CHAPTER 6

ENVIRONMENTAL IMPACT ASSESSMENT FOR URBAN NATURAL AREAS

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6.1 INTRODUCTION

For several decades, citizen groups have been challenging developers at public hearings. Recently, the process has become more formalized with more and more jurisdictions requiring Environmental Impact Assessments (EIA's). But the task of challenging an EIA has seemed formidable. The EIA documents prepared by the project's proponent, usually a government agency or a professional consultant, have been highly technical and often the size of a small city telephone book. Citizens have been reluctant to criticize EIA's and strong challenges from opponents of projects have not been common.

The requirement for EIA's is growing across Canada. At the federal level, EIA's have been required since 1973 when the Cabinet established the Environmental Assessment and Review Process (EARP). Under EARP, federal departments, crown corporations, and private companies receiving federal funds are required to prepare an EIA for all projects which might have an adverse effect on the environment. At the provincial level, the use of EIA's will inevitably increase as the provinces continue to develop and expand their own EIA requirements. At this time, nine provinces have established EIA procedures, seven by using existing environmental legislation as a means to require an EIA, while New Brunswick has followed the federal example of establishing an EIA policy along with an administrative process to make sure EIA's are undertaken. Ontario is unique in being the only province to pass a new act (The Environmental Assessment Act, 1975) along the lines of the American model which requires that an EIA be prepared for a wide range of public and private projects before approval to proceed is given (Table 6-1).

Canadian experience in municipal environmental impact assessment processes is quite limited. The City of Winnipeg in 1972 adopted a legal requirement for impact studies of public projects, but this has been considerably scaled down as a result of legal challenges and internal problems. Several Ontario municipalities, the Regional Municipality of Waterloo and the City of Mississauga, for example, have also instituted EIA requirements. Recently, in 1980, Ontario implemented regulations requiring EIA's for municipal projects exceeding two million dollars in cost.[1] It is likely that similar requirements will eventually be imposed in other provinces as well.

The trend in Canada is, therefore, to increase the use of the impact assessment process. Consequently there is a need for individuals interested in environmental protection to understand what an EIA is, what its components are, and most important, what are its strengths and weaknesses.

The purpose of this chapter is not to guide the reader in preparing an EIA. The preparation of an EIA document usually involves a comprehensive and expensive study with several participating disciplines (ecology, economics, sociology) and often exceeds a year in preparation time. Guidelines for preparing an EIA are well documented elsewhere.[2]

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[1] Amendments to Ontario's Environmental Assessment Act were made in June and October, 1980. Those amendments required EIA's be prepared for all municipal projects which were likely to have a significant environmental impact: hazardous waste sites; new rail facilities; land fill sites serving a population larger than 1500 people; and others. EIA's were also required for other municipal projects exceeding a cost of two million dollars. The amendments also listed projects exempted from the municipal EIA requirement: drainage works; subdivision agreements; and others.

[2] For guides to the preparation of an EIA, the reader should consult one or more of the following references: Canter (1977); Dickert and Domeny (1974); Munn (1979). For additional references on preparing an EIA see Armour (1979).

Table 6-1. Provincial approaches to environmental impact assessment, 1980

Provinces	Basis for environmental assessment		
	Use specific act	Use other environmental legislation	Use EA policy or administrative procedure
British Columbia		x	xa
Alberta		x	
Saskatchewan		x	xb
Manitoba		x	xb
Ontario	x		
Quebec	xc	x	
New Brunswick			xa
Nova Scotia		x	
Newfoundland	xc	x	xb
Prince Edward Island			x

a = for public projects; b = underway; c = being considered
Adapted from Lang and Armour (1978)

British Columbia: The Environment and Land Use Act, 1971; Land Act, 1970; Pollution Control Act; Coal Mines Regulation Act, 1969; The Water Act, 1960; Guidelines for Environmental Impact Assessment of Power Projects; Coal Development Guidelines; Guidelines for Linear Developments; Guidelines for Environmental Impact; Control of Development on B.C. Crown Lands.

Alberta: The Land Surface and Reclamation Act, Chapter 34, 1973; Environmental Impact Assessment System Guidelines.

Saskatchewan: Department of the Environment Act, Chapter 31, 1972; Environmental Impact Assessment Policy and Guidelines.

Manitoba: Clean Environment Act, Chapter 130, 1972; Environmental Assessment and Review Policy.

Ontario: The Environmental Assessment Act, 1975; Environmental Assessment Guidelines.

Quebec: The Environmental Quality Act, Chapter 49, 1972; Regulations.

New Brunswick: Environmental Impact Assessment Policy, 1975.

Nova Scotia: The Environmental Protection Act, Chapter 6, 1973; The Water Act, Chapter 335, 1973; Guidelines for Environmental Assessment.

Prince Edward Island: Executive Council Minute 16/73, 1973.

Newfoundland: Approval in principle given to the drafting of an Environmental Assessment Act.

The environmental activist will most often be reviewing or challenging an EIA document done by others. Consequently, the purpose of this chapter is to explain the EIA process in simple terms and to examine the contents of a typical EIA document so that the activist or student can successfully review an existing EIA. It should be clear that the EIA process presents an important opportunity to seek to protect natural features in urban areas. As the EIA process becomes more widely used, those individuals most successful in preserving woodlots, ravine lands, wetlands and wildlife habitat in urban areas will be those who successfully challenge existing EIA's and who force the EIA process to give sufficient weight to natural amenities.

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6.2 THE ORIGINS OF EIA

An EIA is a form of pre-action evaluation that was designed to determine whether or not to proceed with a project so as to prevent or minimize environmental degradation. The need for a decision-making mechanism like EIA arose from the bitter experience of having to live with the environmental consequences of large-scale public and private projects. In the prosperous years of the 1950's and 1960's, a large number of dams, highways, canals, airports and residential subdivisions were built at a rapid pace with little forethought given to potentially harmful environmental changes. Time after time, decision-makers were surprised to learn that unanticipated and undesirable environmental changes had occurred as a result of those projects. Unwanted changes were typically discovered after the project had been completed when little could be done to remedy the damage.

One was the W.A.C. Bennet Dam constructed on the Peace River in British Columbia in 1967. The dam was built to provide water storage and electric power for the province; however, it was discovered after the dam was completed, that holding back the river was depriving the Peace-Athabasca delta (1110 km downstream) of necessary water flows. The annual spring flood proved to be essential to the ecosystems of the delta. Continued withholding of flood water would have meant a permanent reduction in biological productivity. After discovering these impacts, modifications were made to the dam to allow some flood water to reach the delta; however, the modifications were costly and did not totally repair the damage done.

After a number of such unhappy experiences, environmental activists of the late 1960's and early 1970's persuaded legislators that some means were needed to discover the probable results of major projects before construction.[3] If environmental changes were known in advance, those projects causing minor environmental changes could be approved, while projects likely to cause major impacts could be rejected before funds had been committed or construction started. In some instances, projects likely to cause major impacts could be approved if it was possible to adopt measures to mitigate or repair adverse effects.

6.3 BASIC ELEMENTS OF AN EIA

At its simplest, an EIA is a decision-making document designed to indicate whether a proposed action should be allowed to proceed or not by the decision-maker. An EIA helps in shaping a decision by following three basic steps:

1. Description - describing the project, its alternatives and the environment to be affected.

2. Prediction - predicting the likely impacts of the project and its alternatives on the environment to be affected.

3. Evaluation - weighing the magnitude and significance of the expected adverse impacts against the beneficial impacts expected from the project.

If the expected benefits of the new project are likely to be more beneficial than the harm done to the environment, the EIA should recommend approval. If, on the other hand, the project is likely to cause extensive environmental damage while the expected benefits are small, the EIA should recommend rejection.

Description, prediction and evaluation are the three fundamental components of an EIA. Each impact assessment, regardless of size, technical sophistication or

[3]The first EIA mechanism to meet this need was created in the National Environmental Policy Act of 1969 (NEPA) in the United States. There has been considerable experimentation in the 1970's with the format and content of EIA's in the United States and Canada as interested parties and legislators have sought to expand and improve the EIA mechanism. The formal requirements implemented in Canada at all three levels of government (federal, provincial and municipal) are briefly reviewed in the introduction (Section 6.1).

complexity must have each of these components to be complete, although the format and content may differ between documents with wide variation in methods used to predict impacts and to evaluate them. A detailed discussion of the description-prediction-evaluation structure of the EIA process follows.

DESCRIPTION

Each EIA must describe in the early part of the document both the project, a set of alternatives and the environment to be affected. First, it must identify the project (a dam, bridge or highway) and describe its location, physical dimensions and construction. Unlike general planning studies, an EIA attempts to estimate the probable changes resulting from a particular project. Therefore, the EIA should describe in adequate detail exactly what the proponent intends to do, where he intends to do it, and how he proposes to go about it.

If the project is a dam, the EIA should describe its location and capacity, as well as the level and spatial extent of the reservoir created by the dam. It should also describe the number of people to be employed constructing it, the time required to construct it, its capacity for recreation, the power it will generate, and other related details. In this way, a clear picture of precisely what will be done is provided for the reviewer.

Secondly, an EIA also requires the proponent to describe alternate ways of meeting the need for which the project has been proposed. There are many different ways of meeting the same goal. Knowing that the object of an EIA is to avoid the unexpected negative impacts of a project, it is only reasonable that an alternative should be chosen that meets the need while causing the least environmental damage.

Requirements for EIA in Canadian jurisdictions often specify that two types of alternatives be considered:

1. alternative ways of carrying out the project; and,

2. alternatives to the project.

If the example is a proposed highway between two towns (A and B), then there are alternative ways of carrying out the project using the approach the proponent has chosen (Fig. 6-1).

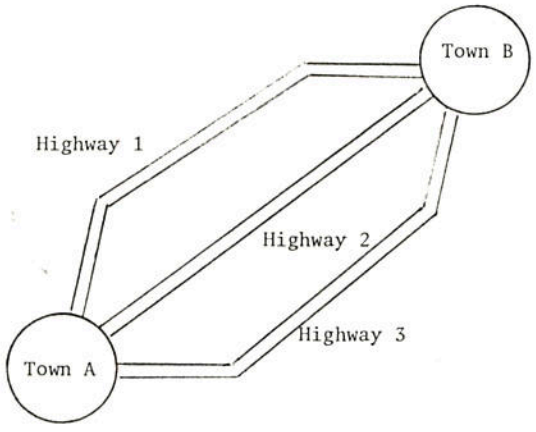

Fig. 6-1. Alternative ways of carrying out the project

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Figure 6-1 indicates that there are three alternative routes for a highway between towns A and B. Routes 1, 2 and 3 are alternative ways of carrying out the project. The project type (a highway) remains unchanged.

There are also alternatives to the project that do not involve the original project type, but rather employ other methods besides the one favoured by the proponent to meet the need. Figure 6.2 indicates that there are three alternatives to the project; air service, a bus line and rail service.

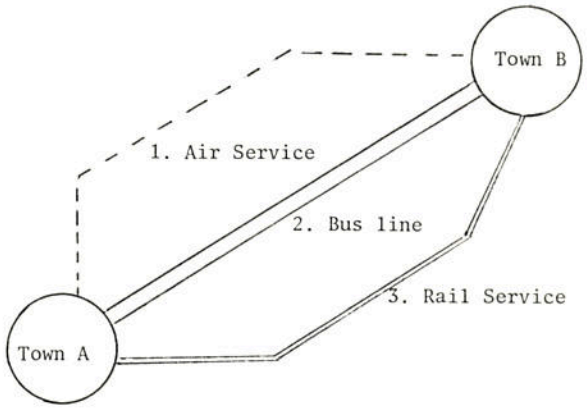

Fig. 6-2. Alternatives to the project

By requiring that both alternative types be included in an EIA, legislators have attempted to ensure that the broadest array of viable alternatives will be considered in an assessment.

Third, an EIA must identify and describe the environment to be affected by the project. The word "environment" is broadly defined in most legislation and regulations to include not only the natural environment but the social and economic environments as well. In the natural environment case, for example, the description should include the natural systems that will likely be affected, such as woodlots, stream channels and wetlands; their physical properties (soils, topography, climate and drainage); and the biotic communities living in these habitats (vegetation, terrestrial and aquatic species).[4]

The identification of the environment to be affected by the project is a critical element in an EIA study. Generally, the area that will be affected by the project is *much larger* than the physical extent of the project or its property boundaries. The W.A.C. Bennet dam is an extreme example where the affected environment extended hundreds of kilometers downstream. However, in most projects, there are some impacts which typically affect large areas. Noise from an airport will affect residents along the flight path several kilometers beyond the airport perimeter. Similarly, water contaminants from an industrial facility will affect water users a considerable distance downstream from the effluent pipe. The environment to be affected should be broad enough to include those impacts.

Project proponents, however, tend to consider the impact area in narrow terms. They are reluctant to consider environmental features some distance from their

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[4]The geophysical and biotic factors are dealt with in greater detail in Chapters 7 and 8 respectively. Socio-economic factors are discussed in Chapter 9. Reference should be made to these chapters for comprehensive discussion of the factors to be included in an EIA.

projects because the smaller the area to be considered, the smaller the number of impacts is likely to be. Instead, they prefer to define the impact area as close as possible to the boundary of the property obtained for the project.

An example is a proposed highway which will pass through a major woodlot (Fig. 6-3). The tendency of the proponent is to define the impact area using the right-of-way boundaries. However, since drainage features and wildlife movement in the woodlot would be substantially changed, the environment to be affected should include woodcover and drainage features.

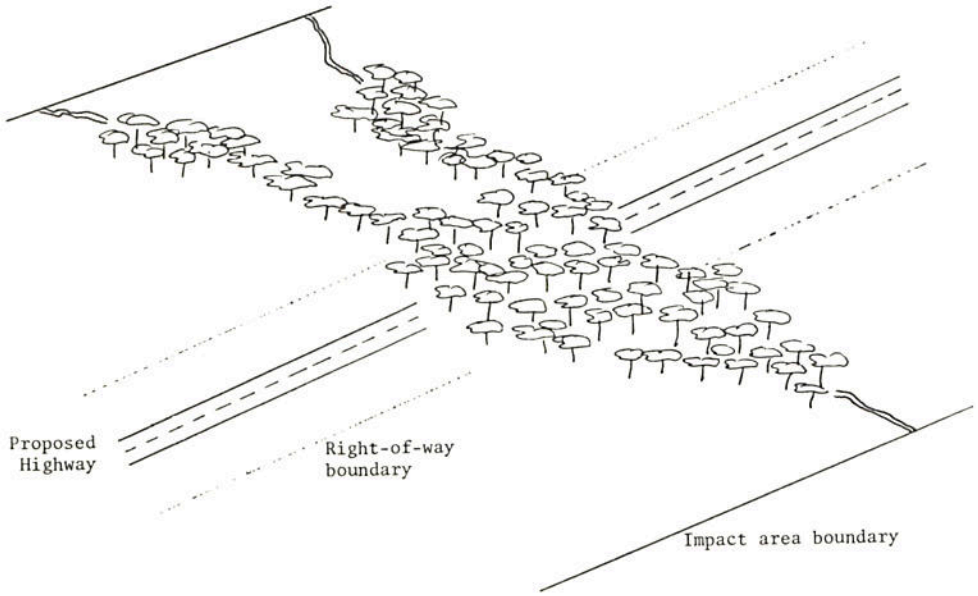

Fig. 6-3. Impact area for a woodlot

Although there are no clear guidelines for determining the boundaries of the environment to be affected, reviewers of an EIA can judge whether the size of the impact area or the array of impact features (soils, drainage, vegetation, wildlife, etc.) is reasonable given their knowledge of the area and its features. If the environment to be affected is defined narrowly, as in the above example, there is reason to challenge the results of the EIA for having omitted a significant area or feature in its assessment of project impacts.

PREDICTION

Once the project has been identified and the environment described, an EIA attempts to predict the impact of the project and its alternatives on the environment. The prediction of impacts lies at the heart of each EIA because the EIA's purpose is to make the environmental consequences of a project known to the decision-maker before the project is approved. This requires an estimate of the environmental changes that will take place.

Unfortunately, predicting the impacts of a physical change such as a dam or highway on complex natural systems (drainage systems, species reproduction and movement, water quality) is much easier said than done. Although there are a number of methods commonly used to predict impacts of projects in EIA studies, the predictions are often unreliable.

The low reliability of impact predictions is due to the complexity of natural systems and their dynamic behaviours. Natural systems tend to behave in unpredictable ways because they have many non-linear and random elements.[5] A change started in one part of a natural system may not move linearly to another part. Instead, it may affect unexpected parts of the natural system through indirect paths of cause and effect making the prediction of those effects extremely difficult.[6] Nevertheless, despite these limitations, each EIA is compelled to make predictions of the likely outcomes of a project. The result is that an EIA often contains questionable predictions of what will happen after the project has been built.

In many EIA studies in the past, impact prediction was simply a matter of judgement. Predictions were based on the intuition of the proponents; in other words, what the builder thought might happen if the project were built. In recent years, however, EIA preparers have attempted to move away from such subjective and unreliable techniques. The EIA studies have tended to be formal using a more systematic set of impact prediction methods.

Although there are several prediction methods available, the assessor conventionally relies on three kinds of impact prediction; engineering methods, expert opinion and comparative methods. These approaches can be described as follows:

1. Engineering methods - Engineering studies have established a number of cause and effect relationships between specific physical actions (the construction of a dam or a smoke stack) and resulting changes in water or air quality. Engineering methods can be used to estimate the changes likely caused by an action and often whether an air or water quality standard will be met.

2. Expert opinion - This method attempts to collect the opinion of experts on the likely outcomes of a project. Experts are usually assembled as a team and are asked to estimate probable changes within their areas of expertise.

3. Comparative methods (checklists) - The impact assessor can estimate the changes likely to occur in his project by referring to a comprehensive list of changes that have been associated with specific project types. The assessor selects (checks) those changes likely to occur. Such checklists can be found for most conventional projects.[7]

In Table 6-2 a checklist of possible changes is presented for a transportation project organized by phase of project development.

Frequently, checklists are presented in a matrix form to indicate cause-effect relationships. This is done by placing two checklists on the axis of a simple two-dimension matrix. One list is the set of actions required for a project and the other is a list of environmental characteristics that might be affected. Each cell in the matrix indicates a possible change in one environmental characteristic caused by one specific action. Figure 6-4 provides a partial illustration of the Leopold *et al.* (1971) impact matrix.

Although the prediction of impacts is a central element of an EIA, the methods most frequently used to predict impacts are not often reliable, consequently

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[5] A linear function is a constant increasing or decreasing trend as, for example, in linear growth. Non-linear growth, on the other hand, is characterized by variable growth rates over time. These variations may or may not be regular.

[6] For a discussion of the difficulties in predicting the outcomes of physical changes in complex natural systems, see Holling (1978).

[7] Canter (1977), Holling (1978) and Munn (1979) provide general discussions of procedures and methods used for prediction in the EIA process. Armour (1979), refers to several key references which discuss the comparative methods used for predicting the impacts associated with seven specific project types - highways; airports; railways and rail transit systems; sewage and solid waste; water resources; energy development, transmission and use; and new towns and subdivisions - in her recent annotated bibliography of EIA literature.

Table 6-2. List of potential impacts for a transportation project organized by phase of project development

I. PLANNING AND DESIGN PHASE

A. Impact on land use through speculation in anticipation of development
B. Impact of uncertainty on economic and social attributes of nearby areas
C. Impact on other planning and provision of public services
D. Acquisition and condemnation of property for project, with subsequent dislocation of families and businesses

II. CONSTRUCTION PHASE

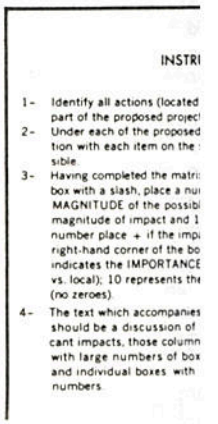
A. Displacement of people
B. Noise
C. Soil erosion and disturbance of natural drainage
D. Interference with water table
E. Water pollution
F. Air pollution (including dust, dirt and burning of debris)
G. Destruction of or damage to wildlife habitat
H. Destruction of parks, recreation areas, historical sites
I. Aesthetic impact of construction activity and destruction of or interference with scenic areas
J. Impact of ancillary activities (e.g. disposal of earth, acquisition of gravel and fill)
K. Commitment of resources to construction
L. Safety hazards

III. OPERATION OF FACILITY

A. Direct
   1. Noise
   2. Air pollution
   3. Water pollution
   4. Socio-economic
   5. Aesthetic
   6. Effects on animal and plant life (ecology)
   7. Demands for energy resources

B. Indirect
   1. Contiguous land use
   2. Regional development patterns
   3. Demand for housing and public facilities
   4. Impact on use of nearby environmental amenities (e.g. parks, woodlands, recreation areas)
   5. Impact of additional and/or improved transportation into congested areas on those areas
   6. Differential usefulness for different economic and ethnic groups (and resulting problems and solutions)
   7. Impact on life styles of increased mobility and other impacts
   8. Impact of improved facility on transportation and related technological development (and consequent impacts)

Source: Canter (1977)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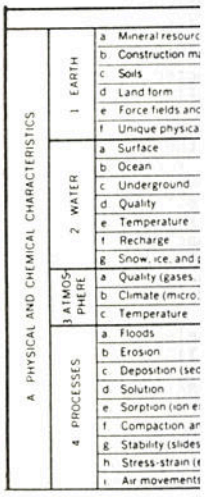

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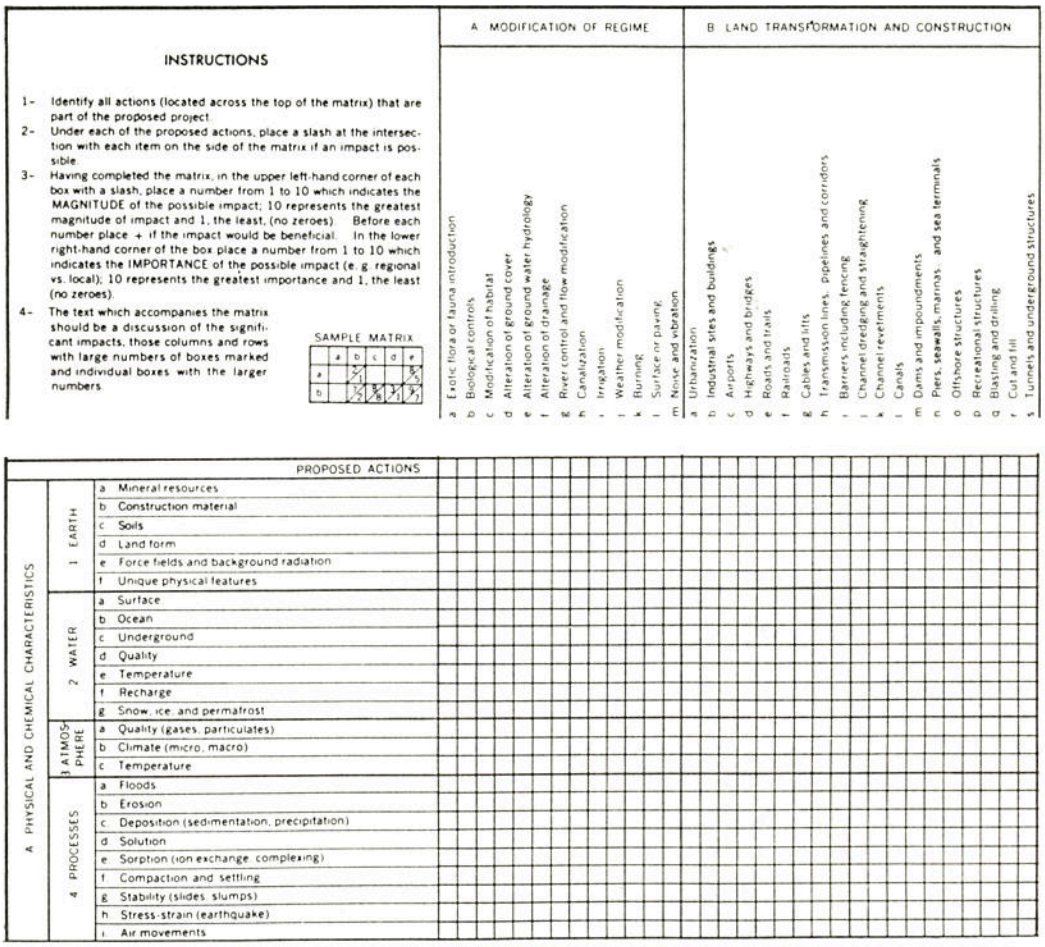

Fig. 6-4. Impact matrix (Source: Leopold *et al.* 1971)

predictions based on the judgement of experts or derived from a simple two-dimensional matrix inspire a low level of confidence. The prediction element of an EIA should be, therefore, an important focus of attention for an EIA reviewer.

EVALUATION

In the prediction stage, a large number of expected geophysical, biotic, social and economic impacts are generated for the project and each alternative. The wide range of impacts predicted presents a complex picture of desirable and undesirable changes for the decision-maker and there is often no alternative that is obviously the best choice. The problem is to choose the right alternative.

The EIA must identify that alternative which satisfies the goals of the project while avoiding an unacceptable level of environmental damage. The EIA may also suggest project modifications to further mitigate or repair expected environmental damage. Therefore, the evaluation task is to select that alternative which has the best balance of positive and negative impacts. This selection can be done *informally* by the decision-maker through visual inspection of the impacts or *formally* by a systematic method that calculates a total score based on individual impacts.

Informal evaluation has been common practice in public decisions before impact assessment. However, informal decisions are largely influenced by the personal opinions and preferences of the decision-maker. He may choose to approve an action he prefers even though its impacts are significant. Also, informal approaches are not easily able to deal with complex evaluation problems. If, for example, a project has a set of six alternatives with ten impacts for each alternative, the decision-maker would have to visually examine sixty impacts at once to choose the appropriate alternative. This may be impossible to do with any degree of fairness and consequently may not lead to the choice of the most appropriate alternative.

Evaluation methods used in an EIA are usually formal procedures which systematically combine the values of each impact into a single value to make the choice among alternatives easier. This process occurs in two phases: analysis, in which the project is divided into action segments and the impacts of each individual action are predicted, and synthesis, in which the impacts for each individual action are aggregated into a single judgement (Fig. 6-5).

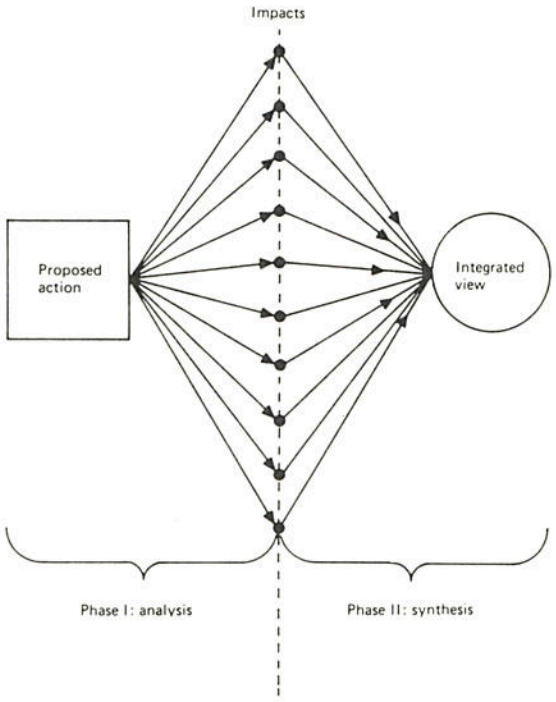

Fig. 6-5. The two phases of evaluation
Source: McAllister (1980)

In addition, formal evaluations in an EIA usually include an objectively derived weighting factor which indicates how the welfare of society as a whole would be affected by project impacts. The weighting factor is used to avoid the previously common practice of the decision-maker approving his favourite project although it reduced overall environmental quality. With a weighting factor, each project impact is weighted and a total score based on each impact is calculated. Formal evaluations in an EIA attempt to select the alternative that will avoid serious environmental impacts. These methods *encourage* decision-makers to approve those projects that improve general environmental quality rather than those which improve the decision-maker's welfare. The EIA's *do not require* decision-makers to approve the former over the latter in most Canadian jurisdictions, as the adoption of the recommendations of an EIA are usually discretionary, and not mandatory.

The two common methods of evaluation used in EIA's that are systematic and objective are environmental quality indices and cost-benefit analysis. These two methods are discussed in turn.

1. Environmental quality indices

This common method of evaluating alternatives in an EIA relies on the assignment of a number score which indicates the severity of the impact multiplied by a weighting value indicating the importance of that impact to arrive at an index of environmental quality. This procedure is illustrated in Fig. 6-6.

Impact parameter	SCORE	x	WEIGHT	=	Environmental quality index
	severity of impact		importance of impact		

Fig. 6-6. Environmental quality index computations

The best alternative is one which attains the highest environmental quality index number summed for all individual impacts. This is known as the Batelle method, first devised for evaluating water development projects, and now used for evaluating a wide range of environmental impacts associated with different types of projects.[8]

2. Cost-benefit analysis

Cost-benefit analysis (CBA) is a method of choosing an alternative by assigning each impact a dollar value. Positive and negative impacts are termed benefits and costs, and are assigned positive and negative dollar values respectively. To make the correct choice, the dollar costs and dollar benefits for each alternative are added up over the expected life of the project. The most appropriate alternative is the one for which the benefits total exceeds the costs total by the greatest margin and/or the alternative which has the largest benefit-cost ratio. This method is dealt with in more detail in Chapter 9.

While a detailed discussion of these and other evaluation methods is beyond the scope of this chapter,[9] it is important that the reviewer be aware of some of the difficulties with most evaluation approaches. Frequently, a large number of impact values are synthesized to produce a single value for each alternative. In this way, a number of alternatives can be compared in one dimension to make the crucial choice. However, there are major problems that affect the outcomes of evaluation that are not resolved by most evaluation methods. These are:

(a) The selection of impact parameters can be substantially biased because there are no firm guides for selecting them. The number and choice of parameters can significantly alter the evaluation outcome.

(b) There are immeasurable and intangible impacts that may be overlooked because they do not have a dollar value or are not easily assigned a score. Such items as scenic vistas, close family ties in a community, or the presence of rare species of plants are not easily quantified and may be neglected.

(c) There is an enormous problem in dealing with the timing of impacts. Some impacts occur immediately while others take many years to occur. Evaluation methods are limited in their ability to deal with differences between short-term and long-term impacts.

(d) There is a major problem in dealing with the distribution of impacts. While the total number of impacts of the best alternative may be small, those impacts may all be felt by some small group in society. In most EIA's the distribution of impacts tends to be ignored, consequently the evaluation methods used do not distribute impacts equitably.

This discussion illustrates some of the problems associated with EIA evaluations. The important point for the EIA reviewer is the fact that, despite

[8]The original method proposed by Dee *et al.* (1973) has been converted and applied to a rapid transit system project in Atlanta (Smith 1974), and to residential subdivision development projects in Oakville, Ontario (Paterson and Dillon 1974). A copy of the latter can be found in the Municipal Reference section of the Metropolitan Toronto Library system.

[9]For a comprehensive review of evaluation methods see McAllister (1980).

attempts to be systematic and objective, evaluation methods presently used to make decisions on large public projects are open to bias. Each EIA evaluation should be scrutinized carefully by the EIA reviewer. In particular, the steps taken to include all relevant impact categories, to objectively develop a social weighting scheme, and to systematically calculate the final score should be closely examined.

6.4 AN EXAMPLE OF AN EIA DOCUMENT

TABLE OF CONTENTS

A reviewer opening the cover of an EIA document prepared for a sewer project in Ontario would likely find the following:

1. Description of the proposed sewer
2. Need for the sewer
3. Existing environmental conditions - the baseline study
4. The alternative to the project
   (a) the "do nothing" alternative
   (b) alternatives to the project
5. Prediction of impacts
   (a) IRREVERSIBLE impacts
   (b) adverse impacts that CANNOT be avoided
6. Evaluation of alternatives
7. Selection
8. Remedial and mitigating measures
9. The recommended alternative

Obviously many of the items in this table of contents are additions to the description-prediction-evaluation format described in Section 6.3, and it is useful to examine some of the unfamiliar items to see where they fit within the basic EIA model.

UNFAMILIAR ITEMS IN THE TABLE OF CONTENTS

A. *NEED* FOR THE SEWER

Most EIA legislation in Canada requires the proponent to present an argument explaining why the project is needed, that is, *why* he is doing it.[10] If the project was being developed by a private business, the explanation would likely be to obtain a reasonable return on investment. But, since most projects requiring an EIA are government actions, the typical need arguments are based on diminishing capacity of a public service system, such as a sewer, and a projected increase in demand. The agency responsible for providing sewer services may argue that the capacity of the existing sewer system is fixed and the projected demand for sewer services in a particular location is increasing. Thus, the project is needed if expected demands for sewer services are to be met.

Need statements are required in many EIA's because identifying the need is important in guiding the choice of alternatives. If the need is expanding sewage disposal capacity, the alternatives may indicate ways of doing so without building a sewer (small sewage disposal mechanisms in each house, land disposal of sewage, or other alternatives). Need statements are also useful as a preliminary means of evaluating the project. If the need is not pressing and the cost of the project is high, then the project may be rejected on the basis of low need because the resources required for the project could be spent more effectively elsewhere.

[10] Section 5(3)(6) of the Ontario Environmental Assessment Act, for example, calls for a statement of the rationale for: (a) the undertaking; (b) the alternative methods of carrying out the undertaking; and, (c) the alternatives to the undertaking.

B. EXISTING ENVIRONMENTAL CONDITIONS - THE *BASELINE* STUDY

The *baseline* study or existing environmental conditions are other names for the description of the environment to be affected. Baseline studies usually occupy the largest portion of the document and are typically the most technical and confusing parts of the study. While the purpose is to describe the relevant environment in order to judge the degree of impact, the baseline usually contains a comprehensive listing of all important and unimportant impact categories along with a detailed description of each feature.

For example, the baseline segment of an EIA for a sewer project might include the following impact categories:

- climate
- physiography
- geology
- drainage
- soils
- air quality
- water quality
- vegetation
- terrestrial species
- aquatic species
- avian species
- social cohesion
- neighbourhood vitality
- economic viability
- aesthetic features

One would also find some of the above categories broken down into minute components; for example:

Aquatic species
- vertebrates
- invertebrates
  - benthic
  - littoral
- microorganisms

Climate
- temperature
- precipitation
- wind velocity and direction
- sunlight
- extreme climatic events

The result is an extremely long list of impact categories each containing extensive detail on the number of species present, their concentration, movement, habitat, etc.

It is a common refrain in the EIA literature that little of this information ever plays a role in the actual decision to approve or reject the project. Often for a sewer project, the climatic detail (listed above) is irrelevant to the decision. In other cases, the level of detail is of no consequence since values for a specific category remain unchanged for all the alternatives, that is, there is no impact. An example of this is the lack of impact of a bridge on stream microorganisms once construction is completed.

In the sewer case, the inclusion of overwhelming detail in the baseline segment does not aid in the decision, rather it fattens the EIA document, increases its complexity, and makes it more difficult for the reviewer to interpret.[11] It is important to recall that the baseline portion of an EIA is nothing more than a description of the environment that will be affected, and that in all likelihood, the level of detail is far in excess of what is necessary to make the decision. The EIA reviewer should learn to review this section in a cursory fashion and devote most attention to the prediction and evaluation portions of the study referring back to the baseline where necessary.

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[11] The problem of cumbersome detail in baseline studies has reached such proportions that attempts are being made in the United States to "scope" the extent of EIA studies. A scoping process was incorporated in the United States Federal EIA procedures in November 1978, to determine the proper content of an EIA before it is prepared. Scoping has been designed to avoid subsequent criticism at two extremes: that unnecessary matters were included, and that essential matters were overlooked in EIA's.

C. THE *DO-NOTHING* ALTERNATIVE

The basic purpose of an impact assessment is to make decisions that avoid unexpected and unwanted environmental changes. One way to avoid such changes is to do nothing at all. In the United States, consideration of a "do-nothing" alternative has been legislated as a formal requirement of an EIA study. While this is not formally required in many Canadian procedures, consideration of this alternative is commonly included in Canadian EIA's.

The "do-nothing" alternative gives the decision-maker an opportunity to consider the need of the project. If, in comparison with other alternatives, the "do-nothing" alternative results in the least environmental damage while social and economic activities are not significantly affected, then the project can be rejected. This alternative is of great importance to the reviewer because the "do-nothing" option, if adequately considered, is a useful way of separating projects that are done for political and financial reasons from those that are actually needed. For example, if an EIA had been required for the Darlington nuclear facility in Ontario, an analysis of the "do-nothing" alternative would likely have indicated that the existing capacity for production of electrical power in the province substantially exceeded demand, consequently doing-nothing would have been the preferred alternative.[12]

D. IRREVERSIBLE AND UNAVOIDABLE IMPACTS

In the impact prediction segment of an EIA, impacts are often divided into two or more types: irreversible impacts and unavoidable impacts.

Irreversible impacts are those changes to the natural environment, the economy, or the community which are permanent. The most common examples are the extinction of a species or the introduction of a foreign species to an existing ecosystem. One example is the Garrison diversion project in North Dakota that Canada has opposed on the grounds that the diversion would introduce foreign fish species to Lake Winnipeg and irreversibly affect the commercially important white-fish population. Irreversible impacts are given particular attention in many EIA's because they are considered to be more serious than other impacts due to their permanence.

Unavoidable impacts are changes to the environment that cannot be prevented by changes in design of the project or location. The classic example of an unavoidable impact is the anticipated decrease in air quality that must occur as a result of building a new highway. Design changes may alter the speed at which cars travel while route location alternatives may avoid woodlots or water bodies. However, since all routes and all designs will generate automobile traffic, air quality must decrease due to added automobile emissions.

Like irreversible impacts, unavoidable impacts are given special attention in EIA documents because they are considered more important. The United States legislation requires that unavoidable impacts and irreversible commitments of resources both be included in an EIA. Irreversible and unavoidable impacts are often given similar treatment in EIA's in Canadian jurisdictions. However, this requirement is not usually mandatory so that such treatment is sometimes omitted.

The EIA reviewer should recognize that such categories of impact are merely attention-getting devices to draw the decision-maker's attention to specific impact types considered by legislators to be particularly important. There are no separate methods available to predict these impacts. Instead, they are predicted by conventional means, then separated from the other impact predictions to increase their visibility. Presumably the decision-maker will give such impacts additional consideration in making the final decision.

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[12] An EIA was not done for the Darlington nuclear facility because it was exempted from the requirements of the Ontario Environmental Assessment Act by Ontario's Minister of the Environment.

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E. REMEDIAL AND MITIGATING MEASURES

Some EIA requirements demand that the document outline remedial and mitigating measures for various predicted impacts that are not avoidable.[13]

Mitigating measures are steps the proponent of a project can take during construction to lessen the impact of the project as described in the initial segment of the EIA. A sewer project which requires excavation through a stream bed can be scheduled to commence in the late summer or fall to reduce (mitigate) the impact on the spawning of aquatic species which typically takes place in the spring. Similarly, a highway project which requires a road cut through elevated topography can reduce erosion by sodding and staking of the road cuts during construction.

Remedial measures, on the other hand, are actions taken after the project is completed, to repair some of the unwanted impacts. Landscaping and tree planting may be used after the completion of a highway to repair the visual impacts of the new facility. Similarly, restocking of fish in a stream depleted by excess sedimentation from construction can restore original species numbers.

Remedial and mitigating measures are considered in an EIA because even those alternatives which have high evaluation scores often will generate significant environmental damage, and it is easier politically to approve a project when it is known that some of the negative effects can be repaired. While remedial and mitigating measures can make a difficult EIA decision more palatable, it is rare that such measures are able to change the evaluation outcome, instead they most often are used as cosmetic measures.

6.5 HOW TO REVIEW AN ENVIRONMENTAL IMPACT ASSESSMENT

Since it is increasingly likely that individuals interested in protecting environmental amenities will have to review and possibly challenge an existing Impact Assessment document, this chapter concludes with a discussion of the appropriate points of attention which should be considered by an EIA reviewer.[14]

THE ENVIRONMENT TO BE AFFECTED

It was pointed out earlier that it is in the proponent's interest to limit as much as possible, the area, and the set of impact categories that he must consider in an EIA. The smaller that area or set of impact categories, the fewer the number of impacts the proponent will have to deal with. Each developer wishes to convey in his EIA that the project will cause only modest, spatially limited environmental dangers. However, the experience has been that ecological, social and economic impacts have frequently been much more extensive than expected. Consequently, an important part of an EIA review is an examination of the environment to be affected. If the EIA has defined the environment too narrowly, it can be challenged by raising examples of similar projects that have had broader environmental consequences than those included in the document. One recent example was the successful challenge of an EIA for a proposed uranium refinery project near Warman, Saskatchewan. The Environmental Assessment Panel found in August 1980 that the proponent had defined the environment too narrowly by omitting religious affiliation and beliefs in its consideration of the social environment.

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[13] The Ontario legislation requires that the EIA describe actions that are necessary "to prevent, change, mitigate, or remedy the effects upon ... the environment". Section 5(3)(c)(iii).

[14] Often challenges to an EIA must be presented before an Environmental Assessment Board or a similar judicial body. In such cases, the formal rules of evidence and courtroom behaviour are often used. For ways of dealing with the hearing process in challenging an EIA, see Emond (1978); Emond and Roman (1980) and Roman *et al.* (1980). Emond discusses strategies for dealing with judicial proceedings in considerable detail.

THE CHOICE OF ALTERNATIVES

The part of an EIA document usually most open to criticism is the set of alternatives put forward by the proponent for evaluation. The proponent usually resents this aspect of the EIA process most, and rarely does it with much enthusiasm. The proponent is usually skilled at doing one thing very well; constructing highways, building subdivisions, laying sewer pipes, etc. Yet for an EIA, he is compelled to think of other ways of meeting the need or achieving the goal besides the "best" way, which is the way he intended doing it in the first place. The proponent often eliminates alternatives before the EIA is started, consequently, in most EIA's the choice of alternatives to be considered is usually very limited and narrow.

The requirements in most provinces in Canada call for EIA's to consider alternatives to the project as well as alternative ways of carrying out the project. Proposing agencies are required to make a good faith effort to consider to the fullest extent possible those alternatives that are "reasonably available". While this does not mean a developer has to consider alternatives that are remote (unproven technologies or unusual designs) it does mean that alternatives to the project should be viable and substantially different than different routes for a proposed highway, for example.

The alternative segment is, therefore, an important focus for the reviewer's attention. The reviewer should first call attention to the "do nothing" alternative, if the EIA in question has not included it. If, in evaluating the "do nothing" alternative, the proponent cannot argue that an important societal goal is not being met, then the project may be successfully challenged on the grounds that it is not needed. In addition to the "do nothing" alternative, the review group should attempt to identify other reasonable alternatives, which have not been included in the EIA that are lower in economic, environmental, or social costs.

A good example of the importance of the choice of alternatives is found in the Highway 24 Feasibility Study done for the Ministry of Transportation and Communications (MTC) of Ontario in 1975. The purpose of that project was to link the two cities of Cambridge and Guelph with a high-speed, inter-urban expressway. While the MTC favoured a new highway, local residents insisted that the upgrading of a portion of the existing highway be considered as an alternative. When that alternative was reluctantly considered, it was found to cost considerably less than a new facility and it produced significantly smaller impacts on the natural environment and on the local agricultural community. Thus, the EIA reviewer has considerable opportunity to protect environmental amenities by making sure that the widest range of alternatives has been included in the study.

PREDICTION

Predicted impacts for alternatives in an EIA are frequently presented in the document with some confidence. The reviewer often has the impression that predicted impacts are the result of an accurate, technical prediction process. However, as was discussed in Section 6.3, existing methods are limited in their predictive abilities; the impacts described are therefore probabilities, not certainties. They may occur, they may be more severe than predicted, or they may not occur at all.

The EIA reviewers should therefore question the confidence with which the predictions have been made. For example, an EIA done for a sewer project may predict a decrease in the local deer population of 100 animals, due to removal of woodcover habitat. If an examination of the prediction reveals that it has been made with an 80% level of confidence, the possible outcomes would range from 80 to 120 animals. This is illustrated in Fig. 6-7.

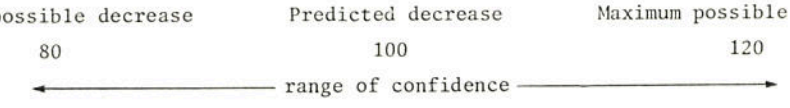

Fig. 6-7. Predictions made with an 80% level of confidence

By questioning the confidence of predictions, the reviewer may be able to establish that the maximum environmental impact (loss of 120 deer) is significant for that deer population. Thus, the project may not be worth the environmental risk given the confidence with which predictions have been made.

EVALUATION

The final focus of the reviewer's attention is the method of evaluating alternatives. The principal failing of most evaluation methods is that they are not objective. Although it is widely recognized that all environmental factors are not equally important, and that each must be weighted in the evaluation process in proportion to its importance, the method of weighting impacts must reflect the preferences of the community rather than the proponent. An evaluation method is objective if the impact categories chosen are appropriate to the environment likely to be affected. It is also objective if the weights assigned to each impact category are obtained from the community and are not created by the proponent.

The reviewer of an EIA can have considerable influence on an EIA decision by examining the evaluation method for the steps taken to objectively determine community preferences for the environmental factors being studied. If the weights used have not been fairly determined or if they do not adequately reflect community preferences, then an EIA may be open to challenge.

6.6 CONCLUSION

The impact assessment process in Canada has not been particularly effective in preventing actions and projects with undesirable environmental consequences from being taken or built. To this point, EIA's have generally tended to confirm the plans of project proponents. This has been due partly to the fact that impact assessments have only been required and produced consistently within the last five years in Canada. Consequently, the process is still relatively new to the decision-maker and to the citizen. While it is true that early EIA studies were poorly done with little attention paid to prediction methods or to the need for objectivity, a large portion of the ineffectiveness of early efforts was due to the general absence of a critical reviewing public.

Fortunately, that disinclination to review EIA documents is fast disappearing as members of the involved public come to understand the description-prediction-evaluation structure of an EIA and those aspects of the impact assessment process open to review:

- identification of the environment to be affected
- the choice of alternatives
- the confidence of impact predictions
- the objectivity in evaluation methods

As the impact assessment process becomes a part of standard practice for projects at the municipal level in Canada, environmental protection will depend on challenging projects which threaten natural areas by critically reviewing their Environmental Impact Assessments.

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