The Environmental Impacts of Aggregate Extraction

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Foreword

This report has been produced for Environment Haliburton (EH!), an interest group based in Haliburton, Ontario. This academic research project was encouraged by Trent University and provided by U-Links for a community based education program. The focus of this report is on the effects that aggregate industries, including ancillary operations, are having on the environment, and more specifically, to the Canada Shield and complex water systems. This report also investigates what environmental assessments are required, what they entail, and what are the best practices for regulating and operating gravel pits.
Introduction

It wasn’t until the mid 1960’s that Ontario became seriously concerned about environmental issues regarding the degradation of land through aggregate extraction. The awareness surrounding this issue has been gradually growing and is currently in plain sight of many Ontario residents. The Canadian Shield consists of soil and bedrock, which makes it a prime candidate for aggregate industries and ancillary operations. The Shield is one of the world’s richest areas in terms of mineral ores (C.E., 2005). Throughout the Shield there are many mining towns extracting these minerals, such as the County of Haliburton. Ontario’s Haliburton County is known for its community stewardship. Unfortunately, it is also susceptible to environmental disruption of ecosystems presented by aggregate industries.

Originally, it was felt that aggregate extraction practices were not efficient and thus there was a need for the establishment of an aggregate policy through the Mineral Resource Committee (1969), the Niagara Escarpment Protection Act (1970), the Pits and Quarries Control Act (1971), and the Niagara Escarpment Planning and Development Act (1973) (Baker et al., 1995). January 1st, 1990, the Aggregate Resources Act (ARA), replaced the Pits and Quarries Control Act (PQCA), the Beach Protection Act and part VII of the Mining Act. In 2007 the ARA was revised and updated.

The ARA is the leading statute for obtaining approval for new aggregate developments. The Ministry of Natural Resources (MNR) provincially administers such requests. Aggregate operations are controlled and regulated on both Crown and private lands. The Provincial Policy Statement (PPS), revised in 2005, recognizes the complex inter-relationships among economic, environmental, and social factors in planning and embodies good planning principles (MAH, 2007). The PPS consists of policies on vital issues that affect communities, such as the efficient
use and management of land and infrastructure and the protection of the environment and resources. Both the ARA and PPS are required for gravel pits and quarries to operate and must comply with certain laws.

An aggregate operation must consider all costs, including compliance with regulation, environmental management, and rehabilitation, in order to be profitable. Transporting aggregate long distances can add significantly to the overall price of the product. Therefore, aggregate operations frequently are located near population centres and other market areas. Haliburton County is a population centre which consists mainly of quarries. A consequence of aggregate extraction is the altering of landscapes and degradation of the environment. However, before an aggregate resource can be developed, the extraction site must qualify for all necessary permits and the approving officials must be convinced that the operation can take place without adversely affecting the environment (E-laws, 2004). It is more difficult now to establish new operations opposed to maintaining current ones.

This report will continue to address the ARA, the PPS, as well as encompass what environmental impacts are affecting the environment due to aggregate extraction, what can be done, and what sustainable practices currently exist. It is imperative that aggregate operations abide by the rules and regulations of the ARA to ensure a safe and healthy future for both individuals and wildlife.
Environmental Concerns

Aggregate industries have raised much controversy within communities due their extracting methods. Through the extraction of aggregates, landscapes are altered which effect ecosystems that contain numerous species, including humans. Water and noise pollution are extensions of aggregate extraction. Extraction sites are known for extending their original land boundaries thus effecting and altering natural landscapes. Aggregate sites also have a tendency to be in close proximity to protected areas thus resulting in the degradation of ecological functions. This is of greater concern when water systems are affected.

Hydro-geological Impacts

The processes that occur when aggregate sites are being resurrected require extensive demolition and construction. This necessitates the removal of any foreign materials, the clearing of land, and the excavation of earth. The tools used for such actions creates the potential for both noise and water pollution. Specifically, the removal of vegetation along shorelines contributes to noise levels. The integrity of the environment is also affected by the excavation of aggregates from the surface and sub-surface of the earth regarding the hydrological aspect. The permeation volume is thus altered (S.T.Q., 2005).

If and when aggregates are extracted from below the established water table it will have impacts on the fragile environment and its natural features. The application process requires that the potential impacts of a proposed development be reviewed and assessed. It is critical that evaluations of proposed land-use changes include a comprehensive environmental analysis. All evaluations must also consider cumulative impacts. For a proposed aggregate development extracting below the water table, the applicable standards are found under Category 2 of the
ARA (E-Laws, 2004). These standards cover three major topics: applications, conditions of approval and notification, and consultation. The ARA standards for hydro-geology require consideration of all features within the ‘zone of influence’ around the quarry (S.T.Q., 2005). This refers to the area where due to dewatering, pre-existing groundwater levels are lowered during the operating life of the quarry. The ARA itself imposes application compliance standards early in the licensing process.

Aggregate extraction degrades natural environments and, through the depletion or contamination of the water table, communities in surrounding areas are affected. Batching plants, involved in the processing of aggregates, have an average water use of about 500 gallons per truck per day in Canada (Wilson, 1993). According to Wilson the alkalinity levels of wash water can be as high as pH 12 (1993). Highly alkaline water is toxic to fish and other aquatic life. At batch plants, wash water from equipment cleaning is often discharged into settling ponds where the solids can settle. However, such plants are required to have process water discharge permits, from federal or provincial environmental agencies (S.T.Q., 2005). These permits require the proper disposal of wastewater from settling ponds. The pH level of wastewater must be lower than 12.5 to not be considered hazardous (Wilson, 1993). Many newer batch plant sites have greatly reduced water use in recent years. In many areas, environmental regulations dictate procedures relative to wastewater treatment. In more urban areas, the on-site rinse water often has to be collected and treated or disposed of at the plant.

Hydro-geological impacts are of great concern for an ecosystem and it’s surrounding environments. It is vital that when excavating aggregate sites that the regulation of water-use and the depth of digging are monitored to assure that there are no permanent side effects. Restoration to any detrimental actions must be ensured. It has been proposed that abandoned
gravel pits be used to artificially restore groundwater. Although groundwater recharging is not an ideal method, the implementation of flooding is (Langer et al., 2003). Through the utilization of abandoned pits and quarries, regulated flooding is feasible but at the cost of the quality of groundwater. Although the following suggestions are not completely restorative they are a feasible option.

Noise Pollution

Due to the process of transporting rock and gravel and the blasts that are required to excavate aggregates, loud and unpleasant noises are produced. It is a constant process that nearby residents must endure that has severe environmental impacts. The Province of Ontario prohibits excess noise that is created by aggregate operations. Citizens have a legal right to report loud noises which can make the government force a limit on noise to such companies (G.W.O., 2007).

In previous years, quarries used explosives to obtain aggregates. Today, aggregate industries currently use small, computerized blasts to mitigate the vibrations. The timing of the blasts are regulated and do not occur at certain times of the day or the year, specifically during nesting periods. There are specific classes that have varying noise regulations throughout Ontario. A Class 1 Area typically is of an urban setting, such as a major population centre. The background sound level is dominated by the sound of road traffic, referred to as ‘urban hum’. Class 2 Areas consist of a low level ‘urban hum’ that would typically be absent during evenings and nights. In a Class 3 Area, sound is often the acoustical environment which consists of sounds typical of agricultural or wilderness areas with little or no road traffic (M.O.E., 1997). The sound level criteria for an outdoor point of reception are presented in the following table.
Table 1-Sound level criteria for an outdoor point of reception

Stationary sources

<table>
<thead>
<tr>
<th>Area</th>
<th>Time of Day</th>
<th>Hourly $L_{eq}(1)$ (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>07:00-23:00</td>
<td>50*</td>
</tr>
<tr>
<td>Class 2</td>
<td>07:00-19:00</td>
<td>50*</td>
</tr>
<tr>
<td>Class 2</td>
<td>19:00-23:00</td>
<td>45*</td>
</tr>
</tbody>
</table>

* or the minimum hourly background sound level $L_{eq}(1)$, whichever is higher (M.O.E., 1997)

Municipalities must be taken into consideration as well. Municipalities and townships may also have their own noise bylaws in place. The Environmental Protection Act (EPA) clearly indicates that sounds are considered a contaminant and that amounts of noise in excess of the prescribed limit by regulation can have an adverse effect (E-Laws, 2004). One of those effects are the impairment of the quality of the natural environment for any use that can be made of it, harm or material discomfort to any person, and an adverse effect on the health of people living close to the aggregate operation.

*Wildlife affected by gravel pit/quarry operations*

Biological diversity is essential to the growth and survival of our planet. Throughout the world, species of animals, plants and other organisms are being lost forever at an alarming rate. The loss of these species is most often due to human activities, especially activities that damage the habitats of these species. Gravel pit and quarry operations can have both negative and positive effects on the surrounding wildlife. It is often a misconception that all of the native species, within operation boundaries, will be expelled from their natural habitat with no place left to reside. However, most species are able to relocate within a matter of days and for many, the quarries become a haven. Unfortunately, the excavation required for aggregate operations often disturbs habitats and puts the residing species at risk of being killed.
Habitat and species at risk are more commonly recognized upon proposed establishing of gravel pits and quarries. Specified operation locations contain habitats that retain a number of species at risk, which are listed in the Provincial and Federal Legislation Affecting Aggregate Extraction. The Blue Racer Snake is an endangered species that has become acquainted with quarries as an alternative habitat (E.C., 2006). Its traditional habitats are prairie type grassland and open prairie-edge woodlands as well as farmland. In the winter the snake hibernates below the frost line in rock formations and quarries. The wood turtle is yet another endangered species that has sought shelter in Sudbury’s quarries (R.O.M., 2007). This is a new habitat for them considering their accustomed habitat consists of rivers, streams, and creeks. This is why the Endangered Species Act exists; for animals that are unable to protect themselves against humans and their disruptive invasions. The purpose of the Endangered Species Act is to identify and protect species that are at risk and their habitats (E.C., 2006). Endangered species are discovering new habitats in residences that require rehabilitation and this poses a dilemma.

Not only are endangered animals residing in quarries but so is the American Ginseng. The American Ginseng is an endangered, long-lived, slow growing perennial herb found in deciduous forests (R.O.M., 2007). This herb is being removed due to the creation of gravel pits and quarries. Another endangered plant is the Prickly Pear Cactus, which is also losing land (E.C., 2006). It is a work in progress to educate industry operators of such species. However, the information to educate others is gradually becoming prevalent for those that intend to excavate the land.

It is difficult to decide if quarries are better off being rehabilitated or not. Natural regeneration of sites has often been quite successful in creating a self-sustaining, diverse plant community and wildlife habitat. The best examples are quarries that have been abandoned for 40
or more years (Andrews, 1990). Both terrestrial and wetland habitats have developed naturally in these places. Since the extraction process is a temporary use of land, the final condition of these sites should be planned. Andrews suggest that the natural regeneration of thriving plant communities is an indication that great potential for restoration exists if the right physical elements are present (1990).

*Dust from gravel pit/quarry operations*

Gravel pits and quarries activities release dust into the atmosphere, this is termed as nuisance of fugitive dust (G.W.O., 2007). The ARA standards for dust is addressed in section 3.0 Prescribed Conditions (2007). This section states that ‘dust will be mitigated on site.’ The ARA refers to mitigation as the process of alleviating, moderating, or reducing the severity of impacts (2007). However, the ARA does not require that dust be eliminated rather lessen the extent of it.

Dust is also referred to as airborne particulate matter (PM). PM ranges in size and this is an issue because the size of the particulate dictates what suppressant methods can be used. The smaller the particle the further it travels and can contain more harmful elements. The larger the particle the less distance it travels and thus settles in a much shorter period of time (G.W.O., 2007). Aggregate industries are responsible for the emanation of dust due to blasting, and crushing, amongst other operations, such as conveyor belts and the transportation of work trucks both on and offsite. Abandoned pits and/or quarries also contribute to dust being produced. This occurs when the wind wafts through pit floors or over aggregates (D.O.E., 2000). The everyday action of extracting from pits also creates dust. This is of concern to surrounding communities because dust may be harmful to individual’s health, can quicken corrosion and can be dangerous.
to vegetation ((Baker et al., 1995)). The dust may contain toxins and when inhaled can cause respiratory problems.

There are various methods which can be implemented to suppress the dust pollution. The application of water mist is used most frequently to suppress dust due to its cost benefit and accessibility. A less safe solution is the use of mineral oils to suppress dust which is later washed off of the aggregates (G.W.O., 2007).

The Ambient Air Quality Criteria (AAQC) is used to assess the general quality of air, while ‘point of impingement’ (POI) limits control air emissions from individual sources of pollution, such as aggregate sites (E-Laws, 2004). Local air protection efforts are of the utmost importance when dealing with possible, hazardous emissions. In order for aggregate sites to be developed their operations emitters are required to obtain Certificates of Approval. This is essential to enforcing compliance with air standards and protecting local communities.
Aggregate Extraction Issues

The core issue surrounding the sustainable development of natural aggregate resources is the conflict between provincial needs and local opposition to resource extraction. This conflict occurs because the negative impacts of extraction are located near the site of extraction, while the benefits from resource extraction are dispersed throughout an entire region.

Provincial benefits commonly are not considered in the local permitting process, and if resource extraction is denied because of local opposition, other costs arise, such as those associated with longer haul routes resulting in more traffic, more accidents, more fuel consumption, generation of more greenhouse gasses, greater wear and tear on vehicles, and higher vehicle replacement rates (Baker et al., 1995). Any gain by the local community that restricts extraction is usually at the expense of the greater public, the greater environment, and some other local area where extraction ultimately takes place.

In order to develop or expand any type of aggregate production, sterilization, permits, and regulations may restrict this development more than any actual limitation of suitable resource availability (Baker et al., 1995). It is often difficult when the government is unwilling or unprepared to deal objectively with conflicts between provincial needs and local opposition. Also, the failure to plan for the protection and extraction of aggregate resources often result in increased environmental damage and an adversarial relation between the aggregate industry and the community.
Sustainable Management of Aggregate Resources

The purpose of sustainable development is to ensure that development meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987).

At a minimum, sustainable development must not endanger the natural systems that support life on earth: the atmosphere, the waters, the soils, and the living creatures including people. In order to achieve sustainable development the manufactured capital and natural capital, (natural resources) that one generation passes on to the next must be maintained or enhanced. However, when dealing with non-renewable resources, such as natural aggregate, it complicates this process.

Aggregate resources are a finite resource. There is no real concern that aggregate resources will be fully consumed. This means that the sustainability of such a resource does not need to be ensured. However, natural aggregates that have a specific use can be more difficult to obtain if not within a decent distance from the extraction site. When a town or city has a local and accessible supply of aggregate resources it takes much work to transport long distances. This not only adds to the overall cost of the product but also contributes to the overall price to the environment.

There are a variety of key issues and policies that relate to the sustainable management of aggregate resources. Unfortunately, policies that are appropriate for government agencies often have few or no clear guidance to the aggregate industry regarding the implementation of sustainable management principles (Langer, 1998). This leaves the industries to design their own practices through interpreting and reviewing basic sustainability doctrines. It is imperative that primary stakeholders assume certain responsibilities in order to apply practical sustainability
of aggregate resources. Stakeholders can range from the government, industries, to public and non-governmental organizations (NGO’s). However, the government must be responsible for developing successful policies (E.C., 2006). Industries must also work in order to be acknowledged as responsible corporate and environmental members of a community. The public and NGO’s must also be educated and informed about aggregate resource management to provide any input of their own, relaying both their proposed objectives, interests and concerns.

All stakeholders have a responsibility to the environment and themselves regarding sustainable aggregate extraction. Through working with the mentioned although broad guidelines, industries can effectively manage their resources and reserves in a sustainable manner. These industries must play a role taking responsibility as an environmental member of the community. If sustainable practices are not in place it is the companies’ role to facilitate and bring together the various stakeholders whilst encouraging each group to partake in proper roles. All stakeholders should be able to participate in the decision process. Participation means more than including stakeholders. Proposals are best utilized when first presented to local governments, citizens, quasi-governmental, and environmental groups (Langer, 1998). Stakeholders will review it and provide their input and concerns, and then modify the proposal.

Federal, provincial, and local governments are implementing the practice of sustainable management of aggregate resources in only a few parts of the World. The aggregate industry can independently utilize sustainable management techniques to achieve goals of meeting their needs for reserves without compromising the ability of future generation to meet their needs.
Conclusion

In order to acquire the rights of aggregate extraction an industry not only needs to secure the ownership of the land and a permit but also needs to secure permission from its neighbours to operate. Permission is secured by earning the trust of the neighbours and community. The way trust is earned is by building and maintaining relationships. Meaningful involvement in the community is key. Resource development must address the needs of the community, the environment, as well as the needs of the company.

The Ministry of Natural Resources is doing its best to ensure that illegal practices of aggregate extraction are not occurring. Unfortunately, due to the lack of licensing officers compared to gravel pits and quarries; only 10 to 20 per cent of them are reviewed per year. It is estimated that one gravel pit and/or quarry is reviewed for inspection and licensing once every five years. If a company is to disregard any rules or regulations a steep penalty is issued, ranging from $20,000 to $30,000 per day. It is uncommon that gravel pit and quarry operators disregard specific laws, such as environmental rules. However, on occasion some companies have been so bold as to disregard the law, however thanks to loyal and respected citizens a viable environmental crime stoppers exists. They urge anyone who has witnessed a ‘crime of nature’ to report it to Crime Stoppers at 1 800 222 8477. Everyone has the power to make a difference to their community and the environment it is taking the first step that is the hardest part.
References


