The Environmental Assessment and Planning in Ontario Project

Case Report No. 3

Environmental Assessment and Aggregate Extraction in Southern Ontario: The Puslinch Case

by

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In the late 1980s problems arose at the intersection of environmental assessment and land use planning in Ontario. Established land use planning practices had failed to satisfy growing environmental concerns about individual undertakings and, more importantly, their cumulative effects. Simultaneously, environmental assessment had evolved into an environmentally-sensitive approach to planning that began to overlaps inefficiently with some land use planning decisions and seemed in some ways attractive for broader application in planning decision making.

These two factors led to two quite different pressures for reform. The first sought broader application of environmental assessment requirements in land use planning decision making, and the second aimed to rationalize application of the two processes in the relatively small area where existing environmental assessment and land use planning requirements clearly overlap. More recent initiatives have begun to explore more ambitious integration. These include land use planning reforms that promise to incorporate at least some of the principles of environmental assessment, and more broadly conceived applications of environmental assessment to programmes and sectoral planning.

The Environmental Assessment and Planning in Ontario Project, initially funded by the Social Sciences and Humanities Research Council of Canada, aims to develop a better understanding of the existing problems and the needs and options for reform. This publication is one of a series of case study reports examining major controversies at the intersection of environmental assessment and planning, and responses to these controversies. For information on other case studies and publications of the project, contact project coordinator and general editor of the case study series, Dr. Robert Gibson at the Department of Environment and Resource Studies, University of Waterloo.

Environmental Assessment and Aggregate Extraction in Southern Ontario: The Puslinch Case Study

Extraction of aggregate resources in southern Ontario has generated conflicts involving municipalities, provincial agencies, affected citizens, the aggregate industry and concerned lobby groups over the past three decades. The conflicts have centred on biophysical and social disruptions caused by the mining of sand, gravel and bedrock, and doubts about the adequacy of regulatory efforts to control these negative effects. Increasingly, public concerns have focused on the cumulative effects of aggregate operations that are highly concentrated in specific localities.

Perhaps the most noteworthy of the aggregates battles in Ontario has been the Puslinch case, initiated in 1986 when the Township of Puslinch attempted use a new Official Plan to restrict further aggregates extraction within the township boundaries to protect against cumulative damage to groundwater and other environmental values. The resulting Ontario Municipal Board hearing, pitting the Township and its residents against the aggregates industry and the province, ended in defeat for the local interests. However, the case spurred more innovative responses, including steps to address cumulative effects concerns through subwatershed planning.

This case study report, initially prepared by Douglas Baker in 1992, was updated and expanded by Darryl Shoemaker in 1994. It does not address more recent developments.

The Authors

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Introduction

Extraction of aggregate resources in southern Ontario has generated conflicts involving municipalities, provincial agencies, affected citizens, the aggregate industry and concerned lobby groups over the past three decades. At the heart of much of the conflict has been the biophysical and social disruptions caused by the mining of sand, gravel and bedrock, and doubts about the adequacy of regulatory efforts to control these negative effects. Increasingly, public concerns have focused on the cumulative effects of aggregate operations that are highly concentrated in specific localities.

In 1986, the Township of Puslinch adopted a new Official Plan that placed additional restrictions on the mining of aggregate resources (sand and gravel) within the township boundaries. The new plan required aggregate developers to seek an Official Plan amendment for any new operation. This would involve council approval, public notice and hearings, and an appeal process. For the aggregates industry the new Official Plan provisions promised a much more involved and costly approvals process than the Township's previous 1984 Official Plan designation, which required only by-law approval. The Township's purpose was to restrict further aggregate extraction and to establish a priority of land uses centred on agriculture and groundwater protection.

The Township Council, supported by local residents, wanted additional restrictions on the aggregate industry mainly because of the perceived and anticipated environmental impacts of aggregate mining in Puslinch. Environmental concerns focused on the effects of mining on the groundwater and wetlands, and the loss of agricultural land. While these concerns were initiated because of concerns about existing operations, the Township was especially worried about the cumulative environmental effects of increased mining activity on agricultural and water resources. Additional problems associated with aggregate extraction were centred around site specific issues such as noise, dust and truck traffic.

The new aggregate mining restrictions in Puslinch Township's 1986 Official Plan were challenged in 1988 by the Ministry of Natural Resources (MNR) and aggregate producers. This led to one of the longest Ontario Municipal Board hearings on record, taking 161 days. For the Board, the essential issue of the hearings was who was going to control aggregate mining: the township with its Official Plan or MNR through the *Pits and Quarries Control Act* and the Mineral Aggregate Policy Statement applied through the planning law?

The purposes of this report are

- to examine the present approach to controlling the effects of aggregate mining through existing policies and legislation;

- to identify the strengths and deficiencies of these existing requirements and practices; and

- to consider means of improving planning and the environmental assessment of aggregate mining.

The initiative of the Township of Puslinch and its fate in the resulting hearings will be given particular attention both for insights into the character and limitations of the current regulatory approach and for illumination of the potential for improvement. However, this report also examines steps taken subsequent to the hearings, especially a subwatershed planning initiative that promises the beginnings of a response to the cumulative effects concerns that underlie the Puslinch case.

Context

The Regulation of Aggregate Resources

Aggregate resources are mainly used for bulk construction purposes. They constitute the primary material for highway construction and concrete production. Natural aggregate sources are non-renewable sand and gravel deposits and bedrock. While these resources are not rare in southern Ontario, they are heavily used, especially where they are found within a cost efficient transportation range of major construction markets. In Ontario, 135 million tonnes were produced in 1991, with a value of $592 million (MND & M 1991). The Greater Toronto Market Area consumes about 30percent of this production (MNR 1992). Appendix A provides a description of the uses and production of mineral aggregate resources.

The extraction of sand, gravel, and bedrock resources is regulated under the *Aggregate Resources Act* (1989) administered by the Ministry of Natural Resources (MNR). MNR also developed and works to implement policies set out in the Mineral Aggregate Resources Policy Statement (1986) issued under the authority of Section 3 of the *Planning Act* (1983). The Statement (MARPS) provides policy direction which municipalities must "have regard for" in land-use planning decisions that may affect aggregate resource extraction.

Aggregate Resources Act (1989)

The *Aggregate Resources Act*, proclaimed on January 1990, replaces the former *Pits and Quarries Control Act* (1971). The Act provides a means to control pit development and rehabilitation by a licencing system that is administered by MNR. A Class "A" licence (to excavate annually more than 20,000 tonnes) or a Class "B" licence (less than 20,000 tonnes) is required for aggregate extraction. For a Class "A" licence, the operator must submit a detailed site plan that outlines features such as topography, mining activity, adjacent properties, the water table and surface water, the sequence of development, and progressive rehabilitation. The plan is to be prepared with at least three separate drawings outlining exisiting features, the operational plan, progressive rehabilitation, and final rehabilitation stages. The site plan for a Class "B" licence requires similar feature descriptions, but less detail. Table 1 provides a comparison of the site plan information required for a Class"A" licence under the *Aggregate Resources Act* and the previous *Pits and Quarries Control Act.*

Table 1 Comparison of Site Plan Requirements

Pits and Quarries Control Act Site Plan Requirements	Aggregate Resources Act Site Plan Requirements
4. (1) No person shall open, establish or operate a pit or quarry except under the authority of a licence issued by the Minister to the operator. (2) An application for a licence to operate a pit or quarry shall be filed with the Minister and shall be accompanied by a site plan in quadruplicate, which shall include: (a) the location, true shape, topography, contours, dimensions, hectarage and description of the lands set aside for the purposes of the pit or quarry; (b) the use of all land and location and use of all buildings and structures lying within a distance of 150 meters of any of the boundaries of the lands set aside for the purpose of the pit or quarry; (c) the location, height, dimensions and use of all buildings and structures of existing or proposed to be erected on the lands set aside; (d) existing and anticipated final grades of excavation contours where necessary and excavation setbacks; (e) drainage provisions; (f) all entrances and exits; (g) as far as possible, ultimate development, progressive and ultimate road plan, any water diversion or strorage, location of stockpiles for stripping and products, tree screening and berming, progressive and ultimate rehabilitation and, where possible, intended land use and ownership of land after the extraction operations have ceased; (h) cross-section where necessary to show geology, progressive pit development and ultimate rehabilitation; and (i) such other information as the Minister may require or as is prescribed by the regulations.	8. (1) The site plan accompanying an application for a Class A licence must show: (a) a key map showing the location of the site; (b) a general description of the site, including lot and concession lines, if any; (c) the shape, dimensions, and hectarage of the site; (d) the use of the land and the location and the use of the buildings and other structures with 150 meters of the site of the pit or within 500 meters of the site of the quarry; (e) the location, dimensions and use of the buildings and other structures existing or proposed to be erected on the site; (f) the location of the excavation setback limits; (g) the location and type of existing and proposed fences; (h) the location of existing and proposed tree screens and the species, size and types of trees; (i) the location dimensions and design of earth berms; (j) any significant natural and man made features; (k) the location and size of existing and proposed stockpiles of topsoil, subsoil and overburden,the location and size of proposed aggregate stockpile areas; (l) the topography of the site including existing and estimated final contours; (m) every existing and proposed entrance to and exit from the site; (n) all existing and proposed major roads on site; (o) the water table and any existing surface water on and surrounding the site and proposed water diversion, storge and drainage facilities on the site and points of discharge to surface waters; (p) subject to available information, the location of water wellls on and within 300 meters of the site; (q) the maximum depth of excavation and whether it is intended to excavate below the water table; (r) the sequence and direction of operation of the pit or quarry; (s) the progressive rehabilitation and final rehabilitation plans; and (t) any other information respecting the site.

In addition to a site plan, an applicant for a Class "A" licence must submit a Section 9 report that details:

- the suitability of the rehabilitation plans with regard to the adjacent lands;
- the environment that may be expected to be affected by the pit operation and any remedial measures that might be required;
- the social and economic effects that may be expected;
- the main haulage routes and proposed truck traffic to and from the site;
- potential hydrology and hydrogeology problems on site;
- the location of on-site overburden, top soil, and aggregate stockpiles; and
- any other planning or land use considerations or information respecting the site.

For an operator to get a licence, he or she must first apply to MNR by filing a site plan, and then give public notice of the application. Any objections to the application, by the municipality or public, can be filed with MNR. Objections may require the Minister to refer the issuing of a licence to the Ontario Municipal Board (OMB).

Under the *Aggregate Resources Act*, an annual fee is payable for the operation of a pit or quarry and the site is subject to inspection by MNR. A production fee of six cents per tonne of aggregate is levied against the operator. The fee is distributed as follows: four cents goes to local municipalities, one cent to the Province, half a cent to counties/regions, and half a cent to the abandoned pit and quarry rehabilitation fund.

An Environmental Impact Statement is not a prerequisite to the granting of a licence. However, every application for a licence is circulated within MNR and externally to relevant conservation authorities, municipalities, the public, and other concerned agencies. An impact assessment can be requested for operations in or adjacent to those areas considered environmentally sensitive. Over the past few years individual and groups dissatisfied with land-use planning decisions in Ontario have lobbied the Ministry of Environment and Energy to designate aggregate proposals under the *Environmental Assessment Act* (Gibson 1992a, 308). However, the province has been generally unwilling to impose environmental assessment requirements where other approval requirements (e.g. *Aggregate Resources Act*) exist.

Many of the designation requests for an environmental assessment are from communities experiencing cumulative environmental effects (CEE). Cumulative environmental effects are defined as:

> A change in the environment resulting from multiple initiatives of the past, present and reasonably foreseeable future, which combine in an additive, amplifying or discontinuous manner. Key instances occur when such interactions threaten or induce impairment or loss of valued environmental components (Shoemaker 1994).

CEE in aggregate-rich municipalities result from a concentration of aggregate operations. These CEE are largely unaccounted for because government assessment of potential environmental effects from aggregate extraction is conducted on a site specific basis. There is no requirement for consideration of CEE under the Act. Regardless of the source of aggregate materials, the nature of their deposition (glaciofluvial, glaciolacustrine, limestone)

ensures that they are highly concentrated locationally in the Ontario landscape. Aggregate operations, therefore, because of the distributional characteristics of the raw resource, must be highly concentrated in specific localities. Aggregate rich municipalities thus experience the concentrated benefits and drawbacks of aggregate mining activities. As a result, many planning agencies have become increasingly concerned about potential CEE issues.

One response has been to develop more stringent rehabilitation guidelines. The passage of the *Aggregate Resources Act* in 1989 significantly improved the rehabilitation process for the aggregate industry. The legacy of abandoned pits and quarries is now addressed through the production fee from which 1/2 cent is held in an abandoned pit and quarry fund. Documentation of abandoned sites and prioritization according to greatest risk has largely been completed for southern Ontario and rehabilitation of prioritized abandoned sites is slated to begin in 1994 (Bob Gibson, MNR, pers. comm. 1994).

As well, progressive rehabilitation is required under the Act (s. 47) and must be illustrated as part of the site plans (s. 8), and detailed in the Section 9 report. Progressive rehabilitation involves staged excavation and rehabilitation where less than one-quarter of the licenced area is disturbed during full operation (McLellan 1985). The Minister is to consider the suitability of progressive rehabilitation in considering whether to issue or refuse a licence (s. 12). Despite these requirements and guidelines for more effective rehabilitation, Ministry of Natural Resources rehabilitation statistics suggest that rehabilitation is still inadequate. Overall, only about 2 percent of of the land disturbed in any given year during 1986-1990 was rehabilitated. As well, as of December 1991, there was aproximately $50 million in the Rehabilitation Security Fund. If all licenced sites are employing progressive rehabilitation a significant accumulation of rehabilitation funds should not occur. "From this large accumulation of funds, it would appear that rehabilitation is not occuring at the expected rates. The reasons for this accumulation remain unclear" (MNR 1992, 5-40). The slight improvement of rehabilitated area in 1991 may signal the beginning of improved rehabilitation practice under the *Aggregate Resources Act*.

Outstanding issues surrounding rehabilitation include the continuing lack of enforcement, community input, and the need for regional planning to coordinate rehabilitation work (Amir 1974, McLellan 1987). Considering the concentrated nature of aggregate extraction operations, coordination of rehabilitation is important in determining the end use of a landscape. To fulfill this role, rehabilitation plans require the assistance of environmental planning and assessment in identifying valued environmental components to guide end-use objectives. Valued environment components are those components of the environment for which there is public or professional concern (Beanlands and Duinker 1983). The opportunity is then presented for development proposals not only to identify potential environmental impacts, but also use rehabilitation to enhance valued ecosystem components. Therefore, input from the affected community is required, allowing for rehabilitation of landscapes which moves beyond regulatory requirements to creative alternatives more suited for future use or enhanced ecosystem integrity. Further elaboration of this concept is contained in the response section.

The Planning Act (1983)

Some municipal control of aggregate resource extraction is provided in the *Planning Act* (s.34) through zoning by-laws and the Official Plan. Municipalities cannot regulate established pits and quarries through zoning by-laws; however, they have locational control over pit and quarry development. No licence under the *Aggregate Resources Act* can be issued unless the conditions comply with the Official Plan. In the event that municipal by-

laws or an Official Plan conflicts with the *Aggregate Resources Act*, however, the Act takes precedence and the municipal regulations are inoperative to the extent of the conflict with the Act (s. 66:1-4). Further control of pit operation is granted to municipalities by the *Municipal Act.* Under this Act, the municipal council may regulate of hours of operation, dust control, types of machinery used, setbacks and grades.

Mineral Aggregate Resources Policy Statement (MARPS)

The Ontario government has issued a total of four policy statements under Section 3 of the *Planning Act* (1983). Proposed reforms to the *Planning Act* will incorporate these four policy statements into a new set of six. All levels of government are required to have "due regard" to policy statements issued under the Act. One of these is MARPS, which established aggregates as a matter of provincial interest at the highest level of policy as approved by Cabinet. MARPS was formulated out of recommendations made by the Ontario Mineral Aggregate Working Party (OMAWP). The working party was established in 1975 to advise government on mineral aggregate policy. After extensive meetings with concerned individuals and groups in Ontario, the working party made 64 recommendations to revise policy and legislation on aggregate extraction. MARPS incorporated 12 of these recommendations which dealt with access to aggregate resources.

The objective of MARPS is to ensure that aggregate resources remain available to local producers, that existing licences are protected from incompatible uses, and that designated reserves are available for future mining. The following planning principles form the basis for the policy:

- aggregates as a non-renewable resource should be recognized as an important component in any comprehensive land use plan;

- aggregates should be available to the consumers of Ontario at a reasonable cost and as such it is necessary to maintain sources of supply as close to markets as possible;

- all parts of Ontario that contain aggregate deposits share a responsibility for meeting the provincial demand;

- it is essential to ensure that extraction is carried out with minimal social and environmental cost;

- other land uses may in "specific instances," take precedence over aggregate extraction; and

- municipalities have an important role in the planning of this resource and should "encourage the concept of extraction as an interim land use activity".

The statement ensures that aggregate resources remain accessible for producers and that management of aggregate producers remains at the provincial level.

MARPS as a planning tool has largely fulfilled is mandate in preventing the incremental restriction of access to aggregate resources. However, the MARPS planning principle of "minimizing social and environmental disruption" has largely remained unfilled as there are no provisions in the policy to account for incremental damage from aggregate extraction. It could be argued that the *Aggregate Resources Act* contains the necessary environmental

provisions to assess and mitigate environmental effects resulting from aggregate extraction. However, as noted above, the Act has a site-specific focus which precludes consideration of CEE. Thus, a gap exists between public and municipal environmental concerns and the requirements of MARPS and the *Aggregate Resources Act*. The significance of this gap is reflected in the ongoing conflict over extraction activities in aggregate rich municipalities.

Issues of Concern

Environment

Developing mineral aggregate in the proximity of the urban demand has generated a series of problems. In many cases, within the urban fringe, suitable sites for subdivision and building are also ideal for aggregate extraction. However, a characteristic of the aggregate industry is that it involves large equipment for open pit mining, production and hauling the product. Loaders, crushers, asphalt and screening plants, and heavy truck traffic are generally associated with larger pit developments. A series of negative environmental impacts frequently accompanies this type of land use.

Property owners adjacent to aggregate operations are usually affected in an adverse manner by

- environmental disruption to flora and fauna;
- adverse visual impact;
- noise and dust disturbance from the mining site;
- truck traffic hazards and road damage on haul routes;
- disturbance to the water table and local wetlands;
- fear of lowered property values; and
- historical absence or inadequacy of past pit and quarry reclamation.

As a result, residents often may want to block or restrict aggregate operations in their community.

While individual operations cause considerable disruption to the immediate surroundings, single operations themselves rarely pose a serious environmental threat. However, several operations within an area can have significant CEE. All of the individual case concerns can be increased by the proliferation of aggregate operations in limited areas. The most serious CEE, however, are those involving groundwater and agricultural lands.

The sand and gravel deposits that make up the resource for aggregates also form the aquifers for groundwater storage and recharge. Large scale mining of these groundwater storage reserves will affect both the storage and flow regimes. There is a great deal of uncertainty about the effect of mining on groundwater flow. Individual assessments of site specific problems, such as those required by the *Aggregate Resources Act*, are inadequate for developing an understanding of CEE on groundwater flow regimes. Planning for the

mining of aggregates below the watertable does not address this uncertainty nor recognize the off-site responsibilities of the possible impacts to local flow regimes.

The mining of aggregates also often conflicts with the preservation of agricultural land. In many cases the most suitable aggregate deposits are located beneath Class 1 and Class 2 agricultural land. While some rehabilitation operations have successfully returned aggregate extraction sites into productive agricultural land, many others have witnessed little progressive rehabilitation or an alternate form of rehabilitation. Of late, alternative rehabilitation is increasing, primarily where extraction goes below the water table to create groundwater extraction ponds. The creation of these ponds effectively retires the land from agricultural production and is a relatively cheap form of rehabilitation. The Food Land Guidelines, a Cabinet Policy introduced in 1978, were desinged to protect prime agricultural land. However, an OMB ruling (Puslinch #O880075) on aggregate extraction, and proposed changes to the *Planning Act* (Sewell 1993), could permit an expansion of below water table extraction.

The Planning Process

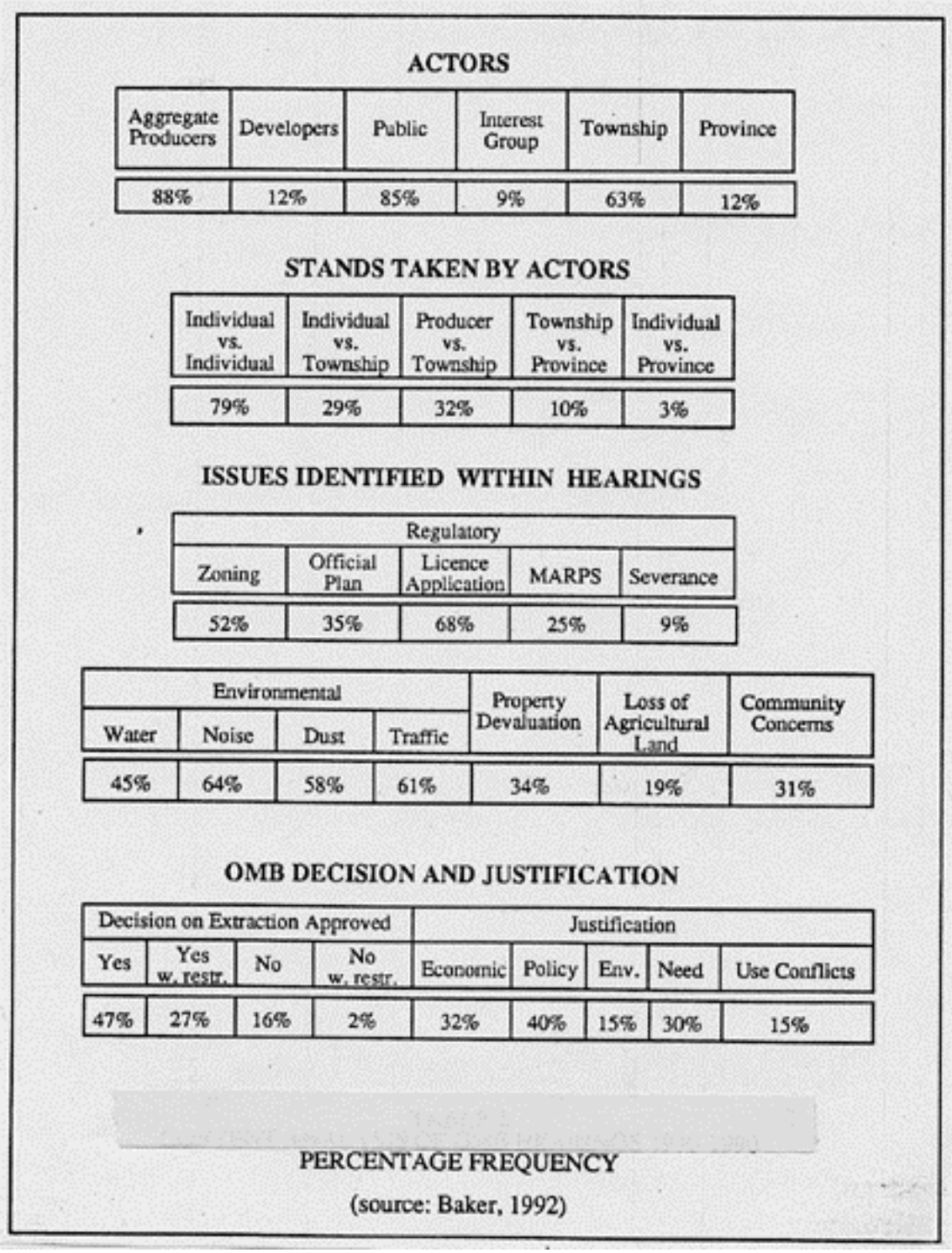
The regulation and rights governing aggregate extraction have changed over the years to serve two objectives. First, the provincial government focused on locating, classifying and protecting the bulk of aggregate reserves in the southern part of the province. This was achieved through the Aggregate Resource Inventory Program and MARPS. Second, the legislation was revised in an attempt to reduce the impact of mining and quarrying on the surrounding environment. The initial *Pits and Quarries Control Act* of 1971 was followed by the *Aggregate Resources Act* in 1989. Thus, regulation of the resource has been based on a dual mandate of developing sources and attempting to control the externalities associated with the development.

The planning and regulation of aggregate resources under this regime has not brought peace to an area characterized by a history of disputes that include a provincial-municipal struggle for control of the resource, a strong aggregate producer's lobby, citizen protest, and a host of tensions between concerned environmental lobby groups and government ministries. Through these "aggregate wars", which have become a virtual tradition in southern Ontario over the past two decades, have come entrenched positions for parties that have rallied for or against the development of aggregate resources. For example, the Foundation of Aggregate Studies operated an information and resource centre based in Toronto to oppose many aggregate developments while the Aggregate Producers Association of Ontario has functioned to lobby in favour of aggregate extraction.

Many of the conflicts over aggregates and planning have led to Ontario Municipal Board (OMB) hearings. Over 150 OMB hearings have been convened under the *Pits and Quarries Control Act* or the *Planning Act* to settle disputes involved with objections to aggregate mining. The OMB is a quasi-judicial, provincially appointed tribunal that conducts hearings into grievances and objections to activities under the *Planning Act.* Unlike the courts, the OMB is not bound by precedent, but rather the legislation and government policy of the day generally defines the parameters within which judgements are made.

The disputes that characterise aggregate mining within the context of the OMB hearings fall into several overlapping generic categories (Table 2). Most OMB hearings in aggregate matters result from controversy surrounding licence applications by producers to develop

Table 2 Content Analysis of OMB Hearings 1970-1990



ACTORS

Aggregate Producers	Developers	Public	Interest Group	Township	Province
88%	12%	85%	9%	63%	12%

STANDS TAKEN BY ACTORS

Individual vs. Individual	Individual vs. Township	Producer vs. Township	Township vs. Province	Individual vs. Province
79%	29%	32%	10%	3%

ISSUES IDENTIFIED WITHIN HEARINGS

Regulatory				
Zoning	Official Plan	Licence Application	MARPS	Severance
52%	35%	68%	25%	9%

Environmental				Property Devaluation	Loss of Agricultural Land	Community Concerns
Water	Noise	Dust	Traffic			
45%	64%	58%	61%	34%	19%	31%

OMB DECISION AND JUSTIFICATION

Decision on Extraction Approved				Justification				
Yes	Yes w. restr.	No	No w. restr.	Economic	Policy	Env.	Need	Use Conflicts
47%	27%	16%	2%	32%	40%	15%	30%	15%

PERCENTAGE FREQUENCY

(source: Baker, 1992)

new sources or expand a present operation. An individual, group or a township may protest the licence application under the *Planning Act* or *Pits and Quarries Control Act*, and force a hearing. Between 1970 and 1990, approximately 68 percent of the hearings centered on licence applications (Baker 1992).

A second type of OMB hearing occurs with challenges to official plans or to zoning by-laws enacted by municipalities. In this situation, a municipality's decision to designate a site as part of an "extractive" zone may be contested by local residents. similarly, an aggregate producer or the province may contest the Official Plan or zoning by-law as overly restrictive for operation expansion. Hearings that contended with Official Plan issues amounted to 35 percent of the total from 1970-1990, and 52 percent of the hearings dealt with zoning by-laws. A third type of hearing focuses on the protection of aggregate reserves from other land uses such as subdivisions. Characteristically, the province would challenge a zoning by-law that would allow new lot creation on or near aggregate reserves.

Because the OMB deals with aggregate conflicts on a case by case basis, its rulings may not resolve conflicts where the dispute centers on the CEE of several aggregate operations in an area. Also, if the aggregate application case is upheld, regardless of the terms and conditions placed on the potential licence, the aggregate producer is only accountable to the province and not the affected community. The OMB may also exacerbate conflict due to the adversarial nature of the hearings and the inequity of resources (eg. to obtain scientific information and legal counsel) between citizens and aggregate companies at the hearings. If residents are not satisfied with an OMB ruling for one site, there is little that the local official can do to reduce the resentment and dissatisfaction. MARPS often dictates the outcome of OMB hearings involving aggregate extractive zoning leaving the province in control of aggregate planning and management. While planning and management are firmly within provincial control, it is the aggregate rich municipalites and affected communities that feel the impact of aggregate extraction. Therefore municipalities continue to attempt to obtain some measure of control over the aspects of aggregate operations which generate negative environmental impacts.

A proliferation of OMB hearings has been the outcome of this municipal intervention. From 1980 to 1990, over 50percent of all new licence applications required an OMB hearing (MNR 1992, 5-31). The municipal intervenors have argued that local control is needed to curtail CEE from a growing concentration of aggregate operations. Municipal governments tend to be more responsive to local citizen concerns and elected municipal counsellors often support anti-aggregate sentiments within the townships. For MNR, provincial control is needed to ensure a continued supply of aggregate at a reasonable cost to consumers. The result is a traditional conflict between the municipalities and the province for the control and planning of resources. The case of aggregate resource management provides a good example of provincial imposition of legislation and policy on municipal governments that are often reluctant to follow the provincial guidance.

Citizens dissatisfied with an OMB ruling may attempt to convince the Minister of the Environment to designate a number of aggregate operations under the *Environmental Assessment Act.* Application of the *Environmental Assessment Act.* is often sought in an anticipatory way to avoid, or in preference to, the environmentally less adequate planning and aggregates law under which no intervenor funding is provided. The province, though, has been generally unwilling to impose environmental assessment requirements where other approval requirements (e.g. those under the *Aggregate Resources Act*) exist.

In addition, aggregate resources are are often exported to meet the MARPS principle of municipalities sharing responsibility of meeting provincial demand. However, the exported aggregate results in little resource rent being returned to the community from which they are

derived. Although the *Aggregate Resources Act* (1989) attempts to remedy the resource rent problem by returning a production levy of 4 cents per tonne to the municipality, the suitability of this rent remains contentious. Aggregate production involves considerable environmental and social impacts resulting from both mining and transportation of material. Residents and municipal coffers are faced with infrastructure costs and environmental uncertainty as a result of mining. The Commission on Development and Planning Reform (Sewell 1993, 27) recommended that the Province of Ontario review the fees assessed against aggregate operations and the proportion allocated to municipalities. The issue of compensation in the form of resource rent needs to be explored further as a possible mitigation measure to offset the externalities associated with aggregate mining.

Summary

The land use conflict that has been generated by aggregate extraction has been an expensive exercise in planning and decision making. It is continuing to demand time and resources from citizens, municipalities, proponents and the province. The problem has six main dimensions:

- An approximately 30-year tradition of conflict has polarized sides and public opinion.
- Several actor groups including the aggregate industry, municipalities, local land owners and provincial interests continue to struggle for control of aggregate resources.
- The OMB hearing system may not serve to mitigate conflict, especially regarding CEE.
- The issue of compensation through resource rent appears not to have been addressed satisfactorily despite improvements in the *Aggregate Resources Act* (1989).
- The property rights structure upon which municipal and provincial planning is based is poorly suited to non-market interests such as the environment or traditional users who may have a different perception of their rights to property. The substantive and procedural basis for planning is inadequate to address the present diversity of interests.
- Woven through all the above issues is an inadequate impact assessment process to determine off-site impacts and potential cumulative environmental effects.

Aggregate Extraction and Impact Assessment: The Puslinch Case Study

Puslinch and Aggregates

Puslinch Township is located approximately 70 kilometres southwest of Toronto. In 1982, the mixture of land uses were divided approximately as follows: agriculture 74 percent, rural residential 14 percent, Grand River Conservation Authority property 5 percent, aggregate

industrial 3 percent, and commercial-industrial properties occupying the remaining 4 percent (Monteith 1982). While the largest use of land in the township remains agricultural, other non-farm uses are rapidly changing the landscape. Residential development, aggregate extraction, and commercial development have all increased significantly along major transportation routes.

The location of the township has been termed both a "blessing and a curse" to the local residents. The "blessing" lies in a rural lifestyle within the close commuting distance to the urban centres. While Puslinch Township is located within commuting distance of five major urban centres--Guelph, Hamilton, Kitchener-Waterloo, Cambridge, and Toronto--it remains relatively sparsely populated and maintains a strong rural, agricultural identity among its 4890 residents (Puslinch Official Plan 1988). As Beesley and Walker (1990) observed of people living in the rural fringe of the Guelph area,

> ...most respondents still articulate that their community is a particulary good place to live owing to some aspect of rurality. Leading the list is the sense that the community is friendly and has a small-town character. This attraction is followed by its quiet nature, removed location, and ample open space. Of course, one of the main (and expected) attractions is proximity to Toronto. People in the fringe like to feel they have the best of both worlds...(p. 30).

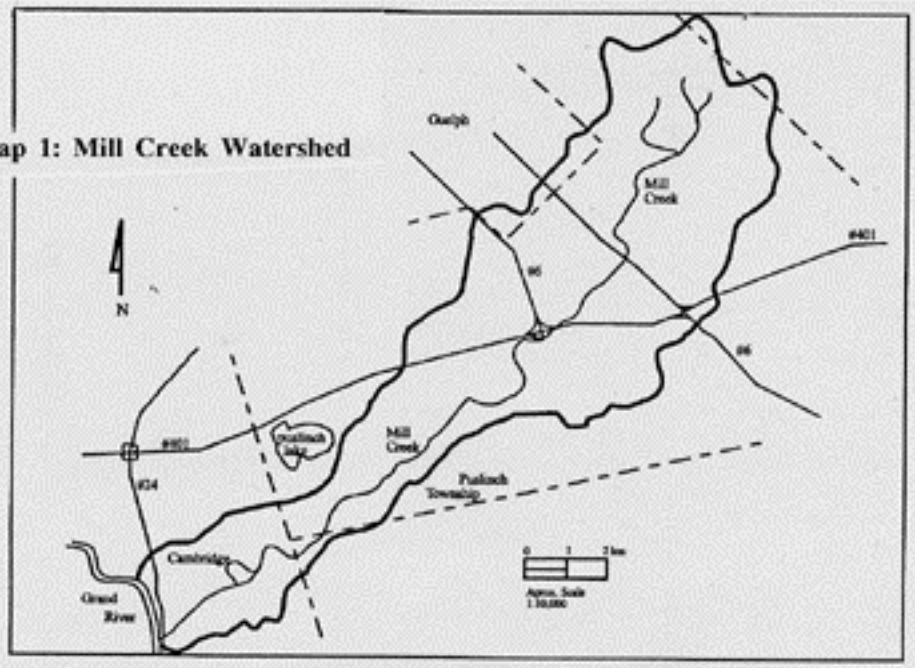
The "curse" of Puslinch to many of its residents involves the abundant aggregate resources within the township and its proximity relation to the high urban demand areas within the "Golden Horseshoe". As McLellan (1989, p. 31) has suggested,

> Townships with a "rural flavour" such as Puslinch and North Dumfries which contain substantial aggregate resources can expect the brunt of the pressure because (1) they are located adjacent to major highways and major urban expansion areas, (2) they unlike adjacent "deficit townships" contain extensive areas of quality sands and gravels potentially available for licensing and, (3) their resources have fortunately been neither depleted nor sterilized by past urban growth.

In Puslinch ninety percent of aggregate production is exported south on highway 6 or east on highway 401. The rate of extraction of aggregate resources in Puslinch increased dramatically from 1.6 million tonnes in 1981 to 4 million tonnes in 1989 before dropping back to 2.2 million tonnes in 1991. As of 1991, Puslinch was the ninth highest aggregate producing municipality in Ontario. This status should be retained or even increase as four more class A pits begin production in 1994 and licence applications are anticipated for two additional sites as the industry expands to meet projected market demands (MNR 1992). Map 1 depicts Mill Creek within Puslinch Township and Map 2 highlights current and potential areas of Mill Creek aggregate operations.

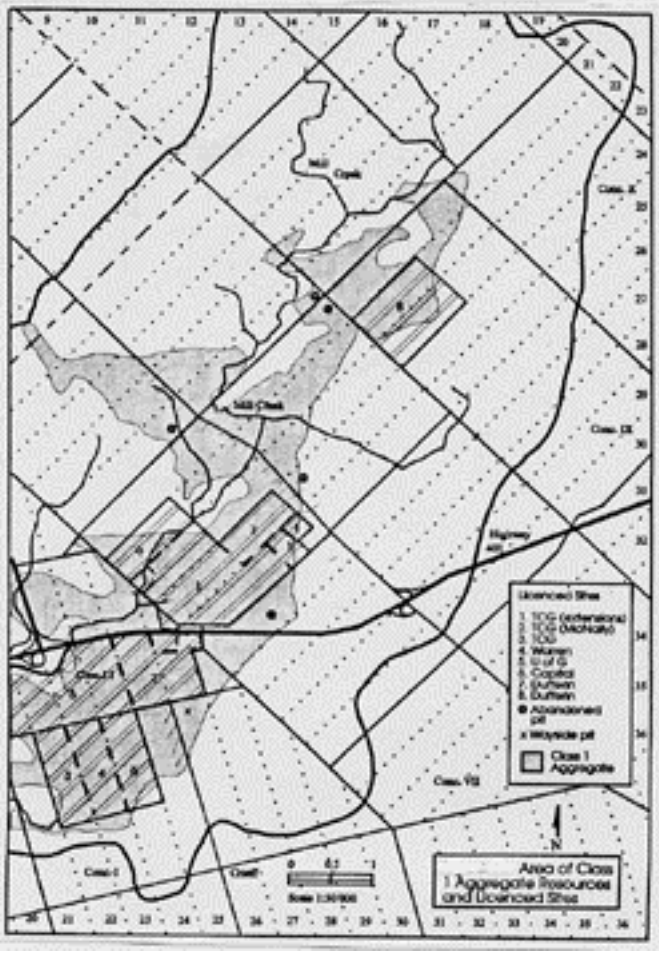
As a result of concerns about exploiting the "dubious wealth" of aggregate resources within the township, Puslinch has attempted to assert control over mining. As early as 1970, Puslinch Township had exceptionally comprehensive by-laws for regulating sand and gravel extraction (Baker 1993, 27). The council designated specific areas where aggregate extraction would be permitted and pit licence applications were likely to be approved. As Bryant and McLellan (1974, 149) noted, "the general climate of opinion in the township - at least represented by the council - would be favourably disposed towards the aggregate industry. But opposition to zone changes are found more with the public." This observation was based on several OMB hearings prior to 1974 where zoning designations placed by council were challenged by local citizens. For example, on three occasions - in 1968, 1971 and 1973 - the township supported by Cox Contruction attempted to amend its by-law to permit extractive uses on 500 acres owned by Cox; each

Map 1: Mill Creek Watershed



Map 2:

Class 1 Aggregates and Licenced Sites in the Mill Creek Watershed



time, the OMB rejected the applications after hearing from local citizens who opposed the extractive designation (Baker 1993, 27).

Increased mining activity and continued citizen opposition, however, caused the Township to change its stance in the 1980's. By 1982 when Cox Construction and the Township again found themselves in an OMB hearing, two key factors had changed. First, a provincial policy on the protection of aggregate had become strongly established, effectively placing control over aggregate development in provincial hands. Second, the township council became much more sympathetic to public opposition of aggregate extraction.

A survey initiated by the Township to discover public perceptions, revealed that land-use conflicts focused primarily around the aggregate industry and its use of land (Hansen 1981b). The conflicts, according to Hansen (1981b, 4), were based on the following perceptions of the aggregate industry in Puslinch:

- aggregate operations destroy agricultural land by disturbing topsoil and removing subsoil material;

- gravel operations pump water to keep their sites dry, and this affects the groundwater level; and

- because of ineffective controls, promised rehabilitation is not done, and the aggregate industry leaves unsightly pits behind when the material has been extracted.

The extent to which these perceptions influenced the Council was revealed in the November 19, 1980 Council minutes where the Cox application was refused:

> Although an extractive industry may be permitted on this property at some time in the future, this application is premature, ie. there is sufficient gravel operations already in existence. This proposal is felt to be a danger to the underlying water. Water pollution may result if the gravel is removed. Due to the creation of an 80 acre pond, there will be a large loss of agricultural land.

Cox Construction appealed to the OMB. The OMB ruled in favour of Cox Construction citing the Township's lack of consideration for the provisions of the Mineral Aggregate Resources Policy Statement for Official Plans (Baker 1993, 27). Despite the OMB's rejection of the Township's case, the Cox decision is significant because it marks the Township's shift from supporting gravel extraction to opposing zoning applications and attempting to assert local control over the industry in the face of growing provincial pressure in policy and legislation (Baker 1993, 27).

The 1989 Puslinch OMB Hearing

In 1986 the Township of Puslinch introduced a new official plan. This plan was drawn up by residents, township council and a planner retained by the Township, who where concerned about CEE resulting from aggregate extraction (McMillan 1993). Primary concerns centred on the effects of mining on groundwater, wetlands and the loss of agricultural land. Additional problems resulting from extaction activities included noise, dust, and truck traffic.

The Official Plan placed an additional restriction on aggregate extraction by requiring all applicants for new aggregate licences to seek an official plan amendment. For the aggregate industry the new official plan provisions promised a much more involved and costly approvals process than the township's previous 1984 official plan designation which required only a by-law approval.

In addition, Section 16.2(2) of the adopted plan stipulated "need" as a requirement that must be demonstrated to Council's satisfaction before an amendment would be considered. There must be an economic and social "need" within the community to justify establishing a new gravel pit. A producer's individual construction need was stated as being insufficient to fulfil this requirement (this section was redrafted during the OMB hearings to remove the condition of local need, however, citizens opposing the pit developments maintained that need should continue to be a governing criterion for the approval of new pits).

As well, the 1986 plan attempted to control excavation below the water table with Development Agreements (under Section 40 of the *Planning Act)*; a specific contract agreement between a proponent and the township. For aggregate developments in Puslinch these agreements would restrict aggregate extraction to no closer than 1 meter above the water table.

The net effect of the Official Plan revisions was to impose overall controls on aggregate operations in the township. Since these controls went well beyond those applied by MNR, the Township's initiative was seen as a challenge to the authority of the Ministry of Natural Resources and the policy set by MARPS. In response, MNR and two aggregate producers seeking licence approval challenged the township's Official Plan. This led to an OMB hearing in 1988.

The events that initiated the OMB hearing started in the summer of 1986, with the Telephone City Gravel Company (TCG) and the University of Guelph's applications to mine below the water table (Map 1). Warren Bitulithic subsequently joined the group during the OMB hearings. The University of Guelph was applying for a zone change from the township in order to develop a 186 hectare property in Puslinch Township for aggregate extraction. The property, containing class 2 and 3 Canada Land Inventory farm land, had been used primarily as a research station for livestock and growing feed. The TCG and Warren properties were also rated as class 2 and 3 farm land and were also used for agricultural purposes. The aggregate licence site plans, which would be carried out over a 25 year period, would leave a combined lake area of 107.5 hectares due to extraction below the water table (Shoemaker 1994). The proposals would affect 67 households in the adjacent area, and along the haul route.

The University of Guelph proposal became a target of particular criticism from local residents, Puslinch Township, and the media. Concerns centred on the loss of farmland due to groundwater extraction ponds and potential impacts to hydrologic regimes. Changes to the hydrogeological flows could potentially cause drying of adjacent class 1 wetland edge, disrupt well use in the area, and alter base flows into Mill Creek affecting its cold water fishery. Critics also challenged the integrity and image of the University of Guelph as an agricultural institution. Representative headlines in local newspapers during late 1986 included the following: "Agricultural College Turning Farmland into Gravel Pit" (Globe and Mail, Oct. 3, 1986) or "Hostile Reception: U of G Accused of Prostituting Itself" (KW Record, Oct.16, 1986).

The Township of Puslinch refused to entertain the TCG and University of Guelph proposals, and as a result both applicants appealed to the OMB: TCG in November 1986 and the University of Guelph in April 1987. These appeals to the OMB followed appeals

by several other aggregate companies who contested the Official Plan designations. The Puslinch OMB hearing panel sat for a 156 days to hear 110 witnesses and examine 434 exhibits (MNR 1992, 5-34). According to the hearing report (# O880075), six different aggregate operators appealed different aspects of the township's zoning in relation to their respective properties. In addition to these site specific interests, the hearing also generated appearances from the Ministry of Natural Resources, the Ministry of Transport, and the Aggregate Producers Association of Ontario in opposition to various aspects of the township's official plan. Support for the township's adopted aggregate policies came from various township residents, the Presbyterian Church of Canada (Crieff Hills Community) and the Ontario Federation of Anglers and Hunters.

The Township of Puslinch's argument centred on the idea that physical and social impacts of extraction had reached a "tolerance level" for CEE. In 1989, when the OMB hearing was initiated, approximately 4.5 million tonnes of gravel were mined, up from 1.6 million tonnes in 1982, and the Township anticipated no end to pressures for further expansion. With ninety percent of aggregate production exported, Puslinch was clearly marked as an attractive source of aggregate for the construction industry servicing the large Toronto market because of its high quality reserves and proximity to highway 401. The Township argued that they were already contributing their fair share of aggregate to satisfy local, regional, and provincial need. This argument is supported by the fact that the Kitchener-Cambridge-Guelph market area is the only remaining net exporter of aggregates to other market areas in the province (MNR 1992, 3-47).

The Township of Puslinch also argued that it should be the responsibility of the aggregate producers to demonstrate that impacts to groundwater resources would be minimal. In the Official Plan, extraction below the water table was prohibited. The reasoning behind the Township's position was that, up until the new Offical Plan in 1986, the burden of proof to demonstrate that there is a negative effect falls upon the objector to an aggregate proposal, rather than the developer of the aggregate site. Regarding groundwater resources, it was very difficult for a resident objecting to an aggregate licence, to clearly demonstrate negative impacts due to inadequate technical and legal resources, and given the uncertainty surrounding hydrogeological science. What several studies did reveal, however, is that the potential for negative impacts on groundwater resources were accentuated by an increase in the area of groundwater extraction ponds.

The Townships' position is clearly stated in the following quotes from a submission to the OMB (Exhibit 28):

> The extraction industry is considered a transitional land use. However, the number of years it may spend as a gravel pit can be considerable. While in the extractive stage, the land use is quite disruptive to the area in which it is located. The presence of heavy gravel trucks travelling on Township, County or Provincial roads both increases the rate of deterioration of the road, as well as increasing the level of dust, noise and traffic hazards. The presence of equipment digging, sorting, grading, etc. on the site also produces new levels of noise and dust never before present in the area. (p.4).

and

> Although the Township understands it must <u>share</u> the responsibility of having aggregate resources, it must also weigh that responsibility against that of providing a suitable living environment for its existing residents. There are limitations to the degree of disruption that residents can tolerate. It is the belief of this Council that the toleration level has been met. (p.8).

The residents also supported the Township's arguments over the potential impacts from the creation of groundwater extraction ponds.

The Ontario Federation of Anglers and Hunters (OFAH) were also concerned about the creation of groundwater extraction ponds and the concentration of aggregate operations in the area surrounding the Mill Creek wetland complex and cold water fishery. They argued that more baseline data on the proposed sites were needed. Also, even with site analysis, combined impacts on the watershed ecosystem as a whole had not been considered in any of the aggregate licence study submissions or by the MNR. Basically, OMAF argued that the lack of scientific data on the sites, and uncertainty involved in the proposals had not been adequately addressed.

A variety of provincial ministries also became involved in the conflict, focusing on the issues of mining below the water table and rehabilitation of agricultural land. Initially, the Ministry of Agriculture and Food (OMAF) strongly supported Puslinch Township's policy of refusing to allow mining below the water table and to protect agricultural land. In the summer of 1988 Jack Riddell, then Minister of Agriculture and Food, was quoted as saying, "This Ministry supports the township Policy Statement on Aggregate Extraction" and openly defended the township's Official Plan designations (Guelph Daily Mercury, Aug. 22, 1988). However, by the time the OMB hearings commenced in November, 1988, OMAF had withdrawn its support for the Official Plan, stating that it would support aggregate extraction on agricultural land in site specific cases.

Aggregate producers opposed the township's Official Plan based on a desire for access to the resource without onerous municipal restrictions. MNR and MTO supported this position recognizing the need to ensure an adequate supply of sand and gravel for market sources and provincially determined needs. MNR and the aggregate producers presented seven main arguments against the Township's initiative.

- The municipality does not have the legal right to designate and control aggregate reserves which are of provincial significance. As a result of the policy designation of MARPS, aggregates should be viewed as a land use of the highest priority, and should take precedence over other land uses such as agriculture.

- The proposed designations contradict previous extraction policies, supported by an OMB decision, for the same area.

- Requiring an official plan amendment for new aggregate sites would prolong decision making and could eliminate the chance of getting an extractive designation.

- There is increasing need for the high quality sand and gravel resources of Puslinch Township to service the high market demand in the Toronto area. The Puslinch area, one of the largest reserves remaining near Toronto, provides a relatively inexpensive source of mineral aggregates. The University of Guelph property could be the single largest source remaining in southern Ontario, with a minimum estimated volume of approximately 34.4 million tonnes.

- The Official Plan should provide a permanent extractive designation for future settlement reference, so that people moving into the community are aware of the designation areas for aggregate mining and land use conflict can be avoided.

- The local concern for groundwater is not based on evidence. There are no scientific data to indicate that mining under the water table will affect the local groundwater regime.

- Consideration of environmental impacts of mining is required under the *Aggregate Resources Act* and this is adequate to resolve concerns on a site specific assessment.

These arguments all hinge on principles outlined in MARPS and the *Aggregate Resources Act.*

After hearing all the arguments, the OMB ruled against municipal authority in the regulation of aggregate resources. The OMB (#O880075) decision included several statements important for aggregate planning in Ontario. In particular the Board ruled that:

- extraction below the water table should be permitted subject to meeting specific criteria; it must be demonstrated that there are substantial aggregate below the water table on prime agricultural lands, and extraction can occur only after all the alternatives have been considered; impacts on the environment, including the quantity and quality of the surface and groundwater resource must be minimized;

- the question of need is not a local matter but a provincial matter as established by MARPS; any consideration of the need for aggregate extraction in an official plan is therefore prohibited by MARPS under Section 3 of the Planning Act; and

- municipalities have no legal authority to require an aggregate producer to enter a development agreement covering matters such as extraction below the water table, haul routes, rehabilitation, etc, in the official plan.

With respect to the four applications (University of Guelph, TCG, Capital Paving and Cox Construction), the Board ordered that their lands be designated "Extractive Industries." As well, in addressing the University of Guelph site, the Board recommended 46 conditions for approval to be attached to the granting of a licence by MNR. The recommended conditions are significantly greater and more complex than previous conditions for any aggregate operation in the province (MNR 1992, 5-35). These conditions were chiefly designed to address potential impacts to the Mill Creek wetlands and cold water fishery (Baker 1993, 29).

The Puslinch OMB hearing dealt with a number of planning issues and conflicting interests. However, the root issue remained "who was going to control aggregate resources, with what means, and for what reasons" (Baker 1993, 28). For the Township, local control was needed to curtail CEE from a growing concentration of aggregate operations. For the MNR, provincial control was needed to ensure a continued supply of aggregate at a reasonable cost to consumers. The Puslinch OMB hearing panel did not effectively address this question nor could it have done so within the OMB mandate. Instead the decision reinforced control by provincial authorities who have yet to address CEE adequately through MARPS or the *Aggregate Resources Act.*

The OMB hearing also lacked the ability to ensure local input into aggregate development and rehabilitation. The OMB provided an adversarial forum where individual, municipal, and provincial interests were placed in opposition to each other and forced to fight over the issues. It was, however, an unequal contest because of the disparity of the resources between the well-funded proponents for aggregate extraction versus the Township and its residents who had considerably less resources and had to carry the burden of proof. The hearing approach allowed for no mediation between parties; solutions were not creatively sought and interests were not mutually enhanced. The OMB left the aggregate producers accountable only to the province and not to the affected community.

The frustration or "tolerance level" of the affected community was not relieved. The result was that following the OMB hearing, the Puslinch community wrote the Minister of the Environment requesting a moratorium on aggregate development in the Mill Creek watershed and designation of the proposed aggregate operations under the *Environmental Assessment Act* (McMillan 1993). The Grand River Conservation Authority (GRCA) met with the Minister of the Environment and recommended that a watershed plan would serve the need better than an environmental assessment due to the use of a regional environmental baseline. The Minister accepted this argument and the Mill Creek Subwatershed study was initiated in the fall of 1993.

Analysis of Issues

Aggregate Supply and Demand

After the Puslinch OMB hearing, MNR undertook a study of the state of aggregate resources in Ontario (MNR 1992). The report concluded that while aggregate resources fulfill an essential role in the economic development of Ontario, Southern Ontario may be moving towards "a critical economic, social and environmental situation in terms of protection of, and access to, aggregate resources required to meet the increasing demands of Ontario residents" (MNR 1992, i). With 60 percent of the aggregate demand coming from the public sector (eg. highway construction), the availability of suitable resources is necessary to ensure a lower cost product for taxpayers.

Shortages of aggregates in specific market areas, especially the Greater Toronto Area which consumes 30 percent of Ontario production, are because of depletion of existing reserves, decreased access to aggregate reserves due to environmental and social restrictions, and sterilization by urbanization. While reserves from outside market areas are still available, greater reliance on them would not only increase transportation costs but also exacerbate related environmental impacts. Increased protection of the Niagara Escarpment and the Oak Ridges Moraine simply shifts aggregate extraction to more remote sources where environmentally significant features may not be accorded the same high degree of protection. Puslinch Township is one of several aggregate rich municipalities facing increased demands for aggregates due to decreased access to reserves in the Niagara Escarpment and Oak Ridges Moraine. Other examples include Oro Township, Mara-Carden Townships, and Mono/Adjala/Erin Townships.

Aggregate demand is projected to increase to 192 million tonnes/year from 1996 to 2000, and to 209 million tonnes from 2001 to 2005 (MNR 1993, 4-12). This demand will place increased pressure on adjacent municipalities with high potential aggregate resource bases. Puslinch Township, which already exports 90percent of its production, has been designated as a significant potential aggregate resources area that will face increasing demands. Puslinch contains 17 active class A licences with 2 more in final approval and 2 others in the planning stages.

With respect to the supply of aggregate resources, a common complaint by aggregate producers is the length of time it takes to licence a site. The licencing process is presently very slow and cumbersome to meet producer's short term supply needs. The time frame necessary to obtain the necessary approvals for a new licence has increased from 1 to 2 years in the 1970s to 3 to 4 years in the 1980s. As well, from 1980 to 1990, over 50percent of all new licence applications required an Ontario Municipal Board (OMB) hearing. This

means certain constraints and uncertainties for producers that are attempting to compete in the demand market. The situation may improve due to greater environmental requirements under the *Aggregate Resources Act* (1989). The challenge is to address the need for aggregates and ensure efficient regulation while maintaining environmental integrity.

Regional Environmental Pressures

The present institutional structure for environmental planning of aggregate resources is divided between provincial and municipal control. Policy direction for the mining of aggregates with respect to other land uses is determined by MARPs, which strongly favours the protection and development of aggregate sources over other land uses. Although the *Aggregate Resources Act* provides for a careful environmental review of site-specific effects, it provides no vehicle for a more comprehensive overview beyond the individual sites to an ecosystem or regional context. CEE of widespread mining in an area, such as Puslinch, are not addressed with the *Aggregate Resources Act.*

The *Aggregate Resources Act* also reflects little appreciation for the limitations of environmental impact science, especially concerning aggregate mining effects on groundwater regimes. The burden of proof is actually not on the aggregate producer to demonstrate that the mining operation will or will not cause environmental damage. All that is required is a site-specific environmental assessment that "describes the environment that may be expected to be affected by the pit or quarry operation and any proposed remedial measures" (s.9(1)(c). This analysis is not even open to public debate unless a rezoning initiative is challenged leading to an OMB hearing. Once in a hearing, the onus of proof falls upon the objectors to the proposal. Therefore, little consideration is given to the uncertainties involved in predicting potential affects on the environment. The only reprieve may be conditions imposed by the OMB which include monitoring.

Within the planning forum, an equitable and fair process is required to address the conflict that arises as a result of different resource-use priorities. By its nature, aggregate mining is not a popular land use. It is essential to balance justified opposition that is based on valid environmental concerns with what may be parochial concerns of less significance to the community. An equitable process should address the interests that represent provincial concern, municipal jurisdiction, and local anxieties. Both the substantive and procedural decisions that are arbitrated in the planning process must address the range of interests that mining affects.

Response Options

Planning Act

This Act provides for municipal control and direction of land uses within the designated boundaries. The Official Plan outlines a blueprint for the development of the community and opportunities for public participation are provided in the formulation of the plan and subsequent decisions on plan amendments and rezoning. This is the primary strength of the *Planning Act.* It gives local authorities responsibility and residents some control over land-use planning.

Although one of the purposes of the *Planning Act* (s.2(a)) is protection of the natural environment, there is no environmental clause in the Act that specifies environmental protection requirements or sets environmental guidelines for development. In the case of aggregate resources, the *Planning Act* assumes that gravel mining is another private land use that can be controlled adequately through by-law regulation or application of other laws. Environmental control is allocated to the *Aggregate Resources Act.* The *Planning Act* does not afford local residents and municipal planners the opportunity to set overall environmental controls on aggregate production as a land use. In the case of aggregate mining, a variety of set-back, noise, and traffic restrictions are presently applied through by-law control but these measures do not ensure environmental protection. The Puslinch case tested the current limits of *Planning Act* use for comprehensive controls, showing what cannot be done.

The *Planning Act* needs to provide local municipalities the authority to incorporate environmental planning into local decision making. Some progress towards this need is being made through reforms to the *Planning Act.* The Commission on Planning and Development Reform proposed that "the province should adopt a comprehensive set of policy statements under Section 3 of the Planning Act" (Sewell 1993, 13). In response to the recommendations of the Sewell Commission (Sewell 1993), the province introduced a reforms to the *Planning Act* to the legislature on May 18, 1994, which includes a set of policies that will replace the four existing policy statements, the Food Land Guidelines and the Growth and Settlement Policy Guidelines. The proposed policies include:

- Natural Heritage, Environmental Protection and Hazard Policies;
- Economic, Community Development, and Infrastructure Policies;
- Housing Policies;
- Agricultural Land Policies;
- Conservation Policies;
- Mineral Aggregate, Mineral, and Petroleum Resource Policies; and
- Interpretation and Implementation Policies.

However, the government does not propose to change the substance of the existing MARPS. This policy statement will be summarized and included in the final set of policy statements which is intended for cabinet consideration (MMA 1993, 5).

With the other policy statements, the government may stengthen environmental protection of valued environmental components and provide for environmental impact statements (EIS) on development proposals that threaten wetlands, Areas of Natural and Scientfic Interest, significant ravines and woodlands, natural corridors, and shorelines (MMA 1993, 17). An EIS would include consideration of alternative methods and a monitoring plan.

Several specific reforms are directly related to aggregate extraction. A reformed Agricultural Land Policy (formerly the Food Land Guidelines) would allow extraction below the water table. The removal of this restriction provides access to a greater reserve of aggregates but only exacerbates the questions surrounding hydrogeological impacts. As well, under the reforms, development of lands adjacent to aggregate extraction areas will only be permitted if it does not hinder or preclude continuation of existing operations. However, in cases where policies conflict, a prohibition takes precedence.

With regard to the planning process, reforms of the OMB are also needed. Specifically, an alternative hearing process should incorporate intervenor funding for local citizens and incorporate mediation prior to the hearing process to discover common interests between parties and possible solutions. The proposed reforms of the *Planning Act* address some of these suggested changes to the OMB as a pilot project is underway to resolve planning disputes without the need for formal OMB hearings.

In response to outstanding problems surrounding compensation to municipalities, the Commission recommended that the Ontario government review the amount of fees assessed against aggregate operations and the proportion allocated to municipalities (Sewell 1993, 27); however, the government has yet to act on this recommendation. The issue of compensation to municipalities that contain a large quantity of aggregate resources has been partially addressed with the production tax (4 cents per tonne) levied under the *Aggregate Resources Act*. However, for those municipalities that are burdened with a high concentration of aggregate resources this tax may be inadequate to address the potential environmental and social disruption that these regions have to sustain.

Environmental Assessment

The environmental assessment process under the Ontario *Enivironmental Assessment Act* offers distinct advantages and disadvantages to the planning process for the mitigation of aggregate mining. The strengths that a formal impact assessment would bring are

- consideration of need and alternatives;
- an integrated perspective based on a broad definition of the environment; and
- provisions for public input and intervenor funding.

However, there are also potential weaknesses:

- Ontario's full environmental assessment process is too involved for individual licence applications. The present licencing process is already cumbersome without a major assessment, review and approval;
- The present environmental assessment process also alienates local decision making at a municipal level; and
- The current law's automatic application only to government projects is inadequate for application to the largely private sector aggregates industry .

The most attractive way of applying the environmental assessment process to aggregate mining, is through incorportating the strengths of environmental assessment into the continuous land-use planning process rather than application as a "one-shot" event. "The objective is not mitigation of pre-selected projects, but good planning that identifies environmentally preferred responses to recognized problems or opportunities. To accomplish this, environmental assessment processes demand integration of broader environmental considerations from the outset of planning" (Gibson 1992a, 316). The inclusion of environmental impact statement requirements in the proposed policy statements moves in this direction but it still does not address needs, alternatives and CEE.

A possible response option is found in the development of two recent policy initiatives. It is proposed that the indicator approach and a cumulative environmental assessment strategy guideline (MOEE 1993; Shoemaker 1993), be integrated into subwatershed studies (MOEE and MNR 1993b) for the assessment of, among other activities, aggregate undertakings. This approach should take advantage of environmental assessment strengths while avoiding several of the weaknesses.

The drafters of the subwatershed strategy argue that if fundamental environmental assessment principles are incorporated into the subwatershed planning process, many of the *Environmental Assessment Act* requirements for specific projects could be met through the subwatershed plan. The information developed through this planning process could be subsequently built upon to satisfy outstanding environmental assessment requirements (MOEE and MNR 1993b). Incorporation of the indicator approach extends this line of reasoning to cover CEE. As well, subwatershed planning provides a more appropriate context for evaluation of multiple development needs, such as aggregates, and their environmental impacts (Shoemaker 1994).

Subwatershed planning is a "more complex but much fairer assessment of interactions of natural processes within broader boundaries, and of the interactions between natural processes and man-made social and economic demands" (MOEE and MNR 1993b, 2). A mandate for use of subwatershed planning could be provided through proposed reforms to the *Planning Act* introduced on May 18, 1994. As part of the reforms, mandatory contents will be stipulated for all municipal and planning board official plans. The specific details will be set out by regulation, and will include matters relating to environmental protection, such as planning for water resources on a watershed basis. This approach has also been taken by the Oak Ridges Technical Working Committee in their draft planning strategy for the Oak Ridges Moraine (ORMTWC 1994).

A subwatershed plan would detail and implement specific subwatershed targets, goals, objectives to establish:

- natural systems linkages and functions;
- surface and groundwater quantity and quality management;
- the enhancement and/or rehabilitation of natural features;
- areas suitable for redevelopment;
- best management practices for incorporation into subdivision designs;
- specific implementation schemes and responsibilities for all recommendations;
- management practices for open space areas and green space corridors; and
- an implementation strategy (MOEE and MNR 1993b, 6).

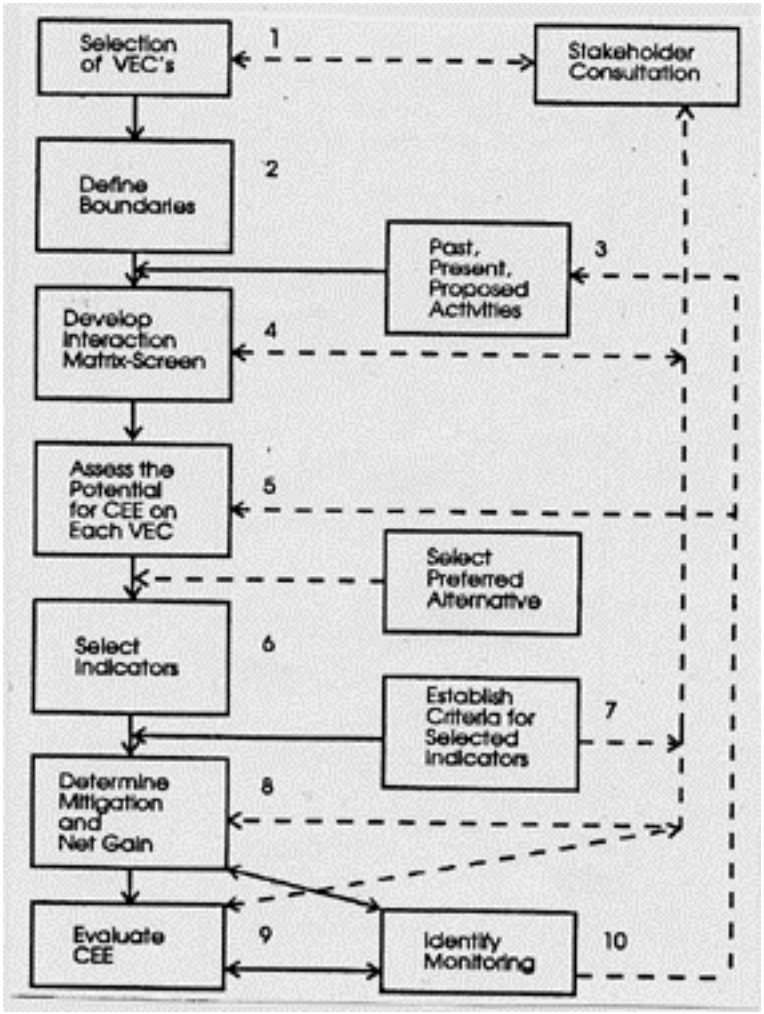
A subwatershed plan would also include consideration of "cumulative impacts of changes to subwatersheds on the natural environment..." (MOEE and MNR 1993b, 9). It would not determine land use, instead the plan would establish constraints, opportunities and approaches for integration into land-use planning decisions (GRCA 1993, 1). Plan recommendations are to be incorporated with Official Plan amendments.

Subwatershed planning provides a unique opportunity to consider CEE in a spatial unit which encompasses both aggregate resources and the affected valued environmental components (MOEE and MNR 1993b). What is needed is an evaluation process for study and monitoring of CEE as they impact valued environmental components in the watershed. The indicator approach provides such an evaluation process.

The basis of the indicator approach is the development of indicators in an evaluation matrix format to measure significant CEE. An indicator is "a character of the environment that, when measured, quantifies the magnitude of stress, habitat characteristics, degree of exposure to the stressor, or degree of ecological response to the exposure" (Environment Canada 1992, 2). Well chosen indicators, often in graphic form, can convey significant amounts of information rapidly and clearly. For the indicator approach, monitoring and feedback are important in educating the public, understanding CEE pathways, aiding in the selection of possible alternatives, indicating where adaptive change may be required, and indicating the nature and extent of environmental stress and response (Shoemaker 1994). The indicator approach, comprised of ten components (Figure 1), is particularly suited for use in environmental assessments; however, the basic components of the approach, especially the use of indicators, facilitates integration into environmental planning.

Figure 1

The Ten Components in the Application of the Indicator Approach



VEC = valued ecosystem component

Because of limited available resrouces available for such work, only where a considerable amount of development activity is proposed should environmental impacts and CEE be assessed in a subwatershed study incorporating the indicator approach (Sewell 1993, 78). Such a situation exists in Wellington Region (including Puslinch Township) and Waterloo Region. Proposed revisions to the Waterloo Region Official Plan (November 1993) include directions to

> • undertake, with the Area Municipalities most affected and the aggregate industry, a study of the cumulative impact - land-use, environmental and social - of local aggregate extraction and develop strategies to address concerns;
>
> • encourage the Ministry of Natural Resources to fund subwatershed studies in rural areas where there is significant aggregate potential; and
>
> • recommend that the Area Municipalities require a subwatershed study to be completed prior to considering a zoning change for aggregates.

The last point, however, may contravene MARPS. As well, even if an aggregate licence is in place before a subwatershed plan is complete, the *Aggregate Resources Act* allows MNR to revise site plans.

In Puslinch, a subwatershed study was initiated on Mill Creek in September 1993. One of the goals of this subwatershed study is to investigate how potential CEE from aggregate extraction has and will affect the Mill Creek watershed environment in general and the groundwater resources in particular (GRCA 1993). The Mill Creek watershed contains the largest primary aggregate resource deposit in Puslinch (Map 2). The watershed also contains the majority of extractive operations in Puslinch - eight active and four more proposed class A sites. The eight licenced sites are all wet pit operations where the water table is so close to the surface that the majority of the deposit, and hence the excavation, is under water (Collis and Fox 1985, 52).

This Mill Creek subwatershed study involves completion of five components (GRCA 1993, 8):

- collection and review of existing information;
- refine and prioritize watershed goals and objectives;
- impact assessment both at present and for future land uses;
- impact mitigation and monitoring; and
- implementation plan.

For the subwatershed consultants, the critical stage of analysis is contained in component three (CH2M Hill 1993). Proposed future land uses are overlaid on the watershed ecosystems and potential environmental impacts of land-use changes are evaluated.

The subwatershed model is used to evaluate the CEE of existing operations and the potential CEE of future aggregate operations and rehabilitation plans. In assessing development through a subwatershed plan a number of components are necessary:

- identification and protection of potential aggregate resource areas;

- environmental evaluation of the area including potential cumulative impacts of operation and end-use phases, with evaluation focused on impacts from proposed developments on functions, attributes and linkages of the subwatershed; and

- a proposed sequence of extraction and net gain rehabilitation.

The subwatershed plan identifies watershed goals and targets based on existing environmental quality within the watershed. The public and a steering committee, comprised of regional representatives, will play a major role in the identification of Subwatershed goals and targets (GRCA 1993). In the Mill Creek case, many of the valued environmental components, notably, maintenance of goundwater resources and prime agricultural land, have already been identified by the community through the OMB hearings. Identification of these goals integrates well into the initial components of the Indicator Approach. In order to use the indicator approach, background information is required on aggregate extraction activities, future rehabilitation plans, potential extraction sites, and potential effects on valued environmental components. Indicators will have to be developed for each of the valued ecosustem components. Examples include surface water quality and quantity, groundwater levels and flows, percent change in wetland area, habitat indices, percent change in area of prime agricultural land, traffic volumes and performance levels, etc.

Use of the indicator approach should help identify key CEE concerns from aggregate extraction. This information can then be integrated into the Puslinch Official Plan to determine suitable zoning for extractive industries. As well, the subwatershed plan should streamline land-use planning by integrating various planning mechanisms:

- comprehensive environmental impact statements under provincial Wetlands Policy (and other Section 3 policies under proposed *Planning Act* reforms);

- Class Environmental Assessments for Water Management and Municipal Works; and

- County of Wellington and Regional Municipality of Waterloo requirements for the watershed-based study (potential CEE of proposed and anticipated development on surface and subsurface resources prior to Official Plan amendments).

The overall results should include both better environmental protection and more efficient decision making:

> The input of environmental objectives and management recommendations to the land-use planning process at appropriate stages should promote informed decision making, which will in turn lead to greater efficiency and effectiveness of both processes (MOEE and MNR 1993, 9).

Aggregate Resources Act

If the use of subwatershed plans and the indicator approach is found to be a realistic response option then it is not necessary for the *Aggregate Resources Act* to have a wide environmental scope. Instead, the Act can focus on what it was designed for--site plan details. The site plans and the Section 9 reports would be guided by and integrated into the subwatershed plans, as required under Section 9 of the Act. For example, information on the extent and type of wetlands in the Mill Creek watershed could be used to guide wetland rehabilitation in siltation ponds created from aggregate processing. However, use of an

ecosystem plan to directly manage a sectoral resource raises some obvious issues. Therefore, it would seem appropriate for MNR to devevlop a mining plan based on and integrated with the subwatershed plan but specifically designed to aid the *Aggregate Resources Act* in management of aggregate resources and potential CEE.

As the agency responsible for regulating aggregate resources development, the Ministry of Natural Resources also has an important role in implementing the Subwatershed Plan and CEA findings. While CEA of aggregate activities should guide land-use planning and rehabilitation, this research highlights that a complex array of operation and end-use activities is involved as well as an equally complex regime for their management. This complexity in aggregate resource development and management, and the land-use conflict that it has enjoined, poses the need for a Mining Plan separate from the Subwatershed Plan. The need for a Mining Plan was recognized by the State of the Resource Study (MNR 1992) which concluded that short- and long-term strategic planning were needed to avert impending licence application reserve shortages and to address environmental concerns related to aggregate resource management (MNR 1992, ii).

MNR should develop a Mining Plan for the Mill Creek watershed which recognizes aggregates as a non-renewable resource which must be managed in conjunction with other resources and land uses in the watershed. The Mining Plan should coordinate aggregate extraction within the watershed that minimizes CEE on valued ecosystem components and ensures progressive rehabilitation. The Mining Plan would be independent as administered by MNR in managing aggregate operations. However, it would also be integrated into the Subwatershed Plan by incorporating recommendations for future aggregate resource sites, operation conditions, and end-use guidelines. The Mining Plan should also be integrated with the Puslinch Official Plan by incorporating the performance criteria, which would have been altered to reflect the Subwatershed Plan, and coordination of Extractive zoning for potential resource sites. The Mining Plan would operate as a guideline or "statement of resource interest" (MNR 1994, 5). Implementation should occur through the Official Plan as the extractive by-law amendment would be subject to meeting Mining Plan performance criteria, and through Section 9 of the *Aggregate Resources Act* which could require consideration of the Mining Plan.

The Mining Plan should be developed in conjunction with the Subwatershed Plan. utilizing the same consultation process. Objectives of the Plan should include:

- efficient licence review and approval through integration with the Mill Creek Subwatershed Plan and Puslinch Official Plan;
- propose areas for extractive designation;
- establish performance standards for aggregate extraction and progressive rehabilitation considering potential for net community gain and recycling;
- formation of an Aggregate Advisory Committee to participate in review of licence applications, site plan reviews, and land-use conflicts involving aggregate resources; and
- monitor and update aggregate production, consumption, supply and reserve information and integrate into the Subwatershed Monitoring Plan.

Use of the public consultation process to develop the Mining Plan and the formation of an Aggregate Advisory Committee would provide the affected community with a means of input never possible under the *Aggregate Resource Act*.

The Ontario Mineral Aggregate Working Party (OMAWP 1977, 15) concluded that "local involvement is essential in the planning and approval process if concerns are to be effectively stated and considered." The OMAWP, therefore, suggested the establishment of an Aggregate Advisory Committee. Following recommendations made by the OMAWP (1977, 17), the Committee should be made up of Municipal staff, industry representatives, MNR staff, and the general public. The Committee would be selected from a list of nominees submitted by the respective local municipal councils, with representation prorated to reflect the proportion of aggregate production at the municipal level and the level of truck traffic hauling aggregate on municipal roads.

In addition to the role cited above in the Mining Plan objectives, the Aggregate Advisory Committee would be responsible for revising the Rehabilitation Claim Guideline to reflect the performance criteria. The Rehabilitation Claim Guideline is a list of claimable and non-claimable items used to evaluate aggregate operator's costs for rehabilitation purposes. Claimable items are refunded out of the rehabilitation deposit which operators pay into at eight cents per tonne. The Claim Guideline has a limited list of claimable items which restricts potential alternative means of site rehabilitation. Revision of the Claim Guidelines, to include a wider range of rehabilitation activities, would allow for more creative rehabilitation in meeting performance criteria.

Development of a Mining Plan would provide a number of benefits. At present, the lead time required to purchase a site, obtain municipal and provincial approval, and start extraction is over four years, unless an OMB hearing is required, in which case it can take up to six years (MNR 1992, 5-30). With the Mining Plan in place, the licencing and approval process under the *Aggregate Resources Act* should be more efficient as most of the baseline data and indicators necessary for the site plans and Section 9 Report would be in place. Also, less time and cost should be necessary in obtaining aggregate resource sites and the necessary zoning due to redesignation of Policy Areas to Extractive zoning in the Official Plan and integration of performance criteria between the Official Plan and Mining Plan. These provisions should also decrease the chance of an OMB hearing from the almost 50 percent of new licence applications which presently require an OMB hearing (MNR 1992, 5-31). Finally, incorporation of Section 3 policies of the Planning Act into the Subwatershed Plan should ensure that aggregate operations, if they meet performance criteria, are in conformity with Section 3 policies and avoid an envirionmental impact statement requirement.

Aside from greater efficiency in approvals, a Mining Plan should ensure more effective progressive rehabilitation which results in a net gain for valued ecosystem components in the Mill Creek watershed. The principle of net community gain refers to placing development in the context of the community and thereby attempting to use practices considered degrading as opportunities for physical and/or social enhancement of the community (Baker and McLellan 1992, 166). Considering the extent of altered and degraded landscapes in the world, preservation alone will not lead to sustainability. The principle only applies to landscapes which have been degraded from an earlier condition (Shoemaker 1994). No loss of existing valued environmental components should occur.

Finally, the Mining Plan could coordinate floodplain extraction by the GRCA. Floodplain resources are a potentially significant source of aggregate resources (MNR 1992, 2-21). Both the Grand River and Upper Thames Conservation Authorities extract aggregates in floodplains to increase flood capacity, enhance degraded habitats, and obtain revenues from the aggregate levy to support other conservation programs. A revenue sharing agreement for Conservation Authority properties has been developed by MNR (Carlisle and Smith 1989).

Planning Implications

According to Baker (1993, 29), "the differences in planning objectives at the municipal and provincial levels, and the means of carrying out the objectives, contributed to much of the conflict between the different planning jurisdictions in Puslinch Township." Puslinch Council attempted to restrict aggregate extraction due to CEE which had breached the township residents "tolerance level". The Township's focus in the Official Plan was to coordinate multiple land-use demands while ensuring environmental integrity. On one hand this focus can be parochial and eschew provincial needs. On the other hand, local planning can empower the people and incorporate community values and interests.

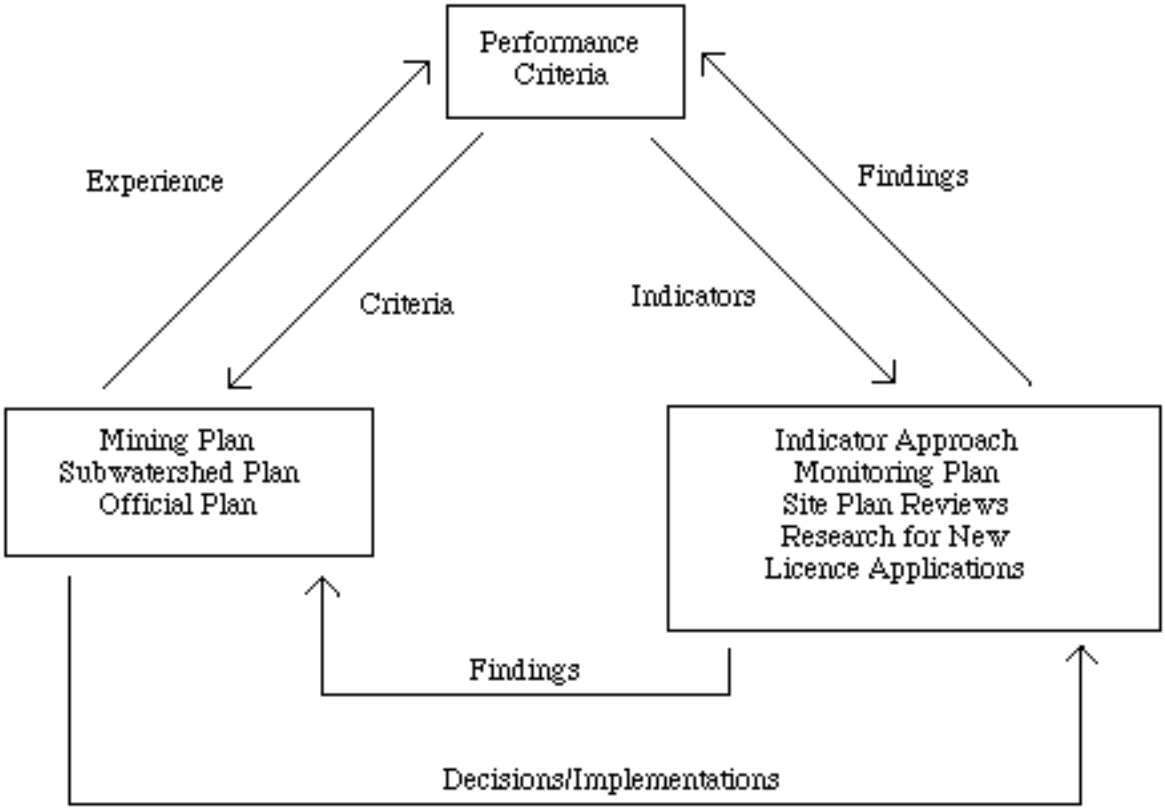
The province, as represented by MNR, did little to involve Puslinch Township in setting its sectoral objectives for aggregate resources (Baker 1993, 29). The provincial mandate was laid out in MARPS which dictated that provincial need for aggregate resources ruled out municipal control and made no provisions for municipal input other than protection of aggregate resources. The diverging interests between MNR and the Township, and a lack of cooperation to work out their differences, led to the lengthy 1989 Puslinch OMB hearing. The adversarial setting of the OMB hearing did little to alleviate the conflict over differing agendas. Indeed, the conflict may only have been excaberated as the OMB failed to address adequately the CEE to which the community was reacting and left the aggregate producers accountable only to the province and not the affected community.

The integration of the Official Plan, Subwatershed Plan, and Mining Plan is a response to CEE and the resulting land-use conflicts. The formation of this "plan triad" at its coreinvolves integrating environmental assessment requirements and decision making into a coherent, regime devoted to achieving community and ecological sustainability. It is a response that, according to Gibson (1992b, 163), should be the next evolutionary step in environmental planning and assessment. Figure 2 illustrates this relationship as it pertains to the planning and management of aggregate resources. The components should be interdependent and iterative, with information from the Monitoring Plan (the last component in the Subwatershed Study) and indicator approach used in re-evaluations of performance criteria, site plan reviews, new licence applications as well as in ongoing work of the "plan triad" (Gibson 1992b, 163).

The "plan triad" provides a means for community participation in aggregate planning and management that has not been present in Puslinch Township. This community participation, however, does not override the provincial need for aggregates as established by MARPS. Rather, it gives Puslinch Township a role in determining where and how aggregates are extracted and what form of rehabilitation is applied to extractive sites. The aggregate producers are then accountable to the community through the performance criteria and Aggregate Advisory Committee.

The "plan triad" should also assist MNR in carrying out the dual mandate of ensuring an adequate aggregate supply to meet market demands while preventing environmental impacts from extraction activities. However, while land-use conflicts should be decreased, an aggregate licence application may still require an OMB hearing. In this situation, consideration of CEE in the Subwatershed Plan, and its integration into the Official Plan and Mining Plan, should satisfy the OMB's increased recognition of CEE.

Figure 2: Integrated Aggregate Management



- after Gibson (1992b, 164)

The challenge for the indicator approach will be to find a means of implementation which avoid the negative mindset of regulatory planning. If net gain is to be incorporated into policy through community input, then a shift in emphasis from threshold/regulatory models to desired/alternative models is required. It is unlikely that the Subwatershed Plan as implemented through the official plan alone can provide this framework. This is why the development of a Mining Plan, where performance criteria determine the acceptability of aggregate proposals would allow for creative designs to meet net gain requirements, is recommended. The Mining Plan also should allow the affected community to play a role in developing these criteria and ensuring their application, and thereby also receive a net gain compensation for contributing to the provincial aggregate resource need.

Conclusion

Sustainable mineral resource use involves balancing two major goals: ensuring that resources are available, and ensuring that the environment is protected. Limited success in attempts to balance or integrate these two goals in Ontario has left the aggregate industry as a good example of conflict between entrenched environmental and economic positions surrounding the development of a natural resource. Several municipalities have attempted to control environmental problems associated with aggregate development where the province

has failed to address to overall negative impacts. The Puslinch hearings illustrated the inadequacy of present mechanisms for resolving conflicts and ensuring sustainability through good planning.

According to Roots (1983, 62), "environmental planning, to be successful, must operate on two scales. It must be larger than the project being planned (to view the environmental effects in the context of all other activities, and the environmental and socio-economic trends and limitations as a whole), and also be part of the specific project development being considered." The Indicator Approach provides an evaluation tool that recognizes both scales of analysis. However, CEA must move beyond analysis to a recognition of potential implications. Hence, the need for performance criteria which provide a basis for evaluation and guidance for rehabilitation. The performance criteria provide a means to ensure the aggregate operations provide a net community gain to the valued ecosystem components of the Mill Creek watershed. These criteria are embodied and implemented through the integration of the Subwatershed Plan, Official Plan, and Mining Plan.

This research has provided an overview of how the Indicator Approach should be applied through the Mill Creek Subwatershed Study. It is also suggested that a Mining Plan, separate from the Subwatershed Study, be considered as an effective means of managing aggregate resources and potential CEE from development of that resource. As aggregate demand is projected to increase, land use conflicts resulting from CEE associated with aggregate resource development will not abate. The opportunity is available to begin effective redress of CEE through proactive and creative planning that seeks to provide a net community gain.

Appendix A

Aggregate Resources

Sources used for aggregates must contain physically suitable product in sufficient volume to warrant mining and be close enough to the points of use that transportation costs are not prohibitive. A good aggregate must be able to resist excessively large or permanent changes in volume when subjected to destructive agencies, such as heavy traffic or freeze-thaw action. A general purpose aggregate is required to be stable against breakdown in use or in stockpile, non-plastic, chemically inert, durable, and strong enough to withstand tensile or compressive loading applied in use. For economies of scale, the source needs to contain a relatively large volume of material to satisfy construction needs.

Aggregate sources can generally be divided into two categories, artificial and natural. For the purposes of this study the discussion will be restricted to natural resources. Natural aggregates are derived from bedrock and unconsolidated sediments, such as sand and gravel.

Bedrock sources are quarried or mined from accessible outcrop deposits. Vertical faces are cut back to expose unweathered material, and the rock that is suitable for aggregate production is drilled and blasted from the face. The quality of the rock is determined by its mineralogical characteristics, strain cracks, fracture patterns, bedding planes, and zones of unsound material. The joint and bedding plane systems are especially important because they indicate the sizes of blocks which probably will be produced in quarrying.

The most common unconsolidated sediments used for aggregate production consist of sand and gravel. The physiography and distribution of the sediments are a result of glaciation during the Late Wisconsin Substage of the Pleistocene Epoch (Chapman and Putman, 1966). The maximum glacial advance occurred approximately 18,000 years ago. The advance of the ice sheet and subsequent recession, deposited a variety of outwash and till deposits. Water melting from the ice created outwash channels and deposited large amounts of sand and gravel in bed and terrace formations. Sediment laden meltwater flowing at the base of the glacier formed eskers and ice-contact drift deposits. Outwash and ice-contact material tend to provide the best material for the production of aggregates because the deposits are moderately-well sorted, have a low silt content, and are usually durable.

Aggregate Use

Aggregate resources are required for a wide variety of uses within the construction industry. The largest quantities of aggregates are used for highway construction, fill purposes and concrete production. From a regional perspective, residential construction forms an important part of the demand market. Individual home construction provides a need for approximately 300 tonnes of aggregate per unit (Canadian Minerals Yearbook 1990).

Not all sand, gravel, and bedrock deposits are suitable to use for aggregate production. The suitability of an aggregate resource for commercial extraction is measured by engineering criteria that set specifications for a product to ensure the product will perform satisfactorily. These criteria establish allowable tolerances of gradation, soundness, durability, chemical stability and other test parameters. Specifications for quality vary according to the different uses for the aggregate; an aggregate product that will be exposed to considerable stress, such as road surfacing, will have more rigid specifications than

material used for fill purposes. Many deposits that have a high silt content or poor soundness are not feasible to use for aggregate production.

The primary demand for aggregates comes from the construction industry. The quantity of material used is closely related to the amount of activity in construction. The unit price of aggregates fluctuates from region to region, with no provincial "standard price." Prices are determined on a local basis depending on factors that affect supply, such as cost of extraction, the amount of processing required, transportation costs, the type of product, or economies of scale (the size of the operation).

The bulk density of mineral aggregates makes transportation to market sources expensive, accounting for approximately one half of the delivered price (Canadian Transport Commission 1978). The high cost of transportation for aggregate materials encourages producers to have their source of supply as near the demand as possible in order to be competitive. A study conducted for the Ministry of Natural Resources in 1980 (Peat, Marwick and Partners and M.M. Dillon Ltd.) revealed that trucking costs for hauling aggregates beyond an approximate distance of 30 kilometres doubled the delivered price of the product. Development of sources close to the demand market can considerably reduce the delivered price of the aggregate, increase an operator's competitive edge and cut construction costs for products such as houses or highways.

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