SUSTAINABILITY OF THE GOGEBIC MINE IN NORTHERN WISCONSIN IN AN ECOLOGICAL, ECONOMIC, AND CULTURAL ASPECT

KYLEE DYCUS
Abstract

In 2014 the Gogebic Taconite, LLC proposed an open pit taconite mine in Northern Wisconsin. This mine would combat the increasing demand for steel in the United States. The Gogebic Iron Range has a geological area that is ideal for extracting taconite. Economically, steel is a commodity that is going to be demanded in the future. An increase in demand will cause a direct increase to the need to supply taconite. However, the process of removing the iron causes ecological, cultural and economic issues, some being negative and positive. The mining industry provides economic growth for the surrounding communities, but could degrade the surrounding land and watersheds. Ecological degradation is of great concern to the native tribes and citizens who thrive because of the land. Iron Ore is a finite resource. The scarcity and common use of natural resources has put a burdened on the land. Ecological, economical and cultural cohesion will need to occur for the mine to be sustainable.

Introduction

The United States produces 87Mt of steel each year. The demand for steel has increased by 65% since 2013 (Coal & Steel Statistics. 2014). Increasing the demand for mining locations. The Gogebic Iron Range has a geological area that is ideal for extracting taconite. Iron Ore is a finite resource. Economically, steel is a demanded commodity thriving into the future. The mining industry increases economic growth by providing an influx of jobs. On the other side the mining industry can have negative impacts that divide a culture. The cultures surrounding the mining towns are often indifferent. Counties near the Gogebic Mine site are in need of jobs and the economic growth the mine could bring. Local citizens and Native American tribes have grown attached to the aesthetics, recreational activities, and agricultural benefits the land brings. For some local citizens and the vast majority of the Native Americans, the land is a way of life. Local farmers and Native Americans are concerned for their crops. Ecologically, the effects of the Gogebic Mine will be long term. Native tribes, such as the Ojibwe and Chippewa, know the Gogebic mine will hinder their wild rice crops. Wild rice is grown in wet areas. In order to harvest the rice natives use a canoe and pull the rice into the canoe. If the watersheds become polluted the wild rice will have difficulties growing. The wild rice crops are a means for the native tribes to make income as well as produce food for the tribe. Acid leaching could harm the local watershed posing a threat to growing wild rice and other crops.

Success for the mine includes economic, ecological and cultural aspects. The mine must succeed in pleasing environmental enthusiasts, economic demand and the divided citizens of the surrounding areas. Pleaseing all parties involved is difficult, however GTech is trying its best. Environmental management is crucial for the health of surrounding watersheds that will directly affect agriculture. If the mine is managed in an efficient manner the outcome will lead to a lower chance of an ecological crisis.

The increasing demand for steel is not going to diminish for years to come. The point is to create awareness and analyze if parties can come together to create a more sustainable mine. Elinor Ostrum is a Noble Prize winning economists and best known for her works regarding governing the commons (Noble Media, 2015). She demonstrated how common property could be managed by user associations and economical analysis can shed light on social organizations (Noble Media, 2015). She believed humans are intelligent enough to make rational decisions regarding the future of our planet. Her statement cannot be argued since industries are
improving their practices to benefit to the world ecologically, economically and culturally through knowledge of surrounding resources. Contrary to Ostrum’s belief in humans and their rational thinking, Garrett Hardin, an American ecologist, believes population increase would be detrimental and the human race is only interested in the self which could be a downfall to the human race. Today both sides are prevalent, but the question of whether both sides can intertwine to apply improved results has yet to be determined.

**Gogebic Mine**

The Gogebic Iron Range is 80 miles long located on the belt of Precambrian bedrock in Northern Wisconsin. See appendix A for a map showing the entire mining site. The Penokee and Gogebic Deposit refer to a 21-mile long segment of Gogebic Iron Range between Upson and Mineral Lake Wisconsin. The geological structure of the area is good for mining. Previously, Wisconsin was mined to extract natural hematic ore, which is higher grade than the ore that is there now. The Penokee and Gogebic deposit contains 20-30 percent iron in the form of magnetite. This type of iron is low grade and the ore must be concentrated and processed into taconite pellets prior to shipping. The process of removing the iron causes ecological, cultural and economic issues, some being negative and positive.

The process of making taconite pellets is extremely long and detrimental to the environment and contains six major steps. The first step is extracting the iron ore from the taconite rock. Taconite rock is extremely hard; therefore explosives must be used to break the rock into small pieces (Minnesota DNR, 2014). Once thousands of pieces of taconite rock are crushed, a truck must come and remove the pieces of rock. The rock is either taken to a nearby facility to continue the pellet process or put on a train car to be taken elsewhere to finish the pellet process (Minnesota DNR, 2014). The process proceeds at the processing plant, where the rocks will be crushed into the size of a marble. The marble-sized pieces are mixed with water and ground in rotating mills until it becomes a fine powder (Minnesota DNR, 2014). Separating the iron ore from the taconite is a crucial step. A magnet is used to separate the iron ore from taconite and the left over rock waste is thrown into tilling basins (Minnesota DNR, 2014). The taconite powder with iron in it is called concentrate, which is rolled with clay in large rotating cylinders (Minnesota DNR, 2014). The cylinders continue to roll the powder into marble sized balls. The balls are dried at extreme temperatures and then left to cool down to become hard. Once the marble sized pellets are completely cooled down they are packed onto ships to be delivered to steel factories where the marbled-sized balls are melted down into steel (Minnesota DNR, 2014).

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species. If environmental management is not properly maintained the pollutants will hinder food production. (Wisconsin Network for Justice and Peace, 2014) Pollutants will be released into air and watersheds during the entirety of the mines lifespan; therefore it is imperative to be aware of the pollutants. Ultimately affecting air and water quality (Behrmann, 2012).

Air quality is affected by particulate emissions. This is a concern for culturally. Workers will be exposed to the air inside and around the mine. Citizens living in the surrounding area will also have the burden of diminished air quality. Remember taconite is extremely hard and combustion will need to occur to extract the taconite. During the combustion particulate emissions will be introduced into the environment. Pollutants will be exposed to the workers and citizens. Particulate matter is a microscopic solid in the form of inhalable aerosols that can be harmful to the human body (McDonald, et. al, 2013). Particulate matter can be blown great distances due to its microscopic size. Construction activities can transport particulate matter easily. Ore removal, crushing, grinding and road dust are all transportation methods for particulate matter. Road construction is the largest source of particulate matter (McDonald, et. al, 2013).

The size of the particulate matter is concerning. If the particles are less then 4-10 micrometers in diameter, then the concern for human harm arises (McDonald, et. al, 2013). Any particulate matter less than 2.5 micrometers in diameter are most likely to from combustion and stack sources. Heat curing of taconite pellets, exhaust of vehicles and other atmospheric contributions would likely be regulated within the context of state air management and permission permitting.

Mineral fibers affect air quality as well. The main mineral fiber concerning mining is Asbestos, which is a human carcinogen by the U.S Department of Health and Human Services, the U.S EPA, and the International Agency for Research of Cancer (McDonald, et. al, 2013). Asbestos is present in ore and waste rock, which will be present in the Gogebic mine. Respiratory-tract cancer, mesothelioma of the lung and abdominal cavity and other cancers can be caused my asbestos (McDonald, et. al, 2013).

In Northeast Minnesota mesothelioma rates have been documented. The cancer rates are comparable statewide, however mesothelioma among males is higher than the average between 1988-2006 (McDonald, et. al, 2013). The study states the 82% of the excess of males is consistent with occupational exposure of mining in Northeast Minnesota. It can be assumed the likely hood of increased cancer rates will occur in the workers at the Gogebic Mine.

Pollutants affecting the air quality are only the beginning of the harmful pollutants that will affect our watersheds, and food production. The taconite mine will also pollute the surrounding watersheds. The watershed has a longer range that could be affected, where as air quality affected a smaller range around the mine. The Gogebic Mine will be located near the headwaters of the Bad River water system; a 50 mile system of streams and lakes all leading to Lake Superior. Pollutants entering the watershed system will produce negative impacts.

Altering the composition of the water and bioaccumulation are two main concerns regarding water quality. Bioaccumulation is the process of absorbing chemicals at a rate faster than the chemical is being lost. Eventually the chemicals absorbed at the bottom of the food chain will continue to work up through the top of the food chain, affecting an entire ecosystem. The rock waste and tailings can cause severe issues in the watersheds if disposal is not properly managed (McDonald, et. al, 2013). Acid formation can occur if rock waste and tailings contain metal sulfides (McDonald, et. al, 2013). It is important to know the Gogebic mine is not a sulfide mine, however, there is sulfide in the rock waste, which could potentially cause the same
sort of effects. While there are many harmful effects acid formation can cause, the most harmful would be altering the pH balance in our surface and groundwater. It important to note the chronic and acute affects of metal in water is a concern only when there are unnatural amounts in the water (McDonald, et. al, 2013). There are occasions when metal in water is extremely present, for example excess amount can cause discoloration an unnatural taste. Although metal in water is a natural process, the process of metal entering waterways via leaching causes the metal to be more soluble and bioavailable (McDonald, et. al, 2013). This reiterates the concern of acid formation, and why it is imperative management of mining waste is a top priority, which can be debated in later sections regarding the Gogebic Taconite Mine.

As I mentioned earlier mining effects food production negatively, which is extremely imperative considering part of the population, such as the Penokee Tribe, gain income and food necessities from wild rice crops and fish from the Great Lakes. Bioaccumulation of methylmercury in the food chain is dangerous for humans that consume a large amount of fish (McDonald, et. al, 2013). Although there is natural mercury in the environment methylmercury is the most dangerous form of mercury. Methylmercury is formed when it binds with organic material in the environment (Behrmann, 2012) It is hazardous to all humans, but experts say that women who are of child bearing age are most at risks for long term effects (Behrmann, 2012). Methylmercury is a potent neurological toxicant and can pass through blood-brain barrier and placenta during pregnancy and cause complications (Behrmann, 2012). The child can have issues developing a healthy nervous system and cause permanent IQ damage. A study done in Minnesota states that 8% of the infants born in Minnesota, Wisconsin and Michigan had higher levels of Mercury in their bodies (Behrmann, 2012). So the mine will not only affect citizens today, but also future citizens.

**Defining Sustainability**

7.3 billion people populate the earth today. As economic development is at its peak, policy makers continue to strive for the improvement of human living standards, often pushing ecological crisis aside. Population is exponentially growing and is continuing to increase every year. Increasing human population triggers a surge in the amount humans consume. Good ecological news dwindles as human population and consumption increase (Dryzek, 2005). Ecological crisis is among the growing population and began with a simple concept of carry capacity; a concept population biologists and ecologist have explored over a long period of time (Dryzek, 2005). In order to prevent exceeding the carrying capacity more than we already have sustainable strategies must be put into place. Implementing sustainable strategies must consider interrelation between industries. Until cultural, economic, ecological intertwine to work together there will never truly be a resolved solution to ecological crises.

Cohesion ecologically, culturally and economically will provide methods of sustainability that allow industries to move forward in using sustainable practices. Implementing sustainability into economic practices and cultural practices will improve ecological success. For most people if the cost outweighs the benefit the product or idea will not be consumed. If industries are against one another, there will never truly be a resolved solution to the ecological crisis. So how can practices be sustainable?

First, sustainability has to be defined. Defining sustainability neutrally will allow practices to be implemented to produce a fair outcome. Defining sustainability is a difficult task. Sustainability is subjective to who one is talking to. It is important to take into consideration
some people do not deem sustainability needed. It is essential to comprehend multiple concepts and definitions when trying to establish a definition for sustainability. Without a clear definition of sustainability it will be difficult to implement solutions to achieve sustainability. While many industries have different definitions of sustainability there is always the underlying theme of sustaining an output.

The triple bottom line approach is crucial to how I will address sustainability throughout my paper. The environment, society and economy are critical to the consideration of a balanced system; therefore they must coexist to create the best sustainable method possible. For my study I have concluded on the following definition of sustainability. Sustainability is the idea of replenishing materials for future generations to consume within the resources the earth has today with the outcome of not depleting resources. There are many possible definitions however, in order to resolve an ecological crisis there must be cohesion between humans and the natural world.

**Tragedy of the Commons**

Steel is a product commonly used in all over the world. In 2013 there was a 65% increase in the use of steel (Coal & Steel Statistics, 2014). The United States is the second largest user of coal. Consuming 97Mt (Coal and Steel Statistics, 2014). We produce the third largest amount of steel at 87Mt (Coal & Steel Statistics, 2014). From the stated statistics it is easy to see that steel is still in high demand in the United States and all over the world. The only way to produce steel is to extract the iron ore to make the steel. Economically steel is a commodity that is not going to be diminished. I would assume the use of steel would continue for years and years to come as long as there is a demand for the produce. It is the simple economic model of supply and demand. The more we demand, the more we have to supply. Iron Ore is a finite resource. The scarcity and common use of natural resources has put a burdened on the land. This is the underlying definition of The Tragedy of the Commons, a metaphor created by Garrett Hardin.

Hardin’s idea of scarcity of common resources was not necessarily original. Thomas Malthus, Marx, Plato and others signified population increase were strain the natural resources of the earth. Aristotle observed, “What is common to the greatest number has the least care bestowed on it. Everyone thinks chiefly of his own, hardly at all of common interest (Ostrum, 1990).” Hardin’s metaphor suggests the sum of rational self interested behavior leads to tragic, collective outcome of the common-pool resources (Dryzek J.S. 2005). Hardin’s metaphor would only prove true if there were limits on the common-pool resources. In order to purpose limits on common resources authoritative rule over resources be implemented. A simple model used by Hardin is that of a cattle herder (Dryzek, J. S.,2005). Hardin states the herder will gain benefits from his heard, but in the long run will endure negative consequences as the result of overgrazing by his herd and others (Ostrum, 1990). Garrett Hardin believed population increase was an issue and the uses of common goods were going to be a downfall in society. The human mind is often wired to think solely of the self. Humans are a selfish species, which is a tragedy in itself. Selfishness bestows problems for the society as whole including the land itself.

The trade of mining exemplifies self-interest. Economically the mine would produce 2,834 jobs 700 of those jobs would be upfront (McDonald, C., et. al, 2013). The mine would generate over $604 million in total economic impact (McDonald, C., et. al, 2013). The numbers
show hope to a community that has income levels lower than $30,000 a year. The short economic benefits are worth the ecological risk. Citizens hope the revenue of the mine and the hope the mine can be reclaimed into a useful purpose once the mine has been depleted of its resources. Ostrum might have been indifferent on the situation.

Elinor Ostrum countered Hardin’s view, expressing more trust in humanity. She believed that mankind was not the downfall, but could use intellectual reasoning to improve ecological crises, as long as the community was informed on ecological awareness. In Ostrum’s book Governing the Commons, Ostrum writes an extensive amount on Hardin’s metaphor relating to the prisoner’s dilemma game. In short the prisoner’s dilemma game expresses how individually rational decisions lead to a collectively irrational outcomes (Ostrum, 1990). So what does this mean for humanity? It simple terms it states humans, who are rational beings, cannot present rational outcomes. If a person does not benefit from the decision it is harder for the person to contribute effectively as a whole. People like incentives, however humans are not irrational. When humans work together and discuss challenging issues the results can be rational and beneficial. The Gogebic Mine cannot be discredited for being one-sided. The EPA, DNR, and citizens are working together to rationalize the impacts of the mine economically, ecologically and culturally. The models Ostrum refer to in her book do not state every person will agree with the outcome.

Ostrum’s view is important in present day, as environmental awareness is continuing to improve everyday. Humans are in fact intellectual, and have the power and critical thinking to improve economic, cultural and ecological outcomes. Humans have started to become aware of ecological crises. It is evident in the cultural aspect of the Gogebic Mine. For the Ojibwe and Chippewa Tribes the Gogebic Mine will cause tremendous cultural effects for their society. The livelihood of the tribe is dependent on the land and recreational use. The mine will be built at the headwater of Tyler Forks and Bad Rivers. The system is 50 miles of extensive streams that extend into Lake Superior (Wisconsin Network for Peace and Justice, 2014). The mine could potentially affect trout and the quality of the drinking water available to the citizens. Long-term affects associated with the Gogebic Mine and the Ojibwe and Chippewa Tribes have a full understanding of how this could hinder their livelihood.

Humans prefer short-term benefits. We are animals of instinct. On the other hand there are humans that prefer short-term effects and believe the Gogebic mine will be economically beneficial to the citizens. We know it will provide more jobs, however how long will this mine be able to be mined? If we are assuming the same length as the Minnesota mine, we can assume 114 years and more. Many questions arise on if the jobs are going to outsourced or given to local citizens. So is the mine going to bring economic improvement to the surrounding counties? Bringing me to the question of how to make the mine more ecological friendly to achieve the same economic success. If you were to ask Ostrum I believe she would say this could be done through successful environmental management.

Methods:

In order to analyze the Gogebic mine a cost benefit analysis was created. I analyzed the mine based on three categories; ecological, economical, and cultural. In order to do this I read literature including material found through the Wisconsin Department of Natural Resources, Governing the Commons by Elinor Ostrum, various articles on the Taconite Mining website for Wisconsin and Minnesota and excerpts of multiple other articles. My statistics came from the
Kylee Dycus

DNR, the World Coal Association, and an article written by Robert Costanza *The Value of the World’s Ecosystem services and Natural Capital*. Upon analyzing the literature I found three categories extremely prevalent throughout the array of material. Ecological issues were a concern for scientists and citizens, economic growth was potential selling point for citizens and both affected the cultural aspect. Thus, providing me the information to look further into each category. I examined each category closely. After my results were fixed, I analyzed the data using Elinor Ostrum and Garrett Hardin’s view on governing the commons and how it correlates to a triple bottom line sustainable outcome. I examined long term versus short-term affects, intellect versus emotional attachment to determine my results.

**Results**

Results of the cost benefit analysis express ecological costs outweigh economic costs. My information came from an array of literary material. I used the Department of Natural Resource’s Bulk Sampling Plan of the mine and Robert Contanza’s article *The Value of the World’s Ecosystem Services and Natural Capital*. The bulk-sampling plan expressed the monetary value of reclamation and labor costs. Contanza’s article provided a monetary value of 17 ecosystems including forests and wetlands, which allowed me to put a value on land that is difficult to define monetarily.

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<th>Drawbacks</th>
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<td>$73.1 Mil</td>
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<th>Positives</th>
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<td>Increased Income (Based on Ave. Mine Worker)</td>
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<td>$62,000.00</td>
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<td>Loss of Rice Crops</td>
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<td>Total Costs</td>
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*Table I. Cost Benefit Analysis of Gogebic Mine*
Discussion

Deriving sustainable results via cohesion of ecological, economical, and cultural aspects is shown to be difficult, disproving my hypothesis. The mine will be sustainable economically as table one suggest, bringing in over 165.9 million dollars to the surrounding counties. The Gogebic Mine will bring in over 3,000 jobs over 35 years (McDonald, et. al, 2013). However, there will be indifferences between the Native Tribes and citizens. Ecologically, the mine will have long-term affects. The affects of the mine are challenging to predict, because of the uncertainty of how the company is going to environmentally manage the mining site. The environmental statement is still in progress, which leads to assumptions. The effects of the mine will produce high levels of rock waste, which has the potential to leach into the watersheds. If this occurs the entire Bad River watershed could be polluted causing clean water supplies to decrease and the possibility of the fish to be contaminated. Contaminated waterways will decrease local farming, and cause drinking water to be undrinkable. Contaminated fish will not be able to be consumed by the Native Tribes, which is crucial to their thriving.

Degradation of the land will occur during the initial bulk sampling of the area and over the lifetime of the mine. Over $27,000 alone will be spent on reclamation of the degradation of new access roads. Building the access roads will wipe out wetlands, which must be reclaimed under EPA ruling. Over all the economic benefits out weigh the ecological negatives. If the mine is managed in an efficient manner this will decrease the risk of ecological crisis. However, until the mine is built and in use it will be hard to assess if the mine will work cohesively with the environment and land. The life span will also directly effect the long-term impacts of the mine.

Table one provides a cost benefit analysis of the Gogebic Mine. Economic positives are enormous and realistic with substantial backing. GTech promised 3,000 jobs, increasing economic growth in the surrounding areas, such as Hurley. For a poor county like Hurley, County in Northern Wisconsin the Gogebic Mine is a way of life. It could provide food for the family, and allow the once thriving county to thrive again. The mine is not limitless. The mine could provide short-term or long-term economic benefits. Economic growth could go through a boom and bust cycle and the surrounding counties could thrive and fall once again. Questions arise of whether or not the mine will economically sustain the county for future generations and the answer could not be determined.

Assessing the mine ecologically is difficult. Table one suggests wetlands and forest have a value of 4.9 trillion dollars a value determined by Costanza. Costanza conducted literary research and performed some original calculations to determine the economical value of 17 ecosystems. My study and analysis focused on a very small-scale area, where as Costanza focused on multiple ecosystems much larger than the area of my study. With this being addressed, adjusting for the smaller area would be difficult. If the study were to be studied further surveying the surrounding counties regarding the cost of the land to them would be a much better representation. However, for now we will use Costanza’s values.

The estimation received critics from various economists, which is fair. Putting a price on wetlands and forests is extremely difficult, especially when there is no defined cost of any ecosystem. Putting a value on our ecosystems is nearly impossible and humans should be willing to conserve every hectare of land we have. However, I believe such a large number raising awareness and impact some humans to really understand how crucial our ecosystems are. Humans need a monetary value on items to prove its importance. Even if the high numbers
seem outrageous in can put a perspective on our ecosystems and the value they can truly have. Is the mine worth degrading crucial ecosystems potentially wiping them out for good? This question is the core of my research, and has still not been answered.

The mine will not be sustainable ecologically and will take the hardest long-term hit. Ecosystems cannot be built in a couple years. It takes times to rebuild a thriving ecosystem, and the mine proposed to use explosives to bust the ground open causing massive amount of rock waste that could cause possibly leach into waterways and wetlands. Leaching of chemicals, such as mercury, would contaminate local wells used by citizens. Bioaccumulation of mercury could occur in aquatic species. Bioaccumulation will not affect aquatic species, but humans as well. If the fish is consumed the mercury content in the fish will be magnified and passed to the human. Mercury is extremely dangerous to pregnant women and young children proving to cause embryonic developmental issues and early developmental issues in young children.

Nutrient cycling in local streams could become unbalanced and the risk of algae blooms could increase, cause less oxygen in the water. Less oxygen will provide a poor habitat for aquatic species.

Culturally the mine is a huge discourse among many. Penokee Tribes are outraged at the possibility of the Gogebic Mine. The Native Tribes not only see it damaging ecologically, the tribes have right to water and land use, which could potentially cause an uproar, which could possibly shut down the mine all together. The native tribes believe it will hinder their agriculture and livelihood. The Tribes rely on the water sources in order to grow wild brown rice. Contaminated watershed will cause adverse affects on the watersheds directly affecting the crops of the tribes. Local farmers are concerned of depleting well supply, which will hinder agriculture and possibly shut down their entire operation. Poverty is at the heart of some towns, creating a debate on why the mine should be constructed. Jobs are nonexistent for some, and the mine would provide work to citizens that have been without for so long. Long-term economic growth is a selling point and provides hope to the generations to come. Each discourse is extremely important in determining the construction of the mine. It is hard to disagree with either side. Bringing the last point of cohesion between all three aspects.

Cohesion between cultural, economic, the environment can occur. The mine will have to abide by certain environmental management practices. Permits will be obtained and reclamation mitigation must occur under EPA and DNR regulations. Whether or not he environmental procedures will be carried out to full capacity is another discourse. Ultimately, the land will have to recover for years in order to get back to the health it is at now. Realistically the health of the land may never become as healthy as it is now, only time and environmentally testing will tell. Holes will have been drilled, crucial topsoil will have been removed and roadways will emerged. Reclamation of the land is crucial, however it is not the fix for all environmental problems. Degradation of forests, and wetland can never be fully be replaced. Discourse between Native Tribes and citizens will continue to occur. Culturally there will be a divide in which one side believes the mine would be beneficial to the community and the other side believing it will be detrimental. In the end the mine will never be fully sustainable. Pollutants, leaching and waste rocks will emerge from the mine. Environmental management is crucial to the outcome of the Gogebic Mine.

During my research of the Gogebic mine Gtech pulled out of the mining opportunity. The exact reason is not known, but speculations have occurred. Gtech told the public the amount of wetlands the mine would hinder is the reason for pulling out of the mining opportunity, however others have speculated residents made enough of an up roar about the mine and the
potential dangers could have also pushed the mine out the door. The iron ore Gtech was mining for was taconite, a very low grade of taconite. Gtech could have done enough testing to conclude mining for the low-grade taconite was not worth the little profitability it might have had.
Appendix A.

Map of Proposed Gogebic Mine


