FEATURE

IMPACT SIGNIFICANCE DETERMINATION—BASIC CONSIDERATIONS AND A SEQUENCED APPROACH

L.W. Canter and G.A. Canty

Environmental and Ground Water Institute, University of Oklahoma

Determination of the significance of anticipated impacts of proposed projects is a key component in the overall environmental impact assessment (EIA) process. Definitions of significance and/or significant impacts are now included in the EIA guidelines or regulations of many countries and international organizations. Where possible in an EIA study, it is desirable to identify and/or establish the significance determination criteria prior to actual study conduction. This paper summarizes some findings of a survey of such definitions resulting from American, European, and other international experiences; both generic definitions and substantive area definitions are highlighted. Traditional perspectives on significance determination have involved institutional (or governmental or regulatory), technical (or professional substantive area), and public interest considerations. A sequenced approach for impact significance determination is described, with this approach organized around ten groups of issues or questions. Examples of such issues include project type/size, project locations in areas with protected or critical resources, and environmental stresses resulting from waste residuals from the project. Examples of significance criteria pertinent to the issues are presented through the paper. Finally, the uses of significance criteria can be noted; included in such uses are: (1) determining if an environmental impact statement (EIS) will be required, or if an environmental assessment/finding of no significant impact (EA/FONSI) will suffice; (2) identifying the impacts that should be mitigated; (3) planning a baseline and/or post-EIS environmental monitoring program; and (4) documenting the interpretive rationale used in the conduction of the environmental impact study.

Address correspondence for reprints to: Dr. L.W. Canter, School of Civil Engineering and Environmental Science, University of Oklahoma, 200 Felgar Street, Room 127, Norman, Oklahoma 73109- 0470.

0195-9255/93/$6.00

Introduction

The National Environmental Policy Act (NEPA) in the United States requires that an environmental impact statement (EIS) be prepared on federal actions that have the potential for significantly affecting the quality of the human environment. The key issue is to determine "what is a significant impact?" If significant impacts, either detrimental or beneficial, are expected to occur, both monetary resources and time will be necessary in preparing an EIS. If the impacts are not significant, as determined via the preparation of an environmental assessment (EA), then a finding of no significant impact (FONSI) can be prepared with considerable savings in money and time.

The issue of significant effects and the resulting need to prepare an EIS is often the focal point of NEPA-related legal actions in the United States. For example, Moore (1992) noted that there were 80 actions brought in the Federal Courts in 1989; 34 were brought because no EIS had been prepared when it was contended that one should have been prepared. The issue was whether there were significant impacts. Since 1974, in every year except two, the issue of significant impacts has been the leading cause of litigation. There were 2,346 NEPA cases filed between 1970 and 1990, with over half of them raising the issue of significant impacts.

This paper begins with the significance definition and determination process as used in the United States. Examples of the uses of screening for significance determination are then included; screening can encompass policy delineations and the conduction of preliminary studies. This is followed by a brief review of definitions and selected processes from several countries and/or governmental institutions. A suggested sequenced approach for determining the significance of one or more impacts is then included. The final section relates to the uses of significance determinations in EA/FONSI/EIS preparation and the planning of mitigation and monitoring programs.

Illustration of Significance Definition—USA

The Council on Environmental Quality regulations issued in 1979 included a definition of significance (Council on Environmental Quality (CEQ) 1987). A key feature of the CEQ regulations is the concept of three levels of analysis; level 1 relates to a categorical exclusion determination, level 2 to the preparation of an environmental assessment and finding of no significant impact, and level 3 to the preparation of an environmental impact statement (U.S. Environmental Protection Agency 1989). Figure 1 depicts the interrelationships among these three levels. Key definitions from the CEQ regulations related to Figure 1 are addressed in the following paragraphs (Council on Environmental Quality 1987).

Federal actions subject to the requirements of NEPA include adoption of treaties and international conventions or agreements; formal documents establishing an agency's policies that will result in or substantially alter agency programs; formal plans, such as official documents prepared or approved by

Ministry of Housing, Physical Planning and Environment. 1984. Environmental impact assessment in the Netherlands. The Hague, The Netherlands, pp. 8–15.

Moore, S.N. 1992. Significance and the National Environmental Policy Act. *National Association of Environmental Professionals Newsletter.* 17(3):8–9.

Principles and Guidelines. 1983. Economic and environmental principles and guidelines for water and related land resources implementation studies. Executive Office of the President, Washington, D.C.

Raman, V. 1983. In-country EIA: India. *EIA Worldletter* 1(3):3–4.

Srodowiska, O. 1985. In-country EIA: Poland. *EIA Worldletter* 2(2):2–3.

U.S. Army Corps of Engineers. 1983. A guide to the analysis of significance. Environmental Resource Section, Seattle District, Seattle, Washington.

U.S. Army Corps of Engineers. 1988. Environmental quality: Procedures for implementing the National Environmental Policy Act, (NEPA). *Federal Register* 53(22):3120–3137.

U.S. Environmental Protection Agency. 1989. Facts about the National Environmental Policy Act. LE-133, Washington, D.C.

Wathern, P. (ed). 1988. *Environmental Impact Assessment: Theory and Practice*, Boston: Unwin Hyman.

Welsh Office. 1989. Environmental assessment—A guide to the procedures. London: HMSO Publications Center, pp. 4–7; 25–34.

Whitaker, C. 1983. In-country EIA: South Australia. *EIA Worldletter* 1(1):2–4.

World Bank. 1989. Operational directive 4.00, annex A3, environmental screening. Washington, D.C.

environmental variables for monitoring during a baseline and/or post-EIS monitoring and auditing study; and (3) documenting the interpretive rationale used during the conduction of the environmental impact study.

This paper is a condensed version of a paper by the same authors and with essentially the same title presented at the 12th Annual Meeting of the International Association for Impact Assessment, Washington, D.C., August 19–22, 1992.

References

Asian Development Bank. 1988. Environmental planning and management and the project cycle. ADB Environment Paper No. 1, Manila, The Philippines, pp. 15–17.

Bass, R.E., and Herson, A.I. 1991. The California Environmental Quality Act: A step-by-step approach. Sacramento: Jones and Stokes Associates, pp. 2-19 to 2-22.

Boshard, J.H., and Staveley, P. 1981. Integration of environmental planning and impact assessment procedures in New South Wales. In *Environmental Assessment in Australia and Canada*, S.D. Clark (ed). Vancouver, British Columbia: Westwater Research Center, pp. 60, 61, 107.

Canter, L.W., and Canty, G.A. 1992. Determination of impact significance—principles and examples. October, 1992. Environmental and Ground Water Institute, University of Oklahoma, Norman, Oklahoma.

Council on Environmental Quality. 1987. 40 Code of Federal Regulations, Ch. V, U.S. Government Printing Office, Washington, D.C., pp. 929–971.

Cutrera, A. 1990. *European Environmental Yearbook*, London: Doctor International.

Duffy, P.J.B. (ed). 1986. Initial assessment guide: Federal environmental assessment and review process. Federal Environmental Assessment Review Office, Ottawa, Ontario, Canada, pp. 9–24.

EIN Department. 1984. In-Country EIA: Netherlands. *EIA Worldletter* 1(4–6).

Environmental Law Institute. 1989. *NEPA Deskbook*, Washington, D.C., pp. 106–239.

European Communities. 1985. Council directive of 27 June, 1985, on the assessment of the effects of certain public and private projects on the environment. *Official Journal of the European Communities*. No. L 175, Brussels, Belgium, pp. 40–48.

Federal Environmental Assessment Review Office. 1986. Initial assessment guide. Ottawa, Ontario, Canada.

Federal Environmental Assessment Review Office. 1985. Initial environmental assessment: Procedures and practices. Toronto, Ontario, Canada, pp. 8–20.

Gilpin, A., and Lewis, J.L. 1990. Environmental impact assessment in Taiwan and Australia—A comparative study. Working Paper No. 20, Environment and Policy Institute, Honolulu, Hawaii.

Lohani, B.N. 1986. Status of environmental impact assessment in Asian and Pacific regional. *EIA Worldletter* November/December: 7–13.

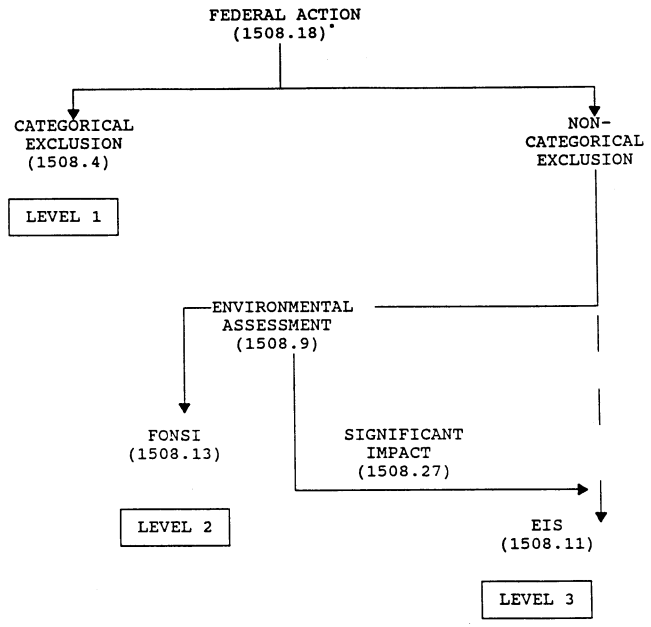


FIGURE 1. Three levels of analysis in the EIA process. * Number denotes paragraph in CEQ regulations that contains definition (Council on Environmental Quality 1987).

federal agencies that guide or prescribe alternative uses of federal resources, and upon which future agency actions will be based; and adoption of programs, such as a group of concerted actions to implement a specific policy or plan; or systematic and connected agency decisions allocating agency resources to implement a specific statutory program or executive directive. In addition, federal actions include approval of specific projects, such as construction or management activities located in a defined geographic area. Projects also include actions approved by permit or other regulatory decision as well as federal and federally assisted activities.

A categorical exclusion refers to a category of actions that do not individually or cumulatively have a significant effect on the human environment, and that have been found to have no such effect in procedures adopted by a federal agency in implementation of the CEQ regulations and for which, therefore, neither an EA nor an EIS is required.

An EA is a concise public document for which a federal agency is responsible that serves to briefly provide sufficient evidence and analysis for determining whether to prepare an EIS or a FONSI; aid an agency's compliance with the NEPA when no EIS is necessary; or facilitate preparation of an EIS when one is necessary. A FONSI

is a document by a federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment and for which an EIS therefore will not be prepared. It shall include the EA or a summary of it and shall note any other environmental documents related to it. The FONSI was initially referred to as a negative declaration.

The definition of significantly or significant impact is the key in the EIA process because a proposed action that significantly affects the human environment requires an EIS. "Significantly" as used in NEPA requires considerations of both context and intensity; and Table 1 delineates these considerations (Council on Environmental Quality 1987).

Finally, the EIS is a detailed written statement as required by Section 102(2)(C) of NEPA. The primary purpose of an EIS is to serve as an action-forcing device to ensure that the policies and goals defined in NEPA are infused into the ongoing programs and actions of the federal government. It shall provide full and fair discussion of significant environmental impacts and shall inform decision-makers and the public of the reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment. The EIS shall be used by federal officials in conjunction with other relevant material to plan actions and make decisions.

As shown in Figure 1, and based on the definitions above, all federal actions can be divided into either categorical exclusions or noncategorical exclusions. Each federal agency has published their list of categorical exclusions following appropriate consultation with CEQ. For federal actions that are noncategorical exclusions, it may be necessary to do an environment assessment (EA) in order to determine whether or not an EIS will be required. Again, agencies have published lists of their typical actions that normally require an EA but not necessarily an EIS; one example is in U.S. Army Corps of Engineers (1988).

The key issue in Figure 1 is related to whether or not the federal action is a "major action significantly affecting the quality of the human environment" (MASAQHE). This phrase is in Section 102 of NEPA. Defining a MASAQHE involves both quantitative and qualitative considerations. The simplest way of defining a major action is to compare a predicted impact with an environmental quality standard for a given parameter. It is possible to do this for many substances found in air and water, for example, carbon monoxide in the atmosphere and dissolved oxygen in water. However, there are many environmental parameters for which only descriptive standards are available, such as scenic vistas and archaeological sites. Agencies may define MASAQHE by project type, indicating that certain projects require impact statements because they are major actions, and others do not because they are minor actions. The definition of "significantly" in Table 1 refers to both context and intensity. Context is primarily related to the "when and where" of the impacts. The ten points listed for intensity can be divided into two groups as follows: (1) those related to environmental laws, regulations, policies, and executive orders (points

the series of questions as follows in the order shown (the answers to any questions can be used to determine if an EIS should be prepared):

1. Does the proposed project, plan, program, and/or policy cause impacts that exceed the definition of significant impacts as contained in pertinent laws, regulations or executive orders?
2. Is a quantitative threshold criterion exceeded in terms of project, plan, or program type, size, or cost?
3. Is the project, plan or program located in a protected habitat or land-use zone, or within an exclusionary zone relative to land usage? Is the environmental resource to be affected a significant resource?
4. Is the proposed project, plan, program and/or policy expected to be in compliance with pertinent environmental laws, regulations, policies, and/or executive orders?
5. What is the anticipated percentage change in pertinent environmental factors from the proposed project, plan, or program, and will the changes be within the normal variability of the factors? What is the sensitivity of the environment to the anticipated changes; or is the environment susceptible or resilient to changes? Will the carrying capacity of the resource be exceeded?
6. Are there sensitive human, living, or inanimate receptors to the environmental stresses from the proposed project, plan, program, and/or policy?
7. Can the anticipated negative impacts be mitigated in a cost-effective manner?
8. What is the professional judgment of experts in the pertinent substantive areas, such as water quality, ecology, planning, landscape architecture, and archaeology?
9. Are there public concerns due to the impact risks of the proposed project, plan, program, and/or policy?
10. Are there cumulative impacts that should be considered or impacts related to future phases of the proposed action and associated cumulative impacts?

Detailed specific questions related to the above ten groups of questions can be developed. Examples of such questions or issues are contained in Tables 4 and 5, respectively.

Other Uses of Significance Determination Process

The focus of this paper has been on the use of the significance determination process to establish whether or not a comprehensive environmental impact study is needed on a proposed project, plan, program, and/or policy. While this is the primary usage of the process, several additional uses can be delineated; examples include: (1) identifying the impacts that should be mitigated; (2) selecting

TABLE 7. Considerations in Significance Definitions from Various Countries and Other Groups *(Continued)*

SPAIN

In significance determination, the nature and location of the project, and the effects on the natural and human environment, are considered. Some mandatory significance has been assigned to certain EC Directive projects.

SRI LANKA

No formal requirement, but informal procedure. EIA reports are required for manufacturing projects in Free Trade Zone.

UNITED KINGDOM

Recent adoption of an EIA Procedure (1988) has required certain projects by virtue of their nature, size, and location to be considered significant. There is also consideration for the natural environment, social concerns, and the nature and magnitude of impacts. In addition, certain projects require mandatory EIA, based on the EC Directive.

URUGUAY

No legal provisions for EIA; however, private and public organizations may ask for project evaluation. Several EIAs have been completed on agro-industry projects, tourist projects, and dams.

FORMER USSR

All new enterprises and renovation of existing facilities are required by legislation to examine impacts on air, water, and the human environment.

VENEZUELA

There is a legal system and institutional framework for the protection, conservation, and enhancement of the environment. EIA is required for projects that will produce either qualitative or quantitative significant impacts; this is in relation to size and location of projects. Most EIAs concern water management projects, mining, oil exploration, and coastal developments.

WALES

There are three main criteria of significance:
(1) context of project with attention to physical size;
(2) location of project (particularly in sensitive environs, i.e., parks); and
(3) potential effects on natural and human environments, i.e., pollution.
Also, there is a special list of projects that require EIA and a list that is dependent on the size, location, or scale of the project.

WORLD BANK

Projects are screened for significance based on nature, magnitude, and sensitivity of the environmental issue. Other factors, such as environmental management capability in the country are considered. There is a listing of types of projects that are significant.

TABLE 1. Context and Intensity Considerations in Defining "Significantly" as Used in the NEPA Process in the USA (Council on Environmental Quality 1987)

(a) Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the local area rather than in the world as a whole. Both short- and long-term effects are relevant.
(b) Intensity. This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity.

1. Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect will be beneficial.
2. The degree to which the proposed action affects public health or safety.
3. Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
4. The degree to which the effects on the quality of the human environment are likely to be highly controversial.
5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
6. The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
8. The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
9. The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.
10. Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

2, 3, 8, 9 and 10 in the list); and (2) those related to other considerations and how they in turn may have implications for environmental laws, regulations, policies, and executive orders (points 1, 4, 5, 6, and 7 in the list).

An excellent series of review questions for assessing significance has been developed by the U.S. Army Corps of Engineers (1983). Additional factors to consider in characterizing impacts from proposed programs/plans/projects include whether the impacts are: (1) beneficial or detrimental; (2) naturally reversible or irreversible; (3) repairable via management practices or irreparable; (4) short-term or long-term; (5) temporary or continuous; (6) expected for the construction or operational phase; (7) local, regional, national, or global; (8) accidental or planned (recognized beforehand); (9) direct or primary, or indirect or secondary; and (10) cumulative or single.

In addition, one of the things that can be done in conjunction with identified significant negative impacts is to consider appropriate mitigation measures that could be applied to reduce negative impacts within reasonable environmental and economic constraints. Again relative to the United States practice, the definition of mitigation includes (Council on Environmental Quality 1987): avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitation, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and/or compensating for the impact by replacing or providing substitute resources or environments. The concept in terms of mitigation would be that if potentially significant negative impacts are identified, and if they can be reduced via mitigation to something of lesser concern, then it would be possible to do an EA without going to a comprehensive study leading to an EIS. This would lead to a "mitigated FONSI." However, it should be noted that this is possible only if the mitigation requirements are carefully delineated so as to ensure that the pertinent measures which have been identified are implemented. This is most easily accomplished for actions approved by permit. Therefore, based upon the above definitions and process, it might be desirable to consider three levels of significance: (1) significant and not mitigable; (2) significant but mitigable; and (3) insignificant.

Screening for Significance Determination

Screening and scoping are terms that have been developed for usage in the environmental impact assessment (EIA) process being implemented in numerous countries. There are both subtle and significant differences between the usage of these terms from country to country. In effect, these terms are really related to the concept of impact significance determination described earlier. Figure 2 illustrates the conceptual relationship between screening and scoping. Fundamentally, if a proponent is developing a specific program, plan, or project, then the basic issue initially is the potential applicability of EIA requirements. Screening basically addresses the issue of whether or not an environmental impact study would be required for the potential program, plan, or project. In many countries the resultant report on the environmental impacts is called an environmental impact assessment (EIA) or an environmental assessment (EA); as noted earlier, in the United States the resultant report is called an environmental impact statement (EIS). Therefore, the fundamental issue addressed via screening is whether or not a comprehensive environmental impact study should be conducted. Scoping is typically introduced after a decision is made on the need for a comprehensive environmental impact study, although it could be used as a component of screening considerations. Scoping is primarily focused on determining the specific issues/impacts that may need to be addressed in a comprehensive environmental impact study.

TABLE 7. Considerations in Significance Definitions from Various Countries and Other Groups *(Continued)*

INDIA

No formal requirement, but informal EIA procedure. Primary consideration is given to location of the project, social and ecological impacts, and health and safety concerns. There is also a monetary threshold.

IRAN

There is no specific law covering EIA, but there is legislation covering environmental protection. The Department of the Environment determines if projects require EIA. Six categories of projects have been defined that require EIA.

IRISH REPUBLIC

Significance is restricted to large-scale industry, actions that impact the environment (". . .result in environmental emissions . . .") and projects costing more than a specified amount. Only projects that require planning permission are considered in significance determinations. Some consideration for the EC Directive has been given.

ITALY

Actions listed in Appendix I of the EC Directive, along with a few additional projects, are predetermined to be significant. There is also regard for environmental factors, location of project, and health and safety concerns.

MEXICO

Legal provisions for EIA exist in Mexico; guidelines have a broad environmental scope. EIA significance is applied (determined) in accordance with the type, location, and potential impact of the project.

NETHERLANDS

Significance is determined based on the nature, scale and location of projects, social concerns, health and safety effects, and impacts on the environment.

PAKISTAN

No formal requirement, but informal procedure. EIA is required on a project-type basis.

PAPUA NEW GUINEA

No formal requirement, but informal EIA procedure. Two specific project types, mining and hydroelectric, have ad hoc EIA.

PERU

No environmental policy law. Current legislation deals with environmental problems, mainly pollution from mining operations. The focus has been limited to specific ecological factors—water and air quality.

TABLE 7. Considerations in Significance Definitions from Various Countries and Other Groups

ASIAN DEVELOPMENT BANK

Broad listing of types of projects (with reference to size) that are considered significant.

BELGIUM

Wallonia: Significance is based on type and size of the project, social considerations, and health and safety effects.

Flaunders: The Flemish Executive has authority to determine which projects require EIA and, therefore, which action is significant. This determination is based on the location of the project, economical and social impacts, health and safety effects, and the importance of the project.

BRAZIL

There are directives that provide a list of the activities for which EIA must be submitted (project type and size).

CHINA

Significance is defined by the type of project, but this is in regard to location, environmental impacts, social considerations, and health and safety effects.

COLOMBIA

There is a formal EIA process which has a list of projects that require environmental impact statements. Projects included are based on type, public health effects, nonrenewable resource development, and impacts on water quality.

DENMARK

Environmental impact procedures are not specifically instituted, but major construction projects require permits from environmental authorities—it can be assumed that a type and size significance determination is used.

EUROPEAN COMMUNITY (EC)

Specific projects with threshold levels are included on a listing of mandatory significance. This list is based on type, size, and location of project.

FRANCE

There is a listing of general and specific types (with size reference) of projects with mandatory significance. Other decisions are made based on: importance of project, potential environmental effects, and a monetary threshold. Potential environmental effects include the natural and human surroundings (environment). Further, the Ministry of the Environment may develop impact studies on its own initiative.

GERMANY (FEDERAL REPUBLIC)

EIA is not quite "formalized"; the Federal Council viewpoint is inconsistent and contradictory. However, significance is based on Appendix I Projects (EC) and type and size of the action.

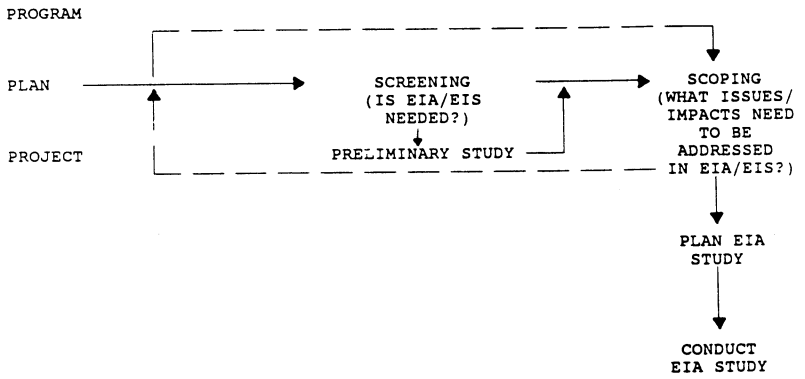


FIGURE 2. Conceptual framework for screening and scoping.

It would be possible to directly determine the need for a comprehensive environmental impact study, and then to address the scope of the issues/impacts that are relevant. Conversely, it may be necessary to conduct a preliminary study as a part of determining whether or not a comprehensive environmental impact study would be necessary. A confusing point is that this "preliminary study" is referred to by different terms in different countries. For example, in the United States the term environmental assessment (EA) is used, whereas in Canada and other countries the term initial environmental evaluation (IEE) finds application. Two fundamental approaches for determining whether or not to prepare a comprehensive environmental impact study for a proposed program/plan/project include the use of policy delineations based on project type or size, or the conduction of a preliminary study.

Screening Via Policy Delineations

An example of a policy basis for screening is the European Community Directive on EIA; this directive has categorized projects depending upon their needs for comprehensive environmental impact studies. Table 2 contains a list of these projects in accordance with project type and size (European Communities 1985). To serve as an example of the member states of the European Community developing further guidance for projects listed in Annex II of Table 2, the United Kingdom has indicated that the need for preparation of an EIA is "unlikely" for the following projects: thermal power stations below 50 MWTh; hydroelectric power stations below 10 MW; windfarms below 1 MW; combined heat and power installations below 50 MWTh; transmission lines below 132 KV; and overhead lines less than 1 km in length. Another example of a policy-based screening approach is that utilized by the World Bank in their guidance on the

TABLE 2. Categorization of Projects as Used by the European Communities (European Communities 1985)

Annex I: *Projects Requiring Environmental Impact Assessments*

1. Crude-oil refineries (excluding undertakings manufacturing only lubricants from crude oil) and installations for the gasification and liquefaction of 500 tons or more of coal or bituminous shale per day.
2. Thermal power stations and other combustion installations with a heat output of 300 megawatts or more and nuclear power stations and other nuclear reactors (except research installations for the production and conversion of fissionable and fertile materials, whose maximum power does not exceed 1 kilowatt continuous thermal load).
3. Installations solely designed for the permanent storage or final disposal of radioactive waste.
4. Integrated works for the initial melting of cast- iron and steel.
5. Installations for the extraction of asbestos and for the processing and transformation of asbestos and products containing asbestos: for asbestos-cement products, with an annual production of more than 20,000 tons of finished products, for friction material, with an annual production of more than 50 tons of finished products, and for other uses of asbestos, utilization of more than 200 tons per year.
6. Integrated chemical installations.
7. Construction of motorways, express roads, and lines for long-distance railway traffic and of airports with a basic runway length of 2,100 m or more.
8. Trading ports and also inland waterways and ports for inland-waterway traffic that permit the passage of vessels of over 1,350 tons.
9. Waste-disposal installations for the incineration, chemical treatment, or land fill of toxic and dangerous wastes.

Annex II: *Projects that May Be Subject to an EIA*[a]

1. Agriculture
   (a) Projects for the restructuring of rural land holdings.
   (b) Projects for the use of uncultivated land or semi- natural areas for intensive agricultural purposes.
   (c) Water-management projects for agriculture.
   (d) Initial afforestation where this may lead to adverse ecological changes and land reclamation for the purposes of conversion to another type of land use.
   (e) Poultry-rearing installations.
   (f) Pig-rearing installations.
   (g) Salmon breeding.
   (h) Reclamation of land from the sea.

2. Extractive industry
   (a) Extraction of peat.
   (b) Deep drillings with the exception of drillings for investigating the stability of the soil and in particular:
   —geothermal drilling,
   —drilling for the storage of nuclear waste material,
   —drilling for water supplies.
   (c) Extraction of minerals other than metalliferrous and energy-producing minerals, such as marble, sand, gravel, shale, salt, phosphates and potash.
   (d) Extraction of coal and lignite by underground mining.
   (e) Extraction of coal and lignite by open-cast mining.
   (f) Extraction of petroleum.

The second division in Table 6 refers to judgment criteria. Different actions have extenuating circumstances that will require decisions to be made based on analysis and professional discretion. In this instance, there are factors that can be partially quantified (such as effects on human and natural environments and the description of the impact), and factors that cannot be quantified, which require personal opinions or judgments. Either case can be used for defining significance. Judgment criteria include effects on the "environment," and decisions based on the "discretion of the decision-maker," and on an "impact basis." The environment is commonly used in significance determinations; this includes both the natural and human surroundings.

There are several opportunities for decision-maker discretion to arise within a proposed action. Actions involving environmental issues may comprise numerous ideas, uses, and plans that create controversy. Different settings, such as local, regional, national, and international, can confound the problem. Therefore, significance is sometimes based on professional judgment, executive authority, the importance of the project/issue, sensitivity of the project/issue, and context; or by the controversy raised. Decisions of significance will not necessarily be determined on verifiable evidence, but may include "intuition." Finally, the characteristics of impacts resulting from a project can be used for significance assessment. Describing the impacts in terms of type, scale, complexity, intensity, and duration develops a basis for comparison and the application of judgment.

Table 7 includes a compilation of considerations in the significance definitions from several countries and agencies/organizations. As can be seen, there is no commonality of definitions; thus, this leads to environmental impact studies being inconsistently conducted from country-to- country, and within a country from agency-to-agency. However, if the principle of a case-by-case analysis is considered along with differing public values in different geographical locations, a uniform definition that would suffice for all projects in all locations would be inappropriate. The information in Table 7 is based on recent literature and reports along with some interpretation; the literature used as a basis for Table 7 included Asian Development Bank (1988), Boshard and Staveley (1981), Cutrera (1990), Duffy (1986), EIN Department (1984), Environmental Law Institute (1989), European Communities (1985), Gilpin and Lewis (1990), Lohani (1986), Ministry of Housing, Physical Planning and Environment (1984), Raman (1983), Srodowiska (1985), Wathern (1988), Welsh Office (1989), and Whitaker (1983).

Significance Determination Via a Sequenced Approach

Based upon the above reviews and examples, a sequenced approach for impact significance determination is suggested. A sequenced approach suggests several levels of consideration in determining the potential significance of impacts from a proposed federal action. This sequenced approach can be achieved via applying

TABLE 6. Hierarchy of Significance Determination Criteria

I. *PREDETERMINED CRITERIA*

A. ATTRIBUTES OF PROJECT
1. Type
2. Size
3. Location
(a) urban/rural
(b) national park
(c) historic site
(d) archaeological
(e) sensitive area
i) wetlands
ii) tidal area
iii) preserves
iv) floodplain
v) coral reef
(f) science value
(g) educational
(h) deep scope
(i) farmlands
(j) residential
4. Cost
5. Resources
(a) loss of resource
(b) large scale energy use
(c) irreversible commitment

B. GUIDELINES/REGULATIONS
1. Mandated Significance
2. Categorical Exclusion
3. Established Laws/Policies
(a) endangered species law
(b) wetlands protection law

II. *JUDGMENTAL CRITERIA*

A. ENVIRONMENTAL CONSIDERATIONS
1. Natural Environment (ecology)
(a) water
(b) air
(c) soil
(d) flora and fauna
(e) pollution
(f) microclimate
(g) endangered species
2. Human Environment
(a) health and safety
i) nuisances
(1) noise
(2) smells
(3) vibration
ii) hazardous
iii) health risks
iv) natural calamity
(b) waste disposal
(c) social
i) aesthetics
ii) recreation
iii) livelihood
iv) lifestyle modification
v) quality of life
(d) cultural
i) religious
(e) population
i) growth
ii) distribution
iii) displacement

B. DISCRETION OF DECISION-MAKER
1. Sensitivity of Issue/Project
2. Importance of Issue/Project
3. Controversial
4. Context
5. Executive Authority
6. Landuse Conflict
7. Precedence Setting
8. Short-term Use vs. Long-term Use

C. IMPACT BASIS
1. Size
2. Type
(a) adverse
(b) beneficial
(c) direct vs. indirect
3. Complexity
4. Duration
5. Intensity

thresholds. In some cases there may be projects (actions) with significant impacts or resources, but they are below the established level and, therefore, are excluded from assessment.

TABLE 2. Categorization of Projects as Used by the European Communities (European Communities 1985) *(Continued)*

(g) Extraction of natural gas.
(h) Extraction of ores.
(i) Extraction of bituminous shale.
(j) Extraction of minerals other than metalliferrous and energy-producing minerals by open-cast mining.
(k) Surface industrial installations for the extraction of coal, petroleum, natural gas and ores, as well as bituminous shale.
(l) Coke ovens (dry coal distillation).
(m) Installations for the manufacture of cement.

3. Energy industry
(a) Industrial installations for the production of electricity, steam, and hot water (unless included in Annex I).
(b) Industrial installations for carrying gas, steam, and hot water; transmission of electrical energy by overhead cables.
(c) Surface storage of natural gas.
(d) Underground storage of combustible gases.
(e) Surface storage of fossil fuels.
(f) Industrial briquetting of coal and lignite.
(g) Installations for the production or enrichment of nuclear fuels.
(h) Installations for the reprocessing of irradiated nuclear fuels.
(i) Installations for the collection and processing of radioactive waste (unless included in Annex I).
(j) Installations for hydroelectric energy production.

4. Processing of metals
(a) Iron and steelworks, including foundries, forges, drawing plants and rolling mills (unless included in Annex I).
(b) Installations for the production, including smelting, refining, drawing and rolling, of nonferrous metals, including precious metals.
(c) Pressing, drawing and stamping of large castings.
(d) Surface treatment and coating of metals.
(e) Boilermaking, manufacture of reservoirs, tanks and other sheet-metal containers.
(f) Manufacture and assembly of motor vehicles and manufacture of motor-vehicle engines.
(g) Shipyards.
(h) Installations for the construction and repair of aircraft.
(i) Manufacture of railway equipment.
(j) Swaging by explosives.
(k) Installations for the roasting and sintering of metallic ores.

5. Manufacture of glass

6. Chemical industry
(a) Treatment of intermediate products and production of chemicals (unless included in Annex I).
(b) Production of pesticides and pharmaceutical products, paint and varnishes, elastomers and peroxides.
(c) Storage facilities for petroleum, petrochemical, and chemical products.

7. Food industry

TABLE 2. Categorization of Projects as Used by the European Communities (European Communities 1985) *(Continued)*

(a) Manufacture of vegetable and animal oils and fats.
(b) Packing and canning of animal vegetable products.
(c) Manufacture of dairy products.
(d) Brewing and malting.
(e) Confectionery and syrup manufacture.
(f) Installations for the slaughter of animals.
(g) Industrial starch manufacturing installations.
(h) Fish-meal and fish-oil factories.
(i) Sugar factories.

8. Textile, leather, wood, and paper industries
   (a) Wool scouring, degreasing, and bleaching factories.
   (b) Manufacture of fiber board, particle board, and plywood.
   (c) Manufacture of pulp, paper, and board.
   (d) Fiber-dyeing factories.
   (e) Cellulose-processing and production installations.
   (f) Tannery and leather-dressing factories.

9. Rubber industry-Manufacture and treatment of elastomer-based products.

10. Infrastructure projects
   (a) Industrial-estate development projects.
   (b) Urban-development projects.
   (c) Ski-lifts and cable-cars.
   (d) Construction of roads, harbors, including fishing harbors, and airfields (projects not listed in Annex I).
   (e) Canalization and flood-relief works.
   (f) Dams and other installations designed to hold water or store it on a long-term basis.
   (g) Tramways, elevated, and underground railways, suspended lines or similar lines of a particular type, used exclusively or mainly for passenger transport.
   (h) Oil and gas pipeline installations.
   (i) Installation of long-distance aqueducts.
   (j) Yacht marinas.

11. Other projects
   (a) Holiday villages, hotel complexes.
   (b) Permanent racing and test tracks for cars and motorcycles.
   (c) Installations for the disposal of industrial and domestic waste (unless included in Annex I).
   (d) Waste-water treatment plants.
   (e) Sludge-deposition sites.
   (f) Storage of scrap iron.
   (g) Test benches for engines, turbines, or reactors.
   (h) Manufacture of artificial mineral fibers.
   (i) Manufacture, packing, loading, or placing in cartridges of gunpowder and explosives.
   (j) Knackers' yards.

12. Modifications to development projects included in Annex I and projects in Annex I undertaken exclusively or mainly for the development and testing of new methods or products and not used for more than one year.

[a]*When member states consider that their characteristics so require.*

TABLE 5. Effects Normally Considered as Significant Based on the California Environmental Quality Act (Bass and Herson 1991)

A project will normally have a significant environmental effect if it will:

- conflict with adopted environmental plans and community goals;
- have a substantial, demonstrable negative aesthetic effect;
- substantially interfere with the movement of resident or migratory fish or wildlife;
- breach published standards relating to solid waste or litter control;
- substantially degrade water quality;
- contaminate a public water supply;
- substantially degrade or deplete ground water resources;
- substantially interfere with ground water recharge;
- disrupt or adversely affect a cultural resource;
- induce substantial growth or concentration of population;
- cause a traffic increase that is substantial in relation to existing street traffic load and capacity;
- displace a large number of people;
- encourage activities requiring large amounts of fuel, water, or energy;
- use fuel, water, or energy wastefully;
- substantially increase ambient noise levels;
- cause substantial flooding, erosion, or siltation;
- expose people or structures to major geologic hazards;
- extend a sewer trunk line with capacity to service new development;
- substantially diminish habitat for fish, wildlife, or plants;
- create a potential public health hazard or expose people or animals and plants to hazards;
- conflict with established recreational, educational, religious, or scientific uses;
- violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations;
- convert prime agricultural land to nonagricultural use or impair productivity of prime agricultural land; and
- interfere with emergency response plans or emergency evacuation.

tions) have been reviewed, and the details are presented elsewhere (Canter and Canty 1992). In this survey, a resource/impact was determined to be significant based on the preparation of an EIS or a similar formal document. This review resulted in the development of a categorization of the considerations used in significance determination. It was found that significance determination could be categorized into two approaches based on the criteria used. For example, all decisions seemed to be founded upon either "predetermined" or "judgmental" criteria. These two main headings can be further subdivided to include more specific determination factors. Table 6 delineates the hierarchy of criteria based on this review.

Predetermined criteria as listed in Table 6 refer to preestablished or assumed thresholds of significance that have been created based on specific attributes of a project or from guidelines developed by regulating agencies. Use of previously developed criteria creates a defined threshold, thereby allowing for a systematic determination. This, in turn, reduces the speculation involved in decision-making. However, there may be limitations to this form of determination due to rigid

TABLE 4. Questions Related to Significance Determination in Canada (Federal Environmental Assessment Review Office 1985)

1. Is the environmental component legally recognized as important?
   - environmental component is important if it is specifically protected by a law, policy, plan, control, or regulation; or is part of a legally defined management unit (e.g., a national park or an ecological reserve).
   - level of legal protection (i.e., federal, provincial, regional, or local) and the type of protection (i.e., law, plan, policy, control, or regulation) can affect the level of importance.
   - present legal status, the past and future predicted status.
   - environmental components legally identified as significant are commonly, also publicly, politically, and professionally, identified as important and, as such, usually rank high in relative importance.
2. Is the environmental component politically or publicly recognized as significant?
   - conditions affecting recognition of an environmental component as politically and publicly important:
     (a) conflict over the use(s);
     (b) resource availability and supply, and changes to that base;
     (c) demand and changes in demand; and
     (d) knowledge about the component and changes in that knowledge.
   - importance can be identified by any segment of the public, and the importance may be perceived rather than real.
   - assessment of the importance of an environmental component based on public input should consider:
     (a) who and how many consider the environmental component to be important;
     (b) the past history of the use;
     (c) the public's expectations of future use;
     (d) value of the environmental component to the public (monetary and otherwise); and
     (e) real or perceived importance.
3. Is the environmental component professionally judged to be important?
   - professional judgment may often form the only basis for recognizing the significance of an environmental component. Careful documentation of that determination is essential.
   - key aspects evaluated by the professional in analyzing importance of an environmental component include:
     (a) past, present, and projected future condition in the assessment area;
     (b) the condition in the context of the local area, the region, the province, the nation;
     (c) the size and extent of the environmental component;
     (d) scarcity;
     (e) monetary value; and
     (f) biological, physical, and socioeconomic attributes of the environmental component.

a detailed listing of effects normally considered as significant under CEQA (Bass and Herson 1991).

Review of Significance Determinations from Various Countries/Agencies

To obtain further information on the significance determination process, the EIA requirements of several countries and agencies (including international organiza-

conduction of environmental assessments (World Bank 1989). Specifically, four categories of projects are delineated: those which would normally require an environmental impact study (Category A), those which may need some limited environmental review (Category B), those which normally do not need an environmental analysis (Category C), and environmentally beneficial projects and emergency recovery projects (Category D). As noted earlier, in the United States the approach has been to delineate categorical exclusions from the EIA process.

Screening Via a Preliminary Study

The second fundamental approach for screening is to conduct a preliminary study and, pending the findings of the study, either proceed to a comprehensive environmental impact study or document that the findings of the preliminary study were such that a comprehensive impact study would not be required. As noted earlier, the key is to determine if significant impacts are expected. Three examples from the United States and Canada will be used to illustrate this approach. The examples typically involve review questions and/or criteria.

Three considerations have been delineated for water resources projects in the United States. Specifically, Principles and Guidelines (1983) defined significance for environmental quality (EQ) resources based on institutional, public, and/or technical recognition. The relevant definitions are included in Table 3 (Principles and Guidelines 1983). The concept is that if one or more of these recognition bases indicate that an EQ resource or attribute is significant, then the impacts on such would also be considered as significant.

Another example involving the conduction of preliminary studies is the procedure developed and utilized in Canada. Figure 3 illustrates the role of screening and initial environmental evaluations in conjunction with the evaluation of a project (Federal Environmental Assessment Review Office 1985). The concept of screening can lead to some proposals being automatically excluded and some being automatically referred. Screening permits the proponent to arrive at one or more of the following conclusions relative to the potential impacts of the proposal: (1) there are insignificant adverse effects; (2) there are significant adverse effects that are mitigable; (3) there are significant adverse effects that may or may not be mitigable; (4) uncertainty exists relative to the environmental effects; (5) the effects are unknown; or (6) significant adverse effects are anticipated, and/or significant public concern exists, thus an environmental impact study should be conducted.

Based only on Figure 3, it is not immediately obvious as to the basis for reviewing the findings of the initial environmental evaluation and determining if a comprehensive environmental impact study should be conducted. In accordance with the procedures in Canada, the central consideration is also associated with determining the significance of the anticipated impacts. In the approach used,

TABLE 3. Impact Significance Considerations for Water Resources Projects in the United States (Principles and Guidelines 1983)

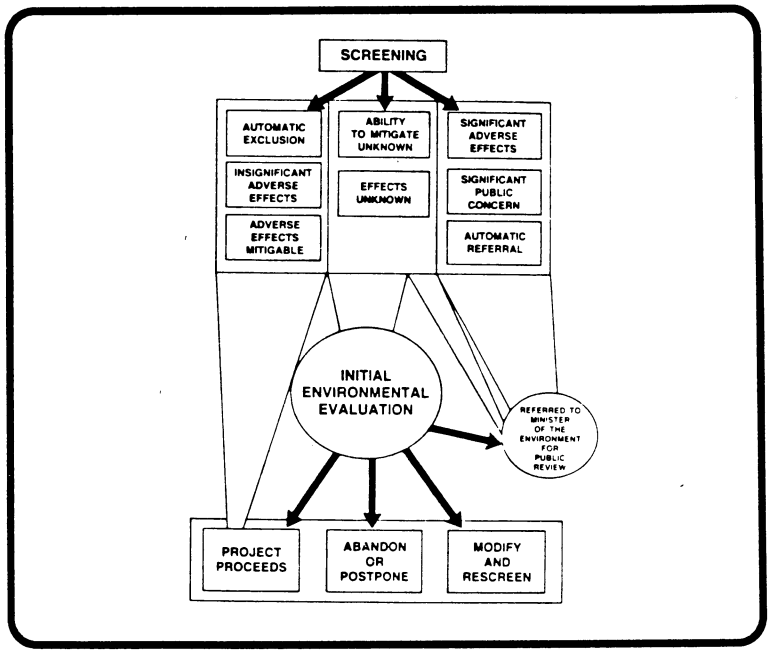
1. Significance based on institutional recognition means that the importance of an EQ resource or attribute is acknowledged in the laws, adopted plans, and other policy statements of public agencies or private groups. Sources of institutional recognition include:

   (a) Public laws, executive orders, rules and regulations, treaties, and other policy statements of the federal government.
   (b) Plans and constitutions, laws, directives, resolutions, gubernatorial directives, and other policy statements of states with jurisdiction in the planning area. Examples are state water and air quality regulations; state historic preservation plans; state lists of rare, threatened, or endangered species; and state comprehensive fish and wildlife management plans.
   (c) Laws, plans, codes, ordinances, and other policy statements of regional and local public entities with jurisdiction in the planning area. Regional entities include river basin commissions, councils of government, and regional planning boards. Local entities include counties, districts, parishes, cities, towns, and villages. Examples of these entities' sources of institutional recognition are regional open space plans, county lists of historic sites, and town zoning ordinances.
   (d) Charters, bylaws, and formal policy statements of private groups. Examples are the National Audubon Society Blue List of Species, properties of the National Trust for Historic Preservation, and properties of the Nature Conservancy.

2. Significance based on public recognition means that some segment of the general public recognizes the importance of an EQ resource or attribute. Public recognition may take the form of controversy, support, conflict, or opposition and may be expressed formally (as in official letters) or informally. Environmentally related customs and traditions should also be considered. EQ resources or attributes recognized by the public will often change over time as public awareness and perceptions change.

3. Significance based on technical recognition means that the importance of an EQ resource or attribute is based on scientific or technical knowledge or judgment of critical resource characteristics. Examples are a graveyard recognized by an archeologist as being the focal point of a 19th century community; a rock outcropping identified by a landscape architect as being an important scenic element based on aesthetic-rating criteria; and a meadow identified by a wildlife biologist as the major breeding ground for a deer herd.

basic questions are asked to determine the significance of ecosystem components and the associated significance of anticipated impacts. Table 4 delineates a sequence of questions that can be used to determine the significance of the resource and anticipated impacts, with the basic presumption for those projects with resources or impacts that are deemed to be significant, an environmental impact study would be required (Federal Environmental Assessment Review Office 1985). Valued ecosystem components must be determined before significant impacts can be discussed. This requires evaluation of the political, legal, public, and professional significance of environmental components. Determination of significant impact also relates to the degree of change in valued ecosystem components measured against some standard or threshold. This requires definition of the magnitude, prevalence, duration, frequency, and likelihood of potential change.



During the initial assessment phase, screening separates proposals into 3 streams according to the degree of potential impact or uncertainty about the impact.

FIGURE 3. Concept of screening as used in Canada (Federal Environmental Assessment Review Office, 1985).

To serve as a final example, the California Environmental Quality Act (CEQA) in the United States defines a significant effect on the environment as a substantial or potentially substantial adverse change in the physical environment (Bass and Herson 1991). Potential impacts are considered significant if a project would substantially: (1) degrade environmental quality; (2) reduce fish or wildlife habitat; (3) cause a fish or wildlife habitat to drop below self-sustaining levels; (4) threaten to eliminate a plant or animal community; (5) reduce the numbers or range of a rare or endangered species; (6) eliminate important examples of the major periods of California history or prehistory; (7) achieve short-term goals to the disadvantage of long-term goals; (8) have possible environmental effects that are individually limited but cumulatively considerable when viewed in connection with past, current, and probable future projects; and/or (9) have environmental effects that will directly or indirectly cause substantial adverse effects on human beings. Table 5 contains