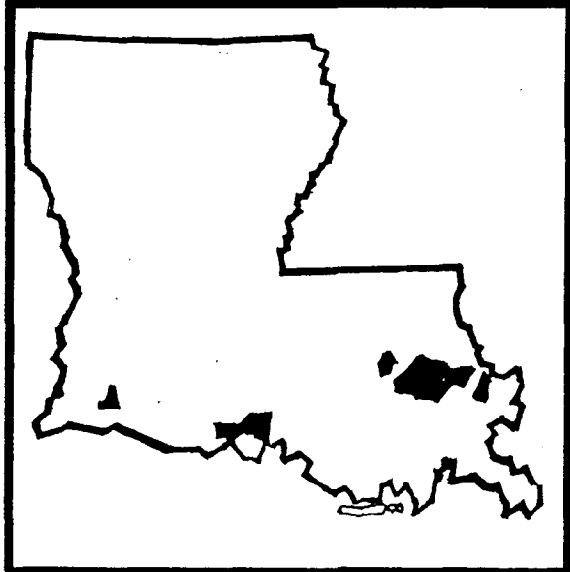
VOLUME 2 IMPACT ASSESSMENT REVIEW



LOUISIANA COASTAL RESOURCE INVENTORY

PREPARED FOR
THE LOUISIANA STATE
PLANNING OFFICE

BURK & ASSOCIATES, INC.

LOUISIANA COASTAL RESOURCE INVENTORY

VOLUME 2
IMPACT ASSESSMENT
REVIEW

PREPARED FOR THE LOUISIANA STATE PLANNING OFFICE

JUNE 1975

BURK & ASSOCIATES, INC.
ENGINEERS
4176 CANAL STREET
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June 30, 1975

Mr. Patrick W. Ryan
Executive Director
Louisiana State Planning Office
P. O. Box 44425
Baton Rouge, Louisiana 70804

Dear Mr. Ryan:

We are happy to submit a 4-volume report which is our contribution to the first year's effort in the developing Louisiana Coastal Resources Program.

This report addresses three aspects of that developing program. It consists of four volumes, involving three separate work tasks. Volume 1 provides an inventory of geographic areas of particular concern which have recreational, historical, cultural, archeological and developmental significance. In Volume 2, methods of assessing environmental impact are reviewed and the existing "state of the art" in Louisiana today is described. Volume 3 consists of an analysis of completed, under construction and proposed projects which may have a significant impact on the coastal area. Volume 4 includes 7 maps which locate areas of particular concern and public projects listed in Volumes 1 and 3.

We have always felt that the Louisiana coast is a unique and vital region due to its abundance of both renewable and non-renewable resources. The coastal ecosystem supports many and varied uses which provide the economic base of South Louisiana. At the same time, use of the coast's resources should not exceed the point where it seriously reduces its phenomenal productivity. Hopefully, the Coastal Resources Program will enable maximum utilization of the coast's vast resources, while at the same time protecting and conserving those areas most vital to the natural system.

We hope we have contributed in the development of a process to reach this goal. Pinpointing areas of concern and locating development projects should help in delineating potential areas of conflict.

Mr. Patrick W. Ryan, Executive Director
Louisiana State Planning Office

June 30, 1975

We have enjoyed our association with your staff and look forward to being of service in the continuing development of this vital program.

Respectfully submitted,

BURK & ASSOCIATES, INC.
Engineers

William R. Burk, III
Vice President

WRB III/ac

ACKNOWLEDGEMENTS

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OVERVIEW

The primary intent of this report is to provide a working aid from which the Louisiana Coastal Management Planning Team can "develop the capability to assess and evaluate impacts of actions". It was originally felt that this objective could be accomplished through a relatively straightforward review and critique of the various environmental impact assessment methodologies that have been tested in practice or proposed in the literature.

Early in the literature review, it became evident that there still remains a great deal of controversy over the proper ways to assess and evaluate impacts. Much of the controversy concerns procedural matters such as determining whether an action is major or its effects significant. However, the arguments most important and most relevant to the coastal planning effort are those which revolve around the very basic concepts upon which the assessment methodologies and even the National Environmental Policy Act (NEPA) itself rest. Dependent upon the manner in which the decision makers and developers of Louisiana's impact assessment policy perceive and accept or reject the various facets of the arguments outlined in this report, impact assessment practice in the State could take on radically different characteristics.

Without either early resolution of these conflicting viewpoints or the development of at least a semi-official attitude toward them, the formulation of impact assessment methodology will be very difficult and will have to proceed along multiple, redundant lines of research.

For these reasons, this report focuses on (1) providing a survey of assessment methodologies that have been used or proposed for use, and (2) presenting in an unbiased manner the views of the authors and critics of these methodologies concerning the conceptual bases upon which they were developed. Those views are presented here solely for the consideration of the reviewer and those who will later be charged with selecting, synthesizing, and implementing impact assessment procedures for the management of Louisiana's coastal resources.

The report is organized into four chapters and four appendices. Chapter I presents a survey of current opinions on the purposes and functions of impact assessment and its relation to planning and resource allocation in general. Chapter II presents a description of the general

types of techniques that have been proposed to perform the various tasks involved in the impact assessment process. Chapter III is a description of the impact assessment process as it is being implemented in Louisiana today. This chapter also indentifies the present relationship of impact assessment to actions now taking place in the coastal areas. Chapter IV is an annotated bibliography of the specific methodologies proposed for impact assessment.

The four appendices are provided for easy reference to pertinent documents and opinions.

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CHAPTER I

IMPACT ASSESSMENT: A CONCEPTUAL APPROACH

Introduction

This discussion of concepts serves a threefold purpose:

1. It provides the researcher with a survey of professional and legal opinion concerning the basic goals and objectives of impact analysis. Such a survey will assist the reader to develop in his own mind a clear understanding of the type of information he would desire to find in an impact assessment, and why he would want to extract such information in the first place.

2. The resulting grasp of these concepts will aid the researcher to decide where in the planning process the various methodologies can be most effectively applied.

3. In practice, much of coastal management with regard to impact assessment will take the form of draft EIS (draft environmental impact statement).* Therefore, discussion in this chapter and in Chapter II will aid the reviewer to understand where and why these documents (EIS's) are considered by many to be less than ideal. These chapters also suggest some measures that can be employed to make the impact assessment preparation and review process more efficient.

General

Before proceeding with this discussion of concepts and impact assessment, there should be a statement of what an impact assessment basically is and is not.

1. It is most important to understand that the impact assessment is a tool, an aid, a thinking process and means of organizing and presenting data. It is not a policy; but rather, it is a gauge of how well given actions conform to policy.

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*The environmental impact statement is required under Section 102(2)(c) of the National Environmental Policy Act of 1969. A copy of that Act is provided at the beginning of this report. Also, a discussion of the legal requirements of the Act is presented in Appendix E of this report.

2. An impact assessment is a means of analyzing the consequences of an action and presenting them to a decision-maker in such a manner as to clearly display the trade-offs, the costs and benefits, required to implement a given course of action.

3. Through a display of trade-offs and an analysis of alternatives, the impact assessment serves as an aid which will permit the decision-maker to determine whether implementation of an action will be the wisest allocation of our resources. That is, the impact assessment is an optimizing process.

4. The impact assessment is not an environmental impact statement (EIS), but rather the primary basis from which an EIS is written. It is apparent that many people equate the environmental impact assessment with the environmental impact statement required by Section 102(2)(c) of the Act (NEPA). Section 102(2)(c) outlines the types of information which must be presented in an impact statement, but it does not address the question of how this information is to be derived or evaluated. Those two operations, the derivation and evaluation of information, are the primary function of the impact assessment. Thus, the impact statement represents the formal organization, documentation, and display of the results of the impact assessment.

5. Finally, an impact assessment is not, and cannot be, a computer program or print out. Computers and computer programs are only another aid, a means of storing, organizing, and retrieving data. The information obtained from such aids may be used to form the basis of an impact assessment.

In this discussion of impact assessment, it is important to note that Louisiana's goals, objectives and attitudes toward resource allocation and impact assessment may not coincide with those of the federal government and others. The State should, therefore, have the capability to: (1) determine the adequacy and validity of the information presented in EIS's and other sources, and (2) determine the degree to which the actions of others conform to the State's plans, goals, and objectives. Development of practical impact assessment procedures will provide one of the tools necessary to accomplish this objective. Of equal importance is the fact that these same procedures will assist the State to better determine how well its own activities fulfill the needs and aspirations of the citizens of Louisiana.

To accomplish this, it is first necessary for the researcher and the State to decide how the impact assessment is to be used, what type of information they wish to derive from the process, and which of the basic methods in use today are most suitable to accomplish the State's objectives. That is, the researcher and the State must select and adopt a set of concepts upon which formulation of the actual impact assessment procedures can be based. The discussion in the following sections is intended to provide some insights into the various points of view concerning this subject.

Impact Assessment and the Planning Process

An important question to be answered before one can even begin to adopt an impact assessment model is "What is the role of the impact assessment in relation to the overall planning process?' The associated problem was best articulated by Jordan (82):

> "The undue interest given to Section 102(2)(c) of the Act has diverted attention that should be directed to the rest of this sweeping piece of legislation. The major shortcoming in implementing the Act has been a failure to put aside the day-to-day problems associated with preparing impact statements and instead define and examine the role of environmental quality in the traditional public decision-making process. This is necessary (to provide) a basis for analyzing how environmental impact assessment should be accomplished in resource planning and management. Curiously, little attention has been given to the issue."

Unfortunately, the language of NEPA is rather vague in defining whether the impact assessment is intended as a documentation of the effects of a proposed action or whether it is to be a principal criterion for determining what action should take place. The result has been the evolution of two basic, opposing points of view. One attitude, expressed by Leopold (90), is that the impact assessment and EIS are discrete functions separate from all others in the planning process. This view, apparently adopted, at least initially, by many federal agencies, contends that the EIS (and thus, the impact assessment) is simply another document to be "filled out" and submitted so that the project can proceed. The EIS and assessment process is, therefore, perceived as

functioning only as a disclosure or informational document serving to reveal the environmental losses resulting from a previously chosen course of action.*

The opposite point of view, articulated by Ortolano (114), argues that impact assessment should be an integral part of each step of the planning process, not merely a single "tack-on" effort, as advocated by Leopold, to be conducted after a course of action has been chosen on the basis of other criteria.

The critics maintain that if the former attitude, the "tack-on" concept, is taken, true optimization of the resource allocation process cannot be accomplished. These individuals feel that the agencies will continue to claim that they have executed their duties in accordance with the law, and the numerous project delays caused by court suits filed by opposition groups will probably continue unabated.

These viewpoints are relevant to Louisiana's coastal management for two reasons: (1) In reviewing federally sponsored projects that affect coastal resources, an awareness of this attitude will allow the reviewer to detect deficiencies in the proposed project that have resulted from a lack of coordination of environmental considerations with those traditionally embodied in the planning process.** (2) Regardless of the attitudes taken by the federal agencies, the State must decide which viewpoint best suits its needs for managing the coastal resources. Such a decision is necessary because it will have a significant influence on the manner in which the impact assessment procedure will be formulated and applied.

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*In defense of this viewpoint, it should be noted that many agencies were ill-prepared to carry out the mandates of NEPA after its passage, and at its outset, were faced with a huge backlog of projects well into the planning stages for which EIS's had to be prepared.

**Perhaps in recognition of the problems caused by the "tack-on" attitude, CEQ's 1973 guidelines (38FR147, August 1, 1973) indicate that impact assessments or statements should be prepared early in the project planning phases, as soon as enough information is available to make the analysis meaningful. They also advise that rather than restricting these matters to a separate analysis, consideration of environmental, social, and economic factors should be integrated into the planning process itself.

Should the "tack-on" approach be adopted, the development of an impact assessment methodology will be somewhat simplified because different methodologies will not have to be adapted to accommodate the various planning levels, but only for project types. However, this appears to be the only advantage offered by the "tack-on" approach. The difficulties related to subject matter, cost of analysis, systems description, valuation, evaluation, data acquisition and public participation still remain to be resolved, and it can be argued that adoption of the "tack-on" approach can only further complicate attempts to resolve these matters. These will be discussed in more detail later in this section.

Integration of the impact assessment into the general planning scheme is viewed as a subject of paramount importance by the authors commenting on the matter. They argue that the primary reason for conducting impact assessment is to ensure that decision-makers have access to all the information necessary to make a choice based on all relevant factors, economic, social, and "environmental." To explain their position, it is necessary to digress for a moment and briefly examine one aspect of the planning process itself.

It is generally accepted that there are several distinct levels at which planning occurs. With project planning being the lowest level, the progressively higher levels are:

1. Functional planning. These are sets of projects that are usually spatially defined. That is, planning may take place for several different types of projects which are related to a specific area-wide plan. For example, the Lake Pontchartrain Hurricane Protection Plan includes levees, barriers, dredging, land development, etc.

2. Program planning. This level refers to the use of a specific set of technologies and relates them to specific types of locations. For example, dredging in the marsh, or flood plain protection or zoning.

3. Policy-only plans. These may consider, for example, the issues of full employment, clear-cutting to provide cheaper homes, or income distribution effects of all projects. (147)

Each of these levels examines needs, plans, and projects with a different perspective. Each approaches an issue by asking different kinds of questions, and therefore, a given problem is often more effectively addressed at one level than another. Such a phenomenon occurs

because the perspective with which problems are viewed becomes increasingly narrow as planning moves down through the hierarchy of planning levels. Simultaneously, as planning activities become more specific, the range of alternatives which are appropriately examined at each level is progressively more restrictive.

If one of the goals of impact assessment is to optimize the use of our resources, than it can be said that with the exclusion of "environmental" considerations, and criteria from any of these levels in the hierarchy, the planning process becomes less than optimal.

A review of EIS's prepared to date reveals that one of the most significant deficiencies common to almost all of these documents is their failure to address a full range of alternatives. When questioned about this point, the preparing agencies refuse to provide the requested analysis, arguing to the effect that "such subjects are beyond the purview of this agency's responsibility." In doing so, they force the questions of "whose responsibility is this evaluation of radically different alternatives?" and "If these alternatives have been considered, what were the results of that analysis, and why were they rejected?"

The obvious answer to the latter question is that radically different solutions to problems are very often not considered in any depth at all, and the ultimate cause cannot be attributed to a failure in the impact statement, but to a deficiency in the higher levels of the planning mechanism. Opposition groups will accuse the hypothetical agency cited above of not complying with the NEPA mandates requiring analysis of all feasible alternatives. Technically, they are correct, and this position has been upheld by the courts. However, in a practical sense, preparation of all-inclusive impact assessments at the project planning level is all but impossible. If one examines the time, effort, and technical expertise required to prepare an adequate project level impact assessment, it becomes obvious that monetary and manpower constraints often preclude a comprehensive analysis of many diverse alternative solutions. It is clearly unreasonable, in most cases, to require each project level impact assessment to evaluate regional processes and fundamentally differing alternative approaches, especially those which would involve the examination of greatly varying technologies, general policies, income distribution effects, institutional or nonstructural alternatives, etc.

As a consequence, one must assume that the single project or project level impact assessment does not adequately fulfill the needs of the decision-maker or the reviewer because it has no supporting framework within which it can function. That is, the EIS or impact assessment can function properly only within the context of a larger, more encompassing plan.

If this is the case, if judgements about impacts do enter into the higher problem definition and alternative formulation phases, it is then only logical to assume that impact assessment must be integrated into each phase of planning if one is to avoid being "locked into" a course of action which is less than optimal. Anderson (8) reinforces this hypothesis by stating that,

> "Many times, more important environmental quality contributions can be made by changes at the institutional and policy levels...(and) the need for careful assessment of the environmental impacts at these higher levels often becomes more critical than individual project review. If the analysis is adequate (throughout the planning process), no alternative use of the consumed resources could yield higher social benefits."

Also, CEQ's 1973 guidelines (38FR147, August 1, 1973) requires that,

> "Initial impacts of proposed actions should be undertaken concurrently with initial technical and economic studies and where required, a draft environmental impact statement prepared and circulated for comment in time to accompany the proposal..." and, "The interdisciplinary approach should not be limited to the preparation of the environmental impact statement, but should also be used in the early planning stages of the proposed action. Early application of such an approach should help assure a systematic evaluation of reasonable alternative courses of action and their potential social, economic and environmental consequences."

In suggesting such a role for the impact analysis, most of the authors reviewed are quick to point out that environmental factors are in no way intended to predominate over the other, more traditional planning considerations. Rather, they are only suggesting that environmental factors be elevated to a position equal with others such that all issues receive balanced attention throughout the planning process.

With regards to the exact positioning of the impact assessment within the planning framework discussed above, there appears to be some disagreement. A few authors believe that impact assessment performed at the higher levels can eliminate the need for further analysis of this type at the project level. However, it is doubtful that such a policy would satisfy the provisions of NEPA, and in addition, the majority of the authors point out that like planning, under this systematic,

holistic approach to impact assessment, examination of causes and effects becomes progressively more specific as the project moves downward through the planning hierarchy. The point is that impact assessment must identify impacts at each of these levels in time for the information to be used when decisions are made at that scale (8). To that end, CEQ (38FR147, August 1, 1973) has stated that,

> "In many cases, broad program statements will be required in order to assess the environmental effects of a number of individual actions on a given geographic area, or environmental impacts that are generic or common to a series of agency actions, or the overall impact of a large-scale program or chain of contemplated projects. Subsequent statements on major individual actions will be necessary where such actions have significant environmental impacts not adequately evaluated in the program statement."

Without consideration of environmental costs at each hierarchical level, the analysis may have a systematic bias leading to decisions that may unnecessarily downgrade the human environment.

Scope

Along with the relationship of the impact assessment to the overall planning process, there are two more points that are the subject of much debate. The first is the scope of the impact assessment, and the second is the manner in which the things that are impacted are valued and evaluated. The latter subject, valuation and evaluation will be treated in the section immediately following this discussion of scope.

The term "scope" as it is used here, refers to both the variety of subject matter that should be included in an impact assessment, and the depth or intensity with which each of these topics should be discussed.

A critical review of EIS's produced to date has led a number of authors to conclude that the information presented in them is both poorly organized and lacking in sufficient subject matter and detail to permit an effective assessment of impacts by decision-makers (8, 48, 113, 110). Poor organization is more a procedural matter than conceptual, and therefore, it is more appropriately discussed in Chapter II.

On the topic of subject matter, the major source of difficulty can be traced to the failure of NEPA and CEQ to provide clear definitions for key terms. For instance, one cannot begin to address the question of subject matter until an acceptable definition of "environment" is agreed upon. The terms "environment" and "environmental" are used about twenty times in Title I of the Act, yet no attempt is made to clarify their meaning.

Ortolano (114) adequately describes the two interpretations that may be taken in establishing working definitions. The first is a very broad definition which proposes that environment be defined as including "the aggregate of all external conditions and influences..that affect the life of a human" (Federal Highway Administration, 1971). Such an all-encompassing definition includes social and economic aspects as well as those biological, chemical, and physical parameters that are more commonly associated with the term environment. Ortolano rejects this interpretation, describing it as "plausible, but not especially useful," but his reasons for doing so appear to be more for expediency than pragmatism. He first states that, "this all-inclusive interpretation of the term environment is absolutely essential in the context of evaluating the advantages and disadvantages of a proposed action or project," and, "...it is noteworthy that any definition that divide impacts into categories like economic, social, and environmental are bound to be arbitrary. Moreover, even assuming a set of arbitrary definitions of various types of impact categories, the interactions between categories are strong. Indeed, these interactions can be so strong as to make the analysis of environmental impacts meaningless in the absence of a consideration of social and economic impacts." This viewpoint is supported repeatedly by most of the authors reviewed, either explicitly, or implicitly through the organization of their impact assessment methodologies.

On the other hand, Ortolano seems to contradict himself by stating that, "the 102 statement* (and by implication the impact assessment) is usefully viewed as a document that focuses on the natural environment."

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*This refers to Section 102(2)(c) of the National Environmental Policy Act of 1969 which calls for the preparation of environmental impact statements, thus the term "102 statement".

That is, the physical, chemical, and biological aspects of our surroundings. That portion of the man-made environment which includes features considered to be of contemporary, historic, or archeological significance are also included in this more restricted definition "because it is essentially dictated by NEPA." In adopting this definition of environment, Ortolano assumes:

> "...that the 102 statement is not intended as a complete project evaluation document. That is, we assume that the 102 statement is not intended as a document that provides a balanced discussion of economic, social, and environmental impacts. Indeed, to paraphrase CEQ, a reasoned discussion of issues related to such subjects as economic impact could take as much space in a 102 statement as the environmental analysis itself, destroying the focus of the 102 statement and undercutting the purposes of NEPA (CEQ, 1972). Social and economic effects need to be briefly discussed in a 102 statement to clarify the line of reasoning used in recommending the proposed action, but the 102 statement is, in our view at least, intended to emphasize only a subset of project impacts."

Ortolano goes on to assert that public disclosure and discussion of social and economic impacts are absolutely necessary, but questions whether the 102 statement is the place to accomplish these tasks. Rather, he believes that the best instruments for providing a balanced discussion of economic, social, and environmental impacts are contained in Section 122 of the River and Harbor and Flood Control Act of 1970 (P.L. 91-611) and the "Principles and Standards for Water and Land Resource Planning" of the U.S. Water Resources Council (38FR 174, Sept. 10, 1973).

A determination of the impact of these two documents on the integration and consideration of socioeconomic and environmental factors into the planning process is not yet possible. Relatively few projects have been developed under these guidelines, and therefore, their effectiveness as a planning tool has not yet been proven. However, certain observations are worth noting. The first is the limited scope of one of the objectives of the Water Resources Council Principles and Standards. This objective specifically provides only for the enhancement of "...national economic development by increasing the value of the Nation's output of goods and

services and improving national economic efficiency." In the development of comprehensive plans under these guidelines, considerations of regional and local economic enhancement are, by inference, secondary, and if they result, it is a by-product of nationally directed efforts. In view of this, it is unclear how State and local plans and policies can affect this comprehensive planning in a substantive manner. The Principles and Standards is limited to two planning objectives at this time, however, there is a possibility that these may soon be expanded to encompass wider considerations in the near future.

The second is that comprehensive plans developed under these guidelines affect only a limited number of agencies, and not all of these agencies' actions having significant impacts on the coastal zone are subject to this kind of evaluation. Notable exceptions from the list of affected agencies and activities are grant projects of HUD and EPA, OCS activities, all regulatory agency permitting activities, and coastal zone management activities. Other projects and activities not affected are those which are totally state or privately funded.

Another consideration is that these guidelines have been criticized as being heavily biased toward development-inducing factors through "asymetrical double counting of benefits and costs among the various accounts." (7)

Finally, it is not yet possible to determine what effect these comprehensive plans will have on the actual selection of projects for implementation, and it is also impossible to determine whether the spirit of these guidelines will be implemented in both plan formulation and project selection.

In spite of these points, it can be said that, in theory, these guidelines do foster a certain amount of integration of environmental and socioeconomic issues at the higher planning levels. They also encourage the examination of substantially different alternatives.

In relation to Louisiana's coastal planning in general, and its impact assessment objectives in particular, the studies called for in these Water Resources Council guidelines may be of use in two ways: (1) They may provide a vehicle by which coastal planning and management objectives can be interjected into and can influence federal planning and alternative formulation processes. (2) It is conceivable that these studies

could also be a means of obtaining both raw data and federal assistance in conducting some of the many coastal planning studies that will be needed in formulating the State's own resource management plans. In view of these possibilities, it would appear advisable for the coastal management study group to pursue the matter in more detail.

While much of the discussion above is pertinent to EIS review, it must be recognized that both technically and philosophically the acceptance of one viewpoint or the other will have a significant influence on both the manner in which impact assessment will be performed in Louisiana and on the information that will be derived from the process. Obviously, acceptance of the restricted definition of environment will reduce the manpower and monetary resources required to perform "the impact assessment" itself. However, if the State wishes to include the impact assessment as an integral part of the pianning process, two separate, but redundant functions will have to be performed. It would appear that the only way the State could feasibly adopt this narrow definition of environment would be through a prior decision that environmental considerations should not be integrated into planning process.

Whatever the outcome, once a definition of "environment" has been accepted, one is then in a position to define other terms such as "environmental impact or effect", "significant action", and "significant impact".

Another point that should be addressed under the heading of scope is that of selection of alternatives for analysis. It is generally agreed that disregard for this function constitutes one of the most common and purpose-defeating inadequacies of impact assessments. Technically, an impact assessment which does not examine a full range of need-satisfying alternatives will often deny the decision maker the opportunity to choose that course of action which will yield the greatest benefits for the least overall cost. Legally, the courts have ruled that a broad range of alternatives, including "no action", must be examined even beyond an agency's jurisdiction or area of expertise. (8,63) Also, CEQ's guidelines (38FR 147, August 1, 1973) have clarified the issue by now requiring evaluation of:

> "Alternatives to the proposed action, including, where relevant, those not within the existing authority of the responsible agency. A rigorous exploration and objective evaluation of the environmental impacts of all

> reasonable alternative actions, particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects, is essential. Sufficient analysis of such alternatives and their environmental benefits, costs and risks should accompany the proposed action through the agency review process in order not to foreclose prematurely options which might enhance environmental quality or have less detrimental effects. Examples of such alternatives include: the alternative of taking no action or of postponing action pending further study; alternatives requiring actions of a significantly different nature which would provide similar benefits with different environmental impacts (e.g., nonstructural alternatives to flood control programs, or mass transit alternatives to highway construction); alternatives related to different designs or details of the proposed action which would present different environmental impacts; alternative measures to provide for compensation of fish and wildlife losses, including the acquisition of land, waters, and interests therein. In each case, the analysis should be sufficiently detailed to reveal the agency's comparative evaluation of environmental benefits, costs and risks of the proposed action and each reasonable alternative."

If impact assessment is accepted as an optimizing process, then selection and analysis of substantially differing alternatives, not just relatively minor alternative design changes, can be seen as the primary means by which this optimization can be accomplished.

Unfortunately, EIS's are more commonly used as instruments of project justification rather than offering a candid assessment of alternatives. In his review of almost 240 Corps of Engineers EIS's, Ortolano (113) noted that:

> "...instead of a discussion of alternatives which might avoid some of the adverse environmental effects resulting from the proposed project, we found terse paragraphs to the effect that other alternatives (usually of the structural variety) were considered in the planning stage, but were

found infeasible from either an economic or technological point of view. In the majority of the statements, the environmental implications of the alternatives were not even discussed".

Non-structural alternatives that were sometimes suggested for analysis by reviewing agencies were invariably dismissed as "infeasible".

The point is that alternatives must not be strawmen to a preselected alternative. The task of formulating alternatives is aimed at developing sets of related actions, or "alternative intervention systems" that could be implemented. All of these actions would have certain common expected effects, namely the purposes of the action, but each would differ significantly from the others in its effects on other social values. That is, alternatives should be formulated in such a manner as to provide meaningful choices among alternative scenarios of a region's future, rather than simply to reflect differences in structural means or economic costs. (6)

It is axiomatic that alternatives must be evaluated on the basis of differences such that decision-makers are presented with a set of "trade-offs" required for the implementation of each alternative. In most cases, the meaningful differences, and thus a true evaluation of trade-offs, can be obtained only through the examination of alternatives embodying fundamentally differing approaches to the problem at hand.

In practice, development of the basis for this selection, analysis, and evaluation of trade-offs of alternatives is extremely difficult to accomplish at the project level, and the derivation of any substantial benefit from an effort performed exclusively at this level appears to be very nearly impossible. An analysis of this sort at the project level requires a substantial outlay of resources in terms of manpower and dollars. The effect is to essentially preclude the desired "meaningful" analysis of alternatives, both because of the disproportionate effort required and because at the project level the scope or range of alternatives that can feasibly be considered has already been substantially narrowed.

If this objective of broad alternatives analysis is to fit within the context of operational reality, development and analysis of such sets of actions must be integrated into each hierarchical level of planning. The types of alternatives that can realistically be examined are expanded. The drain on manpower and money is reduced because the resources often already available at each planning level are more fully utilized.

And finally, since each level builds on the data and conclusions of the preceding level, repetitive operations are eliminated because each new function is directed toward successively more specific issues. If each level of analysis is adequate and is based on the best available facts, the preparation of impact assessments at each planning level and environmental statements or reports at the project level becomes a much more simplified matter.

By the definition established earlier, this discussion of scope included the depth and intensity of analysis required for a useful impact assessment. A related subject is the use of logical analysis.

It would seem that the subject of depth and intensity of analysis would need little explanation, however, many reviewers have found a surprising lack of both pertinent detail and logical analysis in a majority of the EIS's examined. The lack of pertinent detail is really more of a procedural matter, but the deficiency is so glaring as to warrant at least a brief discussion here.

The earlier attempts at writing EIS's were heavily criticized for their failure to include sufficient pertinent detail to allow a reasonably independent opinion to be bormed about the project in question. The general agency response to these criticisms has been to pad EIS's with more data and appendices which are at best of indirect relevance to the project, and which serve only to confound the reviewability of the document.

This problem is often compounded by the use of generalities, an unnecessary exhortation of views rather than reliance on scientifically derived hard fact, and the inappropriate use of scientific jargon.

Most critics of the impact assessment process feel there is a pressing need to reduce the level of generalities contained in these documents. Ortolano's (113) analysis of the problem conveys the desired ideas:

> "One of the strongest impressions we had following the review of the statements was that a large number of reported impacts were so general as to be not terribly useful. The following are typical of these general descriptions: elimination of vegetation, loss of wildlife habitat,

alteration of aesthetics, and the modification of flora and fauna. The utility of such phrases for purposses of decision-making is terribly limited for a number of reasons. For one thing, such general descriptions do not indicate the scope or importance of the change in either absolute or relative terms. Another limitation of these general descriptions, and indeed, of a great majority of the descriptions employed in the statements, is that they are not given in terms that are likely to be understood by the general reader."

Ortolano cited some examples to illustrate the limited usefulness of general descriptions:

"The first example concerns the manner in which aesthetic issues were treated in projects involving levees. These issues were described in terms using phrases such as 'reduced visual aesthetics' or 'detraction from scenic qualities'. While the description of alterations in aesthetic qualities is admittedly not a simple matter, the descriptions generally reported hardly enabled the reader to understand the issues even at a superficial level. The second illustration of the limits of these general phrases is the frequently used argument that dredging will lead to increases in turbidity that are temporary and minor. Several questions remain unanswered. Should one worry about this increased turbidity? What are the implications of such changes? The changes in turbidity were asserted to be temporary and minor, but does it follow that the implications of such changes will also be temporary and minor? It certainly is not true in general that a minor change is a given parameter will have implications that are also minor."

A related deficiency commonly found in the impact assessment is a failure to replace exhortation of views with a logical analysis of fact. While the state of scientific knowledge is not always advanced enough to permit such substitution, every effort should be made to provide arguments that are verifiable either from data supplied or substantiated in literature. Where speculative arguments must be used, they should be identified as such.

Scientific jargon is objectionable for two reasons. The first is that the impact assessment should be geared toward achieving the greatest possible understanding by those outside of that particular specialized field of knowledge from which the term is extracted. The second is that this scientific jargon is sometimes misused by those writing the assessment, thereby confusing even those intimately familiar with the subject being discussed. Ortolano (113) describes this as the use of "eco-terminology". Some examples of such inappropriate usage include: "conversion of the system from lotic to lentic", "replacement of hydric with mesophytic forest types", and "alteration of the flora and fauna environment".

The end result of the use of these ambiguities and irrelevant material, and failure to adhere to verifiable fact is that the significant impacts and implications of projects are often buried under mounds of data and verbiage. They are often so unclearly defined as to require expert knowledge to detect, extract, and evaluate them. Obviously, such practices defeat the purposes of the impact assessment document which is intended, in part, to allow independent evaluation by reasonably knowledgeable and intelligent persons.

A common fault of impact assessments and impact assessment methodologies can be found in their failure to view and analyze impacts in terms of their effects on systems (113).

One of the objectives of impact assessment is to provide decision-makers with an estimation of the effects of an action on the human and natural environments. It is generally agreed that this objective cannot be accomplished through a simple identification and quantification of the resources impacted. The purpose of identifying and quantifying impacts is not for the sake of documentation alone, but rather to allow the reviewer to understand the manner in which these impacts may or may not have impaired the functioning of resources we find valuable or desirable to preserve for some other reason. It is often the case that large impacts in terms of quantity do not necessarily constitute a serious impairment of valued functions. It can also be demonstrated that there are instances in which the exact opposite is true. In either case, determination of whether the impact is significant or not can be made only through an analysis of the workings of the involved systems. That is, impact assessment must be concerned not only with the impacted resources per se, but also with the impairment or enhancement or resource functions. To name an impact without

describing how it affects the functioning of a natural or human system, and thus its utility to man, is of very little use to a reviewer who is not intimately knowledgeable of the system affected. (7)

In adopting or synthesizing an impact assessment methodology, it is fundamental that the forecasting of impacts (prediction of change) is a function that cannot be accomplished without establishing cause--effect relationships and tracing these phenomena through the web of natural and human systems. It should be noted also that cumulative impact assessment, of which the single project assessment is a part, is concerned almost entirely with the functioning of human and natural systems.

In addition to its utility in understanding impacts, the use of systems analysis can be of great assistance in formulating alternatives. In this task systems description can be of great assistance in formulating alternatives. In this task systems description can be used to detect the multiple leverage or intervention points in a system, thereby allowing the planner to avoid many adverse impacts and enhance beneficial effects. Project developers must be made aware of the fact that there are interrelationships among important factors in any planning situation that may either neutralize or magnify the impacts on any single factor. For instance, a knowledge of marshland systems has shown that many of these areas are deficient in nitrogen. In light of this fact, decision-makers may find it desirable to supplement the natural nitrogen supply by allowing certain industries to discharge their pretreated wastewaters into marsh areas. Such a scheme could result in lower treatment costs for the industry and enhanced production in the estuary.

Finally, it should be noted that there is a significant difference between systems description and analysis as it is used here, and systems modeling. This difference is mainly one of magnitude and detail. Systems modeling is a very complex, time and money consuming proposition aimed at documenting the workings and effect of influences on a specific system. Such models are of great assistance in preparing single project impact assessments when they are available, however, substantial improvement can be obtained without such sophisticated aids. The systems analysis called for in this context is more simple and less formal, drawing mainly on the experience and knowledge of various professionals.

Therefore, regardless of whether one adopts a restricted or expansive definition of environment, the word "functions" must somehow be

included in the definition, because the environment in all its aspects is a dynamic thing of which its processes or functions are as much a part as its physical attributes.

Valuation and Evaluation

One of the major purposes of NEPA was to ensure, "...that presently unquantified environmental amenities and attitudes may be given appropriate consideration in decision-making along with economic and technical considerations." (National Environmental Policy Act of 1969).

The most immediate problem resulting from this mandate was that the formal methodology needed to analyze, evaluate, and integrate these "unquantified environmental amenities and values" into the planning process was essentially non-existent. Recognizing this fact, the Act further directed the federal agencies to, "...identify and develop procedures..." to accomplish this objective. This in turn sparked a great deal of research and debate to determine the best means of resolving the problem. The following discussion is intended to provide a general survey of opinions and the problems that have been encountered by others in attempting to deal with this subject.

Even though the preceding sections have addressed some very important conceptual matters, no definition of "impact assessment" has yet been introduced. No clear definition is apparent in the legislation, but such a definition is essential to the discussion of values and evaluation as they relate to the assessment process. Therefore, the term, as it is used in this report, is defined as: "The process through which all significant changes that may be brought about through the implementation of a proposed action are analyzed and evaluated".

The terms "analyzed" and "evaluated" are emphasized because the character, complexity, and scope of the impact assessment methodology is influenced to a great extent depending on how definitions of each of the terms are interpreted.

It can be stated with reasonable certainty of acceptance that impact analysis is the process whereby the actions required to implement a project are linked to environmental parameters and functions. Having established the nature and magnitude of these linkages, the nature and magnitude of the resulting changes are then estimated. Impact analysis

also embodies the function of describing the implications of the forecasted changes. This description of the implication of change is based on professional judgment and predetermined standards and criteria. In short, impact analysis may be equated with impact prediction, and the term "changes" is synonymous with "impacts". Parenthetically, equating the two terms serves to emphasize the fact that impacts may be either beneficial or detrimental.

In practice, impact analysis involves the description of the condition of the environment as it exists in the present, and the prediction of how that environment will exist both in the presence of the proposed project and in the absence of that project. It is generally accepted that the results of this type of analysis, the differences obtained between the two predicted futures, are the impacts of the project. Ortolano (115) appears to be the lone dissenter, arguing that:

> "The definition (above) takes an impact as the difference between forecasted future conditions. However, the state-of-the-art in forecasting changes in environmental conditions is primitive; and presenting the differences between uncertain forecasts can lead to a great deal of difficulty in interpretation. For this reason an alternative definition is proposed.
>
> The alternative definition considers an environmental impact as a change in an environmental characteristic measured from a benchmark condition representing the existing state of the environmental characteristic. In adopting this definition, it is assumed that the impacts of the 'no project alternative' will be forecasted; thus differences between the 'with and without' project condition can always be determined."

While the definition proposed by Ortolano has the virtue of being expedient, it also has shortcomings so serious as to argue against its adoption. Academically and pragmatically, such a definition is unacceptable because it does not permit the evaluation of significant processes that would continue in the absence of the proposed project. If such a definition were employed, one can imagine the difficulty that could be encountered in attempting to explain the need for maintenance dredging at the mouth of the Mississippi River.

For the purposes of this report, Ortolano's argument is rejected in favor of the more expansive definition that describes an impact as the difference between the two estimated future conditions.

Up to this point in the assessment process, impact analysis or prediction, no value judgments should have been introduced. The process, thus far, is intended only to describe impacts in qualitative and quantitative terms, and to provide an interpretation of the implications of the detected changes. The only value judgments that may influence this analysis are found in the unavoidable bias inherent in the selection of the parameters to be analyzed.

Beyond this point, the assessment enters the impact evaluation phase, and it is this phase that is the subject of the greatest controversy. In the years since the passage of NEPA, a great deal of improvement has occurred in the impact analysis function. Even so, the impact analysis issue is still being debated, and means of improvement are continually being sought. In contrast, the controversy over impact evaluation is still gaining momentum.

Several important issues are involved which markedly influence the nature of the remaining assessment functions.

The first issue centers around the question of who should perform the evaluation of these impacts. That is, in the analysis phase the nature, magnitude, and implications of impacts have been identified. It is now necessary in the evaluation phase to attach some social value to each of the parameters impacted, and to determine the overall desirability of the proposed project and alternatives.

A review of the literature reveals that many impact analyses fail to distinguish between impact prediction and the evaluation of their desirability. One should not confuse the determination that an action will have a favorable or adverse effect on a resource function with those value judgments which state whether the effects are desirable or not. The first is a professional opinion based on scientifically derived fact or opinion. The second is a judgment of the relative importance of the affected social values (7). Therefore, in this report, impact evaluation is defined as: The process whereby one relates the detected qualitative and quantitative changes in environmental parameters

and functions to a value that the affected parties place on each of them. Further, impact evaluation is the process through which decision-makers superimpose social values on the trade-offs, the assets and liabilities, required for the implementation of each alternative, and either rank or select those alternatives which will yield the greatest positive allocation of resources.

In relation to the development of an impact assessment methodology for use in Louisiana, the key word which needs to be defined is "decision-maker". Ortolano (115) and others argue that planners and other experts in no way constitute decision-makers. In his view,

> "A distinction is made between analysis and evaluation because it allows us to separate those issues that are the principal concern of planners, and those issues that are the principal concern of decision-makers,"

and, as a result,

> "Decision-makers order the alternative action by taking account of the preferences of those individuals or groups directly affected by the alternative actions, and various objectives and criteria of national and regional significance. The planner's role in the assessment process is limited to the provision of results from various impact analyses in order that decisions regarding which alternative action is preferred can be made in an informed way. Thus, planners do not evaluate impacts; rather, according to our use of the term, they provide the results from impact analyses to assist 'decision-makers' and various affected publics."

In contrast, other authors, either explicitly or implicitly through the organization of their impact assessment methodologies, argue that this is not the case, that planners and other experts are qualified decision-makers in a limited sense. They feel that planners and experts as decision-makers are appropriate in the limited role of <u>assisting</u> the final decision-makers in determining what the social values and issues involved really are. Also, many projects are so complex, and the values and issues involved are so conflicting that it is a valid function of these experts to <u>assist</u> the final decision-makers by testing the sensitivity of each alternative to these social values and issues. The result of this sensitivity testing is a ranking of alternatives.

Much of the objection to this type of alternative evaluation by experts is founded in the belief that assessment performed in this manner tends to "hide" the value judgments on which the evaluation is based, and, presumably, thereby causing the selection of an alternative on the basis of false values. As will be discussed shortly, these sensitivity tests often result in a single numerical value, ratio, or index. Of these and, by inference, sensitivity testing by experts in general, Lord and Warner (46) stated,

> "Nonetheless, we are forced to conclude that the indices of environmental quality which we have examined carry more danger than promise if adopted in their present forms. It is too easy for a busy decision-maker to accept uncritically a numerical value whether embodies in a benefit-cost ratio or an environmental quality index. It is also too easy for such an index to become a substitute for full information and the resolution of conflicts by creative plan formulation and political bargaining."

Without question, these fears should receive consideration. In practice, application of these sensitivity testing systems has been negligent in establishing and communicating the basis for the value judgments upon which this testing has been based. But it should be noted that such deficiencies are a procedural matter rather than one of concept. As a matter of procedure, these deficiencies are easily corrected by requiring explicit identification and documentation of the basis for the value judgments employed by developing more sophisticated techniques for display of trade-offs, and by requiring alternatives to be evaluated with a range of value judgments where their basis is unclear. It is just as easy for a busy decision-maker to fail to give adequate consideration to the relationship of impacts to social values as it is for that person to uncritically accept a studied evaluation by experts.

In the light of the preceding discussion, if one accepts the argument that planners and experts can play no legitimate role in the detection and interpretation of social values, then this treatment of values and evaluation should end here. The development of impact assessment methodology will then be restricted to the refinement of predictive tools and impact interpretation and communication techniques.

If, on the other hand, one accepts impact evaluation and alternative ranking as being valid functions for experts to undertake, obviously, the development of impact assessment methodologies will be considerably more complicated.

It is often difficult enough to develop techniques to qualitatively and quantitatively describe and interpret impacts; however, it is far more difficult to attach social values to these parameters and functions and weigh them in relation to other noncommensurate factors. For instance, it is possible to gauge the relative magnitude of an impact on a scenic resource by employing surrogate measures such as viewer-miles. However, the matter becomes far more complicated and controversial when one attempts to evaluate the loss or gain of this measure in relation to such factors as construction costs, tons of silt eroded annually, driver safety, etc. Difficult though it may be, at some point in the project planning process, a person or group of persons must evaluate each of these dissimilar factors, display them in some fashion so that trade-offs between alternatives may be compared, and, in the end, rank or select one of the alternatives for implementation.

All of the more "sophisticated" impact evaluation and alternative evaluation techniques that have been devised are really a form of benefit-cost analysis, but, of course, not benefit-cost in the traditional sense. These have been developed with the objective of setting up "accounts" for as many socially valued factors as possible, such that the trade-offs between alternatives can be clarified and emphasized for the consideration of decision-makers.

There are four basic approaches that have evolved to achieve this objective: (1) the traditional strict benefit-cost analysis, (2) various weighting schemes, (3) plan compliance-type methods, and (4) the factor profile method.

Prior to the passage of NEPA, the system used to determine the best allocation of resources was dominated by what is referred to here as the strict or traditional benefit-cost analysis. A thorough appraisal of the traditional benefit-cost analysis would take several large volumes to treat properly, and thus, it is far beyond the scope of this report. The most that can be accomplished here is to point out some of the uses, abuses, and pitfalls of benefit-cost analysis that have been discussed in the literature. A historical perspective is helpful in understanding the reasons for this criticism in the literature.

During the first half of this century, federal projects were selected and approved mainly on the basis of political desirability, generally without much regard for a detailed analysis of overall social costs and benefits. Over the years, the political desirability of this system declined,

and it was replaced with a more tightly controlled system of evaluation and approval administered by the Office of Management and Budget (OMB), formerly the Bureau of the Budget. This system essentially required the proponent agencies to evaluate proposed projects on the basis of the estimated costs and benefits, and it gave OMB extensive powers to approve or disapprove porjects for economic reasons. In theory, OMB exercises tight control over the estimation of these costs and benefits through a set of explicit guidelines. It is generally agreed that the institution and implementation of this new system represented a significant improvement. However, during the 1960's this new system was subjected to much criticism because of its failure to take into consideration "secondary and collateral pecuniary costs, biota damages, wildland quality degradation, and social equity effects."(8)

In response to these deficiencies in project analysis and evaluation, the National Environmental Policy Act of 1969 was passed.

Despite the passage of NEPA, and the intent of the provisions contained therein, many federal agencies appear to continue to rely almost exclusively on this criterion (benefit-cost analysis) as the basis of alternative formulation and selection. Few, if any, of the critics contend that traditional benefit-cost analyses are not useful. In fact, most will agree that these analyses are essential to project evaluation and should remain as one of the most important criteria in that evaluation. However, they do propose that certain adjustments be made in the procedure, and that policies need to be developed to more equitably integrate factors not considered or improperly considered in the benefit-cost analysis into the general planning and project evaluation process.

One of the most important objections to this almost exclusive reliance on benefit-cost analysis is that it was developed as an economic rationale, not a bio-socio economic rationale. The intent of the OMB procedures and the procedures set up under the "Principles, Standards, and Procedures for Water and Land Resources Planning" (38FR 174, Sept. 10, 1973) have already been discussed. These provide the basis for the benefit-cost analysis, and it appears that, up to this time, their interjection into the impact assessment and EIS process has not fulfilled the mandates of NEPA.

From the preceding discussion, it has been established that impacts should be assessed according to a range of societal values. In examining the benefit-cost analysis, Edmunds (54) and Anderson (6) note that components are assigned unit values and then their worth is estimated

at a fixed discount rate and an amortization period which is considered to be the useful life of the project. They object to this procedure for two reasons. The first is that the discount rate is considered unreasonably low, favoring large capital investment. Though this may be acceptable in a process which seeks to evaluate dissimilar projects for the purpose of selecting one for funding, these critics contend that it unreasonably biases an evaluation of alternatives in an impact assessment. If sensitivity testing were applied, the results could be quite different. That is, if a range of societal values were applied in the form of higher discount rates, a large number of projects would be shown to be economically unfeasible even without adjusting the component values.

The second problem that they note is found in the amortization period. All value components are generally evaluated for a fixed period, usually ranging from 25 to 100 years. In doing so, they fail to reflect the fact that most natural components have a useful lifetime far in excess of this amortization period. Again, application of the traditional benefit-cost analysis is useful for OMB purposes, but its utility in its present form for impact assessment is limited.

Still another important objection to exclusive reliance on benefit-cost analysis is that it tends to conceal impacts, and thus, it is a poor method for displaying trade-offs for the consideration of the decision-maker. (43) One of the more frequent comments made by the public on federal agency draft EIS's has been that the components and assumptions used in arriving at the benefit-cost ratio are seldom explained in even the most cursory manner. What these people are really asking for is a more informative display of the trade-offs involved in the alternative selection. Since the public is almost universally considered to be a qualified decision-maker, these impact assessments should be responsive to that need. CEQ's thinking on the subject (38FR 147, August 1, 1973) is clear, "...agencies that prepare benefit-cost analyses of proposed actions should attach such analyses, or summaries thereof, to the environmental impact statement, and should clearly indicate the extent to which environmental costs have not been reflected in such analyses."

Any method which seeks to reduce all impacts or even most impacts to monetary terms needs to be closely scrutinized, and the basis for those value assumptions validated. The fact is that many socially important parameters defy valuation in these terms (8). The result is that these

parameters are either ignored in the overall analysis and evaluation, or they are assigned completely arbitrary and baseless values and are absorbed into an amorphous benefit-cost ratio without further discussion. For instance, a recent (1973) final EIS assigned a total annual worth of less than $10.00 per year to an acre of estuarine marsh in Louisiana. It may be that OMB and Water Resources Council guidelines proscribe this valuation for their own purposes; however, it is doubtful if this amount would be an accepted societal value by the average fisherman, sportsman, or citizen of Louisiana.

The point is that the underpinnings of benefit-cost analysis are both complex and arcane. It was developed to serve a quite different need than impact assessment as it should be performed today, and if it is to be used, new guidelines should be developed. Besides clarifying the values and assumptions employed, a sensitivity testing function should be added. And, finally, it should be restricted to the evaluation of those parameters which easily lend themselves to monetary valuation, leaving the remaining parameters for separate evaluation. Bishop's factor profile method (22) appears to offer a significant step in this direction.

Most of the effort in developing resource valuation and alternative evaluation methods has been applied to the refinement of various weighting techniques. These seek to display differences among alternatives by reducing all impacts to dimensionless numbers. Generally, these numbers are then aggregated into a single dimensionless value which, by comparison with the aggregated values of other alternatives provides a simple means for ranking.

There are a number of ways used to arrive at these dimensionless numbers, but in general they are all composed of a hard data component and a weighting factor which represents the assessor's subjective estimation of the value or importance of the component which is impacted.

These weighting methods have been widely criticized for many of the same reasons as the benefit-cost analysis. Andrews (8) summarized his view of these methodologies by stating:

> "...the attempt to develop a single numerical score for each alternative covering a broad range of factors whose measurement and relationships to 'environmental quality' are so disputable, is worse than useless as an aid to evaluation. Rather than revealing trade-offs and

decision issues, it hides them, and it hides them beneath layers of value judgments in such a way that objective and informed review is made impossible."

Without a doubt, this is an extremely important point to resolve if one is to adopt a weighting methodology for use in Louisiana. Some other important objections and questions that have been raised are as follows:

1. Are the value judgments of experts representative of societal values in general, and therefore valid as inputs into the assessment process?

2. Are the requisite assumptions of linearity and additivity so limiting as to preclude use of the methodology?

3. Is the possibility of double counting similarly limiting?

4. Is the method sufficiently flexible to allow the comparison of radically different alternatives and the no action option?

In favor of these weighting schemes, it should be noted that they do allow for integration of natural, social, and economic factors, and, in at least one instance, they have been shown to be effective. This instance referred to is the Georgia experience (75), where a group of planners were given a mandate to select a highway routing after all other attempts at resolving the problem failed. The weighting system apparently worked well because the value jedgments were developed by a team of experts whom all parties trusted to be as objective and as fair as possible.

Also, in response to criticism of their own proposed weighting-type system, Dee, et al. (44) wrote:

"Finally, Eisel and Gaudette, along with Lord and Warner, are opposed to aggregating impacts in an explicit fashion into an index. What they fail to accept is the realization that making a comparison of alternatives by a multidimensional set of impacts is extremely difficult. Therefore, most citizens, as well as political decision-makers must use an implicit weighting system to compare alternatives. We feel that this type of implicit weighting system has

been at least a partial cause of many of the environmental problems facing society today and therefore favor an explicit weighting or value system."

The final basic variation of impact evaluation is the plan compliance-type method. These seek to eliminate most of the issue of impact evaluation at least at the project level through the adoption of comprehensive plans which specifically define the nature, magnitude, and location of actions which may or may not take place within the planning area. Generally, impact analysis is performed in the same manner as it would be under any of the other approaches, but impact evaluation is restricted to a determination of the degree to which a proposed action fulfills or conforms to the plan.

While the adoption of such an approach appears to be highly desirable, there are two important factors which make its application difficult. The first and most obvious is that the plan itself must be formulated and adopted. In doing so, the value decisions which are being removed from the project level assessments must be resolved at this higher plan formulation level. Also, in order to be effective, the plan must enjoy wide support among the affected parties.

The other significant factor affecting the application of this system is that extreme care must be taken in the wording of the master plan if one is to avoid conflicts over interpretation. A carelessly worded plan can be far worse than none at all.

Conclusions

It is clear that no single impact assessment methodology will be applicable to all projects and plans that the coastal management body will be evaluating, and, thus multiple techniques will have to be developed to accommodate a full range of project types and planning levels. It is also clear that none of these methodologies are magic formulas that will immediately solve all of our project assessment problems. Many of the methodologies that have been proposed can be effective. However, their effectiveness is more dependent on the skill of the user and his desire to objectively and fairly analyze and/or evaluate proposals than on the methodology itself. Much of the criticism about "hiding" value judgments and impacts can be remedial by a candid narrative which discusses all of the assumptions and factors involved. As a matter of course, all of these "mathematically" oriented methodologies must be accompanied

by such an explanatory narrative, because without one, they cannot be considered to be true, complete assessment techniques. Many of the faults that have been attributed to the various methodologies can be corrected to some degree with relatively minor adjustments. All of these techniques are really no more than aids, means of organizing and displaying thoughts. Some are better applied in a given situation than others, but the factor that counts most is the person or persons who apply the technique.

Selection and adaption of an impact assessment methodology for use in Louisiana's coastal planning effort cannot proceed efficiently until some of the basic questions raised in the foregoing are provided with at least some operational answers. It is most essential that the planning team determine what role the impact assessment is to play in the overall management of coastal resources, what is the proper scope and nature of the impacts to be addressed, by whom are values to be assigned, and how are they to be incorporated into the impact assessment and decision-making process.

Finally, this report concentrates on the task of developing a single-project or project level impact assessment methodology. Probably the greatest impediment to the accomplishment of that task, the one thing that will make every attempt less than satisfactory, is that there exists no framework within which project level impact assessment can function. The range of difficulties and possibilities is so great as to make proper analysis and evaluation of impacts at only the project level all but impossible. In this regard, Andrew's (8) assessment of the situation is appropriate:

> "Despite the new term and the new mystique, impact assessment is not a new or separate process to be assigned to a new office. It is a new conceptualization of the process of plan formulation and planning analysis. A broader range of consequences is involved, as is a more sophisticated understanding of the real world as a complex web of interlinked systems. In particular, impact assessment requires a conscious linkage repeated throughout the planning process, between the identification of potentially significant impacts and the selection of alternatives for further consideration."

CHAPTER II

IMPACT ASSESSMENT: THE STATE OF THE ART

INTRODUCTION

The previous chapter has dealt with some of the basic factors that must be considered before the process of selection and adaptation of a specific impact assessment methodology can begin. Once the researcher and decision-makers have determined the nature and extent of the functions they wish the impact assessment to perform, it is then possible to begin the process of determining how those functions can best be accomplished.

The intent of this chapter is to identify the principal tasks required to perform an impact assessment and to provide a summary of general techniques that have been proposed to accomplish the various tasks involved in impact assessment. As the chapter progresses, it will become evident that many of the proposed "methodologies" are inadequate to perform all of the tasks of a complete impact assessment. Some of the "methodologies" are geared almost entirely toward the identification of impacts, while others add impact or trade-off display functions and still others omit certain vital functions such as systems analysis.

In reviewing these methodologies, the reader should be cognizant of the fact that impact assessment has a relatively short history of development and consequently the process is still more of an art than the precise, scientific process that hopefully it will become.

General

Discussion of the specific tasks required to perform an impact assessment is complicated by two factors: (1) The nature and order of performance of these tasks vary according to the planning level to which they are applied; and (2) relatively little has been done to define the structure of impact assessment at the higher planning levels. Also, the structure of the assessment will vary significantly depending upon whether or not valuation and evaluation functions are judged to be valid components of the formal methodology. Therefore, to simplify the illustration and discussion of specific tasks, this chapter is directed primarily to the project level assessment and presumes the evaluation function to be a valid component.

IMPACT ASSESSMENT TASKS

Impact assessment as it is defined in Chapter 1 can be separated into two broad functions: impact analysis and impact evaluation.

In impact analysis, actions required to implement a project are linked to environmental parameters and functions. The nature and magnitude of these linkages are then determined and the nature and magnitude of the resulting changes are estimated. Impact analysis also embodies the function of describing the implications of the forecasted changes.

Impact evaluation is the process through which social values are attached to the components that are undergoing change. Once social values have been attached, alternatives are evaluated and ranked.

Inserted into the project planning process, these impact analysis and evaluation functions are performed in nine tasks:

1. Problem Definition
2. Plan Formulation
3. Systems Description
4. Identification of Impacts
5. Prediction of Change
6. Analysis of Implications of Change
7. Display of Trade-Offs
8. Resource Valuation
9. Alternative Evaluation

Problem Definition

In the problem definition stage, needs and desires of the project area are examined.

If the assessment was being performed as part of an area-wide development plan, these needs and desires could be determined from such studies as land use projections, per capita demands, population trends, or potential industrial needs. The result of this type of impace assessment and planning process would be a set of general goals and objectives: x number of jobs, y number of housing units, etc. However, it is assumed here that such goals and objectives have already been defined through prior studies, and this function is not performed as part of the project level impact assessment.

Plan Formulation

The plan formulation phase is a cyclic function that starts out with the development of a set of preliminary alternatives which may be redefined and reformulated as impacts and predicted changes are identified in subsequent steps of the assessment process.

The only guidance that can be offered in regards to performance of this function is that at the outset the assessing team and the project sponsors should strive to formulate substantially differing alternatives. For impact assessment to work properly, the initial set of alternatives should be formulated such that different sets of effects are produced while still achieving most or all of the particular projects stated goals and objectives. This differs from "traditional" planning in that process generally examined a more narrowly defined set of alternatives dealing chiefly with alternative designs for substantially the same project.

One other point to note is that beyond this point all alternatives should be treated as a "proposed action" and each should be examined in equal depth with the others. Elimination of an alternative from further consideration should not occur until it has been clearly shown to be vastly inferior to the others. And finally, evaluation of alternative designs for substantially the same project should be undertaken only in the latter stages of the assessment when it becomes necessary either to distinguish between two or more alternatives whose overall impacts appear to be equal, or when an alternative has been selected and it becomes necessary to optimize that alternative.

Systems Description and Impact Identification

The primary purpose of the systems descriptions and impact identification tasks is to aid the assessor in identifying those key factors which will be used to evaluate and further formulate alternatives. Ortolano (114) refers to these as "evaluative factors; Andrews (8) calls them "resource functions." Whatever the term used, the outcome of the assessment is dependent on their selection, and failure to exercise discretion in this selection phase may bias the assessment toward the "wrong" alternative.

In the systems descreption task, the proposed project alternative is broken down into its various components, and actions required to implement each component are identified and described. At the project level, a prior knowledge and understanding of the surrounding natural, social, and economic systems is assumed. What remains to be done in the project level assessment is to relate the components and actions of an alternative to the specific natural, social, and economic systems. That is, identify

the points at which the project systems interface with the existing systems in the project area.

A task intimately related to that of systems description is that of impact identification. The interface points identified in the comparison of systems indicate the presence of a first order or primary impact. Because of the interdependent nature of environmental components, the occurrence of a primary impact is almost invariably accompanied by multiple sets of secondary and tertiary impacts. A systems description approach to the identification of impacts is vital because it is the only effective way in which these interrelationships and feed-backs can be traced. For instance, a knowledge of economic social and natural systems might demonstrate that the addition of ten thousand acres of grazing land would have an economically benefical impact on cattle raisers. However, such an action might require the alteration of that same acreage from salt marsh to pasture. Since the salt marsh is responsible for the production of fisheries products, its removal will have some economically detrimental impact on sport and commercial fishermen, trappers, and hunters. In practical applications, these relationships are not always so simple and easy to identify.

A major thrust of the intent of NEPA was to eliminate the occurrence of unexpected consequences of human actions. This, in effect, is the task of impact identification. The act, therefore, specified the use of an interdisciplinary evaluative team as a primary means to avoid overlooking significant impacts. Although the use of such a team cannot be classified as an impact assessment methodology per se, it certainly can be considered to be a prerequisite for the analysis and evaluation of any major action. That is, the multidisciplinary team is without doubt the best insurance against important factors being overlooked. (74)

Other than the use of an interdisciplinary team, the simplest and most common approach to impact identification is the use of a checklist such as the one developed for the U.S. Army. (152) Checklists are usually developed to provide a listing of actions and impacts that may occur as a result of the implementation of a given type of project. Applied to a specific project, the assessor merely marks off those impacts he believes may occur if the project is implemented.

Modification of the checklist has resulted in the development of the matrix. Matrices, like the one proposed by Leopold (88), are really two dimensional checklists which attempt to identify cause - effect relationships. One axis is a checklist of project components and actions; the other is a checklist of environmental components and characteristics.

Checklists and checklist-type matrices primarily offer the advantage of being extremely simple to understand and use, and for this reason, they are widely used by evaluating agencies. In addition to their simplicity, they serve two purposes: (1) As elements of agency guidelines, they identify categories of possible effects that are important to that agency, as matters of policy regardless of the concerns of professionals or other groups in a specific case. (2) They provide sources of ideas concerning potentially significant types of effects. As such, they aid the assessor to avoid omitting potentially significant elements from the assessment. (8) (3) A checklist serves as a tangible document rather than an intangible thought process. In this way, the reviewer is able to determine what impacts were judged unlikely to occur as well as those that the assessing team believes will occur. Such a process eliminates the need to ask the question, "Was this considered?" (74)

While the advantages cited above are useful, the use of checklists does pose some problems. First, checklists by themselves are static, tending to suggest only the direct affects of various types of actions. At best, they suggest a large number of direct impacts of individual causative actions on individual environmental characteristics. However, they provide little assistance in identifying the interrelated, jointly caused, cumulative, and sometimes synergistic impacts that are often found in practical situations.

The second problem is that the use of a preconceived checklist could eliminate the essential task of examining the project in the context of the existing and proposed systems so that correct priorities for analysis of evaluative factors may be set. That is, checklists are many times are not specific enough either for the project or the project site area, and therefore, the formal does not sufficiently focus the assessor or reviewer on the critical factors that need evaluation. (48) This is particularly true of such checklist-matrices as Leopolds'. (88) The manner in which it identifies impacts is both ambiguous and tedious.

Still, checklists and matrices can perform useful functions in specific impact assessment situations. For instance, a checklist was developed for the Interstate Commerce Commission as a simple means of determining if an EIS is called for in a particular situation. (66) Hopkins (74) proposes that, to be useful in a practical situation, checklists should be structured and used in a heirarchical manner. In essence, this would entail an initial pass at a very high level of generality such as land, water, air, plants, animals, and man. If no effects can be identified in a given general category, then subcategories within that broad area are not pursued. If effects are noted, the next pass occurs at a more specific level. The process is then repeated for successively more narrowly defined categories. At the ultimate level of detail, the items explored may be unique to the individual project and therefore not part of any prepared or published list. This method, of course, is still subject to the criticisms noted earlier.

The point to remember is that even though some checklists and checklist matrices are proposed as full assessment methodologies, they in fact are not. They are an aid to the assessment process, and only provide a starting point for a more complex, detailed process which of necessity must be accompanied by an explanitory narrative. Dee's Environmental Evaluation System (42) and Odum's Optimum Pathway Matrix (110) are examples of checklists and matrices being incorporated into a more comprehensive analysis and evaluation methodology.

Also, as Andrews (8) points out, there is a definite need in many situations to derive outside opinion as to exactly what constitutes an important evaluative factor. Such opinion is often sought out through public meetings, personal contacts multidisciplinary groups, opinion surveys, and other ways. To aid in this function, several gaming techniques have been developed. The NEXUS procedure, described by Armstrong and Hobson (16) is designed to identify key factors and conflicting assumptions about potential impacts. NEXUS has the same advantages and disadvantages as any checklist procedure, except that it is specifically designed to fit a given situation as apposed to the standard checklist which is developed to fit a class of situations. Another gaming technique is the KSIM, developed by Kane, et al. (83) KSIM is a sophisticated, computer-assisted method of feeding back information about impacts to aid in the identification of important evaluative factors. (20)

Checklists and checklist matrices function best to focus the attention of the assessor on matters that need to be examined as a matter of policy, and, if viewed as such, they can be quite useful. Beyond this, it is the responsibility of the planner and the affected parties to search out the important factors that the evaluation should be based upon, and to ensure that these receive proper consideration.

Systems description carries the impact identification process one step further. Impact identification and systems description tasks are difficult to separate because impact identification is really an intermediate step in the overall task of systems description. It was pointed out earlier that the assessor must disaggregate a proposed alternative into its basic components and functions, examining the action as a system to determine the points of interaction with the surrounding natural, social, and economic systems. These initial points of interaction constitute primary impacts, and invariably they lead further interactions which represent secondary and tertiary impacts. Thus, the use of systems descriptions, whether implicitly or explicitly, is unavoidable in the task of impact identification. Checklists and checklist matrices do not specifically incorporate this function, and therefore, unnecessarily increase the probability of error. In response, several techniques were developed to assist in the integration of the two tasks.

One is the cross-impact matrix. Cross-impact matrices were developed to upgrade the older cause-effect matrices by attempting to show two way linkages and feedbacks rather than simply first order, one way causal relationships. Where Leopold's matrix (88) had causes listed in the columns and effects in the rows, a cross-impact matrix has basically the same list of items on both columns and rows, allowing interrelationships to be demonstrated. The system developed by Wirth and Associates (171) illustrates the use of a cross-impact matrix. Though this system is rudimentary, it does recognize and provoke thought about the two way relationships and feedbacks that characterize real situations.

Another, more sophisticated method for describing systems is to illustrate them for what they are: networks. The network approach seeks to break down a proposed alternative into its component parts and actions, and to follow each as it acts and reacts with related systems. As the analysis progresses, actual network diagrams or webs are constructed to illustrate the relationships. The approach used by Nathans (103) illustrates a crude application of such networks.

Sorensen's stepped matrix procedure (134,138) attempts to combine the advantages of matrices and networks with the analytical capabilities of a computer system. This is really a combination of Leopold's matrix procedure and the Nathans approach, and while it incorporates the good points of these systems, it also tends to include many of the weaknesses of each. Sorenson's technique begins with a matrix, disaggregating a proposed action into the specific impact - inducing factors associated with it. Then, entering a network-type system, these factors are related to a list of initial environmental conditions, and in turn, these are used to forecast what he calls "consequent conditions". From these "consequent conditions", a forecast of resulting effects is made.

Andrews (8) points out that the major problem with this approach is that, like the Nathans approach, these networks are unidirectional and laking the feedbacks necessary to make them a true systems description. They differ from Nathans' networks primarily in their tiered structure intended to illustrate these cause - condition - effect relationships. Sorenson's system is still being developed and refined, but Andrews believes that some problems such as validity of data and assumptions, ease of transference to other situations, time, expense, etc. will remain because they are characteristic of all computer simulation models.

The KSIM gaming technique described earlier also makes use of systems analysis in that it was designed for the explicit purpose of providing feedbacks to the participants about the relationships of their assumptions or

inputs. Given a set of inputs, linkages, and outputs, the model shows the values of outputs as a function of time. (20) In general, the KSIM procedure is an excellent illustration of the basic thought process necessary for the description of social and natural systems. Also, it allows these analytical functions to be carried out at a level that permits understanding and active participation by persons who are not professional systems analysts or modelers. (8)

The problems with the KSIM are: (1) its limitation to one or two dozen variables; (2) its assumption that all relationships can be represented by a simple nonlinear growth equation. The problem of a limited number of variables can be resolved by resorting to a more complex model, but this is a condition that KSIM was designed to eliminate. That is, it was designed to focus on those limited factors the evaluating group deem most important. (8)

The inaccuracy inherent in the assumptive use of a nonlinear growth equation limits KSIM to use as a gaming technique for testing and challenging assumptions, precluding its use as a predictive tool. (8)

Finally, the discussion of impact identification and systems description should include a clarification of the meaning and use of land suitability rating methods such as that proposed by McHarg. (95) The land suitability table provides information about the variation of impacts and costs due to the variations in the characteristics of land. That is, a land suitability rating table relates a proposed action to the characteristics of sites on which it might be located, indicating a rating for all impacts or costs which vary with respect to each factor of site quality. (74)

The impact table or matrix is complementary to, but distinct from the land suitability table. An impact table indicates the impact which occurs in terms of a change in indicators of environmental quality, based on all characteristics of the site on which the activity is located. The land suitability rating table can then be seen as a prerequisite to the construction of an impact matrix.

It is possible to combine the two into a three dimensional framework, but this is not particularly useful for recording information. Rather, a set of two dimensional tables is more appropriate. This could be done by using either a set of impact matrices, one for each type of site, or a set of suitability tables, one for each impact. (74)

Prediction of Change

While the forecasting of effects or the prediction of change can be seen as one of the most vital functions of impact assessment, it is not a vital concern for development of the impact assessment methodology itself. Rather, all impact assessment methodologies presume the prior existence of predictive tools, and it is the purpose of the methodology to organize and supply information for use by the chosen predictive tool. It is also the function of the assessment methodology to organize and further refine the results of the prediction process. In other words, prediction of change can be viewed as a function outside of, but absolutely necessary to impact assessment. Obviously, the results of the overall impact assessment depend quite heavily on the accuracy and reliability of the predictive method employed, but the predictive method is only as good as the information fed into that system. Also, impact prediction is only a mid-point in the total assessment process. In refining, interpreting and displaying these changes, the impact assessment methodology plays at least as important a role as the predictive tool. Each presumes the existence of the other, but they can be developed independently of each other and can be used interchangably.

Most impact assessment methodologies, as they appear in the literature, presume the use of intuitive prediction methods, relying primarily on the professional judgement of the users; however, more sophisticated approaches are available for impact prediction. Examples include Delphi techniques for assembling expert concensus, statistical correlation techniques, experimental manipulation of analygous systems, manipulation of mathematical simulation models and others.

One function of the impact assessment methodology that does have to do with prediction is that of impact measurement.

Measurement of impacts under the traditional benefit-cost analysis method was comparatively simple because the developers of that technique intentionally selected parameters for evaluation that were relatively easy to quantify. However, with the passage of NEPA and its accompanying demand that all possible costs be accounted for, more comprehensive systems for costs (impacts) measurement had to be applied to the project analysis.

In attempting to develop appropriate means for measuring impacts, developers of impact assessment methodologies were confronted with two problems. One is that of uncertainty and duration of effects. The problem of estimating the duration of effects is wholly a function of the predictive method applied and, as such, it is only noted here. Uncertainty, however,

is properly a function of three assessment tasks: impact measurement, prediction and evaluation. In the majority of methodologies, the subject is ignored. An exception is the University of Georgia approach (110) in which an error factor is applied as the last step in the evaluation function. Presumably, predictive tools such as computer assisted systems models are routinely subjected to statistical methods to compensate for error. The problem with impact measurement and prediction is that in many instances the assessor's knowledge of the affected systems is rudimentary at best, and the result is an equally crude estimation of quantities and predictions. In any case, wherever uncertainty is introduced, there should be an attempt to compensate or, at the very least, it should be explicity noted.

A second problem is that some factors involved in impact analysis do not readily lend themselves to conventional measurement. Examples of these are aesthetics, safety, environmental quality, physical and mental health. It has been a long - standing practice to quantify these factors by applying surrogate measures such as viewer miles or deaths per passenger mile. There are other parameters such as quality of life, archeological sites, or endangered species whose qualities are so nebulous as to completely defy measurement. As an absolute quantity, these can only be noted and left for treatment in the evaluation function.

However, in dealing with a comparison of alternatives, there are several ways to express most impacts on similar factors. To illustrate these, one must consider the possible types of measurement. As Hophins (74) points out, the most basic level, and a prerequisite to all others, is nominal measurement. This is simply a naming of elements, but it implies the not necessarily trivial ability to distinguish like elements from unlike elements. For instance, before one can indicate an impact on a salt marsh, one must be able to distinguish salt marsh from other kinds of marsh.

The next most specific scale of measurement is ordinal. As the term implies, this scale involves an ordering or ranking. For instance, the toxicity of one pesticide may be greater than another but at this scale of measurement no indication is given as to how much more.

To determine how much more, interval measurement can be used. This indicates the difference in some arbitrary unit appropriate to the particular parameter such as air pollution. A statement can be made that one alternative leads to some number of units of air pollution more than another. At this scale, one can deal only in difference between levels, not ratios, since the zero level is not meaningfully defined.

The most specific scale of measurement is the ratio. Measurement at this scale is based on an arbitrary unit of difference, but it also requires a fixed, meaningful zero point. At this scale, if one alternative impacts 10 acres of marsh and another uses 5 acres, it is appropriate to express the difference as a ratio. That is, one alternative impacts twice as much marsh as another.

This discussion of levels of measurement is relevant because many factors in impact assessment cannot always be expressed as one would desire, in a ratio. For instance, it could be assumed that the existing condition is a zero point and the positive or negative changes could be expressed as ratios of change. However, if one wishes to aggregate impacts, the complexity of measuring aggregate environmental quality indicators such as for air pollution renders the use of ratio measurement impractical. In such a case, the assessor must deal with an entire set of pollutants for which no common denominator exists. Therefore, the typical approach is to construct interval or ordinal indices of degrees of environmental change.

Since all impacts cannot be expressed in similar dimensions and measurement scales, the ideal impact methodology should be adaptable enough to deal with each variation.

Analysis of Implications of Change

Analysis of the implications of change is another task that is important to the overall assessment, but one for which there can be little formal framework built into a methodology.

It would be of little meaning to state that a project will destroy 100 acres of marsh without relating that figure back to other facts such as the total quantity available, the rate at which marsh is being consumed and the effect each of these may have on fisheries and other factors. At best, one can rely on numerical comparisons such as these and, at the least, professional opinions should be stated. In most cases, this analysis of implications of change should focus on the degree to which actions enhance or deteriorate the functions of the affected systems. In a few cases, a discussion of functions is not applicable and other means must be devised to communicate the relevance of the impact.

Display of Trade-offs

Many impact assessment methodologies treat the display of trade-offs task as though it were an integral part of the two remaining tasks, resource valuation and alternatives evaluation and ranking. As a matter of clarity, and to assist in the independent evaluation of alternatives by others, the display

of trade-offs should be a separate and distinct documentation. The statements of the nature or degree of impact derived for each factor from the preceding tasks should be presented in the raw form for others to consider. As was discussed in Chapter I, it is in fact a matter of opinion whether the formal impact assessment methodology should go beyond this point at all. Many persons believe that further manipulation succeeds only in biasing the analysis with the value judgements of the wrong group of people and effectively precludes evaluation by the "proper" decision-makers by disguising the true nature and extent of trade-offs.

The most sophisticated "valueless" display of trade-offs is the factor profile method proposed by Bishop. (22) This technique separates impacts into two basic categories, impacts for which the application of monetary values is inappropriate, and a benefit-cost analysis which is amenable to that type of measurement. This method is considered valueless in that it clearly separates those factors for which monetary values are well-accepted from those for which the assignment of dollar values is subject to dispute.

In this system, similar unvalued, but quantified parameters are scaled against each other and displayed on a vertical chart. Using a paired comparison technique, decision-makers seek to reach agreement on the alternative which offers the best combination of benefit-cost analysis and non-valued factors. This technique works best when both the number of decision-makers and the number of evaluative factors are limited. Bishop cautions would be modifiers of the system that the area under the resulting factor profile curve is not necessarily integrative to a single quantifiable value.

A different kind of display technique, the account method, is illustrated by the Atomic Energy Commission impact assessment guidelines. (157) These guidelines specify the procedure for disaggregating a proposed alternative into its various subsystems and sets up a separate "account" for each. Also specified are the units in which each evaluative factor is to be measured. Columns are supplied to enter the magnitude of the expected impact for each alternative on each factor. Accompanying each entry is a page citation refering to supporting information in the narrative.

This technique is useful in displaying a large quantity of technical information in such a manner as to permit direct comparison of all alternatives on each point. However, it is limited in several respects: (1) It does not offer any means for displaying composite effects; (2) There is no means for aggregating the data presented; and (3) It does not aid in the illustration of interrelationships among impacts and subsystems.

The AEC's procedure is an excellent means of communicating large amounts of technical information, but it is a very poor means of communicating a general understanding of the composite consequences of sets of alternatives. As it is offered by the AEC guidelines the system leaves much to be desired. However, it has possibilities for upgrading through the use of more complete evaluative techniques.

Kane's KSIM displays trade-offs in the form of computer tracings which can be produced for each of the initial assumptions for each of the alternatives. Then, the results from any combination of these can be recalled and presented on a single display format.

Resource Valuation and Alternative Evaluation

Resource valuation as described in Chapter I is the task in which social values are attached to the resources impacted. It was also noted that the development of these values is very difficult with any kind of concensus at the project level. Ideally then, the greatest portion of the resource valuation task should be supplied from an overall framework resulting from cumulative impact assessment and regional studies, both natural and socio-economic. However, this is seldom the case in reality and, therefore, it is necessary to provide for the development of these factors in the project level impact assessment methodology.

One of the simplest techniques to apply is that of standards and constraint - setting. If the project or one of its components falls below the standard or outside a constraint, it is automatically rejected. The most successfully applied example of this is illustrated by air emission controls. If a proposed project will not violate the new source standards set by the areas's management plan, a permit is granted with no further investigation or evaluation.

One of the oldest and most copied techniques for the application of values and display of trade-offs is that of McHarg. This combines the land use suitability rating table with a map overlay technique. Several factors are then combined to give a visual indication of areas of low or high impact. This procedure is somewhat limited in its ability to perform all of the tasks of impact assessment, but it was conceived for a different reason.

Modifications and adaptations of the McHarg method are numerous. One of the most notable is the EDAP procedure developed by Landscapes Limited. This is a very flexible procedure designed to determine a least impact corridor for such things as transmission line and highway siting. As a computer

assisted system, it is designed to permit the injection of any number of varied value judgements to test the validity of those assumptions.

Another approach that has been widely explored is the use of various scaling and weighting techniques. These are exemplified by the University of Georgia approach (110) and Battelle's Environmental Evaluation System. (42)

There are numerous variations of these weighting techniques, but in general, they all follow the same basic steps. The identified impacts are scaled or expressed as a percent, relating similar impacts from several alternatives. Scaled factors are then reduced to a dimensionless number by attaching some relative value number derived from a rating scale. The final step is to aggregate these into a single dimensionless number which represents the "total" or "cumulative" impact of all factors for that alternative. Alternative evaluation then becomes a simple matter of comparing the numbers derived in this manner for each alternative.

The problems and criticisms of such weighting methods are numerous. One is the extreme amount of subjective judgement that goes into the weighting of impacts. Some critics contend that weighting and manipulation of raw data tends to distort factual data and obscure value judgements making them difficult to challenge. These are very poor methods for displaying trade-offs. The final criticism is that the assumptions of linearity and additivity necessary for the aggregation of impacts need to be validated.

The final evaluation technique to be discussed is the impact matrix table proposed by Leopold. Andrews (8) sums up his opinion of this technique by stating that it is one of the least useful display techniques. Also, it is excessively detailed, its numerical ratings are confusing, and comparison of alternatives by this method is almost impossible.

In summary, it is possible to classify evaluation procedures into three general types: (1) direct display techniques such as the factor profile, network diagrams, and simple impact matrices; (2) constraint setting techniques which use established standards and criteria to reduce the number of trade-offs to be balanced; and (3) weighting techniques such as the University of Georgia approach. Of the three, the easiest to apply is the constraint-setting technique. The major difficulty in implementing this technique is the problem of convincing the affected parties to agree on the criteria and standards. The advantage is that validation of these standards and criteria needs to be accomplished only once. . This same problem applies to weighting procedures, except that validation of weights must be established for every proposed project. Direct display techniques offer

the advantage of presenting data in a clear, unbiased manner, allowing totally independent evaluation by a number of parties with conflicting viewpoints.

Conclusions

This chapter presents an outline of the tasks involved in the impact assessment process, and addresses in a general manner the various techniques that have been proposed to accomplish each task. A survey of these techniques indicates that there is much work yet to be done if these are to be broadly accepted as project evaluation methodologies. As the proposed methodologies have been presented in the literature, it is evident that many are useful only for the performance of a few of the tasks of assessment, and as such, their effective application in practical situations depends on their use in combination with other techniques.

A primary obstacle to the application of most techniques is the difficulty, in most cases, of validating value judgements. In the absence of comprehensive, region-wide studies and a more encompassing framework of policies, criteria, and planning, the project level impact assessment is restricted to a purely descriptive plane. The absence of this framework makes the comparison of alternatives difficult and tedious, and if value judgements are applied, the impact assessment is left open to dispute.

In selecting one or more of these techniques for use in a given situation, the assessor should make a preliminary estimation of the magnitude and importance of the project. An administrative action of this kind will allow wise allocation of manpower and data gathering resources. Much of the day to day impact assessment that faces a monitoring or regulatory agency can be handled with a minimum of personnel and other resources, since these projects are amenable to evaluation using standardized techniques and forms. Assessment techniques for projects of larger magnitude or social importance must be carefully chosen and tailored to fit each situation.

CHAPTER III
IMPACT ASSESSMENT IN LOUISIANA

Introduction

The material in this chapter is directed toward demonstrating the relationship of responsibilities, policies and guidelines of some of the State and Federal agencies to the function of environmental impact assessment. The specific regulatory, project planning, and project implementation activities performed by each of the agencies affecting the coastal resources has been adequately described in other reports, and therefore, this report does not attempt to cover the same ground. For a more indepth review of agency responsibility and function, the reader is referred to the following:

> Louisiana Government and the Coastal Zone. Prepared by the Louisiana Advisory Commission on Coastal and Marine Resources. March 31, 1972.
>
> Recommendations for the Environmental Protection Plan. Report Number 3. Louisiana Superport Studies.
>
> Wetlands '73: Toward Coastal Management In Louisiana. Annual Report of the Louisiana Advisory Commission on Coastal and Marine Resources. March, 1973.
>
> Environmental Protection Plan of the Louisiana Deep Draft Harbor and Terminal Authority. January 26, 1974.
>
> Louisiana State Agencies Handbook. Public Affairs Research Council of Louisiana, Inc. March, 1969.

In the period since the references cited above were published, the only significant change which has occurred involves the Corps of Engineers jurisdiction. On March 27, 1975, a U.S. District Court ruled that the Corps of Engineers' responsibilities, under Section 404 of the Federal Water Pollution Control Act Amendment of 1973, must be expanded to include a new definition of "the waters of the United States." Four alternative definitions have been proposed by the Corps, but none has been selected as yet.

Activities Subject To Impact Assessment In The Coastal Zone

Preparation of formal impact assessments in Louisiana is performed entirely in response to the provisions of NEPA, and thus is applied only to actions which are either federally funded or federally regulated. Those actions which are initiated either by the State or by private parties and which receive neither federal funding nor fall under federal regulatory jurisdiction are not subjected to formal impact assessment procedures.

Projects falling under the former category, federally funded or regulated, are of several types: public works projects, projects requiring federal permits, federally sponsored programs or projects that are not developed under Water Resources Council guidelines, and federally sponsored actions which have been determined to be insignificant as a class.

Public Works Projects

Public works projects are processed through a long, drawn out procedure that may cover 10 to 15 years from conception to project implementation. Prior to the passage of NEPA in 1969, impact assessment of these projects on the federal level was restricted mainly to that which was provided for in the traditional benefit-cost analysis. After the passage of the Act, impact statements had to be prepared for all projects which had not yet been implemented, and all continuing programs.

New projects of the public works variety in the coastal zone are generally developed under the guidelines of the Water Resources Council and are also examined under the provisions of Section 102(2)(c) of NEPA. Due to the excessively long delay between project conception and implementation, impact statements and plans must be reviewed and up-dated periodically (every 3 to 5 years) to include any new data that may have been gathered, and also to determine if the project is still justified in view of shifting attitudes, policies, and needs.

The manner in which public works projects are initiated, planned, and implemented varies slightly depending on the particular sponsoring or responsible agency. For purposes of illustration, the development of a Corps of Engineers public works project is traced below.

In general, a Corps project, from conception to implementation, must follow these steps:

1. A project is conceived by local, state, or federal entities and is introduced to the Committee on Public Works of either the House or Senate for consideration.

2. The committee then adopts a resolution calling for a preauthorization study, and forwards this to the Corps Chief of Engineers.

3. The Chief of Engineers then directs the proper district to proceed with the preauthorization study.

4. The preauthorization study assesses the general feasibiliby and environmental impact. Included in this study is a draft environmental impact statement. If the project is found to be technically feasible and the benefit-cost analysis ratio is determined to be 1:1 or greater, a district project report is written recommending further study. A benefit-cost ratio of less than 1:1 indicates the project is not feasible.

5. The district project report is sent to Division Headquarters and then to the Chief of Engineers for review.

6. If these levels concur with the conclusions of the report, it is returned to the Public Works Committee. If the project or project report is found to be inadequate, it is returned to the district level for revision.

7. If the report is favorable and the committee concurs, it is placed before the full House or Senate as part of a bill. If it is passed, the Corps is directed to conduct a post-authorization study.

8. In the post authorization study, the project is examined in much greater depth for technical feasibility and the impact statement is refined and expanded if necessary. If this study shows that the benefit-cost ratio is still 1:1 or greater, it is sent to the divisional and national level for review.

9. If the review at both these levels is favorable, it is returned again to the Public Works Committee for their review. If they concur with the results of the study, a general design study is authorized in which the general design specifications are determined. A revision of the EIS is included in this study.

10. With the completion of this study, a project report is returned to Congress for project authorization. The project is included as a part of a bill, passed by Congress, and signed by the President.

11. Before obtaining funding, the bill is examined by the OMB (Management & Budget). If they concur that the project should be funded, the project is returned to Congress in an appropriations bill.

12. Once Congress passes the appropriations bill, the project is funded and can go to development of detailed design specifications and construction.

Permits

Actions requiring federal permits are subjected to examination through the environmental impact statement process only if preliminary assessment indicates the likelihood of significant impacts or controversy.

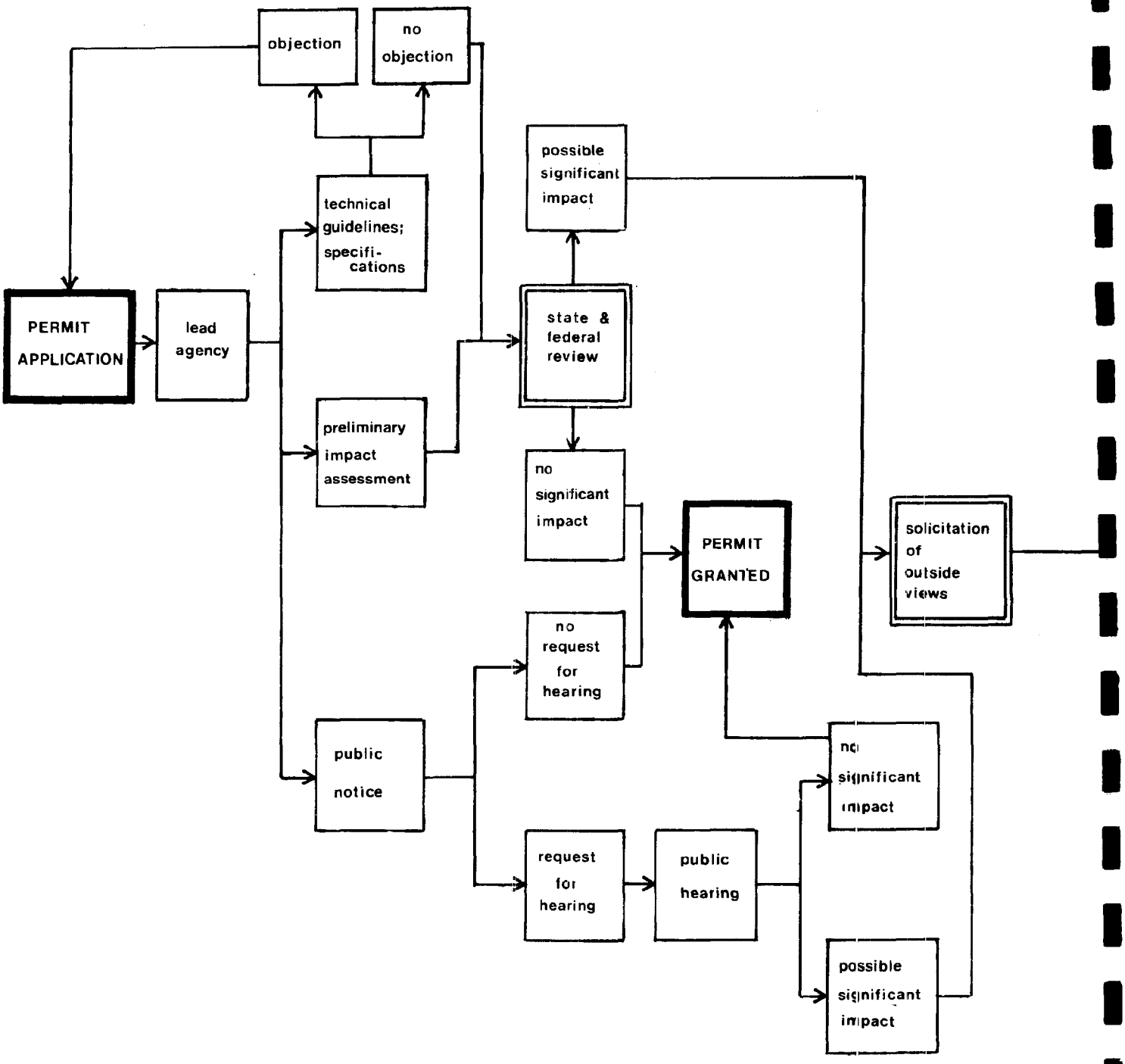
The majority of permits issued in Louisiana's coastal zone are granted by three agencies: the U.S. Army Corps of Engineers, the Environmental Protection Agency (EPA), and the U.S. Coast Guard.

The Corps of Engineers issues permits on projects affecting flood control, navigation, dredge and fill operations, and national defense. In regulating activities affecting those areas of its jurisdiction, the Corps may also consider any factor affecting the general public welfare, including environmental effects on fish and wildlife, aesthetics, and water pollution. As noted earlier, the physical limits of the Corp's jurisdiction are not well-defined at the moment, but are almost certain to be greatly extended. The State exercises no permitting authority exactly equivalent to that of the Corps. The Corps of Engineers permit examination and approval process is outlined in Figure 1.

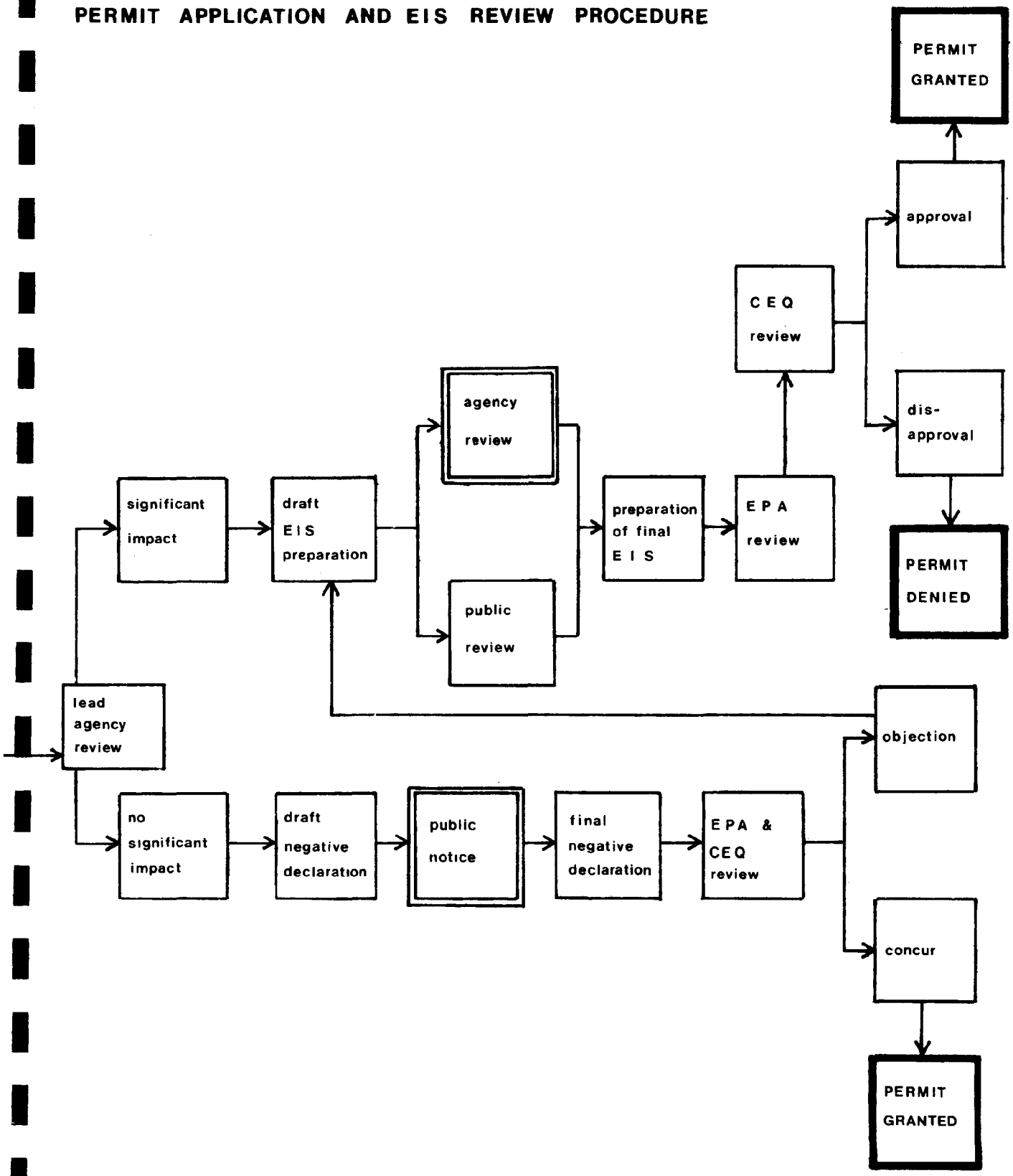
Issuance of permits under the direct authority of the EPA is restricted to regulation of water discharges. EPA also exercises indirect control over air discharges.

Industries wishing to discharge into Louisiana waters are required to obtain two separate permits. The first is a State permit which is issued under the direct authority of the Louisiana Stream Control Commission (SCC).

FIGURE 1: GENERALIZED CORPS OF ENGINEERS



PERMIT APPLICATION AND EIS REVIEW PROCEDURE



Through this permit, the SCC may require an applicant to achieve effluent quality more stringent than that called for under EPA discharge standards. The second permit is that required by EPA under the National Pollutant Discharge Elimination System (NPDES). These permits are prepared by the Louisiana Stream Control Commission, but are issued under the authority of the EPA. Louisiana will be able to assume direct permitting authority over the NPDES permits if the State passes legislation bringing the State's discharge regulation laws into compliance with EPA regulations. Similarly, NPDES permits for municipal discharges are prepared by the State Health Department, but are issued under the authority of EPA. The State may require more stringent discharge standards than those of EPA, and also, the State may gain direct permitting authority by passing the appropriate legislation. Under rare conditions preparation of an environmental impact statement may be required before a permit is issued under the NPDES.

Air emissions are regulated by the Louisiana Air Control Commission through a permitting system analagous to the NPDES for water discharges. In this case, the State's implementation plan meets EPA requirements, and therefore, the Air Control Commission has direct control over the issuance of permits. EPA exercises indirect control over the State's permit granting process in the following manner. If an applicant wishes to emit materials at a rate higher than established standards, he must receive a variance from the State Air Control Commission. However, the granting of a variance requires a revision of the State's implementation plan, which in turn can be done only through the permission of the EPA. EPA will allow revision of the plan only if the applicant and the Commission can demonstrate that such action will not violate ambient air quality standards.

Impact statements are not prepared in direct response to applications for air emission permits. Impact assessment for these permits takes the form of a determination of the extent that the source either complies with emission standards or may cause ambient air quality standards to be violated. The social, economic, and natural implications of the emissions are not examined for each permit application, since these factors have already been considered in the development of the federal and State plans.

The U.S. Coast Guard's control over coastal activities through the issuance of permits is restricted to two areas: (1) permits to allow construction of bridges over navigable waters, and (2) permits regulating offshore dumping. These permits are processed in the same manner as the Corps permits.

None of the federal government's permitting activities are developed or covered under Water Resources Council guidelines.

Insignificant Actions

Actions which have been determined to be insignificant as a class are subjected to at least some degree of impact analysis through the benefit-cost analysis procedure required for funding approval from the Office of Management and Budget. In addition, each agency is required by CEQ guidelines to develop lists of significant and non-significant classes of projects and actions. Such a requirement affords an additional degree of impact analysis. Also, some of the programs from which these spring are developed in accordance with Water Resources Council guidelines.

Actions that have been declared to be insignificant as a class are generally of the type that provide funding for upgrading or maintenance projects such as road resurfacing and minor additions to improve safety. Agencies charged with implementing these projects are required to develop guidelines to ensure precautions are taken to prevent or mitigate impacts.

Other Federal Projects and Actions

Certain federally sponsored projects that may have significant impacts on coastal resources do not fall under any of the categories listed above. An example of such a project is the Department of Agriculture's mirex or fire ant eradication program. Such projects or programs are not developed under Water Resources Council guidelines, but are subject to evaluation by the sponsoring agency through the EIS procedure.

Non-Federal Actions

The final category of projects that affect the coastal zone are those programs and/or actions that are administered or funded entirely through State or private resources and that require no federal permits. Impact assessment of State sponsored projects and programs is performed in a less formal manner through coordination among the affected agencies. Privately sponsored and funded projects are examined in a similar manner.

Federal Impact Assessment Policy and Activities

In general, guidelines issued by federal agencies regarding impact assessment have been concerned almost exclusively with procedural and

administrative matters rather than establishing complete assessment methodologies as they have been described in Chapters I and II in this report.

Beginning in 1974, Federal agency assessment guidelines had to be revised to bring them into compliance with the new CEQ directives promulgated in August, 1973. The scope and usefulness of these revisions varied from agency to agency, but, in general, they resulted in a more precise enumeration of the types of impacts to be examined, some suggestions as to how these impacts can be measured, and a policy statement calling for integration of the impact assessment and statement into all levels of the planning process. Most call for an explicit integration of local, regional, state, and public comments and opposition into the decision-making process. Also, the new guidelines describe more explicitly the range of alternatives to be considered and points in the planning process where they are to be considered.

Still, with the exception of the Federal Highway Administration, none of the agencies have responded to the related problems of how alternatives are to be screened and selected for implementation. CEQ's 1973 directive explicitly emphasizes the need to objectively quantify impacts, but only indirectly implies in the section entitled, "Responsibilities of Commenting Entities", that agencies should have some evaluation system. "Emphasis should be placed on the assessment of the environmental impacts of the proposed action, and the acceptability (emphasis added) of those impacts on the quality of the environment, particularly as contrasted with the impacts of reasonable alternatives to the action." (38FR 147, August 1, 1973)

The response of the Federal Highway Administration to the problems of how to evaluate impacts and alternatives is to require the lower level highway agencies to develop and identify in their Action Plans procedures for performing these functions.

The fact that most federal agencies have not developed and implemented complete impact assessment methodologies is understandable when one considers the nature of these entities, the state of the art of impact assessment, and the failure of CEQ to provide more explicit guidance.

Much of the impetus toward active development of techniques to include the evaluation function in the assessment process has been funded through various federal programs or EIS subcontracts to consultants, but their direct application by federal agencies active in Louisiana's coastal

zone has been slow to emerge. One agency, the Department of the Army, has issued recommended procedures for the organization and description of impacts, but these are applied at the discretion of the local branch, and they do not deal directly with the problems of valuation and evaluation.

The ultimate impact of the revisions prompted by the new CEQ guidelines is, therefore, difficult to assess, because the revised agency guidelines have had little time to be applied under practical conditions. In general, the overall quality and scope of the data included in the EIS should be improved, and there should be an expanded consideration of alternatives. Also, improved integration of impact assessment into the various levels of the planning process can be expected. However, with the exception of the information contained in the benefit-cost analysis, most new federal agency EIS's are not expected to deal in a systematic, explicit manner with resource values and alternatives evaluation methods. Rather, these documents can be expected to continue to approach impact assessment on the impact analysis level as described in Chapter I of this report. If this assumption is correct, value judgements and the derivation of conclusions will continue to be treated in a superficial, indirect manner.

Thus, the future character and quality of the impact statement and assessment processes as they relate to the project planning process is uncertain. However, prior to the revisions prompted by CEQ's 1973 guidelines, it was evident that: (1) Complete integration of environmental and socio-economic impacts was not occurring on the project level. (2) There was little continuity between the enviro-socio economic analysis performed at the comprehensive planning level (studies developed under Water Resources Council guidelines) and the project planning level. (3) Values and conclusions used by the federal planning entity in formulating plans and projects may not have coincided with those of the affected local, regional, and state bodies. (4) The EIS, as it has been prepared by federal agencies, has been less than ideal as a basis for informed decision-making at the project level. (5) Local, regional, and state interests have not necessarily been fully evaluated in all cases, or may not have been fully considered as a result of negligence or lack of appropriate methodology.

Beyond this, summaries and evaluations of federal guidelines for preparation of impact assessments and statements do not appear in this report because they have little bearing on the usefulness of the environmental impact statement as that document relates to Coastal Zone Planning and the decision-making process. Under the present application of

the process, the usefulness of the impact assessment and the accompanying impact statement depends largely on the inclination of the preparer and the agency interpretation of the descriptions they contain.

Obviously, certain qualitative and quantitative data must be provided in these documents to satisfy the provisions of CEQ. However, if the state, regional, or local authority is not satisfied with the character and quality of the project assessments and evaluations offered by the federal agencies, the State's logical option is to assure itself of the validity of the data provided and then proceed to evaluate the project and its alternatives on the basis of their own policies, criteria and plans. In such a manner, the State and its various subdivisions stand a far better chance of assuring that federal actions are responsive to their own needs.

State Agency Impact Assessment Activities

Primary responsibility for evaluating, regulating, and monitoring the use and commitment of coastal resources and activities in Louisiana is divided among a number of state agencies or bodies: Air Control Division of the Bureau of Environmental Health, Conservation Department, Department of Highways, Department of Public Works, Engineering Division of the Bureau of Environmental Health, Environmental Section of the Attorney General's Office, Governor's Council on Environmental Quality, Mineral Board, Office of State Planning, Offshore Terminal Authority, Parks and Recreation Commission, State Land Office, Stream Control Commission, and Wildlife and Fisheries Commission.

Those agencies exercising the most significant control over ongoing and proposed activities in the coastal areas are the Air Control Division and Engineering Division of the Bureau of Environmental Health, Department of Highways, Department of Public Works, Stream Control Commission, and Wildlife and Fisheries Commission. Also, because of their proximity to and legal interest in coastal activities, the attitudes and authority of the affected city and parish governments, levee boards, and planning commissions significantly influence the use of resources.

With the exception of the Department of Highways, none of the State's agencies or commissions prepare formal impact assessments. Most impact assessment performed in the State is done on an informal level, in the sense that no specific procedures or guidelines are spelled out in agency regulations. Project reports and applications are examined to determine their conformance with the standards and regulations under the purview

of the particular agency, and, where deemed appropriate, field inspection is conducted. If the project in question appears to be in compliance with the agency's standards and guidelines, a letter of no objection is usually issued. If one or more of the parameters are violated, the variance is similarly noted and efforts are initiated to bring the project into compliance.

Actions for which impact assessment is performed are of several types. The two which constitute the bulk of assessment activity are permit application review and draft EIS review. Other review and regulatory activity focuses on approval, inspection, and certification of private projects and review and coordination of programs and activities initiated at the state, regional, and local levels.

The major obstacles confronting these agencies in their attempts to evaluate activities in the coastal zone have been adequately described in the publication, Louisiana Government and The Coastal Zone - 1972, written by the Louisiana Advisory Commission on Coastal and Marine Resources. The evaluation of the problems and needs of the states regulatory agencies contained in that publication compliments the analysis in Chapter I of this report.

Quoting from the Advisory Commission report, those deficiencies and needs have been determined to be:

1. "The State's overall pollution control effort is quite segmented..."

2. "...the lack of any comprehensive concept of the coastal zone as a unique ecological entity; ...only rarely was there recognition of the area as separate and distinct. In brief, little attention is devoted to the management of coastal resources on a systematic and system-wide basis."

3. "Due to this general lack of special recognition of and attention to the coastal zone by the agencies, several corollary problems arise. In the first place, there are no offices, divisions, or sections within any of the agencies that are devoted exclusively to solving problems of the coastal zone as they relate to the particular activities of the agency. Hence, relatively little attention is devoted to regional, cooperative planning; and the agencies, for the most part, view their own problems as separate and detached from the larger problems of the coastal zone as a whole."

4. "A second corollary of the lack of special recognition and attention to the coastal zone is the absence of any clear-cut state policies or priorities as to how coastal resources--air, water, minerals, fish, wildlife, recreation, land--should be utilized in future years. Wise management of natural resources requires rational policy decisions regarding the many complex and interdependent uses of these resources. Many environmental quality-economic development issues are involved. Yet individuals charged with the authority and responsibility to make complex decisions regarding the utilization of coastal resources have nowhere to look for general policy guidance--they are operating in a policy vacuum in this regard.

An example of this lack of clear-cut policies or priorities in which resource decision-makers presently operate is the current environmental review procedure of the Wildlife and Fisheries Commission. The Commission is routinely requested, by both federal and state agencies, to review proposed projects for their impact on the environment. However, there is no direct statutory basis for these reviews, and there is no clear state policy setting out environmental priorities. Hence, the decisions are necessarily made on an informal ad hoc basis.

Another example of the lack of clear resource management policy is that there is no state policy guiding the State Parks and Recreation Commission in defining how public park areas are to be preserved or utilized.

In addition, there are no formalized standards or criteria guiding the State Land Office in determining how land owned by the state or its political subdivisions is to be utilized. Moreover, there are no established environmental guidelines for reviewing public works projects undertaken by the Department of Public Works in terms of their potential impact on the coastal ecology and living resources (except when the Corps of Engineers is also involved)."

5. "As a result of this lack of policy guidance, the resolution of natural resource issues and problems within the context of the coastal zone becomes difficult. There is no frame work for decision-making and each issue is resolved on an individual and ad hoc basis with perhaps insufficient consideration given to the long-range effect on other beneficial uses of the coastal zone. For a state whose well-being is so closely tied to its marine and coastal resources, this is certainly unfortunate."

6. "A related problem to the present decision-making procedure concerns the appointment of new boards or commissions to solve particular narrowly-defined problems or to promote special projects.

   Presently there are several such boards. These special purpose boards and commissions would appear to be generally underfunded and unable to rely on a stable source of funding. As a result, these boards and commissions are frequently understaffed and may be unable to perform their jobs adequately. Additionally, these special purpose boards and commissions may tend to compete with other agencies which have broader perspectives and may be better equipped to make decisions on a systematic and system-wide basis."

7. "...agencies sometimes have problems of coordination. For example, the state's activities with regard to transportation are divided among several agencies with the result that there is no one central focus for comprehensive transportation planning where Louisiana has jurisdiction."

   "Another area where there may be problems involving a lack of coordination is in the pollution control field." "...it appears that the present state administrative framework for pollution control activities lacks centralized control and coordination. At present, there is no single agency in state government that has clear responsibility for the overall pollution control program."

8. "Another issue with regard to the administration of natural resource agencies concerns the current reliance on boards and commissions to govern the various agencies."

9. "A further problem confronting many of the agencies operating in the coastal zone is a perennial one--lack of funds. Many of the agencies studied feel that they are understaffed, underequipped, and that salary schedules are too low."

These problems, viewed as a whole, have resulted in the substitution of federal agency interpretations, values, and criteria in much of the decision-making process rather than state and local values. That is, many of the decisions concerning coastal resource allocation are being made on the basis of federal agency judgement rather than that of the State and local governments. As the Corps of Engineers stated in a 1973 EIS, "An overall plan for coastal land use in Louisiana does not currently exist, and it is not known when such a plan will be available for its implementation. In absence of an overall plan, the Corps of Engineers considers it feasible and desirable to proceed with projects that are determined (by the Corps) to be in the best total public interest." (Final Environmental Statement: Atchafalaya River and Bayous Chene, Bouef, and Black, Louisiana, March, 1973).

If the State wishes its own values, criteria, and interpretations to be substituted for those of the federal agencies, it must first determine in a more precise manner exactly what the State's values and criteria are, and it must then devise a means of applying them to specific activities.

CHAPTER IV

IMPACT ASSESSMENT METHODOLOGIES: AN ANNOTATED BIBLIOGRAPHY

Adkins, William G. and Dock Burke Jr., 1971. "Interim Report: Social, Economic, and Environmental Factors in Highway Decision Making", research conducted for the Texas Highway Department in cooperation with the U.S. Department of transportation, Federal Highway Administration: College Station, Texas; Texas Transportation Institute, Texas A & M University.

The Adkins methodology is a checklist using a +5 to -5 rating system for evaluating impacts but providing no guidelines for measuring impacts. The approach was developed to deal specifically with the evaluation of highway route alternatives. Because the bulk of parameters used relate directly to highway transportation, the approach is not readily adaptable to other types of projects.

The parameters used are broken down into categories of transportation, environmental, sociological, and economic impact. Environmental parameters are generally deficient in ecological considerations. Social parameters emphasize community facilities and services.

Route alternatives are scored +5 to -5 in comparison to the present state of the project area, not the expected future state without the project. Since the approach uses only subjective relative estimations of impacts, the data, manpower, and cost requirements are very flexible. Reliance on subjective ratings without guidelines for such ratings greatly reduces the replicability of analysis and generally limits the valid use of the approach to a case-by-case comparison of alternatives only.

The detailed listing of social and, to a lesser extent, economic parameters may be helpful for identifying and cateloging impacts in other types of projects. An interesting feature of possible value to other analyses using relative rating systems is the practice of summarizing the number as well as the magnitude of plus and minus ratings for each impact category. The number of pluses and minuses may be a more reliable indicator for alternative comparison since it is less subject to the arbitrariness of subjective weighting. These summarizations are additive and thus implicitly weigh all impacts equally. (20, 166)

Alden, H.R., "Environmental Impact Assessment, A Procedure For Coordinating and Organizing Environmental Planning", College of Forestry and Natural Resources, Colorado State University, Fort Collins, Colorado, and Thorne Ecological Institute, Boulder, Colorado, unpublished.

This paper presents a seven-step procedure for conducting an environmental impact assessment leading to environmental planning. The seven steps are as follows:

(a) Coordination and communication
(b) Environmental resource inventory
(c) Evaluation of environmental dynamics
(d) Map graphics
(e) Description of the proposed land use changes
(f) Evaluation of environmental impacts resulting from proposed alternative land uses.
(g) Recommendations to avoid or mitigate environmental impacts.

The methods presented have been tested on several proposed land use changes in the Rocky Mountain West.

Anderson, J. et al., October, 1973. "Environmental Assessment", in Environment: A New Focus for Land Use Planning. National Science Foundation, Wash., D.C., NSF/RA/E-74-001.

Environmental evaluation processes are analyzed in this paper in an attempt to aid governmental bodies, at all levels, in the assessment of environmental impact. The numerous questions for which answers are being sought regarding environmental assessment are seen as having one central similarity in this discourse: they pose problems of evaluation in which comparisons are being made between alternatives which require the assignment of weights to the impacts of these alternatives - to the gains and losses of environmental, social and economic things of value; and to the gains and losses of different individuals or groups - in order to decide the "best" action to be taken.

Andrews, R.N.L., April, 1974. Comments on "An environmental Evaluation System For Water Resource Planning," by Norbert Dee, et al. Water Resources Research, Vol. 10, No. 2, pp. 376-78.

This comment questions several features of the system of Dee et al. The discussion centers on the meaning of "parameter importance values," the selection of parameters, the boundaries of the analysis, the value functions used, and the need for more discussion of productive techniques. (20)

Andrew, R.N.L., 1973. "Approaches to Impact Assessment: Comparison and Critique". Presented at Short Courses on Impact Assessment in Water Resource Planning: Amherst, Massachusetts; Ann Arbor, Michigan; and East Sound, Washington, May and June 1973.

This paper identifies the principal tasks that must be performed in an impact assessment of a major action; and in the context of these tasks, introduces and critically compares a series of procedures that have recently been developed or used for such assessment. It is the contention of the author that these procedures vary considerably in their general usefulness; that most of them are appropriate for only some rather than all of the tasks associated with impact assessment; and that the tasks for which some of them are best suited are not those emphasized by their authors.

The task of planning impact assessment is subdivided into:

1. Identifying evaluative factors
2. Developing a system description
3. Formulating alternatives
4. The forecasting of effects
5. The display of trade-offs
6. The evaluation of alternative sets of actions.

Some of the procedures included are U.S.G.S. Circular 645, Battelle-Columbus Laboratories/Bureau of Reclamation, Kane, and Sorensen. (20)

1. Identification of evaluative factors:
   a. Checklists
   b. Matrices
   c. Gaming Approach (NEXUS)
   d. Public and professional involvement in terms of meetings, workshops and opinion surveys.

2. Systems Descriptions
   a. Cross-impact Matrices (Werth and Associates)
   b. Networks (Robert R. Nathans Associates)
   c. Combinations of matrices and networks
      i. Stepped Matrix (Sorensen)
      ii. K-SIM Technique (Kane)

3. Formulation of Alternatives:
   a. This task cannot be effected through the development of a "methodology". Rather, it must remain a function of the planners of a project and guidelines set by the agency, state or planning party.

4. Forecasting of Effects:
   a. Intuitive approach; professional opinion
   b. Delphi Techniques
   c. Experimental manipulation of analagous systems

d. Manipulation of a mathematical simulation of the system under study.

5. Display of Trade-offs:
   a. Cross-impact matrices
   b. Narrative scenarios
   c. Computer tracings (e.g., K-SIM)
   d. Overlay techniques (McHarg)
   e. Factor Profiles (Bishop)
   f. Accounts or trade-off balance sheets (U.S. Water Resources Council) (Atomic Energy Commission)

6. Evaluation:
   a. Direct display techniques (matrices, overlays, etc.)
   b. Constraint setting; establishing standards and criteria
   c. Weighting procedures: (Leopold) (Stover) (Battelle-Columbus Laboratories).

Armstrong, R.H.R., and Margaret Hobson, 1970. "The Use of Gaming/Simulation Techniques in the Decision Making Process." United Nations Paper No. ESA/PA/MMTS/21.

This method as been dubbed the NEXUS procedure by the authors. It has been used in many situations as a device for eliciting key factors and conflicting assumptions about potential impacts of a project. It is used in a workshop setting in which participants, presumably reflecting a range of competences or views on the planning situation, may start with a blank board, and place around its edge items which each considers most important in the planning situation at hand. A particular action is them assumed and the participants attempt to identify the items which might be significantly affected by it, first individually, and then, by discussion and argument over conflicting assumptions, collectively as a concensus. Gridded scaling cards can be used around the outside of the board to keep track of conflicting assumptions, magnitudes of impacts, or sequences of impacts.

NEXUS has essentially the same advantages and limitations as other checklist procedures, except that it was explicitly designed to incorporate multiple and conflicting judgements in a particular situation rather than as a standard checklist to fit all situations. As a result, it involves greater risks of ignoring some types of impacts, since it is very sensitive to the views and abilities of the participants using it. For the same reason, however, it may provide a better tool for identifying the potential impacts that are perceived by participants as most significant, and thus for setting appropriate priorities for further research and analysis. It can also contribute to establishment of an open dialogue between agency personnel, non-agency professionals, and interested citizens, which could be educative for all of them. (8)

Arthur D. Little, Inc., April, 1971. "Transportation and Environment: Synthesis for Action, Impact of National Environmental Policy Act of 1969 on the Department of Transportation, Volume 1: Summary." Prepared for Office of the Secretary, DOT (Washington, D.C.)

This report is neither directly applicable to water resources planning, nor is it limited in scope to environmental impact assessment per se. However, Chapter III (pp. 23-38) contains a useful conceptual discussion of the problems inherent in measuring environmental impacts. It is suggested that an environmental impact can be described in terms of its "amount, effect and value," where the "amount" is a quantity related to the physical or social process that occurs, the "effect" is the response generated by the amount, and the "value" is an indicator of the cost of the impact. The primary difficulty lies in the fact that, at present, "only the 'amount' can ordinarily be measured or forecast quantitatively, and even this is generally only possible for physical rather than social impacts."

Potential environmental impacts of transportation projects are presented in tabular form arranged according to category (e.g., noise, air quality, water quality) and phase of project development. The classification of impacts by phase of development - planning and design, construction, and operation of facility (subdivided into direct and indirect impacts) is a useful concept. Recognition of the fact that environmental effects can occur in the planning and design phase, i.e., before the start of construction, is notable.

Chapter III also presents five conceptual procedures for determining the significance of an impact and analyzing the trade-offs between alternatives. These are: (1) reliance on the emergence of controversy, (2) evidence of governmental concern through the "A-95 comment process," (3) presumption of a direct relationship between significance and project scale or cost, (4) reliance on the professional judgment of a multidisciplinary team of experts to predict the probability of significant impacts intuitively, against a graded "significance scale," and (5) environmental cost-benefit calculation, utilizing a systematic framework in which environmental values are analyzed and evaluated using some kind of "units of environmental quality." None of these procedures is elaborated upon to any extent.

In general, the reference cited is a useful discussion of some of the important issues of impact analysis, particularly as they apply to transportation projects, but does not present a complete analytical technique. (20,114,166)

"Assessing the Social Impacts Of Oil Spills", Proceedings of an Invitational Symposium Co-Sponsored by The Institute on Man and Science and the U.S. Environmental Protection Agency, Institute on Man and Science, Rensselaerville, New York, September 25-28, 1973.

This report presents the results of an invitational symposium held to encourage the development of techniques and methodologies for the assessment of the social impacts of oil spills. The following major topics were presented at the symposium:

(a) A general overview of the oil spill problem
(b) A description of the primary method currently used to assess oil pollution damage, i.e., EPA's biological assessment of oil spill impacts
(c) An examination of the legal response to oil spills by damaged parties
(d) The response of oil companies and their insurance companies to oil spills
(e) Three methodologies to assess the social impact of oil spills, i.e., systems analysis, economic techniques and political science approaches
(f) The role of public interest groups
(g) Direction and priorities for future developments in assessment techniques and methodologies. (20)

Ballard, 1974. "Water Related Land Use Planning Guidelines, Interstate Commission on the Potomac River Basin, Washington, D.C.

This paper describes a methodology that can be used to perform land use planning for water-related projects. A step-by-step approach for carrying out the planning process is presented. Methods for accomplishing each step are described together with the physical and environmental factors which should be considered.

Battelle Columbus Laboratories, Columbus, Ohio, 1973. "Development of the Arizona Environmental and Economic Trade-Off Model," Office of the Governor, State of Arizona.

This report describes the Arizona Trade-Off Model (ATOM) which provides a means of analyzing the manner in which human activity impacts upon the natural environment at a macro, or aggregate, level. It furnishes a means for evaluating the results of policy or program alternatives before they are implemented. It is designed primarily for the evaluation of policies or programs affecting rates of economic growth, the location of populations and activities, the general level of environmental quality, and the use of land resources.

The model focuses on economic change, demographic growth, and environmental quality. Economic growth is measured in terms of changes in employment by industry, changes in the size of the labor force, and unemployment rates.

Demographic growth is measured by both migration and natural increase. Environmental quality is evaluated through application of four quantifiable as well as subjective environmental components: ecology, physical/chemical, aesthetics, and human interest. The trade-offs between economic growth and environmental quality are measured in terms of economic opportunity costs. In doing so, the intangible benefits of an improved environment can be balanced against problems caused by economic growth.

In ATOM, the environment is defined in a broad context. The impacts of various economic development and environmental policies are measured in four major categories:

1) Physical/Chemical
2) Ecology
3) Aesthetics
4) Human Interest.

These categories are also incorporated into ATOM as potential environmental constraints on types and magnitudes of economic development. The constraints of environmental policies may be used to modify the growth that is desired in a state, a county, or a city.

Two types of environmental constraints are used in the ATOM to assess the feasibility and desirability of economic development. These include physical-chemical constraints and land-use constraints.

(a) Physical-Chemical Constraints

The waste released by an industry or population has impacts on the air, water, and land of Arizona. These impacts are measured by changes in physical/chemical parameters such as Biochemical Oxygen Demand, Suspended Solids, Sulphur Oxides, and Particulate matter. In ATOM direct measurements of these parameters are used to establish environmental constraints. That is, alternate levels of say BOD or SO_2, may be allowed to enter the environment and by changing these allowable levels, various environmental policies can be introduced into the model.

(b) Land-Use Factors

The location of an industry or population center, its design, and the amount of waste released at a site have impacts on the aesthetics, ecology, and human interest of the environment. A detailed site specific environmental analysis can measure the direct impact of these components. Because site specific, geographic detail is not practical at the present level of model development and these categories cannot be related directly to

development, as is achieved in the physical/chemical category, a macro-environmental approach is used. This approach incorporates these semi-quantifiable components into ATOM through special land-use factors.

The other three categories of the environment (aesthetics, ecology, and human interest), are transformed into "land-use" factors. Therefore, a constraint on aesthetics, ecology, and human interest is implemented in the model by constraining the type of and extent of land use allowed in a particular location in Arizona. (20)

Bender, M. and Ahmed, S.B., February, 1974. "Index of the Composite Environment (ICE): A basis for Evaluating Environmental Effects of Electrical Power Generating Plants in Response to NEPA." Oak Ridge National Laboratory, Oak Ridge, Tennessee. ORNL-TM-4492.

This manual presents a procedure for: 1) Evaluating the environmental impacts of electric power generating plants; 2) Correlation of impacts with economic considerations; 3) Selection of alternative site locations and plant types. The ultimate intent of the method is to enable the evaluator, acting in the public interest, to see the balance of trade-offs for several alternatives in terms of both environmental and monetary costs.

Two major evaluative components are involved in the method. The first is an environmental impact evaluation component in which impacts of each alternative are defined, evaluated, weighted, and aggregated. The second is an economic evaluation which is a modification of the traditional benefit-cost analysis.

Two purposes can be served by this type of analysis: 1) preliminary screening of potential sites and power generation combinations; and 2) a mathematically derived, graphically displayed method for determining the point of diminishing returns between economics of power generation and environmental quality obtained.

The authors contend that with this method "... it is possible to measure relative environmental impact as a function of environmental controls available through engineering and operational alternatives."

The need for inclusion of both environmental constraints in the evaluation process is emphasized. Environmental constraints are based on regulatory requirements in combination with a value scale for damages which may be mitigated by appropriate environmental controls. The economic constraints are related to market price and demand considerations with resource availability as an independent limitation.

The matter of public preference and its influence on environmental evaluation is recognized, and approaches to weighting various elements of the ICE are suggested to balance their significance. The AEC Table of Environmental Impacts is used as the basis of the approach developed in this study, but its application is not restricted to this combination of environmental effects. It is adaptable to almost any type of environmental evaluation where monetary and non-monetary considerations are involved.

Risk-sensitive control actions are identified as important factors in environmental evaluation. The lack of suitable methodology for appraising risk is noted, and certain qualitative guidelines are offered with respect tc environmental decisions as a means of establishing a suitable risk-aversion attitude.

The approach is designed to meet the needs of regulatory agencies which must deal with environmental impacts. With some further development of detailed methodology and with proper use of reference experience, the approach described in this report should be usable in providing a rational basis for environmental evaluation for regulatory purposes in response to NEPA.

The method proposed in this document is a rather sophisticated and complicated approach to impact assessment. In theory, it more closely approaches a true impact assessment than any other reviewed. The strong point of the method is that it attempts to clearly delineate the trade-offs, both "monetary" and "environmental". It goes further than most approaches by specifying the means by which the traditional economic costs and benefits are to be compared with the attainment or retention of environmental quality.

The problem with the approach is its complexity would take a fair amount of expertise and training to utilize, and its presentation to the public would be quite defficult. Inevitably the value judgement inherent in both the environmental weighting system and the economic analysis become buried in the graphs and aggregation of factors. Manipulation of the data could easily bias the analysis.

The concepts and methods applied in this approach are worth further consideration.

Bishop, B., 1972. "An Approach to Evaluating Environmental, Social, and Economic Factors In Water Resources Planning," Water Resources Bulletin, Vol. 8, No. 4, pp. 724-734.

Decisions among water resources planning alternatives must consider, along with engineering and economics, a variety of environmental and soical effects which are viewed and weighted differently by different interest groups. This paper briefly discusses present methods of project evaluation and then describes an appoach adapted from highway planning literature for evaluating both monetary and non-monetary variables and presenting them to decision makers at all levels. Social and environmental consequences are analyzed and presented using a graphical description called a "factor profile" which measures in appropriate units all relevant non-monetary effects of each alter-

native. Then, using the factor profile and engineering-economic analysis, a series of paired comparisons are made to obtain a preference ranking among alternatives. Since preference decisions are extremely complex, a step by step procedure to simplify the decision-making process is described. A case example considering four proposed flood control alternatives with the relevant environmental and social impacts is given to illustrate the use of the factor profile and the decision making procedure.

As a basis for evaluating and communicating both monetary and non-monetary consequences, two rules must be kept in mind:

1. The decisions must be based on the differences among alternatives.
2. That money consequences must be separated from the consequences that are not reducible to monetary terms; then these irreducibles must be weighed against the money consequences as part of the decision making process.

Methodology:

1. Economic Analysis

Perform an economic study which includes all factors that can be reduced to monetary terms. This step is essentially a conventional cost-benefit analysis.

Once the costs and benefits for each alternative have been assigned, an incremental analysis is performed. This yields a second B/C ratio which relates the benefits and costs of one alternative to each of the others. The result is a ranking of alternatives according to benefits and costs.

2. Factor Analysis

a. Select factors for examination. Factors and measures should be selected which will adequately describe all important elements of community and environmental impact.

b. Prepare factor profile. This is a graphical representation based on the factors which describe by some appropriate unit of measure the effects of each proposed alternative.

3. Economic and Factor Profile Analysis

Alternatives are compared on the basis of the economic analysis and the factor profiles.

a. Alternatives which are clearly dominated by other in both the economic and factor analysis can be eliminated immediately.

b. Paired comparisons of alternatives. For each viable alternative, the incremental gains and losses for each factor are compared with the remaining set of alternatives.

From this point, the trade-offs that will be required for the implementation of one alternative versus those required for each of the other alternatives can be clearly seen. It is then up to the decision-maker to choose an alternative in light of the monetary and non-monetary gains and losses.

A major draw-back of this system is the lack of a method for aggregating the total impact of each alternative.

An associated problem is found in the selection of "factors" for analysis. The relative worth of alternatives can be affected by assigning too many or too few factors pertaining to economic-engineering parameters on one hand or environmental-social factors on the other. This is the analysis can be prejudiced toward one alternative or another by manipulating the number and subject matter of the factors analyzed. This problem is evident in all of the "dimensionless number-type" analysis.

The authors of this article provide no enlightenment as to how one should go about selecting these factors for analysis, except that factors found to be essentially identical for feasible alternatives should be eliminated from the analysis. Such action, as they stress, allows the evaluator to concentrate on the differences between alternatives.

Interjection of the "no action" alternative complicates the analysis. It does not appear to have been set up for that type of examination. Differences between the no action and any other alternative are almost all-encompassing.

The system's strong point, in the view of some, is that it does not require the assignment of weighting factors, and allows the reviewer to make his own estimate of the worth of the "losses and benefits."

Bisselle, C.A., et al., 1972. "National Environmental Indices: Air Quality and Outdoor Recreation." MTR-6159, The MITRE Corporation, McLean, Virginia.

Separate indices of Air Pollution and Outdoor Recreation have been formulated and computed for a number of cities in the United States. Guidelines for implementation of an operational data collection and reporting system to allow routine computation of these indices are also contained in this report. The results have been prepared by The MITRE Corporation for selected use by the Council on Environmental Quality in preparing its third Annual Report on Environmental Quality. (20)

Breese, et al, 1965. "The Impact of Large Installations on Nearby Areas," Department of the Navy, Bureau of Yards and Docks, U.S. Naval Civil Engineering Laboratory, Port Hueneme, California, prepared by Bureau of Urban Research, Princeton University (AD 641925).

This analysis of the impact of large installations on nearby areas was undertaken, first, to identify both the characteristics of impact patterns and the devices for anticipating related events and issues, specifying their nature and importance. Stress is placed on the critical early years of the impact situation, for it is then that the characteristics of forthcoming changes begin to become evident and harbingers for the future become clear. The second objective is to suggest procedures or methods for dealing effectively with the impact situation during its various stages of development, particularly in the critical early years.

The study consists of an introduction in Part 1, followed by five case studies in Part 2, and recommendations in Part 3. The case studies are United States Steel Corporation's Fairless Works, the Grumman aircraft plant on Long Island, the reactivation of a U.S. Air Force base near Dover, Maryland, a U.S. Navy training base (Sampson) in central New York State, and the Savannah River plant of the AEC. (20)

Bromley, D.W., et al., 1972. "Water Resource Projects and Environmental Impacts: Towards a Conceptual Model," Water Resources Center, University of Wisconsin, Madison.

As multiobjective evaluation of water resource investments becomes more common, it is important to develop conceptual bases for including monetary as well as nonmonetary impacts in the evaluation process. This is currently hampered by the lack of a comprehensive and systematic model which permits the identification and display of the many project impacts. And, more importantly, there is little information on the linkage between economic activity and many environmental impacts. A start is made by depicting natural resource use by sector of economic activity, with concentration on land use. A simulation model is developed which will determine acres in certain land use categories in Southern Idaho over time without any water development. By being able to predict land use changes with and without a project, the first step in linking economic activity to certain environmental impacts has been taken. (20)

Brown, T.J., 1972. "A Suitability Basis For Analysis." University of Mighican, Presented at Conference on Impact Assessment in Water Resource Planning, Ann Arbor, Michigan, June 3-9, 1973.

This paper presents a highly abstract approach to the problem of land use planning. It begins with the premise that "Each area of land, water, or air has a suitability for certain single or multiple land uses and a rank order within these use categories." The author then proceeds to present systems analysis techniques to determine the optimum suitability for a given land parcel, and to show how these techniques are applied in two case studies. His methodology is as follows: The first step is one of problem determination, where the consequences of an action and the magnitude of their impact upon the present functions of the resources are assessed. The second step involves definition of the study area. It is important to select the smallest body of land which will in fact include all the pertinent physiographic and economic features which will impinge upon the study. The last step is the suitability evaluation methodology itself. The author says that suitability analysis in which natural resources constrain development rather than attract it is the desirable procedure. The analysis procedure consists first of a descriptive inventory of relevant data concerning the area, which are then subjected to multiple factor analysis such as "sieving" or overlaying, or use of a numerical point rating system. The selection of the particular method will be a function of the conditions of available data and other factors. Two examples of case studies applying analytical methods are then given. These are the Staten Island Study done by Ian McHarg in 1969, and the Honey Hill Study, done by Carl Steinitz of Harvard University in 1971. (20)

"Bureau of Outdoor Recreation. March 1974. Handbook: Applications of Remote Sensing and Computer Techniques for Recreation Planning," Vol. 1,2,3 and 4. University of Winconson, Madison, Wisconson.

This environmental assessment system is unique in its remote sensing data gathering and its computer-generated overlays. Statistical methods for sampling the project area (divided into cells for study by random sampling) are documented. A total Impact Index (II) is calculated for each of the cells and compared to the Expected Impact testing of other methodologies. (20)

Cairns, J., 1967. "The Use of Quality Control Techniques in the Management of Aquatic Ecosystems." In Water Resources Bulletin, Vol. 3, pp. 47-53.

The article contains a brief summary of the effects of pollution upon the structure of aquatic communities and outlines the reasons for regional management. A plan for carrying out such a program is suggested. (20)

Cardini, L.P., 1973. "Guide to Professions For Impact Assessment." Presented at Conference on Impact Assessment in Water Resource Planning, Ann Arbor, Michigan, June 3-9, 1973.

This guide is intended to provide the user with a listing of professional expertise in the area of impact assessment. The list of environmental effects around which the guide is structured is based on the Corps of Engineers report "Guidelines for Assessment of Economic, Social, and Environmental Effects of Civil Work Projects," pursuant to Section 122 of the River and Harbor and Flood Control Act of 1970, dated 28 September 1972.

The first part of the guide lists environmental impacts by type, and the professions which may provide insight into each type and subtype. Three major impact types are identified, social effects, economic effects, and environmental effects. For example, under social effects, a sub-type is "desirable community growth." The professions listed under this are: anthropology - applied, cultrual, political, social, human ecology; demography; economy - regional, urban, economic geography; planning - all fields; political science - government, public administration, political psychology; home economics; history; sociology - social psychology, social work, rural and urban sociology; mathematics - statistics, simulation; aerial photogrammetry; cartography.

Part two of the guide gives a definition of each profession cited in part one. (20)

Central New York Regional Planning and Development Board. 1972. "Environmental Resources Management," Prepared for Department of Housing and Urban Development. (Available from the National Technical Information Service as PB 217-517.)

This methodology employs a matrix approach to assess in simple terms the major and minor, direct and indirect impacts of certain water-related construction activities. It is designed primarily to measure only the physical impacts of water resource projects in a water shed, and is based on an identification of the specific, small-scale component activities that are included in any project. Restricted to physical impacts on nine different types of watershed area (e.g., wetlands) and fourteen types of activities (e.g., tree removal), the procedure indicates four possible levels of impact-receptor interactions (major direct through minor indirect). Low to moderate resources in terms of time, money, or personnel are required for the methodology, due principally to its simple way of quantification (major versus minor impact). However, the procedure is severely limited in its ability to compare different projects or the magnitude of different impacts. There is no spatial or temporal differentiation, hence the full range of impacts cannot be assessed. Impact uncertainty and high damage-low probability impacts are also not considered. Only two levels of the magnitude of an impact are identified while the importance of the impacts are not assessed, resulting in moderate replicability. The lack

of objective evaluation criteria may produce ambiguous results. NEPA requirements for impact assessments are not directly met by this procedure.

The value of this methodology is less in the actual assessment of the quantitative impacts of a potential project than in a "capability rating system" which determines recommended development policies based on existing land characteristics. Thus, guidelines on desirable and undesirable activities with respect to the nine types of watershed areas are used to map a region in terms of the optimum land use plan. The actual mapping procedure is not described, however, and hence that aspect of the impact assessment methodology cannot be evaluated here. (20, 166)

Commonwealth Associates, Inc. 1972. "Environmental Analysis Systems," Report R-1447, Prepared for Northern States Power Company, Jackson, Michigan. Appendix B under separate cover.)

A comprehensive environmental evaluation system for comparing alternative proposals for facility location and development is described. The system utilizes a concept of environmental hierarchy and an external weighting of this hierarchy to develop a relative adverse environmental impact number for each alternative. The alternatives are then displayed on a two-dimensional plot of impact vs. differential cost. Appendix B describes an iterative computer display system that performs the calculations and permits the investigation of the effects of changes in the external weights. (20)

Crawford, A.B. 1973. "Impact Analysis Using Differentially Weighted Evaluative Criteria," in Multiple Criteria Decisionmaking, Cochrane and Zeleny, Eds., University of South Carolina Press.

This paper is of two parts: the first deals with a method of analyzing alternative plans using multiple evaluative criteria, and the other discusses its application in an analysis of the value of impacts of several highway corridor alternatives. Delphi techniques are used to generate needed information for the model. After the weights of evaluative criteria are established, a computer-aided analysis procedure yields the impact information. In final, through a computer-generated matrix the alternative's value-sensitive consequences can be learned.

Cross, F.L., 1973. "Assessing Environmental Impact," Pollution Engineering, Vol. 5, No. 6, p. 34(2).

An examination of scientific and matrix analysis. The author compares scientific and subjective impacts and value judgment techniques. He reviews the methodologies of Leopold, Battelle, and the Army Corps of Engineers. It is suggested that environmental data should be charted on an Assessment Function Curve, which may well not be linear. (20)

Dee, Norbert and Neil L. Droby, April, 1972, "Environmental Assessments for Effective Water Quality Management Planning," prepared by Battelle-Columbus Laboratories for the Environmental Protection Agency (Washington, D.C.).

This short (23 pp) report was prepared to give guidance to those planners responsible for preparing environmental assessments for basic, metropolitan, and regional water quality management plans. The report itself does not contain any new material: the discussion concerning the content of an environmental assessment is taken largely from EPA's published procedures for EIS preparation; the approach and "method of conceptualizing the environment" represents an abbreviated version of the "Environmental Evaluation System (EES)" developed for the Bureau of Reclamation (Dee, et al., Jan. 1972). However, in this report the EES is presented more in terms of a conceptual framework, rather than a detailed methodology. The environment is again broken down into four major categories, subdivided here into seventeen components, a number of which have been slightly renamed. Environmental parameters are not specified, but a list of suggested parameters (based on the aforementioned study for the Bureau of Reclamation) is given. Their methodology for weighting and aggregating non-commensurate environmental values, developed in the other roport, is only alluded to here. They simply state that, "To trade off beneficial impacts with adverse impacts and to obtain a net impact, each parameter must be assigned a weight. This weight should reflect the parameter's relative importance in the entire environmental system."

In essence, this report deals primarily with the impact analysis part of their overall assessment methodology; the evaluation procedure is described only in concept. However, two weaknesses can be discerned in their "systematic view of the environment," i.e., their "classification approach" to impact identification. Since their approach is, for the most part, a categorized check list, it is subject to an inherent weakness of any checklist: namely, there is no provision for dealing with the many interrelationships among the items in the checklist. The other major shortcoming in the framework is that it does not deal explicitly with the temporal aspect of impact analysis. It should be noted that these problems are recognized and briefly discussed (though not resolved) in this report.

Dee, Norbert, et al., January 1972. "Environmental Evaluation System for Water Resource Planning," final report to the Bureau of Reclamation, U.S. Department of the Interior, prepared by Battelle-Columbus Laboratories (Columbus, Ohio).

This report presents the refined version of the Environmental Evaluation System (EES) for evaluating the environmental impacts of the Bureau of Reclamation's water resource projects, developed under a previous contract. These refinements were made in the course of field testing the system on the Bureau's Bear River Project in Utah, Idaho and Wyoming.

This methodology is a checklist procedure emphasizing quantitative impact assessment. It was designed for major water resource projects but most parameters used are also appropriate for other types of projects. Seventy-eight specific environmental parameters are defined within the four categories of ecology, environmental pollution, aesthetics, and human interest. The approach does not deal with economic or secondary impacts and social impacts are only partially covered within the human interest.

The EES developed by Battelle-Columbus is based upon a hierarchical arrangement of environmental quality indicators - an arrangement that classifies the major areas of environmental concern into major categories, components, and ultimately into parameters and measurements of environmental quality. The EES provides for environmental impact evaluations in four major categories: ecology, environmental pollution, esthetics, and human interest. These four categories are further broken down into 18 components and finally into 78 parameters.

In response to requirements established by the Bureau of Reclamation, the approach used in developing the EES was comprehensive, systematic, and interdisciplinary. The research team that participated in the development of the EES was comprised of individuals representing the following disciplines: civil engineering, water resources management, sociology, ecology, and landscape architecture.

The EES described in this report provides a means for measuring or estimating selected evnironmental impacts of Bureau projects in commensurate units termed Environmental Impact Units. Results of using the EES include a total score in Environmental Impact Units "with" and "without" the proposed project; the difference between the two scores is one measure of environmental impact. Environmental impact scores developed in the EES are based upon the magnitude of specific environmental impacts and their relative importance as judged by the interdisciplinary team conducting the research.

The categories and components developed for the EES for Bureau of Reclamation project evaluations are:

(240) Ecology
- (140) Species and Populations

(402) Environmental Pollution
- (318) Water Pollution
- (52) Air Pollution

(100) Habitats and Communities Ecosystems (Descriptive only)

(28) Land Pollution
(4) Noise Pollution

(153) Esthetics
- (32) Land
- (5) Air
- (52) Water
- (24) Biota
- (10) Man-Made Objects
- (30) Composition
- (28) Land Pollution
- (4) Noise Pollution

(205) Human Interest
- (48) Educational/Scientific Packages
- (55) Historical Packages
- (28) Cultures
- (37) Mood/Atmosphere
- (37) Life Patterns

the key level in the hierarchy is the third -- "environmental parameters". These parameters were carefully selected so that each would represent "a unit or an aspect of environmental significance worthy of separate consideration." It is at this level that a technique for transforming all the parmeters into commensurate units is introduced. The technique consists of the following three steps: (1) The parameter estimates (based on environmental measurement data, level 4 of the EES, are transformed into "environmental quality values (EQ" (from 1 to 1) by means of "value functions" which relate environmental quality to some parameter scale (e.g., feet, acres, mg/l). (2) All the parameters are weighted in porportion to their relative importance. These weights are determined by the research team using "ranked pairwise comparisons" and an adaptation of the so-called Delphi method, and are expressed Parameter Importance Units (PIU) based on a total of 1,000 PIU. (3) The commensurate units, called Environmental Impacts Units (EIU), are then obtained by multiplying PIU by EQ.

It is not very difficult to find fault with this evaluation system. All of the problem areas inherent in impact evaluation approaches in general, noted in section 3.3 of the chapter, can be found in this approach. In addition, the method contains a number of specific weaknesses aside from the general problems involved in quantifying aspects of environmental quality which have not yet even been qualitatively well described, and aggregating all these values into one measure. The EES has no provision for dealing with interrelationships among parameters. Another major weakness is the complete omission of secondary or project-induced ("Indirect-use" is their terminology) impacts from consideration in the EES. These secondary impacts were excluded from the scope of the study because they were outside the "responsibility of the Bureau."

For the reasons noted both above and in section 3.3 of the chapter, we do not share the reports rather cavalier contention that the approach is "... ready for use by the Bureau of Reclamation in both its project planning and evaluation activities." (114, 20, 166)

Dee, Norbert, et al., 1973. "Planning Methodology for Water Quality Management: Environmental Evaluation System," Columbus, Ohio: Battelle Memorial Institute.

This unique methodology of impact assessment defies ready classification since it contains elements of checklist, matrix, and network approaches. Areas of possible impacts are defined by a hierarchical system of four categories (ecology, physical/chemical, aesthetic, social), 19 components and 64 parameters. An interaction matrix is presented to indicate which activities associated with water quality treatment projects generally impact which parameters. The range of parameters used is comprehensive, excluding only economic variables.

Impact measurement incorporates two important elements. A set of "ranges" is specified for each parameter to express impact magnitude on a scale from zero to one. The ranges assigned to each parameter with a component are then combined by means of an "environmental assessment tree" into a summary environmental impact score for that component. The significance of impacts on each component is quantified by a set of assigned weights. A net impact can be obtained for any alternative by multiplying each component score by its weight factor and summing across components.

The key features of the methodology are its comprehensiveness, its explicitness in defining procedures for impact identification and scoring, and its flexibility in allowing use of best available data.

Sections of the report explain the several uses of the methodology in an overall planning effort and discuss means of public participation. The data, time, and cost requirements of the methodology when used for impact assessment are moderate, though a small amount of training would be required to familiarize users with the techniques used.

Because of its explicitness, the methodology possesses only minor ambiguities and should be highly replicable. Because the environmental assessment trees are developed specifically for water treatment facilities, the methodology cannot be adapted to other types of projects without reconstructing the trees though the parameters could be useful as a simple checklist.

One potentially significant obstacle to use of the approach is the difficulty of explaining the procedures to the public. Regardless of the validity of the "trees", they are unfamiliar devices developed by highly specialized multivariant analysis techniques and public acceptance of conclusions reached by their use may be low. (166)

Ditton, R.B. and T.L. Goodale, 1972. "Environmental Impact Analysis: Philosophy and Methods," Editors, Sea Grant Publication WIS-SG-72-111, Proceedings of the Conference on Environmental Impact Analysis, Green Bay, Wisconsin.

This book is a congeries of articles on the environmental assessment process. Authors evaluate present methods, suggest criteria around which future techniques should evolve, and provide interpretation as to the purpose and scope of the entire assessment endeavor. Articles of special interest are:

J. Armstrong: "Systems Approach to Environmental Impact;" calls for time space grid systems that consider density, duration, and the synergistic effects occurring with other proposed systems.

P. Sager: "Conceptualizing Environmental Impact;" warns that it is premature to construct a framework of critical factors and associated values scales in the absence of a widely accepted philosophy of environmental variables.

E. Roshin: "Some Thoughts on Impact Statements and Mathematics," warns that quantification can result in twisted interpretations and dangerous de-emphasis of those parameters that do not readily lend themselves to quantification.

J. Sorensen: "Some Procedures and Programs for Environmental Impact Analysis;" states that it is necessary to deal with secondary effects. One should list possible environmental effects and then define salient ones due to aspects of scarcity or uniqueness. Recommends "cause-condition-effect" networks.

Krauskopf and Bunde: "Evaluation of Environmental Impact Through A Computer Modeling Process;" regards the essence of impact as the loss of deversity, recommends a computerized four-phased "Regional Environmental Management Allocation Process" (REMAP).

Dunning, Mark C. 1974. "A Systematic Approach to Social Impact Assessment." U.S. Army Corps of Engineers, St. Louis District, Presented at Fifth Annual Environmental Design Research Association Conference, Milwaukee, Wisconson. May 29 - 31, 1974.

The approach to social impact assessment discussed in this paper is compased of two parts. In the first portion of the process, the project area is disaggregated into major interest groups and publics. Major community issues are also identified so that the character of interrelationships among these groups is more apparent. This type of baseline data is aimed at developing an understanding of the project area social system. Utilizing this understanding as a frame of reference, plans are then compared on the basis of the manner in which costs and benefits are distributed over the project area. By forecasting future social conditions given the assumptions of plans or perceptions guiding planning, an understanding of the social trade-offs that alternative plans entail can be developed. This understanding in turn can be reapplied into the planning process to add another dimension to choices that must be made in developing project plans.

Dyer, J.S., 1973. "A Time-Sharing Computer Program for the Solution of the Multiple Criteria Problem." Management Science, Vol. 19, No. 12

This note presents a description of a time-sharing computer program written to implement a man-machine interactive algorithm for the solution of the multiple criteria problem. The interactive algorithm was suggested in a recent paper by Geoffrion, "Vector Maximal Decomposition Programming," Working Paper No. 164, Western Management Science Institute, University of California, Los Angeles, September 1970. A unique feature of this program is the man-machine dialog which obtains information from the decision-maker through a series of simple, ordinal comparisons.

Eisel, L.M., and J.J. Gaudette. April 1974. "Comments on An Environmental Evaluation System For Water Resource Planning by Norbert Dee, et al." Water Resources Research, Vol. 10, No. 2, pp. 379 - 380.

This comment criticizes the system of Dee et al. They claim that this system is not consistent with the NEPA and Water Resource Council's principles of disaggregated information to decision makers. They further question the desirability of estimating the necessary weights and parameters. (20)

The authors of this evaluation believe that the Environmental Evaluation System (EES) is "inadequate for use under real conditions for several reasons.

They object to weighting and aggregation on the grounds that, though these systems consolidate the data, they obscure the basis of value judgements, making it difficult for reviewers to question these judgements. By providing a detailed explanation of the value judgements, one would, however, "compromise the data aggregation objective of the EES."

The EES system tends to obscure new problems a proposed project may create. Dee's system tries to correct for this by the use of the "red flag" procedure.

The EES procedure most vulnerable to criticism involves the PIU. These weights are to be established by "society" and they would not vary "..once they have been established by society." The authors do not describe who constitutes "society", nor how society is to determine these weights. The legislative process has been suggested by others to provide these weights. Freeman and Haveman argue that such an action would be "... naive, unworkable, and undesirable." The authors feel that such weighting by nonelected technicians would simply insert, highly undesirable "personal and biased judgements into the process."

The authors maintain that in the development of the EES. Dee, et. al., ignore and incorporate the evaluation problems that have plagued welfare economists for years.

That these weights would be invariant from project to project is criticized as being unrealistic.

Further, assigning weights to such parameters as D.O. and B.O.D. can easily be questioned, but when one attempts to assign values to such parameters as "awe-inspiring", "oneness with nature", etc., the liklihood of disagreement increases dramatically.

Lord and Warner have succinctly summarized the deficiencies in methodologies similar to the EES:

> "Nonetheless, we are forced to conclude that the indices of environmental quality which we have examined carry more danger than promise if adopted in their present forms. It is too easy for a busy decision maker to accept uncritically a numerical value whether embodied in a benefit-cost ratio or an environmental index. It is also too easy for such an index to become a substitute for full public information and the resolution of conflicts by creative plan formulation and political bargaining."

Environmental Impact Center, Inc. November, 1973. "A Methodology for Assessing Environmental Impact of Water Resources." Cambridge, Massachusetts

Environmental impacts of water resource projects are assessed with a dynamic simulation model for forecasting regional economic and demographic changes and their interactions with water supply and water quality over time. The model was applied to the Massachusetts portion of the Connecticut River Basin.

Modular sectors were developed to forecast regional population and industrial levels, intra-regional land use patterns, and recreational activities. These are linked to a water sector which models stream flows, water supply withdrawals and consumption, and water quality in terms of dissolved oxygen and carbonaceous and nitrogenous oxygen demand. Water quality is based on both point wasteloads from domestic and industrial sources and dispersed source wasteloads from urban runoff. A final module represents biological activities in a stream, including algal concentrations and fish populations.

The population and industry sectors project demographic and economic changes in the region under study. Population is subdivided into six age groups. Industry is divided into eight categories based on cost factors influencing industrial location decisions. These two sectors are linked through supply and demand for labor: job opportunities encourage in-migration; regional labor markets and wage rates affect industrial growth.

Land use is forecasted from demand for single-family and multi-family dwellings, based on demographic characteristics, and demand for commercial and industrial space, based on the industry mix in the region. Groups of households and businesses with similar demands choose locations

within the region based on the extent to which the characteristics of subregional zones match their preferences. Within each zone, land is converted to urban use or re-developed at higher densities depending on the level of demand for each use relative to the existing supply. Land uses forecasted include single- and multi- family residential, industrial and commercial, other urban uses, including institutional and roads and streets, recreational land, and vacant land.

The water sector uses information on the amount and distribution of land uses to forecast water withdrawal and consumption, and point and dispersed source wasteloads for each reach in the river system of the region. Water quality is estimated in terms of dissolved oxygen and carbonaceous and nitrogenous oxygen demand. Steady-state conditions are assumed, with base flows and temperature specified exogenously. The transient water quality impacts of dispersed source wastes are estimated in a submodel by superimposing a storm on the assumed steady-state conditions. Wastewater management plans may be evaluated by specifying outfall locations, treatment levels, and service areas for proposed wastewater systems. The water sector can also be used to estimate the impacts of flow augmentation and interbasin transfers of water.

The recreation sector uses information on socioeconomic characteristics, the amount of existing recreational land, and facilities (including competition among different sites) and water quality to forecast recreational visits in the region and extent of recreation-supported employment. Recreational activities are subdivided into fishing, boating, swimming, and sightseeing.

The riverine ecosystem is modeled in the biology sector in terms of three trophic levels: algae, zooplankton, and fish. Biological activities are, of course, dependent upon water quality in the reach, including both nutrient and dissolved oxygen concentrations. The biology and recreation sectors interact through fishing.

The model was applied to the Massachusetts portion of the Connecticut River Basin to test its accuracy and to identify possible limitations or difficulties when applied to a specific situation. Model simulations were compared to measured or estimated changes in the region wherever possible. (20)

> Environmetrics, Inc. 1971. "The River Basin Model: An Overview." Environmental Protection Agency, Water Pollution Control Research Series, Washington, D.C.

The River Basin Model is a man-machine simulation model, used primarily to replicate the interactions taking place, within a real or hypothetical area, between the local water system and the full range of economic, social, and governmental activities of that area. It is a water resource model representing supply of, demand for, and quality of water, but it is also a labor market model, a land use and assessment model, and several more; it is a

model of an entire regional system with water a subsystem realistically interacting with all the other major subsystems; the output from the operating programs of the computer package illustrates the impact that the water system has on such phenomena as housing selection, employment, and government budgetary activity. Model users are given control over all the resources of the local area being represented. Most of the local business and population use municipally supplied water which must be drawn from the local water system and treated if necessary. The model users may make a wide range of private and public policy decisions which affect the simulations for each of the above phenomena, and which impact the environmental quality of the represented area. (20)

Fabos, J.C. 1973. "Model for Landscape Resource Assessment," Water Resources Research Center, University of Massachusetts at Amherst, Part 1 of the "Metropolitan Landscape Planning Model".

The development and application of a landscape resource assessment model designed to estimate landscape change, both positive and negative, caused by urbanization in the Boston metropolitan region since 1945. The model incorporates the quantitative assessment techniques which were designed to estimate water quality, the use of questionnaires, matrices, mapping of value change isopleths, and other sub-models for parameter evaluations. This is only the first step - a second step is planned that will be designed to provide planners with a model for land use allocation and land use activity management. (20)

Flamm, B. 1973. "A Philosophy of Environmental Impact Assessment." Journal of Soil and Water Conservation, Vol. 28, No. 5, September/ October, 1973 pp. 201ff.

In this view of the assessment process, preferences are expressed for an operational model dealing with interrelationships. When concern with process and procedures dies down, quality and substantive aspects can be more attended. He defines adequate statements and explains why a matrix "in suo jure" is not enough. A broad qualitative procedure of environmental assessment concludes the paper. (20)

Of particular note is the author's opinion that many individual actions now requiring an EIS may not need one in the future if the action is covered by a good up-to-date plan and EIS on the plan. This leads to the conclusion that EIS's on more general plans are very desirable.

However, most analytical methods developed to date are oriented toward single projects. Therefore, the author calls for new research for the development of a framework for analysis of various "hierarchies" of actions or levels of plannings.

The author points out that although the emphasis of NEPA was originally thought to be an evaluation of already agreed upon actions and a casual look at possible alternatives, it is becoming evident that through experience, court interpretations, administrative actions, GAO opinion, and CEQ activities, the NEPA process has evolved into a more useful decision-making concept.

Franklin, William E. and Robert G. Hunt, April 1972. "Environmental Impacts of Polystyrene Foam and Molded Pulp Meat-Trays, A Summary", prepared for Mobil Chemical Company by Midwest Research Institute (Kansas City, Missouri).

This report is worthy of note for the unique environmental impact assessment concept it presents. Because the actual analysis is of little concern in this review, and because the details of the analysis can be faulted in a number of aspects, only the concept below is considered.

The objective of the study was to analyze the "...total environmental impact caused by the production, delivery, consumer use, and final disposal of two alternative fresh meat packages, polystyrene foam and molded wood pulp." The methodology, which they label "environmental profile analysis," is similar in concept to economic "input-output analysis." The analysis attempts to consider the total environmental impact of each product by systematically identifying all the inputs (raw materials and energy) and the outputs (wastewater volume, solid wastes, atmospheric emissions, and waterborne wastes). The "impacts" are quantified, in the manner of conventional economic input-output analysis, by using a standard unit of product output as a basis for calculation. A "further refinement" of the analysis is made by developing a weighted index system which takes into account the relative seriousness of each environmental impact.

The approach, as applied in this analysis, fails to consider a number of important aspects of the environment; the method essentially deals with physical changes only. There is some question as to whether many projects, which do not produce a product, per se, would be amenable to such an approach. However, in concept at least, the approach might provide a useful way of identifying the general scope of impacts which should be identified. (114)

Heuting, R. 1974. "A Statistical System for Estimating the Deterioration of the Human Environment," in Statistical and Mathematical Aspects of Pollution Problems. J.W. Pratt, Ed pp. 123 - 132.

The author measures deterioration in the environment as decreased availability of functions of an environmental component. Such a decrease would be the manifest result of competition of functions: hence in assessment, one should analyze where competition of functions takes place thus tagging a deleterious effect. The author sees this competition taking on quantitative, spatial and qualitative aspects. In schematic representations

indicators are used with statistical reflection in the compilation of "cells" which serve as units in planning processes. This paper is concluded with a section on the shadow pricing of environmental functions. (20)

Garrison, J. et al. 1972. "Use Of Structured Value Analysis in Resource Allocation Models," M 72-5, The MITRE Corporation, McLean, Virginia.

This document summarizes a briefing on the application of structures value analysis and resource allocation problems.

Structured Value Analysis is a method of determining the benefits, impacts or values of projects in terms of an abstract set of value criteria. The basic comparison is straightforward and merely relates project parameters or characteristics to a measure of value specified by the decision-makers. These relationships provide the basis for obtaining a numerical value for the project.

The analysis makes use of value judgments of experts, either individually or by consensus, to provide information and data where hard data are unavailable. As such, much of the information going into the model is subjective, but the results can be of high utility.

Four principles were held central in developing the SVA technique: it should be adaptive; be as simple to use as possible; yield repeatable conclusive results; and give a complete measure of the project, using expert value judgments as part of the evaluation process.

Essentially, Structured Value Analysis is a procedure which separates a complex decision process into a set of relatively simple, but interrelated, decisions. Each of these simple decisions is quantified and then combined, according to rules established by the decision maker, to arrive at a single measure of project value. The steps for performing a structured value analysis are to identify the parameters, establish measurement scales for parameters, establish value functions, establish weights, calculate structural value, and sensitivity analysis. (M)

Of course, this system is open to the same criticisms as have been discussed earlier in the evaluation of similar subjective weighting and aggregation systems.

Highway Research Board, 1973. "Environmental Considerations in Planning, Design, and Construction," Special Report 138. National Research Council, National Academy of Sciences - National Academy of Engineering.

This report is a compendium of various papers given at a conference sponsored by the National Research Council. Five major topics are covered. The first is a recapitulation of the current status of highways in relationship

to the environment. The requirements of including environmental and social factors into highway planning and design are discussed. The second major topic covers the environmental planning process. Included here are discussions of what makes a good environmental statement, how to elicit and incorporate citizen participation in the planning process, how to evaluate tradeoffs among the soical, economic and environmental effects, and how to identify and evaluate the "no-build" alternative. The third topic deals with the preservation of recreational, natural, and historical values within a proposed highway corridor. Three case studies of corridor selection are given: the Milwaukee-Green Bay Interstate, the Guelph-Dundas area of Ontario, and the Moanalua Corridor of Hawaii Interstate H-3. The first two of these utilized some computer tools in the analysis. Action strategies and evinronmental values are then discussed, stressing conservation, and biological, recreational, historical, and prehistoric values. The fourth major topic covers visual quality in highway design. Preservation of landscape features, aestetics, and methods for achieving visual quality are discussed.

Finally, the effects of highway construction on the environment are discussed. Included here are effects of construction equipment sources of and solutions to pollution, effects on aquatic life, and methods for dealing with pests in the highway landscape. (20, 166)

Highway Research Board, 1971. "Planning and Evaluation of Transportation System." Highway Research Record, Number 348. National Research Council, National Academy of Sciences - National Academy of Engineering.

The papers in this record present a wide range of concepts and techniques that can be used to improve the transportation planning process. Many of the tools discussed are highly technical. Among these are several mathematical models, some of which use computer techniques. Theoretical aspects of transportation networks are analyzed and methods for optimization are presented.

About one-third of the report consists of papers on public attitudes towards transportation system. Surveys in Chicago, in Manhattan (concerning staggered work-hours), and in Hampton Roads, Virginia, are cited. The concepts of centralized transportation centers are then discussed. (20)

Hill, et al., 1973. "Physical Systems Modeling as a Tool is Water Resources Planning," Engineering Journal, Volume 56, No. 9, September 1973.

A short critique of past and present Canadian assessment systems. The article notes that only recently have concepts of "environmental quality" and "social well being" been incorporated into these systems.

The author presents his interpretation of the assessment -- planning process in flow chart format. Attitudes toward economic development that will significantly influence the objectives of environmental quality are noted. In interdisciplinary assessment studies one must define how each specialist views the problem, who will use the model and what is modeled. (20)

Hopkins, L.D., et al., 1973. "Environmental Impact Statements: A Handbook for Writers and Reviewers." Prepared by the Department of Landscape Architecture, University of Illinois, Urban-Champaign.

This handbook has been prepared for writers and reviewers of environmental impact statements (EIS) in the State of Illinois to help fill the need for basic introductory materials on how to write impact statements.

It provides suggestions and should serve as a reference for content, organization, and format of presentation. It is particularly aimed at the reviewing activities of the task force of the Natural Resources Development Board charged with reviewing statements for the state, and at staff in state agencies who are writing statements, reviewing statements from other agencies, or contracting to have statements written.

The handbook is organized in four distinct sections which may in toto be viewed as a brief introductory instruction manual. Each of the sections also stands alone as a reference source. In Chapter I, an organization is suggested for the writing of impact statements. In Chapter II, environmental impact assessment methods and their application, including reference information on checklists, analytical frameworks, and evaluation, are reviewed. In Chapter III, a set of examples illustrating successful and unsucessful attempts to fulfill the requirements of the act is given so as to illustrate interpretations, organization, and content. Finally, in Chapter IV, a listing of important sources of information concerning environmental effects for the State of Illinois is provided.

The authors first pointed out that Section 102(c) is poorly organized, and have offered a reorganization to clarify the procedure for review, to make it less repetitive and vague. "The original intent ...was to indicate types of questions to be answered through the use of scientific data, not to provide a statement outline."

Without deleting any elements of Section '02(C) the restructured outline is as follows:

I. Description of Present Conditions

II. Description of Alternative Actions
   A. Maintain status quo
   B. Engineering alternative

C. Design alternatives
D. Location alternatives
E. Institutional alternatives

III. Describe Probable Impacts of Each Alternative by Relating the Expected Future Conditions to Present Conditions

A. Adverse
B. Beneficial
C. Short versus long run
D. Irreversible or irretrievable commitment

IV. Identify the Alternative Chosen and Indicate Evaluation Which Led to Choice

V. Describe Probable Impacts of Proposed Action in Detail

A. Beneficial
B. Unavoidable adverse

VI. Describe Techniques to be Used to Minimize Harm

Section I, above, requires a broad description of present conditions which will encompass the area affected by all of the alternatives. Included should be an indication of the need for the project's benefits.

Section II, the future conditions resulting from implementation of each alternative are described. This provides the basis for evaluation and choice, but should not be an evaluation per se. Also, each alternative should be treated as a proposed action.

In IV, there should be a discussion of trade-offs that resulted in selection of the alternative.

Section V, requires a more detailed discussion of the impacts of the proposed action.

VI, is self-explanitory.

Section II Impact Assessment

The authors stress the need for a mutidisciplinary team.

To achieve comprehensive analysis the authors suggest the use of checklists, heirarchically structured, and beginning at general levels (land, water, air, etc.) and working toward specifics.

These checklists should be included in the EIS. I.e., a checklist should be a tangible document rather than an intangible thought process. This allows the reviewer to determine whether a specific impact was considered or not.

Two separate types of checklists can be developed:

1. An outline of the components or attributes of the project or action proposed.
2. An outline of the indicators of effects on environmental factors.

Environmental Assessment Tables and Matrices

An environmental impact matrix is not the same as, and should not be confused with a land suitability rating table. A land suitability matrix, such as described by McHarg provides information about the variation of impacts and costs due to the variations in the characteristics of land.

An impact matrix is quite different. Using indices of environmental change, it describes those indices or indicator that are likely to be affected by the action. For evaluation using the matrisx system, the authors state that both types of tables are required. They are separate and distinct, providing different types of information. The existence of one implies the existence of the other.

The land suitability rating table relates a proposed action to the characteristics of sites on which it might be located, indicating a rating accounting for all impacts or costs which vary with respect to each factor of site quality. The impacts table indicates the impact which occurs in terms of a change in indicators of environmental quality based on all characteristics of the site on which the activity is located.

The best known matrix is that proposed by Leopold. However, it can be somewhat confusing to use in regards to whether it is to be filled in relative to impacts or to site conditions. It has also been criticized for its inability to relate secondary and tertiary effects to causal actions or more precisely, to processes. Also, there is no way specified in which one can total the impacts on various parameters to give a relative value for each alternative. Therefore, selection is somewhat difficult.

Sorensen's stepped matrix attempts to solve some of these difficulties by using a network or tree form to show the relationship between actions and impacts.

It should be remembered that these are systems for identifying and recording impacts; they neither quantify those impacts, nor do they attach any significance to an impact as it affects human or natural systems.

Measurement of Impacts and Evaluation

It is important to distinguish between the measurement of impact and the evaluation of the effect of impact.

In the first case, one attempts to express the magnitude of the impact, i.e., how much will be destroyed, enhanced, etc. Here, one is looking for data about charges in the environment and must rely on scientific knowledge.

In the second case, one attempts to place a value on an impact relative to "the appropriate constituency". Here, one is looking for the relative values of the society or segments of society concerned in the evaluation of a project. This is inherently a value judgement and connot be based (entirely) on scientific research into environmental systems.

Measurement of Impact

Measurement of impacts takes place on four levels:

1. Nominal - a naming of elements
2. Ordinal Scales - implies a ranking according to same criterion. There is no indication of how much, simply a ranking.
3. Interval measurement - shows how much a parameter varies from the next, either by conventional or arbitrary units.
4. Ratio Scale - relies on an arbitrary unit of difference, but a fixed meaningful zero.

This discussion of levels of measurements is necessary and important, because it should be realized that measurement of all impacts cannot be accomplished at any one level. This fact immediately requires the statement writer and reviewer to deal with uncommensurate quantities. It also requires that a system be developed which can deal with many types of information.

To assist in this process, the authors suggest the development of a standard table of units in which the various parameters should be measured.

Evaluation

The raw data that would have been gathered up to this point should appear in the EIS for others to consider.

To choose between alternatives, one must place relative values on the impacts described previously. One must also be able to aggregate these values in some fashion so that an overall picture of the impacts can be obtained and related to the "costs and benefits of the various alternatives."

This transformation of impact levels into values must be based on values held, either explicitly or implicitly by some consistency.

The author then presents some examples of implicit and explicit assignments of values.

In summary, one should first provide:

1. A tabular or matrix presentation of degrees of environmental change.
2. One should indicate either implicitly or explicitly the evaluation of these which lead to the proposed solution.

When presented in this form, the tabular summaries can be:

1. The basis for writing and impact statement (this is how Leopold envisioned it.)
2. A comparison of alternatives.
3. A framework for evaluation.
4. The basis for evaluation by others.

In a separate section, the authors provide annotated examples of impact statement elements. Included is an excellent critique.

In general:

1. One should stress the need to write in language that can be understood by laymen.
2. Assertions made in an EIS should be documented.
3. Consultation and cooperation among federal, state and local agencies, should take place as much as possible.
4. On-site inspection by both writers and reviewers should be stressed.

Documentation

To be in compliance with NEPA, the originating agency should ensure that all necessary documentation on potential environmental impacts is included in the draft statement.

If documentation is not available, and an intuitive assertion is made, this fact should be identified.

Definition

As has been noted by other authors, the use of "scientific jargon" can be misleading and often is erroneous.

The use of technical language cannot be eliminated, but where it is used, it should be accompanied by definitions and/or explanations.

Analysis of Alternatives

As noted by other authors, one of the deficiencies in EIS's is their selection of alternatives for analysis. Their opinion of the cort cases concerning the subject is that agencies must examine alternatives, which are outside their legal mandate. E.g., A highway department must examine such alternatives as means of passenger movement other than the construction of a new highway and alternative highway routes.

Another common shortcoming in EIS preparation is the failure to present adequate information about all feasible alternatives. Frequently these are given cursory treatment denying the reviewer the opportunity to fully compare

summary comparison of individual attributes (environmental characteristics) by bar charts. The problems of determining relative importance and severity of impacts, and of providing a single number to indicate total environmental impact (thereby masking the distribution of the impact among its attributes) are avoided by assuming that each attribute is of equal importance. (20)

In following the procedures described in the handbook, the user is involved in both a systematic and interdisciplinary process. This is accomplished by following an eight step algorithm in which details of the proposed action and associated alternatives are identified and evaluated for environmental effects in both the biophysical and socioeconomic realm. Briefly, the steps in the procedure are outlined as follows:

Step 1. Identify the need for an EIA or an EIS.
Step 2. Establish details of the proposed action.
Step 3. Examine environmental attributes, impact analysis worksheets and summary sheets.
Step 4. Evaluate impacts using attribute descriptor package.
Step 5. Summarize impacts on summary sheet.
Step 6. Examine alternatives.
Step 7. Address the eight points of CEQ Guidelines.
Step 8. Process final document.

Examples of representative Army actions that might have a significant environmental impact (Step 1) are given, and guidance is provided in the identification of Army activities (steps 2 and 4) in nine functional areas:

1. Construction
2. Operation, Maintenance and Repair
3. Training
4. Mission Change
5. Real Estate
6. Procurement
7. Industrial Activities
8. Research, Development, Test and Evaluation
9. Administration and Support.

Environmental attributes (Steps 3 and 4) are identified and characterized in detail via "descriptor packages" located in Appendix A of the handbook. The environmental attributes are forty-six (46) in number and are classified in the following categories:

1. Air
2. Water
3. Land
4. Ecology
5. Sound
6. Human
7. Economic.

Each attribute descriptor package is comprised of the following:

A. Definition
B. Army activities which affect the attribute
C. Source of effects
D. Variables to be measured
E. How variables are measured
F. Evaluation and interpretation of data
G. Special conditions
H. Geographic and temporal effects
I. Mitigation of impact
J. Other comments
K. References or other information sources.

After evaluating the effect of the proposed action and the alternatives (Step 6) on the interdisciplinary attributes, and summarizing the effect (Step 5), it is recommended that the assessment be documented in the format suggested by the CEQ Guidelines (Step 7). Each of the eight points in the CEQ Guidelines are discussed in detail and Army-related examples are presented.

Finally, information regarding processing of assessments and statements (Step 8) is given.

Appendix B is a copy of Chapter 2 of AR 200-1, "Environmental Considerations in DA Actions.

This manual presents very much of a "cookbook" method. It is useful in that it provides an extensive checklist of activities to be examined against a list of about 45 "environmental attributes". This information is to be used as the basis for a written analysis. To aid this analysis, standardized methods for quantifying most parameters are described.

Impacts in the matrix are noted as either as negative (x) or Positive (+). These summarized for each environmental attribute on a separate summary sheet.

While this manual represents a significant step toward a more informative and better organized impact assessment, it does not rectify many of the glaring inadequacies found in many DOA impact statements. In particular, it does not even allude to the problems caused by reliance on the traditional benefit-cost approach; it perpetuates the practice of relegating alternatives analysis to a side-issue; and it does not emphasize the need for inclusion of the impact assessment process into the project planning process. The manual does, however, suggest that "...an assessment be prepared on a program level which covers many projects or activities."

Finally, since the methodology employed is a simple matrix, it is subject to many of the same criticisms as apply to any other matrix or checklist approach.

Johnson, Johnson and Ray, September, 1973. "A Technique For River Planning in a Rapidly Urbanized Watershed." Ann Arbor, Michigan.

This report on the Boardman River Study describes a methodology for environmental impact evaluation and the application of the methodology to the Boardman River area. The purpose of this study was to review and evaluate the existing status and uses of the area, and to develop guidelines for controlled future development and environmental preservation of the area.

The methodology for evaluating land use is primarily based on a set of maps displaying various aspects of the environment, and a set of matrices relating the maps and a proposed action which will impinge upon the environment. Among the aspects which are mapped are: soil aspects (slope, erodibility,...), hydrology, geology, vegetation, wildlife, climate, and land use. The matrices relate existing land use (ex: fishing/hunting) types of actions involved in construction practice (ex: drilling) and the natural conditions (ex. wildlife). In the action/land use intersection, a visual indication of predictable impact (high, medium, low) is given. In the action/environmental condition intersection, a map key code is given, indicating which detailed map to consult for a visual display of the impact.

The report then shows several maps and indices relevant to the Boardman River area. The results of the study are summarized, and a set of recommendations is made. The strongest recommendation is to utilize existing legislative tools, such as zoning acts, on a regional basis to control further development. An appendix is included giving model zoning acts for the river region and for townships. (20)

Johnson, W.K., 1971. "Proceedings of the Symposium on Environmental Assessment of Resources Development." Institue for Technology and Society, Sacramento State College, Sacramento, California.

This report is a compilation of the written summaries of the 15 papers given at a conference held June 14-15, 1971. Included are a number of papers concerning the assessment of specific impacts (e.g., aquatic, biological, wildlife and ecological, archaeological, etc.). The papers are quite general in scope but provide a useful input to planners charged with preparing environmental statements. (20)

Jordan, J. 1973. "A Philosophy of Environmental Impact Assessment", J. of Soil and Water Conservation, Vol. 28, No. 5, September/October, 1973, p. 205 ff.

NEPA has resulted in too much attention to its 102 (2)C and consequently a diminution of attention to its other parts. The author further

states that one cannot discuss a framework for assessment prior to considering assessment in terms of the broader planning process. The methodologies of Johnson, Ortolano, and Andrews are reviewed. A caveat of employing specific methodologies as a singular means of attaining satisfactory environmental assessment concludes the paper. (20)

Kane, J., et al., 1973. "KSIM: A Methodology For Interactive Resource Policy Simulation," Water Resources Research, Vol. 9, No. 1, pp. 65-79.

A new mathematical language (KSIM) has been developed and designed for interactive team use. Many features of KSIM make it particularly appropriate for use in formulating environmental policy. (1) It is easily grasped by the nonmathematical specialist and can communicate the workings of complex, nonlinear feedback systems to such people. (2) It allows for ready entry of such 'soft' subjective variables as environmental quality and national sovereignty. (3) It emphasizes the significance of structural relations rather than numerical prediction. (4) It is flexible and easily generalized. As an illustration of its use, we show how KSIM can facilitate discussion of the multiple impacts of possible Canadian water sales to the United States. (20)

The basic methodology is a combined matrix and network, using a limited number of variables to focus on the implications of differing sets of assumptions about their relationships. This approach to systems description is probably the most sophisticated in concept, yet simple and transferable in application of any of the approaches reviewed.

In contrast to most of the approaches reviewed, Kane's KSIM was derived from an attempt to apply systems concepts to the assessment of impacts and cross-impacts, rather than in response to NEPA.

KSIM starts with a group of participants--as in NEXUS and other gaming approaches--identifying 3 to 15 variables or "evaluative factors" which they consider significant elements of the system in question. This list is then entered in both the rows and the columns of a blank grid, forming a cross-impact matrix. All cells of the matrix are then filled in, using the participants' estimates of the strength and direction of the relationship between each pair of factors; single and double pluses and minuses can be used for this, or the magnitudes can be scaled as percentages between 0 and 1 in a range of possible values agreed to by the participants for each variable. This matrix can then be easily transformed, either directly by a computer or manually if desired, into a network representing the interactions that have been estimated; and finally, a tracing of their relationships over time is generated, using a nonlinear (sigmoid) growth curve in a "canned" computer program to represent the assumed form of each relationship.

The chief values of KSIM are that it provides a simplified and understandable introduction to systems description and analysis; and that unlike any other approach discussed above, it provides feedback to the participants

about relationships among their assumptions, which can then be thought out more clearly and manipulated in successive computer runs. In general, KSIM illustrates well the basic thought process that is necessary for describing social and natural systems, at a level that permits understanding and active participation by persons who are not professional systems analysts or modelers.

The limitations of KSIM include its limitation to one or two dozen variables; to use more would make completion of the matrix more and more tedious, and thus decreasingly useful in a workshop setting. Far more complex system models exist, of course, and can be utilized if one desires a more complex systems description; this detailed complexity of description is not the purpose of KSIM, however.

Another limitation of KSIM is its simplistic assumption that all relationships can be represented by a simple nonlinear growth equation. Many functions do follow this pattern, if they are scaled properly; but many others do not, and for this reason, KSIM should be used as a gaming device for playing out and challenging assumptions rather than as a predective tool.

Finally, the output of KSIM is determined wholly by the group judgments put into it from the cross-impact matrix, and by the relationships among these judgements that are assumed by the computer program; it is no more accurate than those judgments and assumptions, and for this reason as well, it should not be taken as an accurate prediction. The value of this sort of output is solely that it provides quick and inexpensive feedback about the relationships among initial sets of assumptions, and for this purpose and the others mentioned three paragraphs above, KSIM is probably the best and most useful approach reviewed. (8)

Krauskopf, T.M. and D.C. Bunde, January, 1972. "Evaluation of Environmental Impact Through a Computer Modelling Process," in R.B. Ditton and T.L. Goodale (eds.), Environmental Impact Analyiss: Philosophy and Methods, University of Wisconsin Sea Grant Publication (Madison, Wisconsin), pp. 107-125.

This paper briefly describes the Regional Environmental Management Allocation Process (REMAP) developed by the University of Wisconsin's Environmental Awareness Center. REMAP, probably more aptly described as a data management system than an environmental impact assessment method per se, consists of four distinct phases: Phase 1, "Data Bank Development," entails computer storage of "objective" data on a cellular basis. Phase 2, "Determinant Establishment," consists of the construction by an interdisciplinary team, of sets of factors (the determinants) which "should influence the location of the facility under examination." In the highway location study described, ten determinants were selected, including both traditional engineering and cost considerations and such things as "impact on ecological system" and "scenic potential". Each determinant is represented by a linear model,

constructed by selecting the data-variables which should influence each determinant, grouping these variables into components, and weighting the influence of each variable within a component. ("The weighting process relies upon the experience of specialists....") The end result of the determinant modelling process is the creation of "Spatial value surface" for each determinent. This "determinant surface" may be displayed in the form of a symbolic map with the highest value cells, represented by the most dense point character, indicating areas most restrictive to the location of the facility under consideration. It would appear that this approach has been influenced by the work of McHarg (1969).

Phase 3, "Alternative Representation," entails the combination of the determinants to form "alternative surfaces" upon which an optimal location may be found. Recognizing that weighting the importance of each determinant involves fairly subjective decisions, the developers of REMAP designed the process so that these weights could be set externally. Thus, "At this stage, opinions can freely interact with the process and the resulting value surfaces displayed for analysis." In another aspect of this phase, a dynamic programming model was developed to select the "lowest effective cost corridor" between two points.

The final phase, "Alternative Analysis," consists of placing any alternative route on any alternative or determinant surface and calculating its "effective cost" for that surface. REMAP can also be used in this phase to assist in the preparation of an EIS. The program can print out a quantification, in acres, of the impact of each corridor upon the resources involved. The fact that all of the resources can be converted into acres is a good indication of the types of variables considered in the model.

The process described suffers from the limitations of most such computer modeling efforts--the assumption of linearity, the value judgements hidden in both selection of variables and weighting coefficients, and the failure to consider environmental parameters which are not amenable to quantification--to mention the most obvious. However, the computer model presented here is intended primarily to serve as an aid in the overall planning and design process. If used for this purpose, rather than for preparing an EIS, it could serve as a useful planning tool. (114, 20, 166)

Considerable training and resources in terms of data requirements would be required to utilize this approach.

This computer program is similar to the one devised by Lanscapes Limited (24), the Environmental Decision and Alignment Program (EDAP).

> Landscapes Limited, 1972. "Environmental Decision and Alignment Process (EDAP)." Modison, Wisconson. Developed jointly with Madison Gas and Electric Co. and Wisconson Power and Light Co.

Like the REMAP method, EDAP is a computer assisted method that was developed to assist in the selection of a least impact corridor for

linear type projects.

Critical data inputs representing social and environmental costs are determined through a systematic examination, isolation, delineating, and information storage about specific natural and cultural characteristics of the area under investigation. These specific characteristics constitute the frame of reference for each of seven levels of organization leading to the selection of the corridor. These basic heirarchical levels are: 1) Determinant; 2) Component; 3) Variable; 4) Data; 5) Policy: Corridor Selection; 6) Right-of-Way Selection; and 7) Management.

The first level utilized in dealing with the problem is the determinant category. Determinants describe the primary aspect of a problem, and the comprehensiveness of a program is achieved at this level. For this presentation, seven determinants were generated which should affect the location of the corridor.

The net level of organization is the component level, describing more detailed aspects of the determinant. The seven basic determinants are composed of 31 components.

At the variable level, the components are composed of 82 variables. Then, at the data level, more detailed information is supplied concerning each variable.

The fifth level of organization is the policy level where determinants are combined with varying influences based on a prescribed policy. For example, one policy may show a greater concern for the natural environment than for system reliability or dollar investment. Each "policy" provides one alternative.

At the right-of-way selection level, low-level, infrared remote sensing was used as the basis for selection and specific impact quantification.

The last level of organization provides the inclusion of management recommendations for the use of the selected right-of-way, replacement and maintenance of vegetation, lease or purchase of the right-of-way and quantification of its impact on natural and cultural resources.

In applying the process, the following 9 stages must be completed:

1. Inter-group constraint seminar, where the scope and intent of the study are determined.
2. Information review
3. Generation of determinants through interaction with clients and interested parties.
4. Generation of variable, data and components.
5. Data bank generation, a process in which data is collected and interpreted, and stored in a computer-compatible format.
6. Determinant model development. Here, a review of the determinants, components variables, and data is conducted with the "client to assure agreement on those factors. Once this is accomplished, numberical weights are assigned to each of the heirarchical levels to demote the relative importance assigned to a given aspect. These weightings are "based on the professional judgement expressed".

7. Policy: corridor selection is the next step where policies are generated. Their basis was derived by reviewing the concerns expressed during interaction with the "client". Once established, determinants were weighted to reflect a specific policy. Then a "computer optinization system" was administered which selected the optimum corridor based on a prescribed policy. As part of the same procedure, resource impact is quantified, and sensitivity to the other policies is reviewed.
8. Right-of-way selection. During this process, "general engineering constraints" are considered in detail, utilizing the infrared photographs and data obtained from them. The exact center line of the project is established, and final quantification of impacts is made.
9. In the final step, infrared photography was utilized to determine appropriate management policies for the right-of-way. These are intended to allow construction of the facility with minimum damage to the surrounding environment and to maintain the facility in "the highest degree of compatability with the environment."

Though a complete, detailed explanation of the EDAP method is not available, certain evaluative statement can be made.

The most noteworthy aspect of this program is the inclusion of the policy: corridor selection level. In this manner, the program appears to be able to include "abstract" concepts in the route selection process. Even further, the operator is able to "test sensitivity (of an alternative) with respect to the other policies".

Personal communication with one of the developers of the system has revealed that the program has been adapted and applied to non-linear projects, and that it can also be modified for use in cumulative impact assessment.

On the other hand, it embodies many of the problems inherent in any system which applies subjective judgements in the form of weightings.

Laurent, E. and J.C. Hite, 1971. "Economic Ecological Analysis in the Charleston Metropolitan Region: An Input - Output Study", Water Resources Research Institute, Clemson University, Clemson, South Carolina.

A general model based on imput - output analysis was developed to incorporate environmental as well as pecuniary values into management systems for natural resources. The complete model was used to quantify economic - ecological linkages in the Charleston, South Carolina area. Further, resource or environmental - income multipliers were generated and used to indicate the direct and indirect impacts, both on the economic and ecologic systems of various types of economic growth, as well as alternative management strategies.

Leopold, L.B., et al., 1971. "A Procedure For Evaluating Environmental Impact", U.S. Geological Survey Circular 645, U.S. Geological Survey, Washington, D.C.

This report contains a procedure that may assist in developing uniform environmental impact statements.

The heart of the system is an open-call matrix which is general enough to be used as a reference checklist or a reminder of the full range of actions and impacts on the environmental assessment to enable the many reviewers of impact reports to determine quickly what are considered to be the significant impacts and their relative importance as evaluated by the originators of the impact report. The matrix consists of 100 columns representing examples of causative actions and 88 rows representing environmental components and characteristics. Although the list of actions is not intended to be exhaustive, it is comprehensive enough to indicate the general type of actions to consider and to stimulate further discussion. The first step in this procedure is to check each column corresponding to an action associated with a particular project. For each column that is marked, the boxes corresponding to the impacts are examined. For each box, a magnitude and importance are specified on a scale of 1 to 10. These two numbers are placed in the boxes and separated by a slash. The importance value is intended to include the subjective evaluation of the impact. No guidance is given on how the importance and magnitude values are to be combined. Each project would have a separate matrix and the criterion for assessing the activities and the values associated with the project was to be based on the professional judgement of the planners. (20, 166)

The completed matrix was intended to function as an abstract of the text of an EIS. The text itself would then focus on a discussion of the reasoning behind the weights assigned. One of the author's intentions was to eliminate discussion of "obviously trivial side issues". Another was to separate the evaluator's judgement from "clearly" factual material. (114)

This procedure is very simple to understand and use, and therefore, is widely applied. As with others of this nature, this matrix serves two purposes:

1. Identify categories of potential effects that are important as matters of policy.
2. Provide sources of ideas concerning potentially significant types of effects.

The use of checklist does present some problems:

1. The lists are static or fixed; not project and situation specific. They provide little assistance in identifying the interrelated, jointly caused, cumulative, and sometimes synergistic impacts that characterize real world systems.
2. The matrix ignores impact in relation to time.

3. No attempt is made to attempt to show relationships between specific environmental characteristics of components, and what have been referred to as "evaluative factors". The use of a preconceived checklist eleminates the essential function of setting priorities for impact analysis, i.e., the identification of functions which are currently performed by certain configurations of environmental components and which have value in social systems.
4. Standard checklists do not include all factors significant in a particular case. (8)
5. Guidelines are minimal and ambiguous, and the subjective nature of the approach leads to low replicability.
6. Indirect impacts, and processes linking actions and impacts are not accounted for.

The authors make no pretense about the ultimate utility of this approach. It was a "preliminary" effort, and a danger lies in its being seized upon as the final answer, which it is not. (114)

Leopold, Luna B., 1969. "Quantitative Comparison of Some Aesthetic Factors Among Rivers", USGS Circular 620 (Washington, D.C.)

This circular presents a preliminary attempt to quantify the factors contributing to the aesthetic appeal of a river. The underlying philosophy of the approach is the following: "Landscape which is unique--that is, different from others or uncommon--has more significance to society than that which is common. The unique qualities which enhance its values to society are those which have some aesthetic, scenic, or human interest connotation." The approach was specifically developed for the purpose of determining if the Hell's Canyon of the Snake River was indeed aesthetically unique, and if so, in what sense.

Three types of factors--physical, biological, and human interest--were considered as relevant to landscape aesthetics. Under these three categories, a total of 46 criteria were chosen to describe a landscape's aesthetic character. In the initial analysis, twelve sites on Idaho rivers in the vicinity of Hell's Canyon were evaluated. Each site was evaluated by assigning a number from 1 to 5 to each of the 46 factors. A "uniqueness ratio," defined as the reciprocal of the number of sites sharing a particular category value, was calculated for each site and each of the 46 factors. A "total uniqueness ratio" for each site was obtained by adding up the uniquiness ratios for all 46 factors; in other words, each factor was weighted equally.

The most unique stream, as determined by this procedure, was a "sluggish, algae infested, murky stream of small gradient that is evidently

nutrient-enriched..." The procedure was then modified to entail a selective comparison of groups of factors chosen to represent "particular aspects of the landscapes." This comparison was accomplished by means of a graphical procedure which, in essence, consisted of a hierarchial ordering, or weighting, of the factors selected, followed by their sequential combination. This procedure entails first combining two factors weighted equally, then another factor weighted equally with the result of the first combination, and so on. Though not obvious in the report, the result of this procedure is to give those factors considered last the most weight, and those combined first the least.

In its actual application, this graphical procedure functioned as follows: The height of nearby hills was weighted equally with the width of the valley to obtain a point on a "landscape scale," which was then combined with the "scenic outlook" factor to obtain a point on a "landscape interest scale," which was finally combined with the "urbanization" factor to obtain a point on the "scale of valley character." This scale was later combined with a "scale of valley character," generated in a similar fashion, to yield a final measure of uniqueness. By this procedure, Hell's Canyon was found to be in a class of its own.

A central problem concerning the uniqueness argument is the choice of the "universe," as Leopold calls it, within which to make the comparisons. That is, should the universe be the entire United States, for example, or only the general area surrounding the site in question? Leopold used both of these; the analysis above for twelve rivers was repeated for the whole United States using river sites within four national parks for comparison. In this case, only the Grand Canyon of the Colorado was found to be more unique than Hell's Canyon.

Leopold's approach is quite interesting, and certainly represents a bold step into a virgin field that is desperately in need of further research. However, it is difficult not to take exception to Leopold's insistence on the objectivity of the approach, to wit: "These (12 sites) were analyzed without introduction of any personal preference or bias." The very act of selecting the 46 criteria for consideration involves personal values. Leopold also assumes a great deal about all peoples' reactions to landscapes, as for example, when he argues that, "Small rivers tumbling over a succession of falls are more impressive or are more aesthetically appealing than a large river which appears sluggish." There is also one minor criticism concerning the graphical techniques used for combining, i.e., weighting, criteria. This technique has a tendency, not unlike that found in more elaborate computer methods, to obscure the actual weighting scheme being used. (114)

Litton, R. Burton, et al., July 1971. "An Aesthetic Overview of the Role of Water in the Landscape", prepared for the National Water Commission by the Department of Landscape Architecture, University of California (Berkeley, Calif.).

This report, while not directed explicitly at assessing environmental impacts, does present a very comprehensive attempt at conceptualizing the visual aspects of the overall "aesthetic experience" to be derived from the interrelationships of water, land forms, and man-made changes in the environment. The fact that the whole aesthetic evaluation problem looms as perhaps one of the more difficult in the whole environmental impact assessment process, coupled with the fact that this overview study presents a very good starting place for a planner faced with this problem, argues for the inclusion of the reference in this literature review.

The study had two basic objectives: (1) to develop a visual classification system for fresh water streams and bodies, and (2) to consider how man's interactions with that water environment could be labeled as "enhancing, compatible, or degrading," The classification framework, which allows for native characteristics and man-made changes to be considered together, forms the basis of the whole approach. The framework is built upon the delineation of three separate units--the landscape unit, the setting unit, and the waterscape unit--varying respectively in character from general to specific, from the large scale to the small. These three units are broken down into a more detailed classification which forms the basis for the water-landscape resource inventory. This inventory functions as an information base for the evaluation process.

The evaluation is based on the premise that "experts" can identify specific criteria which must be satisfied in order for a composition to be aesthetically pleasing. The criteria identified in this study were variety, vividness, and unity. No attempt was made to assign any numerical values to the evaluation; rather a description of a high-quality and a low-quality situation was given for each criterion under each classification element.

The second part of the research involved the classification of man-made elements and improvements and the evaluation of their aesthetic impact on the environment. Man-made structures or alterations are described in five main categories of elements: linear, area, mass, enclosing, and point. (Color and texture are also considered.) Five terms are also defined by which to evaluate the "consequences" of these elements on the water oriented landscape: unifying, focal, enclosing, organizing, and modifying/enhancing. The "evaluation procedure" is similar to that used in examining the pre-project landscape. A description of a high- and low-quality situation is given for each evaluation term under each major unit.

The report is very good reference for anyone interested in the evaluation of visual impacts. Appendix C, which lists the factors selected by eleven different investigators as a basis for their aesthetic quality evaluations, functions as a very useful state-of-the-art survey. The bibiography of almost 200 entries should also be quite useful. (114)

Manheim, M.L. and J.H. Suhrbier, 1972. "Community Values: A Strategy for Project Planning," Highway Research Record No. 380.

A proposed strategy for project planning, location, and design, with emphasis on the approach to community values and other related social and environmental factors, is described. Five aspects of the strategy are discussed: (a) the objective of the location-design process; (b) the desired process dynamics and a recommended 4-stage process strategy of initial survey, issue analysis, design and negotiation, and ratification; (c) the principal roles, activities, and organizational structure implied for the team of individuals having responsibility for a project study; (d) the dangers of the approach as perceived by a highway agency and a community; and (e) the applicability of the approach to system (network) planning and other public policy problems.

McHarg, Ian L., 1969. Design with Nature, the Natural History Press (Garden City, N.Y.).

A literature review of this type would be incomplete without the inclusion of a reference by McHarg. While the McHarg approach is not labeled as environmental impact assessment per se, (note that Design with Nature predates the NEPA), the planning procedures he has fostered have, in fact, very much involved the analysis and evaluation of environmental impacts. Indeed, as is evidenced by a number of the methodologies reviewed herein, McHarg's influence in this field is considerable.

Design with Nature contains much more than McHarg's approach to planning: it contains a whole McHarg philosophy. Of primary interest, however, is the approach--the "ecological planning process." Below is an attempt to abstract the essence of this approach from the case studies presented in Design with Nature. The approach consists of an ecological inventory combined with an analysis of land use capabilities or suitabilities for different uses; the technique employed makes use of transparent overlays--first to combine the variables influencing the suitability of the land for a specific use, then to combine various suitability maps to identify areas of compatible and/or competitive land use. The approach is probably best explanined by recourse to an example: In the Staten Island Study, five suitability studies were prepared--for conservation, passive recreation, active recreation, residential development, and commercial-industrial development. To make the map showing intrinsic suitability for conservation, McHarg employed twelve variables (including such things as features of historic value, habitats, geologic features, scarce ecological associations, etc.). For each variable a map was constructed using five tones of gray to indicate the areal extent and value of each factor. (Highest values were represented by the darkest tone, lowest values were left blank.) All twelve maps were then made into transparent negatives, superimposed

and photographed. The resulting photograph represented the summation of all the values employed (each weighted equally) and was therefore indicative of the areas most to least intrinsically suitable for conservation. A similar procedure was used to construct a map in each of the four other suitability studies.

The five suitability maps were then combined graphically to determine a composite land use map. First, complementary maps were combined; thus, the residential map was combined with the map for industrial-commercial development, and the map for passive recreation combined with the one for active reaction. This resulted in three maps--conservation, recreation, and urbanization--which were then combined by resorting to color--shades of yellow, blue, and gray respectively. Finally, areas of compatibility and conflict were identified by superimposing the three maps, the resulting new color combinations indicating values. For example, high values for conservation and recreation, where found together, were indicated on the map by green (the combination of yellow and blue). (114)

As noted above, McHarg's influence can be observed in a number of the methodologies developed for assessing environmental impacts. The reasons for this influence are summed up nicely by Steinitz, et al. (1969, p. 182):

> More than any other method we have studied, McHarg's attempts to integrate all of the various natural factors into its analysis of land use. His inventory stage is clear and explicit and has served as a model for many similar studies by others. Data collected in the inventory lead directly into the analyses of land use suitabilities and compatibilities. These analyses are perhaps McHarg's major contribution to resource analysis methodology.

This approach is basically an earlier, noncomputerized version of the ideas presented in the Krauskopf reference. Its basic value is as a method for screening alternative project sites or routes. Within this limited use, it is applicable to a variety of project types.

Limitations of the approach include its inability to quantify as well as identify possible impacts and its implicit weighting of all characteristics mapped.

Resource requirements of the McHarg approach are somewhat less demanding, in terms of data, than those of the Krauskopf approach because information is not directly quantified, only categorized into three levels. High degrees of skill and training are required, however, to prepare the map overlays.

The approach seems most useful as a "first cut method" of identifying and sifting out alternative project sites, preliminary to detailed impact analysis. (166)

Meyers, C.R. "Regional Modeling Abstracts: A Bibliography of Regional Analysis," Regional Environmental Systems Analysis Program, Work Supported by the National Science Foundation RANN Program under NSL Interagency Agreement # AA-R-4-79.

This bibliography is comprised of five individual volumes, each containing 1000 abstracts of literature acquired and indexed by the Regional Environmental Systems Analysis (RESA) Program of the Oak Ridge National Laboratory - National Science Foundation Environmental Program are given. The abstracts cover literature on the development and use of mathematical models capable of simulating the economic, demographic, societal, ecological and land-use responses of a geographical region to alternative policy decision. Access to the abstracts is achieved through various indexes: Key word, author, permuted title word, and permuted key word (or phrase). (20)

Volume I - ORNL-NSF-EP-7, 1971
Volume II - ORNAL-NSF-EP-10, 1971
Volume III - ORNAL-NSF-EP-23, 1972
Volume IV - ORNL-NSF-EP-37, March 1973
Volume V - ORNL-NSF-EP-54, June 1973.

Miernyl, W., 1969. "An Industry Forecasting Model With Water Quantity and Quality Constraints," West Virginia University, Morgantown, Department of Economics, in Systems Analysis for Great Lakes Water Research, pp. 49-58.

A method used to make long-range projections of economic activity in the Colorado River Basin with water quantity and quality constraints was described. Six sets of projections were made, one for each sub-basin of the Colordao River Basin, with 1980 and 2010 as the target years. The forecasting model was the conventional open Leontief input-output model with changing input coefficients. Separate transaction tables were constructed for each of the six sub-basins, with 1960 as the base year. Non-agricultural and agricultural data were collected and linked together by balancing import rows and export columns, the result being a "pure" interregional interindustry model. A flow diagram of the computational procedures, which involved eleven steps for input-output projections, was shown. Two sets of projections were completed, one for water quality only and the other involving both quantity and quality constraints. Three general illustrative cases, for agricultural sectors, commercial and industrial users, and municipal users, were sketched, in order to measure damages due to water quality degradation, total gross output as given by the quantity constrained projections, minus total gross output in the quality-constrained projections was used. (20)

Miller, J.R., 1966. "A Systematic Procedure For Assessing The Worth of Complex Alternatives," MTR-260, The MITRE Corporation, Bedford, Massachusetts.

This paper addresses the problem of assessing worth. It is assumed that a decision context has been specified and that a fixed set of discrete alternatives has been produced. It then remains to assess the worth of each alternative, to estimate the resource drains required by each, and to combine these considerations, along with considerations of risk/uncertainty, so as to arrive at a final decision. The bulk of this paper is directed toward worth assessment.

To aid in the assessment process, a detailed procedure has been devised. The purpose of this procedure is set forth, and step-by-step instructions for its actual implementation are presented. A live instance of its complete application is also provided for illustrative purposes.

An experiment was performed whose purpose was to validate the procedure (i.e., to demonstrate that it could be carried out successfully by professional decision-makers). Results drawn from the experiment are interpreted, and conclusions are drawn, along with additional implications for decision-making. The procedure and the experiment are reviewed critically, and suggestions are made for further research.

The procedure is both general and flexible with respect to type of decision, type of alternative, and type of worth criterion. However, its application may be restricted by type of decision-making personnel and certain contextual factors. (20)

Moore, John L., et al., 1972. "A Methodology for Evaluating Manufacturing Environmental Impact Statements for Delaware's Coastal Zone," Report of the State of Delaware, Columbus, Ohio: Battelle Memorial Institute.

This approach was not designed as a method for impact analysis but its principles could be adapted for such use. It employs a network approach, linking a list of manufacturing-related activities-to potential environmental alterations-to major environmental effects, and finally-to human uses affected. The primary strength of the set of linked matrices is their utility in displaying cause-condition-effect networks and tracing out secondary impact chains.

Such networks are useful primarily for identifying impacts and the issues of impact magnitude and significance are addressed only in terms of high, moderate, low, or negligible damage. As a result of these subjective evaluations the approach would have low replicability as an assessment technique. For such a use, guidelines would likely need to be proposed to define the evaluation categories.

The approach incorporates indicators especially tailored to manufacturing facilities in a coastal zone though most indicators would also be pertinent to other types of projects.

The approach would perhaps be valuable as a visual summary of an impact analysis for communication to the public and decision makers. (166, 20)

Morisawa, Marie, 1971. "Evaluating Riverscapes," in Coates, D.R. (ed.), Environmental Geomorphology, Proceedings of the First Annual Geomorphology Symposium Series, State University of New York (Binghampton, N.Y.), pp. 91-106.

In this short paper the author presents two approaches which she has employed in her efforts to evaluate the aesthetics of riverscapes. The first approach makes use of an "expert's" evaluation, presumably based in large part on factors "traditionally" considered important in analyzing aesthetics, e.g., spatial relationships and arrangements of lines and masses, light and color. The second approach examines the preferences of numbers of people and attempts to correlate preference with various landscape characteristics.

To operationalize the first approach, Morisawa's study team first asked themselves why natural scenery looked beautiful; that is, what factors were important to them in viewing a river? On the basis of this exercise, a "scenic evaluation sheet" was constructed which listed 10 factors (vista, color, vegetation, relief, serenity, naturalness, accessibility, riffles, turbidity, and pollution) to be evaluated on a scale of 1 to 5. The ratings were set up in such a way as to be "objective"; by this they meant that "... ratings were defined in such a way as to minimize operator variance." Though not explicitly noted, one assumes that these factors were weighted equally.

The second approach makes use of a set of 45 color slides shown to viewers who are asked to evaluate each slide on a scale of 1 to 6--1 being "extremely beautiful, breath-taking," as opposed to 6, which is "very unattractive, an eyesore." A limited amount of demographic data on the viewer is also collected for possible later correlation. At the time this paper was presented, this approach had been tried only on a small and very non-random sample of viewers. The intention was to obtain the preferences of a large, unbiased sample, and then use factor analysis to link preferences to specific physical characteristics of the riverscapes.

The first approach is not very elaborate, and suffers from the weaknesses inherent in any evaluation procedure that relies exclusively on professional judgments. The second approach, however, is viewed with great interest. (114)

Morrison, et al., 1973. "General Environmental Siting Criteria for Power Plants." Presented at the American Nuclear Society, 1973 Winter Meeting, San Francisco, California November 11-16, 1973.

This presentation discusses the background of siting criteria, current approaches and trends. The federal and state procedures and the state regulatory statutes are surveyed as well as current methodologies for environmental evaluation. In addition, Appendix A has "Examples of State Siting Regulations" and Appendix B has "Examples of Environmental Impact Assessment Methodologies."

The presentation is nontechnical and is useful as a primer on siting criteria.

Nathans, Robert R. Associates, 1972. "U.S. Deepwater Port Study, Vol. IV: The Environmental and Ecological Aspects of Deepwater Ports." U.S. Army Engineer Institute for Water Resources, IWR Report 72-8.

The system used in this study is the network. A somewhat more sophisticated approach to systems description.

The study starts from a major, complex problem: deep water port alternatives for off-loading petroleum and other bulk cargoes. It immediately redefines this problem as a study of alternative delivery systems for these cargoes and proceeds to disaggregate these alternative systems into lists of their components: dredging, ship movements, cargo transfer, processing, and so forth. That is, it identifies specific elements associated with each alternative system for bulk cargo delivery. Similarly, it next disaggregates the existing situation (environment) into a list of those specific components (evaluative factors) that are of interest to affected publics, professions, and policymakers, and that affect those that are of interest. Once these lists have been derived, the authors are able to construct network diagrams or webs showing relationships among the components, and thus, insights into some of the chains of consequences that might be produced by alternative delivery systems.

Some of the problems in particular are glaring. In particular, the arbitrariness and oversimplification of the networks in their present form, and the absence of any attempt to construct feedbacks and interrelationships among the system elements. This approach is presented at a very early conceptual phase, relying wholly upon the consultant's professional judgements rather than upon the full range of appropriate professions and publics. It clearly would require additional research to establish the nature, extents, and significance of the relationships which the networks suggest, as well as others which they omit.

The useful lessons of the Nathans study include disaggregation of a complex planning problem into its key constituents, without regard to jurisdictional limitations; its attention to indirect impacts; and its attempts to describe the sequences of impacts leading only to eventually to the variables of greatest interest for decision-makers. (8)

Nichols, D.R. and J.M. Buchanan Banks, 1974. "Seismic Hazards and Land-use Planning," Geological Survey Circular 690, U.S. Geological Survey, Washington, D.C.

Urban planners and public officials in California and in many other parts of the United States have become increasingly concerned about the possible effects of future earthquakes and how to minimize damage and reduce loss of life. Interest in seismic hazards has increased further after the adoption in 1971 by the California legislature of an amendment to the State Planning Law that includes a "Seismic Safety Element" as a mandatory element of the General Plan (Chapter 150, Section 65302 of the Government Code). This requirement, along with concerns for other geologic hazards and for conservation of natural resources, has focused the attention of planners on the contributions that geology and other earth sciences can make to the planning process.

This report outlines those earthquake-induced geologic conditions that could be hazardous, the type of problems they may pose, how information can be obtained to assess the degree of hazard, and some possible implications to land use. (20)

North, R.M., et al., June 1974. "Survey of Economic-Ecologic Impacts of Small Watershed Development. Institute of Natural Resources, University of Georgia, Athens, Georgia NTIS # PB-235-407.

This report attempts to develop several new aspects of small watershed evaluation in its central thrust of improving the overall identification and measurement of impacts and consequences of stream modifications such as impoundments, channelization for flood control, and others. These contributions include: (1) careful follow up by expost analyses of land use changes and resulting economic-ecologic impacts using air photographs, overflights and field sampling: (2) comparisons of basically similar developed vs. undeveloped watersheds over identical time spans to eliminate exogenous influences which distort most expost analyses; (3) measurements of benthos and other aquatic life in similar developed vs. undeveloped watersheds for both diversity of species and productivity; and (4) measurements of vegetative growth rates, especially with respect to channelization.

Methods were developed to measure changes over time in the two project and two analogue non-project watersheds, and to approximate net impacts induced by the project construction on the basis of differences in land uses, productivity, land values, tree growth rates, benthos, fish populations, wildlife and water quality. Also included is an evaluation of the economic benefits derived from the projects versus adverse ecological impacts.

The purpose of the research was to evaluate the effectiveness of existing benefit cost estimates in portraying project success on both economic and ecologic criteria. The more specific objectives wire to:

(1) compare the actual and estimated benefits and costs accuring to project design purposes;
(2) estimate associated economic changes induced by the projects which were not enumerated in project formulation and planning, whether for lack of authorization or for lack of data or awareness;
(3) suggest methods and values for expanding benefit-cost considerations to additional economic and ecologic impacts expected in future projects.

The economic benefit cost analysis applied in this study is noteworthy because of its demonstration of serious inaccuracies in the original benefit cost analysis and its identification of some of the flaws in the original methodology applied prior to project implementation.

The ecological analysis yielded less specific results that allowed only generalized discussion of the ecologic costs. While the analyses used to determine changes in individual parameters are of interest, no means of impact aggregation or direct comparison of economic-ecologic impacts is provided.

O'Connor, M.F., 1972. "The Application of Multi-attribute Scaling Procedures To The Development of Indices of Value," Engineering Psychology Laboratory, The University of Michigan, Ann Arbor, Michigan.

Using procedures developed in the study of multidimensional utility analysis, two indices of water quality are developed. One index describes the quality of a surface body of raw water which will be used to sustain a fish and wildlife population. A second index describes the quality of a surface body of raw water which will be treated as is necessary and used as a public water supply. Since the first use involves mainly the health of the wildlife population whereas the second use involves human health and also economic and aeasthetic consideration, it is anticipated that if the use to which the water will be put is important enough to merit a separate index, these two indices should assign very different numbers to samples of water.

The multi-attribute scaling procedures were applied to this task by assessing, from water quality engineers, (1) judgement about which

variables should be included in the index, (2) the type of rule for combining the variables, (3) the relative importance weights of the different variables, and (4) a curve describing the functional relation between water quality and each variable.

Water quality indices were obtained for two specific purposes -- for "public water supply" and for "fish and wildlife." The experimenter used a modified Delphi procedure for obtaining consensus among the engineers for each of the indices. Even after the applications of the Delphi procedure, the engineers disagreed on the importance weights, so a sensitivity analysis applied the different indices to actual measurements on samples of river water. This analysis indicated that the disagreement about the weights was not crucial to the measurement of water quality. In fact, a major conclusion of this research is that the multi-attribute scaling procedures are sufficiently robust so that, while great care should be used in determining the purpose for which the index will be used and in selecting variables for inclusion, relatively little time and effort need be invested in resolving small differences among quality functions and among relative weights. (20)

Odum, E.P., 1969. "The Strategy of Ecosystem Development," Science, Vol. 164, April 18, pp. 262-270.

This article summarizes, in the form of a tabular model, components and stages of development at the ecosystem level as a means of emphasizing those aspects of ecological succession that can be accepted on the basis of present knowledge, those that require more study and those that have special relevance to human ecology. (20)

Orlob, Gerald T., et al., October 1970. "Wild Rivers: Methods for Evaluation," prepared by Water Resources Engineers, Inc. for the U.S. Department of the Interior, Office of Water Resources Research (Walnut Creek, California).

The evaluation procedures presented in this report are not directly applicable to environmental impact assessment; nor do they provide assistance in evaluating any specific aspects of the environment. The report is included in this literature review primarily as an extreme example of an attempt at quantifying intangibles.

Two methods were proposed, developed and tested (on the Skagit River basin in Washington) for evaluating the "worth" of wild rivers, with the ultimate goal of providing a basis for decisions regarding development versus preservation of these rivers. Both approaches employ traditional benefit-cost analysis as the basic evaluation frameworks. Each approach includes procedures for computing "total" benefits, both monetary and nonmonetary; however, on the other side of the ledger, only monetary

costs are included. One might note parenthetically, that it is precisely these nonmonetary costs, not considered in either method, which constitute the adverse environmental impacts that the NEPA was designed to bring into the planning process.

The first approach, the "benefits foregone - subjective decision method," is based on the assumption that "nonmonetary benefits associated with the wild, least-developed condition of a river basin must be at least equal to, and perhaps greater than, the foregone monetary benefits that would accrue if the basin were developed to its fullest." The essence of the procedure is the development of parabolic functions assumed to express these nonmonetary benefits which will be gained or lost through further development. The authors note that "subjective decisions" are involved in choosing the values of the coefficients for this parabolic function--one to determine the direction and curvature of the function, the other to establish the degree of development at which nonmonetary benefits are expected to be maximal or minimal. Values of two other coefficients (for the monetary benefits and cost functions) also have to be "chosen," but this seems a minor undertaking compared to the above. Once these functions are thus "determined," it is a straightforward procedure to compute benefits and costs.

The second approach, the "nonmonetary expression of benefits method," does not attempt to derive continuous functions, but instead is "directed at the evaluation of discrete, identifiable development levels." The essence of this method is the assumption that nonmonetary benefits are equal to the monetary benefits multiplied by an "R value" (normally between 0 and 2). A number of subjective judgement get lumped into this R value. A table is provided which gives a summary of the range of values for R for various land and water development purposes or uses. Further guidance is provided in an appendix which gives R values for "descriptive subfactors" of each of these uses. The authors make no claim that these values are "correct in the absolute," but do feel that they are correct in a relative sense. Nowhere, however, do they address the question of whether or not the values for these R values (or the coefficients of the first approach) can, in fact, be rationally determined.

A sensitivity analysis was undertaken for the second method, with some interesting results, and some questionable conclusions. "The major finding was that the optimal degree of development was less affected by variations in the R values than by variations in either use, price, or interest rate." On the basis of this, the authors concluded that perhaps "...more research was needed on the knowable, easily estimable quantities than on the inestimable, intangible factors which seem to have less effect on the final result." The above finding, together with the result that one "...would expect higher levels of development to be optimal when higher R values are used, "suggests that there may be problems in using this method.

Ortolano, L., 1973. "Analyzing the Environmental Impacts of Water Projects," Institute for Water Resources, IWR Report #73-3, Department of the Army, Corps of Engineers, Available from NTIS, AD-766286.

This report presents the results of a faculty-student collaboration that took place at Stanford University during the 1971-72 academic year. The workshop is meant to develop ideas that will be useful to the Corps of Engineers planners concerned with the preparation of an Environmental Impact Statement for federal action "significantly affecting the quality of human environment." (Specifically, Section 102(2) (C) of the NEPA of 1969).

The issues of the report are concerned with water resources projects commonly developed by the Corps of Engineers (reservoir and channelization project, coastal dredging and spoil disposal projects). Impact assessment and evaluation are the essence of the report and center upon environmental, social, and economic change forecasts and are described in quantitative and qualitative terms. Decision-making and alternatives are also discussed concerning the system of ordering preferences according to values placed on each alternative by individuals or groups, and the decision-makers taking into account the preference of the individual or group directly affected by the alternative.

The report is divided into two major parts, the first of which deals with the issues of environmental impact analysis, and discusses an analysis of what courts have said about the content of the NEPA 102 statement and guidelines issued by various federal agencies. Included are reviews of existing literature on methodologies for environmental impact assessment, with an annotated bibliography of selected materials relevant to NEPA statements. Primarily Part One is concerned with the analysis of the section 102 statement and aids to environmental impact analysis, delving to some extent into a discussion of elusive issues and practical lessons derived from the Workshop experience.

Part Two represents the results of applying many of the ideas of Part One in analyzing environmental impacts. (20)

Ortolano, L., 1973. "Impact Assessment in The Water Resources." Paper Presented at the Short Course on Impact Assessment in Water Resources Planning, Amherst, Massachusetts; Ann Arbor, Michigan; and East Sound, Washington, May and June 1973.

The primary objective of this paper is to describe "impact assessment" and how it fits into the "preauthorization" planning process carried out at the district offices of the U.S. Army Corps of Engineers. The discussion addresses at a very basic level, with what and why water

planning is done, the activities involved in the preauthorization planning process, and the definition of impact assessment as the identification, description, and evaluation of changes associated with alternative actions. (20)

Ortolano, L., 1973. "Water Resources Impact Assessment: Cause-effect Relationships." Stanford University, Unpublished Manuscript.

The paper demonstrates that planning activities (i.e., problem definition, formulation of alternatives, impact analysis, and evaluation) all take place beginning at the earliest stages of the planning process. This point is made with the aid of an example concerning water related problems in Carmel Valley, California. The material relating to Carmel Valley was developed during the course of a recent workshop held at Stanford University; examples from this Carmel Valley case are used to demonstrate points raised in various sections of the paper.

The report then treats a fundamental question in impact assessment; i.e., which impacts need to be projected and described? The answer to this question is given in terms of the evaluative factors (i.e., the concerns, concepts, parameters, etc. that are used by affected publics and decision-makers in establishing a preference ordering among alternatives). Information on the meaning and relative importance of evaluative factors serves to guide decisions on which impacts to analyze in detail.

The need to systematically and comprehensively identify all the significant causes of change associated with proposed actions are considered. For this purpose a scheme that classifies "causative factors" is introduced as an aid to both planners and the public. The use of this classification scheme is demonstrated by an application involving the Carmel Valley case study.

The report then deals with what is sometimes referred to as the first law of ecology, namely, that "everything is connected to everything else." The main concern is that each impact becomes in itself a new "cause," the impacts of which may need to be delineated. When all possible impacts stemming from various "causes" are set out, the result is a complex network of cause-effect linkages which are tied together by various feedback relationships were treated in the Carmel Valley case study is presented.

Attention is then focused on what are alternatively referred to as "indirect" or "secondary" impacts. The difficulties involved in defining and dealing with indirect impacts are discussed. An approach followed in treating one of the several significant types of indirect impacts that came up in the course of the Carmel Valley case study is also presented.

Finally, a summary of concepts that are useful in thinking about and describing impacts is provided. A number of characteristics of impacts (e.g., short term vs. long term, deterministic vs. stochastic, etc.) are summarized. Some basic issues that need to be considered in communicating information about impacts are discussed. This provides an appropriate conclusion since

one of the principal reasons for planning is the development and communication of information to help people understand issues and make choices. (20)

Ortolano, 1974. "Issues in Water Resources Impact Assessment," Journal of the Hydraulics Division, ASCE, Vol. 100, No. HY 1, pp. 173-187.

Formal impact assessment, defined as the identification, description, and evaluation of changes associated with proposed actions, have been mandated by recent legislation relevant to Federal water resources agencies. This paper uses an example involving proposed reservoirs in Carmel Valley, California to demonstrate the various concepts which are introduced. The paper demonstrates how "evaluative factors," defined as the goals, concerns, constraints, etc., that affected publics and other decision-makers consider in ranking alternative actions, can be used in deciding on which impacts to forecast and at what levels of detail. The paper presents a classification of "causative factors" which encourages a systematic examination of the various aspects of a proposed action that may bring about change. Network diagrams of cause-effect relations, and the problems associated with the analysis of indirect impacts are also analyzed. The paper summarizes a number of characteristics of impacts which can be used in describing the results of an impact assessment. (20)

Ortolano, L. and W. Hill, 1972. "An Analysis of Environmental Statements for Corps of Engineers' Water Projects." U.S. Army Engineer Institute for Water Resources, Alexandria, Virginia, IWR Report 72-3, (AD 747-374).

This publication presents the results of an intensive analysis of 234 Corps of Engineers environmental impact statements prepared in accordance with Sec. 102 (2) (c) of the National Environmental Policy Act (NEPA). The analysis includes a detailed catalog and summary of impacts included in the statements for: 1) projects on coastal waters including dredging, spoil disposal, breakwaters, jetties and groins, revetments, dikes and barriers; and 2) projects on inland water including channelization, dams and reservoirs, levees, dredging spoil disposal, construction and other miscellaneous structures and activities. In addition, the analysis catalogs and summarizes the impacts of various project purposes. A summary of the coverage of other points required by Sec. 102 (2) (c) of NEPA is also included. The proper role of environmental statements is suggested and, within that context, an assessment of the 234 statements is rendered, together with suggestions for improvement. (20)

The authors conclude that the majority of the 243 EIS's examined were "decidedly less than adequate." "In short, they did not seem to add a great deal of information, in terms of new data or analyses, to that contained in existing project documents."

In defense of the Corps, the authors note budgetary and manpower restrictions, complicated by uncertainty as to the exact scope and intent of the legislation and a huge backlog of projects well along in the planning stages.

Perkins, John M., et al., 1974. "Markov Method Applied to Planning." A paper prepared for presentation at the Fourth Iranian Conference on Engineering Pahlavi university, Shiraz, Iran. May 12-16, 1974.

The method described in this paper is a modification of input-output analysis. The authors claim it can be applied to: 1) investment planning to maximize profits, employment, per capita income, balance of payments, and social objectives; 2) demand forecasting for energy, labor, recreational facilities, and products; and 3) allocation planning to establish priorities for development of various sectors which achieve economic goals while minimizing resource usage and/or environmental damage.

The intent of this paper was to describe the approach used in making an electric load forecast for a region, and thus, its use in connection with environmental analysis could not be evaluated. However, the example appears to be sufficiently unique to warrent further investigation into the technique.

Parton, W.J. and A. Eddy, 1970. "A Numerical Model of Human Population Dynamics Influenced by a Polluted Environment." Preprint, American Meteorological Society, Boston, Massachusetts, p. 248-252. (Presented at the National Conference on Weather Modification, 2nd, Santa Barbara, California, April 6-9, 1970).

A numerical model of the urban-rural ecosystem has been formulated with the objective of simulating interactions between the various segments of the total ecosystem. A decision-making executive routinely coordinates the interactions between five submodels, comprising an atmospheric model, hydrology model, city model, zoology model, and botany model. The atmospheric model must predict variations in the weather for periods of time up to 30 years. The parameters predicted include: wind speed and direction, rainfall, relative humidity, cloud cover temperature, radiation, and air pollution. Air pollution is determined at any point in the field by considering dispersion from multiple point sources. The model suggested by Pasquill and modified by Gifford is used to estimate pollution concentrations as a function of distance from the point sources. This model uses the wind direction and speed, stability, and solar angle to predict the pollution dispersion. The atmospheric model has provisions for modifying the rainfall frequency and intensity as a function of air pollution and heat island effect. There are also

provisions to simulate the effect of artificial weather modifications on the whole ecosystem. The parameters predicted by the hydrology model include: evaporation of water from soil and lake surface, storm runoff, soil moisture, lake level, water pollution, and river hydrograph. The urban model is primarily concerned with population dyamics of the city. The zoology model consists of man and dairy and beef cattle as consumers. The growth of grass, alfalfa, and wheat are included in the botany model. Future work on this model will be directed toward increasing the realism in the ecosystem components. (M)

Peterson, G.L. and E.S. Neiman, 1969. "Modeling and Predicting Human Response to the Visual Recreation Environment." Journal of Leisure Research, Vol. 1, No. 3 Summer, pp. 219-237.

The purpose of this paper is to develop and apply a conceptual and methodological approach for analyzing subjective response to the appearance of the recreation environment. The conceptual framework employs a mathematical preference model to hypothesize and quantify a man-environment relationship. To obtain data for the model, recreation environments were simulated by photos and responses classified by techniques of psychological measurement. The preference functions should be sensitive to differences in characteristics of alternative environments as well as to differences in people's responses to the same environmental conditions. It is hypothesized that such responses are influenced by measurable factors such as life style, social rank, culture rank, culture, and personality. The model is demonstrated using Lake Michigan beaches. Results show that two groups with different preferences are identifiable. The larger group prefers scenic natural beaches and the smaller prefers city swimming beaches. The study shows conflicting user preferences for the characteristics of beaches. Studies of this nature would be helpful to the water planner in determining the types of recreation facilities that should be provided. (20)

Pikul, R., 1974. "Development of Environmental Indices" in Statistical and Mathematical Aspects of Pollution Problems, J.W. Pratt, Ed., pp. 103-121.

An index approach to environmental assessment. The author presents an initial formulation of environmental indices in 14 "environmental classes." A method of ranking indices while taking cost and value considerations into account is discussed. The assessment of impact is facilitated by tracking and analyzing the behavior of these indices. Each mathematical index is analyzed according to factors of impact, utility, value, cost, and importance. (20)

Requiam, H., 1972. "Establishing Priorities Among Environmental Stresses," in Indicators of Environmental Quality Proceedings, Symposium, W.A. Thomas, Ed., Environmental Science Research Series, Volume 1, pp. 71 ff.

An appraisal of the difficulties of environmental assessment. The author notes there is difficulty in ranking individual environmental problems even among dedicated environmentalists. Apparent effects are often not the most important, and the acute often only shades into the chronic. The author notes that traditional reductionists favor breaking the system down into simple components which lend themselves to a specialized approach. Logistics for handling unquantifiables are presented. One would proceed to make subjective evaluation for each environmental stress using Persistence, Range, and Value indices. The simple product of assessment scales is used to indicate the relative importance of stress with respect to any one of the environmental resources systems. (20)

Schlesinger, B. and D. Daetz, 1973. "A Conceptual Framework for Applying Environmental Assessment Matrix Techniques," Journal of Environmental Sciences, Vol. 16, No. 4, July/August 1973, pp. 11-16.

Since the enactment of the National Environmental Policy Act (NEPA, 1969), a number of systematic checklists and matrix procedures have been proposed and utilized as guides to environmental assessment efforts. This article presents a conceptual framework within which the matrix technique can be viewed, its potential usefulness realized, and its inherent shortcomings recognized. It is shown that, if properly applied, an Environmental Assessment Matrix can embody all relevant aspects of the environment potentially affected by some significant project, as well as the magnitude of each impact, the importance of these effects, their durations and even their interrelationships and probabilities. As an adjunct to consideration of these factors of alternative proposals, the matrix technique can be used to indicate sensitivity or bounds of the solution, and act as a guide to mitigating measures that might be required. Various proposed matrix techniques are examined and evaluated with respect to this conceptual framework.

The matrix structure is an adaptation of the Leopold matrix of U.S.G.S. Circular 645, but includes a weighting scheme to combine the magnitude and importance scales. (20)

Sewell, W.R.D., 1973. "Broadening the Approach to Evaluation in Resource Management Decision-Making," Journal of Environmental Management, Vol. 1, No. 1.

This article concerns itself with the presentation of a descriptive model of the policy-making process. Also examined is the extent to which present procedures of evaluation are able to provide the date required by decision-makers. The entire identification, evaluation, and selection process is examined. The author states that the opportunity costs of using a resource for one purpose rather than another is too often not considered as a part of the environmental impact. Further, he argues that assessment procedures are biased toward development as he points out several other salient shortcomings in the present methods of evaluating environmental impacts. (20)

Shafer, E.L., et al., 1969. "Natural Lanscape Preferences: A Predictive Model," in Journal of Leisure Research, Vol. 1, No. 1, pp. 1-29.

This article reports on a study to identify the quantitative variables in a natural landscape that are significantly related to public preference for that landscape. In the study black and white photographs of the landscapes were used. It was determined that preference for the landscape depends on the area or perimeter measurement of six items within the photograph.

Simmons, H.B., et al., 1972. "Physical Modeling Applied to Coastal Zone Pollution Problems," Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Miscellaneous Paper Y-72-2.

It is necessary to determine effects of pollution before pollution takes place. This requires a predictive capability. One tool used to make this predictive capability more meaningful is physical scale modeling - problem-solving technique that entails development, construction, verification, and testing of a scale model of a particular prototype. Different types of physical models are discussed with emphasis on determining extent and duration of pollution within an area. Specific examples include a sediment-trapping plan in Savannah Harbor, effect of an inlet across Sandy Hook in New York Harbor, and pollutant dispersion from two sources in Brunswick Harbor. Laboratory ecosystem modeling is described as a planning tool specifically designed to predict chemical, biological, and ecological phenomena (20)

Sinha, E., 1971. "Methods, Models and Instruments for Studies of Aquatic Pollution, an Annotated Bibliography," Ocean Engineering Information Service, La Jolla, California, Ocean Engineering Information Series Vol. 5.

This bibliography contains 204 abstracts of literature providing substantial scientific and technical information on methods, models and instruments used in studies of aquatic pollution and means of abatement. These deal with the detection, identification and measurement of the parameters of pollution, biotic constituents, detergents and nutrients, pesticides, oil, metals, and non-metallic toxicants. Various aspects of water quality management are encompassed. Pertinent patents, a bibliography of bibliographies, a subject outline, a keyterm index, and an index citing all authors and co-authors are included. (20)

Smith, William L., "Quantifying the Environmental Impact of Transportation Systems", Van Doren-Hazard-Stallings-Schnacke, Topeka, Kansas (undated) (mineographed).

The Smith approach, as developed for highway route selection, is a checklist system based on the concepts of probability and supply-demand. The approach attempts to identify the alternative with least social cost to environmental resources and maximum social benefit to system resources. Environmental resources elements are listed as: agriculture, wildlife conservation, interference, noise, physical features, and replacement. System resources elements are listed as aesthetics, cost, mode interface, and travel desires. For each element, categories are defined and used to classify zones of the project area. Numerical probabilities of supply and of demand are then assigned to each zone for each element. These are multiplied to produce a "probability of least social cost" (or maximum social benefit). These least social cost probabilities are then multiplied across the elements to produce a total for the route alternative under examination.

The approach is tailored and perhaps limited to project situations requiring comparison of siting alternatives. The range of environmental factors examined is very limited, but presumably could be expanded to cover more adequately ecological, pollution, and social considerations.

Since procedures for determining supply and demand probabilities are not described, it is difficult to anticipate the amounts of data, manpower and money required to use the approach. The primary limitations of this methodology are difficulties inherent in assigning probabilities, particularly demand probabilities, and the implicitly equal weightings assigned to each element analyzed when multiplying to yield an aggregate score for an alternative. (166)

Sorenson, Jens C., June 1971. "A Framework for Identification and Control of Resource Degradation and Conflict in the Multiple Use of the Coastal Zone," M.S. Thesis, Dept. of Landscape Architecutre, University of California (Berkeley, Calif.).

This thesis focuses on the identification of a very specific set of environmental impacts--the adverse impacts resulting from conflicting uses and resource degradation in the (California) coastal zone. However, the procedure developed is general enough to be applicable to any environment.

The "impact system framework" developed and discussed in parts II and III (pp. 10-19) is based on the network analysis approach developed by the Travelers Research Corporation (TRC, 1069). Sorenson modified the TRC approach by adding an additional factor, "uses," in front of their "cause-condition-effect" relationships. He also devised a new format for organizing and displaying these various relationships. This new format was "a stepped matrix attached to a network." All this is in fact is two matrices--"uses vs. causal factors" and "causal factors vs. initial conditions"--joined together along the common axis, with a network analysis of "initial conditions leading to consequent conditions which in turn lead to effect" attached to the second matrix. These net work factors (i.e., initial conditions, consequent conditions, and effects) all come under the title of "possible adverse impact." One ends up with a single display which identifies uses, causal factors, and adverse impacts, and traces the interrelationships between them. Two additional columns are provided (but not filled in) for "corrective action or control mechanisms" and a "reference index."

As was the case with the TRC matrices, the linkages identified represent only "potential relationships." All the relationships indicated between causal factors and conditions, however, had been observed to occur within the california coastal zone.

The framework developed in this study was presented as being "still in the formative stage of development." The limitations of the display format presented were recognized, and it was concluded that the next step in the development of the method should be computerization of the matrices and networks. (114, 20, 166)

Sorenson, J.C. and M.L. Moss, April, 1973. "Procedures and Programs to Assist in the Environmental Impact Statement Process," SG-Pub-No. 27, USC-SG-AS2-73, Institute of Urban and Regional Development, University of California, and Center for Urban Affairs, University of Southern Calif.

This paper considers the issues which arise in impact assessment processes and also examines alternative methods for preparing and reviewing impact statements.

Impact assessment methods are discussed as a three-stage process involving: (1) identification of the environmental, social and economic conditions that may be changed by the project; (2) prediction of the intensity and spatial dimensions of the changes likely to occur; and (3) evaluation of the costs and benefits of the condition changes. (20)

Sorensen, J. and J.E. Pepper, 1973. "Procedures for Regional Clearinghouse Review of Environmental Impact Statements - Phase Two." Review Draft, Prepared for the Association of Bay Area Governments, Berkeley, California, April 1973.

The primary objective of the study described in this report was the development of procedures which the Association of Bay Area Governments (ABAG) could use to review environmental impact statements as specified by the National Environmental Policy Act (NEPA) of 1969, and the California Environmental Quality Act of 1970.

The report is organized into three major sections. Part one presents impact checklists for eight project types. These are: (a) highways, including right-of-way, access roads, bridges, and highway vehicles; (b) housing; (c) water supply, treatment and transportation; (d) waste water, treatment and transportation; (e) impoundments and/or flow diversions; (f) stream channelization; (g) navigation channels; and (h) deep water facilities. For each project type, the checklist gives ten impact categories which must be considered. These are: (1) Displacement or preemption of current land use or users; (2) Relocation of uses or users; (3) Relationship of project to access and/or circulation patterns; (4) Relationship of project to earth and vegetation conditions; (5) Relationship of project to hydrolic conditions; (6) Relationship of project to atmospheric conditions; (7) Relationship of project to visual conditions; (8) Relationship of project to sonic conditions; (9) Influences on Surrounding Land Use; and (10) The project in context of regional plans and programs. For each of the ten impact categories, the checklist gives a listing of condition changes organized in sequence of occurrence. Actions or activities that could generate a change in a particular initial condition are indicated with bars above the respective condition. All the condition changes listed describe adverse impact. The user could easily develop a similar checklist, using antonyms, for beneficial impact. The checklist also mentions the responsible agency, both federal and state or local, for each stated condition change. It also lists environmental condition (E.C.) index numbers which relate to mapped or spatially recorded environmental and socio-economic information necessary to estimate both the probability of occurrence and the actual degree or dimension of change for the specific identified impacts.

Part Two of the report is an index, coded to the E.C. index numbers in the checklist, which lists the existing maps and spatially defined infor-

mation in the bay area that could be used to estimate the occurrence and degree of the impacts identified by the project type checklists. Part Three of the report lists criteria for determining whether a specific project type may produce impacts that would be of regional significance to ABAG. (20,166)

Stanley, J., 1972. "Environmental Factors Related to Land Use Planning and Industrial Development," W.J. Stanley Associates, Paper No. 73-51, Presented at the 65th Annual Meeting of the Air Pollution Control Association, Miami Beach, Florida, June 18-22.

This paper describes criteria for decision making concerning land use planning and industrial development. Planning inputs and air, water and land use limitations are discussed. The conflict of alternatives concerning single solutions is also brought forward. Opportunities of collective approach to problem solving by public and private agencies and incentives such as public financing and added tax credits are also discussed. The most important consideration pointed out is that many of the pollution problems cannot be solved, but must be traded off and managed in an orderly fashion. (20)

Steinitz, Carl, et al., July 1969. "A Comparative Study of Resource Analysis Methods," Department of Landscape Architecture Research Office, Graduate School of Design, Harvard University, mimeo (Cambridge, Mass.).

This study presents a comparative analysis of sixteen selected approaches to resource analysis. While these approaches do not deal with environmental impact assessment per se (this comparative study itself predates the NEPA), many of them might be adapted and used to this end. In fact, the influence of one of the approaches analyzed in this study--that of Ian Mcharg (pp. 177-197 of Steinitz)--has been noted in a number of the papers discussed above.

The part of the report of primary interest herein is Section III (pp. 82-283) which describes the methods analyzed, including: "their methodological goals; the constraints under which the method was developed or under which it operates; the data variables which are investigated; logic of the analytic approach; the applicability of the method to other areas, scales, and purposes; and its principal documentation." Thus, Section III contains a potentially useful analysis of the more significant approaches to resource analysis as of 1969. (114)

Stover, Lloyd V., March 1973. "Environmental Impact Assessment: A Procedure." Environment and Technology Assessments, Inc., Washington, D.C.

This methodology is a checklist procedure for a general quantitative evaluation of environmental impacts from development activities. The type and range of these activities is not specified, but is believed to be comprehensive. Fifty different impact parameters are sufficient to include most possible effects, and thereby allow much flexibility. Subparameters indicate specific impacts, but there is no indication of how the individual measures are aggregated into a single parameter value. While spatial differences in impacts are not indicated, both initial and future impacts are included and explicitly compared. Resource requirements are moderate to heavy, especially in terms of an interdisciplinary personnel team which grows as more subparameters are included, requiring additional expertise in specific areas. However, the actual measurements are not based on specific criteria and are only partially quantitative, with seven possible values ranging from an extremely beneficial impact to an extremely detrimental one. Therefore, there is potential for ambiguous and subjective results, with only moderate replicability. Impact areas are implicitly assumed to be of eaual importance. A specific methodology is mentioned for choosing the optimum alternative in terms of benefits and adverse effects. The procedure for alternatives comparison may be the most interesting aspect of the procedure, with results given in terms of the proportional significance of an impact vis-a-vis other potential alternatives. There is no explicit mention of either public involvement in the process, or environmental risks.

The impact assessment procedure is presented as only one step in a total evaluation scheme which includes concepts of dynamic ecological stability and other ideas. (20, 114, 166)

The author states that an environmental evaluation method must be "systematic (and therefore) applicable to almost any project. Further, the results should be reasonably repeatable by separate evaluation teams.

The result was the development of an impact identification (essentially a checklist) and weighting system similar to Georgia's Optimum Pathway Matrix. The major difference being Stover's omission of the use of computers and the accompanying random error generation.

The Environmental Impact Index (EII)

1. Develop an EII for each significant environmental function from the standpoint of:
   a. Initial Impact (II)
   b. Future Impact (FI)
   c. Time factor (Duration of Impact) (T)

2. Assign numerical value to each of the three components by a value rating system which considers magnitude and significance of impact. Values are arrived at by the interdisciplinary team on the basis of factual information assembled and interpreted to the best of the team's professional judgement.

This process is repeated for each of approximately 50 significant environmental functions.

The final evaluation states in numerical form a summarized consideration of the magnitude and significance of the proposed development in relation to its impact on the total environment.

Outlined, the process is as follows:

1. Define the objectives of the project, and describe how it satisfies future and present needs.
2. Estimate the magnitude and significance of the project or service.
3. Estimate social & economic benefits of the project.
4. Determine the specific end products of the project (End items: facilities equipment services).
5. Describe and estimate the magnitude of unknown, vague and unclear aspects.
6. Make all information understandable and communicable.
7. Assess initial and future impact values.
8. Calculate environmental impact index for each significant environmental function.

A rating and value system is applied as follows:

1. On the basis of hard data and professional judgement for each significant environmental function affected, rate the magnitude of initial impact on a scale from +5 for an extremely beneficial impact to -5 for an extremely detrimental impact.
2. Rate future impact in a similar manner, using a scale of +10 to -10.
3. Compute for each significant environmental function the environmental impact index (EII) according to the following:

   EII = II + T (FI)

   Where T = length of time in years the significant environmental function is affected

   II = initial impact from activation through turnkey

   FI = future impact of operational activity with impact significance

Alternative Proportional Value (APV)

This portion of the overall analysis evaluates design concepts for their ability to reduce or minimize significant adverse effects of the proposed development on the total environment.

The APV for each significant function is determined by assigning a value of 1.0 to the alternative having the most significant impact on that particular function. All other alternatives will have a less significant impact and are assigned values in proportion to their effect on the function.

Functional Impact Value (FIV)

The FIV is a determination of the impact of an alternative design concept on an environmental function. It is arrived at by multiplying the EII by the APV.

The values thus obtained for each significant function affected are added up for the alternative, yielding a number that expresses the total impact of the alternative. The remaining alternatives are evaluated in a similar manner, yielding a set of numerical values which can then be compared.

The two or three alternative design concepts promising the maximum positive benefits and the lowest negative adversity would then be reassessed, disregarding the remaining alternatives.

The article contains one chart depicting a systematic interdisciplinary approach to environmental assessment, and another depecting elements to be considered in assessment.

Several flaws or areas of uncertainty are evident in the system:

1. All "significant functions" are assumed to be of equal importance. In doing so, some functions may be assigned weighting in excess of their actual value. It appears that the authors feel that there are enough of these weightings on both sides of the scale to cancel each other out.
2. The reasoning behind the expansion of the II scale from +5, -5 to +10, -10 on the FI scale is unclear. The authors intended to show the FI as being more significant, but this is not true in all cases.
3. It is also unclear why, in the formula to determine EII, the II is not multiplied by a time factor as is the FI.

The authors are aware of these limitations, and are in the process of revising the procedure.

Tamblyn, Thomas A. and E.A. Cedarborg (Bechtel Power Corp.), 1974. "The Environmental Assessment Matrix As A Site Selection Trol - A Case Study." Presented at the Nuclear Society Symposium on Nuclear Power Plant Siting, Portland, Oregon, August 25-28, 1974.

Though a perfect formula for unopposed site selection has not been developed, a relatively universal approach appears to be evolving. The site selection process begins with consideration of a large, perhaps multi-state, region and progressively narrows the study area to smaller candidate areas. These candidate sites are then screened to develop a list of preferred

sites. As the geographic area being considered is decreased, the depth of inquiry is increased.

The Environmental Assessment Matrix was developed for application as a site selection tool. This procedure is an adaptation of the concept of an environmental impact matrix, developed by Leopold, et al., and described in U.S.G.S. Circular No. 645.

For the case study the detailed Environmental Assessment Matrix was utilized for the final screening of five preferred sites that had been selected from an original set of 40 candidate sites. A sensitivity analysis was also conducted, and indicated that even though all of the sites had similar environmental rankings, two of the sites were better from an overall environmental point of view. (20)

"Three Approaches to Environmental Resource Analysis," Prepared by: Landscape Architecture Research Service, Harvard University, and The Conservation Foundation, Washington, D.C., November 1967.

An overview of three land use planning analysis methods: G. Angus Hill, Phillip H. Lewis Jr., and Ian L. McHarg. The three methodologies are compared on: (1) their identification of spatial and environmental patterns beyond single factor analysis and simple spatial location, (2) their identification and evaluation of key elements and forces that affect the quality of the environment, (3) their review of analysis material for incorporation in the planning process, and (4) their treatment of the environment as an entity. (20)

Travelers Research Corporation, 1969. "The Development of a Procedure and Knowledge Requirements for Marine Resource Planning," prepared for the Marine Resources Council of the Nassau-Suffolk Regional Planning Board (Hartford, Conn.).

While this research pre-dates the NEPA, and therefore is not labelled as an environmental impact study per se, it does, in fact, deal explicitly with the problem of identifying environmental impacts for one particular environment. Furthermore, the approach developed is applicable to environmental impact assessment in general, and has been adopted and extended by other researchers in this field (e.g., Sorenson (1971) and Leopold (1971 noted above.)

The overall objective of the research was to develop a methodology and the associated knowledge required for effective planning and management of Long Island's marine resources. The research program was structured into a series of six "functional steps," the first two of which are described in the two reports annotated below:

"Functional Step One: The Classification of Marine Resource Problems of Nassau and Suffolk Counties," April 1969.

Of principal interest as regards environmental impact assessment is section 6, "Approach to Problem Analysis" (pp. 57-62). The approach is basically the so-called "systems approach," wherein the many complex interrelationships between man's activities and the environment are supposedly recognized, and dealt with by taking a "total system" viewpoint. In this case, the system was characterized as a "branching network of cause-condition-effect relationships among human activities and environmental elements (or conditions)." To demonstrate the approach, a preliminary network analysis of dredging was undertaken.

"The Status of Research Activity on Functional Step Two," July 15, 1969.

The objective of this step of the research was to identify the knowledge requirements for sound decision making in regard to the marine resources in question. Of primary interest is section 3.2 (pp. 9-13) which focuses on an approach to network development. As a basis for the later development of networks, TRC constructed three matrices which were to function as "guides" for the identification of potential cause-condition-effect relationships. The first matrix lists 35 causal factors on the vertical axis against 39 environmental conditions affected on the horizontal. A dot was placed in each one of the (1365 possible) squares where they thought a potential relationship might exist. Two more matrices were constructed, and similar procedures applied, in order to identify hypothesized interactions among environmental conditions and potential links between environmental conditions and human activities. These matrices would then be used to develop the various networks. At the time of this status report, a computer program was being designed to store the matrices and to retrieve the information and present it in a way that would facilitate the construction of the network analyses. (114)

Upchurch, S.B. and D.C.N. Robb, 1972, "Mathematical Models: Planning Tools for the Great Lakes," Water Resources Bulletin 8(2), pp. 338-348.

Present and projected water and related land-resource problems and demands in the Great Lakes Basin are assessed by mathematical modeling A two-phase program, comprising a feasibility and design study followed by contracted and in-house modeling, data assembly and plan development, has been initiated. Models will be used to identify sensitivities of the lakes to planning and management alternatives, insufficiencies in the data base and inadequately understood ecosystem interactions. The long-term effects of planning alternatives and their impacts on neighboring lakes and states can also be evaluated, along with the consequences of environmental accidents and increased pollution levels. (20)

U.S. Army Corps of Engineers, 1973. "Environmental Impact Assessment Study for Army Military Programs," Technical Report D-13, Construction Engineering Research Laboratory, Champaign, Illinois.

Potential environmental impacts are identified by a computer-aided assessment program developed for Army activities. Eleven technical areas of specialty are used in describing the environment. Environmental impact analysis proceeds at three levels: (1) detailed level; (2) review level; and (3) controversial attributes level. "Ramification remarks" were developed for noting potentially important construction impacts, as well as procedures for minimizing adverse impacts. (20)

U.S. Army Corps of Engineers, Tulsa District, 1972. "Matrix Analysis af Alternatives for Water Resource Development," draft technical paper.

Despite the title, this methodology can be considered a checklist under the definitions used here since, though a display matrix is used to summarize and compare the impacts of project alternatives, impacts are not linked to specific project actions. The approach was developed to deal specifically with reservoir construction projects but could be readily adapted to other project types.

Potential impacts are identified within three broad objectives: environmental quality, human life quality, and economics. For each impact type identified, a series of factors are described, indicating possible measureable indicators. Impact magnitude is not measured in physical units but by a relative impact system. This system assigns the future state of an environmental characteristic without the project a score of zero; then assigns the project alternative possessing the greatest impact on that characteristic a score of +5 (For positive impact), or -5 (for negative impact). All other alternatives are assigned scores between 0 and 5 by comparison. The raw scores thus obtained are multiplied by weights determined subjectively by the impact analysis team.

Like the Georgia approach, the Tulsa methodology tests for the significance of differences between alternatives by introducing error factors and conducting repeated runs. The statistical manipulations are different from those used in the Georgia approach, however, and considered by the Corps' writers to be more valid.

Resource requirements of the Tulsa methodology are variable. Since specific types or levels of data are not required, data needs are quite flexible. The consideration of error, however, requires specific skills and computer facilities.

The major limitations of the approach, aside from the required computerization, are the lack of clear guidelines on exactly how to measure impacts and the lack of guidance on how the future no-project state is to be

defined and described in the analysis. Without careful description of the assumptions made, replicability of analyses made using the approach may be low since only relative measures are used. Since all measurements are relative, it may also be difficult in some cases to deal with impacts that are not clearly definable as gains or losses.

The key ideas of wider interest incorporated in the Tulsa approach include reliance on relative rather than absolute impact measurement, statistical tests of significance with error introduction, and specific use of the no-project condition, as a base line for impact evaluation. (20,166)

U.S. Army Corps of Engineers, 1972. "U.S. Deepwater Port Study, the Environmental and Ecological Aspects of Deepwater Ports," Volume IV, IWR Report 72-8, Institute for Water Resources.

The environmental portion of the Deepwater Port Study has three principal objectives:

1. To develop background information about the environmental and ecological effects of deepwater ports development and operation to aid in identifying the significant elements of any port alternatives.
2. To develop an analytical framework within which the environmental effects of alternative proposals can be identified, analyzed, and evaluated.
3. Conduct a preliminary analysis of a selected set of alternatives.

The analytic framework is a network to relate the cause-effect relationships that lead from the activities to the environmental effects. This network is used to develop a checklist of components and relationships. A subjective analysis of the particular elements is conducted and a ranking of elements made into categories of high, medium and low value. The environmental factors rated are aesthetics, water quality, air quality, uniqueness, general ecology, wildlife, wetlands, fin fish, shellfish, water supply, health and safety, water contact recreation, shoreland recreation, agriculture, industry, residential, marine transportation, and land transportation. The analysis of the effect on each element should consider the construction, presence, operations, and secondary development related to the project. The duration of the effect is categorized as temporary, permanent, or irreversible. (20)

U.S. Bureau of Reclamation, 1972. "Multiagency Task Force, Guidelines for Implementing Principles and Standards for Multiobjective Planning of Water Resources", Review Draft, Washington.

The Task Force approach is an attempt to coordinate features of the Water Resources Council's Proposed Principles and Standards for Planning Water and Related Land Resources with requirements of NEPA. It develops a checklist of environmental components and categories organized in the same manner as the WEC Guidelines. The categories of potential impacts examined deal comprehensively with biological, physical, cultural, and historical resources, and pollution factors but do not treat social or economic impacts. Impacts are measured in quantitative terms where possible and also rated subjectivly on "quality" and "human influence". In addition, uniqueness and irreversibility considerations are included where appropriate. Several suggestions for summary tables and bar graphs are offered as communications aids.

The approach is general enough to have wide applicability to various types of projects, though its impact categories are perhaps better tailored to rural than urban environments. No specific data or other resources are required to conduct an analysis, though an interdisciplinary project team is specified to assign the subjective weightings. Since quality, human influence, uniqueness, and irreversibilities are all subjectively rated using general considerations only, results produced by the approach may be highly variable. Significant ambiguities include a generally inadequate explanation of how human influence impacts are to be rated and interpreted.

Key ideas incorporated in the approach include explicit identification of the without-project environment as distinct from present conditions, and use of uniqueness rating system for evaluating quality and human influence (worst known, average, best known, etc.). The methodology is unique among those examined in not labeling impacts as environmental benefits or costs but only as impacts to be valued by others. The approach also argues against the aggregation of impacts. (20, 166)

U.S. Environmental Protection Agency, 1973. "Aesthetics in Environmental Planning," EPA-600/5-73-009, Washington, D.C.

This report addresses the relationship of aesthetics to environmental planning. Methodologies for measuring or quantifying aesthetics are reviewed, as well as a review of the state of the art of research in basic theory for understanding the unquantifiable. A similar review of selected planning agencies guidelines and procedures for integrating aesthetics into the planning process is followed with an outline of suggested future research needs. (20)

U.S. Environmental Protection Agency, 1973. "Methodology for Ranking of Energy Systems." Appendix B of "Environmental Considerations in Future Energy Growth. Volume I. Fuel/Energy Systems: Technical Summaries and Associated Environmental Burdens." Report to Office of Research and Development by Battelle's Columbus and Pacific Northwest Laboratories.

A method is described to perform an initial ranking of energy systems based on the environmental burdens they impose. In concept the ranking system is based on methodology developed for the Bureau of Reclamation, U.S. Department of Interior. The ranking system uses a hierarchy of environmental burdens under four major environmental categories. Weighting factors were employed at each level of the hierarchy to combine the environmental burdens into an environmental index for each proposed energy system. A sensitivity analysis was conducted to gain an appreciation of the dependence of the index on the uncertainties of the input data. (20)

"U.S. Water Resources Council, Proposed Principles and Standards For Planning Water and Related Land Resources." Federal Register, Vol. 36 No. 245, December 21, 1971, pp. 24144-24194.

These principles and standards provide for a system of accounts to measure beneficial and adverse effects for multiobjective planning of water and related land use projects. The specific major categories are national economic development, environment, regional development, and social factors. (20)

Vlachos, E., 1973. "Sociological Considerations in Systemic Analysis," Colorado State University, Presented at Conference on Impact Assessment in Water Resources Planning, Ann Arbor, Michigan, June 3-9, 1973.

This paper attempts to connect sociological considerations to the planning process. The following major points are discussed.

1. How does one systematically describe the "human community" or the surrounding social system?
2. In adopting a social systems point of view, what are the component parts, basic definitions and concepts associated with the human community, which would permit us to identify appropriate variables or evaluative factors?
3. In identifying evaluative factors, how do we then proceed in assessing the impact of public projects on the human community?

4. In such an assessment methodology, what is the role and utility of social indicators?
5. In making inferences about the world around us (recognizing also the inherent difficulties in elusive social measurement procedures), what are some of the pitfalls and fallacies involved in the aggregation of our observations?
6. What are some general principles of evaluating the effects (both short-term impacts and long-range consequences) of a public project on a community? (20)

Walton, L. Ellis, Jr., and James E. Lewis, 1971. "A Manual for Conducting Environmental Impact Studies," Virginia, through the National Technical Information Service PB-210 222).

The Walton methodology is a checklist, unique in its almost total reliance on social impact categories and strong public participation. The approach was developed for the evaluation of highway alternatives and identifies different impact analysis procedures for the conceptual, corridor, and design states of highway planning. All impacts are measured by either their dollar value or a weighted function of the number of persons affected. (The weights used are to be determined subjectively by the study team.) The basis for most measurements is a personal interview with a representative of each facility or service impacted.

Resource requirements for such a technique are highly sensitive to project scale. The extensive interviewing required may make the approach impractical for many medium-size or large projects because agencies preparing impact statements seldom have the necessary manpower or the money to contract for such extensive interviewing.

Analyses produced by the approach may have very poor replicability due to the lack of specific data used and the criticality of the decision regarding boundaries of the analysis since many impacts are measured in numbers of people affected. There is also no means of systematically taking into account the extent to which these people are affected.

The key ideas of broader interest put forth by the approach are the use of only social impacts without direct consideration of other impacts (pollution, ecology, etc.), the heavy dependence on public involvement and specific suggestions on how the public may be involved, and the recognition of the need for different analyses of different stages of project development. (20, 166)

Wengert, N., 1969. "Approaches to Value Choices," in Regional Planning - Challenge and Prospects, New York, Frederick Praeger, pp.98-102.

This article discusses the problems of values in environmental planning. The author points out that environmental decisions will be affected by the often conflicting goals of different professionals with different objectives. Such differences are based on technological background, authority, and associates of each person involved. To deal with such difficulties, the author suggests three basic needs. The values must be identified, and awareness of mechanisms and processes for making value choices must be developed, and it must be recognized that value decisions often involve hard choices. The author stresses the importance, in decision-making for environmental planning, of a cost benefit analysis of the factors involved. (20)

Western Systems Coordinating Council, 1971. "Environmental Committee, Environmental Guidelines" (Mr. Robert Coe, Southern California Electric Company, Environmental Committee Chairman.)

The Environmental Guidelines are intended primarily as a planning tool for siting power generation and transmission facilities. However, they address many of the concerns of environmental impact analysis and have been used in the preparation of impact statement. Viewed as an impact assessment methodology, the approach is an ad hoc procedure, suggesting general areas and types of impacts but not listing specific parameters to examine.

The approach considers a range of pollution, ecological, economical, economic (business economics), and social impacts but does not address secondary impacts such as induced growth, or energy use patterns. The format of the approach is an outline of considerations important to the selection of sites for each of several types of facilities -- e.g., thermal generating plants, transmission lines, hydroelectric and pumped storage, and substations. An additional section offers suggestions for a public information program.

Since the approach does not suggest specific means of measuring or evaluating impacts no particular types of data or resources are required. The application of this approach is limited to the siting of electric power facilities with little carry over to other types of projects. (166)

Whitman, Ira L., et al., June 1971. "Design of an Environmental Evaluation System," Final Report of the Bureau of Reclamation, U.S. Dept. of the Interior, prepared by Battelle-Columbus Laboratories (Columbus, Ohio).

This report develops a detailed Environmental Evaluation System (EES) for assessing the environmental impacts of the Bureau of Reclamation's water resource development projects. The EES is based upon a hierarchial arrangement of critical environmental quality parameters which are assigned weights, expressed in environmental quality units (EQU) which reflect their relative importance. The environmental parameters were weighted in such a way that the total value would add up to 1000 EQU. The EES also provides for the identification of "red flags"--fragile elements of the environment that may serve as a warning or signal of significant environmental impact for a project.

This report is now outdated by a report describing the follow-on work which resulted in a number of minor modifications in the EIS based on field tests of the approach. For example, EQU were replaced by PIU-- "parameter importance units"--in the later report. For a more detailed discussion of this approach, the reader is referred to the annotation of the report by Dee, et al. (1972). (114, 20)

Wirth, Theodore J. and Associates, 1972. "Report and Draft Environmental Impact Statement for the Lake Tahoe Plan and Effectuating Ordinances." South Lake Tahoe, California: Tahoe Regional Planning Commission.

This report utilizes a cross-impact matrix which differs from cause-effect matrices (such as the USGS procedure) in an important respect. They show two-way linkages and feedbacks rather than simply first order, one way causal relationships. Where the USGS procedure had "causes" on the columns and "effects" on the rows, a cross impact matrix has basically the same list of items on both columns and rows, so that all interrelationships may be considered.

A dot in the matrix indicates a potentially significant relationship, and the location of it in the matrix indicates the direction of causality; all relationships shown are assumed to be conflicts. For each row, a separate expanded matrix is then used to display the extent of mitigation that would result from adoption of the proposed plan and effectuating ordinances and a final matrix, similar to the first, then displays the net changes in initial relationships that would be expected if the proposed plan and ordinances were adopted.

The Tahoe approach has many of the same strengths and weaknesses as approaches discussed above. It does, however, have two advantages over techniques such as the USGS matrix. The first is that it is simpler, limiting

itself to the identification of relationships rather than attempting the dubious specificity of ratings between 1 and 10. The second is that it recognizes, in rudimentary way, the two-way rather than one-way relationships among its components; and it thereby permits more sophisticated thought about these relationships and about the full consequences of actions taken to alter them. This approach shares with Leopold's a difficulty in comparing alternatives (the Tahoe study does not even attempt to deal with alternatives, serving instead primarily as a display format to show the effects of a single proposed package of actions). It also shares a heavy reliance on in-house judgements rather than an open solicitation of value issues from all interested parties. It is discussed here, however, for two reasons: first, because it illustrates the difference between a cross-impact matrix and a cause-effect matrix; and second, because it does attempt a simple form of systems description, rather than simply a matrix formulation of a checklist as exemplified by Leopold. (8)

Wolf, C.P., 1974. "Social Impact Assessment: The State of the Art." U.S. Army Corps of Engineers, Presented at Fifth Annual Environmental Design Research Association Conference, Milwaukee. May 29 - 31, 1974.

This paper presents a state-of-the-art report on social impact assessment. The analytical problem of social impact assessment is examined. A wide variety of substantive and methodological approaches to the analytical problem are presented and their practitioners indentified.

A brief "resource inventory" of social science methodologies and techniques that can be associated with varying approaches to the analytical problem are presented. In the present state of the art these are not yet systematically related; however, a means for achieving this, keyed to one operational methodology for social impact assessment, is proposed. Also, a few empirical applications of these approaches and methods are given. (8)

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APPENDIX A

FEDERAL ENVIRONMENTAL ASSESSMENT LEGISLATION

APPENDIX A

FEDERAL ENVIRONMENTAL ASSESSMENT LEGISLATION [1]

BACKGROUND

In the brief period since its initial enactment, the National Environmental Policy Act of 1969 (commonly referred to as NEPA) has emerged as the single most influential force shaping U.S. environmental management efforts. Rather than vaguely asserting a collective social responsibility for the quality of the nation's environment, NEPA provided: 1) the first clear statement of national policy spanning all major government actions with potential environmental impacts, and 2) an integrated institutional framework wherein the overall social costs and benefits of such actions could be systematically identified and evaluated by requiring explicit consideration of environmental factors traditionally neglected in public decision making processes.

The major provisions of NEPA can be summarized as follows:

- A general policy statement of federal environmental responsibility
- Creation of the Council on Environmental Quality (CEQ) within the Executive Office of the President
- Requirements and guidelines for preparation of environmental impact statements

STATEMENT OF NATIONAL ENVIRONMENTAL POLICY

The fundamental importance of NEPA relates to its initial policy declaration of the goals of federal environmental policy and the explicit criteria it affords (in a legal context) for determination of what is meant by the term "environmental quality." In clarifying what is meant by "environmental quality," Section 101 of the Act requires that all Federal departments and agencies use all practicable means to improve and coordinate their planning, functioning, and programming to achieve a clearly defined set of national environmental goals relating to:

- Minimizing the long-term environmental effects of all federal actions

Taken From: Resource and Land Investigations (RALI) Program: Methodologies for Environmental Analysis. Volume I. Environmental Assessment. August, 1974. Prepared by MITRE Corp. for U.S. Geological Survey Contract No. 14-08-0001-14715

- The right of society to safe, healthy and aesthetic environment
- Multiple use of environmental resources
- Preservation of historic and natural landmarks
- Balanced population growth and resouce utilization
- Recycling of scarce natural resources

The ultimate power of NEPA in shaping U.S. environmental policies is embodied in its statement of policy which introduces an environmental awareness into all public sector activities - especially those wherein environmental oversight is not specifically mandated by existing legislation or administrative practice. This category of federal activities constitutes the great majority of all public sector policies and programs whose design and implementation were previously immune from challenge on environmental grounds since no clear violation of existing pollution control regulations was involved.

While it is still too early to formulate any conclusions on the overall impact of NEPA policy declarations on federal environmental activities, certain preliminary observations should be cited:

- Federal agencies have realigned their organizational structure and procedural guidelines to facilitate compliance with NEPA requirements (primarily in the area of environmental impact statements).
- A more integrated perspective has emerged in federal decision-making efforts in response to NEPA declarations on agency responsiblities to consider all aspects of program implementation (including those which transcend the traditional benefit/cost criteria of economic efficiency analysis).
- New channels of communication and technical coordination have emerged between federal, state and local agencies whose programs interact in areas not clearly within the mandated jurisdiction of a single organizational entity.
- The courts have interpreted the policy declaration in Section 102 of NEPA as a clear statement of congressional intent and commitment to both maintaining and improving the nation's environmental quality. The statutory requirements of NEPA are thus accepted as the basis for review and challenge of agency administrative authority, regulations, policies and procedures if a determination is made of deficiencies or inconsistencies precluding full compliance with NEPA.

The future impact of NEPA will be largely determined by the effectiveness of recent efforts to weaken its statutory requirements particularly

with regard to environmental review (i.e., impact statement requirements) of proposed federal actions. Some initial waivers of NEPA requirements have already been approved by a Congress increasingly concerned with critical energy shortages and the effects of environmental review in delaying new projects with an energy orientation. Future waivers of NEPA may also occur in the cases of industrial and economic sectors already suffering major dislocations because of energy constraints and overall economic uncertainty.

THE COUNCIL ON ENVIRONMENTAL QUALITY

The Council on Environmental Quality (CEQ) was established under Section 202 of the National Environmental Policy Act as an advisory and coordinating body on environmental policy within the executive branch (similar to the Council of Economic Advisors role in economic policy issues). CEQ consists of three members appointed by the President for indefinite terms subject only to initial Senate confirmation. Major statutory responsibilities of CEQ include the following tasks:

- Prepare the annual Environmental Quality Report required by Section 201.
- Monitor and analyze information concerning conditions and trends in the quality of the environment.
- Review and appraise federal programs and activities relative to the NEPA policy declaration.
- Develop and recommend to the President national policies to promote the improvement of environmental quality.
- Conduct studies, research and analyses relating to ecological systems and environmental quality.

Considering the wide ranging set of responsibilities set forth in its enabling legislation, CEQ has effectively maintained a relatively low profile operation during its brief existence, although its staff has interacted frequently and with significant influence on the President's domestic advisors in shaping environmental policy. Major policy initiatives generated by CEQ, however, have been frequently negated by the Office of Management and Budget citing fiscal and budgetary constraints or jurisdictional problems arising from establishment of the newly organized Environmental Protection Agency (EPA). Most of the administration's environmental legislation written and enacted since 1970 has been prepared largely by the Council. The subject areas of this legislation include toxic substances, pesticides, noise and the new water pollution control bill. (The water pollution legislation was considerably modified by the Senate before its enactment.)

Although not created as a provision of NEPA, EPA emerged at approximately the same time as CEQ in response to a reorganization of the executive branch, which entailed the consolidation of Federal programs dealing with air pollution, water pollution, solid waste disposal, pesticide regulation, and radiation. Although EPA and CEQ are both concerned with environmental policy, there is a significant difference between the two. CEQ is located within the Executive Office of the President and is responsible for policy advice, reviewing and coordinating environmental impact statements as well as environmental control activities of all federal agencies. The staff is small which limits their involvement in other agencies' activities. EPA, however, is an operating line agency responsible for administering and conducting all federal pollution control programs, focusing attention on pollution control as a strategy for securing environmental quality as well as preservation of wildlife and natural resources. In the environmental impact statement process, for example, EPA functions like any other federal agency in reviewing statements.

Currently, CEQ has focused on studying a limited number of critical environmental issues such as environmental effects of exploiting the Atlantic outer continental shalf and the environmental aspects related to major domestic energy issues. The Council is intending to renew its efforts at developing quantitative indication of environmental quality.

THE ENVIRONMENTAL IMPACT STATEMENT PROCESS

The Environmental Impact Statement Process, as outlined in Section 102, NEPA, was specifically designed as a way of assessing the environmental consequences of proposals for major federal actions against the effects of feasible alternatives rather than a cursory exposition of agency intent or justification for the program in question. The primary objective is to have Federal agencies seriously analyze their policy alternatives before actual decisions are made relative to potentially adverse environmental effects. Under the provisions of NEPA, the Council on Environmental Quality became the primary administrating body with the responsibility for developing explicit guidelines regarding the processes of preparation and reviewing of impact statements.

Under terms of CEQ guidelines, an environmental impact statement must include:

- A comprehensive technical description of the proposed action.
- An analysis of the probable impact (both costs and benefits) of the proposed action on the overall environment, including impact on ecological systems, land use and development patterns, community and social organization and relevant quality of life indicators.

(a) The environmental impact of the proposed action.
(b) Any adverse environmental effects which cannot be avoided if the proposal is implemented.
(c) Mitigation measures proposed to minimize the impact.
(d) Alternatives to the proposed action.
(e) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.
(f) Any irreversible environmental changes which would be involved in the proposed action should it be implemented."

The major distinction between the California Act and NEPA is the CEQA requirement to specify the measures undertaken to minimize the environmental impact. Although the "mitigation entry" was not necessarily an entirely new consideration, the requirement was a needed clarification and represented a significant advance in the impact assessment process.

In addition to the above requirements, 1973 Guidelines to Implement CEQA added a seventh entry to the list above.

(g) The growth- inducing impact of the proposed action. This is another significant addition to CEQA since it requires discussion of both the direct and indirect (induced) impacts of the project. (The latter had generally been omitted in earlier impact stuides.)

CEQA mandated the responsibility of administering the State environmental impact statement requirement to the Office of Planning and Research (OPR). Section 21103 stated that OPR was responsible for establishing guidelines, criteria and procedures for the preparation and evaluation of the impact statements. However, OPR was not given any clear authority to ensure that the review process had an effect in modifying proposals with potentially adverse environmental consequences.

Although CEQA lacks effective means for corrective action, it does contain significant clarification of specific goals for the EIS. The policy section of the Act enumerates these goals.

"The Legislature further finds and declares that it is the policy of the state to:

(a) Develop and maintain a high quality environment now and in the future, and take all action necessary to protect, rehabilitate, and enhance the environmental quality of the state.

- A description of any probable adverse environmental effects which cannot be avoided or which can be reduced in severity to acceptable levels.
- Analysis, studies and descriptions of possible alternatives to the recommended course of action, and their environmental effects (including alternatives beyond the immediate scope of responsibility of the relevant agency).
- Detailed consideration of any irreversible or irretrievable commitments of scarce environmental resources.

Considerable variation is encountered between impact statements prepared by different agencies, although all theoretically comply with the same basic requirements. Furthermore, such variation is likely to decline over time as agencies become more familiar with NEPA requirements and expand their internal capabilities for impact statement preparation. The sequence of steps required by recently enacted CEQ guidelines for preparing environmental impact statements is shown in Figure 7.

The environmental impact statement process has been repeatedly modified and revised in response to CEQ guidelines and numerous court decisions interpreting the requirements of relevant sections of NEPA. The ultimate goal of CEQ guidelines has been to make the process of impact statement preparation self-implementing so as to minimize the need for futher intervention by CEQ or the judiciary. Achievement of this goal, however, has been somwhat constrained by:

- initial confusion surrounding administration efforts to implement NEPA requirements for environmental impact analysis,
- the absence of any clearly defined enforcement procedures within NEPA to insure compliance with impact statement requirements,
- the traditional reluctance of federal agencies to modify their operating procedures and decision-making processes to satisfy newly imposed administrative requirements which transcend the immediate concerns of such agencies, and
- increased resistance to administrative requirements for environmental protection with the net effect of delaying implementation of what is perceived by some to be critically needed projects and programs.

Guidance in implementing the requirements of the NEPA is provided to Federal agencies by the Council on Environmental Quality (CEQ) in its August 1973 guidelines for the preparation of environmental statements (referred to hereafter as "the CEQ Guidelines"). In relation to the statutory clause "major Federal actions significantly affecting the quality of the human environment," the Guidelines state, among other things, that . . .

1. THRESHOLD DETERMINATION OF IMPACT STATEMENT REQUIREMENT

2. DRAFT STATEMENT PREPARATION

3. DRAFT STATEMENT REVIEW (INCLUDING PUBLIC HEARINGS)

4. ADDRESS COMMENTS ON DRAFT STATEMENT

5. REVISIONS & FINAL STATEMENT PREPARATION

6. FINAL IMPACT STATEMENT

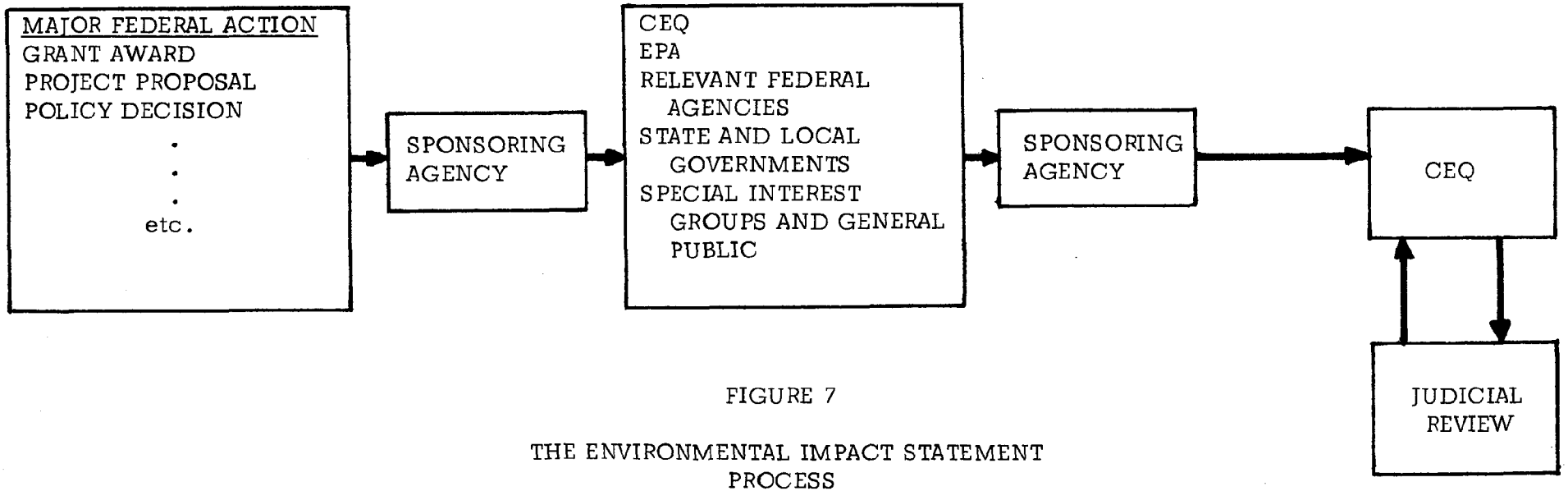

FIGURE 7

THE ENVIRONMENTAL IMPACT STATEMENT PROCESS

"The identification of major actions significantly affecting the environment is the responsibility of each Federal agency, to be carried out aginst the background of its own particular operations. The action must be a (1) 'major' action, (2) which is a 'Federal action', (3) which has a 'significant' effect, and (4) which involves the 'quality of the human environment'. The words 'major' and 'significantly' are intended to imply thresholds of importance and impact that must be met before a statement is required."

The criteria which have been developed by various Federal agencies to identify major actions significantly affecting the quality of human environment are examined in Appendix B. The CEQ guidelines stipulate that the impact of a proposed action is to be considered in the context of the overall cumulative impact of that action and related Federal actions and projects in the area, and further actions contemplated; in cases of proposed major actions, the environmental impact of which is likely to be highly controversial, an environmental impact statement (EIS) is to be prepared.

Neither NEPA nor the Guidelines defines precisely the term "human environment". However, section 101 (b) of the NEPA indicates that broad range of aspects of the environment to be surveyed in any assessment of significant effect.

Section 101 (b) states . . .

"In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may -- (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice; (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

Appendix II of the CEQ Guidelines outlines the areas of environmental impact to be considered in assessing the significance of an action.

These potential impact areas are summarized in Table 1. Further, the CEQ specifies that both the direct and indirect effects of any particular action are to be considered. It is clear, therefore, that the term "human environment" is to be interpreted in its broadest sense so as to encompass all the factors and conditions that affect the life of humans.

Most Federal agencies have developed procedural guidelines and criteria more specific than those published by CEQ in terms of identifying major actions significantly affecting the quality of the human environment (and thus requiring an EIS). These are detailed in the procedural guildelines for each agency published in the Federal Register (see Table II).

TABLE I

AREAS OF ENVIRONMENTAL IMPACT

- AIR:
  - Air Quality
  - Weather Modification
- WATER:
  - Water Quality
  - Marine Pollution, Commercial Fishery Conservation, and Shellfish Sanitation
- FISH AND WILDLIFE
- SOLID WASTE
- NOISE
- RADIATION
- HAZARDOUS SUBSTANCES:
  - Toxic Materials
  - Food Additives and Contamination of Foodstuffs
  - Pesticides
  - Transportation and Handling of Hazardous Materials
- ENERGY SUPPLY AND NATURAL RESOURCES DEVELOPMENT:
  - Electric Energy Development, Generation and Transmission, and Use
  - Petroleum Development, Production, Transmission, and Use
  - Natural Gas Development, Production, Transmission, and Use
  - Coal and Minerals Development, Mining, Conversion, Processing, Transport, and Use
  - Energy and Natural Resources Conservation
- LAND USE AND MANAGEMENT:
  - Land Use Changes, Planning and Regulation of Land Development
  - Public Land Management
- PROTECTION OF ENVIRONMENTALLY CRITICAL AREAS - FLOODPLAINS, WETLANDS, BEACHES AND DUNES, UNSTABLE SOILS, STEEP SLOPES, AQUIFER RECHARGE AREAS, ETC.

- LAND USE IN COASTAL AREAS
- REDEVELOPMENT AND CONSTRUCTION IN BUILT-UP AREAS
- DENSITY AND CONGESTION MITIGATION
- NEIGHBORHOOD CHARACTER AND CONTINUITY
- IMPACTS ON LOW-INCOME POPULATIONS
- HISTORIC, ARCHITECTURAL, AND ARCHEOLOGICAL PRESERVATION
- SOIL AND PLANT CONSERVATION AND HYDROLOGY
- OUTDOOR RECREATION

TABLE II
SUMMARY INFORMATION ON AGENCY CRITERIA

FEDERAL AGENCY	REFERENCE	GUIDANCE AND/OR CRITERIA				
		NO GUIDANCE BEYOND CEQ GUIDELINES	ENUMERATION OF ACTIONS	ENUMERATION OF AREAS OF IMPACT	DEFINITIVE BUT NOT QUANTITATIVE CRITERIA	QUANTITATIVE CRITERIA
APPALACHIAN REGIONAL COMMISSION	36 F.R. 23676	●				
ATOMIC ENERGY COMMISSION	37 F.R. 2268		●			●
CANAL ZONE GOVERNMENT	36 F.R. 22669	●				
CENTRAL INTELLIGENCE AGENCY	37 F.R. 22670		●			
CIVIL AERONAUTICS BOARD	36 F.R. 12513		●			
DELAWARE RIVER BASIN COMMISSION	36 F.R. 20381					●
DEPARTMENT OF AGRICULTURE	36 F.R. 23667		●			
Agricultural Stabilization and Conservation Service	37 F.R. 22669					
Farmers Home Administration	37 F.R. 17459			●		
Forest Service	36 F.R. 23669			●		
Rural Electrification Admin.	36 F.R. 23672					●
Soil Conservation Service	36 F.R. 23674			●	●	●
DEPARTMENT OF COMMERCE	36 F.R. 21368		●	●		
Economic Development Admin.	37 F.R. 22671			●		
Maritime Administration	37 F.R. 22673	●				
DEPARTMENT OF DEFENSE	36 F.R. 15750			●		
Department of the Army, Corps of Engineers	37 F.R. 2525				●	
DEPARTMENT OF HEALTH, EDUC. & WELFARE	36 F.R. 23676			●		
Food and Drug Administration	37 F.R. 13636		●			
DEPARTMENT OF HOUSING & URBAN DEVEL.	38 F.R. 19182					●
DEPARTMENT OF INTERIOR	36 F.R. 19343		●			
Alaska Power Administration	37 F.R. 7008		●			
Bonneville Power Administration	37 F.R. 815		●			
Bureau of Indian Affairs	37 F.R. 22677			●		
Bureau of Land Management	37 F.R. 15015			●		
Bureau of Mines	37 F.R. 2895		●			
Bureau of Outdoor Recreation	37 F.R. 6501		●			
Bureau of Reclamation	37 F.R. 1126			●		
Bureau of Sport Fisheries & Wildlife	37 F.R. 22681		●			
Geological Survey	37 F.R. 5263		●			
National Park Service	37 F.R. 4373		●			
Office of Coal Research	37 F.R. 1414		●			
Office of Saline Water	37 F.R. 545		●			
Southwestern Power Administration	37 F.R. 9246				●	
DEPARTMENT OF JUSTICE						
Law Enforcement Assistance Admin.	37 F.R. 4418			●		
DEPARTMENT OF STATE	37 F.R. 19167		●			
Agency for International Develop.	37 F.R. 22687			●		
International Boundary & Water Com.	37 F.R. 22688		●			
DEPARTMENT OF TRANSPORTATION	36 F.R. 23679		●	●		
Coast Guard	36 F.R. 23682		●	●		
Federal Aviation Administration	36 F.R. 23686		●	●		
Federal Highway Administration	36 F.R. 23696			●		
St. Lawrence Seaway Develop. Corp.	37 F.R. 22695		●			
Urban Mass Transportation Admin.	37 F.R. 22692		●			
DEPARTMENT OF THE TREASURY	36 F.R. 14221	●				
Internal Revenue Service	36 F.R. 15061		●			
ENVIRONMENTAL PROTECTION AGENCY	37 F.R. 879			●		
FEDERAL COMMUNICATIONS COMMISSION	37 F.R. 15711					●
FEDERAL MARITIME COMMISSION	37 F.R. 20184	●				
FEDERAL POWER COMMISSION	36 F.R. 22738					●
FEDERAL TRADE COMMISSION	36 F.R. 22814				●	
GENERAL SERVICES ADMINISTRATION						
Federal Supply Service	36 F.R. 23702	●				
Property Management & Disposal Ser.	36 F.R. 23704	●				
Public Buildings Service	36 F.R. 23337		●	●		
Transportation & Communications Ser.	36 F.R. 23652		●	●		
INTERSTATE COMMERCE COMMISSION	37 F.R. 6318	●				
NATIONAL AERONAUTICS & SPACE ADMIN.	36 F.R. 21753	●				
NATIONAL CAPITAL PLANNING COMMISSION	37 F.R. 2268		●			
NATIONAL SCIENCE FOUNDATION	36 F.R. 23709	●				
OFFICE OF ECONOMIC OPPORTUNITY	37 F.R. 22696		●			
U.S. POSTAL SERVICE	37 F.R. 13322			●		●
SMALL BUSINESS ADMINISTRATION	37 F.R. 22697	●	●			
TENNESSEE VALLEY AUTHORITY	36 F.R. 21010		●			
VETERANS ADMINISTRATION	37 F.R. 8591					
WATER RESOURCES COUNCIL	36 F.R. 23711				●	

TRENDS IN STATE ENVIRONMENTAL IMPACT ASSESSMENT LEGISLATION

Passage of the National Environmental Policy Act of 1969 resulted in a series of subsequent legislative actions creating virtually identical environmental assessment procedures at the state level. In this context, NEPA has functioned as a catalyst to stimulate state level concern for the environmental consequences of a wide range of governmental actions which have the potential to generate significant environmental effects.

Within the procedural framework established by NEPA at the federal level, many states have established similar environmental assessment programs (Table III). These laws, which require that an environmental impact statement be prepared on state funded projects, are referred to as state NEPA equivalents. In this context, equivalent is used to mean equal in function, i.e., the assessment of environmental impact prior to initiation of the actual project or program. While all the state laws are not completely analogous to the Federal law (except for establishing jurisdictional domain), they do represent limited variations from the NEPA precedent and have differences which might alleviate some of the difficulties in the still-incomplete NEPA framework.

As was noted in the discussion on NEPA, however, these laws do not provide explicit guidelines or criteria for evaluating the environmental effects of a specific project or program. Rather, they are more accurately termed "full disclosure" laws which attempt to provide political decision makers and the general public with a more complete awareness of a project's overall effect on the quality of the environment.

TABLE III

SUMMARY OF EXISTING AND PROPOSED
STATE ENVIRONMENTAL IMPACT ASSESSMENT LEGISLATION
(THROUGH JUNE 1973)

STATE	LEGISLATIVE ACTION
California	NEPA equivalent, Assembly Bill No. 2045, Environmental Protection Act of 1970
Colorado	State Environmental Policy Act enacted in 1973
Delaware	Critical area approach, the Coastal Zone Act of 1971 requires an EIS for coastal zone development
Florida	Critical area approach, Land and Water Use Act, EIS for development of special areas
Georgia	Legislation planned, Department of Natural Resources considering submission of legislation
Hawaii	NEPA equivalent, the Environmental Quality Act of 1970, Act 132 SLH 1970
Indiana	NEPA equivalent, the Indiana Environmental Policy Act of 1971, Senate Enrolled Act No. 278
Kentucky	Legislation submitted, House Bill No. 3, a general environmental bill
Louisiana	Legislation planned - state NEPA would organize EIS review
Maryland	Critical area approach as part of land use act
Massachusetts	NEPA equivalent, Massachusetts House Bill 5574, effective January 1, 1973

STATE	LEGISLATIVE ACTION
Michigan	Administrative action, Governor's Directive 1-10, has the power of law
Minnesota	NEPA equivalent effective in 1974
Montana	NEPA equivalent, the Montana Environmental Policy Act, House Bill 66, included in the 1971 supplement to Fish & Game Laws
Nevada	Critical area approach, the Utility Environmental Protection Action, EIS for all utilities
New Jersey	Administrative action, environmental impact guidelines for New Jersey Thruway Authority construction
New Mexico	Administrative action, the Environmental Quality Council has dictated guidelines for state EIS action, power of law
New York	State NEPA equivalent; administrative action requires review by Department of Environmental Conservation on capital budget actions
North Carolina	NEPA equivalent, North Carolina Environmental Policy Act of 1971, House Bill 649
North Dakota	Legislation planned, bill in planning stages, may be presented before next legislature
Oregon	Legislation planned, Program Coordination Unit is developing a State NEPA for presentation to the legislature
Rhode Island	Legislation submitted, a NEPA-like bill was introduced, never emerged from committee

STATE	LEGISLATIVE ACTION
Texas	Administrative action, requires EIS on state-funded projects, analogous to NEPA requirement, power of law
Vermont	Administrative action, the Land-Use and Development Law requires permits for land use changes, which must be in line with prepared land use plans
Virginia	NEPA equivalent passed legislature without impact statement requirement
Washington	NEPA equivalent, the Washington State Environmental Policy Act of 1971
Wisconsin	NEPA equivalent, the Wisconsin Environmental Policy Act (1972), Assembly Bill 875

During the period between the signing of the National Environmental Policy Act on January 1, 1970 and August 1972, eight states had established legislation requiring environmental impact statements on all state funded projects which may significantly affect the environment: California, Hawaii, Indiana, Massachusetts, Montana, North Carolina, Washington and Wisconsin. In addition, Michigan and Texas had utilized existing administrative powers (i.e., executive orders) to establish the requirements of an impact statement. Three states had established a critical area approach requiring an environmental impact statement for specific areas of concern:

a. Delaware (Coastal Zone Management Act)
b. Florida (Land and Water Use Act)
c. Nevada (Environmental Protection Act)

In addition, as indicated in Table III, nine other states were in the process of approving NEPA type legislation in early 1973, with indications that this number has increased significantly within the past year and one-half.

The following section summarizes some of the major aspects of NEPA type legislation in the eight states previously cited as being among the first to legislate in this area.

SUMMARY OF SELECTED STATE ENVIRONMENTAL ASSESSMENT LEGISLATION[28]

California

The California Environmental Quality Act of 1970 (CEQA) was perhaps the earliest of the state NEPA equivalents tended to be a replicate of NEPA, with the same inherent shortcomings. In fact, the description of the impact statement process under CEQA's Chapter 3 was almost identical to the NEPA EIS requirements.

> "All state agencies, boards, and commissions shall include in any report on any project they propose to carry out which could have a significant effect on the environment of the state, a detailed statement by the responsible state official setting forth the following:

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28 Based on Relevant State Statutes and Summary of State Legislation by Gordon A. Enk, Beyond NEPA, Criteria for Environmental Impact Review, Institute for Man and Science, 1973.

(b) Take all action necessary to provide the people of this state with clean air and water, enjoyment of aesthetic, natural, scenic, and historic environmental qualities, and freedom from excessive noise.
(c) Prevent elimination of fish or wildlife species due to man's activities, ensure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities and examples of the major periods of California history.
(d) Ensure that the long-term protection of the environment shall be the guiding criterion in public decisions.
(e) Create and maintain conditions under which man and nature can exist in productive harmony to fulfill the social and economic requirements of present and future generations.
(f) Require governmental agencies at all levels to develop standards and procedures necessary to protect environmental quality.
(g) Require governmental agencies at all levels to consider qualitative factors as well as economic and technical factors and long-term benefits and costs and to consider alternatives to proposed actions affecting the environment."

Hawaii

The Hawaii NEPA equivalent, the Environmental Quality Act of 1970, Act 132 SLH 1970, (HEQA) also closely parallels the NEPA requirements for Environmental Impact Statements content:

" (b) Include, in every recommendation or report on proposals for legislation, and any other major State actions or projects utilizing State funds and/or State lands, that significantly affect the quality of the human and natural environment, a detailed statement by the responsible official on (1) the environmental impact of the proposed action, (2) any adverse environmental effects which cannot be avoided should the proposal be implemented, (3) alternatives to the proposed action, (4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and (5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented" . . .

While the EIS content was not altered from NEPA by the Hawaii EQA, the review mechanism was more clearly defined under the State's legislation. The Office of Environmental Quality Control (OEQC) was charged with the duties of coordinating the impact statement requirement, much like the Council on Environmental Quality on the Federal level. OEQC was to establish a clearinghouse for the dissemination of the draft

environmental impact statements, then consolidate and evaluate the comments received from concerned environmental agencies. Specific procedures were outlined for inviting citizens groups to comment on the impact statements. In addition, HEQA also gave the Governor final authority for approving or rejecting proposed State projects.

Under the Hawaii EQA, the modified impact statement, which reflects the comments of public and private groups, must be approved or disapproved by the Governor, with the assistance of the neutral OEQC. In other words, the filing agency cannot approve its own actions under this system as Federal agencies can under NEPA. The evaluation of the proposal is the responsibility of neutral third parties -- the Governor and the Office of Environmental Quality Control. This separation of evaluational powers from the filing agency represented a departure from the Federal NEPA plan. It separated advocacy of projects from evaluation of environmental impacts and thereby attempted to balance the various trade-offs necessary to meet social needs.

Indiana

The Indiana Environmental Policy Act of 1971 is another illustration of NEPA-type legislation. In addition to the environmental impact statement definition (taken directly from NEPA) the "Environmental Bill of Rights" was also included, with the substitution of Indiana State government for the Federal government in the wording. The Indiana Act reflects virtually no substantial differences from NEPA at the Federal level and contains no significant elements which warrant further discussion or elaboration.

Massachusetts

The Massachusetts Environmental Protection Act represents a departure from verbatim restatements of NEPA. It directed the establishment of a State Division of Environmental Protection within the Attorney General's Office, with powers to

> . . . "prevent or remedy damage to the environment caused by any person, body, agency, or authority of the Commonwealth or any political subdivision thereof at the request of an appropriate agency (or on his own initiative) by commencing or intervening in a proceeding before any political subdivision of the Commonwealth."

The key phrase "damage to the environment," has applicability to State environmental impact statements and is defined further on in Section 11C of the Act:

> As used in this section, 'damage to the environment' shall mean any destruction, damage or impairment, actual or probable, to any of the natural resources in the Commonwealth and shall include, but not be limited to, air pollution, improper sewage disposal, pesticide pollution, excessive noise, improper operation of dumping grounds, or the impairment or eutrophication of rivers, streams, flood plains, lakes, ponds or other surface or subsurface water resources, destruction of seashores, dunes, marine resources, wetlands, open spaces, natural areas, parks or historic districts or sites. Damage to the environment shall not include any insignificant destruction, damage or impairment to such natural resources.

In order to identify and prevent potential environmental degradation, a procedure was provided by the Act to require publication of an environmental impact study prior to initiating the proposed action. The Act requires that:

> "An environmental impact report shall contain detailed statements describing the nature and extent of the proposed work and its environmental impact; all measures being utilized to minimize environmental damage, any adverse short-term and long-term environmental consequences which cannot be avoided should the work be performed; and alternatives to the proposed action and their environmental consequences. The preparation of said report shall be commenced during the initial planning and design phase of any work, project, or activity subject to this section."

Under the Massachusetts Act, the Attorney General can institute judicial action to challenge agency decisions in cases of potentially adverse environmental impact.

Montana

The Montana Environmental Policy Act, enacted in 1970, is another verbatim transposition of NEPA requirements. These sections dealing with the preparation and evaluation of an EIS parallel the contents of NEPA's Title 1. The Montana Act also established an Environmental Quality Council, which was charged with developing state environmental policy goals and evaluating proposals and actions in the environmental spectrum. The Montana Environmental Quality Council, like the Federal CEQ, is an advisory group with no apparent enforcement function.

North Carolina

The North Carolina Environmental Policy Act (NCEPA) of 1971, closely parallels NEPA's impact statement process by requiring for all

major state actions "a detailed statement by the responsible official setting forth the following:

(a) the environmental impact of the proposed action;

(b) any significant adverse environmental effects which cannot be avoided should the proposal be implemented;

(c) mitigation measures proposed to minimize the impact;

(d) alternatives to the proposed action;

(e) the relationship between the short-term uses of the environment involved in the proposed action and the maintenance of long-term productivity; and

(f) any irreversible and irretrievale environmental changes which would be involved in the proposed action."

The North Carolina Act added the requirement to discuss mitigation of adverse impacts in a manner similar to the California requirement.

In cases of unavoidable impact, the Act noted that:

> "Whenever, in the judgement of the responsible State official, the information obtained in preparing the statement indicates that a major adverse change in the environment, or conflicts concerning alternative uses of available natural resources, would result from a specific program, project or action, and that an appropriate alternative cannot be developed, such information shall be presented to the Governor for review and final decision by him or by such agency as he may designate, in the exercise of the powers of the Governor."

Thus, under this Act, impact policy involving projects with major environmental adversities are made by the Governor or his designee. A differentiation was made between the project advocate and the project evaluator and such separation may lead to more impartial judgements of environmental effects.

Washington

The Washington State Environmental Policy Act of 1971 very closely followed the NEPA precedent for preparation and evaluation of environmental impact statements.

The Washington Act granted the Department of Ecology broad powers to establish guidelines and criteria for the preparation of environmental impact statements. That Department has developed these guidelines and state agencies have a clear idea of what factors to consider in EIS preparation. Thus, instead of fully describing the desired content of an impact statement in the legislation per se, the responsibility was given to a state agency which has subsequently developed the needed procedural and substantive guidelines.

Wisconsin

The Wisconsin Environmental Policy Act (1972), also substantially follows the NEPA precedent. The description of the contents of a State environmental impact statement contained one innovative element, requiring state agencies to include details of the beneficial aspects of the proposed project, both short-term and long-term, and the economic advantages of the proposal.

In essence, this requirement directs that project justification be contained in the impact statement, whether it be on environmental or economic grounds. Since such a directive was not explicitly mentioned in NEPA, the Wisconsin Act addition further defined the impact statement. This was the only major difference contained in the Wisconsin Act. Otherwise the legislation directs State agencies to refer to the guidelines issued under NEPA and the Council on Environmental Quality.

APPENDIX B

CRITERIA EMPLOYED BY FEDERAL AGENCIES IN DETERMINING NEED FOR AN IMPACT STATEMENT UNDER NEPA

APPENDIX B

CRITERIA EMPLOYED BY FEDERAL AGENCIES IN DETERMINING NEED FOR AN IMPACT STATEMENT UNDER NEPA [1]

INTRODUCTION

Guidelines published by the Council on Environmental Quality in August 1973 provide the basis for Federal agency response to NEPA requirements. One of the most critical areas of NEPA response is the determination of what constitutes a "major" federal action and thus requires an Environmental Impact Statement. The following section outlines the criteria used by selected Federal agencies in assessing the need for EIS review of proposed projects and programs. This summary is based on agency guidelines pulbished in the Federal Register.

DEPARTMENT OF AGRICULTURE

Forest Service

An environmental statement will be prepared for new regulations, policies, and procedures which have major environmental effects. Environmental statements will be prepared on major proposed plans, programs. and major projects directly undertaken by the Forest Service, or supported in whole or in part through land use permits, leases, contracts, grants, cooperative agreements, subsidies, technical assistance or granting of rights. The need for environmental statements should be seriously considered for the activities given below:

a. Multiple use plan (forest or unit)
b. Timber management plan
c. Forest 5-year timber sale action plan
d. Rural area development plan
e. Mining permits and certain prospecting permits. This applies to minerals owned by United States. May also apply to certain aspects of removal or reserved minerals (e.g., operating plan of mineral operator)
   (1) Surface mining except for minor sand, gravel, and stone excavation and minor mineral activities (mica, feldspar, etc.)
   (2) Deep mining
   (3) Development of major oil and gas fields with appurtenant facilities.

Taken From: Resource and Land Investigations (RALI)
Program: Methodologies for Environmental Analysis.
Volume I. Environmental Assessment. August, 1974.
Prepared by MITRE Corp. for U.S. Geological Survey
Contract No. 14-08-0001-14715

f. Major public service developments (e.g., winter sports sites, resorts, and marinas)
g. Chemical programs including pesticides, fertilizers, and other programs
h. Water resource development projects
i. Cooperative state programs
j. Large-scale on-the-ground research activities such as some pilot tests involving chemicals or drastic treatment of sizable areas
k. Vegetative-type conversion involving substantial acreage
l. Forest transportation system plan
m. Major highways and bridges if not included under l
n. Prescribed burning program if not included under c., including roller chopping, rock raking, shearing, cabling, etc.
o. Rights-of-way permits for major transmission lines
p. Major sewage treatment facilities
q. Major acquisition or exchange.

Source: 36 FR23669

DEPARTMENT OF DEFENSE

A. The proponent of the action should consider all aspects of the action to determine if it will interfere unreasonably with the living conditions of man, wildlife, or marine life, or with any ecosystems on an immediate, short-range or long-range basis. Examples of factors to be considered are:

1. Effect on water.
   a. Will the action:
      (1) Introduce toxic or hazardous substances or significant amounts of chemicals, organic substances or solid wastes into bodies of water,
      (2) Significantly increase sedimentation in a body of water, or
      (3) Significantly alter the temperature of a body of water?
   b. Will the action improve the quality of a body of water?
2. Effect on atmosphere.
   a. Will the action result in emissions into the atmosphere of toxic or hazardous substances or significant amounts of other pollutants?
   b. Will the action result in the creation of excessive noise, considering the proximity of and the likely effects of the noise on humans or wildlife?
   c. Will the action tend to reduce the amount of pollution in atmosphere?
3. Effect on natural resources.
   a. Will the action result in significant destruction of vegetation, wildlife, or marine life?
   b. Will the action enhance the quality of vegetation, wildlife, or marine life?

c. Will the action significantly affect soil quality?
d. Will the action result in contamination or deterioration of food or food sources?

4. Other values.
   a. Will the action significantly affect, beneficially or adversely, the health or welfare of man, including aesthetic considerations?
   b. Will the action significantly affect, beneficially or adversely, other forms of life or ecosystems of which they are a part?

B. Certain types of actions require close environmental scrutiny because of the possibility that they may either affect the quality of the environment or create environmental controversy.

It may be desirable in such cases to have a complete presentation of the environmental aspects of the proposed action available for any interested party. For these reasons, consideration shall be given to assessing the environmental effects of the following types of actions in writing even though a detailed assessment indicates that the action is not a MASAQHE.*

1. Development or purchase of a new type of aircraft, ship or vehicle, or of a substantially modified propulsion system for any aircraft, ship or vehicle.
2. Development or purchase of a new weapon system.
3. Real estate acquisitions or outleases of land.
4. Construction projects.
5. New installations (bases, posts, etc.).
6. Disposal of biological or chemical munitions, pesticides or herbicides other than in the manner in which they are intended to be used.
7. Intentional disposal of any substances in a significant quantity or on a continuing or periodic basis.
8. Mission changes which increase the number of personnel in an area to a degree that will tax the environmental capability of the local civilian community.
9. Any action which, because of real, potential or purported adverse environmental consequences, is a subject of controversy among

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* Major action significantly affecting the quality of the human environment.

people who will be affected by the action, or which, although not the subject of controversy, is likely to create controversy when the proposed action becomes known by the public.

Source: 36 FR15750

Army Corps of Engineers

Corps of Engineers actions that require the preparation of an environmental statement include the following:

a. Legislation. Recommendations or reports to the Congress on proposals for legislation affecting Corps of Engineers programs including proposals to authorize projects (survey, review and comprehensive reports) and other legislation.

b. Proposals under continuing authorities. Recommendations or reports on proposals for authorization of projects by the Chief of Engineers or the Secretary of the Army under special authorities.

c. Construction or land acquisition not started. Initiation of construction or land acquisition on projects not yet started but for which funds have been appropriated or are provided by the current FY Appropriation Act.

d. Requests for initiation of construction or land acquisition. Budget submissions requesting funds for the initiation of construction or land acquisition on authorized projects.

e. Continuing construction and land acquisition. Statements for projects in continuing construction or land acquisition status will be submitted in accordance with the criteria and the schedule established in compliance with j. below.

f. Operation, maintenance, and management. Statements for projects which are in an operation, maintenance, and management status will be submitted in accordance with the criteria and the schedule established in compliance with j. below.
   (1) certain administrative actions regarding utilization of project resources
   (2) operation and maintenance exceptions:
      (a) completed projects turned over to local interests for operation and maintenance.
      (b) projects where only infrequent periodic maintenance is performed. Statements may be deferred until request of funds for maintenance.

g. Regulatory permits. Subject to the considerations contained in

the specific regulations applicable to the particular activity, issuance of permits for structures, discharges, deposits, or other actions in navigable waters of the United States this requirement does not apply:

(1) in areas of continuing programs or activities where an overall statement has been filed with CEQ on the general program or activity ("unbrella statement") . . .

(2) with respect to environmental statements for fixed or anchored structures or artificial islands on Outer Continental Shelf lands under mineral lease from the Department of the Interior . . .

h. Non-Federal construction of authorized projects. Where the non-Federal agency cooperating with the Corps of Engineers will accomplish the construction, a final environmental statement will be filed by the Corps.

i. . . .For disposal of surplus project lands for development of port and industrial facilities . . . the District Engineer will prepare an environmental statement . . .

j. . . .Statements on projects in a continuing construction or operation and maintenance status will be submitted in order of priority

k. over a 3-year period. Those projects having the greatest impact upon the enviornment and those projects where proposed actions are such as to preclude the possible adoption of alternative plans will be considered highest in priority.

Operation and maintenance. . . . In the development of plans for operation, maintenance, and management activities, all possible significant effects on the environment will be considered. Discussion should be addressed only as the adverse environmental impacts relate to the operation of the project and the on-going O & M programs. Typical examples of these activities . . . are as follows:

(1) disposal of dredged material in wetlands or marshlands

(2) disposal of polluted dredged material in unconfined or open water areas

(3) debris collection and disposal activities

(4) resource management program involving the cutting, sale and/or disposal of forest resources; extensive plant disease eradication; predator or vector control; and aquatic plant control

(5) reservoir regulation in which some environmental benefits must be sacrificed for other environmental benefits or econimic considerations, e.g., undersirable drawdown to provide water for power and for down-stream quality control

(6) leases, licenses, rights-of-way, administrative permits, and other actions involving use by others of project resources, if impact is significant and not otherwise covered

redesignation of project land under management by the Corps from scenic buffer or "green belt", undeveloped natural area, or wildlife management area to more intensive type of public use or some other type of use.

Source: 37 FR2525

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

The General Counsel, in consultation with the Deputy Undersecretary ... shall determine which HUD legislative proposals shall be accompanied by an environmental statement. Promulgation of guidance documents may be "major actions", and in each case a determination shall be made in consultation with the Deputy Undersecretary as to whether or not there is a significant impact on the human environment. In all cases where there is a significant environmental impact, environmental statement shall be prepared prior to promulgation. Except as noted herein the promulgation of guidance documents shall be the principal means for administering environmental quality standards within the department.

The table below . . . sets forth thresholds above which "special clearance" is required. Special clearance must be followed by a negative statement or a 102(2)C environmental statement. In general, the 102(2)C statement shall be completed for projects which are controversial with regard to whether or not HUD and other environmental policies and standards are being met, or precedent-making in the sense that important environmental circumstances relating to the proposal are not treated in central office guidance documents.

Decision points for completing environmental clearances on applications	Thresholds
New communities activities (note A-95 requirement)	
1. Debt guarantee or certification of eligibility - offer of commitment or major change to approved plan	All projects for actions 1, 2, and 3 require 102(2)C statements.
2. Interest loan - same decision point as No. 1	

3. Grant for waiver of tax exemption - same decision point as No. 1	Planning grants under action 4 will have an environmental assessment in 102(2)C format as a final product.
4. Special planning loan or grant (see threshold).	

Open space (note A-95 requirement)

Approval of application for funds or major amendatory.	1. All sanitary landfill projects, or 2. Projects upon which two or more surface areas of water will be impounded, or 3. Projects in excess of 300 acres.

Water and sewer (note A-95 requirement)

Approval of application to fund a facility (note: The Environmental Protection Agency funds interceptor sewers and waste treatment plants).	1. Projects requiring new water treatment plants, or 2. Projects resulting in impoundment of water of more than five acres.

Urban renewal (note A-95 requirement)

(Conventional) approval of either the urban renewal plan or fund reservation to carry the real estate acquisition, public improvements, rehabilitation, clearance or resale aspects of plan to completion. (Neighborhood development - a special mechanism for funding annual increments of renewal) approval of fund reservation i.e., approval of locality's plan and budget for 12 months of activities to implement the plan (see conventional). Approval of major amendatories that trigger thresholds.	1. Plans that change concentration in the renewal area approaching or in excess of 50 percent increase in density, or in vehicular traffic, or in demand for energy, or in demand for other public services, or 2. Conversions of use expected to produce noise, waste products or waste energy which exceed capacity of existing facilities and airsheds to absorb them in manner that meets applicable standards. 3. Projects involving structures on National Register of Historic Places. 4. Plans involving an increase of 100 or more feet in the height of any structure over any previously existing structure.

Public facilities loans (note A-95 requirement)

Approval of application or major amendatory.	Same as water and sewer and open space.
Model cities (note A-95 requirement) Approval of application or major amendatory.	Use urban renewal, open space, and water and sewer thresholds.
Housing assistance or insurance (see also HPMC-FHA 1600. Ire: A-95) Approval of feasibility letter, or major proposed change in the letter or project, for Subdivisions Title X (large scale subdivisions). Multifamily mortgage insurance. Mobile home courts, nursing homes. Letter of notification of site approval or disapproval for public housing projects. Approval of fund reservation for college housing or major change to a fund reservation. State of HUD commitment for other programs not listed.	1. 50 lot subdivision, or 2. 100 unit multifamily structures, or 3. 200 unit college housing structures, or 4. 100 unit mobile home courts (some regional administrators have suggested 50; discretion is granted to use this figure), or 5. 100 bed nursing homes, or 6. any proposal involving sites for which compliance with central office environmental policies and standards is in doubt or under challenge.
Demonstration projects Approval of application or major proposed amendatory or change in the project.	Projects totalling $500,000 or more (from all sources) in new construction.
Flood and disaster insurance (note A-95 requirement) Designation by HUD of area having special flood hazard.	After normal administrative review, use negative statement prior to designations, or prepare 102(2)C statement.

Source: 38 FR19182

ENVIRONMENTAL PROTECTION AGENCY

A. The following general guidelines shall be used when assessing an Agency action to determine if it will have a significant impact on the environment and therefore require an impact statement.

1. Significant environmental effects.
   a. Although there is some latitude in defining "significant effect" on the quality of the human environment, it is mandatory that "significant effects" encompass both adverse and beneficial effects.
   b. Significant effects should include environmental consequences of both a primary and secondary nature. Primary effects (e.g., siltation during construction of waste treatment facilities) should not be given greater consideration than secondary effects (e.g., land use), which often have more far reaching environmental consequences.
2. Individually small but cumulatively large actions. The total expected environmental impact of precedent-setting actions and individually small, but cumulatively large actions, shall be identified and considered fully.
3. Controversial or nationally significant actions. An environmental impact statement shall be prepared and processed when an Agency action is likely to be highly controversial or nationally significant.
4. Specific criteria for preparing impact statements on waste water treatment facilities and water quality management plans. For the following specific situations, an impact statement shall always be prepared and processed:
   a. When the project or plan is highly controversial for any reason, including the degree of treatment, method of final waste disposal, or the location of a plant or facility. In the case of location, where controversy centers only on the disruption incident to construction and serious effort is made to restore the environs as much as possible, an impact statement is not required.
   b. When a project or plan defaces (either by physical presence or odor) a residential development or a recognized scenic area, on either public or private lands. An impact statement shall not be required if the physical alteration is unobtrusive, or a permanent industrial facility already exists in the area and the proposed project will not constitute a commitment of substantial additional land to industrial use, providing all other effects are unobtrusive.
   c. When a facility is to be sited on public land (or on private land in an urban area, which because of its natural beauty and wilderness state has potential or is being considered for public park development), and

the loss of aesthetics incurred through construction and maintenance of the facility substantially reduces its value as a public park.

d. When the treated effluent being discharged will meet water quality standards applicable to the receiving waters but the public is using these waters for activities that require a classification higher than their present classification.
e. When a project will result in a substantial displacement of population.
f. When the environmental impact is the result of a number of projects impacting upon the same resources, as when a number of projects individually divert water from one river basin into another, or discharge effluent into the ocean instead of using the effluent to recharge the ground water aquifer.
g. When an existing plant is being refurbished to improve its treatment capabilities and the additions involve controversy or substantial additional impacts. However, where there is no substantial new land use, noise, or odor, an impact statement shall normally not be required.
h. When the project or plan will result in the installation of a major interceptor line that will provide service to undeveloped areas or permit expansion of already developed areas, and the effects that this will have on residential and commercial growth have not been adequately considered in the interim or final plan encompassing the project, or in the grant application and associated documents.

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

Some Bureau actions may fall into more than one of the categories below.

A. Recommendations or favorable reports to the Congress relating to legislation, including appropriations.
B. Projects, programs, and continuing actions, including research:
   1. Directly undertaken by the Bureau;
   2. Supported in whole or in part through bureau contracts;
   3. Involving a Bureau lease, permit, license or other entitlement of use.
C. Recommendations or adoption of policies, standards, procedures, regulations, and plans which affect the environment.

D. Actions relating to natural or cultural resources:
   1. Acquisition or disposal;
   2. Regulation, permission, prohibition, or other institutional control of their use;
   3. Their operational or physical management;
   4. Construction or operation of various structures to manage them; and
   5. Recommendations of comprehensive, or project plans for their management.

Source: 37 FR15015

Bureau of Reclamation

"Major Federal actions significantly affecting the quality of the human environment" is to be construed with a view to the overall "cumulative impact" of the action proposed, and of further actions contemplated. Such actions may be "localized in their impact", but, if the components of the environment or its uniqueness may be significantly affected, the statement is to be prepared...Bureau plans and actions of the following types may require environmental impact statements. This list is neither mandatory nor all inclusive, and the responsible official must base his judgement on the criteria in 7. below (see when to prepare)

A. Recommendations or favorable reports to the Congress relating to legislation that changes the legal or administrative status afforded to the environment and legislation relating to appropriations for programs or projects that result in significant impact on the environment.

B. Projects, programs, and continuing activities including research:
   1. Directly undertaken by the Bureau of Reclamation
   2. Supported in whole or in part through Federal contracts, grants, subsidies, loans, or other forms of financial assistance
   3. Involving a Federal lease, permit, license, certificate, or other entitlement for use.

C. Recommendation or adoption of policies, principles, standards, procedures, regulations, and plans which affect the environment through changes in management, operation or maintenance of facilities or which modify the legal or administrative protection afforded environmental resources.

D. Actions relating to natural or cultural resources:
   1. Acquisition or disposal of the resources
   2. Regulation, permission, prohibition, or other institutional control of uses

3. Their operational or physical management
4. Construction or operation of various structures to manage them
5. Recommendations of comprehensive, program, or project plans for their management for which immediate authorization is anticipated based on recommendations made.

E. Activities that will significantly affect the following will require an environmental statement:
1. Rare or endangered species -- plant, animal, or fish
2. Formally classified areas such as Wilderness Areas, Primitive Areas, Wild and Scenic Rivers, National Recreation Areas, Archeological Areas, Geological Areas, National Trails, National Wildlife Refuges, State Wildlife Refuges or Management Areas, parks or similar locally designated areas, and areas being studied for classification for such purposes.
3. Municipal watersheds
4. Reservoir operation (major changes)
5. Large roadless areas
6. Scenic attractions
7. Wetlands and estuaries
8. Free-flowing streams or major changes in regulated streams
9. Air quality
10. Water quality
11. Key wildlife or fish habitat.

F. Planning Federal water and related land resources projects and programs. Examples: irrigation, municipal and/or industrial water, hydroelectric projects, and atmospheric water resources management programs.

G. Research or investigations where the on-the-ground tests involve treatment or modification of natural resources.

H. Construction activities on Federal water and related land resources projects and programs. Examples: Irrigation, municipal and/or industrial water; hydroelectric projects which have not been covered by a prior environmental statement, or where there has been a major change in design from that presented in the authorization report and environmental statement accompanying that report; and major new transmission lines or transmission line relocations.

I. Other activities such as:
1. Changes in river operation or reservoir operation procedures
2. Major dam modification programs
3. Major canal modification programs
4. Vegetative management programs
5. Major acquisition leases, exchanges, or disposals of lands
6. Major public service developments, such as recreation facilities developed after the initial construction period

7. Major powerplant modification programs.

Source: 37 FR1126

Bureau of Sport Fisheries and Wildlife

"Actions significantly affecting the environment" include but are not limited to:

A. Recommendations or favorable reports relating to legislation;

B. Projects and continuing activities: directly undertaken by Federal agencies; supported in whole or in part through Federal contracts, grants, subsidies, loans, or other forms of funding assistance; involving a Federal lease, permit, license, certificate, or other entitlement for use;

C. Policy, regulations, and procedure making: in addition, departmental guidelines indicate the following actions relating to natural or cultural resources may require an environmental statement:
   1. Acquisition or disposal
   2. Regulation, permission, prohibition, or other institutional control of uses
   3. Their operational or physical management
   4. Construction or operation of various structures to manage the resource
   5. Recommendations of comprehensive, program, or project plans.

General Statements. Bureau program items for which it is determined that a single general or blanket statement can usually be used to cover each broad program item.

1. Fishery research program field or development tests
2. Wildlife research program field or development tests
3. Waterfowl production areas (lease, easement, fee title, or gift)
4. Federal aid.

Some elements of the programs conducted by the State Fish and Game Departments with the use of Federal aid funds may have significant effect on the human environment. In those cases, it is expected that EIS's will be prepared for those specific projects. The State may be asked to provide all necessary information for preparation of the statement.

5. Wildlife Services (total program)
   a. animal damage control
6. Fishery Services (total program)
   a. Lamprey control

7. Establishment of Bureau policy on offroad vehicle use, control of camping, picnicking, boating, waterskiing, nonconforming recreational uses, hunting, fishing, access to and across, or other uses of Bureau lands
8. Routine operation of all existing refuges
9. Routine operation of all fish hatcheries.

Specific Statements. Bureau program items for which it is determined that specific EIS's should usually be prepared for the individual facilities or actions.

1. Establishment of a new National Wildlife Refuge, Hatchery, or Research Laboratory. Complete to cover all aspects of the new project from land acquisition to construction, development, and operation at the ultimate planned level (Bureau-owned, leased, withdrawn from public land, received by gift, under cooperative agreement, or any other source -- including facilities acquired or developed and turned over to the Bureau by the Corps of Engineers, Bureau of Reclamation, or other Federal or State agency, including those as part of a water development or other project, unless fully covered by the EIS of the other agency).
2. Wilderness status proposals for Bureau lands.
3. When a master plan for an existing refuge is completed or an existing master plan is revised enough to indicate a change in the environmental impact from that expected under the earlier plan
4. Whenever portions or all of a refuge are to pass out of Bureau control by abolition of the refuge, termination of lease or easement, land disposition (including by exchange), or by lease to Federal, State, or other agency or party
5. Whenever any significant action at that facility, not already covered by an impact statement, is to take place (as land acquisition or disposition construction program, major change in operation practice or the completion or alteration of the master plan occurs), a full impact statement will be prepared.
6. All major construction items modifying, adding to, or deleting parts of existing facilities where a significant impact on the human environment may result (unless covered by prior EIS)
   a. refuges
   b. hatcheries
   c. research laboratories.
7. Introductory stocking, or rearing for purpose of introductory stocking, of exotic species of fish, birds, mammals, insects, other animals or their parasites into habitat outside their presently established natural range

8. Bureau-conducted programs involving use of major quantities of pesticides, herbicides, or other chemical substances for control of organisms
9. Major irreversible actions such as cutting of timber or mining on Bureau lands.
10. Legislative proposals drafted by or for the Bureau which will be favorably supported by the Department
11. Legislative proposals drafted outside the Department which are of major concern to Bureau programs ans which are to be supported by the Department.

Source: 37FR22681

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

1. Recommendations for favorable reports relating to legislation (including that for appropriations)
2. Projects and continuing activities:
   a. directly undertaken by the Department or any agency thereof;
   b. supported in whole or in part through Federal contracts, grants, subsidies, loans, or other forms of funding assistance;
   c. involving a Federal lease, permit, license, certificate or other entitlement for use.
3. Policy, regulations, and procedure-making that significantly affect the quality of the human environment.

Source: 36 FR 23676

Food and Drug Administration

A. The need for preparing an environmental impact statement shall be considered for the following agency actions:
   1. Recommendations or reports made to Congress on proposals for legislation in instances where the agency has primary responsibility for the subject matter involved;
   2. Destruction of articles condemned after seizure or enjoined;
   3. Destruction of articles following detention or recall at agency request;
   4. Destruction of articles banned by regulation;
   5. Disposition of Food and Drug Administration laboratory waste materials;
   6. Establishment by regulation of labeling or other requirements for marketing articles;
   7. Establishment by regulation of standards for articles (except food standards);

8. Approval of new drug and abbreviated new drug applications and old drug monographs;
9. Approval of new animal drug and abbreviated new animal drug applications and old animal drug monographs;
10. Approval of antibiotic drug monographs;
11. Approval of food additive petitions;
12. Approval of color additive petitions; and
13. Policy, regulations, and procedure-making which significantly affect the quality of the human environment.

B. An environmental impact statement will not be required for amendments to existing regulations and approvals of supplements to existing approvals unless the change is substantial.

C. Environmental impact statements are not required for the following agency actions:
1. Recommendations for court action concerning foods, drugs, devices, cosmetics, electronic products, and hazardous substances

Source: 37 FR 13636

Tennessee Valley Authority

A. Actions which may affect the quality of the human environment and which require notice to the Office Health and Environmental Science and the Division of Law include but are not limited to:
1. Water resource and other natural resource development or reclamation projects;
2. New power-generating facilities, or significant modifications to existing facilities;
3. Transmission system facilities;
4. Urban and industrial development proposals;
5. Weed and vector control methods;
6. Major recreation facilities;
7. Proposals for and policies related to the use and disposal of TVA lands and land rights;
8. Effluent-producing facilities or any use of TVA land which may result in the production or deposit of effluent;
9. Recommendations or reports relating to legislation or appropriations;
10. Permits under Section 26a of the TVA Act;
11. TVA policy-, procedure-, and regulation-making; and
12. Any action, the environmental impact of which is anticipated to be highly controversial.

Source: 36 FR 21010

DEPARTMENT OF TRANSPORTATION

Requirements calling for either a negative declaration or a statement pursuant to Section 102(2) (C) of NEPA apply to, but are not limited to, the following: all grants, loans, contracts, purchases, leases, construction, research and development involving construction, rulemaking and regulatory actions, certifications, licensing, permits, plans (both internal DOT plans and external plans, such as the annual work programs submitted to NHTSA), formal approvals (e.g., of non-Federal work plans), legislative proposals, directives, program or budget proposals or actions (except for continuation of existing programs at approximately current levels, i.e., plus or minus 25 percent).

A. Major. Any Federal action significantly affecting the environment is deemed to be "major" and a statement shall be prepared.

B. Federal actions. This term includes the entire range of activity undertaken by the DOT. Actions include but are not limited to:
   1. Direct Federal programs, projects and administrative activities, such as:
      a. research, development, and demonstration projects
      b. rulemaking and regulations
      c. construction of and operation of Federal facilities
      d. waste disposal
      e. transportation of dangerous or contaminated commodities
      f. making of treaties or agreements (international or with other Federal or State governments)
      g. development of plans.
   2. Federal grants, loans, or other financial assistance
   3. a. federal permits, licenses, certifications, approvals, leases, or any entitlements for use, such as:
      (1) aircraft certification
      (2) approval for use and integration into the NAS of privately financed air navigation equipment

Source: 36 FR 14221

Federal Aviation Administration

Order 1051.1A of the FAA entitled "Procedures for Considering Environmental Impacts of Proposed FAA Actions", dated June 19, 1973, provides the guidance which follows.

A. Environmental statements are ordinarily required of all FAA organizational units for the following types of actions:

1. Actions involving Section 4(f) of the DOT Act
2. Actions involving Section 106 of the Historic Preservation Act
3. Actions involving functions under the Airport and Airway Development Act as required by Order FAA 5050.2
4. Actions likely to be highly controversial on the basis of the following environmental impact factors:
   a. air quality
   b. water quality
   c. noise
   d. ground water
   e. drainage/sediment
   f. natural resources
   g. ecological
   h. cultural
   i. aesthetic
   j. congestion
   k. divides community
   l. disrupts community
   m. housing relocation
   n. land use compatibility
   o. economic
   p. safety.
5. Actions subject to ad hoc determination by the Secretary or the FAA Administrator that an environmental impact statement is required.

Source: 36 FR 23696

Federal Highway Administration

A. Draft and final environmental statements should be prepared and processed in accordance with the procedures required by this memorandum for all highway sections falling under one or more of the following three categories:
   1. Highway sections where organized opposition has occurred or is anticipated to occur.
   2. Highway sections significantly affecting historic or conservation lands (public or private) independent or whether they are section 4(f) cases.
   3. Highway sections which are classed as major actions and are also likely to significantly affect the quality of the human environment. This category requires a two-step analysis. First, it must be determined if the proposed highway section is a major action; secondly, the significance of the effects upon the human environment must be determined.

B. The following should be used to determine whether a proposal to construct or improve a highway section is a major action.

1. Highway sections entirely or generally on new location.
2. Major upgrading of an existing highway section resulting in a functional characteristic change (e.g., a local road becoming an arterial highway). Such changes usually result by adding lanes, interchanges, access control, medians, etc., and require extensive right of way acquisition and construction (grading, base, paving, bridges, etc) which have the potential of significantly affecting the human environment.

C. Any of the following highway sections should ordinarily be considered as significantly affecting the quality of the human environment.

1. A highway section that is likely to have a significantly adverse impact on natural, ecological, cultural, or scenic resources of national, State or local significance.
2. A highway section that is likely to be highly controversial regarding relocation housing resources.
3. A highway section that divides or disrupts an established community or disrupts orderly, planned development or is inconsistent with plans or goals that have been adopted by the community in which the project is located or causes increased congestion.
4. A highway section which involves inconsistency with any national standard relating to the environment; has a significantly detrimental impact on air or water quality or on ambient noise levels for adjoining areas; involves a possibility of contamination of a public water supply system; or affects ground water, flooding, erosion, or sedimentation.

D. Negative declarations shall be prepared for all highway sections which are not major actions and for highway sections, even though classed as major actions, where it is determined there is no significant effect upon the quality of human environment as a result of the study and early coordination. Highway improvements of the following types are not likely to have significant impacts upon the environment:

1. Signing, marking signalization and railroad protection devices.
2. Acquisition of scenic easements.
3. Modernization of an existing highway by resurfacing; less than lane width widening; adding shoulders: auxiliary lanes for localized purposes (weaving, climbing, speed-changing, etc.).

Source: 36 FR 23696

APPENDIX C

A LEGAL ANALYSIS OF THE REQUIREMENTS OF SECTION 102(2)(C) OF THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

APPENDIX C

A Legal Analysis of the Requirements of Section 102(2) (C) of the National Environmental Policy Act of 1969*

1. Introduction

The National Environmental Policy Act (NEPA) was passed into law January 1, 1970. It consists of three major parts. The first part declares that it is the national policy to maintain environmental quality, and directs federal agencies to "use all practical means" to meet the following environmental goals:

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
(2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;
(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources (§101(b)).

The second part of the Act contains a set of "action forcing" procedural requirements to ensure that environmental factors are given adequate consideration in the decision-making process. This part of the Act (in particular, Section 102(2) (C)) requires that federal agencies:

include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed

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*Richard R. Young and Alexander T. Henson. In Analyzing the Environmental Impacts of Water Projects. Ed. by Leonard Ortolano. A report submitted to U. S. Army Engineer Institute for Water Resources, Alexandria, VA, March 1973.

statement by the responsible official on--

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. (§102(2)(C))

The third part of NEPA establishes a national Council on Environmental Quality (CEQ) in the Office of the President. The CEQ is directed to prepare an annual Environmental Quality Report, gather information on changes in environmental quality, review agency proposals to determine whether they comply with the policies of NEPA, and recommend to the President policies which will enhance the nation's environment.

This chapter is concerned with the second part of the Act, specifically Section 102(2)(C) which calls for a "detailed statement" assessing the environmental impacts of proposed agency action. The primary focus of the chapter is on the following question: What kind of information must be contained in this "102 statement" in order to satisfy the requirements of NEPA? Neither the legislative history of Section 102 nor the wording of the Act itself provide much specific guidance on the required content of environmental impact statements. The statutory scheme has left considerable room for interpretation to the implementing agencies, the CEQ, and the courts. The following chapter considers the interpretations provided by CEQ and various implementing agencies; this chapter is concerned, primarily, with the interpretations provided by the courts.[1]

The "judge-made law" in this area is in an early stage of development. There are a number of decisions, however, which provide substantial guid-

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[1]The portion of environmental law which concerns the judicial response to NEPA is subject to rapid change as an increasing number of cases are heard by the courts. This chapter considers the judicial response to Section 102 of NEPA as of winter, 1972.

ance to an agency trying to assess environmental impacts under NEPA.[2] The issues which these decisions address include the role of scientific opinion in the assessment of impacts, the evaluation of potential alternatives, and the quantification of environmental impacts.

2. The Legislative History of Section 102

As it was initially introduced by Senator Jackson, NEPA did not contain anything resembling the current provision requiring environmental impact statements. The Act in its initial form simply directed the Secretary of the Interior to conduct research on the issue of environmental quality. Following a Senate hearing on National Environmental Policy[3], Senator Jackson amended his bill to include among other things a set of provisions closely resembling what is now Section 102.[4] The bill was further modified when it was reported out of the Senate Interior Committee,[5] and was again changed by a House-Senate Conference.[6] All of these versions of the bill make clear the Congressional purpose to insure that federal agencies consider environmental factors before deciding on a particular course of action. They do not, however, shed much light on the intended content of the detailed environmental inquiry required under Section 102(2)(C).

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[2]To understand the manner in which judicial decisions interrelate, it is useful to consider the hierarchy of federal judge-made law. An interpretation of a federal statute by the United States Supreme Court is binding in all other courts. Below the Supreme Court there are eleven regional circuit courts of appeal. Within each circuit there are a number of trial courts called federal district courts. A district court decision is law in the case before it (unless it is subsequently overruled). While it is of some precedential value, it is not binding when similar issues are raised in other district courts. Because of their power to reverse district court rulings, circuit court decisions provide the authoritative law for all of the district courts within their region. They also provide a strong precedent for district courts in other regions and some precedent for other circuit courts. It is possible that different circuits will interpret a federal statute differently, in this event the Supreme Court can resolve the conflict or it can refuse to hear the case and let the conflicting circuit decisions stand.

[3]Hearings on National Environmental Policy Before the Senate Interior and Insular Affairs Comm., 91st Cong. 1st Sess. (1969).

[4]Id. at 206.

[5]S. Rep. No. 296, 91st Cong., 1st Sess. (1969).

[6]115 Cong. Rec. 12633-34 (1969).

There are two modifications in the legislative evolution of NEPA which potentially reflect on the intended content of environmental impact statements. First, the bill as reported out of the Senate Interior Committee was directed to actions "significantly affecting" environmental quality[7] whereas the prior language had simply been "affecting."[8] This should probably be read as an effort to put some limit on the scope of Section 102, but there is no specific discussion of this intention in the legislative history. Second, under the version of the bill that passed the Senate, Section 102 required a "finding" by the responsible official that

> (i) the environmental impact of the proposed action has been studied and considered;
>
> (ii) any adverse environmental effects which cannot be avoided by following reasonable alternatives are justified by other stated considerations of national policy;'
>
> (iii) local short-term uses of man's environment are consistent with maintaining and enhancing long-term productivity; and that
>
> (iv) any irreversible and irretrievable commitments of resources are warrented.[9]

These provisions are basically identical to the provisions of 102(2)(C) in its present form. The departure from the Senate version is that instead of a "finding" the Act now requires a "detailed statement" and the reference to "considerations of national policy" in (ii) above has been dropped from Section 102 altogether. These changes do not appear to have been designed to alter the content of 102 statements, rather they were an attempt to clarify the Act's relation to other environmental legislation. Senator Muskie, the instigator of the change apparently feared that the language instructing the agency official to make a "finding" could be read to preempt environmental standards created by other legislation (e.g., air quality standards under the Air Quality Act of 1967, 33 U.S.C. §§1151-75 (1970), and water quality standards established under the Federal Water Polution Control Act, 42 U.S.C. §1857.) The amended version of the Act, in Section 104, specifically provides that these independent standards must continue to be met.

The bulk of the legislative background of NEPA is composed of general speeches on the need for protecting the quality of the environment. While there was no discussion going directly to the content of 102 statements,

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[7] S. Rep., supra note 5 at 2.
[8] Hearings, supra note 3 at 207.
[9] S. Rep., supra note 5 at 2.

the legislative history at several points supports an extremely broad definition of what is meant by "environmental quality."

> (Environmental quality) is concerned with the maintenance and management of those life support systems--natural and manmade--upon which the health, happiness, economic welfare, and physical survival of human beings depend.[10]

This would not only include the degradation of the natural environment but would also include the "quality" of manmade structures (e.g. "faltering and poorly designed transportation systems" and "poor architectural design and ugliness in public and private structures").[11] Certainly the history of the Act establishes aesthetics as a necessary environmental concern. In fact, given an extreme interpretation, it may even be read to include within the range of a project's "environmental impacts" such structural considerations as whether a transportation system will function properly.

This ambiguity as to what Congress meant by "environment" was carried over into the Act itself. Two examples should suffice. Within Section 101, a sub-part of Title I "Declaration of National Environmental Policy," there are numerous references to the quality of the natural environment. However, Section 101 also finds that it is the Congressional purpose to:

> preserve important historic (and) cultural ... aspects of our national heritage, and maintain wherever possible, an environment which supports diversity and variety of individual choice.

Clearly the term "environment" as used in this context is meant to encompass a broader view of man's relation to the world than would be found in a definition of "environment" limited to man's natural surroundings such as air, water, and wildlife. A second example is found in Section 202 which requires the President to prepare an annual Environmental Quality Report. This report is to include commentary on:

> the status and condition of the major natural, manmade, or altered environmental clases of the Nation, including, but not limited to, the air, the aquatic, including marine, estuarine, and fresh water, and the terrestial environment, including, but not limited to, the forest, dryland, wetland, range, urban, suburban, and rural environment.

Again "environment" includes natural surrounding (e.g. "air," "aquatic", "forest", "dryland", "wetland", "range"). It also apparently includes "manmade" contributions to the human situation. The 1971 Report, for

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[10] Hearings, supra note 3 at 40.

[11] S. Rep., supra note 5 at 4.

example, has a section entitled "the inner city environment" which examines such non-natural impacts as overcrowding, neighborhood deterioration, and the transportation crisis.[12]

3. The Judicial Response to NEPA

3.1 Introduction

As might have been predicted, the self-policing aspect of NEPA (agency compliance with Section 102 and CEQ review under Section 204(3)) has not been entirely satisfactory; the courts have frequently been asked to step in and enforce the Act to preserve some environmental interest which is being threatened. This has often resulted in the postponement of agency projects and the revision of agency procedures.

An agency decision on a given project can be challenged at two levels. First, it can be argued that the process of decision making utilized by the agency does not comply with NEPA standards as found in Section 102. In a broad sense this is equivalent to saying that at the time the decision was made, the decision maker did not have sufficient environmental information before him. The second approach is to argue that while the environmental input to the decision maker might have been adequate, his decision against a particular environmental interest contravened the policies of the Act as stated in Section 101. In essence this is to say that in a particular case the decision came out wrong. While agency decisions have been subjected to some substantive review under NEPA,[13] the

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[12]See Environmental Quality, the Second Annual Report on Environmental Quality August 1971, pp. 197-204. As an example of the Report's concern for impacts which would not typically fall within a narrow definition of "environment" consider the following statement: "If a new highway severs a neighborhood, it decreases casual, social interaction between the two severed sides. It creates a psychological or visual barrier and often a physical obstacle. More than liberal vehicular access and an occasional pedestrian crossing are necessary to overcome the highway barrier. Even when continuous across-highway access is provided--as in the case of elevated structure construction--the highway's uninhabited strip remains a psychological and social barricade." Id. at 202.

[13]Although there is conflicting authority on whether NEPA provides judicial review of the "substance" of agency decisions, (see EDF v. Corps of Engineers (Gillham Dam) 470 F.2d 289, 299 N.15 (1972) and cases cited therein) the practical effect of this issue is minimal. To the extent that the results of agency decisions will be judicially reviewed, the most lenient standard of judicial scrutiny will be applied. Substantive agency determinations will be judicially overruled only when complaining litigants are able to prove that the decision was "arbitrary and capricious." See 470 F.2d at 300.

most significant aspect of the judicial response to NEPA has come from repeated holdings that section 102 imposes an environmental "full disclosure" requirement as a prerequisite to project construction. Where environmental factors have not been given adequate consideration in the decision-making process the resulting decisions have not been allowed to stand.

A good example of the courts' concern for environmental inputs in the agency decision-making process is found in the D.C. Circuit's decision in Calvert Cliffs Coordinating Committee v. Atomic Energy Commission.[14] The court in Calvert Cliffs was faced with an attack on the Atomic Energy Commission's licensing procedure. The claim was that this procedure gave inadequate consideration to environmental factors. For example, the environmental impacts contained in a project's 102 statement were not routinely considered by the agency's reviewing board. The court overturned this procedure because it did not insure adequate consideration of environmental consequences. Section 102 of the Act requires agencies to consider environmental factors to "the fullest extent possible." This language was given a very forceful interpretation in Calvert Cliffs:

> We conclude, then, that Section 102 of NEPA mandates a particular sort of careful and informed decision-making process and creates judicially enforceable duties ... (I)f the decision was reached procedurally without individualized consideration and balancing of environmental factors--conducted fully and in good faith--it is the responsibility of the courts to reverse.[15]

By insisting that decision makers carefully balance environmental considerations, the courts impose a substantial burden on the drafters of 102 statements. Unless all significant environmental data is contained in these statements the informed consideration of environmental factors cannot be carried out.

Calvert Cliffs dealt with one aspect of the problem of environmental input into the agency decision-making process, i.e., presupposing the requisite environmental information is available, did the decision maker consider it? A more troublesome aspect of the problem involves the initial compilation of the information on which the decision must be based. The question

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[14] 449 F. 2d 1109 (D.C. Cir. 1971). See, also, EDF v. Corps of Engineers, 740 F.2d 289 (8th Cir. 1972); Committee for Nuclear Responsibility v. Seaborg 3 E.R. 1226, 1 E.L.R. 20469 (D.C. Cir. 1971); Environmental Defense Fund v. Tennessee Valley Authority, 3 E.R. 1553, 2 E.L.R. 20444 (E.D. Tenn., 1972); Natural Resources Defense Council v. Morton, 3 E.R. 1558, E.L.R. 20029 (D.C. Cir. 1972).

[15] 449 F. 2d at 1115

discussed in the remainder of this chapter is, what kinds of environmental input does NEPA require? Or, put another way, what have the courts said about the content of 102 statements?

Despite a rash of litigation centering on Section 102 of NEPA, of the 64 cases reported in the April 1972 102 Monitor, only five were actively concerned with the content of 102 statements.[16] Two cases stand out both for the depth of their inquiry into the problems of 102 content, and their potential for influencing future litigation.

3.2 Specific Identification of All Possible Environmental Consequences--Gillham Dam and Tennessee-Tombigbee.

In Environmental Defense Fund v. Corps of Engineers of the United States Army[17] (hereinafter Gillham Dam), EDF, along with several local plaintiffs, sought to stop construction of a dam on the Cossatot River. The Cossatot is one of the last free flowing rivers in that part of Arkansas. Further construction of the dam was enjoined by a federal district court on the grounds that the 12 page environmental impact statement prepared by the Corps did not satisfy the requirements of NEPA.[18] In Environmental Defense Fund v. Corps of Engineers of the United States Army[19] (hereinafter Tennesses-Tombigbee), however, a similar attack on a Corps impact statement of approximately 55 pages was unsuccessful in enjoining the construction of the Tennessee-Tombigbee Waterway in Alabama and Mississippi. The Gillham Dam and Tennessee-Tombigbee decisions are difficult to compare in that there are vast differences in the quality of the Corps impact statements that were before the two courts. In Gillham Dam the impact statement was patently defective, in Tennessee-Tombigbee the court uniformly upheld the sufficiency of the statement. These two cases serve to highlight the difficulties that still remain in characterizing the required content of an environmental impact statement.

In Gillham Dam the court asserted the broad proposition that impact statements "should at a minimum contain such information as will alert the President, the Council on Environmental Quality, the public, and indeed, the Congress, to all possible environmental consequences of proposed agency action."[20] The necessity of disclosing all possible

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[16]The rest of the cases were concerned with threshold questions, e.g., whether NEPA was intended to apply retroactively, or what types of projects require 102 statements. See generally, H.P. Green, The National Environmental Policy Act in the Courts, The Conservation Foundation (Wash., D.D., May 1972).

[17]325 F. Supp. 749 (W.D. Ark. 1971).

[18]Id. The injunction was set aside after a hearing on a new impact statement submitted by the Corps which was approximately 200 pages in length, contained an additional 1500 pages in six appendices, and was prepared at an alleged cost of approximately $250,000. 342 F. Supp. aff'd 470 F. 2d 289 (1972).

[19]4 E.R.C. 1408 (N.D. Miss. Aug. 4, 1972).

[20]325 F. Supp. at 759.

environmental consequences was explicitly rejected as the appropriate test by the court in Tennessee-Tombigbee. Instead, the court found that NEPA requires the disclosure of only those environmental consequences which are both "significant" and "probable."[21] Those general tests yielded different results when applied to several similar disclosures in the two cases.

In Gilham Dam the court pointed out that the affected area must be adequately described "zoologically" before any meaningful evaluations can be made. That is, adequate zoological studies must exist or be undertaken before an environmental statement can be prepared. To meet this adequacy requirement the court found such zoological studies must analyze the following issues: What are the existing food chains in the area? Would they be drastically affected? Are there any "keystone" species in the area? (A keystone species is described as a critical species necessary to maintain the biological stability of the area.) Are there any "relic" species in the area? (Relic species are those that provide clues as to the evolution of certain species.) Once these studies have been made, the court would require examinations of the effect of the project on species stability, species diversity, and biological productivity.[22]

Most of the above requirements are so general as to be applicable for any type of water resource project; the court also mentioned a number of specific issues. With respect to the proposed dam on the Cossotot River, the court required such particularized examinations as the possibility and effect of abnormal and anomalous growth conditions in certain species of fish (e.g., stunted growth or extra vertebrae); the possibility and effect of "dead" downstream areas; the effect of the migration of rough fish upstream from the impoundment; the effect of impoundment on the frequency and quantity of alluvial deposits downstream; and the probable effect of reservoir "drawdowns."[23]

While it is not clear from the court's opinion in Tennessee-Tombigbee that any of the inquiries required by Gillham Dam were ignored, the court did set limits on the required disclosure of a project's impact on fauna. Specifically, the court found that the impact statement need not disclose the possibility that as a result of the project several distinct species would face extinction, where, due to the diversity of the ecosystem, the ecological balance would not be significantly affected.

> "(W)e cannot accept the narrow view of the taxonomist who would attach significance to every species, irrespec-

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[21] 4. E.R.C. at 1419.
[22] 325 F. Supp. at 746-48.
[23] Id.

> tive of its role or function. It would serve no useful purpose to require the EIS to discuss those organisms which often can be found elsewhere, are of academic interest only to the specialist, and perform no special role or function."[24]

Generally, the court in Tennessee-Tombigbee was satisfied when the impact statement acknowledged the existence of problems; it did not require problems which the Corps deemed insignificant to be discussed in detail. For example the Corps was not required to: disclose the specific identity of several "insignificant" species of fish which were threatened by the project,[25] substantively discuss the possible migration of Eurasian milfoil,[26] identify particular archeological and historic sites to be inundated by the project,[27] or identify the particular areas of the river which would be subject to waterlogging.[28] Perhaps of more significance was the court's finding that, where alternative solutions were presented in the impact statement, the Corps did not need to indicate how it would ultimately dispose of the substantial spoil which the project would create.[29]

The Implications of Induced Changes in Population. One issue raised in Gillham Dam which was not discussed in the Tennessee-Tombigbee decision is the importance of project induced population changes. Because of the potential environmental consequences of these changes, the court in Gillham Dam felt the Corps' environmental statement was inadequate in that it "did not project the possibility of population changes and the effect thereof upon the project."[30] To adequately reflect population changes, the horizons of the statement must be broadened to cover what could be considered "induced effects," e.g., a flood control project's influence in enabling people to take up residence on a flood plain.

The decision in Gilham Dam further implies that the environmental effects of population changes must also be assessed. Specifically, it faults the Corps' assertion that water quality would be improved by the project, because the Corps failed to delineate the water quality costs incident to increased population growth.[31] Requiring the assessment of the environmental impact of potential population changes poses a very difficult question; namely, how does one limit the scope of the inquiry? The

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[24] 4. E.R.C. at 1420.
[25] Id. at 1421.
[26] Id. at 1422.
[27] Id. at 1423.
[28] Id. at 1424.
[29] Id. at 1423.
[30] 325 F. Supp. at 748.
[31] Id. at 761.

problem can be characterized by the following example. Suppose it is desired to build a dam to control floods. Suppose further that such action would spur development of the flood plain. The dilemma involves determining the extent to which that development's impact on the environment has to be assessed. Does the effect of increased automobile traffic have to be assessed? What about sewage disposal; the necessity for more roads; for more shopping centers? This dilemma has not been resolved by any court; in fact it remains one of the more significant unanswered questions associated with the preparation of environmental impact statements.

3.3 The Role of Evidence and Scientific Opinion

Elaboration of the "Course of Inquiry." Though the requirements of NEPA call for "conclusions" as to environmental consequences in impact statements, several courts have indicated that these conclusions must be supported by evidence included in the statement. The courts have stressed that the statement must be detailed and bring to the attention of the decision makers all relevant data upon which to base a decision. This requirement was summarized in the case of Ely v. Velde where the Fourth Circuit Court of Appeals said:

> With regard to NEPA, the statutory requirement of a 'detailed statement' ... on the environmental consequences of the proposed action places a heavy burden on the (agency). To enable a court to ascertain whether there has been genuine, not a perfunctory compliance with NEPA, the (agency) will be required to explicate fully its course of inquiry, its analysis and its reasoning.[32]

Similarly, the court in Environmental Defense Fund v. Tennessee Valley Authority refused to accept an impact statement's cost-benefit analysis which could not be evaluated by a non-expert and which rested "almost entirely on unsupported conclusions."[33]

A further example of an impact statement being held inadequate because its conclusions were not adequately supported by scientific evidence, is found in Gillham Dam. Here the court noted that:

> The impact statement concludes that the project will have the effect of enhancing the water quality of the Cossotot. The plaintiff's evidence which is persuasive, indicates that the quality of the water of the Cossotot in its natural state could hardly be improved upon.[34]

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[32] 451 F. Supp. 1130, 1139 (4th Cir. 1971).
[33] 2 E.L.R. 20044, 20045 (E.D. Tenn., 1972).
[34] 325 F. Supp. at 746.

After citing further examples of inadequate substantiation, the opinion concluded,

> In other words, plaintiffs contend that the impact statement simply does not set forth a detailed study and examination of the important environmental factors involved. On the basis of the record and the evidence presented at the preliminary hearing the Court is inclined to agree. It recognizes, of course, that much investigation and analysis may have been made and considered by the defendants even though not reflected in the impact statement . . .[35]

Inclusion of Conflicting Scientific Opinion. Section 102(2)(C)(ii) of NEPA requires that impact statements include comment on the adverse environmental effects of the proposed action. Under recent decisions, it is not sufficient that the statement simply include an agency's conclusions regarding potential adverse effects, the statement must also include (if tendered) scientific opinion which disagrees with the agency's environmental predictions. The intent behind this requirement of presenting conflicting evidence is clear; the party who drafts the statement is not to covertly influence the decision by deleting evidence which in not supportive of the agency's position. In the case of Committee for Nuclear Responsibility v. Seaborg,[36] the court of appeals for the District of Columbia circuit stated the applicable law as follows:

> The court is not to rule on the relative merits of competing scientific opinion. Its function is only to assure that the statement sets forth the opposing scientific opinion and does not take the arbitrary and impermissible approach of completely omitting from the statement, and hence, from the focus that the statement was intended to provide for the deciding officials, any reference whatever to the existence of responsible scientific opinions concerning possible adverse environmental effects...Only responsible opposing views need be included and hence there is room for discretion on the part of the officials preparing the statement; but there is no room for an assumption that their determination is conclusive. The agency need not set forth

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[35] Id. at 748.

[36] 3 E.R. 1226, 1 E.L.R. 20469, (D.C. Cir. 1971).

> at full length views with which it disagrees, all that is required is a meaningful reference that identifies the problem at hand for the responsible officials.[37]

In Gillham Dam the court found that the mandate to include adverse opinions in impact statements pertained to economic as well as environmental conclusions. To illustrate this point the court pointed to testimony which challenged the "interest rate" and "project life" figures used by the Corps in determining the project's cost-benefit ratio.[38]

Compliance with Existing Law. In Calvert Cliffs the question was raised whether compliance with existing laws which provide for the establishment of environmental quality standrads (e.g., the Federal Water Quality Control Act), obviated the need to include adverse effects, acceptable under those standards, in a project's impact statement. The court, rejecting the agency's argument that the legislative history of NEPA made such inquiry unnecessary, reasoned that compliance with state and federal standards indicates no more than that minimum conditions have been met. Under these circumstances there could still be environmental degradation of consequence to decision makers, albeit no part of it bad enough to violate a particular standard. The recent Federal Water Pollution Control Act Amendments of 1972[39] have made established water quality standards controlling for purposes of NEPA, thus abolishing this aspect of the rule of Calvert Cliffs. The court's decision, however, is still potentially applicable to standards established under other environmental protection statutes.

3.4. Alternatives and the Extent of Their Impact Assessment

Consideration of All Feasible Alternatives. Section 102(2) (C) (iii) of NEPA requires that impact statements consider "alternatives to the proposed action." The courts have interpreted this provision to require that, within reasonable limits, all feasible alternatives must be studied and analyzed. In Gilham Dam the court, while stating that structural alternatives had not been adequately explored, required that non-structural alternatives to the dam also be considered. In that case, the non-structural alternatives mentioned were flood plain management, private and/or publicly subsidized insurance, acquisition of fee title to the land of the flood plain, and, significantly, no action at all. Implicit in this requirement is the proposition that the agency had to consider alternatives which it had no power to implement. This point was made explicitly in Natural Resources Defense Council (NRDC) v. Morton.[40] Here the controversy involved the adequacy of a 102 statement for the proposed leasing

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[37] 3 E.R. at 1228.

[38] 325 F. Supp. at 761. In Tennessee-Tombigbee, however, the court suggested that such economic determinations were intended by Congress to be left to the discretion of the Corps. 4 E.R.C. 1409, 1413 (N.D. Miss. 1972).

[39] See Section 511(C)(2).

[40] 3 E.R. 1658, 2 E.L.R. 20029 (D.C. Cir. Jan. 13, 1972).

of federal lands for oil drilling on the outer continental shelf off the coast of Louisiana. In its environmental impact statement the Department of the Interior summarily dismissed a variety of alternatives and decided that oil drilling should be permitted. These alternatives to the proposed leasing included: elimination of import quotas; increased onshore exploration and development; development of oil shale; increased nuclear energy development; increased use of low sulfur coal and/or desulfurization of coal; development of coal liquification and gasification; development of geothermal resources; and development of tar sands. The court held that the agency's dismissal of the above alternatives without further study was unwarranted. To comply with NEPA the court ruled that further investigation of all reasonable alternatives was necessary regardless of the agency's power to implement them. Admittedly, the potential range of alternatives could be very broad, yet the court here stated: "When the proposed action is an integral part of a coordinated plan to deal with a broad problem, the range of alternatives that must be evaluated is broadened."[41]

Analyzing the Environmental Impacts of Alternatives. Assuming that the function of the impact statements required by NEPA is to insure that federal decision makers adequately consider the environment in designing public projects, it would follow that if they are to consider alternatives to the project as proposed, the environmental consequences of these alternatives must also be fed into the deliberation. While such attempts to analyze the environmental consequences of alternatives could force an agency to undertake information gathering far outside its field of expertise,[42] it has, within limits, been judicially required. In NRDC v. Morton the court held that "subject to a rule of reason ... implicit in this aspect of the law ... the thrust of NEPA (is) that the pertinent statement serve to gather in one place a discussion of the relative environmental impact of the alternatives."[43]

3.5 The Quantification of Environmental Impacts

The final aspect of the courts' interpretation of Section 102 which will be discussed in this chapter is the relation between the environmental impact statement required in Section 102(2)(C), and Section 102 (B) which requires the development of methods and procedures to "insure that presently unquantified environmental amenities and values may be given appropriate consideration ..." Does an impact statement give appropriate

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[41] 3 E.R. at 1560.

[42] For example, it is unlikely the Corps of Engineers has internal expertise on the possible environmental consequences of increased trucking as an alternative to the proposed deepening of port facilities.

[43] 3 E.R. at 1562.

consideration to environmental concerns if it does not seek to "quantify" environmental as well as technical and economic consequences of the project? The argument in favor of quantification is based on the recognition that a key element in the determination of whether a project will go forward is the project's cost-benefit ratio. Economic benefits, because they are readily "quantifiable," are universally included in this ratio; adverse environmental consequences, because they are not easily quantifiable, are generally left out. The cost-benefit determination, therefore, does not adequately consider environmental impacts.

NEPA can be read to require one of two alternatives to cost-benefit accounting based on economic considerations alone. Either the Act requires that the cost-benefit ratio should not be determinative--that is, that environmental considerations should be separately considered against the economic and technical benefits of a project (in essence balancing apples against oranges). Or, a second interpretation is that the Act calls for cost-benefit decision making, but requires that environmental factors be "quantified" in terms of dollars before they are plugged into a standard cost-benefit balance (i.e., converting apples to oranges and then balancing oranges on both sides of the scale). The judicial inquiry into these two potential interpretations of the Act has left the question unsettled. While no court has ever read the Act to require absolute quantification of all environmental effects in a 102 statement, and some courts have indicated that the calculation of the cost-benefit has been left to agency discretion,[44] at least two decisions can be read to support the consideration of environmental issues within a cost-benefit framework.[45]

The decision in Calvert Cliffs clearly requires that environmental concerns be balanced against predicted economic benefits; further it consistently characterizes this process as a "cost-benefit" balance.

> To ensure that the balancing analysis is carried out and given full effect, Section 102(2)(C) requires that responsible officials of all agencies prepare a "detailed statement" covering the impact of particular

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[44]See e.g., EDF v. Corps of Engineers (Tennessee-Tombigbee), 4 E.R.C. 1408, 1413.

[45]We do not mean to suggest that it is appropriate for the courts to enjoin a project under NEPA based on a judicial determination that the project costs exceed its benefits; this decision clearly is entrusted to Congress, see e.g., EDF v. Corps of Engineers 325 F. Supp. at 740. Rather we suggest that NEPA might be applied to the manner in which the agency determines a project's cost-benefit ratio and subsequently presents it to Congress.

> actions on the environment, the environmental costs which might be avoided, and alternative measures which might alter the cost-benefit equation.[46]

On its face, the decision in Calvert Cliffs does not specifically demand quantification of environmental impacts, it might even be argued that the court was just being imprecise in its frequent references to "cost-benefit" balancing. This is not, however, the way the decision was read by the Atomic Energy Commission. In responding to the court's order to revise its rules, the proposed AEC revision would now require that:

> The cost-benefit analysis shall, to the fullest extent practicable, quantify the various factors considered. To the extent that such factors cannot be quantified, they shall be discussed in qualitative terms.[47]

The second instance in which the courts have spoken on the "quantification" issues is in Gillham Dam discussed at length above. In one of the murkier parts of this opinion, the court denies that it will "require the impossible" by finding an impact statement inadequate for failing to quantify environmental concerns; at the same time it points to the failure to quantify as a major defect in the impact statement at issue in the case.

> (Because the defendants did not) assign values to presently unquantified environmental amenities...the defendants have been unable, as a practical matter, to take into consideration, in estimating costs and benefits, the "value" of the Cossatot as a free-flowing stream.[48]

Requiring the quantification of environmental concerns within a cost-benefit framework cuts both ways on the issue of environmental protection. The argument in favor of quantification is based on the realization, noted in Gillham Dam, that the present process of arriving at a cost-benefit ratio is often entirely one-sided in favor of projects as proposed. Generally the project's effects on the natural environment are not reflected at all in the cost-benefit figure. When such effects are quantified, the effort is generally limited to pro-project environmental impacts such as increased recreational potential.[49] Where possible, quantifying adverse environmental impacts, and adding this figure to the project's cost-benefit ratio would make the economic analysis of the proposed project's value more realistic.

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[46] 449 F. 2d 1109, 1114 (D.C. Cir. 1971).

[47] 36 Fed. Reg. 18072 (1971).

[48] 325 F. Supp. 749, 757 (1971).

[49] See S. Doc. No. 97, 87th Cong., 2d Sess., at 8-11 (1962). See generally, O. Eckstein, Water Resources Development, 40-41 (Harvard Univ. Press, 1958); Note, Cost-Benefit Analysis and the National Environmental Policy Act of 1969, 24 Stan. L. Rev. 1092 (1972).

While quantifying environmental impacts may insure that a project's adverse environmental effects are at least considered when the project is reviewed, treating the natural environment as just one other factor in a cost-benefit balance may undercut the essential purpose of NEPA. It may be the case that NEPA demands that the protection of the environment occupy a "preferred" place in agency decision making. In effect the agency would be told to balance apples and oranges giving the apples special weight. There is at least some support for this view in the Act. Under Section 101(b) federal agencies are ordered to use "all practical means, consistent with other essential considerations of national policy" to protect the environment. Just prior to the Act's passage, Senator Jackson stated:

> (NEPA) establishes priorities and gives expression to our national goals and aspirations. It provides a statutory foundation to which administrators may refer for guidance in making decisions which find environmental values in conflict with other values . . . If there are to be departures from this standard of excellence they should be exceptions to the rule and the policy. [50]

While the Act's history may not justify an interpretation which requires substantive preference for environmental factors over economic and technical concerns in a particular situation,[51] any "quantification" of environmental factors limiting consideration of adverse environmental effects to a strictly mechanical comparison against economic benefits would also be in danger of judicial reversal. The most appropriate ground for a federal agency faced with the quantification question would probably be to quantify, to the extent possible, for the purposes of computing the cost-benefit ratio, and then to make a separate determination considering the project's environmental consequences independently.

4. Conclusion

The spirit in which the courts will enforce Section 102(2)(C) of NEPA is clear. The environmental impact statement prepared by the federal agency must be sufficiently thorough that the final decision on the project will be made in full awareness of its potential environmental consequences. Beyond such generalities the courts have been willing, in

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[50] 115 Cong. Rec. 40416 (1969).

[51] For examples of statutes which do appear to require a preference for environmental values, see the Department of Transportation Act (49 U.S.C. §1953(f) (1968)), the Urban Mass Transportation Assistance Act (49 U.S.C. §1610 (1970)), and the Airport and Airway Development Act (49 U.S.C. §1716(c)(4) (1970)).

a number of instances, to identify particular environmental inputs without which an impact statement is inadequate. In time the courts will be able to draw some fairly clear boundaries around the information which is required in impact statements. At this early stage, however, one is relegated to considering the persuasiveness of a number of ground-breaking decisions which press for an extremely broad interpretation of the impact statement requirement.[52] The potential for judicial creativity in this area will be tempered by the fact that at some point the courts must reach an upper limit of the resources which they will require to be expended gathering and presenting environmental data.

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[52]See for example the decision of a South Dakota district court in Nolop v. Volpe, 3 E.R. 1338, 1 E.L.R. 20617 (D.S.D. Dec. 11, 1971), relying on the decision in Gillham Dam.

APPENDIX D

EXECUTIVE ORDER 11514

THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

EXECUTIVE ORDER 11514

Protection and Enhancement of Environmental Quality

By virtue of the authority vested in me as President of the United States and in furtherance of the purpose and policy of the National Environmental Policy Act of 1969 (Public Law No. 91-190, approved January 1, 1970), it is ordered as follows:

Sec. 1. Policy. The Federal Government shall provide leadership in protecting and enhancing the quality of the Nation's environment to sustain and enrich human life. Federal agencies shall initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals. The Council on Environmental Quality, through the Chairman, shall advise and assist the President in leading this national effort.

Sec. 2. Responsibilities of Federal agencies. Consonant with Title I of the National Environmental Policy Act of 1969, hereafter referred to as the "Act", the heads of Federal agencies shall:

(a) Monitor, evaluate, and control on a continuing basis their agencies' activities as to protect and enhance the quality of the environment. Such activities shall include those directed to controlling pollution and enhancing the environment and those designed to accomplish other program objectives which may affect the quality of the environment. Agencies shall develop programs and measures to protect and enhance environmental quality and shall assess progress in meeting the specific objectives of such activities. Heads of agencies shall consult with appropriate Federal, State, and local agencies in carrying out their activities as they affect the quality of the environment.

(b) Develop procedures to ensure the fullest practicable provision of timely public information and understanding of Federal plans and programs with environmental impact in order to obtain the views of interested parties. These procedures shall include, whenever appropriate, provision for public hearings, and shall provide the public with relevant information, including information on alternative courses of action. Federal agencies shall also encourage State and local agencies to adopt similar procedures for informing the public concerning their activities affecting the quality of the environment.

(c) Insure that information regarding existing or potential environmental problems and control methods developed as part of research, development, demonstration, test, or evaluation activities is made available to Federal agencies, States, counties, municipalities, institutions, and other entities, as appropriate.

(d) Review their agencies' statutory authority, administrative regulations, policies, and procedures, including those relating to loans, grants, contracts, leases, licenses, or permits, in order to identify any deficiencies or inconsistencies therein which prohibit or limit full compliance with the purposes and provisions of the Act. A report on this review and the corrective actions taken or planned, including such measures to be proposed to the President as may be necessary to bring their authority and policies into conformance with the intent, purposes, and procedures of the Act, shall be provided to the Council on Environmental Quality not later than September 1, 1970.

(e) Engage in exchange of data and research results, and cooperate with agencies of other governments to foster the purposes of the Act.

(f) Proceed, in coordination with other agencies, with actions required by section 102 of the Act.

Sec. 3. Responsibilities of Council on Environmental Quality. The Council on Environmental Quality shall:

(a) Evaluate existing and proposed policies and activities of the Federal Government directed to the control of pollution and the enhancement of the environment and to the accomplishment of other objectives which affect the quality of the environment. This shall include continuing review of procedures employed in the development and enforcement of Federal standards affecting environmental quality. Based upon such evaluations the Council shall, where appropriate, recommend to the President policies and programs to achieve more effective protection and enhancement of environmental quality and shall, where appropriate, seek resolution of significant environmental issues.

(b) Recommend to the President and to the agencies priorities among programs designed for the control of pollution and for enhancement of the environment.

(c) Determine the need for new policies and programs for dealing with environmental problems not being adequately addressed.

(d) Conduct, as it determines to be appropriate, public hearings or conferences on issues of environmental significance.

(e) Promote the development and use of indices and monitoring systems (1) to assess environmental conditions and trends, (2) to predict the environmental impact of proposed public and private actions, and (3) to determine the effectiveness of programs for protecting and enhancing environmental quality.

(f) Coordinate Federal programs related to environmental quality.

(g) Advise and assist the President and the agencies in achieving international cooperation for dealing with environmental problems, under the foreign policy guidance of the Secretary of State.

(h) Issue guidelines to Federal agencies for the preparation of detailed statements on proposals for legislation and other Federal actions affecting the environment, as required by section 102 (2) (C) of the Act.

(i) Issue such other instructions to agencies, and request such reports and other information from them, as may be required to carry out the Council's responsibilities under the Act.

(j) Assist the President in preparing the annual Environmental Quality Report provided for in section 201 of the Act.

(k) Foster investigations, studies, surveys, research, and analyses relating to (i) ecological systems and environmental quality, (ii) the impact of new and changing technologies thereon, and (iii) means of preventing or reducing adverse effects from such technologies.

Sec. 4. Amendments of E.O. 11472. (Omitted, See 711:0111 for E.O. 11472 as emended.)

THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

PURPOSE

Sec. 2. The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

TITLE I

DECLARATION OF NATIONAL ENVIRONMENTAL POLICY

Sec. 101. (a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may--

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

Sec. 102. The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall--

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on--

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate Federal, State, and local agencies, which

are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of title 5, United States Code, and shall accompany the proposal through the existing agency review processes;

(D) study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources;

(E) recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(F) make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(G) initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(H) assist the Council on Environmental Quality established by title II of this Act.

Sec. 103. All agencies of the Federal Government shall review their present statutory authority, administrative regulations, and current policies and procedures for the purpose of determining whether there are any deficiencies or inconsistencies therein which prohibit full compliance with the purposes and provisions of the Act and shall propose to the President not later than July 1, 1971, such measures as may be necessary to bring their authority and policies into conformity with the intent, purposes, and procedures set forth in this Act.

Sec. 104. Nothing in Section 102 or 103 shall in any way affect the specific statutory obligations of any Federal agency (1) to comply with criteria or standards of environmental quality, (2) to coordinate or consult with any other Federal or State agency, or (3) to act, or refrain from acting contingent upon the recommendations or certification of any other Federal or State agency.

Sec. 105. The policies and goals set forth in this Act are supplementary to those set forth in existing authorizations of Federal agencies.

TITLE II

COUNCIL ON ENVIRONMENTAL QUALITY

Sec. 201. The President shall transmit to the Congress annually beginning July 1, 1970, an Environmental Quality Report (hereinafter referred to as the "report") which shall set forth (1) the status and condition of the major natural, manmade, or altered environmental classes of the Nation, including, but not limited to, the air, the aquatic, including marine, estuarine, and fresh water, and the terrestrial environment, including, but not limited to, the forest dryland, wetland, range, urban, suburban, and rural environment; (2) current and forseeable trends in the quality, management and utilization of such environments and the effects of those trends on the social, economic, and other requirements of the Nation; (3) the adequacy of available natural resources for fulfilling human and economic requirements of the Nation in the light of expected population pressures; (4) a review of the programs and activities (including regulatory activities) of the Federal Government, the State and local governments, and nongovernmental entities or individuals, with particular reference to their effect on the environment and on the conservation, development and utilization of natural resources; and (5) a program for remedying the deficiencies of existing programs and activities, together with recommendations for legislation.

Sec. 202. There is created in the Executive Office of the President a Council on Environmental Quality (hereinafter referred to as the "Council"). The Council shall be composed of three members who shall be appointed by the President to serve at his pleasure, by and with the advice and consent of the Senate. The President shall designate one of the members of the Council to serve as Chairman. Each member shall be a person who, as a result of his training, experience, and attainments, is exceptionally well qualified to analyze and interpret environmental trends and information of all kinds; to appraise programs and activities of the Federal Government in the light of the policy set forth in title I of this Act; to be conscious of and responsive to the scientific, economic, social, esthetic, and cultural needs and interests of the Nation; and to formulate and recommend national policies to promote the improvement of the quality of the environment.

Sec. 203. The Council may employ such officers and employees as may be necessary to carry out its functions under this Act. In addition, the Council may employ and fix the compensation of such experts and consultants as may be necessary for the carrying out of its functions under this Act, in accordance with section 3109 of title 5,

United States Code (but without regard to the last sentence thereof).

Sec. 204. It shall be the duty and function of the Council--

(1) to assist and advise the President in the preparation of the Environmental Quality Report required by section 201;

(2) to gather timely and quthorative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are likely to interfere, with the achievement of the policy set forth in title I of this Act, and to compile and submit to the President studies relating to such conditions and trends;

(3) to review and appraise the various programs and activities of the Federal Government in the light of the policy set forth in title I of this Act for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto;

(4) to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and goals of the Nation;

(5) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality;

(6) to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes;

(7) to report at least once each year to the President on the state and condition of the environment; and

(8) to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the President may request.

Sec. 205. In exercising its powers, functions, and duties under this Act, the Council shall--

(1) consult with the Citizens' Advisory Committee on Environmental Quality established by Executive Order numbered 11472, dated May 29, 1969, and with such representatives of science, industry, agriculture, labor, conservation organizations, State and local governments, and other groups, as it deems advisable; and

(2) utilize, to the fullest extent possible, the services, facilities, and information (including statistical information) of public and private agencies and organizations, and individuals, in order that duplication of effort and expense may be avoided, thus assuring

that the Council's activities will not unnecessarily overlap or conflict with similar activities authorized by law and performed by established agencies.

Sec. 206. Members of the Council shall serve full time and the Chairman of the Council shall be compensated at the rate provided for Level II of the Executive Schedule Pay Rates (5 U.S.C. 5313). The other members of the Council shall be compensated at the rate provided for Level IV of the Executive Schedule Pay Rates (5 U.S.C. 5315).

Sec. 207. There are authorized to be appropriated to carry out the provisions of this Act not to exceed $300,000 for fiscal year 1970, $700,000 for fiscal year 1971, and $1,000,000 for each fiscal year thereafter.