    - During inclement weather and poor road conditions and upon notification by the LGU
  - ASSOCIATED TRUCKING: Stipulate that truck terminal operations remote from the silica sand mining and processing facilities may not begin associated truck fleet operations more than one hour before the specified plant hours of operation, nor extend more than one hour beyond daily end of specified plant

hours of operations. This will not, however, limit movements of individual trucks at the terminal for unit maintenance, repositioning, delivery of supplies, or the movement of employees and their individual vehicles on, around, or to and from the terminal, nor will it apply to established operations of the terminal for other customer's services.

- MAINTANCE/REPAIR at the MINE SITE: Similar to "Associated Trucking", LGUs could stipulate the hours in which repair and maintenance of equipment and heavy machinery is to occur if noise generated from this activity has a potential to impact adjacent land uses.

- It is recommended to develop a grievance process in which neighboring properties owners, residents, and other affected persons have the ability to address issues and problems stemming from a silica sand project. The grievance process can incorporated in the local permit and is applicable to address several operational processes addressed in this section. Criteria and considerations to include in a grievance process:
  - All grievances are addressed in writing or phone call to the applicant.
  - Require the applicant to keep a log of all grievances they have received. If the grievance can be mitigated immediately, then the applicant should address the concern.
  - Require the applicant to give regular updates (monthly or quarterly) that reports complaints and responses to complaints. LGU could require public meetings as a condition of the permit.
    - Specify that meetings should review all grievances and mitigation efforts reported for the month. If the grievance requires further consultation from the LGU, specify that the applicant should work with the LGU to determine if a violation of federal, state, or local regulations has occurred.
    - Specify that the organization of monthly meeting should be the sole responsibility of the applicant.
    - Monthly outreach meetings should be jointly led by the applicant and a representative of an LGU.
    - Specify that staff time required to prepare for and participate in meetings should reimbursed by applicant.
- Stipulate within the local permit or in ordinance corrective actions, fines, and/or temporary revocation of permit may be implemented if an applicant is non-compliant on terms specified in permit.
- Truck terminals remote from the silica sand mining and processing but supporting significant and continuing fleet operations for sand transportation should be subject to reasonable nuisance mitigation measures specified by the local jurisdiction directly associated with the sand transportation fleet activity. This may include but is not limited to noise regulation in the form of employee operating protocols to reduce truck, horn, and warning device noise; noise barriers at points of close contact between facility and neighboring residents or businesses; and light regulation in the form of shutters, baffles, or barriers to block direct light impacts from truck terminal's fixed lighting or from truck headlights during hours of darkness.

D.3. Reclamation

a. Brief Description of Silica Sand Project Concerns

Reclamation serves the interest of the general welfare to control the possible adverse environmental effects of mining, to conserve natural resources, and to encourage the planning of future land utilization, while promoting good mining practices. The objective of a reclamation plan is to produce a landscape that is safe, stable, and compatible with the surrounding landscape and final land use. Inadequate mine reclamation may result in undesirable outcomes, often not immediately observed, such as the focused infiltration of surface contaminants to groundwater, altered water quality in nearby springs and streams, accelerated soil erosion, and the creation of physical hazards, such as sinkholes.

b. Narrative Description and Background Information

All stakeholders benefit from good mine planning and effective reclamation of a mine site. For the general public, reclamation ensures that land disturbances are minimized. In addition, reclamation ensures that disturbed land areas are returned to productive use for agriculture, forestry, natural environments, recreation, residential, or industrial use as soon as possible. For operators, good mine planning promotes efficient mining practices and extraction of a resource. For the environment, good mine planning reduces hazards such as water contamination, production of dust, loss of topsoil, destruction of fish and wildlife habitat, and promote an operation's environmental sustainability.

To protect groundwater, future land use options require well-thought-out planning. Where mining activities remove critical protective geologic materials above an aquifer, post-reclamation land uses have the potential to degrade groundwater quality. Agricultural crop production, with its inherent use of nutrients and pesticides (and in many cases, animal waste), landfills, and manufacturing are land uses of particular concern on reclaimed mining sites. Karst areas in the Paleozoic Plateau are particularly susceptible to groundwater contamination; however, the removal of protective materials has the potential to impact groundwater quality in the Minnesota River Valley as well.

Planning for reclamation and mine closure should occur before the mine opens. Even though a reclamation plan is agreed upon, it is important to convey to the applicant the expectation of continuous improvement in operating practices and equipment with the goal of increasing environmental performance of a mining, processing, or transload facility. Areas of continuous improvement include, but not limited to:

- Minimizing the footprint of the development
- Minimizing the disturbance to sensitive features, the environment, and cultural resources.

- Maximizing resource extraction
- Minimizing water use
- Decreasing dust, noise, and vibration output
- Improving recovery and processing of soil
- Maximizing the direct placement of topsoil
- Increasing rate of progressive reclamation
- Reducing emissions from equipment, processing facilities, and transload sites
- Increasing energy efficiency in lighting
- Minimizing the length of time disturbed lands are unreclaimed.

While there is much technical information presented in this section, the document cannot broadly serve as handbook or guide to reclamation. Fortunately, many resources, guides, and handbooks dedicated to assisting LGUs with reclamation issues are available, which are listed in "References" of this section. Another consideration, the Department of Natural Resource is in the process of developing and adopting rules for the reclamation of silica sand mines (MN Law 2013, Chapter 114, Article 4, Section 105b) which are expected to be completed in 2015. Rule development will follow procedures specified by Minnesota Administrative Procedure Act (APA), Minnesota Statute Chapter 14. As a result, the adopted reclamation rules that are finalized may differ from the information presented in this document.

c. List of Silica Sand Project Potential Impacts

A poorly planned mine site has an increased potential to impact the environment and surrounding communities in the following ways:

- Lack of mine and reclamation planning can result in larger open mining areas, creation of additional sources of dust, increased exposure of ambient dust, negative effect on cultural resources, and increase of visual impacts.
- Improper site drainage has the potential to funnel water to sensitive features, create karst features, and impact groundwater.
- Groundwater contamination from the removal of protective geologic materials.
- Groundwater contamination from inappropriate land uses on previously mined areas where protective geologic materials have been removed.
- Inadequately managed sites
    - Pose safety hazards to the public.
    - Result in soil loss, have lack of erosion control and increase sediment load to nearby streams and lakes.
    - Result in the introduction or spread of invasive species.
- Withholding all reclamation until the end of the mine's life can result in:
    - Deteriorated and less fertile soils that have been stockpiled over time.
    - More expensive and longer establishment of revegetation.
    - Lack of reclamation segments and test plots for revegetation
    - Higher financial assurance and liability.
    - Increased likelihood of infestations of invasive species.

d. Recommendations, Standards, Criteria, Considerations

The following standards and criteria have been partially derived or modified from Wisconsin Admin Code NR135, Minnesota DNR Sand and Gravel Reclamation Handbook, Alberta, Canada- A Users Guide to Pit and Quarry Reclamation in Alberta, and Washington DNR Best Management Practices for Reclaiming Surface Mines in Washington and Oregon.

Examples of reclamation performance standards that could be included in ordinance are:

- Silica sand reclamation shall be conducted, to the extent practicable, to minimize the disturbed area by mining and to provide for reclamation of portions of the site while mining continues on other portions of the mine site.
- The mine site shall be restored, to the extent practicable, to a condition at least as suitable as that which existed before the lands were affected by silica sand mining operations.
- Reclamation of silica sand mines shall comply with any other applicable federal, state, and local laws including those related to environmental protection, zoning, and land use controls.
- A silica sand mine site shall be reclaimed in a manner that does not cause a permanent lowering of the water table and result in adverse effects on surface waters or significant reduction in the quantity of groundwater reasonably available for future users of groundwater.
- Reclamation of a silica sand mine shall be conducted in a manner which does not negatively impact groundwater quality as regulated by federal, state, or local law.
- Intermittent mining may be conducted provided that the possibility of intermittent cessation of operations is addressed in an operator's reclamation permit, no environmental pollution or erosion of sediments is occurring, and financial assurance for reclamation is maintained covering all remaining portions of the site that have been affected by silica sand mining and that have not been reclaimed.
- During reclamation, landforms shall be designed and constructed to complement nearby natural terrain, minimize adverse water quality and quantity effects on receiving waters, enhance the survival and propagation of vegetation, be structurally sound, control erosion, promote early completion and progressive reclamation, and encourage the prompt conversion from mining to an approved subsequent use.

<u>Paleozoic Plateau</u>

- Flow of water shall be managed during mine development and reclamation activities so not to accelerate the development of karst and other secondary porosity features in the underlying bedrock materials.

Requirements for Mine and Reclamation Plans: The following information is recommended to be included in mine and reclamation plans submitted to an LGU. Some information may already be required in other portions of a local permit, water management plans, and state required permits.

(1) Applicant Information

- A brief description of the general location and nature of the silica sand project.
- A legal description of the property on which the silica sand project is located or proposed, including the parcel(s) identification numbers.
- The names, addresses, telephone numbers, and email addresses of all persons or organizations who are owners of the property on which the silica sand project is located.
- If the property is being leased, the names, addresses, telephone numbers, and email addresses of all persons or organizations who are lessors of the property on which the silica sand project is located.
- If the project operation is being managed by a third-party company or organization that is not the owner or lessor, the name, addresses, telephone numbers, and email addresses of the all persons or organizations responsible for operating the mine and/or facility in the project area.
- Stipulate that an LGU must be notified 120 days in advance of any changes in status of owner, lessor, and/or operator and pursuant of financial assurance agreements.

(2) Assessment of Pre-mining Conditions: The applicant should describe the pre-mining conditions of the site and adjacent to the site, which includes:

- Description and map of current land use within and ½ mile adjacent to project area.
- Assess and provide a map indicating groundwater elevation, hydrologic gradient, and groundwater flow direction for the project area and other additional information specified in the "Groundwater Monitoring Plan – Site Characterization" section.
- Provide maps and cross-section of pre-mining conditions as they currently exist in the project area:
    - Size 10-20 acres, not less than 1" = 100'
    - Size of 20-80 acres, not less than 1"= 200'
    - Size of >80 acres, ~ 1" = 400' or scale that is determined to be most appropriated.
- Cross-sections that adequately characterized the geologic variability of overburden and deposit thickness, geologic composition of the deposit, contacts between geologically distinct material and the approximate groundwater elevation as determined by hydrogeological investigations.
- Conduct a field assessment to determine topsoil thickness of both A and B horizons. Display this information on a site map overlaying topsoil units using Natural Resource Conservation Service (NRCS) soil data. Make special note where topsoil is less than 1 foot to C horizon.
- Map indicating ownership within and ½ mile adjacent to the project area.
- Map of all structures within and adjacent up to ½ mile adjacent to the project area and the purpose for which each structure is used, including buildings, pipelines, cables, railroads, and power lines.
- Map of existing roads within project area.
- Map of previous excavations in the project area.
- A list and description of known or inferred cultural resources within a project area.
- Contours within the project area at intervals no larger than two (2) feet.

- Map and description of a pre-mining vegetation and wildlife survey. Survey should indicate percent of grass basal cover, native vegetation cover, invasive species cover, rock cover, etc. Identify native and invasive species, diversity of plant and wildlife. The applicant should describe data collection methods and provide photos of transects. This baseline data on the existing plant community can be used in part to establish criteria for release of financial assurance.

Paleozoic Plateau

- Indicate the location of the site and if it is within 1 mile of a designated trout stream or class 2A waters and subject to additional permitted authorized by Minn. Stat, section 103G.217 and would require an issuance of a Trout Stream Setback permit from the DNR.
- Location of all seeps, springs, sinkholes, and other karst features within 1 mile of the mine site (as recommended in the Considerations for Setbacks – Trout Stream and Class 2A section).
- Since this region is an ecologically sensitive region, LGUs may want to require Natural Heritage Reviews be done on all projects regardless of size in order to assess the project's potential to negatively impact any state-listed species or other rare features.

(3) Mine Planning: During the lifetime of the mine, the applicant should provide the information about the logical sequencing of a mine.

- Describe the projected life of the operations including beginning and ending of operations and any phases or stages. Indicate on a map the proposed sequence of mining the deposit and display the following information:
    - Permitted area of the mine (shape, size, and depth of mine), including boundaries of the areas that will be disturbed by mining, setback boundaries that apply to the silica sand project, all permanent boundary markers, and location of buffers, berms, fences, and gated mine entrance.
    - Location of proposed access roads and rail road spurs to be built in conjunction with the silica sand mining operation.
    - Numbered segments and the direction and sequence of mining.
    - Soil storage areas and sequence of stripping, storing, and replacement of overburden on mined segments. If topsoil to the C horizon is less than 1 foot over a significant area of the mine, stipulate that both A and B horizons may be stockpiled together. Mine sites where A and B soil horizons are greater than 1 foot, it may be desirable to keep distinguishable soil horizons in separate piles and reclaim in the original soil sequence.
    - Location of operation plant, processing areas, transload sites and related infrastructure.
    - Location of wells, water pipes, and settling ponds.

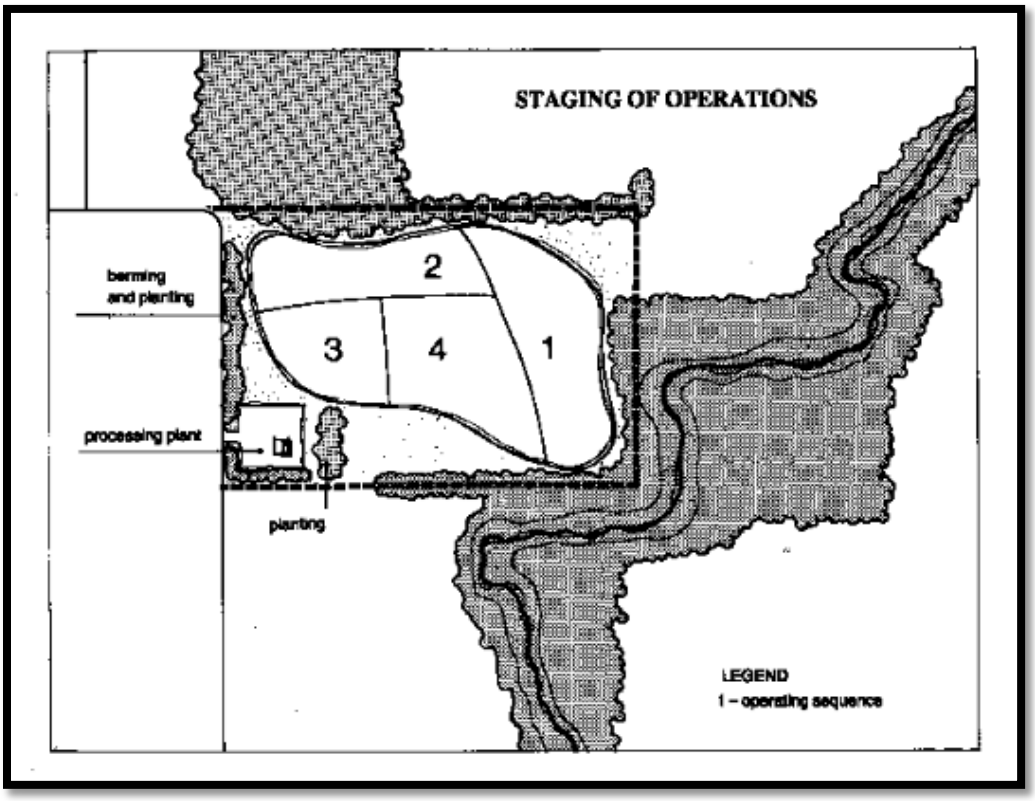

Figure 4. Example of map showing sequence of mining

LEGEND

1) Dogleg access to screen view from road
2) Buffer Strip
3) Fencing
4) Topsoil Storage
5) Overburden Storage
6) Reclaimed
7) Progressive Active Reclamation
8) Working Space
9) Exposed Gravel
10) Overburden goes to active reclamation (7)
11) Topsoil goes to topsoil storage (4)
12) Cleared Area

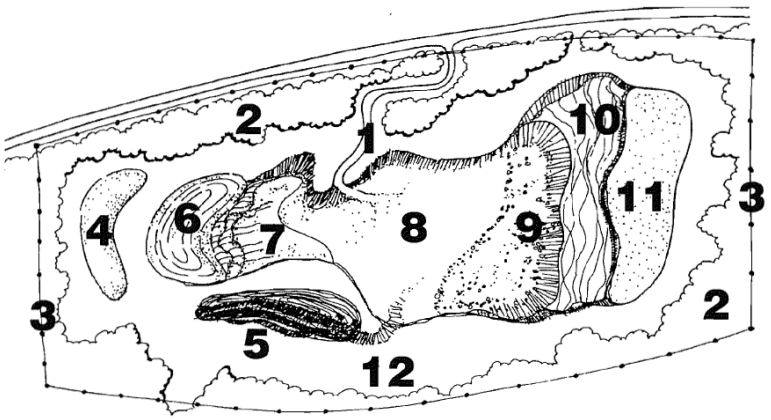

Figure 4. A number of structures and mine features are associated with typical non-metallic mining operations: the mine pit, topsoil storage, overburden storage, product stockpiles, berms, mine entrance, processing facilities, ponds, and weigh station (Alberta Land Conservation, Pit and Quarries, Reclamation in Alberta).

- Negotiate berm height with respect to visual impacts to nearby residences and stipulate that berms are to be maintained and kept free of invasive species.
- For visual and noise impacts reduction, describe how the existing topography and site characteristics of the mine will be maximized, i.e.:
    - Storage of overburden in berms along the site, plant vegetation on berms to reduce noise and dust eemissions.
    - Plant vegetation (such as trees, shrubs, and native grasses) well ahead of mining to maximize time of establishment.
    - Place loud stationary equipment, such as the crusher, in an excavated area below the surrounding terrain.
- Describe how the equipment will to be used in excavating and processing of silica sand.
- Describe the use of flocculants, range of potential consumption/use of flocculants.
- Provide estimates for the following:
    - The volume to be mined in each phase of mining.
    - Volume of waste products (processed sand) used in reclamation. A LGU should specify if off-site silica sand is allowable to use in reclamation.
    - Volume of overburden and topsoil to be used in reclamation.
- Describe the methods that will be used at the cessation of seasonal operations to stabilize slopes from erosion, prevent topsoil from erosion, and prevent the establishment of invasive species.
- Describe how invasive species and weeds will be managed on the entire site including stockpiles, berms, and road shoulders.
- Describe how silica sand tracked out from site, spilled on to rail road, and/or any other unintentional dispersion of sand will be removed.

(4) Interim Reclamation: Mines may experience a period inactivity for a number of reasons, such as downturns in market or changes of ownership. Also, portions of the mine may become inactive, like an unused stockpile or working face. Setting conditions within the local permit to address interim reclamation during suspension of mining is important in controlling dust, invasive species, as well as storm water run-off. Conditions may include:

- Describing methods used to stabilize slopes with earthwork and use of using fast-growing vegetation, such as cereal grains, that establish quickly.
- Set and define durations of inactivity (i.e. one year for a mine, two years for an unused/unmodified stockpile) before reclamation activities need to be implemented.
- Topsoil should not be moved for interim reclamation purposes due to the significant loss of soil each time it is moved.

(5) Final Land Use and Proposed Reclamation:

- Describe proposed reclamation including final slopes, high wall reduction, benching, terracing, and other slope stabilization.
- Provide map showing location of anticipated topography, water impoundments, and artificial lakes. The topographic interval for maps can be specified (i.e. 2 foot contour intervals). The final topography should take into consideration of stormwater runoff and prevention of stormwater contaminants from the entering site.

- Provide information about the location of surface structures, roads, and related facilities to remain on the site after reclamation.
- Describe the methods proposed for the disposal or reclamation of oversized and undersized material. Stipulate if sand processed with polyacrylamide-based and/or poly-diallyldimenthylammonium chloride based flocculants are acceptable reclamation material.
- Describe short-term and potentially long-term maintenance needed to support reclamation.
- Stipulate that the preferred seed sources for reclamation should be local and sourced from the Minnesota State Approved Seed Mix that has been approved by Mn/DOT, BWSR, and the DNR. Selection of seed should not require regular or seasonal applications of nutrients or pesticides.
- Stipulate that the placement of overburden and soil should be placed in original stratigraphic sequence.
- Criteria for assessing when reclamation is complete and financial assurance may be released:
    - Percent cover of an area that is covered, shaded or intercepted by desired vegetation. A performance standard to use may be 90% cover averaged over the site at 90% statistical confidence level. Measurement of revegetation should correspond with peak vegetative growth, which is usually in August.
    - Diversity of species can also be predictor of the long-term stability of a plant community.
    - Quantified survivorship of tree plantings success.
    - For wetlands restoration, an evaluation measuring species frequency of occurrence and density and percent cover along transects.
    - Elimination of high walls, cut slopes, and/or topographic depression on the site, unless otherwise approved.
- Financial Assurance is released when goals specified by the reclamation plan are met and the LGU is satisfied the mine site is reclaimed to a stable, self-sustaining condition.

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D.4. Financial Assurance

a. Description of Silica Sand Project Concerns

The purpose of requiring financial assurance is to ensure that the LGU has access to funds to implement closure of a mining operation if the operator (permit holder) is unable to fully complete reclamation and closure of the mine lands and surrounding lands affected by mining activities. In this way the general public will not bear the cost of reclaiming and fully closing an abandoned mine site. It is to be used only in the case that the operator/permit holder is no longer able to complete the reclamation of the site. Any progressive reclamation, reclamation or closure activities would be conducted as needed and paid for by the operator.

In terms of silica sand projects, the potential financial impacts of closing a mine site depends on the size of the mine and the scope of the project. Currently, silica sand projects range from a single, small acreage mine site, to a collection of several small mine sites, to greater than 1000 acre project site with processing and transload facilities.

b. Narrative Description and Background Information

Financial assurance guarantees that funds will be available for an LGU to implement the reclamation plan of a mine site in the event of abandonment of a mine site or facility, temporary or permanent closure of a mine site, or the unsuccessful reclamation of mine areas which do not meet the specified reclamation performance standards specified within the reclamation plan. The calculated cost of site closure at any given time should be enough to close the site at that time. The amount should be modified as the site changes over time and adjusted annually. That plan and associated financial assurance mechanism is called the contingency reclamation plan. Financial assurance can be supplemented (increased) to include any corrective actions resulting from non-compliance with design and operating criteria of the permitted activity.

c. List of silica Sand Project Potential Impacts

The impacts of not requiring financial assurance include:

- Leaving an open and unreclaimed mine site may be unsafe to the general public.
- The financial burden of reclaiming abandoned mine sites falling onto the county or township.

d. Recommendations, Standards, Criteria, Considerations

The State has well-developed information for financial assurance that is applied to other extractive or landscape altering industries such as iron mining, non-ferrous mining, and solid waste disposal facilities. These tools can also be applied to the varying range of silica sand projects across the state. The criteria/suggestions for financial assurance are addressed in this section in three components:

(1) Financial Assurance Mechanisms
(2) Items to Consider When Calculating Financial Assurance
(3) Managing Financial Assurance

(1) FINANCIAL ASSURANCE MECHANISMS: The Minnesota Pollution Control Agency (MPCA) wrote rules, adopted in 2010, specifying financial assurance mechanisms for solid waste disposal facilities (MN Rules, Chapter 7035). These rules were developed in consultation with an advisory committee that included a representative of the DNR and were partially based upon experience of implementing financial assurance for large-scale mining operations.

Rules were also designed to be implemented by LGUs that regulate landfills (Minn. R. Ch. 7035.2705 – 7035.5000). These rules are a useful financial assistance tool for local regulatory authorities because specific contract language, calculation tools, and suggested processes that can be used by LGUs. Summaries of financial assurance mechanisms modified from *Solid Waste Financial Assurance* (W-SW3-25; Minnesota Pollution Control Agency published document) are described below. Specific language for these mechanisms can be found in Minnesota Rules, Chapter 7035.

- TRUST FUNDS (Minn. R. Ch. 7035.2805): A trust can be set up, with the LGU or LGU named as the beneficiary, through a trust agreement. An independent trustee manages the reserve funds and has the authority to engage in trust operations. Applicants must make monthly payments into the fund until it equal the sum of the current cost estimates and is considered fully funded. The rule provides a method for calculating the monthly payment amount.

- DEDICATED LONG-TERM CARE TRUST FUNDS (Minn. R. Ch. 7035.2720): This is a special kind of trust fund that may be used only by public sector applicants. The elements are similar to those of the trust fund described above except the trustee, under a dedicated fund, is a local government official and the trust set up is a part of the municipal treasury. The dedicated trust fund is set up by a resolution enacted by the appropriate local governmental unit such as a city council or county board.

- SURETY BOND GUARENTEEING PAYMENT INTO A TRUST FUND (Minn. R. Ch. 7035.2725): A surety bond is a contract which assures that if the applicant fails to establish a trust fund before beginning final site closure, the surety will deposit the required amount (the penal sum of the bond which must equal current cost estimates) into the trust account before final site closure. A surety bond has no expiration date.

- SURETY BOND GUARANTEEING PERFORMANCE (Minn. R. Ch. 7035.2735): This bond has basic provisions similar to the payment guarantee bond, but makes a different guaranty. The surety, in this case, guarantees that the applicant will perform closure, postclosure care, and corrective action activities in accordance with appropriate plans and LGU orders. If the applicant does not perform as required, the surety promises to deposit the required funds into a standby trust.

- LETTER OF CREDIT (Minn. R. Ch. 7035.2745): A letter of credit extends the credit of the issuing bank or institution to the LGU, on behalf of the applicant. The LGU may draw on the credit if the applicant fails to perform required closure, postclosure care, or corrective action work. The letter of credit is issued equal to the sum of the current cost estimates. It should be irrevocable and must be issued for at least one year. It should be non-expiring and extended automatically from year to year unless the lender gives the LGU prior notice of intent not to renew it. A standby trust fund must also be established with a letter or credit.

- STANDBY TRUST (Minn. R. Ch. 7035.2705): If an applicant provides a surety bond, a letter of credit, or self-insurance as financial assurance, the applicant must also establish a "standby" trust account that receives payment from either the surety or the bank which issues the letter of credit. Payment would be made into the standby trust account if the applicant fails to perform as promised or before final closure operations begin.

(2) ITEMS TO CONSIDER WHEN CALCULATING FINANCIAL ASSURANCE: The following list identifies some activities associated with reclaiming a mine site. This list is not exhaustive but gives a framework of discussion for an applicant and an LGU to review tasks required for the reclamation of mine lands.

The calculation of the financial assurance is dependent upon the size and scope of the mining activity. The calculation should be based upon current dollar value at the time of the estimate and the cost to the LGU of administering and hiring a third party to conduct corrective action and reclamation activities. No salvage value attributed to the sale of stockpiles, waste, facility structures, equipment, land or other assets should be used for estimating purposes. For each item, the applicant should consider the cost per unit (i.e. disturbed acres of land) and the number of units to determine the final amount.

- REMOVAL OF BUILDINGS and INFRASTRUCTURE: Activities necessary to remove and properly dispose of permanent structures, roads, utilities, equipment, etc.

- GRADING AND REGRADING: Activities necessary to ensure soil and slope stabilization. This would include the cost of erosion control materials, fill materials, equipment and labor.

- TOPSOIL: Activities and funds necessary to redistribute, purchase, apply, and amend topsoil to a thickness specified within the reclamation plan, including the cost of equipment and labor.

- REVEGETATION and SEEDING: Activities and funds necessary to transplant and seed the site to performance standards specified within the reclamation site, including the cost of equipment and labor.

- VEGETATION STABILIZATION: The cost of mulching, netting or other stabilization materials, equipment, amendments, and labor.

- SHORT-TERM SITE MAINTENANCE: Covers a period of time until the mine meets interim reclamation performance standards as determined from reclamation plan. This may include costs for additional seeding, sloping, and regrading slopes (i.e. repair damaged areas; improve poorly performing areas) as well as the costs for equipment and labor.

- LONG-TERM SITE MAINTENANCE: Covers periods of time between first interim reclamation until the site is deemed to meet final reclamation performance standards. This would coincide with when the financial assurance may be returned. Depending on the reclamation plan, costs for additional seeding, vegetation, equipment and labor may be needed to sustain the site.

(3) MANAGING FINANCIAL ASSURANCE: Financial assurances should ensure a source of funds for LGUs if the applicant fails to perform reclamation activities including closure and postclosure maintenance needed if operations cease as well as corrective actions as required by LGUs if noncompliance with design and operation criteria in the permit occurs.

General criteria for financial assurance include:

- Assurance of funds sufficient to cover cost estimated reclamation and corrective action cost estimates;
- Assurance that the funds will be available and made payable to the LGU when needed;
- Assurance that the funds will be fully valid, binding, and enforceable under state and federal law;
- Assurance that the funds will not be dischargeable through bankruptcy, and
- All terms and conditions of the financial assurance must be approved by the LGU. The LGU, in evaluating financial assurance, should use individuals with documented experience in the analysis. The reasonable cost of the evaluation shall be paid by the applicant.

Financial assurance in the amount equal to the estimated contingency reclamation cost:

- Should be submitted to the LGU for approval before the issuance of a permit to mine and before granting an amendment to the permit
- Continuously maintained by the applicant
- Adjusted annually for the following reasons
  - If the new cost estimate is approved and is greater than the amount of the existing financial assurance, the applicant provides additional financial assurance in an amount equal to the increase; or
  - If the new cost estimate is approved and is less than the amount of existing financial assurance, the applicant can be released from maintaining financial assurance in an amount equal to the decrease.
  - Yearly update of cost estimate.

Financial assurance can be made available to the LGU when the operator is not in compliance with either the contingency reclamation plan or the corrective action plan.

- A LGU would need to develop a procedural process of commencement, for example:
  - Serving an order to forfeit the financial assurance on the person, institution, or trustee holding the financial assurance; and
  - Serving a notice of measures required to correct the situation and the time available for correction on the applicant.
- If conditions that provided grounds for the order are corrected within a period established by the LGU and if measures approved by the LGU are taken to ensure that the conditions do not recur, the order can be canceled.
- If the conditions that provided grounds for the order are not corrected, the LGU can proceed with accessing and expending the funds provided by this part to implement the contingency reclamation or corrective action plans.

Financial assurance may be canceled by the applicant, on approval of the LGU, only after it is replaced by an alternate mechanism or after the applicant is released from the financial assurance when:

- An operator/applicant substitutes alternative financial assurance;
- The LGU determines all reclamation activities have been completed according to the reclamation plan;
- Conditions necessitating postclosure maintenance no longer exist and are not likely to recur, and
- Any corrective actions have been successfully accomplished.

The applicant must ensure that the provider of financial assurance gives the LGU notice on the order of 120 days prior to cancellation of the financial assurance mechanism. Upon receipt of this notice, the LGU initiates a proceeding to access the financial assurance. That process could be halted if acceptable financial assurance is reestablished.

If the mine or facility changes ownership, the new applicant must be in compliance with the requirements set in financial assurance ordinance/conditional use permit before the permit is

transferred. Only after the new owner re-establishes their new financial assurance mechanism and it is approved may the former applicant be released from their requirements.

If there is a failure to comply with the specified criteria, an LGU may deny, suspend, revoke, or modify the permit to mine.

References

Minnesota Statutes, Chapter 93.44 to 93.51: https://www.revisor.mn.gov/statutes/?id=93
Minnesota Rules, Chapter 7035, Solid Waste: https://www.revisor.mn.gov/rules/?id=7035
Minnesota Rules, Chapter 6130 (ferrous): https://www.revisor.mn.gov/rules/?id=6130
Minnesota Rules, Chapter 6132 (non-ferrous): https://www.revisor.mn.gov/rules/?id=6132
MPCA Solid Waste Financial Assurance Document 3.25, April 2003:
http://www.pca.state.mn.us/index.php/view-document.html?gid=12790

D.5. Blasting and Blast Plan Requirements

a. Brief Description of Silica Sand Project Concerns

Sandstone deposits vary in terms of how well individual sand grains are cemented together. For moderately to well-cemented sandstone deposits, blasting may be required to break up and access a deposit.

b. Narrative Description and Background Information

The regulatory oversight of non-metallic blasting in Minnesota is the purview of an LGU. Since Minnesota is one of a few non-coal producing states, federal standards developed by the Office of Service Mining and Reclamation and Enforcement (OSM) are not applied within the state. Therefore, federal jurisdiction in Minnesota is limited to confines of the mine and overseen by Mining Safety and Health Administration (MSHA). MSHA regulations are specific to the storage, transportation, and use of explosives (30 C.F.R §56.61-56.63) and do not regulate the blasting activity itself. However, OSM does have very well-developed blasting performance standards based on continuous research and development for regulation of the coal industry. Portions of the federal blasting standards are commonly adapted by LGUs via ordinance (Dunn County, WI Blasting Ordinance) or addressed in Conditional Use Permits (Le Sueur County CUP #29000 for Unimin Kasota Mine).

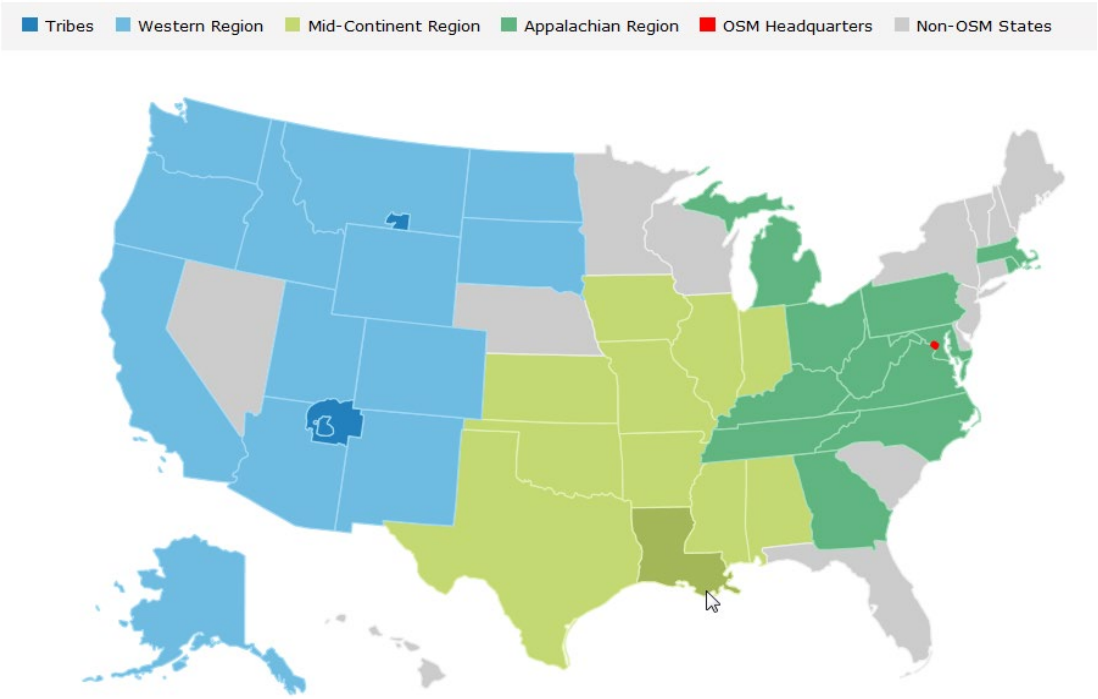


Figure 5. Map of the United States of America showing the regulatory authority of the Office of Surface Mining Reclamation and Enforcement (OSM).

At the state level, the State Fire Marshal, which is a division within the Minnesota Department of Public Safety, issues licenses and permits (MN Statute 229F.73 and 299F.74) "for persons who manufacture, assemble, warehouse or store explosives or blasting agents as well as those possess explosives or blasting agents." The state also regulates blasting for ferrous and non-ferrous mining. The Department of Natural Resources (DNR) has rules for blasting standards to regulate metallic mining (MN Rule 6132.2900). Although these standards do not apply to non-metallic mining, they are commonly adopted by LGUs regulating aggregate and silica sand quarries.

LGUs have the authority to regulate and monitor blasting activity for non-metallic mining. The designated approval authority may impose additional restriction or conditions as it deems necessary to protect the public interest.

Impacts of blasting to nearby structures is dependent upon many site-specific, geologic factors, such as the density of the rock, the type of overburden (material that needs to be stripped away to access a deposit), the presence and thickness of unconsolidated overburden, and the direction of the blast. Therefore, each site where blasting is occurring should require a site-specific blasting plan and monitoring plan.

In a survey sent out to LGUs that host or have silica sand resources, 93% of the respondents said "yes" to the question 'does you jurisdiction host or expect to host mining activity that requires blasting.' Within this section, information, protocols and specifications that can applied to

blasting activities are addressed, which consist of a compilation of protocols developed by LGUs, state rules, and federal guidance documents, and the Code of Federal Rules (C.F.R).

c. List of Silica Sand Project Potential Impacts

Blasting could present serious risk to human health and safety, damage to property, as well as the risk to groundwater contamination. Over the past 100 years, the federal government has developed safety protocols that improved the reliability and safety of blasting methodologies. With that said, some risks and impacts associated with blasting include:

- Inadequate blast area security and pre-blasting notification can pose a safety threat to the public.
- Vibration through the air (overpressure/air blast): a shock wave caused by blasting that is over and above atmospheric pressure. Air blasts are measured in wave frequencies (Hz) and with sound (dB). Air blasts from mining activity have the potential to rattle and break windows.
- Vibration through the earth (ground vibration): elastic waves that propagate through the ground. Ground vibrations are measured in wave frequencies hertz (Hz). Ground vibrations from mining activity have the potential to crack walls, crack foundations of structures, and detrimental impact historical buildings and structures.
- Ground vibrations have greater potential impacts in areas with thicker unconsolidated sediment and in older houses that have plaster walls.
- Potential to contaminate groundwater by the release of nitrates. A widely used industrial blasting agent is ammonia nitrate/fuel oil (ANFO). ANFO quickly dissolves in water leaching ammonium and nitrate to groundwater as it dissolves in the blast hole.

d. Recommendations, Standards, Criteria, Considerations

The intent of this section is not to review safety protocols that are implemented within a mine and regulated by MSHA, but to give tools for LGUs to consider for mitigating and monitoring the potential impacts of blasting that occur outside the mine site boundary. In terms of geographic region, , extra precaution is needed in the Minnesota River Valley where thickness of unconsolidated sediment is generally greater than in the Paleozoic Plateau and ground vibrations may travel farther (Siskind, et. al., 1980).

(1) Application to Blast: A LGU can require an application for a permit to blast within the applicable jurisdiction. This application would have to apply to all blasting activity that includes but is not limited to the construction, placement or erection of a structure; operations of non-metallic mine; and the demolition of buildings or other structures.

- Application for a permit to blast should require (1) an individual who holds a valid blaster's license issued by the Minnesota State Fire Marshall or comparable licensure through another state, and (2) submission by and issuance to a lasting business entity.
- Application for a blasting permit may include the following information:
    - Applicant name including individuals of a partnership, and officers of a corporation including a limited liability corporation, license number, address, contact phone numbers, and email address of the applicant.
    - A statement (devised by the LGU) and signature indicating acceptance of responsibility for blasting activity, by an individual who holds a valid blaster's license issued by the Minnesota State Fire Marshall with the proper classification. Name, address, license number, contact phone numbers, and email address of the blaster in charge of the blast, if different from the applicant.
    - Name, address, contact phone numbers, and email address of any person (agent or employee) in charge of the operation who will respond to inquiries by the LGU.
    - A map showing the location of the blasting site including the location of all the buildings located within ½ mile of the controlled blasting site, names, addresses, and contact information of owners of those buildings.
- The LGU would have to establish a procedure to process applicants which could include, but not limited to:
    - A process of application review to determine completeness and compliance with existing permit or ordinance.
    - A process of approval/denial through a department, commission, or board.
    - Development a fee structure or application fee.

(2) Pre-blast Survey: Is a record on paper, video, or a unalterable electronic file to document the condition of a dwelling, structure, or water well within a specified radius of the blasting before the commencement of blasting activity. It is recommended that ordinance or a local permit includes language specifying protocols for pre-blasting surveys such as:

- The survey is to be completed by a third party consultant and available to the landowner upon request.
- At least 30 days before initiation of blasting, the operator should notify neighbors within ½ mile of the blast by using reasonable efforts.
- Written notification by the company should indicate that, upon written request, the mine company will perform a pre-blasting survey. The notification will indicate that no survey will be completed unless the resident and/or landowner makes a written request for the pre-blast survey and a water quality test for existing wells to the LGU.
- Survey is to include inspection of the baseline condition of a house or structure, including assessments of both the interior and exterior condition of a structure, condition of a water well, and water well testing (see Water Quality Standards Section, Sample Collection and Analysis Subsection for private well monitoring standards).
- The survey and water well testing should be completed at the expense of the mine company.

- The goal of the survey is to record the baseline condition of a house or structure, including assessments of both the interior and exterior condition of a structure, and establish water quality issues.
- The resident of owner can request a copy of the survey and well test at any time. The company has 72 hours to provide the pre-blasting survey results upon request.

(3) Notification Standards**:** Is a process to notify neighbors, residents, and landowners within a specified radius around a blast site. Parameters that could be included in standards for blasting notification include but limited to:

- Time at which to notify residents and neighbors of initial blasting activities. Common practice requires a 30 day notice (OSM Blasting Performance Standards, 30 Code of Federal Regulations).
- Notify county, township, residents and neighbors of subsequent blasting activities within 72 hours of blast.
- Determination of reasonable efforts of notification. Reasonable efforts can include a written notice, phone call, email, or verbally in person.
- Whenever blasting is being conducted within the vicinity 1/2 mile of gas, electric, water, fire alarm, telephone, telegraph, or steam utilities, these utility companies shall be notified no less than 72 hours prior to commencing blasting.

(4) Blasting Standards: can be modified to reflect the conditions specific to the jurisdiction. The language below can be modified to be incorporated into ordinance or local permit.

- Operator will use all industry standard measures to control fly rock with the intent that fly rock not leave the mine property.
- Prior to any blasting event at the excavation and mining site, the mining operation will give notice of the impending blasting event by displaying a fluorescent flag and legible sign within 100 feet of all public roads bordering the blasting site.
- Use of a distinctive warning signal should be sounded by horn immediately prior to blasting event.
- ANFO should not be used in blastholes with standing water in the bottom.
- No blast peak particle velocity (PPV) of ground vibration should exceed levels from 0.50 to 2.0 inch per second.
- No blast peak particle velocity of ground vibration should exceed 0.03 inch per second for a registered, historical building or structure.
- Air blast should not exceed the maximum limits specified by OSM (30 C.F.R) at the location of any dwelling, public building, historic structure, school, church, or community or institutional building outside of the project boundary (see table below):

Lower frequency limit of measuring system, in Hz (±3 dB)	Maximum level, in dB
0.1 Hz or lower—flat response [1]	134 peak.
2 Hz or lower—flat response	133 peak.
6 Hz or lower—flat response	129 peak.

(5) Blasting plans, logs and monitoring: Is a tool to record details associated with a blasting event. Logs can be used to help mitigate issues associated with a blast.

- Require blasting plans to be prepared as a condition of the local permit.
- Require modifications of the blasting plan to be reviewed and approved by the LGU to address safety and public concerns.
- Hire a third party reviewer to analyze the competency of plans and blasting proposals. Cost of review can be charged to the company.
- Require companies to prepare blasting logs to record each blasting event that is maintained for a period not less than 5 years after a blasting event.
- Copies of every blasting log shall be given to the LGU within 5 working days of a blast.
- Information to record in a blasting log includes:
  - Name, signature, and license number of the blaster in charge of the blast
  - Specific blast location, including address, bench and station number if applicable
  - Type of blasting operation
  - Date and time of the blast
  - Meteorological conditions, including temperature inversions, wind speed, and directions as can be determined from the United States Weather Bureau, and ground-based observations
  - Diagram of the blast layout and the delay pattern
  - Number of holes
  - Hole depth and diameter
  - Spacing of holes
  - Burden
  - Maximum holes per delay
  - Maximum pounds of explosives per delay
  - Number, type and length of stemming used between decks
  - Total pounds and type of explosives per each delay
  - Distance to nearest inhabited building not owned by the applicant
  - Type of initiation used
  - Seismographic and airblast records, which shall include all of the following:
    - Type of instrument and last laboratory calibration date.
    - Maps of the exact location of monitoring instrument(s)
    - Records of the date, time, and distance from the blast.
    - Name of the person and firm taking the reading.
    - Trigger levels for ground and air vibrations
    - The vibration and airblast levels recorded.
  - Particle velocity should be recorded in three mutually perpendicular directions.
- In the event that seismograph monitoring exceeds standards identified in either the Blast Plan or local permit, the company will notify the LGU(s) within 5 working days
- Seismic data gathered for each blasting event shall be witnessed, reviewed, analyzed for compliance parameters, and signed by applicant's blaster. If upon such review, the data indicate a violation, then corrective actions shall be taken such as reducing blasting charge/delay or other measures as deemed necessary to assure vibration compliance at the prescribed boundaries.

- Water Resource Management Plan should address potential nitrate contamination due to blasting.

References

Siskind, D. E., Stagg, M. S., Kopp, J. W., & Dowding, C. H. (1980). Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting, RI 8507, US. *Bureau of Mines, available from International Society of Explosives Engineers*.

Workman, J. L., & Calder, P. N. (1994). Flyrock prediction and control in surface mine blasting. In *PROCEEDINGS OF THE CONFERENCE ON EXPLOSIVES AND BLASTING TECHNIQUE* (pp. 59-59). SOCIETY OF EXPLOSIVES ENGINEERS.

Bureau of Mines Information Circular IC 9135 (1987), Surface Mine Blasting, Proceedings: Bureau of Mines Technology Transfer Seminar, Chicago, IL, pp 1-113

Office of Surface Mining Reclamation and Enforcement Technical Library:
http://www.techtransfer.osmre.gov/NTTMainSite/osmlibrary.shtm

LeSueur County, Conditional Use Permit (CUP) #29000, Unimin Corporation South Mine, Kasota Township, February 26, 2013.

Town of Dunn, Ordinance #11-21

D.6. Inspections

a. Description of Silica Sand Project Concerns

Inspections of a silica mine, processing facility, or transload facility helps enforce and monitor compliance of conditions specified within a local permit.

b. Narrative Description and Background Information

As mentioned in other Operations sections, the Mining Safety and Health Administration (MSHA) is charged with inspecting a mine site with the protection of the worker in mind. It is the purview of the LGU to inspect and enforce the requirements of their own permit. The inspection could be done by LGU staff or contracted to a third party. The cost of the inspection can be incorporated into an escrow account that can be accessed by the LGU to cover the cost of administering the permit.

To enter and inspect an active mine site, the inspector on behalf of the LGU must hold and show a current certificate of safety training by MSHA. Additional training may be required to enter underground mines.

c. List of Silica Sand Project Potential Impacts

- LGUs may lack the resources needed to determine if a silica sand facility is operating within the conditions outlined in a local permit.
- LGUs may lack the staff that has the expertise to conduct on-site inspections.
- Authority to inspect may be omitted in local permits which can potentially limit an LGUs ability to determine if a silica sand facility is operating within the conditions outlined in a local permit.
- Corrective action implementation may be omitted from a local permit.

d. Recommendations, Standards, Criteria, Considerations

Detailed inspection protocols listed below were derived from California's Surface Mine Inspection Guidelines. Guidelines were developed by the California State Mining and Geology Board with cooperation from the California Department of Conservation's Office of Mine Reclamation. It is the intent of the guidelines to recognize that those who conduct surface mining field inspections will have specific professional expertise, but may not be fully knowledgeable in all facets of surface mine inspections or state and federal environmental standards.

- As a condition of approval for a local permit for a silica sand project (mine, processing, and/ or transload facility), the LGU shall reserve the right to go on and inspect the subject property, at the discretion of the LGU.
- It is recommended that an LGU should make, at a minimum, annual inspections.
- Per Minnesota Statute 471.59 (Joint Exercise of Powers): "Two or more governmental units, by agreement entered into through action of their governing bodies, may jointly or cooperatively exercise any power common to the contracting parties or any similar powers, including those which are the same except for the territorial limits within which they may be exercised. The agreement may provide for the exercise of such powers by one or more of the participating governmental units on behalf of the other participating units."
- LGUs should consider implementing corrective action plans and/or requirements within local permits to ensure silica sand facilities correct the noncompliance identified by the LGU as a result of an inspection. The corrective actions are intended to bring a silica sand facility back into compliance with local permit requirements.
- If an LGU does not have the staff or expertise to conduct mine site inspections, hiring of third party consultants at the expense of the applicant is recommended.

PRE-INSPECTION: Prior to conducting the inspection, the inspector should contact the mine operator, owner, or agent and schedule a time for the inspection. Also, contact or invite State

regulators for joint inspection if site requires. It is important that a representative who is knowledgeable about the mine's operations be present during the inspection.

- Pre-inspection work-up should take note of any previously documented deficiencies or violations and determine the operation's current state with respect to any remedial actions or timetables to correct the deficiencies or violations.
- Thoroughly review the reclamation plan. Pay special attention to maps, figures, cross-sections, and schematics. Review any conditions of approval that may have been imposed during the permitting process that relate to reclamation/operation activities. The local permit may specify requirements to which the mine must adhere during its operations.
- Thoroughly review the current financial assurance and amount. Determine if the financial assurance is still in effect, completed correctly on the approved form, or if is to expire. If either the financial assurance amount or the financial assurance instrument is not current (i.e. out of date or does not address all reclamation plan issues, has not been updated, is incorrect), note the areas of inadequacy and include them as possible deficiencies in final inspection report.
- Obtain a recent base map or aerial photograph of the mine/facility site showing the site's facilities for ease in mapping the conditions observed during the actual inspection.

Paleozoic Plateau

- Thoroughly review location of any known springs, sink holes, seeps within 1 mile of site location (Karst Features Map is available on DNR Data Deli).

MINE/FACILITY INSPECTION: During the conduct of the site inspection, it is recommended that the operator, mine manager, or operator's representative that is familiar with the mine site and activities accompany the inspector. As the inspection proceeds, the inspector should ask questions about any activities that the inspector believes may not be incompliance with the local permit, or that appear to be new from the previous year's operations.

- Prior to commencing the mine/facility inspection, the inspector should meet with the operator/representative at the site.
    - Introduce members of the inspection party.
    - Explain the purpose and scope of the inspection
    - Review safety requirements with the operator or safety officer of that mine/facility.
    - Ask the operator for information on the mine/facility current activities (i.e. is the site idle, currently mining, is blasting to take place, are trucks operating, is sand being processed, etc.) Ask about any safety concerns about which the inspector needs to be aware.
- During the inspection, the following items should be observed and described.
    - Any inconsistencies with the requirements of the reclamation plan and other plans referenced within the Conditional Use Permit.
    - Photographs and physical measurements of the site and its features should be obtained to document findings and the condition and appearance of the mine site,

especially any conditions that preclude reclamation of the site in accordance with the approved reclamation requirements.

- Describe location, including UTM or latitude and longitude from GPS.
- Describe mine inspection activity, who was present, areas observed and why, and any areas that were not allowed to be observed if applicable (i.e. an area prepared for blasting).
- Describe and inspect restrictions to public access to the site (e.g. gate, fences, warning signs) as specified by the local permit.
- Observe and describe the current mining operation/facility and mineral product(s). Identify any unique or relevant sand extraction, processing, or storage characteristics that are not described in the reclamation plan and other plans referenced with the local permit.
- Observe and visually describe stability of any cut or fill slopes within a mine. Note the current slope configuration and conditions (e.g. are slopes clean or vegetated, do they have erosion rills or gullies, are slumps or slides apparent, etc.); do the slopes appear to be at the correct angles and heights as prescribed in the reclamation plan or Conditions of Approval; are the slopes supposed to be benched at specific intervals; what is the condition of the inter-bench slope stability? Based on the observed condition of the slope, should a licensed geologist or engineer be consulted to assess the long term stability of the slope; that is, might the present condition of the slope indicate that its approved final design as called for in the reclamation plan may not be achievable?
- Observe and describe the condition, configuration, and characteristics of any mine waste piles and/or tailings piles.
- Observe berms of ponds; take note of any seeps from berms. Measure or note the freeboard of ponds and. Look for regrading activities.
- Observe and describe the activities for soil salvaging and stockpiling for future reclamation operations. Determine if the stockpiled soil is protected from erosive actions.
- Observe and describe any reclamation activities that are concurrent with mining. Are these actions described as part of the phased reclamation activities in the reclamation plan or conditions of the local permit? Inquire as to the extent of any reclamation actions that are proposed for the coming year. Do any of the areas designated in the reclamation plan require unique protection or special attentions, such as to prevent adverse impacts to state-listed endangered or threatened species?
- Determine if any backfilling of an excavation or creation of a fill slope has occurred. Determine if the filling activities require engineering designs or specifications or permits as described in the approved reclamation plan.
- Observe and describe any active revegetation pilot programs. Note if the revegetation programs are in accordance with the requirements of the reclamation plan, and if monitoring is occurring. Request copies of any monitoring data.
- Observe and describe any natural occurring revegetation. Observe the presence of invasive species that is inconsistent with the approved reclamation plan.
- Observe and describe any sedimentation basins that will be left in place that are out of compliance with the reclamation plan.

- Determine if previously cited deficiencies or violations have been corrected, partially corrected, or not addressed by the operator. It is recommended that the operator be informed of the inspector's determination regarding the status of previously cited deficiencies or violation during the inspection.
- Determine if the observed operation and the physical condition of the mine site are in accordance with the requirements contained in the approved local permit. If new deficiencies or violations are observed, these should be documented and called to the attention of the operator during the inspection routine.
- Determine if the financial assurance equates to the actual physical site conditions. Consider if the current financial assurance amount is adequate to the complete reclamation of the entire site if mining activities ceased operation at any time within the coming year. Determine if the financial assurance amount would adequately cover the remediation of any deficiencies or violations noted during the current inspection.
- Are there any other observed and documented conditions that are related to another regulatory agency, such as some form of contamination or pollution? If so, report to appropriate State agency.
- Sketch the mine's current development and mine/facility conditions on a base map or form with annotations of findings.

· Following the completion of the inspection tour, the inspector should review the results and findings of the inspection with the operator or the operator's representative, and any lead agency personnel in attendance.

Paleozoic Plateau

· Ask mine/facility operator or representative of any sudden drainage of stormwater retention or settling ponds/basins.
· Look for channeling of water and development of new sinkholes or collapse features.

POST-INSPECTION: This section specifies the steps necessary to secure the inspection information and prepare an inspection report for distribution.

· Process and evaluate field inspection information.
· If possible, map mine information using GIS base map and plot location of photos. If GIS is not available, prepare a map from available database sources and other document file information.
· Download or process pictures and prepare annotated photos (date, location, photo reference, and description of view).
· Review field data and notes. Compile an inspection report consisting of a Summary of Observations, Conclusions, and Recommendations. The report should include any conversations with the mine/facility operator or other local/state agency personnel on site during the inspection activities. Include a list of conclusions regarding the conformance of the mine operations with its local permit, reclamation plan and other reference plans within the permit, and adequacy of financial assurance.
· Recommendations for proposed actions to correct observed deficiencies or violations should be made in the Summary. The recommendations may relate to proposed actions to be taken by the operator, or to further inspection activities by specialists. The recommendations may include the use of a licensed geologist or engineer to more

thoroughly evaluate suspected problems dealing with slope stability issues or other geological or engineering issues, the use of botanists to investigate revegetation issues, and the use of any other specialists where the scope of concern may be outside the inspector's particular expertise.

References

California Surface Mine Inspection Guidelines:
http://www.conservation.ca.gov/smgb/guidelines/Documents/inspect_guidelns.pdf

E. Considerations for Setbacks and Buffers

Setbacks and buffers by themselves are by no means the only way to protect surrounding land uses from potential impacts of silica sand mining, processing, and transportation. Consequently, it is not recommended that setbacks and buffers be relied upon as the primary method of protecting nearby land uses or natural features. Additional data and time, thorough and robust land-use planning, and implementation through zoning districts, is perhaps the best way to ensure compatibility of land uses. Environmental review can also be used to ensure proper identification and mitigation of impacts. And finally, comprehensive mine planning and environmental monitoring may also provide the necessary information to move a project forward. Other sections of this document provide guidance on assessing, avoiding, minimizing, and mitigating adverse impacts associated with silica sand projects.

Where setbacks are required, it is assumed that they are for allowable land uses (permitted outright or subject to a discretionary approval); that is, there is an underlying assumption that the proposed land use is not prohibited. However, there are scenarios where a setback results in the severe restriction or prohibition of silica sand projects. If restrictions or prohibitions on silica sand projects are what are desired by the LGU for local reasons, other methods such as zoning or ordinance development can more effectively meet this objective.

The terms "setback" and "buffer," for the purposes of this document, have the following meanings:

- **Setback**: a required minimum distance between a proposed land-use feature and an existing (human-made) land-use or natural feature.
- **Buffer**: a strip of land containing vegetation, fencing, berming, or other construction.

It is important to note that this section includes eleven subsection topics that vary in several ways from potential impact concerns, region considerations, feature characteristics and regulatory processes. For example, pertaining to the section on Residential Land Uses; setbacks, land use and development are not governed by existing state regulations (statutes or rules) but are locally controlled under authority of state planning and zoning enabling laws (MS Chapters 394 and 462). Consequently, recommendations in these subsections concentrate on considerations, implications and discussion on setback ranges on both established setbacks and example ones. For other subsection topics such as Calcareous Fens in which standards and criteria are already identified in state statute, recommendations concentrate on how to work with state agencies as decisions are being made at the local level.

For setbacks and buffers from proposed silica sand operations to surrounding land uses, determining setbacks and buffers is a matter of local discretion. General considerations are provided to help guide local government decision-making.

- Setbacks for silica sand projects can be established in land-use regulations, applicable across an entire jurisdiction or zoning district (rather than determined on a case-by-case basis). As project components may vary widely from one project the next, the setback may want to be considered a minimum that may be increased as needed. To allow for setback adjustments, LGUs would want to include a provision that would allow the setback to be adjusted through the discretionary approval of local permitting outside of land-use regulations.

- Setbacks and buffers for silica sand projects may be determined on a case-by-case, site-specific basis, and required through a discretionary land-use approval, such as a conditional use permit.

- Where a setback is intended to protect a land use (human use of land—residences, churches, schools, offices, etc.—as opposed to natural or historical feature, such as lakes, bluffs, burial site, etc.), setbacks from property lines provide more consistent separation than setbacks between the uses themselves.

- In cases of natural features or historical features, such as water bodies and burial sites, setbacks between natural and historic features are recommended to be from the feature itself (rather than from property lines). However, setback to property lines may be appropriate where the feature is included as part of a larger natural or historic property(ies) that serves additional purposes, such as a state park or historic districts.

- Another tool for consideration is limiting mining to "overlay districts" within a jurisdiction. Mining overlay districts serve the following functions:
    a. Preserves land where mining is not an appropriate land use.
    b. Allows mining in areas of compatible land uses or within areas of low population density.
    c. Concentrates mining to a given area and allows for the development of appropriate infrastructure to support mining.
    d. Informs incoming landowners and residents that mining will be occurring within an area. This helps prevent and mitigate future land use conflict.
    e. Mining overlay districts are temporary land uses. Upon cession of mining and reclamation, land use can serve other functions for the community.
- In situations where a proposed project is located near or across differing jurisdictional areas, LGUs are encouraged to work together to determine the best course of action when considering setbacks (which may differ between the jurisdictions) and the land use for which they are being considered (human use of land and natural features).

Determining Setbacks

Determining the appropriate jurisdiction-wide or zoning district-wide setback can be challenging. A small setback may not adequately protect land uses. A large setback may restrict allowable uses to a greater degree than the LGU intends. Ultimately, the setback determination may reflect a compromise between objectives.

The potential impacts of a proposed project, from which a setback is intended to protect, can vary widely. Potential impacts can vary according to the project scale, proposed components and characteristics of the project, project location and site characteristics, and land uses and character of the larger surrounding area.

To get an idea how large a setback might have to be protective in most instances, local governments may wish to review previous sections of this document and consult with experts for professional opinion on what are estimated maximum extents of potential impacts, such as the maximum extent of a shock wave from blasting.

As mentioned above, where setbacks are required, they are assumed to be required for allowable uses. The effect of setbacks on the use of land is illustrated in Figures 1a through 1d. Increasingly large setbacks from property lines limit the amount of area for development. The example demonstrated in Figure 1d depicts that on a quarter-section of land (a 160 acre parcel); a setback from a property line of 1,000 feet would limit development to nine acres. A setback on the same size parcel in excess of 1,320 feet (i.e., ¼ mile) would preclude any silica sand development on the property.

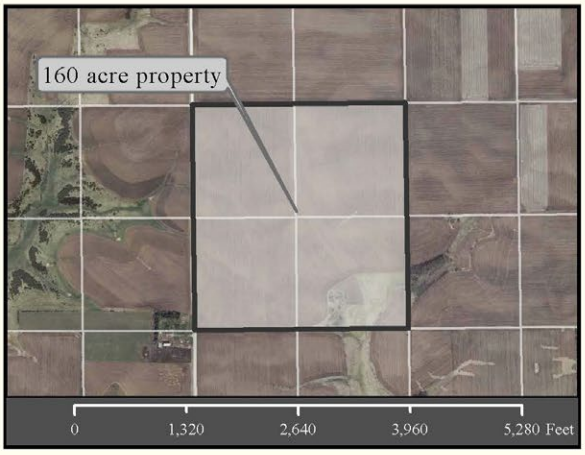


Figure 1a: Conceptual map displaying a 160 acre property (black boundary) proposed to be developed into a mine. The property owner does not own any land adjacent to this property.

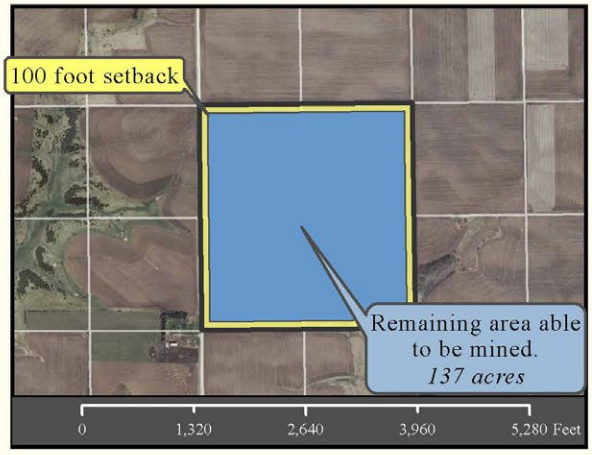


Figure 1b: Conceptual map displaying the 160 acre property and 100 foot setbacks from property lines (yellow), and remaining 86% of the total property area that is able to be mined (blue).

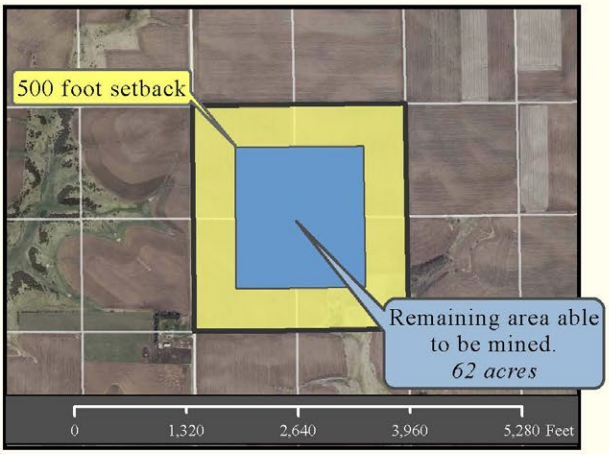


Figure 1c: Conceptual map displaying the 160 acre property and 500 foot setbacks from property lines (yellow), and remaining 39% of the total property area that is able to be mined (blue).

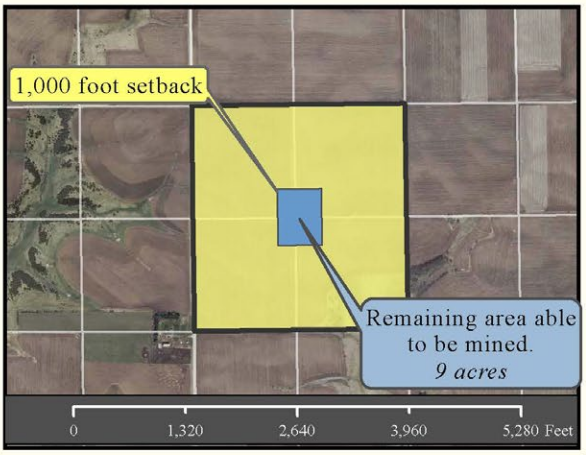


Figure 1d: Conceptual map displaying the 160 acre property and 1,000 foot setbacks from property lines (yellow), and remaining 6% of the total property area that is able to be mined (blue).

Figures 1a, 1b, 1c and 1d. Illustration of effects of increasing setbacks from property lines on development area of quarter-section of land (a 160-acre parcel).

Similarly, as illustrated in Figure 2 using a 40-acre parcel and applying a 300-foot setback from a property line would limit the development to 12 acres.

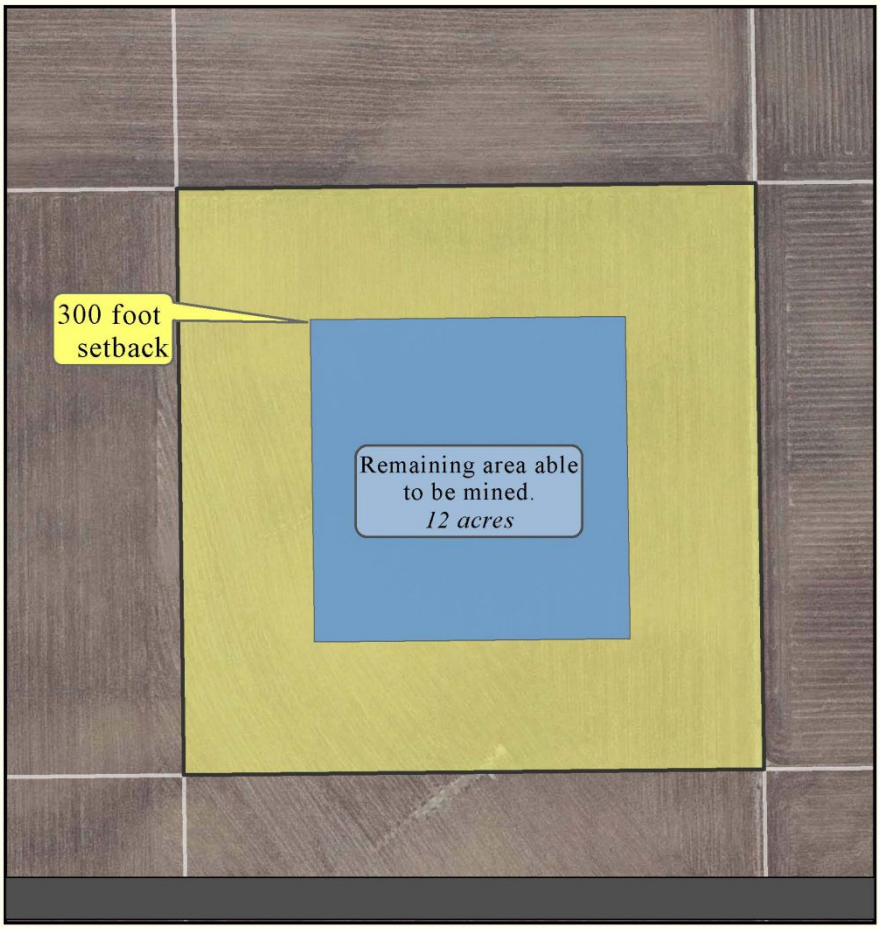


Figure: Conceptual map displaying the 40 acre property and 300 foot setbacks from property lines (yellow), and remaining 30% of the total property area that is able to be mined (blue).

Figure 2. Conceptual map displaying the 40-acre property and 300-foot setbacks from property lines (yellow), and remaining 30% of the total property area that is able to be mined (blue).

The table below provides setback from property line and property acreage examples.

For quarter-quarter sections (40 acres)

Setback from property line	100	200	300	500	600	1000
Net area in acres	28.80	19.43	11.90	2.35	0.33	0.00
Percentage remaining	72%	49%	30%	6%	1%	0%

For quarter sections (160 acres)

Setback from property line	100	200	300	500	600	1000
Net area in acres	136.68	115.19	95.54	61.74	47.60	9.40
Percentage remaining	85%	72%	60%	39%	30%	6%

Consequently, local governments may wish to consider:

- What are the ranges of parcels that are likely candidates for silica sand development, and what would be the effect on development area of alternative property-line setback dimensions (see Figures1a-1d and 2)?
- What are the effects on development area of alternative setback dimensions from houses (see Figure 3)?
- What are the types of development the setback will be applied to, i.e. silica sand mining, processing and/or transload facilities?

It should be noted that the effect on development is different for localized land uses (such as residential zoning districts, or natural features, such as streams) compared with widely dispersed land uses (such as residences in an agricultural zoning district or otherwise rural area). A large setback from a localized land-use or natural feature will not affect development area across entire jurisdictions or districts in the same way as setbacks from dispersed land uses.

Designing Buffers

Buffers for protecting land uses differ in function from buffers to protect natural features. Vegetative buffers between land uses and natural features are generally meant to slow and filter runoff, to lessen the impact of light and noise on wildlife, and to visually screen recreational uses.

Buffers between proposed silica sand projects and land uses can only be effectively designed on a case-by-case, site-specific basis due to variation in topography, project characteristics, and setting.

Consequently, subsections below do not necessarily provide specific guidance on buffers for land uses. It should be noted however, that an LGU can make buffers a general design requirement in the Operations Plan as part of the local application. The following points should be considered when designing buffers for land uses:

- Vegetative buffers (trees and shrubs primarily) can be effective for softening visual impacts of an adjacent land use, can be moderately effective for blocking or softening light, and have been found to be largely ineffective for blocking or softening sound (noise impacts). To be effective in blocking or softening light impacts, vegetation needs to be sufficiently dense (either through buffer width, density of plantings, or a combination of the two), needs to be evergreen to provide screening in winter months, needs to be sufficiently high (which depends on the site and project characteristics). Foliage also may need to extend to the ground (i.e., shrubs or evergreen trees).

- If vegetative buffers are required, the ability to successfully establish and maintain them needs to be considered and addressed in permit conditions.

- Solid fence or berms can be effective in reducing noise and light impacts. Again, site and project-specific factors will dictate specifications such as positioning height, materials,

etc. Aesthetics (visual impacts) of the solid fence or berm itself may also need to be considered and addressed, such as through use of landscaping.

References

Davidson, M, and Dolnick, F. (Ed.) (1999), *A Glossary of Zoning, Development, and Planning Terms*, Planning Advisory Service Report Number 491/492, Washington D.C., Chicago, Planners Press, American Planning Association.

Kendig, L., Connor, S., Byrd, C., Heyman, J. (1980), *Performance Zoning*, Washington D.C., Chicago, Planners Press, American Planning Association.

(1960), *Zoning Buffers: Solution or Panacea*, Planning Advisory Service Information Report No. 133, American Society of Planning Officials

E.1. Residential Land Uses

While this section applies to residential land uses, these concepts can also be applied to other land uses that are not compatible with silica sand projects such as schools, hospitals, and churches.

a. Description of Silica Sand Project Concerns

Silica sand mining, processing, and transload pose potential air quality (silica dust), noise, light, visual, vibration and stormwater runoff or impacts as described elsewhere in this document.

In general, potential negative impacts to residential properties do not differ between the Paleozoic Plateau and the Minnesota River Valley. However, local land uses vary and should be contemplated as part of the process.

b. Narrative Description and Background Information

It is recommended that setbacks are determined using the considerations discussed in the introductory portion of this section. If a setback is established through land-use regulations, it should be considered a minimum in which an LGU may want to add a provision that allows the setback to be increased through the discretionary approval of local permitting. This would allow for the consideration of a specific proposed project component(s) in which an LGU may want to adjust the setback more or less. Local land uses, residential density, project scale, proposed components and characteristics of the project and project location are all factors to consider.

LGUs may want to consider establishing larger setbacks from cities and residential zoning districts, and should consider avoiding the establishment of residential zoning districts near existing mining operations.

Where a setback is intended to protect a land use (human use of land—residences, churches, schools, offices, etc.—as opposed to natural or historical feature, such as lakes, bluffs, burial site, etc.), setbacks from property lines provide more consistent separation than setbacks between the uses themselves. This is because human uses of land change much more quickly over time than natural features. For example, a 1,000-foot setback from a mine to a house that is 800 feet from the property line does not protect the landowner who planned to build a new house closer to the property line. Similarly, the setback from the house to the mine may not recognize outdoor activities on the residential property—a garden or a patio for example—that might also be impacted by a proposed silica sand project. For these reasons, generally, setbacks from land uses such as residences are generally recommended to be measured from the property line, rather than from the land-use feature (e.g., dwelling).

As mentioned above, a general recommendation is to establish a setback from the property line, rather than from the land-use feature itself (e.g., from houses). However, there may be instances in which certain uses, such as residences, are closer to their property lines than is typical in the zoning district. In such instances, while the setback from property lines might provide adequate protection in the majority of cases, the dimension may not be adequately protective of the exceptions. A solution is to overlay setbacks from property lines with setbacks from land uses (such as from houses). When that is done, the greater of the two setbacks (from the property line or from the land use) applies. In Figure 1, a 200-foot setback from property lines is shown with an overlay of a 500-foot setback from residences. The house in the upper right is 300 feet from its property line, so a 200-foot setback provides a 500-foot separation (presumably most residences in the area are 300 feet or more from property lines, making the 200-foot setback from property lines adequate to provide a 500-foot separation in most instances). The house in the lower left, however, is atypically close to its property line, at 100 feet. The overlain 500-foot setback from the house provides an additional 200 feet of separation.

Figure 1. Diagram showing developable area boundary for silica sand activities where 200-foot setbacks are required from the property lines or 500-foot setbacks are required from existing dwellings, whichever is greater.

Higher densities pose additional constraints to proposed projects when considering overlaying multiple property setbacks. Figure 2 illustrates that as setbacks from houses approach the width of the typical parcel of land in the area, the amount of land available for development is diminished to where it is ultimately precluded. This is because the circles created by the setbacks tend toward touching or overlapping, leaving little room in between.

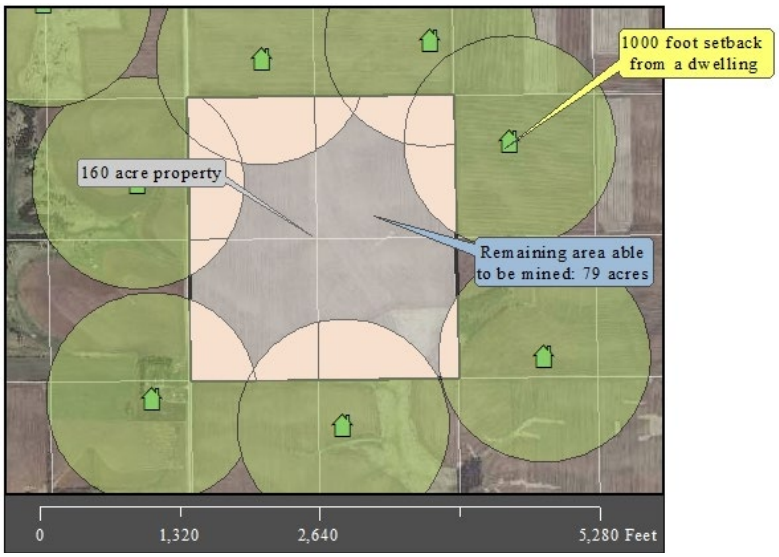


Figure 2. Conceptual map displaying a 160-acre parcel with 1,000-foot setbacks drawn around surrounding dwellings. Note the limited area between the circles.

Pertaining to silica sand projects, some LGUs have already established setbacks for residences or residential districts. Established setbacks include both those set from property lines and those from residences or residential districts. In response to a request from the EQB for consideration in the production of this document, LGUs reported the following ranges of setbacks (in feet) in local regulations:

Paleozoic Plateau

12 LGUs responding *(also see columns labeled "N=" for number providing data)*	**from Property Lines (in feet)**			**from Residences or Residential Districts (in feet)**		
	Smallest	Largest	*N=*	Smallest	Largest	*N=*
Mines	20	50	*6*	1,000	2,000	*5*
Processing	20	50	*5*	500	1,500	*3*
Trans-Load	20	50	*5*	500	1,500	*3*

Minnesota River Valley

3 LGUs responding *(also see columns labeled "N=" for number providing data)*	**from Property Lines (in feet)**			**from Residences or Residential Districts (in feet)**		
	Smallest	Largest	*N=*	Smallest	Largest	*N=*
Mines	30	50	*3*	200	500	*3*
Processing	50	100	*3*	200	500	*3*
Trans-Load	30	50	*3*	200	200	*2*

Other Areas in Minnesota

8 LGUs responding *(also see columns labeled "N=" for number providing data)*	**from Property Lines (in feet)**			**from Residences or Residential Districts (in feet)**		
	Smallest	Largest	*N=*	Smallest	Largest	*N=*
Mines	50	50	*1*	no data	no data	*0*
Processing	50	50	*1*	no data	no data	*0*
Trans-Load	50	50	*1*	no data	no data	*0*

All LGUs Surveyed

Total 18 LGUs responding *(also see columns labeled "N=" for number providing data)*	**from Property Lines (in feet)**			**from Residences or Residential Districts (in feet)**		
	Smallest	Largest	*N=*	Smallest	Largest	*N=*
Mines	20	50	*10*	200	2000	*8*
Processing	20	100	*9*	200	1500	*6*
Trans-Load	20	50	*9*	200	1500	*5*

c. List of Silica Sand Project Potential Impacts

These impacts do not vary between the Minnesota River Valley and the Paleozoic Plateau.

- Air quality (silica dust)
- Noise
- Light
- Visual
- Stormwater runoff
- Vibration

d. Recommendations, Standards, Criteria, Considerations

1. Minimum setbacks in land-use regulations can be used to provide a base level of protection to neighboring residences. However, the specifics of the project and the site need to be considered and setbacks are more effectively determined on a project-specific basis.
2. Setbacks from property lines provide a more consistent separation than setbacks from residential dwellings.
3. Setbacks from residential structures may offer additional distance between residents and a given land use.
4. A setback from residential land uses is often a compromise between objectives: the greater protection offered by a large setback, and the lesser restriction upon allowable uses offered by a small setback. Factors regarding protection and effect on allowable land use should both be considered by LGUs.
5. Larger setbacks are recommended from cities and residential zoning districts, and LGUs should consider avoiding the establishment of residential zoning districts near existing mining operations.
6. In all recommendations above, where a proposed project is located near or across differing jurisdictional areas, LGUs are encouraged to work together to determine the best course of action when considering setbacks and the land use for which they are being considered.

E.2. Streets, Roads and Highways

a. Description of Silica Sand Project Concerns

Potential impacts to streets, roads, and highways from silica sand projects include silica sand (including dust), noise, light, visual, vibration, and stormwater runoff. Transportation relating to silica sand projects may impact roads by causing incursions into the road structure itself,

including cuts, fills, bridges and approaches, signal and support installations, shoulder uses, and etc. The proximity of silica sand projects to parkways, scenic byways, and designated trails can adversely impact natural, recreational, cultural, or scenic resources that are in the vicinity.

b. Narrative Description and Background Information

Impacts from silica sand (tracking of silica dust and mud), noise, light, visual, stormwater runoff are discussed in other subsections of this document and may be best addressed through local permitting and regulations.

Potential incursions into the road structure itself, including cuts, fills, bridges and approaches, signal and support installations, shoulder uses, and etc. The engineered structure of a heavy duty road depends on the underlying geology of the land, slopes of fill material, drainage, and constructed facilities (bridges, abutments, retaining walls, tunnels, rest areas, dedicated use shoulder such as bus lanes, turnouts, passing, recreational, etc.). The road structure needs to be adequately separated from excavations for mines, new ponds, and other construction to protect structure and safety.

Several LGUs have already established setbacks for streets, roads, and/or highways. It may be useful for LGUs to consider setbacks for silica sand activities that other LGUs have established. In response to a request from the EQB for consideration in the production of this document, LGUs reported the following ranges of setbacks (in feet):

Paleozoic Plateau

12 LGUs responding	Smallest	Largest
From Streets	30	30
From Township Roads	70	95
From County Roads	45	100
From State Highway	100	100

Minnesota River

3 LGUs responding	Smallest	Largest
From Streets	no data	no data
From Township Roads	no data	no data
From County Roads	30	100
From State Highway	no data	no data

Other Areas in Minnesota

3 LGUs responding	Smallest	Largest
From Streets	no data	no data
From Township Roads	no data	no data
From County Roads	50	50

From State Highway	no data	no data

All LGUs Surveyed

Total 18 LGUs responding	**Smallest**	**Largest**
From Streets	30	30
From Township Roads	70	95
From County Roads	30	100
From State Highway	100	100

A jurisdictional-wide setback could be adopted as detailed above, but LGUs may want to consider the option to deal with concerns on a project-specific basis, with mitigation established through a discretionary local permit.

c. List of Silica Sand Project Potential Impacts

Potential impacts listed are applicable to both the Minnesota River Valley and the Paleozoic Plateau.

- Air quality (silica dust), noise, light, visual, vibration and water (runoff) impacts to users of streets, roads, and highways
- Incursions into the road structure
- Impacts to intrinsic qualities of parkways, scenic byways, and designated trails

d. Recommendations, Standards, Criteria, Considerations

- Setbacks from transportation rights-of-way should be determined based on specified scope of facility, geology of land underlying the road or railroad, and presence of ancillary facilities including yards, shops, rest areas, pull-outs, and other extensions.
- A jurisdictional-wide setback could be adopted as detailed above, but LGUs may want to consider the option to deal with concerns on a project-specific basis, with mitigation established through a discretionary local permit.
- Parkways, scenic byways, and designated trails should be identified in permit applications. Impacts to intrinsic qualities (intrinsic qualities include natural, cultural, recreational, and scenic) of such roadways, and mitigation measures should be identified and clearly described. Consultation with MnDOT prior to filing permits applications is strongly recommended.

E.3. Ordinary High Water Level (OHWL) of Public Waters and Shorelands

a. Description of Silica Sand Project Concerns

The **Ordinary High Water Level (OHWL)** is a dynamic area of high biodiversity and ecological function. Silica sand mining, processing, stockpiling and transload have the potential to remove vegetative cover, disturb soils, reconfigure topography, change surface water runoff and modify groundwater hydrology. This can lead to long-term fundamental changes to the land in the vicinity of the mining activity, especially in sensitive riparian areas such as Minnesota Public Waters and Public Waters Wetlands shoreland areas.

b. Narrative Description and Background Information

The Ordinary High Water Level (OHWL) is a reference point that defines the DNR's regulatory authority over development projects that will alter the course, current, or cross section of Public Waters. Public Waters (and Public Water Wetlands) are designated lakes, wetlands, and watercourses over which the DNR has regulatory jurisdiction (MS 106G005 Subd. 15). Project proponents must apply to the DNR for a Public Waters Work Permit for most development projects located below the OHWL. Upon review of the permit application information, along with comments received from DNR and LGU, the DNR Commissioner may authorize, deny, or limit a project through the addition of conditions. If a Public Water Work Permit is required, the permit must be obtained prior to commencement of the project.

For lakes and wetlands, the OHWL is the highest water level that has been maintained for a sufficient period of time to leave evidence upon the landscape. The OHWL is commonly that point where the natural vegetation changes from predominately aquatic to predominantly terrestrial (See Figure 1). For watercourses, the OHWL is the elevation of the top of the bank of the channel. For reservoirs and flowages, the OHWL is the operating elevation of the normal summer pool. These guidelines apply to Public Waters as defined in Minnesota Statutes, Section 103G.005, subdivisions 15 and 18, which have been inventoried by the Commissioner according to Minnesota Statutes, Section 103G.201.

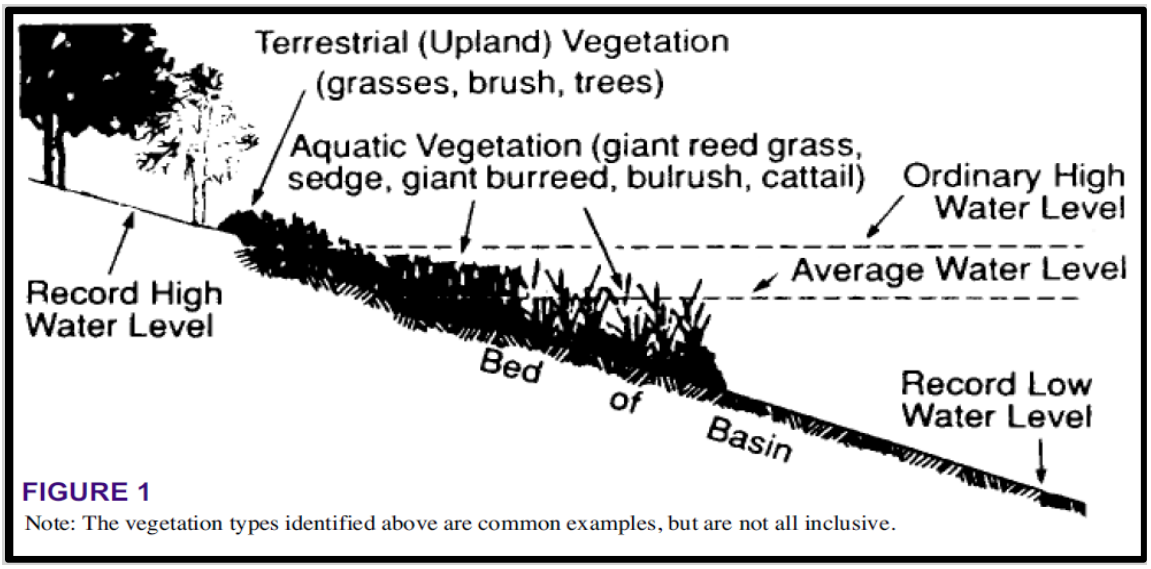


FIGURE 1

Note: The vegetation types identified above are common examples, but are not all inclusive.

Figure depicting vegetation transitions between upland and the OHWL.

Shoreland Management Program

The OHWL is used by local units of government as a reference point to determine the Minnesota Shoreland Management Program's waterward district boundary. It is used as a reference point from which to measure structural setbacks from water bodies and watercourses named in the ordinance.

The regulatory purpose of the shoreland development authority is contained in Minnesota Statute 103F.201:

103F.201 REGULATORY PURPOSE OF SHORELAND DEVELOPMENT.
To promote the policies in section 103A.201 and chapter 116, it is in the interest of the public health, safety, and welfare to:

(1) Provide guidance for the wise development of shorelands of public waters and thus preserves and enhance the quality of surface waters;
(2) Preserve the economic and natural environmental values of shorelands; and
(3) Provide for the wise use of water and related land resources of the state.

The Shoreland Management Program (Program) provides the backbone of statewide standards that local governmental units must adopt into their own land use controls to provide for the orderly development and protection of Minnesota's shorelands - both rivers and lakes. The Program's standards and criteria are intended to preserve and enhance the quality of surface waters, conserve the economic and natural environmental values of shorelands, and provide for the wise use of water and related land resources of the state. Specific goals include the preservation of natural riparian vegetative, near shore bluff protections, conservation of open space, reduction of surface water runoff, and protection of near-shore fish and wildlife habitat. In addition, the Program helps to protect water resources from sewage, chemical and sediment pollution associated with construction storm water runoff, agriculture runoff and other hydrologic changes related to riparian development.

For counties, the "shoreland district" applies to all public waters basins 25 acres or larger. The shoreland district includes all land within 1,000 feet of a lake's OHWL. On rivers and streams having a drainage area of 2 square miles or greater, the shoreland district extends 300 feet from the OHWL, which is usually the top of the streambank. The shoreland district can expand beyond 300 feet when it is part of a designated floodplain as identified by a Federal Emergency Management Agency Flood Insurance Study (FIS).

The DNR established minimum statewide standards in the 1970 shoreland rules for land development within the shoreland district. In 1973, the legislature amended the Shoreland Management Act to include municipalities. Within cities, the shoreland district can include basins as small as 10 acres. Municipal shoreland management standards were established in 1976. At that time, DNR Waters (now DNR Ecological and Water Resources Division) began to identify and notify cities on the need to adopt the standards into their local zoning ordinances.

The existing Shoreland Management rules provide some level of protection to shorelands. Rule 6120.3200, Subp. 4, allows for "Extractive use" as a conditional use in most lake and river classes and districts in the shoreland district. The standards for extractive uses are found in Rule 6120.3300, Subp. 9:

> Subp. 9. **Extractive use standards.** Processing machinery must be located consistent with setback standards for structures from ordinary high water levels of public waters and from bluffs. An extractive use site development and restoration plan must be developed, approved by the local government, and followed over the course of operation of the site. The plan must address dust, noise, possible pollutant discharges, hours and duration of operation, and anticipated vegetation and topographic alterations. It must also identify actions to be taken during operation to mitigate adverse environmental impacts, particularly erosion, and must clearly explain how the site will be rehabilitated after extractive activities end.

In addition, shoreland alterations are regulated under 6120.3300, Subp. 4, which states that "Alterations of vegetation and topography must be controlled by local governments to prevent erosion into public waters, fix nutrients, preserve shoreland aesthetics, preserve historic values, prevent bank slumping, and protect fish and wildlife habitat." It also prohibits intensive vegetation clearing within the shore impact zones (land located between the OHWL and line parallel to a setback of 50% of the structure setback), bluff impact zones (the bluff and land located within 20 feet from the top of the bluff), and on steep slopes (land were agricultural activity or development is either not recommended or described poorly suited due to slope steepness and soil characteristics).

The shoreland rules are administered through local zoning ordinances which may be stricter than statewide standards. Not all local units of government have adopted shoreland ordinances. State-wide minimum shoreland standards were last updated in 1989. The DNR led a highly participatory public process to update the shoreland rules in 2009 and 2010. In 2010, the DNR submitted draft standards to the Governor for approval. The Governor returned the draft standards for further work and the DNR's rulemaking authority lapsed.

In a recent survey of LGUs, 67% (10 of 15 respondents) of the participants had established an OHWL setback in their ordinances. The setbacks ranged from 25 to 300 feet. The other 33% of participants (5 of 15 respondents) either had no setback or deemed the question not applicable to their ordinances.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both geographic regions.

- Degradation or loss of fish and wildlife habitat
- Loss of open space
- Increase in runoff

- Increase in water pollution
- Loss of springs and seeps
- Loss of wildlife migration corridors
- Loss of fish spawning opportunities
- Loss of future alternative riparian use or development
- Loss of landscape aesthetics
- Reduction in riparian property values
- Reduction in recreational use and enjoyment
- Additional hydrologic changes
- Degradation of trout habitat

d. Recommendations, Standards, Criteria, Considerations

In order to protect Public Waters, Public Water Wetlands and sensitive shoreland areas from potentially negative impacts associated with silica sand mining and related activities in proximity to the OHWL, the following actions could be considered by LGUs in both the Paleozoic Plateau and Minnesota River Valley:

1. Provide written comments to the DNR Area Hydrologist on all Public Waters Work Permit applications associated with silica sand mining, processing, stockpiling or transloading.
2. For LGUs with an existing shoreland ordinance, follow established state process to amend the ordinance to further restrict silica sand mining, processing, stockpiling and transloading. Options include:
   - Option 1: prohibit all silica sand mining activities within shore and bluff impact zones and on steep slopes, or
   - Option 2: prohibit all silica sand mining activities within shore and bluff impact zones, within the required setbacks for structures from the OHWL and top of bluff, as well as on steep slopes (as defined through the shoreland ordinance), or
   - Option 3: prohibit all silica sand mining activities within entire shoreland district.
3. For communities without an existing shoreland ordinance, adopt a shoreland ordinance following the state's model ordinance and established process. The ordinance may include further restriction of silica sand mining, processing, stockpiling and transloading as outlined in the options above in 2.

References

Ordinary High Water Level (OHWL)
State Statutes: 103G.001 – 103G.411 WATERS OF THE STATE
Minnesota Rules: 6115.0010 – 6115.0280 PUBLIC WATER RESOURCES

DNR web page:
http://www.dnr.state.mn.us/waters/surfacewater_section/hydrographics/ohw.html

Shoreland Management Program

State Statute:	103F.201– 103F.227 SHORELAND DEVELOPMENT
	116. POLLUTION CONTROL AGENCY
	103A. WATER POLICY AND INFORMATION
Minnesota Rules:	6120.2500 – 6120.3900 SHORELAND MANAGEMENT

DNR web page:
http://www.dnr.state.mn.us/waters/watermgmt_section/shoreland/index.html

E.4. Bluffs

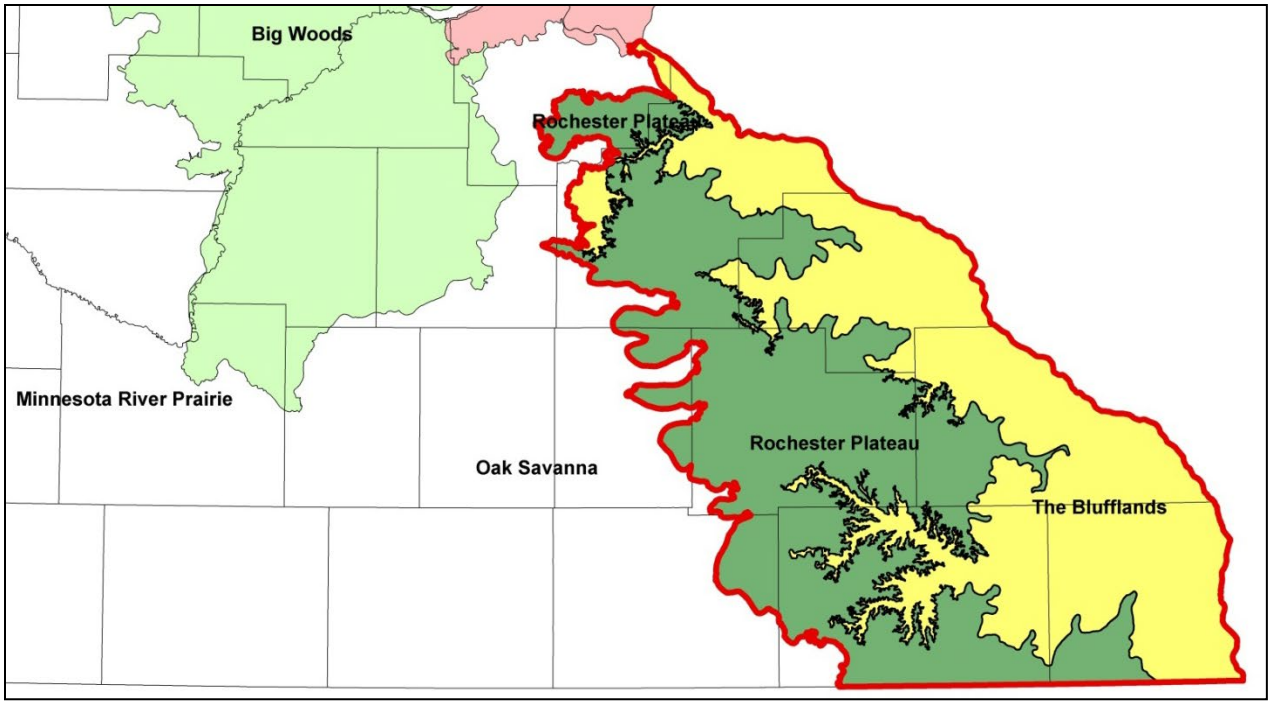
a. Description of Silica Sand Project Concerns

Bluffs are a definitive landscape feature in Southeast Minnesota but can also be found along the Minnesota River Valley. Silica sand mining activities have the potential to substantially and permanently modify the landscape by removing bluffs or portions of bluffs.

In the Paleozoic Platuea, bluffs are targeted for silica sand mining. Silica sand mining in the Minnesota River Valley is currently focused on old river terraces. The river terraces are positioned between the modern day floodplain and the bluffs that mark the outer margin of the ancient River Warren floodplain. It is likely that silica sand mining will continue to target the terraces because they offer relatively easy access to the Jordan Sandstone.

b. Narrative Description and Background Information

The distinctive, high relief landscape located in portions of southeast Minnesota, western Wisconsin, northeast Iowa and northwest Illinois is often referred to as the Driftless Area. In Minnesota, the area is generally referred to as the Bluffland Landscape. Officially, the DNR classifies this area as the Paleozoic Plateau Ecological Section. The DNR further differentiates the landscape by breaking the Paleozoic Plateau into two Ecological Subsections; namely the Blufflands Subsection and the Rochester Plateau Subsection.



The Blufflands and Rochester Plateau Subsections were not covered by glacial ice during the most recent Wisconsin glacial period so water and wind have sculpted the Paleozoic rocks for many thousands of years. This extensive weathering period facilitated the development of a mature surface water drainage pattern resulting in the landscape's characteristically steep valleys and high bluffs. The bluffs contained within the Rochester Plateau Subsection tend to be formed by remnant, sometimes isolated, St. Peter Sandstone buttes.

The Blufflands Subsection is a loess-capped plateau. In the east, loess lies directly on bedrock. In the southeast, loess overlies red clayey residuum that was formed directly from weathering of the limestone or sandstone. Paleozoic sedimentary rocks, including the silica sand bearing Jordan and Wonewoc Sandstones, are exposed in steep valley walls but are generally mantled with colluvium or loess. The greatest topographic relief occurs along the Mississippi River, where relief is up to 600 feet.

The Blufflands Subsection is characterized by bluff prairies, steep bluffs, and stream valleys. Numerous cold-water trout streams feed major rivers such as the Root, Whitewater, Zumbro, and Cannon Rivers. Most of the designated trout streams in Southeast Minnesota are located within the Blufflands Ecological Subsection. Rich hardwood forests grow along the river valleys, and river-bottom forests grow along major streams and backwaters. There are few lakes.

It is known or predicted that the Blufflands Ecological Subsection contains 156 species designated as being in Species of Greatest Conservation Need (SGCN) – the most of all the subsections in Minnesota. These SGCN include 82 species that are federally-listed or state-listed. In the Blufflands, nine mammal SGCN are known or predicted to occur which accounts

for 41% of all mammal SGCN in the state. These numbers will be updated with the 2014 SGCN listing.

Reptiles, amphibians, snails, mussels, and fish are special features of the Blufflands landscape, including timber rattlesnakes, milk snakes, paddlefish, shovelnose sturgeon, pallid shiners, American eels, pirate perch, skipjack herrings, and several Pleistocene snails. In addition, the Blufflands provides a critical migratory corridor for forest songbirds, raptors, and waterfowl. It is the most important subsection for reptiles and one of the most important subsections for mollusks. It is an important area for birds such as Henslow's sparrows, prothonotary warblers, red-shouldered hawks, Louisiana waterthrushes, and peregrine falcons. It is also an important area for Karner blue butterflies and Blanding's turtles.

The DNR has long recognized the uniqueness and importance of the Bluffland Landscape. Starting in the 1990s, the DNR funded a Bluffland Landscape Coordinator position to work with Local Units of Government to manage growth and protect the bluffs from inappropriate development. The DNR encouraged and assisted LGUs with the writing and adoption of Bluffland Protection Ordinances. This was a not a state mandated land use program but a volunteer effort supported by DNR staff to protect the bluffs. A number of counties and cities in the Paleozoic Plateau have adopted bluff protection through local ordinance.

A bluff, toe and top of the bluff can be defined in ordinance as:

BLUFF. A natural topographic feature such as a hill, cliff, or embankment having the following characteristics:

A. The slope rises at least twenty-five (25) feet above the toe of the bluff; and
B. The grade of the slope from the toe of the bluff to a point twenty-five (25) feet or more above the toe of the bluff averages thirty (30) percent or greater;

TOE OF THE BLUFF. The point on a bluff where there is, as visually observed, a clearly identifiable break in the slope, from gentler to steeper slope above. If no break in the slope is apparent, the toe of the bluff shall be determined to be the lowest end of the lowest fifty (50) foot segment that exceeds twenty (20) percent slope.

TOP OF THE BLUFF. The point on a bluff where there is, as visually observed a clearly identifiable break in the slope, from steeper to gentler slope above. If no break in the slope is apparent, the top of the bluff shall be determined to be the highest end of the highest fifty (50) foot segment that exceeds twenty (20) percent slope.

Protection of bluffs near Public Waters and contained within the State Shoreland Management Program's shoreland district are regulated according to the standards established in the LGUs shoreland ordinance. However, the majority of all bluffs in the Paleozoic Plateau and Minnesota River Valley are located outside of shoreland districts and therefore are not protected unless the LGU has adopted a bluff protection ordinance.

c. List of Silica Sand Project Potential Impacts

Minnesota River Valley

- Disturbance of bluff toe at margin of terrace
- Loss of landscape aesthetics
- Loss of forest and prairie habitat
- Loss of open space
- Increase in water pollution
- Reduction in recreational use and enjoyment
- Hydrologic changes, including those impacting calcareous fens
- Loss of habitat corridors provided by steep slopes and tops of bluffs
- Increased vulnerability to invasive species
- Cultural resources such as burial mounds, rock shelters and caves, rock art, cultural landscapes, and traditional cultural properties/sacred sites

Paleozoic Plateau

- Major change to landscape
- Loss of forest and prairie habitat
- Loss of open space
- Increase in water pollution
- Loss of landscape aesthetics
- Reduction in recreational use and enjoyment
- Hydrologic changes including functionality of edge effect
- Degradation of trout habitat
- Loss of Species of Greatest Conservation Needs
- Loss of habitat corridors provided by steep slopes and tops of bluffs
- Increased vulnerability to invasive species
- Cultural resources such as burial mounds, rock shelters and caves, rock art, cultural landscapes, and traditional cultural properties/sacred sites

d. Recommendations, Standards, Criteria, Considerations

In order to protect the biologically important and geologically sensitive bluffs from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities, Paleozoic Plateau and Minnesota River Valley LGUs could consider the following actions:

1. For LGUs with an Existing Bluffland Protection Ordinance:

1. In the LGU mining ordinance, require that the applicant submit a DNR NHIS Data Request Form in order to determine potential impacts to rare features. The form should be obtained early in project development so the NHIS Response can be provided with the application. *Note: A NHIS correspondence letter is valid for one year. Through project development (including early planning, application, environmental review and

permitting) it may be necessary to request an updated review from the DNR to ensure that all recorded rare and natural resources are incorporated in project considerations.

- In the LGU mining ordinance, require the applicant to complete a comprehensive cultural resource inventory to document the presence or absence thereof on the project site(s) and adjacent properties.
- To protect the integrity of the entire bluff face, prohibit silica sand mining between the top of the bluff and toe of the bluff.
- Establish a horizontal setback distance from the toe of the bluff in order to further protect the integrity of the bluff by guarding against accelerated erosion or mass wasting. A recent LGU survey found that 10 of 16 respondents had bluff protection in their ordinances. Bluff setbacks range from 30 to 300 feet with the larger setbacks providing the greater protection.
- Establish a horizontal setback from the top of the bluff and limit the height of overburden and sand product stockpiling above natural grade to eliminate visual intrusion from State and County Highways and recreational viewscapes. Relatively easy to use GIS software packages are now readily available to assist in the completion of a site viewscape evaluation from identified vantage points. A recent LGU survey indicates that for those LGUs with bluff protection in their ordinances, bluff setbacks range from 30 to 300 feet with the larger setbacks providing the greater protection.
- To further reduce visual impacts and stabilize the mine perimeter, require the immediate establishment of permanent vegetation on the outside facing slope of all berms.

2. For LGUs without an Existing Bluffland Protection Ordinance:

- Adopt a bluffland ordinance similar to neighboring LGUs.
- Include the recommendations from #1 above.

References

DNR web site:
http://www.dnr.state.mn.us/ecs/222Lc/index.html

E.5. Designated Trout Streams, Class 2A Water as Designated in the Rules of the Pollution Control Agency, or any Perennially Flowing Tributary of a Designated Trout Stream or Class 2A Water

a. Description of Silica Sand Project Concerns

Trout are very sensitive to water temperature, stream sedimentation and water clarity outside of their preferred range. Silica sand mining and related activities have the potential to negatively

impact water temperature, quantity and clarity as well as other water quality parameters and stream substrates. Designated trout streams are those streams the DNR has determined to have the water quality characteristics capable of supporting trout. Streams with MPCA Class 2A water quality classification are generally capable of supporting trout and other coldwater organisms. MPCA Class 2A streams and DNR designated trout streams are generally the same subset of streams in Minnesota.

b. Narrative Description and Background Information

DNR Designated Trout Streams

The 700 miles of DNR designated trout streams in the Paleozoic Plateau depend on groundwater inputs to supply cold and clear water necessary to sustain healthy trout populations. Fewer designated trout streams exist in the Minnesota River Valley but they are a significant resource in need of protection and preservation. The DNR strives to provide protection, improvement, and restoration of coldwater aquatic habitats and fish communities so that this unique resource is available for future generations.

The DNR follows process and criteria set by statute to identify and officially designate trout streams. A majority of streams that support trout populations are designated as such by DNR. The DNR has focused management on steams with fishable trout populations but also incorporates public input into decisions regarding trout designation. As a result, some streams that support trout are not currently designated as such by the DNR.

Ecologically sensitive, and popular with anglers from around the upper Midwest, these streams require special attention to assure that they remain healthy and productive. Designated trout streams in this region rise from springs and seeps thus remaining cold in summer and relatively warm in the winter. The limestone bedrock and alluvial soils make the water hard, nonacidic, and very biologically productive. Southeast streams produce an abundant aquatic invertebrate community of mayflies, caddis flies and midges that are a critical food for trout. Shoreline trees shade streams and help keep water temperatures cold. Warming of the stream water by discharged mine processing water, stormwater or reduced shade along the stream corridor by tree removal can degrade trout habitat leading to less robust trout populations and other undesirable changes in the stream ecosystem.

Accelerated soil erosion and sedimentation is also a concern in trout waters. The potential for gravel riffles to be covered with fine-grained sediment originating from sand mining activities could degraded spawning habitat, suffocate buried trout eggs in redds (nests) and reduce invertebrate production. Clearing of shoreline trees takes away the underwater root wads and fallen trees that provide trout cover from current and predators. Shoreline trees also shade and help keep water temperatures cold.

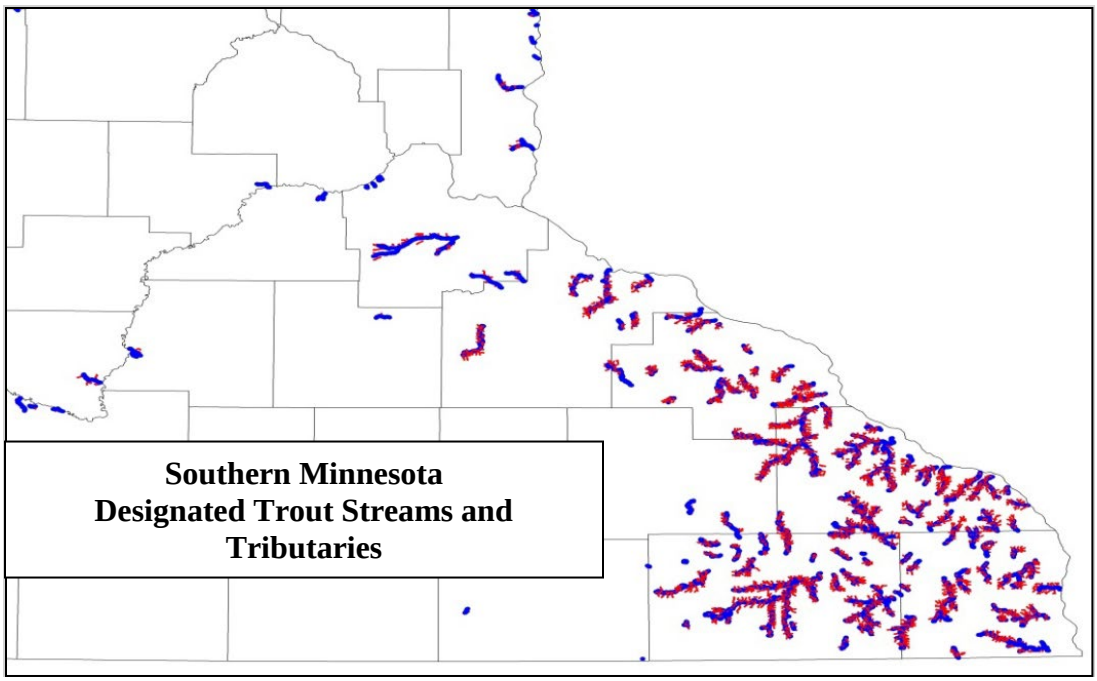


Figure depicting southern Minnesota Designated Trout Streams and Tributaries

MPCA Class 2A waters; aquatic life and recreation.

The MPCA sets Water Quality Standards to protect beneficial uses such as healthy fish, invertebrate and plant communities, swimming, water recreation, and fish consumption. Water quality standards are also used to evaluate water monitoring data to assess the quality of the state's water resources. The standards are used to identify waters that are polluted, impaired or in need of additional protection. They also facilitate the setting of effluent limits and treatment requirements for discharge permits and cleanup activities.
MPCA defines Class 2A water as:

The quality of Class 2A surface waters shall be such as to permit the propagation and maintenance of a healthy community of cold water sport or commercial fish and associated aquatic life, and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. This class of surface waters is also protected as a source of drinking water.

MPCA classification of 2A waters has mirrored DNR trout stream designation in the past. Recently MPCA has begun to deviate from DNR classification for some streams, applying coldwater (2A) aquatic life standards to a handful of undesignated streams that indicate the potential to support a coldwater community based on water temperature and species present.

Paleozoic Plateau

Groundwater discharge from natural springs and seeps in southeast Minnesota is vital to sustaining the region's trout streams and recreational, commercial, agricultural, environmental, aesthetic, and economic values. Recognizing this, the 2013 Legislature prohibited the excavation or mining of silica sand in this region within one mile of any designated trout stream ***unless a Silica Sand Mining Trout Stream Setback Permit has been issued by the DNR commissioner***. In essence, State Statute 103G.217 DRIFTLESS AREA WATER RESOURCES provides a one mile setback from designated trout streams, tributaries to designated trout streams, streams that potentially could be designated trout streams (Class 2A streams) and the springs and seeps that discharge groundwater to trout streams, unless and until, the DNR Commissioner is satisfied that the propose silica sand mining activity will not have a detrimental impact.

As a result, DNR has developed a process to administer Silica Sand Mining Trout Stream Setback Permit applications. The permit application process requires an applicant to complete a hydrogeologic evaluation and collect any other information necessary to assess potential impacts to trout streams, springs, seeps, calcareous fens, domestic wells and other hydrogeologic features. Based upon the evaluation, the DNR will identify appropriate setbacks from designated trout streams, springs, and other hydrogeologic features, ***such as the top of the water table***, and any other restrictions necessary to safeguard these resources. The DNR commissioner is authorized to grant permits, with or without conditions, or deny them.

The permit applicant must complete a hydrogeological evaluation that is based on a properly scoped and completed investigation. The permitting application process begins with a pre-application meeting and site-visit with the project proposer to review the proposed mining operation and provide direction on the preparation of the remaining application materials.

The hydrogeological evaluation must include all information necessary to assess potential impacts to trout streams, springs, seeps, calcareous fens, and other hydrogeologic features including private and public drinking water supplies. Based upon the hydrogeological evaluation, the Commissioner will identify appropriate setbacks from designated trout streams, springs, and other hydrogeologic features and any other restrictions necessary to protect trout stream water quantity, quality, and habitat. This could include denial of the permit and restrictions on mining within the water table as mentioned above and further discussed below.

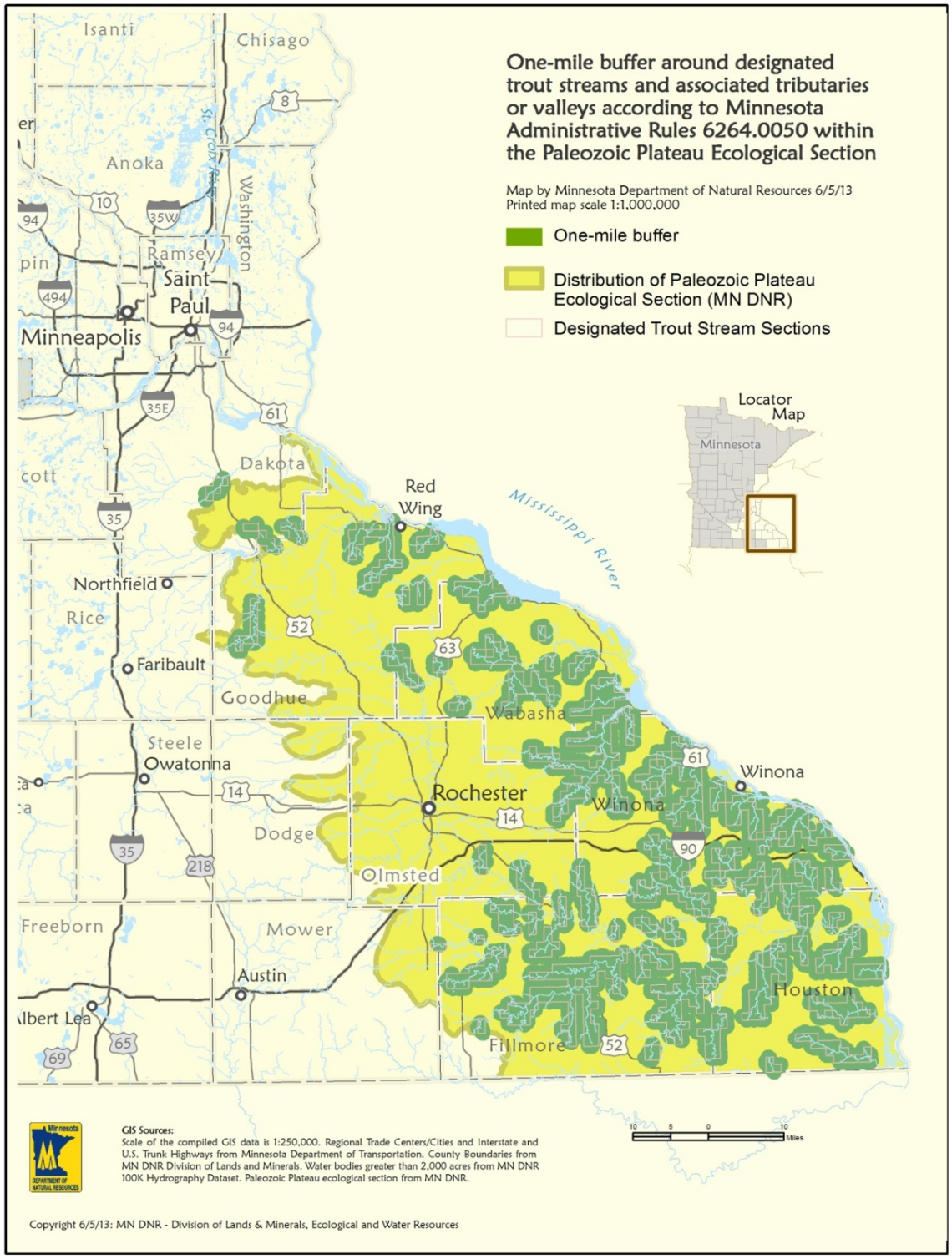


Figure depicting one-mile buffer around Designated Trout Streams and associated Tributaries and Valleys in Paleozoic Plateau

Criteria DNR will consider in evaluating proposed silica sand mining operations and in determining setback distances and other restrictions:

1. Trout stream temperature. Does the proposed silica sand mining operation have the potential to increase trout stream temperature?
2. Stream base flow or stream quantity. Does the proposed silica sand mining operation have the potential to cause a reduction in groundwater base flow recharge to trout streams or a reduction in trout stream flow volumes?
3. Spring water quality. Does the proposed silica sand mining operation have the potential to lessen the quality of spring water, including its temperature, turbidity, or contamination?
4. Surface Water runoff. Is there a threat of negative impacts to streams from increased surface water runoff from silica sand mining operations?
5. Processing, stockpiling. Is there a threat of negative impacts to streams from the processing or stock piling of sand or leachate from those processes?
6. Recreation: Does the proposed silica sand mining operation have the potential to lessen the recreational use or productivity of the trout streams due to the operation of the silica mine?

Permit Application Submittals Requirements: A two-tier approach will be used in evaluating proposed silica sand mining operations. Tier 1 includes dry mining operations where mining does not extend below the water table and groundwater extraction is limited to less than 10,000 gallons per day or one million gallons per year. Typically, dry mining operations are expected to have less environmental concerns than wet mining. Tier 2 includes wet mining operations where excavation occurs below the water table or when an appropriation permit is required. Early in the process the DNR will determine if it will be a Tier 1 (less potential for adverse effects) or Tier 2 (higher potential for adverse impacts; more rigorous information requirements) application. Tier 2 projects, if permitted, are likely to have more stringent restrictions.

Delineation of Areas of Concern: The "area of concern" is the area near the proposed mining operation and adjacent potentially impacting features such as trout streams, springs or calcareous fens. Following the submittal of a General Mine Location Map with Supporting Information document (Requirement 1. listed below), a meeting between the project proposer and DNR is required to begin the permitting process. An "area of concern" will be determined by the DNR on a site specific basis using the general mine location map, supporting information, surface watersheds, springsheds, groundwater recharge areas and other considerations. The "area of concern" will be the focus of the hydrogeological evaluation.

Pre-application water monitoring: Monitoring wells, springs, and other significant water features in the area of concern are to be monitored for at least one year prior to application. The area of concern will often extend beyond the boundaries of the mine operation. When an Environmental Assessment Worksheet is required, the collection of data, such as spring monitoring, will also be required as part of the environmental review.

Hydrogeological Evaluation Work Plan: A draft hydrogeological evaluation work plan must be submitted to the DNR for review and approval. The general requirements for a Silica Sand Mining Trout Stream Setback Permit Application are outlined below. All required submittals must be provided with the permit application for it to be considered complete. The DNR Commissioner may waive a specific permit application requirement if the information provided is deemed adequate by the Commissioner to fully describe and quantify the proposed mining activity's potential to impact trout streams, springs, seeps, calcareous fens and other hydrogeologic features. Coordination with DNR staff is required for all work plans, interim reports and final documents. The Commissioner may assess the project proposer fees to cover the reasonable costs of duties performed.

Tier 1 Dry Mining Permit Applications - applies to all proposed mines that are above the highest known water table and do not appropriate surface water or groundwater for dewatering, sand processing, sand transportation or mining operations. A Tier 1 permit application requires the following submittals:

1. General Mine Location Map with Supporting Information that includes:

    a. Elevations and topographic contours
    b. Roads
    c. Surface water bodies
    d. Designated trout streams, tributaries within sections that contain designated trout streams, springs, seeps, calcareous fens and other wetlands
    e. Property lines
    f. Mine footprint
    g. Buildings
    h. Equipment and fuel storage areas
    i. Watershed boundaries
    j. Springshed if delineated

2. Stream and Wetland Resources Report - Field delineation, mapping and characterization of streams, springs, seeps, calcareous fens and other wetlands.

3. Groundwater and Stream Monitoring Plan – A "Groundwater and Stream Monitoring Plan" must be submitted to the DNR which includes descriptions of the design, installation, management and operations of the planned monitoring network for the site. The monitoring network will be installed and operated prior to initiation of mining activities to establish baseline conditions. Monitoring will continue throughout mining period to track water trends over time. DNR review of the Monitoring Network Plan is required prior to initiation of work. Monitoring requirements include:

    a. Groundwater monitoring wells in all formations including the formation below the formation targeted for mining.
    b. Groundwater levels in private and public wells.
    c. Monitoring of streams and springs for stage, discharge, turbidity, temperature, and specific conductivity.

d. Pre-mining monitoring for 12 months will be required to determine base line conditions.
e. Based on site specific conditions, it may be necessary to periodically sample streams, springs and wells for other parameters such as dissolved oxygen, specified anions and cations, potential contaminants of concern and natural and anthropogenic tracers.

The scope and requirements for the monitoring network will be adjusted based upon mining plans and the 12 months of baseline groundwater monitoring. Dry mining operations (Tier 1) will typically require a less extensive monitoring network than wet mining operations (Tier 2).

4. Hydrogeological Evaluation Report – The hydrogeological evaluation report summarizes the information gathered from the general mine location map with supporting information document, stream and wetlands resources report, monitoring network, additional field surveys and GIS analysis. The report should include:

    a. Arial extent and depth of the silica sand deposits.
    b. Geologic units and contacts including unit thickness illustrated with geologic cross sections.
    c. Aquifer units.
    d. Confining units (clay, shale, siltstone).
    e. Faults and structure.
    f. Depth to bedrock.
    g. Depth to the water table/potentiometric surface - must be determined by field measurements of static water levels in monitoring wells located on site.
    f. Inventory, characterization and mapping of all karst features including sinkholes, sinking streams, and caves.
    g. Comprehensive and complete inventory, characterization and mapping of domestic wells, irrigation wells, and public supply wells.
    h. Location of exploratory boreholes with boring logs.
    i. Location of monitoring wells with water well and boring records.
    j. Gather and display stream flow and groundwater hydrogeologic information.
    k. This information shall be summarized in a Hydrogeologic Conceptual Model based on the resource information/data collected and should include a hydrogeologic cross section(s) sufficient to characterize site and area conditions.

5. Mining Plan (See Operations section for further guidance)

    a. Mining progression and timing.
    b. Final depth of the mine.
    c. Spoil pile locations and treatments.
    d. Material processing plans including washing sites, transport, water sources, and treatment methods.
    e. Equipment maintenance areas.
    f. Road locations.

6. Mine Reclamation Plan – Because the interim and final disposition of the mine has the potential to negatively impact trout streams, a detailed mine reclamation plan is required. See Operations, Reclamation subsection for more guidance.

Tier 2 Wet Mining Permit Applications – additional requirements apply to all proposed silica sand mines that need to appropriate water for dewatering, sand processing, sand transportation, and mining operations below the water table. Tier 2 permit applications must include all of the Tier 1 submittal requirements plus the following submittal for the "area of concern".

1. Comprehensive Hydrogeologic Investigation Report – A work plan must be prepared with planned activities and submitted to the DNR for review prior to initiating the work. Report component requirements are dependent on proposed project activities an may include:

    a. Additional exploratory boreholes with boring logs.
    b. Additional monitoring wells with water well and boring logs.
    c. Nested monitoring wells.
    d. Geologic cross sections parallel and perpendicular to groundwater flow direction.
    e. Groundwater water table and potentiometric contour maps.
    f. Flow net analysis of groundwater flow direction.
    g. Aquifer testing to characterize aquifer, confining layer properties and boundaries.
    h. Surface and subsurface geophysics.
    i. Bedrock topographic map.
    j. Depth to bedrock map.
    k. Dye-tracing from surface karst features to springs, seeps, streams and wells.
    l. Fracture analysis.
    m. Air photo interpretation.
    n. GIS analysis.
    o. Groundwater computer model that is properly calibrated, validated, and well documented with clearly stated input values and assumptions.
    p. Groundwater computer model scenario comparisons and forward simulations.
    q. Groundwater computer modeling with particle tracking and contaminant transport capabilities.
    r. Thermal modeling/monitoring of streams and groundwater.

Annual Report

If a permit is issued, an annual report will be required which describes actual mining and reclamation completed during the past year, submits and analyzes groundwater and surface water monitoring data, identifies the mining and reclamation activities planned for the upcoming year, and submits a contingency reclamation plan to be implemented if operations cease in the upcoming year.

Corrective Action

If after a permit is issued and operations have begun, violations of the permit terms or conditions are observed, immediate action will be taken by the DNR to have the mine operator correct the violation.

Annual Permit Fee

If a permit is issued and operations begun, ongoing monitoring and regular inspection of the mining operation will help ensure the protection of the trout stream resource. An annual silica sand mining trout stream setback permit fee will be charged to the mine operator based on the level of staff effort and professional services rate and billable hours.

Existing Silica Sand Mining Operations

Silica sand mining operations which were operating before May 24, 2013 are not required to obtain the silica sand mining trout stream setback permit. However, if an existing silica sand mine expansion is proposed that requires a CUP/IUP by the LGU, the DNR will require a silica sand mining trout stream setback permit.

d. Recommendations, Standards, Criteria, Considerations

Paleozoic Plateau

In order to protect the biologically important and sensitive trout streams from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities ***within*** the Paleozoic Plateau Ecological Section, LGUs could consider the following actions:

1. Provide the DNR Area Hydrologist with LGU comments on Silica Sand Mine Trout Stream Permit applications within the permit comment period.
2. Participate in coordination meetings between the DNR and the permit applicant.

Minnesota River Valley

In order to protect the biologically important and sensitive trout streams from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities in areas ***outside*** of the Paleozoic Plateau Ecological Section, LGUs could consider the following actions:

1. Require the permit applicant to submit a (1) scope of work and (2) hydrogeological evaluation report for LGU review and approval that is comprehensive and demonstrates that their proposed project has been adequately evaluated in regards to the following criteria:
   - Trout stream temperature. Does the proposed silica sand mining operation have the potential to increase trout stream temperature?

- Stream base flow or stream quantity. Does the proposed silica sand mining operation have the potential to cause a reduction in groundwater base flow recharge to trout streams or a reduction in trout stream flow volumes?
- Spring water quality. Does the proposed silica sand mining operation have the potential to lessen the quality of spring water, including its temperature, turbidity, or contamination?
- Surface Water runoff. Is there a threat of negative impacts to streams from increased surface water runoff from silica sand mining operations?
- Processing, stockpiling. Is there a threat of negative impacts to streams from the processing or stock piling of sand or leachate from those processes?
- Recreation: Does the proposed silica sand mining operation have the potential to lessen the recreational use or productivity of the trout streams due to the operation of the silica sand mine?

2. Follow DNR process for Silica Sand Mining Trout Stream Permit as outlined above.

References

State Statutes: 97C.005 SPECIAL MANAGEMENT WATERS
103G.201 PUBLIC WATERS INVENTORY
103G.217 DRIFTLESS AREA WATER RESOURCES
103G.285 SURFACE WATER APPROPRIATIONS
115.44 CLASSIFICATION OF WATERS

Minnesota Rules: 6115.0190-0231 PUBLIC WATERS RULES
6264.0050 RESTRICTIONS ON DESIGNATED TROUT LAKES AND STREAMS
7050.0222 SPECIFIC WATER QUALITY STANDARDS FOR CLASS 2 WATERS

DNR web page:
http://www.dnr.state.mn.us/fishing/trout_streams/index.html

DNR web page:
http://files.dnr.state.mn.us/lands_minerals/silicasand/silicasand-troutstream-setback-factsheet.pdf

MPCA web page:
http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/water-quality-standards.html

E.6. Calcareous Fens

a. Description of Silica Sand Project Concerns

Calcareous seepage fens are one of the rarest natural communities in the United States. These fens have been reported in 10 states, mostly in the Midwest. Approximately 200 are known in Minnesota, most of which are only a few acres in extent. Calcareous fens are concentrated at the bases of terrace escarpments in river valleys in southeastern Minnesota and on the sides of morainal hills and valley side slopes in southern, northwest and west-central Minnesota. Silica sand mining activities have the potential to physically disturb, fill or alter the hydrology of calcareous fens. Dewatering, washing, processing and transportation of sand have the potential to substantially change the groundwater flow regime that supports a calcareous fen.

b. Narrative Description and Background Information

Calcareous fens are rare and distinctive wetlands characterized by a substrate of non-acidic peat and dependent on a constant supply of cold, oxygen-poor groundwater rich in calcium and magnesium bicarbonates. This calcium-rich environment supports a plant community dominated by "calciphiles," or calcium-loving species. These fens typically occur on slight slopes where upwelling water eventually drains away and where surface water inputs are minimal. Sometimes they occur as domes of peat that grow to the height of the hydraulic head. These settings create an unusual wetland regime where the substrate is almost always saturated to the surface, but flooding is rare and brief. In addition to the rarity of the community itself, calcareous seepage fens support a disproportionately large number of rare plant species in Minnesota, four of which occur almost exclusively in this community.

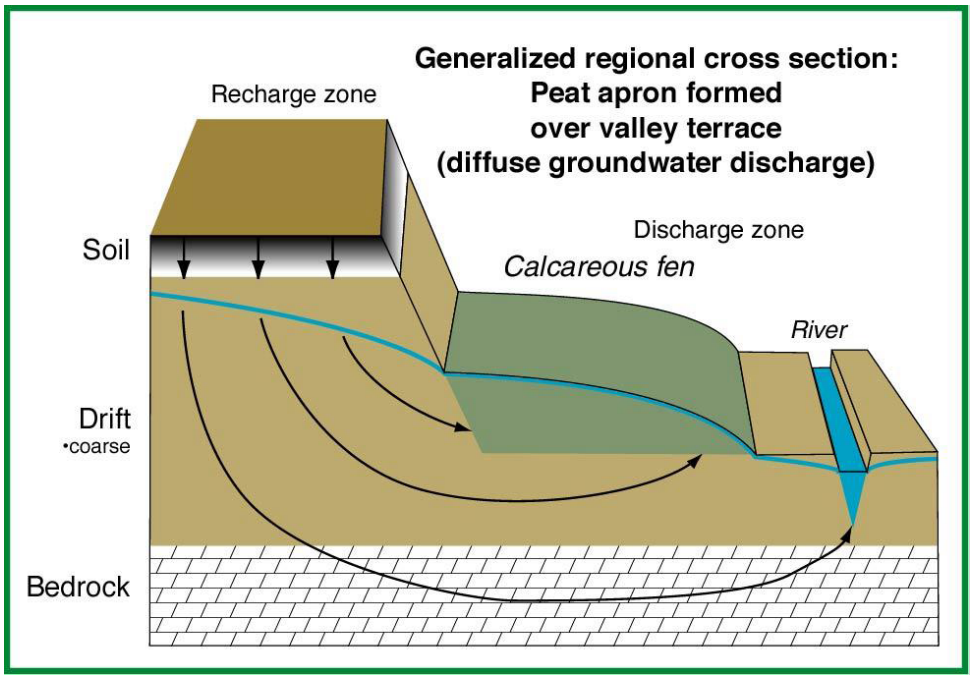


Figure of generalized regional cross section of groundwater discharge for site conditions needed for calcareous fens.

Under the Minnesota Wetlands Conservation Act (WCA), impacts to calcareous seepage fens are regulated by the DNR. According to the WCA rules, calcareous fens may not be filled, drained, or otherwise degraded, wholly or partially, by any activity, unless the Commissioner of Natural Resources, under an approved calcareous fen management plan, decides some alteration is necessary. For DNR well construction approvals with subsequent appropriation permit applications within 5 miles of a known calcareous fen, submittal requirements are automatically elevated to a higher level of technical data collection, analysis and review to better understand the hydrogeologic setting and to avoid impacts. Other wetland types bordering a calcareous fen provide a critical buffer from activities in the vicinity and help to protect the integrity of the fen.

In addition to the protection afforded by WCA, destruction of any state-threatened plants occurring on a calcareous fen may be regulated under Minnesota's endangered species law. MPCA rules prohibit discharge of any sewage, industrial waste, or other waste to a calcareous fen.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both geographic regions.

- Alteration of groundwater flow regime
- Physical disturbance
- Alteration of surface water flow

- Loss of protected species
- Discharge to outstanding resource value water
- Alteration of soil and water chemistry from discharges to fen
- Loss of surrounding wetland habitat that act as a buffer for calcareous fens

d. Recommendations, Standards, Criteria, Considerations

In order to protect calcareous fens from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities, Paleozoic Plateau and Minnesota River Valley LGUs could consider requiring the following actions in local permitting:

1. Consult the official list of known calcareous fens on the DNR's website to determine if any calcareous fens are located in the vicinity of proposed activities. If so, notify the DNR Area Hydrologist.
2. Report all known or suspected calcareous fens in the LGU's jurisdiction that are not on the official list of calcareous fens to the DNR Area Hydrologist for verification and official listing of the fens.
3. Utilize appropriate provisions of the WCA to avoid the loss of any wetlands that buffer a calcareous fen.
4. For all projects that involve dewatering, require a survey of wetlands within 1.5 miles of the project boundary to determine if any unknown calcareous fens may be present. Surveys should be conducted by personnel qualified to identify calcareous fens.
5. If potential calcareous fen impacts are identified, further consultation with the DNR is required.

References

State Statutes: 84.0895 PROTECTION OF THREATENED AND ENDANGERED SPECIES
103G.223 CALCAREOUS FENS

Minnesota Rules: 7050.0180 NONDEGRADATION FOR OUTSTANDING RESOURCE VALUE WATERS
8420.0935 STANDARDS AND CRITERIA FOR IDENTIFICATION, PROTECTION, AND MANAGEMENT OF CALCAREOUS FENS.

DNR web pages:
http://files.dnr.state.mn.us/natural_resources/water/wetlands/calcareous_fen_fact_sheet_dec_2011.pdf

http://files.dnr.state.mn.us/natural_resources/npc/open_rich_peatland/opp93.pdf

http://www.dnr.state.mn.us/wetlands/type2_calcareous_fen.html

http://files.dnr.state.mn.us/publications/waters/calcareous_fen_list_nov_2009.pdf

E.7. Wellhead Protection Areas as Defined in Section 103I.005

a. Description of Silica Sand Project Concerns

Removal of protective geologic materials can result in increased groundwater vulnerability to land use activities. Additionally, mining activities could result in different recharge patterns, groundwater flow conditions or other aquifer properties. Should these aquifer properties differ substantially from those used in delineating a nearby wellhead protection area, the integrity of the methodology used for the delineation would be undermined. If such circumstances arise, the wellhead protection area delineation will need to be re-assessed.

b. Narrative Description and Background Information

Wellhead protection planning (WHP) is a means of preventing contamination of either wells or the groundwater system supplying wells using effective management of potential sources of contamination in all or a portion of the well's recharge area. Wellhead protection is a legal requirement that was adopted by the state in December 1997. Procedures and time frames for wellhead planning are described in Minnesota Rules Parts 4720.5100 to 4720.5590, and apply to community and non-community public water supply systems that rely on groundwater for their source of drinking water.

Wellhead protection planning is conducted within Drinking Water Supply Management Areas (DWSMA), which are the management areas around scientifically-derived wellhead protection areas. These areas and the vulnerability associated with them are determined by public water supply systems using site specific information. Resource protection measures embedded in wellhead protection planning efforts are derived based on the physical setting of the DWSMA and the potential sources of contamination identified at the time of plan preparation.

In general, WHP areas provide buffers to water supply wells. No additional setbacks are required unless silica sand mining activities will result in impacts to the parameters used to develop the WHP plan. In addition, all potential contaminant sources are required to meet isolation distances to all wells as described in MN Statute I031 and MR Chapter 4725.

c. List of Silica Sand Project Potential Impacts

Most potential impacts are similar for both the Minnesota River Valley and the Paleozoic Plateau.

- Alteration of groundwater flow regime;

- Physical disturbance, especially the removal of confining layers that afford some geologic protection to aquifers used for water supply (causing increased vulnerability to groundwater contamination);
- Change in recharge patterns;
- Alteration of surface water flow.

The one area of concern unique to the Paleozoic Plateau is the potential for silica sand mining operations and the water handling associated with silica sand mining to lead to the development of karst features in the carbonate bedrock of the region. Such features are known to develop rapidly in some settings. The complex groundwater flow patterns and very rapid travel times associated with aquifers that exhibit these features can make protection efforts difficult. Accordingly, mine development and reclamation activities specific to the Paleozoic Plateau (as described elsewhere in this document) are designed to minimize the likelihood that mining activities would accelerate the development of karst and other secondary porosity features in the underlying bedrock materials.

d. Recommendations, Standards, Criteria, Considerations

The following language could be considered for use in ordinance development or in permitting requirements:

- Prior to mining, an inventory of all wells, shall be conducted within the portions of a DWSMA proposed for silica sand mining activities and within a 1 mile radius of the proposed project boundary. Unused, unsealed wells shall be brought back into use or sealed in accordance with Minnesota Statutes, Chapter 103I and Minnesota Rules, Chapter 4725. Additional information is available on the MDH website at Well Sealing.

References

MDH maintains current information on the locations and vulnerability characteristics of wellhead protection areas and drinking water supply management areas at: http://www.health.state.mn.us/divs/eh/water/swp/maps/index.htm**.**

MDH guidance on stormwater infiltration in wellhead protection areas is available on its website: http://www.health.state.mn.us/divs/eh/water/swp/stormwater.pdf

MDH has compiled a list of issues and associated management measures for mining within wellhead protection areas. This information is available here: http://www.health.state.mn.us/divs/eh/water/swp/mining.pdf

E.8. Critical Natural Habitat Acquired by the Commissioner of Natural Resources under Section 84.944 of Minnesota Statutes

a. Description of Silica Sand Project Concerns

"Critical natural habitats" are defined as lands or waters funded under MS 84.943 that are acquired under provisions of MS 84.944 Acquisition of Critical Natural Habitats. The lands or waters (outdoor recreation units) acquired are designated as a unit within the state Outdoor Recreation System such as a state park. Silica sand mining activities have the potential to negatively affect these outdoor recreation units through the introduction or spread of invasive species and through changes in hydrology, increased erosion, sedimentation, pollution, a reduction in the recreational user experience, loss of connectivity of landscapes, loss of wildlife habitat and native plant communities and wildlife displacement. Many of these outdoor recreation units, once acquired, are protected from direct impacts.

Although these outdoor recreation units are individually established under unique criteria (e.g. outdoor recreation value, protection of natural features, historic preservation) which are intrinsically tied to their location on the landscape; the outdoor recreation units either in the Minnesota River Valley and Paleozoic Plateau Ecological Section face similar potential impacts.

The outdoor recreation units that may be affected will depend on the location and type of silica sand operations being proposed. Depending on the extent to which the silica sand resources are mined, processed or transported, the cumulative effect on Minnesota's sensitive resources could be significant.

b. Narrative Description and Background Information

According to *Minnesota Statutes* (*MS*) section 84.944 in determining what critical natural habitats shall be acquired or improved, the commissioner shall consider:

1) *The significance of the land or water as existing or potential habitat for fish and wildlife and providing fish and wildlife oriented recreation;*
2) *The significance of the land, water, or habitat improvement to maintain or enhance native plant, fish, or wildlife species designated as endangered or threatened under section 84.895.*
3) *The presence of native ecological communities that are now uncommon or diminishing; and*
4) *The significance of the land, water, or habitat improvement to protect or enhance natural features within or contiguous to natural areas including fish spawning areas, wildlife management areas, scientific and natural areas, riparian habitat and fish and wildlife management projects.*

In accordance with considerations mentioned above, "critical natural habitats" may only be acquired under MS section 84.944 if it is designated as a unit within the state Outdoor Recreational System as defined under section 86A.05. Outdoor recreational units include; state

parks; state recreation areas; state trails; state scientific and natural areas; state wilderness areas; state forests; state wildlife and management areas; state water access site; state wildlife, scenic and recreational rivers, state historic sites; state rest areas; additional parks; aquatic management areas; and state boater waysides.

"Critical natural habitats" also include those identified under sections 89.018, subdivision 2, paragraph (a), 97A.101, 97A.125, 97C.001 and 97C.011 which include public water reserves and management areas, wildlife habitats on private land, experimental waters and muskellunge lakes, respectively.

Silica sand resources in Minnesota are found primarily in the Minnesota River Valley and the Paleozoic Plateau (southeastern) portions of the state. From a natural resource perspective, these areas include unique and critical habitats that should be protected. The Minnesota River Valley includes gently rolling hills that historically were covered with oak savanna, tallgrass prairie and maple-basswood forest. The Paleozoic Plateau is characterized by bluffs, prairies and stream valleys, provides a critical migratory corridor for birds, is comprised of numerous cold-water streams, has the highest number of SGCN, and is one of the most important areas for reptiles and mullusks. The EQB Report on Silica Sand Final Report (March 20, 2013) includes more information on sensitive resources found within these areas and potential impacts silica sand activities may have to these resources.

Most outdoor recreation units in these areas have been designated under specific criteria on a per-site basis. These criteria could be, for example, that the site contains a native prairie; a unique or historical view shed of the Mississippi River or offers recreational opportunities valued in Minnesota such as trout stream fishing, camping, and wildlife viewing for example. For this reason, management methods and recreational opportunities vary among areas. This makes it impossible to identify specific impacts silica sand activities will have on critical natural habitats, even if they fall under similar designations, without site specific information.

Even with site specific information, it may be difficult for LGUs to assess what type of impacts may be associated with proposed activities for outdoor recreation units that aren't directly impacted. The outdoor recreation units may consist of complex habitat systems with varying degrees of consideration that need to be made from a broader landscape perspective (e.g. seed transport, hydrology, wildlife corridors). More obvious impacts that may be easier to assess include noise or visual impact; but the loss and value of habitat and habitat connectivity or migratory impacts may be more difficult to discern. Consultation with area experts and site managers could be a useful tool in assessing site impacts and is encouraged. In the scenario where the outdoor recreation unit is adjacent to the proposed project site, the DNR should be consulted early in the process.

The vicinity of the proposed project to these outdoor recreation units introduces another consideration. An example on visual impacts: A proposed silica sand mining operation is located on a bluff feature. Two state trails are located within ¼ mile of the proposed project; one trail is located on the toe of the bluff, the other on the top. Even though the proposed project is located within ¼ mile of both trails, the trail on the top of the bluff may have visual impacts while the other located at the toe of the bluff does not. Generally, the DNR recommends that "vicinity" be

considered as critical natural habitats located within one mile of the proposed project boundary. Outdoor recreation units identified within that distance should then be evaluated individually for potential impacts applying considerations such as the one in the example above.

Features within outdoor recreation units or for which the property may have been designated may be discussed in other Considerations for Setback and Buffer subsections. For example, Seminary Fen Scientific and Natural Area is located within the Minnesota River Valley. However, one of resources for which the critical natural habitat was named is a calcareous fen. Special considerations and recommendations for calcareous fens are discussed in subsection 6. In this scenario, it is recommended that the LGU follow the recommendations for the unique feature or whichever is more restrictive. It should be noted that other site features in addition to, for example, the calcareous fen, may need to be considered when determining an appropriate course of action. Referring back to the example above, the Seminary Fen SNA also includes a designated trout stream and state-listed rare plants.

It is also important to note the obvious higher density of the designated sites within the Paleozoic Plateau. This are of the state with its many unique features is referred to as the Driftless Area and in in Minnesota, is generally referred to as the Bluffland Landsape. This should not be interpreted by LGUs to mean that resources outside of this area are not as valued or require less protection; but, rather point out that density of these resources should be considered when considering cumulative impacts and landscape connectivity.

When considering boundaries

Some outdoor recreation units such as state parks and state recreation areas have legislatively authorized statutory boundaries. Statutory boundaries are comprised of state-acquired parcels and privately-owned properties (lands in which the landowner agrees to be included within the statutory boundary but whose property is not impacted by the agreement). Statutory boundaries allow the DNR the authorization to negotiate with willing sellers for acquisition of lands contained within that statutory boundary. Statutory boundaries provide additional opportunity to state parks and state recreational areas to preserve plant communities, natural areas and culturally significant historic sites.

When considering features

The NHIS provides information on Minnesota's rare plants, animals, native plant communities, and other rare features such as animal aggregations. The NHIS is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities, and other natural features and is continually updated as new information becomes available. The data are commonly used for land conservation programs, environmental review, planning, management research and education. A Natural Heritage Review [or NHIS Review] can be obtained through a formal request made to the DNR. If it is determined that the proposed project has the potential to adversely affect any state-listed or other rare features recommendations for avoidance and/or minimization will be included with the response along with DNR area contact information. Information on how to obtain NHIS data along with a fee schedule for services can be found on the DNR website.

Many resources are available that provide information about the species or features associated with critical natural habitats (and other habitats in general). The DNR website link to" Nature" is one of those resources. This interactive webpage includes links to webpages on Minnesota's animals, climate, ecological classification system, forests, invasive species, native plant communities, nongame wildlife, plants, prairies, water and rocks and minerals. Numerous other resources are available via the internet that include other state websites, local governments (county/city), non-governmental organizations (e.g. The Nature Conservancy, Ducks Unlimited, the Minnesota Land Trust, etc.), university websites (e.g. University of Minnesota) and federal government websites (e.g. United States Fish and Wildlife Service, United States Park Service, etc.). Caution should be applied when using information gathered from non-research based entities.

More information on outdoor recreation units can be found on the DNR website. Most of the links are located under the Destination Tab located on the main webpage at www.dnr.state.mn.us. This information includes maps, outdoor recreation units characteristics/features and recreational features.

The locations of most of the outdoor recreation units referenced in this subsection are available in spatial data format and can be found on the DNR Data Deli website. The DNR GIS Data Deli is an internet-based spatial data acquisition site that allows users to download raw computer-readable data for use in Geographic Information System (GIS) or image processing systems. Local land-use plans and watershed plans are other resources that should include locations of outdoor recreation units and their unique and valued features.

c. List of Silica Sand Project Potential Impacts

Minnesota River Valley and Paleozoic Plateau

- Reduction in SGCN
- Impacts to state-listed species that rely on designated outdoor recreation units
- Loss of habitat and habitat corridors
- Introduction and/or spread of invasive species
- Increase in water pollution
- Hydrologic impacts to lakes, streams and wetlands (landscape and recreational implications)
- Recreational user safety (increased traffic and large equipment)
- Increased fragmentation and degradation of habitat (both protected and non-)
- Visual impacts to recreational users
- Noise impacts to recreational users

d. Recommendations, Standards, Criteria, Considerations

To protect outdoor recreation units from potential negative impacts associated with silica sand mining, processing and transportation LGUs could consider the following be required in local application/permitting processes:

1. Require that the applicant submit a DNR NHIS Data Request Form in order to determine potential impacts to rare features. The form should be obtained early in project development so the NHIS Response can be provided with the application. *Note: A NHIS correspondence letter is valid for one year. Through project development (including early planning, application, environmental review and permitting) it may be necessary to request an updated review from the DNR to ensure that all recorded rare and natural resources are incorporated in project considerations.
2. Consult the DNR's website or DNR area offices to determine if an outdoor recreation is located in the vicinity of proposed activities.
3. If an outdoor recreation unit is found to be adjacent to the proposed project, the DNR should be consulted early in the process.
4. If the outdoor recreation unit is found to be in the vicinity of the proposed project, LGUs/project proposers should consider the proposed activities and the potential impacts to the outdoor recreation units. A DNR area expert or manager could be consulted to help assess potential impacts.
5. Impacts in any scenario should be avoided or minimized to the extent feasible by requiring:
    a. **Setbacks**: There are no existing setback requirements in *Minnesota Rules* for outdoor recreational units ("critical natural habitats"). As with residential setbacks, minimum setbacks in land-use regulations can be used to provide a base level of protection. However, the specifics of the project and the site need to be considered and setbacks are more effectively determined on a project-specific basis. In a land-use regulation pertaining to outdoor recreational units, it may be appropriate to establish a setback of 500 feet or greater from the property line.
    b. **Vegetative buffers**: Require a vegetative buffer along the perimeter of the project area. Vegetative buffers provide both a visual and noise barrier to mining, processing and transporting activities if designed properly. Vegetative buffers also help provide erosion control, reduce soil/water runoff from the site and may help to avoid or manage the spread or establishment of invasive species.
    c. **Best Management Practices**: Project proposers should be required to follow BMPs. (discussed in more detail in the Operations Section of this document)
    d. The use of ecologically appropriate materials both during operations and reclamation. For example, this could include the required use of wildlife-friendly erosion control mesh and native seed mixes from local seed sources (see Operations).

References

The Office of the Revisor of Statutes website:
http://www.revisor.leg.state.mn.us

DNR main website:

www.dnr.state.mn.us

DNR Natural Heritage Information System webpage:
http://www.dnr.state.mn.us/eco/nhnrp/nhis.html

DNR Index webpage on Nature:
http://www.dnr.state.mn.us/nr/index.html

DNR Data Deli webpage:
http://deli.dnr.state.mn.us

Attach: Wildlife-friendly erosion control mesh flyer.
Attach: Minnesota's State-Listed Species (August 2013)

E.9. Natural Resource Easement Paid Wholly or in Part by Public Funds

a. Description of Silica Sand Project Concerns

Silica sand mining activities have the potential to negatively affect natural resource easements through the introduction or spread of invasive species; changes in hydrology; loss of wildlife habitat and wildlife displacement; reduction in the recreational user experience; loss of connectivity of landscapes; and through increased erosion, sedimentation and pollution. The potential effects are likely to be indirect impacts as easements set forth specific restrictions on development and land use which would likely protect them from direct impacts.

Natural resource easements are individually obtained for the protection of certain features or for natural resource recreation. Although the Minnesota River Valley and Paleozoic Plateau Ecological Section offer some different rare features and recreational experiences, the resources in both face similar potential impacts.

The natural resource easements (lands) that will be affected will depend on the location and type of silica sand operations. Depending on the extent to which the silica sand resources are mined, processed or transported, the cumulative effect on Minnesota's natural resources could be significant.

b. Narrative Description and Background Information

Easements are defined as a certain right to use the real property of another without possessing it. Easements often include a set of restrictions a landowner voluntarily agrees to that limits how the land can be used. The landowner who legally agrees to the easement and all future owners are legally obligated to abide to the agreed-upon restrictions that are placed on the land's development and use. The existence of an easement should be part of the recorded deed for the

property. The restrictions are dependent on the features that the easement is intended to protect or serve. Public access is not always a condition of the agreement. Easements that fit under the category of "natural resource easements" include conservation, scenic and trail easements. The funding can be from local, state and/or federal sources.

It should be noted that the intention of this subsection is not to provide an exhaustive list of natural resource easements and all reasons for which they were acquired. Rather, this subsection is meant to bring attention to those which may be encountered and may need to be cogitated when reviewing a proposed silica sand project. The focus in this subsection is given to natural resource easements held by the state; however, local government, non-governmental organizations (NGOs) and federal governments also hold easements in the state of Minnesota and should be given equal consideration.

The comments and recommendations provided in this subsection are the technical opinions of state agencies. Natural Resource easements held by other entities as identified above may have additional concerns or differing recommendations. Therefore LGUs are strongly encouraged to contact easement holders identified in the project area as appropriate.

Conservation Easements

State natural resource easements include conservation easements which are defined in Minnesota Statutes 84C. There are more than 15 different types of state-funded conservation easements, each with a different purpose. Primarily, these are administered by four easement holders: Board of Water and Soil Resources (BWSR), Department of Natural Resources (DNR), Duck Unlimited (DU), and Minnesota Land Trust (MLT). Conservations easements include those acquired for aquatic management areas; native prairie banks; wildlife management areas; Reinvest in Minnesota (RIM) Reserve Program; trout streams; scientific and natural areas; wild and scenic rivers; wildlife management areas; water banks; northern pike spawning areas; Forest Legacy; Minnesota Forests for the Future and Metro Greenways. Many of these are considered outdoor recreation units (subsection 8). Easements are another method to add additional protection to units when not all properties of interest are available to be acquired. Other conservation easements such as native prairie banks are only protected through conservation easements.

Currently more than 6,600 state-funded conservation easements protect about 600,000 acres. The Paleozoic Plateau contains 481 conservation easements, the majority of which are trout streams. The Minnesota River Valley currently has 14 conservation easements of various types. These do not include RIM conservation easements. *Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report February 28, 2011* is a good resource to learn more about conservation easements held by the DNR. As the report date is 2011, numbers provided within that document may not be representative of current easements.

Pertaining to RIM conservation easements, BWSR currently holds 6,700 RIM conservation easements that provide protection for 250,500 acres across the State. Within the Paleozoic Plateau alone there are 422 easements that encompass 10,100 acres.

Federal governments easement holders can include the United States Fish and Wildlife Service (FWS); the Natural Resources Conservation Service (NRCS) the United States National Park Service (NPS) and the United States Bureau of Land Management (BLM). These natural resource easements can be acquired and managed in various ways. For example, The NRCS offers programs to landowners who want to maintain or enhance their land in a beneficial way to the environment by providing technical help and financial assistance but depends on landowners and organizations to do the work. The conservation easement programs offered include the Grassland Reserve Program, Wetlands Reserve Program and Healthy Forest Reserve Program. The FWS provides technical and financial assistance to local land trusts and community conservation foundations similar to NRCS but also could own and manage easements such as wetland easements, grassland easement and others.

Non-governmental organization easement holders include organizations such as Ducks Unlimited, Inc. (Wetlands American Trust), Minnesota Land Trust and The Nature Conservancy. Conservation easement types include many of those identified above under state and federal government.

Local governments can also hold easements for similar purposes as mentioned above. Conservation easement types can vary by LGU. The LGU should be prepared to provide project proposers with information on conservation easements that they hold early during project planning.

Scenic Easements

State scenic easements are those easements acquired by the Minnesota Department of Transportation under M.S. 173.04 Scenic Area. These easements are acquired to preserve the natural beauty of a specific area and its visibility from the highway. The rights may require the removal, by owner of the land, any structure necessary to accomplish visibility. These easements are federally funded.

The DNR may acquire scenic easements to implement the Wild and Scenic Rivers System. The purpose of Wild and Scenic River Systems are to preserve and protect the outstanding scenic, recreational, national, historical, and scientific values of certain Minnesota rivers and adjacent lands. There is one Wild and Scenic and Recreational River located within the Paleozoic Plateau that is a segment of the Cannon River.

Trails Easements

Trail easements are easements acquired for the purpose of developing or designating a trail segment for recreational purposes. Trail easements offer the user access to other natural resource features and critical natural habitats discussed in other sections and subsections of this document. Trail easements can be held by local, state and federal governments as well as non-governmental organizations. These easements can be designated for a variety of uses and reasons. The DNR for example manages trails and trail systems for many uses that include cross-country, biking, horseback riding, off-highway vehicles, hiking and snowmobile trails. Many of these trail types

are also managed by non-state entities. Trail systems may tie into larger long-distance trails that can be held in easements by many easement holders.

Four state trail easements are managed by the DNR located within the Paleozoic Plateau. Within the Minnesota River Valley, one state trail easement that is part of the Minnesota Valley State Trail. Currently, no National Park System trails are within this area of the state.

Considerations

As discussed above, natural resources easements are obtained for a variety of reasons. Natural resource easements may be obtained for recreational purposes, the protection and preservation of rare and unique features and several of these easements may be part of or considered critical natural habitats. For this reason, the considerations and cautionary mentions are similar to those in subsection 8 of Buffers and Setbacks.

The restrictions of each individual easement are dependent on the features that the easement is intended to protect or for the purpose for which the easement was obtained. This makes it difficult to state with any certainty what specific impacts silica sand activities may have to natural resource easements even for those that fall under similar designations, without site specific information.

Even with site specific information, it may be difficult for LGUs to assess what type of impacts may be associated with proposed activities for natural resource easements that aren't directly impacted. Natural resource easements lands may consist of complex habitat systems with varying degrees of consideration that need to be made from a broader landscape perspective (e.g. seed transport, hydrology, and wildlife corridors). More obvious impacts that may be easier to assess include noise or visual impact; but the loss and value of habitat and habitat connectivity or migratory impacts may be more difficult to discern. Consultation with area experts and site managers could be a useful tool in assessing site impacts and is encouraged. In the scenario where the natural resource easement is adjacent to the proposed project site, the easement holder should be consulted early in the process.

The vicinity of the proposed project to a natural resource easement introduces another consideration. An example on visual impacts: A proposed silica sand mining operation is located on a bluff feature. Two state trails are located within ¼ mile of the proposed project; one trail is located on the toe of the bluff, the other on the top. Even though the proposed project is located within ¼ mile of both trails, the trail on the top of the bluff may be subject to visual impacts while the other located at the toe of the bluff does not. Generally, it is recommended that "vicinity" be considered as natural resource easements located within one mile of the proposed project boundary. Natural resource easements identified within that distance should then be evaluated individually for potential impacts applying considerations such as the one in the example above.

Features within natural resource easements may be discussed in other Setback and Buffer subsections. An example would be a calcareous fen. Special considerations and recommendations for calcareous fens are discussed in subsection 6. In this scenario, it is

recommended that the LGU follow the recommendations for the unique feature or whichever is more restrictive. It should be noted that other site features in addition to, for example, the calcareous fen, may need to be considered when determining an appropriate course of action.

When considering features

The Natural Heritage Information System provides information on Minnesota's rare plants, animals, native plant communities, and other rare features such as geologic features and animal aggregations. The NHIS is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities, and other natural features and is continually updated as new information becomes available. The data are commonly used for land conservation programs, environmental review, planning, management research and education. A NHIS Review can be obtained through a formal request made to the DNR. If it is determined that the proposed project has the potential to adversely affect any state-listed or other rare features recommendations for avoidance and minimization will be included with the response along with DNR area contact information. Information on how to obtain NHIS data along with a fee schedule for services can be found on the DNR website.

There are many resources available that provide information about the species or features associated with natural resource easements (and other habitats in general). The DNR website link to "Nature" is one of those resources. This interactive webpage includes links to webpages on Minnesota's animals, climate, ecological classification system, forests, invasive species, native plant communities, nongame wildlife, plants, prairies, water and rocks and minerals. Numerous other resources are available via the internet that include other state websites, local governments (county/city), non-governmental organizations (e.g. The Nature Conservancy, Ducks Unlimited, the Minnesota Land Trust, etc.), university websites (e.g. University of Minnesota) and federal government websites (e.g. United States Fish and Wildlife Service, United States Park Service, and etc.). Caution should be applied when using information gathered from non-research based entities.

How to find out where natural resource easements are located

The National Conservation Easement Database (NCED) includes records from land trusts and public agencies throughout the United States. The purpose of NCED is to provide a nationwide system for sharing and managing information about conservation easements. The website allows the user to run reports on your state(s) of interest. More advanced searches include but are not limited to easement types, easements by counties, easement holders, and easement purposes. The report includes graphs/charts that aid in the interpretation of conservation easements and queries offer map depictions. The easement records within the system are provided voluntarily and updated periodically. Easement holders and landowners both are encouraged to participate. In Minnesota several state, federal and non-governmental organizations participate in this program. Few local governments were identified as participants in the database. To run a report for your area of interest or to learn more on how to participate in the NCED, visit the website at www.conservationeasement.us.

The locations of several natural resource easements discussed in this subsection are available in spatial data format and can be found on the DNR Data Deli website. The DNR GIS Data Deli is an internet-based spatial data acquisition site that allows users to download raw computer-readable data for use in Geographic Information System (GIS) or image processing systems. Local land-use plans and watershed plans are other resources that should include locations of critical natural habitats and their unique and valued features.

Most easements are filed in the public records of the county in which the land is located. For counties who have not established an electronic database which allows them to sort land records by type, locating easements can be difficult. However, other resource planning tools such as local land-use and/or regional development plans and some watershed plans should already have identified many of these easements and could be useful tools when reviewing proposed projects.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both geographic regions.

- Loss of habitat and habitat corridors
- Introduction and/or spread of invasive species
- Increase in water pollution
- Hydrologic changes (landscape and recreational implications
- Recreational user safety (increased traffic and large equipment)
- Reduction in SGCN
- Impacts to state-listed species that rely on protected resources
- Increased fragmentation and degradation of habitat (both protected and non-)
- Visual impacts to recreational users
- Noise impacts to recreational users

d. Recommendations, Standards, Criteria, Considerations

Natural resource easements are one method to protect and preserve land; other methods include zoning and local regulations, state or federal laws and regulations, and public ownership. To protect natural resource easements from potential negative impacts associated with silica sand mining, processing and transportation LGUs could consider the following be required in local application/permitting processes:

1. Require that the applicant submit a DNR NHIS Data Request Form in order to determine potential impacts to rare features. The form should be obtained early in project development so the NHIS Response can be provided with the application. *Note: A NHIS correspondence letter is valid for one year. Through project development (including early planning, application, environmental review and permitting) it may be necessary to request an updated review from the DNR to ensure that all recorded rare and natural resources are incorporated in project considerations.

2. Consult available resources to determine natural resource easements are adjacent to or in the vicinity of the proposed project. If a natural resource easement is found to be adjacent to the proposed project, the easement holder should be consulted early in the process.
3. If the natural resource easement is found to be in the vicinity of the proposed project, LGUs/project proposers should consider the proposed activities and the potential impacts to the critical natural habitat. Area experts or easement managers could be consulted to help assess potential impacts.
4. Impacts in any scenario should be avoided or minimized to the extent feasible by requiring:
    a. **Setbacks**: There are no existing setback requirements in *Minnesota Rules* for natural resource easements. As with residential setbacks, minimum setbacks in land-use regulations can be used to provide a base level of protection. However, the specifics of the project and the site need to be considered and setbacks are more effectively determined on a project-specific basis. In a land-use regulation pertaining to natural resource easements, it may be appropriate to establish a setback of 500 feet or greater from the property line.
    b. **Vegetative buffers**: Require a vegetative buffer along the perimeter of the project area. Vegetative buffers provide both a visual and noise barrier to mining, processing and transporting activities if designed properly. Vegetative buffers also help provide erosion control, reduce soil/water runoff from the site and may help to avoid or manage the spread or establishment of invasive species.
    c. **Best Management Practices**: Project proposers should be required to follow BMPs. (discussed in more detail in the Operations section of this document)
    d. The use of ecologically appropriate materials both during operations and reclamation. For example, this could include the required use of wildlife-friendly erosion control mesh and native seed mixes from local seed sources.

Long-term planning could include working with area experts and landowners to identify lands that contain rare and sensitive features to determine whether a natural resource easement or other method of protection such as purchasing the land in fee.

References

The Office of the Revisor of Statutes website:
http://www.revisor.leg.state.mn.us

DNR Data Deli website:
http://deli.dnr.state.mn.us

DNR main website:
http://www.dnr.state.mn.us/

NCED website:
http://www.conservationeasement.us/

BWSR webpage on easements:

http://www.bwsr.state.mn.us/easements/

USFWS webpage on habitat management techniques:
http://www.fws.gov/mountain-prairie/pfw/r6pfw8b.htm

NRCS website on Easements:
www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/

E.10. Floodplains

a. Description of Silica Sand Project Concerns

Floodplains are areas adjacent to rivers, streams, and lakes that are susceptible to flooding. Along large rivers, such as the Mississippi and Minnesota Rivers, floodplains usually are flooded during spring after heavy snow seasons but flooding can also result from intense rains. Floodplains may include normally dry areas adjacent to wetlands, small ponds, or other low areas. Silica sand mining activities have the potential to be flooded if located in or near a floodplain.

Flooding of a silica sand mine and associated activities could potentially result in floodwater contamination, groundwater contamination, rerouting of the stream, alteration of surface water flow, operations shut down, loss of berm or bank, loss of vegetated upland , loss of wetland buffer, accelerated erosion, loss of equipment, increased sedimentation, loss of productivity and degradation of fish and wildlife habitat.

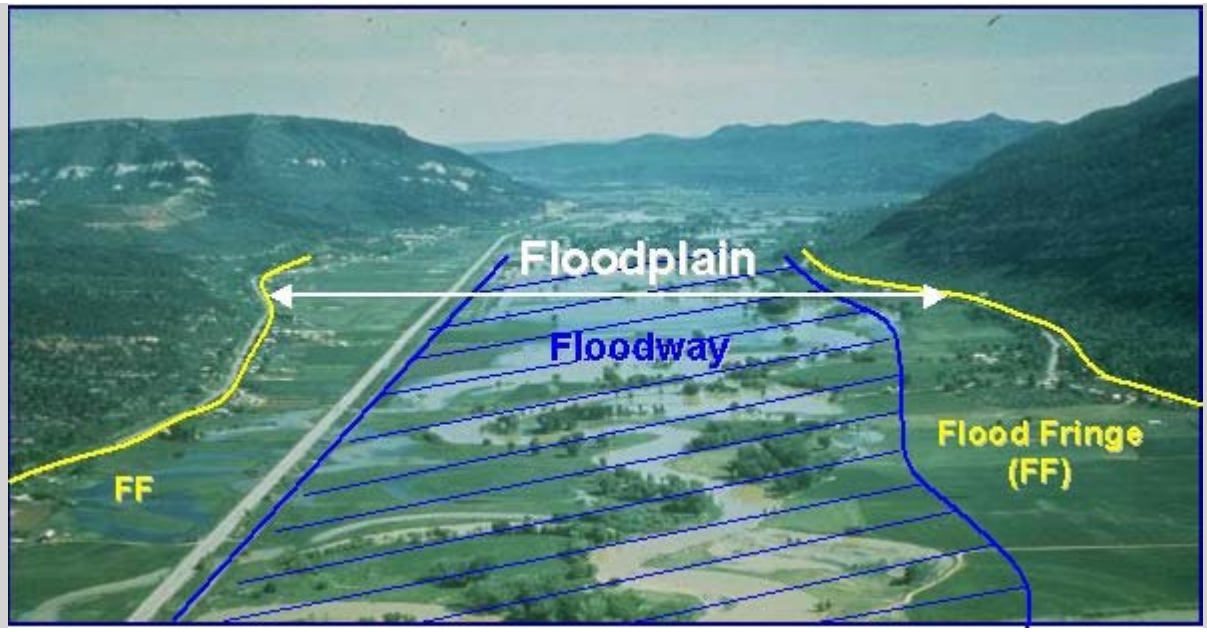
b. Narrative Description and Background Information

In 1969, the Minnesota Legislature enacted the State Floodplain Management Act. By law, Minnesota's flood prone communities are required to: 1) adopt floodplain management regulations when adequate technical information is available to identify floodplain areas; and 2) enroll and maintain eligibility in the National Flood Insurance Program (NFIP) so that the people of Minnesota may insure themselves from future losses through the purchase of flood insurance. In 1987, the Flood Plain Management Act was amended to establish a state cost-sharing grant program to help local government units plan for and implement flood hazard mitigation measures. The Department of Natural Resources (DNR) is the state agency with overall responsibility for implementation of the State Flood Plain Management Act.

At the state level, the DNR has promulgated minimum standards for floodplain management entitled "Statewide Standards and Criteria for Management of Flood Plain Areas of Minnesota" These standards have two direct applications: 1) all local floodplain regulations adopted after June 30, 1970 must be compliant with these standards; and 2) all state agencies and local units of

government must comply with Minnesota Regulations in the construction of structures, roads, bridges or other facilities located within floodplain areas delineated by local ordinance.

Floodplain management regulations are administered by local zoning authorities. Local floodplain regulatory programs, administered by county government, predominately for the unincorporated areas of a county, and by municipal government for the incorporated areas of a county, must be compliant with federal and state floodplain management standards. Both federal and state standards identify the 100-year floodplain as the minimum area necessary for regulation at the local level. The 100-year floodplain is the land adjoining lakes and rivers that would be covered by the 1-percent chance (or 100-year) flood. LGUs may regulate activities in the 500-year floodplain, instead of just the 1-percent chance (100-year) floodplain. Federal Emergency Management Agency (FEMA) maps usually show floodplains associated with rivers, streams, and large lakes, but the community may also regulate locally identified areas as high flooding risks. Sound floodplain management principles stress the need for a comprehensive approach to solving flood problems by emphasizing nonstructural measures.



The community's floodplain management regulations must include the minimum federal and state regulations, but often have more restrictive regulations.

Local zoning regulations identify permitted land uses in the floodway and flood fringe portions of the floodplain. In the floodway portion, high-velocity floodwaters are expected so most types of development are prohibited. In the flood fringe portion of the floodplain, where the backwater or low-velocity floodwaters occur, development may be allowed if it meets standards.

Mining of many types of surface deposits is common in floodplains, and such uses are addressed in MN Rule 6120. Below are excerpts from Minnesota Rule 6120 regarding permitted and prohibited uses.

6120.5800 ZONING: LAND USES PERMITTED IN FLOODWAY AND FLOOD FRINGE AREAS.

Subp. 3. Permitted uses within the floodway or between levees. Local zoning ordinances may designate specified uses as permitted or special permit uses provided such uses have a low flood damage potential and will not materially obstruct flood flows or increase velocities or stages of the regional flood. However, uses that are likely to cause pollution of waters, as defined in Minnesota Statutes 1969, section 115.01, and are prohibited unless adequate safeguards approved by the state water pollution control agency are provided. All other uses are prohibited including storage of any potentially hazardous materials which if subject to flooding may become buoyant, flammable, explosive, or may be injurious to human, animal, or plant life.

Subp. 3.A. The following uses may be permitted within the floodway or between levees:

A. Uses having a low flood damage potential including agricultural uses, recreational uses, parking lots, loading areas, storage yards, airport landing strips, certain sand and gravel operations, water control structures, navigation facilities, and other open space uses.

Subp. 4. Development of flood fringe areas adjacent to and outside of floodways.

Subp. 4.F. Storage of materials. Materials that, in time of flooding, are buoyant, flammable, explosive, or could be injurious to human, animal, or plant life shall be stored at or above the flood protection elevation, floodproofed, or protected by structural measures consistent with the standards set forth herein. Furthermore, storage of materials likely to cause pollution of the waters, as defined in Minnesota Statutes 1969, section 115.01, if subject to flooding are prohibited unless adequate safeguards approved by the state water pollution control agency are provided.

The DNR's model floodplain ordinances allow "Extraction and storage of sand, gravel, and other materials" as conditional uses within the floodway, with specific controls:

4.41 All Uses. No conditional use shall be allowed that will cause any increase in the stage of the 1% chance or regional flood or cause an increase in flood damages in the reach or reaches affected.

4.42 Fill; Storage of Materials and Equipment:

(a) The storage or processing of materials that are, in time of flooding, flammable, explosive, or potentially injurious to human, animal, or plant life is prohibited.

(b) Fill, dredge spoil, and other similar materials deposited or stored in the floodplain must be protected from erosion by vegetative cover, mulching, riprap or other acceptable method. Permanent sand and gravel operations and similar uses must be covered by a long-term site development plan.

(c) Temporary placement of fill, other materials, or equipment which would cause an increase to the stage of the 1% percent chance or regional flood shall only be allowed if the (Governing Body) has approved a plan that assures removal of the materials from the floodway based upon the flood warning time available.

Similar provisions apply in the flood fringe:

5.45 The placement of more than 1,000 cubic yards of fill or other similar material on a parcel (other than for the purpose of elevating a structure to the regulatory flood protection elevation) must comply with an approved erosion/sedimentation control plan.

(a) The plan must clearly specify methods to be used to stabilize the fill on site for a flood event at a minimum of the regional (1% chance) flood event.

(b) The plan must be prepared and certified by a registered professional engineer or other qualified individual acceptable to the (Governing Body).

(c) The plan may incorporate alternative procedures for removal of the material from the floodplain if adequate flood warning time exists.

6120.5900 SUPPLEMENTAL STANDARDS AND CRITERIA FOR FLOODPLAIN MANAGEMENT.

Subpart 1. In general. Supplemental measures for floodplain management should be included in local governmental comprehensive floodplain management programs and adopted or provided in addition to local zoning ordinances when sufficient technical data and resources are available for their effectuation. All local governmental units shall provide for control of the development and use of floodplains in flood hazard areas by adopting the following specific regulations and measures where practical to supplement and complement floodplain zoning ordinances and provide comprehensive floodplain management.

In a recent survey of LGU, 3 of 15 respondents had ordinances that prohibited silica sand mining in the floodplain. The majority of the remaining participating LGUs (10 of 15 respondents) had no explicit setback restrictions or deemed the question not applicable to their ordinances.

c. List of Silica Sand Project Potential Concerns

Potential impacts are similar for both geographic regions.

- Floodwater contamination
- Groundwater contamination
- Alteration of surface water flow
- Rerouting of the stream
- Loss of wetland buffer
- Accelerated erosion
- Loss of berm or bank
- Loss of vegetative buffer
- Increased sedimentation

- Degradation of fish and wildlife habitat
- Effect on cultural resources

d. Recommendations, Standards, Criteria, Considerations

The assessment is that the *actual mining operation* is unlikely to cause pollution if properly managed under the standards listed above. However, in order to protect floodplains, surface water and groundwater from potential pollution from silica sand processing, stockpiling and transportation activities, Minnesota River Valley and Paleozoic Plateau LGUs could consider the following actions:

1. Amend the existing local floodplain ordinance to list silica processing, stockpiling and transloading as prohibited uses in the floodway and flood fringe because of the inherent pollution potential, unless and until, the MPCA determines adequate safeguards are in place and formally approves them by permit.

In addition, Minnesota Rule 6120.5900 authorizes the LGU to adopt supplemental measures to protect floodplain resources from the potential impacts (beyond pollution) associated with the inundation of a silica sand mine by floodwaters. Potential impacts include the alteration of surface water flow, rerouting of the stream, loss of wetland buffers, accelerated erosion, loss of berm or banks, loss of vegetative buffers, increased sedimentation and degradation of fish and wildlife habitat.

The following supplemental standards could be considered to improve natural resources protection in floodplains:

1. Prohibit any temporary placement of fill and other material (as in 4.42 (c) above) along rivers with flashier flood characteristics where adequate warning time is not available.
2. Require a flood response plan for LGU approval that details how potential floodplain damages will be avoided, mitigated, repaired or compensated for in the event of a flood.

References

State Statutes: 103A. WATER POLICY AND INFORMATION
103F.101- 103F.165 FLOODPLAIN MANAGEMENT
103H. GROUNDWATER PROTECTION
CHAPTER 115. WATER POLLUTION CONTROL
CHAPTER 116. POLLUTION CONTROL AGENCY

Minnesota Rules: 6120.5000 - 6120.6200 FLOODPLAIN MANAGEMENT

DNR web page:
http://www.dnr.state.mn.us/waters/watermgmt_section/floodplain/index.html

Local Governmental Unit Survey Results:
https://www.surveymonkey.com/sr.aspx?sm=qkaIu71vdR_2fqmXMaOYsLnAJKgFH4Fy7NOSxsQqAaP74_3d

E.11. Cultural Resources

a. Description of Silica Sand Project Concerns

Silica sand activities have the potential to disturb or destroy areas of cultural significance through indirect means or direct mean. Potential indirect effects on historic properties include but are not limited to, dust, noise, vibrations, changes in access and lighting. Direct impacts include but are not limited to, the destruction or alteration of historic properties as a result of ground disturbance through mining activities including mine, processing and transportation facility construction.

b. Narrative Description and Background Information

The Minnesota River Valley and the Paleozoic Plateau as well as other regions throughout Minnesota have been occupied by humans for millennia and have the potential to contain historic properties. Historic properties include significant archaeological sites, historic buildings or structures (individual properties and districts), historic landscapes, and traditional cultural properties. Historic properties are identified and designated by various processes at local, state and federal levels of government. *Identification* is accomplished by inventories of known or likely resources. *Designation* could include local listings of historic properties or could include the State or National Register of Historic Places.

In Minnesota, state law requires that all levels of government, state and local, "have a responsibility to protect the physical features and historic character of properties designated in M.S. sections 138.662 and 138.664 or listed on the National Register of Historic Places…". Most cultural resource investigation and protection activity is carried out through federal and state governmental actions. If any silica mining projects receives federal assistance (which includes permits, licenses, approvals, or any level of funding), then Section 106 of the National Historic Preservation Act of 1966 is triggered, and the LGU is required to work with the lead federal agency in completing the Section 106 review. If a state agency permits or funds a silica sand mining project, that state agency is required to conduct reviews under Minnesota statutes protecting cultural resources. These laws apply across the state. In some situations, local governments and private landowners are required to comply with these statutes or LGUs may have ordinances of their own overseen by heritage preservation commissions (M.S. 471.193).

Minnesota Statutes pertaining to cultural resources:

Chapter 138. Historical Societies; Sites; Archives; Archaeology; Folklife

Chapter 307. Private Cemeteries.

These statutes are discussed in more detail below. As mentioned above, several of these do not require action by private landowner. In instances where action is required, the items have been "called out" below. For those that do not require action by a private landowner, similar to natural resources, actions that promote cultural resource protection and preservation are encouraged.

The hiring of a professional archaeologist and historian (qualifications can be found at http://www.cr.nps.gov/local-law/arch_stnds_9.htm) to study and review permitted projects in an effort to identify archaeological and architectural resources and consider potential impacts to these historic properties is one way to further preservation per state statute, if done in consultation with the Minnesota State Historic Preservation Office of the State Archaeologist.

Chapter 138.

Minnesota Field Archaeology Act (MS 138.31-138.42) establishes the office of the State Archaeologist; requires licenses to engage in archaeology on nonfederal public land; establishes ownership, custody and use of objects and data recovered during survey; and requires state agencies to submit development plans to the State Archaeologist, the Minnesota Historical Society (MNHS) and the Minnesota Indian Affairs Council for review when there are known or suspected archaeological sites in the area.

Under MS 138.40, Subd. 3, agencies controlling said lands must submit plans to the State Archaeologist and the MHS for review of developments on their lands where archaeological sites are known or scientifically predicted to exist. The State Archaeologist and MNHS have 30 days to comment on the plans. "Land" means land or water areas owned, leased or otherwise subject to "the paramount right of the state, county, township, or municipality" where archaeological sites are or may be located. For industry projects that propose use of state agency land, the state agency needs to comply with the statute.

Minnesota Historic Sites Act (MS 138.661-138.669) establishes the requirement that state agencies and political subdivisions have a responsibility to protect historical resources. This section also defines the State Historic Sites Network and the State Register of Historic Places, and requires that state agencies consult with the State Historic Preservation Office (SHPO) at the MNHS before undertaking, funding or licensing projects that may affect properties on the Network or on the State or National Registers of Historic Places. Before carrying out any undertaking that would affect designated or listed properties, or funding or licensing an undertaking by other parties, the state department or agency must consult with the MNHS pursuant to the society's established procedures to determine appropriate treatments and to seek ways to avoid and mitigate any adverse effects on designated or listed properties. If the state department or agency and the MNHS agree in writing on a suitable course of action, the project may proceed.

Chapter 307.08. Private Cemeteries Act

The Private Cemetery Act (M.S. 307.08) affords all human remains and burials older than 50 years and located outside of platted, recorded or identified cemeteries; protection from unauthorized disturbance. This statute applies to burials on either public or private lands or waters. The law defines what actions are felonies or gross misdemeanors related to private cemeteries. As required under Subd. 10, state or political subdivision controlling the lands or waters or, in the case of private lands, the landowner or developer, should submit construction and development plans to the state archaeologist for review prior to the time bids are advertised and prior to any disturbance within the burial area if identified. In most situations, agencies and landowners or private developers do not know where sites are located and they do not have the in-house ability to scientifically predict where sites could be located. To proactively predict the presence of sites LGUs could require a project proposer hire professionals to conduct a scientific assessment for use during project scoping and conceptual site planning to avoid effect. *It is important to note that MS 307.08 requires all levels or government and private landowners and developers to comply with the statute, unlike FieldArchaeology and Historic Sites, which do not.*

Effective Practices

The most effective way to use the current non-federal environmental review process to protect historic properties in Minnesota and silica sand activities is to provide local governments with the tools to determine if projects within their jurisdiction have the potential to harm historic properties.

With regard to archaeological resources, the State Archaeologist estimates that less than 1% of sites are recorded in his database, the official archaeological inventory for Minnesota. Thus agencies need to not only assess the impacts to known sites, but to locations that are "scientifically predicted" to contain sites assuming that 99+% of Minnesota's sites are not in this inventory. Direct access to the State Archaeologist's database would provide agencies with known site locations, but should not be provided to inappropriate officials or to the general public as it may encourage illegal activities such as trespassing, vandalism, and burial site disturbance.

Regarding historic resources the SHPO maintains the state's inventory of historic buildings, structures, and landscapes. This list is much more complete than the archaeological inventory because the locations of most history-architecture properties can be recorded by simply viewing and/or doing archival research. In the 1970s and 1980s, the SHPO conducted intensive surveys of historic standing structures statewide. This inventory is constantly being added to and updated with information on newly identified historic properties through federal and state project reviews and local preservation efforts. There is less concern for data privacy for this database.

The first step in cultural resource impact review should always be to first contact the SHPO and the State Archaeologist to get a list of known properties and ask them for their recommendations with regard to the potential for uninventoried historic properties, assessing impacts to known properties, and the need for a more intensive literature search or even actual site survey.

To expedite and inform permitting agencies, it is encouraged that LGUs require an applicant hire professionals to conduct an historic properties assessment for use during project scoping and

conceptual site planning to avoid potential effects to historic properties. The SHPO has archaeological and architectural/history survey guidance manuals which are available for use in completing these assessments.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both the Minnesota River Valley and Paleozoic Plateau geographic regions under consideration.

Potential Direct Impacts:

- Direct disturbance, destruction, demolition, moving or physical alteration of an historic property

Potential Indirect Impacts:

- Impacts to access, increase in traffic, noise, dust, vibration, atmospheric and visual impacts, including adverse impacts to the setting and changes in use of an historic property;
- Also includes reasonably foreseeable cumulative impacts of all of these.

d. Recommendations, Standards, Criteria, Considerations

While Minnesota statutes regarding cultural resources are more prescriptive on the process that state agencies are required to follow, political subdivisions are still required to "protect the physical features and historic character of properties designated in sections 138.662 and 138.664 or listed on the National Register of Historic Places…" (MS 138.665). To protect and preserve cultural resources from potentially negative impacts associated with silica sand mining and related activities in both the Minnesota River Valley and the Paleozoic Plateau geographic regions, the LGUs could consider requiring the following in local permitting.

- For review of developments on lands where archaeological sites are known or scientifically predicted to exist, require a project proposer hire a professional consultant to conduct an archaeological assessment to determine if known or suspected sites are present and if consultation with SHPO and OSA should occur.
- Regarding historic resources, require a project proposer hire a professional consultant to conduct a history/architectural assessment to identify historic properties and assess potential effects to properties as a result of silica mining activities. If historic properties are identified, consultation with SHPO should occur. Since M.S. 307.08 applies to all levels of government and private land owners, on all projects, the LGUs should consult with the State Archaeologist to determine if known or suspected burials are present, and to work through the appropriate steps under that statute if burials are present.

LGUs should be aware of local preservation and land use ordinances that may require local review of project activities and require project proposers to follow the local requirements for those ordinances.

Resources

Minnesota State Historic Preservation Office
http://www.mnhs.org/shpo/

MnSHPO Survey & Inventory Information
http://www.mnhs.org/shpo/survey/index.htm

MnSHPO Federal and State Compliance Information
http://www.mnhs.org/shpo/review/index.htm

Minnesota Office of the State Archaeologist
http://www.osa.admin.state.mn.us/

Advisory Council on Historic Preservation
http://www.achp.gov/

Advisory Council on Historic Preservation: Section 106 Toolkit
http://www.achp.gov/apptoolkit.html

National Historic Preservation Act
http://www.achp.gov/nhpa.html

National Register of Historic Places
http://www.nationalregisterofhistoricplaces.com/

Minnesota Field Archaeology Act
https://www.revisor.mn.gov/statutes/?id=138.31

Minnesota Historic Sites Act
https://www.revisor.mn.gov/statutes/?id=138.661

Winona County Zoning Ordinance
http://www.co.winona.mn.us/sites/winonacounty.new.rschooltoday.com/files/wczo_2011_for_web_smaller%20with%20amendments2.pdf see Chapter 11