

**WATER RESOURCES DECISION MAKING
ON THE BASIS OF THE PUBLIC INTEREST**

A Report Submitted to the:

U.S. ARMY ENGINEER INSTITUTE FOR WATER RESOURCES

KINGMAN BUILDING

FORT BELVOIR, VIRGINIA 22060

by

Department of Civil Engineering

Stanford University

Stanford, California 94305

under

Contract Number DACW73-73-C-0046

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FEBRUARY 1975

IWR Contract Report 75-1

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER IWR Contract Report 75-1	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) WATER RESOURCES DECISION MAKING ON THE BASIS OF THE PUBLIC INTEREST		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Dr. Leonard Ortolano		8. CONTRACT OR GRANT NUMBER(s) DACW73-73-C-0046
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of Civil Engineering Stanford University Stanford, California 94305		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Engineer Institute for Water Resources Kingman Building Fort Belvoir, Virginia 22060		12. REPORT DATE February 1975
		13. NUMBER OF PAGES 57
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Distribution unlimited; approved for public release.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Public participation, public interest, decision making, water resources planning, multiple objective planning, preauthorization studies, economics, benefit-cost ratios		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The concept of water resources decision making in the public interest is both fundamental and elusive. This report discusses alternative perspectives that have been suggested for defining the public interest and provides an overview of the decision making involved in a typical water resources planning study. It then examines various approaches to determining the public interest in pre- authorization planning and decision making. It also presents an argument in		

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support of current trends away from reliance on economic efficiency as a basis for defining the public interest, and toward the direct involvement of citizens in determining the factors and weights used in defining the public interest. The argument proceeds in three principal parts, each of which constitutes a chapter.

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Approved for public release; distribution unlimited.

Copies may be purchased from:

National Technical Information Service
U. S. Department of Commerce
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This report is not to be construed as necessarily representing the views of the Federal Government or of the Corps of Engineers, U. S. Army.

ACKNOWLEDGMENTS

I am indebted to William W. Hill, Bryan Jenkins and Thomas P. Wagner, graduate students in Stanford's Department of Civil Engineering, for constructive criticism of an earlier draft. Thanks are also due to David Aggerholm, formerly with the Institute for Water Resources, and now at the University of Massachusetts, for the many contributions which he made to the development of this report. The reviews provided by various Corps planners have also been useful. The task of typing the final report was performed admirably by Maureen Rittenberg with the assistance of Grace Evans.

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CHAPTER ONE

THE PUBLIC INTEREST AND CORPS PLANNING

The concept of water resources decision making in the public interest is both fundamental and elusive. It is fundamental in the sense that both legislation and Corps guidance indicate that the public interest is to serve as the basis for decision making. It is elusive in the sense that there is continuing confusion and debate as to what it means to say that a water resources action has been decided upon on the basis of the public interest. This report seeks to reduce this confusion.

Although it is customary to specify the purpose and scope in the opening pages of a technical report, it is convenient to employ a slightly different format herein. Thus, this chapter begins with a discussion of alternative perspectives that have been suggested for defining the public interest. It then provides an overview of the decision making involved in a typical water resources planning study. Finally, it presents the purpose, scope and organization of the remainder of the report.

DEFINING THE PUBLIC INTEREST

A widely agreed upon basis for ranking alternative Federal water resources plans is the concept of the public interest. For example, in the River and Harbor and Flood Control Act of 1970 (P.L. 91-611), the Congress required that a recommended action be "in the best overall public interest." This requirement was subsequently included in Corps of Engineers guidance [U.S. Army, 1972]. If it is accepted that the concept of the public interest provides the basis for plan ranking, questions remain as to how and by whom the public interest should be defined and determined. These questions have been the subject of debate by scholars for generations.* Although these questions are difficult to deal with, they are inescapable if decisions are to be made in the public interest.

* See, for example, Meyerson and Banfield [1955, pp. 322-329].

The approach followed herein is to analyze water resources planning and decision making by focusing on the following two sets of fundamental questions:

1. What factors should be considered in ranking alternatives? That is, what factors comprise the public interest in any given decision making situation? Also, how and by whom should such factors be defined?
2. How should the factors be weighed relative to one another so that the "trade off" analysis required in ranking alternatives can be carried out? In particular, whose "weights" are relevant, and how should weights be determined and utilized in ranking alternatives?

This report examines several approaches that have been used to determine the public interest in the context of water resources decision making. For each such approach, the report elaborates on how the above mentioned factors and weights are determined.

During the past few decades, there have been varying degrees of direct citizen involvement in determining the factors and weights used as a basis for Federal water resources decision making. During the 1950's, for example, factors and weights were determined by the Congress, the Administration, Federal agency personnel and various special interest groups. The concept of economic efficiency played a central role in plan ranking. Moreover, with a few notable exceptions, individual citizens seemed content to leave water resources decision making in the hands of various authorities charged with the responsibility for making such decisions.

In the 1970's, however, individual citizens (generally acting as members of citizen's groups) seem much less content to leave Federal water resources planning and decision making to those charged by Congress and the Administration to carry out such activities. The increasing volume of citizen initiated litigation concerning the environmental and social aspects of Federal water resource proposals is one reflection of the public's increased desire to become involved in water resources planning and decision making.

The aforementioned variations in the level of direct citizen involvement in the delineation of factors and weights is also reflected in the literature

dealing with theories of democracy. At one extreme, advocates of what is sometimes referred to as "democratic elitism", argue that determination of the public interest should be made by elected officials, or those acting with authority granted by elected officers.* Individual citizens participate in public decision making by voting, periodically, for representatives. At the other extreme, advocates of a "participatory theory of democracy" see the public interest as "measured not only by the correctness of the decisions reached (the product), but also by the extent of public participation in reaching them (the process)" [Schafer, 1974, p. 494 et. seq.]. Direct citizen involvement in determining factors and weights is considered essential by advocates of participatory democracy. As Schafer puts it, the forms of citizen involvement called for include "defining problems and proposing, discussing, planning, making and implementing the decisions which affect their [i.e., the citizens] lives" [1974, p. 499].

The extent of direct citizen involvement in the determination of factors and weights is thus seen as a central issue in water resources decision making in the public interest. If it is assumed that the environmental and social consequences of proposed water resources developments will continue to be a source of great concern, it can be expected that citizens will attempt to participate directly in water resources planning and decision making. More specifically, individual citizens and citizens groups will attempt to be involved directly in the determination of factors and weights during various stages of planning. And to the extent that they are not satisfied that their concerns have been given adequate consideration, citizen's groups will be likely to continue their reliance on the courts in an effort to influence water resources decision making.

In the remainder of this report, the discussion of water resources decision making in the public interest is carried out at a less abstract level. The report focuses on the planning and decision making associated with Corps of Engineers pre-authorization studies. An overview of pre-authorization planning and decision making is presented below, following which the principal argument of this report is outlined and the organization of the remaining chapters is presented.

* For a discussion of democratic elitism see Schafer [1974], or, more generally, Bachrach [1967].

THE NATURE OF DECISION MAKING IN PRE-AUTHORIZATION STUDIES

The decision making process for Corps of Engineers pre-authorization type studies can be conveniently thought of in terms of three parts:

(1) district level planning, during which time a great deal of information is generated regarding concerns and alternative actions, and a proposed action is ultimately recommended; (2) formal reviews of the District's recommendation, where interested publics, local, state and Federal agencies, and the Corps hierarchy are given opportunities to examine the basis for the District's recommendation and to propose modifications; and (3) program level decision making, where the District's recommendation is compared with the many recommendations made by various Corps District offices for purposes of program budgeting and appropriation.*

District Level Planning

A pre-authorization planning study typically involves the collection, analysis and evaluation of a great deal of information relating to: (1) the identification of water related problems and concerns, (2) the delineation of alternative actions, and (3) the description of environmental, social and economic effects associated with the alternative actions. This process of information generation involves a considerable degree of implicit and explicit decision making regarding what is or is not to be considered in the planning study.

The District Engineer is the nominal decision maker at the district level, since he is charged by the Office of the Chief of Engineers with making a recommendation for action. Inasmuch as the process of generating information influences the nature of the District Engineer's recommendation, there are many others involved in decision making at the district level. These "decision makers" include all those who participate substantively in the planning process, and may be categorized generally as follows:

1. The District and/or Division staffs involved in undertaking the planning study and making recommendations to the District Engineer;

* For a more complete discussion of pre-authorization planning, see the manual prepared by the Board of Engineers for Rivers and Harbors [U.S. Army, 1974].

2. The representatives of local, state and Federal agencies who may participate in the District's study effort through routine inter-agency coordination;
3. The individual citizens and interest group representatives who may take part in the District's planning through public meetings, citizen advisory groups, etc.; and,
4. The local or state organizations who will participate in sharing the cost of activities recommended by the Corps.

In effect, the District Engineer's decision is shaped by a myriad of individual decisions which are made by those who collectively participate in the planning.

The existence of a multiplicity of decision makers at the district level is corroborated by results from a study of Federal water agency decision making by Ingram. She observed that: "A large number of local, state and Federal officials and private individuals participate in decisions at a number of separate decision points" [1972, p. 1177]. Ingram also noted that: "Local support is required to generate activity on a water development project and push it through the complicated series of stages in the authorization and appropriations process" [1972, p. 1178]. Moreover, "As a general rule, agreement is reached at each stage of decision making before a water development project is moved on to another stage" [1972, p. 1180].

Formal Reviews of the District's Recommendation

As indicated above, there may be a great deal of participation by citizen groups and other agencies throughout the course of district level planning. Once the stage has been reached where the District Engineer has made a tentative recommendation for an action, a series of formal reviews by individuals, groups and agencies is conducted. These formal reviews provide individuals, groups and agencies with an opportunity to examine the District Engineer's tentative recommendation from their own perspective, and propose modifications of various types. The District Engineer's tentative recommendation is often modified as a result of this series of reviews.

The following four sets of reviews are especially noteworthy:

1. Formal reviews by state and Federal agencies which are required by legislation such as the Fish and Wildlife Coordination Act (Public Law 85-264)*;

* For a full listing of Congressionally legislated interagency coordination requirements, see Wolff [1971, Table 4-1].

2. Opportunities for review and comment by all interested agencies, individual citizens and citizens' groups required by the guidelines implementing the National Environmental Policy Act of 1969;
3. Formal "in-house" reviews by various offices within the Corps of Engineers (i.e., the Division, Office of the Chief of Engineers, Board of Engineers for Rivers and Harbors, and Office of Secretary of the Army); and,
4. Reviews conducted for the Administration by the Office of Management and Budget.

The nature of the District's response to suggestions received during the course of these reviews depends on the formal authority or political power of the reviewer. For example, suggestions made in the course of the review conducted by the Board of Engineers for Rivers and Harbors often lead to revisions in the District's recommendations. In contrast, comments made by other Federal agencies are subject to the so-called rule of "mutual accommodation" whereby agencies negotiate in the interests of avoiding extreme and/or potentially embarrassing positions [Ingram, 1972, pp. 1184]. The way in which the District responds to changes suggested by special interest groups depends on the District's perception of the validity of the suggestions and the extent of local or broader support for the suggested changes. Although Districts typically attempt to gain support for their recommendations by accommodating different interests, this is not always possible. Those who feel that the Corps has not been responsive to their concerns sometimes take recourse to the courts as a way of participating in the decision process.

Program Level Decision Making

The decision process described above essentially involves the delineation of a particular course of action which the Corps, together with local entities, proposes to carry out. In contrast, program level decision making centers around the determination by Congress and the Administration of which of the actions recommended by various Districts through the Chief of Engineers are to be authorized and/or implemented. Such program level decision making is not of concern herein. Rather, the concern is with the

process of deciding on which of several alternative actions, developed during the course of a pre-authorization type study, is to be presented to the Congress.

PURPOSE, SCOPE AND ORGANIZATION OF THIS REPORT

The remainder of this report examines various approaches to determining the public interest in pre-authorization planning and decision making. It also presents an argument in support of current trends away from reliance on economic efficiency as a basis for defining the public interest, and toward the direct involvement of citizens in determining the factors and weights used in defining the public interest. The argument proceeds in three principal parts, each of which constitutes a chapter.

Chapter Two considers economic efficiency, the conceptual basis for ranking alternatives that was widely used and accepted throughout the 1950's and 1960's. The Chapter outlines the theoretical basis for use of efficiency in plan ranking, shows how economic efficiency considerations fit in the traditional pre-authorization planning process, and discusses economic efficiency in terms of the factors and weights used in defining the public interest. Chapter Two also describes the criticisms which have contributed to shifts away from a reliance on economic efficiency as a basis for determining the public interest. These criticisms have come from citizens groups who felt that their concerns were not adequately reflected by the efficiency concept, and from scholars who have argued that efficiency defines the public interest too narrowly.

Chapter Three describes recent efforts to respond to the critics of economic efficiency. It discusses several recent techniques for ranking alternatives on the basis of "multiple objectives". These techniques are discussed in terms of how and by whom the factors and weights used in ranking alternatives are determined. Chapter Three also argues that the criticisms of the efficiency concept which have been put forth by various citizens groups cannot be met solely by the introduction of multiple objectives. These citizen critics are essentially calling for a substantive role in the determination of factors and weights. Although there has been an increase in public involvement in pre-authorization planning, there is evidence to suggest that

this public involvement has not been fully integrated into the decision making process. Moreover, the traditional process for pre-authorization planning is not well suited to accomplish this integration. What is called for is a pre-authorization planning process which can accommodate extensive public involvement and can fully integrate the contributions which various groups seem eager to make in delineating factors and weights.

Having established the necessity for integrating public involvement into the determination of factors and weights, Chapter Four describes one way of accomplishing this integration. That is, Chapter Four describes a process that is well suited to planning situations in which citizens are to be involved directly in the determination of the public interest.

CHAPTER TWO

THE ECONOMIC EFFICIENCY CONCEPT IN THEORY AND PRACTICE

This chapter focuses on the economic efficiency criterion for ranking alternative actions. It elaborates on benefit-cost analysis as an application of the efficiency criterion, and on the ways in which the efficiency criterion was generally applied in pre-authorization studies conducted during the 1960's. The chapter also examines the criticisms of the efficiency concept which were raised frequently in the late 1960's.

THEORETICAL FOUNDATIONS FOR THE EFFICIENCY CONCEPT

In the context of pre-authorization planning, economic efficiency represents a criterion for selecting among mutually exclusive actions. Given that there are a number of alternatives which satisfy technical and financial feasibility requirements, application of the economic efficiency criterion involves selection of the action with the greatest positive contribution to net national income.

Application of the economic efficiency criterion presupposes that the objective, with respect to which benefits and costs are defined, is the maximization of net national income; i.e., "the positive difference between willingness to pay for output and the cost of providing it" [Herfindahl and Kneese, 1974, p. 222]. The use of "willingness to pay" as a measure of benefit of the output of a public water resources development bears some resemblance to the use of price as a measure of benefit derived by an individual purchasing commodities produced by the private sector. That is, given a perfectly competitive market at equilibrium, the "values-in-exchange" of commodities at the margin are equal to the prices. The resultant benefit of a commodity is said to be equal to the price which the consumer pays. The term "benefit" is used as a measure of value and reflects consumers' willingness to allocate income to the purchase of the commodity" [Eckstein, 1958, p. 24].

Using analogous reasoning, the national income benefits from a water resources development are often taken as the worth of the outputs if exchanged

at market prices, where the markets are perfectly competitive and in equilibrium.* If prices are regulated, then an imputed price equivalent to a perfectly competitive market price (sometimes referred to as a shadow price) is used. If prices are nonexistent (i.e., there are no markets for the output in question) then benefits are taken to be equal to the cost of providing comparable output by the cheapest alternative means, assuming the alternative would be built in the absence of the proposed project.

The application of the economic efficiency criterion has been rationalized in various ways. For example, Lind argues, "Assuming that the [national income] costs and benefits are correctly measured, an investment is justified if the benefits which will accrue as its consequence are greater than the costs incurred. This proposition is simply a straightforward statement of an efficiency condition for any productive activity" [1968, p. 46]. To maximize economic efficiency, the discounted net national income benefits are maximized.

The criterion that discounted net national income benefits be positive, or that benefits divided by costs be greater than one, can be shown to be a compensation criterion [Marglin, 1962, p. 21 et seq.]. It indicates that "beneficiaries can fully compensate those who incur the costs of a project and still be better off than they were initially; in addition, they could not have been made as well off by a payment of a sum less than or equal to the cost of the project" [Lind, 1968, p. 47].

Contemporary rationalizations of the use of the economic efficiency criterion often refer to Pigou's pioneering work in welfare economics. In this connection, Pigou used the term "economic welfare" to represent "that part of social welfare that can be brought directly or indirectly into relation with the measuring rod of money" [1932, p. 11]. The term "national income" refers to the monetary total of economic welfare; i.e., "the objective counterpart of economic welfare" [Pigou, 1932, p. 11].

Although economic welfare cannot be considered an index of total welfare, national income is often defended as a first approximation of total welfare

* It is common to use the terms "economic efficiency benefits" and "national income benefits" interchangeably, and this practice will be followed herein [c.f., Howe, 1971, p. 16]. A discussion of the theoretical distinction between the two terms is given by Marglin [1962, p. 28].

under certain assumptions such as the absence of significant externalities* [Harberger, 1971, p. 788]. Pigou discussed the connection between economic welfare and total welfare as follows:

"When we have ascertained the effect of any cause on economic welfare, we may, unless, of course, there is specific evidence to the contrary, regard this effect as probably equivalent in direction, though not in magnitude, to the effect on total welfare....

"In short, there is a presumption--what Edgeworth calls an 'unverified probability'--that qualitative conclusions about the effect of an economic cause will hold good also of the effect on total welfare [1932, p. 20].

THE EFFICIENCY CONCEPT AND BENEFIT-COST ANALYSIS

The basis for water resources plan ranking prior to the 1970's consisted of the so-called "benefit-cost" analysis. The notion of economic efficiency is at the heart of this analysis, inasmuch as it provides the conceptual basis for defining benefits and costs. That is, benefits are defined in terms of increases in national income, and costs are defined as the "aggregate income foregone from precluded uses of the economic resources in question" [American Water Resources Association, 1970, p. 110]. Moreover, assuming that all significant effects brought about by an action can be reflected as changes in net national income, advocates of benefit-cost analysis would argue that the "best" action is the one which makes the greatest positive contribution to net national income [Seckler and Hartmen, 1970, p. 292]. This decision criterion suggests that the extent to which the public interest is served by an action is reflected by the magnitude of the action's net contribution to national income.

The impetus for utilizing the maximization of net national income as a criterion for water resources decision making is contained in the Flood Control Act of 1936. Under this Act, a Corps of Engineers' flood control project was to be undertaken only if:

[T]he benefits, to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise not adversely affected.

* External effects are goods and/or services flowing to consumers or producers whether they want them or not, and without their paying for them or being able to avoid them by making a payment.

The unofficial but widely used guidelines for implementing this reckoning of benefits and costs were elaborated by the Subcommittee on Evaluation Standards of the Inter-agency Committee on Water Resources [1950]. From 1962 to 1973, the official guidance for conducting benefit-cost analyses on proposed Federal water resources developments was the so-called "Senate Document 97" [President's Water Resources Council, 1962]. Since 1973, the efficiency criterion has been greatly extended by the U.S. Water Resources Council's "Principles and Standards" [1973].

Throughout the 1960's, benefit-cost analysis was used to determine whether a proposed action satisfied the constraint that monetary benefits exceed costs. That is, the condition that the ratio of benefits to costs be greater than one was viewed as a nationally imposed constraint that reflected the view of Congress and the Administration that Federal funds devoted to certain activities must be spent in a way that leads to a net increase in national income. Benefit-cost analysis was also used as an approach to making choices about project scale, or the selection of actions from a set of alternatives.

When the efficiency concept, as embodied in benefit-cost analyses, is used to rank alternatives, it is assumed that all of the significant factors which comprise the public interest take the form of changes in national income. The mandate to consider such changes in ranking alternative water plans is set forth at a very general level in the various laws authorizing Federal water resources studies (e.g., the Flood Control Act of 1936) and the operating policies of the Office of Management and Budget [Bracken, 1973, p. 486]. The specific procedures for measuring the changes in national income are set out in various administrative regulations developed by the water resources agencies and various interagency committees (e.g., Senate Document 97). The actual computation of changes in national income are made by the economists and engineers who are part of the staffs of the water agencies. While these computations often involve ad-hoc procedures developed on the basis of professional judgment, the computations are generally consistent with the various regulations that make up the policies of the water agencies.

When the efficiency concept is employed as the basis for ranking alternatives, there are no "weights" involved. All factors are measured in the same units, namely dollars, and these are simply added together. (The addition of dollar valued changes, regardless of who experiences the changes, relies on the assumption that the marginal utility of income is equal between individuals.) The use of weights becomes relevant when factors are measured in different units and/or relate to different program objectives.

THE EFFICIENCY CONCEPT IN PRACTICE

In principle, the use of the economic efficiency criterion to rank alternative actions rests on a narrow, Federally oriented perspective for defining the public interest. This is the case, inasmuch as the Congress, the Administration, and the staffs of the Federal water resources agencies are the only participants in the process of defining the public interest when the efficiency criterion is employed.

In practice, however, the economic efficiency criterion has not been applied as the sole criterion for ranking alternatives. As noted below, there are several points in a typical pre-authorization planning process at which state and local agencies and at least some elements of the public have an opportunity to contribute to the process of defining the public interest. The discussion that follows, which is derived from informal interviews with a number of Corps planners, concerns pre-authorization planning as it was typically carried out in the 1960's. The discussion cannot be definitive, inasmuch as pre-authorization planning varies among Corps Districts and over time as well.

District level planning on pre-authorization studies was generally carried out in a highly structured fashion during the 1960's. The planning process involved several activities carried out in sequence; i.e., the identification of water related problems and needs, the formulation of alternatives, the economic evaluation of alternatives, and the tentative recommendation of a plan of action. Some reiteration between the formulation and evaluation activities was common.

In the early stages of pre-authorization planning, the concerns of those organizations or agencies which might be involved in sharing the cost of a Corps project were actively solicited. In addition, the views of a host of

governmental agencies and special interest groups were solicited using formal written communications; public meetings were sometimes used for this purpose. Thus, the early stages of a pre-authorization study carried out during the 1960's provided various governmental agencies and special interest groups with an opportunity to indicate which factors they felt were important in formulating and ranking alternatives.

The identification of water related problems and needs was typically considered to occur only at the beginning of a study. Following this, Corps planners carried out the engineering studies required in formulating technically feasible alternative actions. Such alternative actions were evaluated by determining their contributions to net national income. Technically feasible alternatives with positive contributions to net national income were ranked according to the magnitude of these contributions.

Although it was the only factor given explicit consideration in the evaluation of alternatives, net national income was not the only factor considered in deciding on a tentative recommendation for action. The ranking of alternative actions also involved the implicit consideration of so-called "intangibles", and the explicit consideration of the views of those organizations involved in cost-sharing.* Corps planners would employ their professional judgments to weigh the various monetary and non-monetary costs and benefits and make a recommendation regarding the desirability of the various feasible alternatives. The groups involved in cost-sharing would engage in a similar decision process as regards the various alternatives. Through a process of negotiation, the Corps planners and the cost-sharing group(s) would reach agreement, and this would constitute the District's tentative selection of a proposed action.

The attainment of agreement between the District and the cost-sharing group(s) was essential; it constituted a financial feasibility test that any recommended action would have to pass. While the attainment of a consensus among all interests as regards which action to pursue was desirable, the existence of honest differences of opinions were such that this would not always be possible. In some Districts, a public meeting was held at this

* "Intangible effects" have been defined as those effects "which are impracticable of being expressed in monetary terms such as scenic values or prevention of loss of life, for example..." [Inter-agency Committee on Water Resources, 1958, p. 7].

point to communicate information regarding the range of alternatives considered, and the alternative which had been tentatively selected. This provided a forum for agencies and groups to register their views regarding the decisions made up to this point in the process, and also provided an opportunity for modifying the tentatively selected action. After the District engineer arrived at a tentative recommendation, it was subjected to a number of formal reviews both inside and outside the Corps, as described above in Chapter One.

Thus, in practice, economic efficiency provided the basis for that portion of the plan ranking activity that was considered to be amenable to quantitative, systematic analysis. In addition, the condition that net national income be positive played the role of a constraint that had to be met before an action could be considered economically feasible. Although non-monetary effects were not ignored, they were not generally given explicit and systematic considerations as part of the "evaluation" activity. Such effects played a role in the process through which the Corps District and cost-sharing group(s) attempted to reach agreement on a course of action.

As indicated above, the efficiency criterion was generally not applied as the rule for ranking alternatives. Various governmental agencies and cost sharing entities helped to define the public interest by indicating which factors they considered important in ranking alternatives. The professional judgment of Corps planners also played an important role in ranking alternatives. During most of the 1960's, however, individual citizens and environmentally oriented citizens' groups had relatively little direct involvement in the process of defining the factors and weights used to rank alternatives. For the most part, individual citizens appeared content to leave the process of defining the public interest to elected representatives and professional planners in the Corps and other agencies.

CRITICISMS OF THE EFFICIENCY CONCEPT

Criticisms from individual citizens

During the late 1960's and early 1970's, the Corps of Engineers and other water resources development agencies experienced a good deal of criticism from

so-called "environmentalists" and others who felt they would be adversely affected by proposed water resources projects. These critics often felt that the Corps: (1) had not provided an opportunity for them to influence the outcome of planning studies; and/or, (2) had not adequately considered environmental and social impacts about which they were concerned.

In its extreme form, the nature of the first criticism can be summarized as follows. Most of the important planning decisions (e.g., which alternatives to examine) were made by Corps planners in collaboration with local groups who stood to benefit from a Corps project. Although individual citizens and environmental groups participated in the planning process through public hearings, these hearings had an insignificant influence on the direction of a planning study. Also, the opportunity that individual citizens and environmental groups had to formally review a Corps recommendation for action occurred at a late stage in the process. At this stage, criticism was viewed as obstructionism and was not taken seriously. The only way to participate effectively was via court action.

The second criticism is closely related to the first and represents a direct attack on the economic efficiency criterion. Critics argued that the economic efficiency criterion did not give adequate consideration to the ways in which proposed water resources projects might influence those aspects of the natural or social environment which could not be evaluated in dollar terms. That is, the critics argued, the economic efficiency criterion was too narrow to reflect their concerns and values. Moreover, since individual citizens were not encouraged to significantly influence the direction of a planning study, there was no way to register these concerns and values early in the planning process.

Criticisms from academics

The mid-'60's was also a period in which scholars from universities and elsewhere began a serious attack on the efficiency concept as the basis for water resources plan ranking. Like some of the citizen critics, academics also argued that economic efficiency provided an inappropriately narrow basis for plan ranking, since many significant social and environmental effects of Federal water resources investments cannot be measured in terms of incremental changes in national income. Indeed, Maass [1966, p. 312] went so far as to say that "the objective of most public programs is not simply, not even principally, economic efficiency."

The various criticisms leveled by academics and others concerned with water planning centered, for the most part, on two limitations of the traditional benefit-cost analysis. One is that the way in which project impacts are distributed (i.e., who gains and who loses) is not accounted for by analyses that emphasize economic efficiency. The second is that environmental quality considerations, which were among the leading public issues emerging in the late '60's, did not receive a thorough and systematic treatment in the traditional benefit-cost analysis. Indeed, much of the concern over environmental quality involved effects that could not be enumerated in dollar terms, and were thus placed among the so-called "intangible" effects.

CHAPTER THREE

GOING BEYOND THE EFFICIENCY CONCEPT: MULTIPLE OBJECTIVE PLANNING

The discussion below focuses on recent efforts to broaden the basis for water resources decision making. It is organized in three parts, the first of which considers recent laws and regulations requiring the explicit and systematic consideration of factors other than economic efficiency in Federal water resources decision making. In particular, the introduction of multiple objectives by both the Congress and the Administration is discussed.

The second part of Chapter Three considers the techniques that have been developed to rank alternative actions on the basis of multiple objectives. It is shown that in typical applications of these techniques, the factors are determined using various laws and regulations and the judgments of professional planners. And the weights are determined by interdisciplinary teams of technical specialists. Insofar as affected publics are not directly involved in the determination of factors and weights, these techniques for multiple objective planning do not accommodate those critics of economic efficiency who feel that affected publics should be given the opportunity to play a substantive role in determining the public interest.

The third part of Chapter Three focuses on public involvement, per se. There it is argued that although the level of public involvement in pre-authorization planning has increased, this increased public involvement has not been well integrated with the determination of factors and weights. This situation occurs, in part, because the traditional pre-authorization planning process is too highly structured to deal with substantive and continuing public involvement in the determination of the public interest.

EFFORTS TO BROADEN THE BASIS FOR DECISION MAKING

Largely as a consequence of the criticism of the economic efficiency concept (e.g., the failure to deal systematically with environmental and social

effects), the early 1970's witnessed the emergence of some fundamental changes in laws, policies, and regulations governing Federal water resources planning. The following are among the more noteworthy of these changes:

(1) The National Environmental Policy Act of 1969 (Public Law 91-190, commonly referred to as NEPA); (2) The River and Harbor and Flood Control Act of 1970 (Public Law 91-611); and (3) The Principles and Standards for Planning Water and Related Land Resources (referred to herein as the "Principles and Standards").

The first of the aforementioned changes, the NEPA, was signed into law on January 1, 1970. It specified a number of environmental quality goals which were to be considered by Federal agencies in their planning and decision making. It also required that an environmental impact statement be prepared for all major Federal actions significantly affecting the quality of the environment. As a consequence of NEPA, Corps of Engineers Districts prepare a sequence of documents describing environmental impacts (i.e., environmental assessments, and draft and final environmental impact statements) in the course of a pre-authorization study. These documents are subject to review by other governmental agencies and individual citizens.

The second of the changes, the River and Harbor and Flood Control Act of 1970, requires (in Section 122) that the Corps of Engineers

[A]ssure that possible adverse economic, social and environmental effects relating to any proposed project have been fully considered in developing such projects and that the final decisions on the project are made in the best overall public interest, taking into consideration the need for flood control, navigation and associated purposes, and the cost of eliminating or minimizing such adverse effects and the following:

1. Air, noise and water pollution;
2. Destruction or disruption of man-made and natural resources, esthetic values, community cohesion and the availability of public facilities and services;
3. Adverse employment effects and tax and property value losses;
4. Injurious displacement of people, businesses and farms; and;
5. Disruption of desirable community and regional growth [Emphasis added].

The Corps of Engineers guidelines dealing with Section 122 of Public Law 91-611 note that the assessment required by Section 122 should deal with effects which are not included in a benefit-cost analysis. The guidelines "are designed to ensure that all significant adverse and beneficial effects of proposed projects are fully considered" [U.S. Army, 1972].

Elsewhere in Public Law 91-611, explicit reference is made to the fact that the objectives of Federal water resources developments under the Act should include more than economic efficiency. In particular, Section 209 of Public Law 91-611 specifies the following four objectives: national economic development, environmental quality, regional economic development and the social well being of the people.

The third of the aforementioned changes, The Principles and Standards for Planning Water and Related Land Resources [U.S. Water Resources Council, 1973], became effective on October 25, 1973. The Principles and Standards promise to have a major influence on Federal water resources planning inasmuch as they require that both environmental quality, and economic efficiency (i.e., national economic development) be considered as objectives of Federal water resources planning and decision making.* In addition, the Principles and Standards make reference to the need for public involvement in planning. Moreover, they point out that a "broad spectrum of public groups and interests must be considered and consulted in the identification of the components" of the environmental quality objective.

The aforementioned laws and regulations, and the associated Corps guidance, make explicit reference to the specific kinds of factors that should be considered in decision making. These laws and regulations also make general reference to the importance of involving various publics directly in water resources planning and decision making. Thus, there appears to be a policy level mandate to consider a wide range of factors in determining the public interest,

* This specification of two objectives (national economic development and environmental quality) in the Principles and Standards is in conflict with Section 209 of Public Law 91-611, wherein four objectives are specified. However, the Principles and Standards indicate that effects in four "accounts" are to be considered in decision making, and these four accounts are the same as the four objectives specified in Section 209.

and to encourage the involvement of publics in the determination of those factors. It is noteworthy that the question of how to determine the weights to be used in making tradeoffs between factors and deciding on course of action is only vaguely treated by the aforementioned laws and regulations.

TECHNIQUES FOR DECISION MAKING BASED ON MULTIPLE OBJECTIVES

Although the laws and regulations establishing the consideration of multiple objectives in water resources decision making appeared in the early 1970's, the development of specific techniques for carrying out such decision making dates back to the early 1960's. The discussion below considers several techniques for ranking alternatives on the basis of multiple objectives. In each case, emphasis is placed on describing how and by whom the factors and weights used in ranking alternatives are determined.

Weighted Sum of Objectives Technique.

The early work dealing with techniques for considering multiple objectives in water resources decision making was carried out by Marglin [1962] and Maass [1966]. Their studies typically considered two objectives, namely economic efficiency and income redistribution. For each alternative under consideration, two kinds of net benefits are computed, efficiency (or national income) net benefits and income redistribution net benefits. The latter are typically defined in terms of net income changes to a particular region or income class. Alternative water resources development proposals are then ranked using a formula consisting of a weighted sum of the contributions to each of the two objectives.*

Using the above noted technique, the factors considered in ranking alternatives are the objectives themselves. Although Marglin and Maass often considered only the economic efficiency and income redistribution objectives in demonstrating their ideas, they recognized that several other objectives might need to be considered. For Marglin and Maass, and those who have extended their work, the objectives are generally taken as given by a policy making body (e.g., the Congress).

* A variation of this approach involves maximizing contributions to one objective, subject to a constraint requiring that a fixed contribution to the second objective be attained. For details, see Marglin [1962]. Also, for a recent extension of the weighted sum of objectives technique, see Major [1974].

The determination of the weights to be used in computing the weighted sum of objectives has been a subject of continuing debate. Although the literature on the establishment of weights to make trade-offs between objectives is voluminous, it is in Steiner's words, "almost entirely theoretical and assertive" [1969, p. 48]. The empirical work that has been undertaken relates principally to the trade-offs between economic efficiency and income redistribution, and looks to past choices and tax data as the basis for inferring the weights that appear to have governed past decisions. However, as Haveman has observed, "while knowledge of ex post implied weights is surely of interest in understanding how the world has worked, it is of but marginal importance in determining what the weights should be" [1968, p. 210]. The numerous technical difficulties associated with examining historical data to infer weights have been discussed at length by Freeman [1970], Haveman [1968], and Mack [1968] among others.

A number of economists and political scientists have suggested that the weights used in making trade-offs between objectives be articulated by policy makers (see, e.g., Maass [1966], Freeman [1970]). Freeman argues that:

Congress itself could take the initiative when establishing a new program by stating its intent as clearly as possible so that this could be translated into a weighting function by the agency for use in administrating the program [1970, p. 360].

This approach recommended by Freeman, and actually as far back as 1962 by Marglin [1962, p. 38], has not been used. There seems little evidence to suggest that policy makers are prepared to articulate specific weights or "shadow premiums" on objectives like income redistribution and environmental quality. Part of the problem is that operationally meaningful measures for objectives such as environmental quality have yet to be invented.

Weighted Sum of Factors Technique

The weighted sum of factors technique recognizes that to provide an operationally meaningful definition of an objective like environmental quality, it is useful to define the objective in terms of its component parts or factors. Thus, the environmental quality objective might be defined in terms of factors like fisheries resources maintained, open-space preserved, etc. This use of specific factors to define objectives is fully elaborated in the Water Resources Council's Principles and Standards.

The weighted sum of factors technique involves describing the relevant objectives in terms of a larger number of component factors. The criterion used in ranking is simply the maximization of a weighted sum of the factors. In very general terms, this approach ranks alternatives on the basis of the following formula:

$$I(j) = w_1 F_1(j) + w_2 F_2(j) + \dots + w_m F_m(j),$$

where

- j = index value used to identify alternative "j", (j=1,...,n),
- n = total number of alternative actions,
- i = index value used to identify factor "i" (i=1,...,m),
- m = total number of factors,
- $F_i(j)$ = numerical rating (or score) of alternative j in terms of its effect on factor i,
- w_i = weight (or "relative value") ascribed to factor i, and
- I(j) = weighted sum of factors for alternative j.

The weighted sum of factors technique has been employed by the Tulsa District of the U.S. Army Corps of Engineers [1972a], and Dee et al. [1971], among others. The discussion below considers how the factors and weights have been determined in typical applications of this technique.

In applications of the weighted sum of factors technique, the relevant objectives are given by laws (e.g., Section 209 of Public Law 91-611) and regulations (e.g., the Water Resources Council's Principles and Standards). Such laws and regulations also serve as a source of the factors which define these objectives. For example, lists of factors are contained in Section 122 of Public Law 91-611 and in the Principles and Standards. It is worth noting that while the factors described in such laws and regulations provide checklists of potential concerns, they often reflect a Federal, as opposed to a local, perspective.

Typical applications of the weighted sum of factors technique rely heavily on the professional judgments of agency planners as a source of factors. This reliance on professional judgment is especially noteworthy in the plan ranking approach described by the Tulsa District [U.S. Army, 1972, p. 5]. In this case, an interdisciplinary team of technical specialists

is given primary responsibility for selecting factors, and scoring each alternative in terms of its effect on each factor; i.e., the team defines and determines the values of the $F_i(j)$ terms introduced above.

In utilizing only laws and regulations and professional judgment in selecting factors, the determination of which factors comprise the public interest is placed in the hands of policy makers, professional planners, and the Federal water resources agencies. While it is possible to involve publics directly in the delineation of factors to be used in the weighted sum of factors computation, this does not appear to be the common practice. Although there has been increasing attention given to public involvement activities in water resources planning, these activities do not appear to be formally integrated with the process of determining the factors used as a basis for defining the public interest.

Typical applications of the weighted sum of factors technique utilize an interdisciplinary planning team for the determination of weights*. For example, both Dee et al. [1971] and the Tulsa District [U.S. Army, 1972a, p. 16] utilize teams of technical specialists for this purpose.** This reliance on technical specialists assumes implicitly that the weights selected by teams of technical specialists reflect the weights of the publics affected by the proposed actions. This assumption is difficult to defend in light of the fact that the affected publics consist of a variety of different individuals and groups which would be likely to set weights in disparate ways.

The use of teams of technical specialists to establish weights is sometimes defended on the grounds that when professionals set the weights, their value judgments will at least be explicit. That is, professional judgments regarding the relative worth of different factors will be set forth in an open and unambiguous manner. Affected publics or their representatives could, in

* It is noteworthy that the Water Resources Councils' Principles and Standards, which serve to guide plan ranking, do not deal with the process of establishing weights to be used in ranking alternatives.

** In a draft technical report by the Tulsa District, it is noted that: "The weights represent the consensus of the interdisciplinary team based on research data or on the opinion of several qualified professionals" [U.S. Army, 1972a, p. 11].

principle at least, select the weights differently and determine the implications of different weights on the ranking of alternatives. Although this possibility exists in principle, public involvement in the process of setting weights is not commonly carried out in practice.

Insofar as affected publics are not generally involved in the determination of factors and weights, the techniques described above do not accommodate those individuals and citizens' groups who have indicated a desire to be more fully involved in the decision process. That is, by relying on laws, regulations and the judgments of professional planners, the techniques involving a weighted sum of factors (or objectives) do not provide citizens with an opportunity to participate directly in plan ranking. Moreover, to the extent that the extensive environmental litigation in the early 1970's reflects an increasing demand for direct public involvement in the determination of factors and weights, the introduction of multiple objectives alone will not satisfy those who are calling for meaningful participation by publics in the process of determining the public interest.

INVOLVING PUBLICS IN THE DETERMINATION OF FACTORS AND WEIGHTS

Applications of the above described techniques for considering multiple objectives in plan ranking do not answer those critics of economic efficiency who feel that affected publics should be given the opportunity to play a substantive role in determining the public interest. The discussion below elaborates further on issues relating to the involvement of publics in the determination of factors and weights.

The increasing pressures for public involvement in pre-authorization planning has led to an increase in the amount of attention given by Corps Districts to public involvement. The typical number of public meetings held during pre-authorization studies has increased from two to three. And in a few cases (e.g., Seattle District), the increased public involvement has become a major component of pre-authorization studies (see, e.g., Sargent [1972]).

Although the level of public involvement in Corps pre-authorization studies has increased, it is not clear that such public involvement has led to a corresponding increase in the influence of publics on decision making. In

particular, there is not much evidence to suggest that publics are being given an increased role in determining the factors and weights to be used in decision making. The Tulsa District report [U.S. Army, 1972a] referred to previously illustrates this point. In the Tulsa District, an interdisciplinary team of technical specialists is given the key role in establishing factors and weights. The results from the Tulsa District's public involvement activities do not appear to be clearly integrated with the determination of factors and weights.*

An important reason for the lack of increased public involvement in the determination of factors and weights is that the traditional pre-authorization planning process is not well suited to accommodate such involvement. The traditional planning process consists of a well structured sequence of steps, in which public involvement generally takes place in the form of three public meetings.** The first meeting, which occurs at the outset of a pre-authorization study, provides an opportunity for District planners to identify local "problems and needs". The second meeting is used to display the results of technical studies of alternatives and their impacts, and to gauge the response of various publics to the alternatives. The third public meeting, which occurs near the end of a pre-authorization study, is used to present the District Engineer's tentative recommendation of a course of action.

The traditional pre-authorization planning process thus involves the participation of publics at well defined stages of the process. However, a structured, sequential planning process is not well adapted to the direct involvement of publics in the determination of factors and weights. The ability of publics to contribute information improves as they gain information which helps them articulate their concerns and formulate their views regarding alternative actions and the impacts of such actions.

* The Tulsa District's description of their use of the weighted sum of factors technique makes no mention of public involvement [U.S. Army, 1972a].

** The word "traditional" is emphasized in recognition of the fact that a number of Districts (e.g., Seattle) have recently employed innovative public involvement formats which differ from the one noted in the discussion above.

To illustrate the difficulties involved in trying to provide a substantive role for publics in the traditional pre-authorization planning process, consider a situation where the process has progressed to the point where several alternative actions have been formulated. At this stage, new information supplied by publics regarding their values and concerns could force planners to reexamine their own perceptions of the "problems and needs". Although the publics may have provided a valuable source of new information, it could be viewed in a negative way by planners because it gives the appearance of "setting the planning process back".

The difficulties associated with a highly structured pre-authorization planning process can be further clarified by observing that publics and review agencies generally have insufficient information to provide substantive feedback to planners early in a pre-authorization study. As planning proceeds and information is provided to publics and review agencies, new concerns and problems often become evident. Indeed, the reaction of publics and review agencies may call for abandonment of previously delineated alternatives, the examination of new alternatives, the assessment of effects that had not been previously considered, etc. In a highly structured process this information is often viewed by planners as occurring "too late", inasmuch as substantial portions of the planning budget may already have been spent. Planners may thus find it difficult to respond to the new demands, e.g., by generating new information relating actions to newly indicated concerns, by giving serious consideration to newly suggested alternatives, etc.

In other words, a highly structured pre-authorization planning process ignores the fact that for water resources planning in the 1970's the nature of the so-called "problems and needs" and specific requirements for information are clarified as the planning process unfolds. In conceiving of planning as a sequence of steps, traditional pre-authorization planning assumes that what needs to be studied and which factors are of concern to people can be specified at the beginning of the process. This assumption may have been appropriate in the 1950's and 1960's, but it is untenable in the 1970's.

CHAPTER FOUR

A PROCESS FOR FIELD LEVEL WATER PLANNING

In order to accommodate the citizen critics of economic efficiency who have argued for a meaningful role for publics in district level planning, a more loosely structured pre-authorization planning process is required. Such a process should aim to integrate public involvement activities with all other planning activities, including the determination of factors and weights which form the basis for decision making in the public interest.

This chapter presents one alternative to the highly structured pre-authorization planning process commonly employed during the 1950's and '60's. This alternative process is not unique; a planning process that is similar to the one advocated herein has been developed by Manheim et al. [1972] (see Appendix A). The process presented is of special interest inasmuch as it was developed especially to meet the demands of pre-authorization planning.

The process considered herein is presented at a conceptual level and in rather general terms. Many of the detailed considerations required in implementing the process are currently being examined in the context of a case study application. The case study, which is being carried out as a joint effort involving the San Francisco District, the Institute for Water Resources and Stanford University, involves an ongoing study of San Pedro Creek, California. Results from the case study will be presented in a forthcoming report.

The planning process advocated herein has the following general features:

1. There are four planning activities: identification of concerns, formulation of alternatives, impact (or effect) analysis, and plan ranking.*
2. These activities are highly interdependent and are linked

*While these planning activities are typical of those found in many descriptions of planning processes (e.g., see Hightower [1969]), they are organized herein in an unusual way.

together by the goals, concerns, constraints, etc. that various decision makers and affected publics consider important in ranking alternative actions. As a matter of convenience, we use the term "evaluative factors" to refer to these goals, concerns, constraints, etc.

3. Each of the planning activities is carried out by both planners and affected publics.

4. The four planning activities are carried out simultaneously, not sequentially.

5. During any particular stage of the planning process, the relationships between activities are defined in terms of information flows (see Figure 4-1).

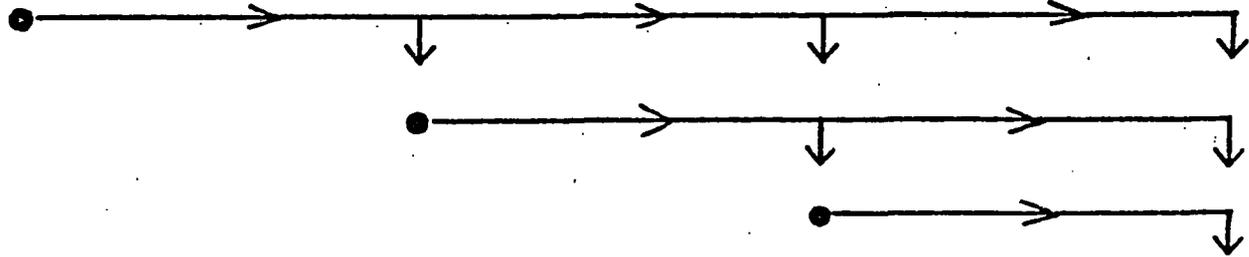
6. As planning proceeds, each activity is repeated a number of times at increasing levels of detail. However, at any one point in time, one activity may receive more emphasis than the others (see Figure 4-2).

A HYPOTHETICAL EXAMPLE ILLUSTRATING THE PROCESS

The example below, which concerns water related issues in the fictitious Charles River Basin (see Figure 4-3), illustrates several points in the chapter. The example is introduced by considering the following transcript of a fictitious meeting held early in the planning process. The "meeting" was attended by representatives of the local Board of Supervisors, the local water utility, the Corps of Engineers, and a number of interested citizens. The "transcript" reflects key points raised in the meeting, and the sequence in which they were raised. In addition to introducing the example, the transcript serves to emphasize that: (1) evaluative factors begin to emerge at the earliest stages of the planning process; and (2) the identification of concerns, the formulation of alternatives, impact analysis and plan ranking occur iteratively and continually.

The points contained in the fictitious transcript are noted below. Letters in parentheses indicate whether the transcript item refers to the identification of concerns (C), formulation of alternatives (A), impact analysis (I), or plan ranking (R).

INFORMATION



ACTIVITIES

Ident. of Concerns

Plan Formulation

Impact Analysis

Plan Ranking

PLANNERS

Determine evaluative factors from national, regional, local perspective

Use evaluative factors to delineate alternatives

Forecast and describe impacts

Organize and display information on alternatives and impacts

AFFECTED PUBLICS

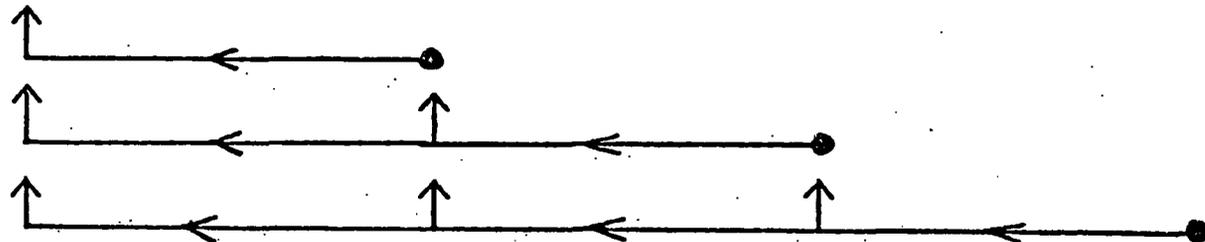
Articulate problems, concerns, etc.

Suggest alternatives

Assist in describing impacts

Value impacts, make tradeoffs, express preferences

INFORMATION



Note: → indicates information flow

Figure 4-1. Information Flow During Any Particular Stage of the Process

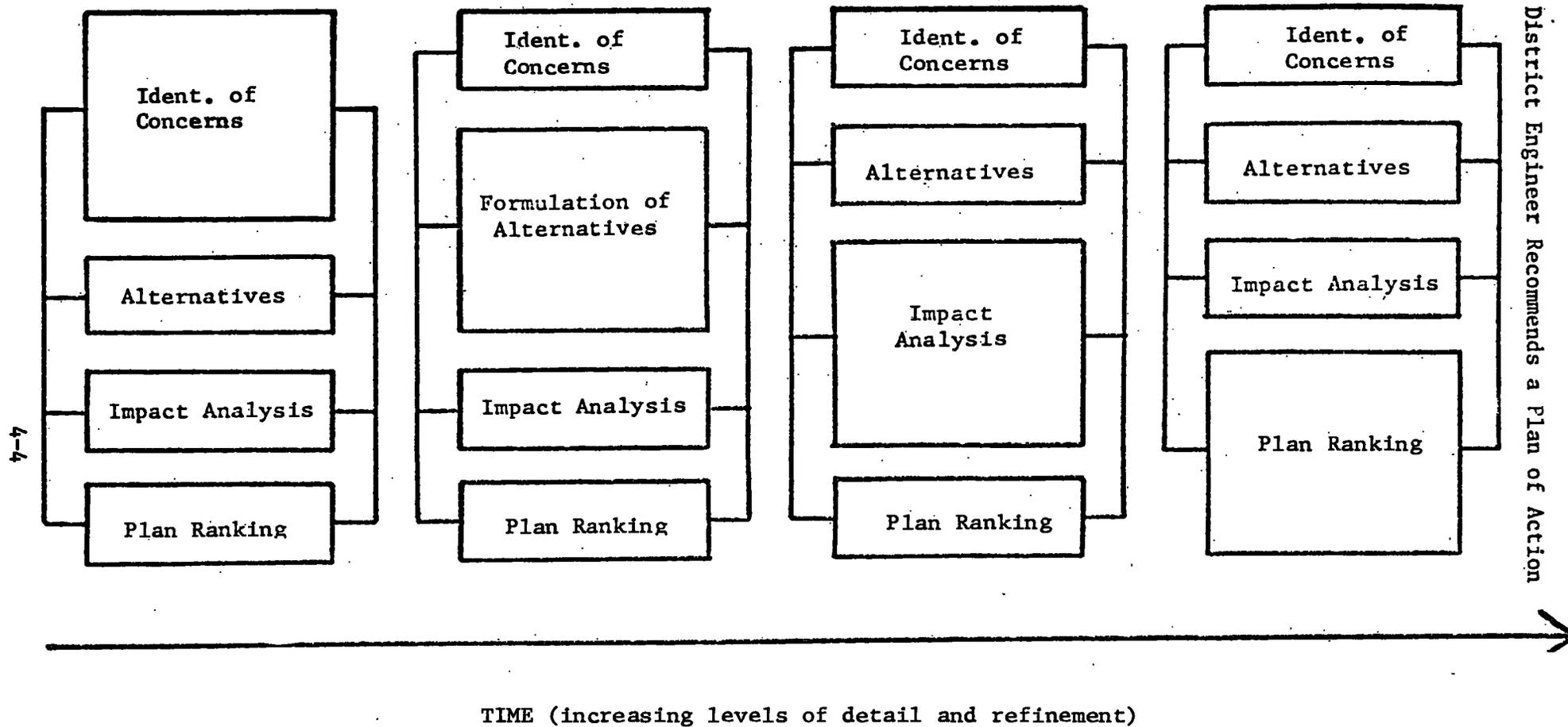


Figure 4-2. A Representation of the Planning Process Over Time

- Note:
- (a) The lines between boxes summarize information flows noted in Figure 1.
 - (b) The sizes of the various boxes suggest the emphasis placed on the four activities at any one point in the process.
 - (c) The figure does not show all possible variations in the way emphasis on activities may shift over time.

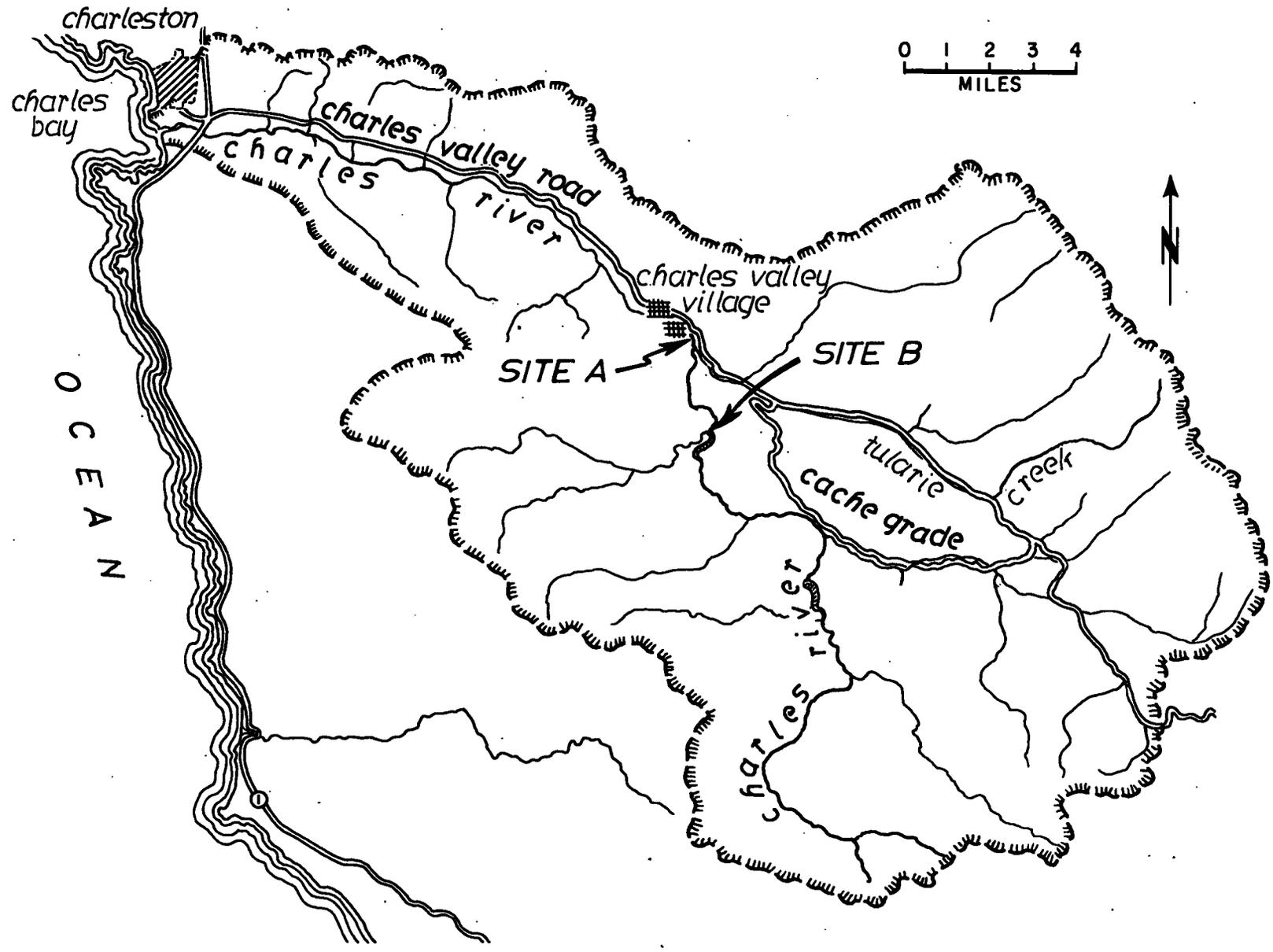


figure 4-3. charles river basin

- . Residents in the lower fifteen miles of Charles Valley have experienced serious flooding three times over the past twenty years (C).
- . Flood damages continue to increase because the "character" of the Valley is shifting from rural to residential (C).
- . Flood damages could be reduced substantially by widening and lining the lower reaches of the Charles River (A/I).
- . Some local residents feel that concrete lined channels are ugly, and that they would destroy the cottonwood trees now growing in the floodplain. A recent lawsuit centered on the deterioration of such cottonwoods (I/R).
- . The County General Plan calls for flood plain zoning (A).
- . A poll recently conducted by the local newspaper showed that many local citizens favor flood plain zoning (R).
- . If flooding is controlled, the lower Valley will be overrun with new subdivisions; and when a major flood occurs it will be disastrous (I/R).
- . Floodplain zoning works a financial hardship on landowners who purchased land with the hope of developing it (I/R).
- . Flooding isn't the only problem. We're also "running out of water" (C).
- . We could meet our water supply "requirements" and solve the flooding problem by using an upstream reservoir (A).
- . As long as we're considering a reservoir, why not open it up to the public as a recreation facility (A).
- . There is a great demand for reservoir-based recreation in this area (C).
- . Recreation would only attract more tourists, and it might lead to increased residential development in the area within view of the reservoir (C/I/R).

THE FOUR PLANNING ACTIVITIES

Identification of Concerns

This activity involves determining existing and projected future conditions that would obtain in the absence of a Corps action, and identifying evaluative factors (i.e., those goals, concerns, constraints, etc.

that affected publics and other decision makers consider in ranking alternative actions). The term evaluative factor is introduced to eliminate the tiring and often fruitless exercises which are undertaken to carefully distinguish between "goals," "objectives," and "constraints."

There are three sources of evaluative factors: institutions, community interaction, and technical and scientific judgments.* The discussion below considers the ways in which planners are involved in the identification and description of evaluative factors from each of these sources.

First, planners must identify the factors to be considered in ranking alternatives from the perspective of affected publics who are not easily reached directly (i.e., on a face-to-face basis). As a matter of convenience such people are loosely referred to as "non-local" publics. The concerns, goals, objectives, etc. of such non-local publics are expressed institutionally at the national, state, regional (and even local) levels in laws, pending legislation, policies, regulations, programs, etc. For example, a state law may govern the preservation of marshes. Examples at the Federal level include the Principles and Standards of the U.S. Water Resources Council [1973]. Still other examples include the policy statements of various interest groups (e.g., Chamber of Commerce, Sierra Club). Planners can obtain this type of information by communicating with various local, state and Federal officials and agency and interest group representatives, and by examining relevant laws, policy statements, regulations, etc.

Second, planners must interact with "local" affected publics to provide information which helps these publics figure out what their problems are (from a local perspective), and helps them identify the factors which they would consider important in ranking alternative actions. To accomplish this, planners need to describe not only the water related concerns as they understand them, but also possible actions and the kinds of effects which might be associated with these actions. Local publics need this information in order to help them think about evaluative factors. Local

*The term "institutions" is employed in an unusual way; it refers to the various laws, regulations and policies of government agencies, and the policy positions of various interest groups.

publics provide information to planners about their own perceptions of their problems and what they would consider important in ranking alternative actions. Methods that can be employed in accomplishing this interaction between planners and local publics include: public meetings, interviews, workshops, questionnaires, citizen advisory boards, etc. Examples of evaluative factors derived from interaction with local publics are contained in the fictitious transcript presented above.

Third, planners must identify evaluative factors based on technical or scientific judgments which affected publics may neither appreciate nor recognize at any one point in the planning process. For example, planners may deem it important to maintain the habitats of certain species in the interests of long term ecological stability. This is one type of information that planners should provide to affected publics.

Planners play a central role in the articulation of evaluative factors. In addition to relying on the aforementioned sources for the identification of factors, planners must continually work to translate the various concerns, needs, etc. of affected publics into technical concepts and parameters that can be used to guide the formulation of alternatives, impact analysis and plan ranking. For example, the "need" to maintain trout fishing in a local stream may be translated by planners into evaluative factors that relate to specific measures like stream dissolved oxygen, temperature, etc.

In addition to the delineation of evaluative factors, this activity also involves developing a sense of the relative significance of such factors. It is essential to avoid the development of long and unmanageable lists of evaluative factors without at least a crude indication of their relative magnitude and the extent to which they are considered important by various decision makers and publics.

Although the identification of concerns may receive the major emphasis in the early stages of the planning process, information relating to all four planning activities is continually developed and communicated right from the beginning of the process. That is to say, information on the formulation of alternatives, impact analysis and plan ranking is also developed and exchanged at this stage in the process.

The identification of evaluative factors influences the conduct of

other planning activities. For example, such factors serve to guide the formulation of alternatives, and to identify the impacts that need to be analyzed. Furthermore, evaluative factors provide a framework for ranking the proposed alternatives. It is also noteworthy that information from the other activities influences the identification of concerns. Information about alternatives and their impacts permits a redefinition of the individuals or groups to be included among affected publics. It may also permit a more refined definition of evaluative factors, and enable affected publics to express their concerns more clearly.

Formulation of Alternative Actions

Conceptualization of alternative futures. The design of alternative actions rests on a set of assumptions, either explicit or implicit, regarding which goals, objectives, constraints, etc. the actions will attempt to deal with. Different sets of planning assumptions (commonly referred to as "design criteria" or "planning objectives") represent different conceptions of what the future will be like; i.e., they represent "alternative futures."

The discussion below considers how the evaluative factors can be used in conceptualizing alternative futures. Recall that evaluative factors are the goals, concerns, constraints, etc. that affected publics and other decision makers consider in ranking alternative actions. Some evaluative factors take the form of operational constraints; e.g., some residents may feel that concrete lined channels would be so ugly that they do not want them to be considered among the feasible actions. Other evaluative factors may take forms which planners can translate into constraints; e.g., the goal of maintaining water quality at levels that permit swimming can be translated into a set of specific constraints on turbidity, coliform bacteria, etc.

Suppose that, wherever possible, evaluative factors are put in the form of constraints. Because people with different values and needs are involved in the identification of evaluative factors, it is to be expected that some of the constraints will not be compatible; i.e., it will not be possible to satisfy all of the constraints simultaneously. For example, it would not be possible to design an action that stimulated eco-

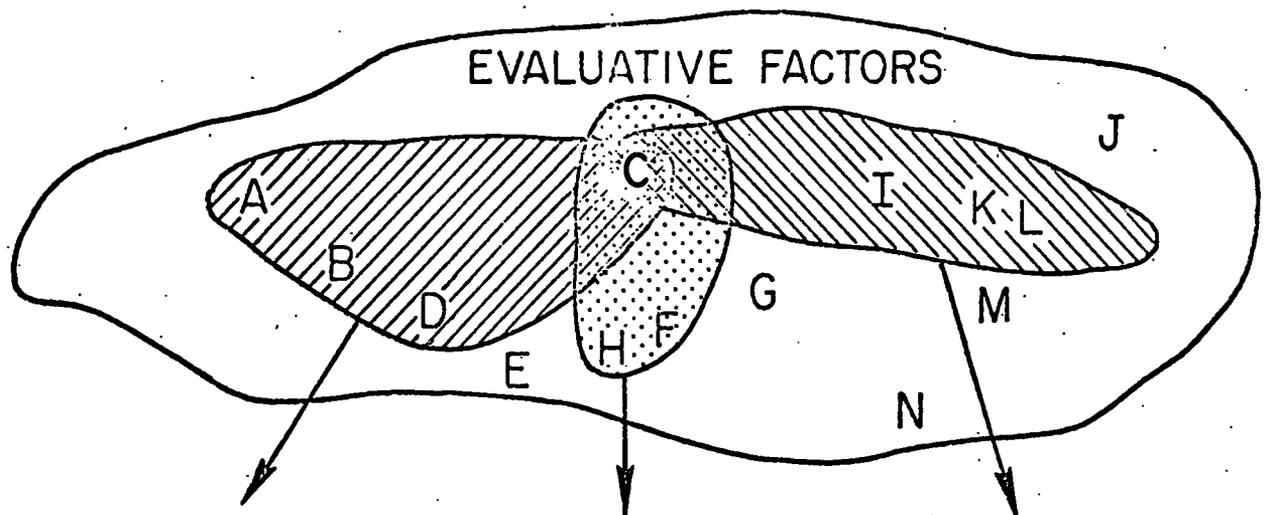
conomic development of a floodplain and maintained floodplain vegetation in its existing form. Thus, before actions can be formulated it is necessary to group the constraints into sets that can be satisfied simultaneously. Different constraint sets represent "alternative futures" (see Figure 4-4).

The process of grouping evaluative factors into mutually consistent sets of constraints can be illustrated using the evaluative factors contained in the fictitious transcript relating to the Charles Valley.* Several of the evaluative factors contained in the transcript could easily be transformed into constraints. For example, the concern for flood damage reduction might be put into the form of a constraint requiring protection against the "X" year flood. As another example, the concern for the visual appearance of the floodplain might be transformed into a constraint that prohibited the use of channel modification works. Table 4-1 contains one view of how the various evaluative factors contained in the transcript might be put into a form which provides the basis for designing alternative actions.

The process of conceptualizing alternative futures involves grouping the various constraints into sets that are consistent. Since the number of constraint sets that can be formed is often unmanageably large, it is useful to employ alternative visions of the future as a device for organizing the constraints into different groups. Thus, in the Charles Valley example, it is possible to imagine two polar cases, one representing only minimal change from existing land use and population, and a second representing an increased intensity of land use based on an expanding resident and tourist population in the Valley. The constraint sets consistent with these perceptions of the future are labeled as No. 1 and No. 3 in Table 4-1. Clearly, it is possible to imagine a number of alternative futures which, in some sense, lie between the polar cases (e.g., constraint set No. 2 in Table 4-1).

Conceptualization of alternative actions. In designing alternative actions there is no reason to restrict attention to only a single set of constraints. Different constraint sets represent alternative futures,

*The transcript is intended to be illustrative only; obviously there would be many more evaluative factors than those raised at a single meeting.

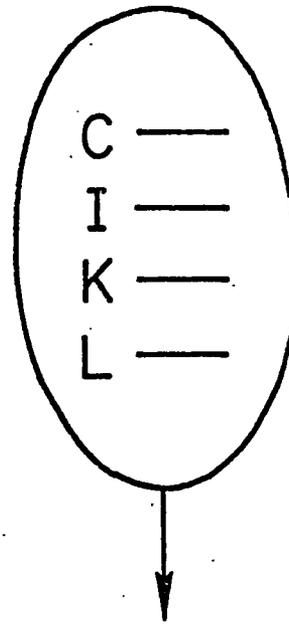
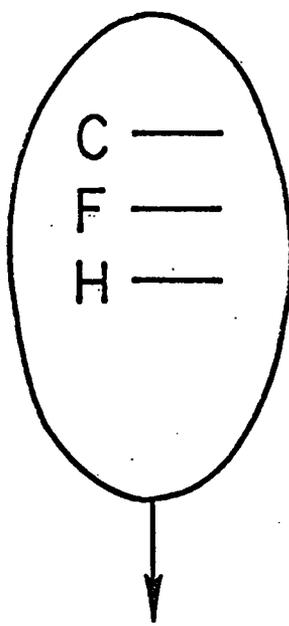
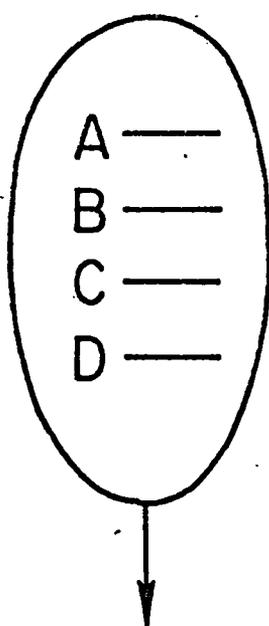


CONCEPTUALIZATION OF ALTERNATIVE FUTURES

CONSTRAINT SET 1

CONSTRAINT SET 2

CONSTRAINT SET M 3



CONCEPTUALIZATION OF ALTERNATIVE ACTIONS

1
2
⋮

1
2
⋮

1
2
⋮

ANALYSIS OF IMPACTS

For each action in each constraint set:

Does the action satisfy constraints in the set that were not used as the basis for its design?

How does the design relate to evaluative factors not contained in the constraint set?

EVALUATION OF ALTERNATIVES

Figure 4-4. Formulation of Alternatives

TABLE 4-1

CONCEPTUALIZATION OF ALTERNATIVE FUTURES

Based on Evaluative Factors from the Charles Valley "Transcript"

Evaluative Factor	Constraint Set No. 1	Constraint Set No. 2	Constraint Set No. 3
Flood damage reduction	Protect against standard project flood	Protect against 50-yr flood	Utilize flood proofing, flood insurance and zoning--no "structural measures"
Water supply "requirements"	Supply safe yield of 40,000 AF/yr	Supply safe yield of 20,000 AF/yr	Reduce future demand by limiting local growth
Reservoir-based recreational opportunities	Supply recreational facilities consistent with regional demand and project type	Supply recreational facilities consistent with local demand and project type	Supply no reservoir based recreation facilities
Tourist population	--	--	Use zoning to control motel and commercial development
Development of view site lots	--	--	Control via zoning and subdivision regulations
Development of flood plain lands	--	Zone flood plain to <u>limit</u> more intensive development	Zone flood plain to prohibit more intensive development
Visual appearance of flood plain (cottonwoods)	--	Prohibit channel modification works	Prohibit channel modification and minimize visual changes
Recommendations in County general plan	--	--	Carry out recommended flood plain zoning

and the planning process should serve to elucidate the nature of different futures. One especially important constraint set is the one that includes no Federal action. This constraint serves to define the so-called "null alternative" which should be explicitly considered in all phases of the planning process and used as a reference point for determining the impact of other alternatives [Manheim and Suhrbier, 1972, p. 43].

Each of the constraints in any given set can be used in one of two ways. A constraint might be used in designing an action; e.g., in the Charles Valley, a reservoir might be designed to provide a safe yield of 40,000 acre feet/year. Alternatively, it might be used in testing a given design; e.g., the reservoir project has national income "benefits" that exceed costs and therefore satisfies the Office of Management and Budget (OMB) constraint that the benefit-cost ratio exceed unity. In other words, some constraints are satisfied in the process of formulating the action, and others (e.g., the benefit-cost constraint) can only be examined after the action is conceived. The examination of the consequences of an action is a part of impact analysis (see Figure 4-4).

The process of conceptualizing alternative actions is more an art than a science. In the past, much of the "art" has involved the use of "engineering judgment" to narrow the range of alternatives early in the planning process. Often this narrowing has been premature because it was based on the value judgments of planners who: (1) restricted their attention to actions which their agency could implement; and/or, (2) did not obtain much information about the values and perspectives of publics. One of the important ways to prevent this premature narrowing in the range of alternatives is to involve the public in planning, especially in the continual articulation of evaluative factors. It is especially important that publics be informed of the way in which alternative constraint sets have been deduced. This is critical since it is the delineation of alternative constraint sets (or "design criteria") that serves to "flavor" the types of alternative actions that both planners and publics will be encouraged to think about. For example, no one is encouraged to think about flood plain zoning if a pervasive constraint is that protection against the "standard project flood" must be provided.

Impact Analysis

Impact analysis involves forecasting and describing changes (impacts, effects) resulting from proposed alternative actions. Such forecasts are generally carried out by planners using technical judgments and various models of how certain changes bring about other changes. Publics can assist planners in making forecasts by virtue of their special knowledge and insights regarding how the local area will respond to new influences (e.g., a reservoir project).

Planners and publics need to make choices in conducting the impact analysis activity. These choices concern the types of impacts that need to be analyzed and the level of detail required in the analysis. Choices have to be made because there rarely are sufficient resources (time, manpower, etc.) or the basic knowledge necessary to determine everything that it would be useful to know about the impacts caused by a particular action. For any given alternative, the information about evaluative factors and their relative importance serves to guide such choices.

To illustrate how evaluative factors can guide an impact analysis, consider the designs for the Charles Valley that are consistent with constraint set No. 1 in Table 4-1. Such actions would include projects designed to protect against the standard project flood, supply 40,000 AF/yr of safe yield for water supply, and provide water based recreational facilities consistent with regional demands and project type. The analysis of impacts associated with such designs would provide information relating to those evaluative factors which were not used in conceptualizing the designs. Thus, using the factors listed in Table 4-1, the impact analysis would involve forecasts of how the alternative actions influenced tourist population, the development of view site lots and floodplain lands, and the appearance of the floodplain. The listing in Table 4-1 which is based on the fictitious transcript presented above, is not intended to be complete. A more complete list of evaluative factors would include the OMB requirement that national income benefits exceed costs, since this is a relevant consideration for any investment proposed by the Corps.

As with all activities in the planning process, impact analysis is carried out continually. In the earliest stages of the process, evaluative factors are defined crudely, alternative solutions are sketched out

in very rough form, and impacts are forecast in general terms. This information is necessary for various decision makers and publics to: (1) think through their own perceptions of what the key evaluative factors are; (2) make their own judgments concerning preferences for different alternatives; and (3) suggest new alternative actions. As the planning process continues, impact analysis becomes more detailed, since the meaning and relative importance of various evaluative factors becomes more clear, and the alternatives under consideration are fewer in number and described in greater detail.

Plan Ranking

The ranking of alternative actions requires that individual citizens, interest groups and those with formal authority for decision making render judgments, at least implicitly, regarding the relative worth or value of alternative actions.* It is essential to recognize that in making such judgments, the question of whether an impact is adverse or beneficial is determined with respect to the interests of those affected by it. Moreover, the important consideration is not how significant any particular impact may be, but the relative importance of that impact as compared to other impacts. This is the basis upon which choices are made. For example, an individual may consider the maintenance of a natural stream channel important. However, he may consider it more important to accept the aesthetic impairment of a concrete lined channel if, all things considered, that appears to him to be the best way to prevent flooding of his property.

The plan ranking activity is complicated by the fact that rankings are made at several different levels. At the most basic level, individuals perform rankings which are reflective of their own interests. At a

*Plan ranking is not the only activity that involves value judgments. Such judgments are made when publics and planners articulate evaluative factors and indicate the relative importance of these factors. They are made implicitly when alternative futures are conceptualized and alternative actions are proposed. And they are made in the course of deciding which impacts to analyze and at what level of detail. As Fox has pointed out, complete objectivity in water resources planning is "an impractical ideal" [1966, p. 269].

second level, individuals within groups perform rankings which are intended to reflect the interests of the groups which they represent. In the process of choosing among alternatives, impacts are valued and weighed and a trade-off analysis is performed. Such trade-off analyses are generally done implicitly and with imperfect information.

Although the plan ranking activity is conducted throughout the district level planning process, the District office must ultimately make an evaluation of its own. The District Engineer is charged with making this evaluation on the basis of a broad range of considerations. As indicated in recent guidelines, the District Engineer "should recommend the alternative that is in the best overall public interest considering the planning objectives, the benefits and costs, and the significant economic, social, and environmental effects, including the cost of treating those that are adverse" [U.S. Army, 1972].

CONCLUDING REMARKS

The description above provides only general guidelines for carrying out field level water resources planning. There is much to be done in the way of testing the ideas presented in the context of real world planning situations. As mentioned above the process is currently being "field tested" by utilizing it on the San Francisco District's study of flooding on San Pedro Creek in California.

Although the San Pedro Creek study is still in progress, the results to date have been interesting. The study is clarifying the problems involved in getting local publics to take an active role in all planning activities from the beginning of a planning effort. It is also revealing that some of the key issues involved in moving away from a structured, sequential planning process and toward the more open and iterative process described above relate to the way in which Districts are organized and management controls are exercised.

The results from the San Pedro Creek study will provide a sequel to this report. They will demonstrate, more clearly, both the strengths and weaknesses of the process described in this chapter. They will also provide the basis for a discussion of specific issues relating to implementation (e.g., questions relating to planning budgets, staffing, organization, etc.).

Because the nature of Federal water resources planning is changing rapidly, experimentation with alternative processes for planning should be encouraged. The San Pedro Creek study represents one such experiment. Other experiments, perhaps with planning processes quite different from the one described herein, are clearly called for.

Appendix A
MANHEIM'S PROCESS FOR HIGHWAY PLANNING*

For several years, Manheim and others at the Urban Systems Laboratory of the Massachusetts Institute of Technology (MIT) have been doing research on the development of "practical approaches for incorporating community and environmental factors into all phases of highway planning, location and design" [Manheim et al., 1972, p. 14]. Although the MIT researchers have directed their efforts toward highway planning, many of their ideas are relevant to water resources planning as well. Manheim et al. concluded early in their research effort "that to be practicable, an evaluation approach could not be developed in isolation, but had to be integrated with the location and design process" [1973, p. 8]. This integration is best described in terms of the planning strategy which Manheim and his colleagues have adopted.

The Four Stage Process

Manheim sees the objective of a professional planning team (referred to as the "location team") as:

[The achievement of] substantial effective, community agreement on a course of action which is feasible, equitable, and desirable [1973, p. 8].

To achieve this objective, the planning team would employ the following loosely structured "process strategy" [Manheim, 1973, p. 11 et seqq.]:

"Stage 1 - Initial Survey - ... to acquire basic data and to develop an understanding of the interests, needs and desires of all potentially affected interest groups....

"Stage 2 - Issue Analysis - ... to develop, for both the team and the interest groups affected, a clear understanding of the issues....[T]he major thrust is on developing a range of alternatives which represent different assumptions about the objectives to be achieved, and which, when presented to various interest groups, helps them to clarify their own objectives....

"Stage 3 - Design and Negotiation - to produce substantial agreement on a single alternative....

* Substantial portions of the first draft of Appendix A were prepared by Thomas P. Wagner, Department of Civil Engineering, Stanford.

"Stage 4 - Ratification - ...[I]f substantial agreement on a program of action has been reached [then,] Stage 4 merely formalizes the agreement at the public hearing. [If no agreement has been reached, the location team recommends an alternative and this is presented at a public hearing. If agreement still is not reached, the location team submits its recommendation to the legally designated authority to which the planning team reports.]

Role of the Planning Team

Manheim's conception of the role of the professional planner is much broader than the traditional one. To him, the planning team's role is "to clarify the issues of choice, [and] to assist the community in determining what is best for itself" [1973, p. 13]. This involves developing alternatives and determining their impacts on various individuals and groups. It also involves an effort to assist individuals and groups in clarifying goals and reaching agreement on a course of action.

Manheim and Suhribier [1972, p. 37] elaborate further on the function of the planning team by suggesting that the team may need to assume the following roles:

1. Agent of the responsible decision making authority
2. Technical advisor to the decision maker
3. Ombudsman and spokesman for interests not represented in the political process
4. Impartial negotiator of conflicts among various interest groups who are in potential conflict
5. Advisor to the community (to help groups clarify their objectives by developing alternatives)
6. Impartial developer of alternatives and of factual information on the impacts of alternatives.

Activities of the Planning Team

Manheim and his associates indicate that in order to achieve the objective of "substantial, effective community agreement," the planning team will have to engage in the following five basic activities: location team management, development of alternatives, impact prediction, evaluation and community interaction.

The location team management activity involves, among other things, "the development and revision as necessary of a process strategy, the general sequence of steps the location team follows in trying to achieve the overall process objectives" [Manheim and Suhrbier, 1972, p. 39]. The development of alternatives activity involves many traditional design activities, but it also involves a great deal of direct citizen involvement in shaping the alternatives. The other three activities, which have been discussed in considerable depth by Manheim et al. [1971], are considered below.

Impact Prediction. Manheim et al. define impact prediction as the "identification and measurement of the consequences of implementing a particular course of action" [1971, p. VI-1]. They describe an overall strategy for impact prediction as follows:

[The impact prediction activity] is a continuous process of making hypotheses [i.e., general statements] about the potential impacts, making predictions, revising the hypotheses, making additional predictions, adjusting the importance given to impacts, and shifting priorities for prediction. Priorities are shifted on the basis of [the] estimated magnitude of impacts and as a result of inputs from community interaction [1971, p. VI-5].

Manheim et al. [1971, pp. VI-19 -- VI-27] have elaborated on the following techniques to aid the location team in identifying potential impacts, affected interests and "spokesmen" for various affected interests:

1. Unstructured experience—This involves the use of past experience from previous projects and already developed knowledge of the current project to identify impacts.
2. Linked chain--In this case, a few spokesmen are initially identified and contacted. They give information on potential impacts, affected interests and other spokesmen. These new spokesmen are in turn contacted and more information is obtained.
3. Community issues—Public involvement techniques are used to identify issues of concern to a community, and the individuals associated with various issues.
4. "Typologies"--Typologies, or categorizations, are used to systematically direct the search for impacts and affected interest groups.
5. Anthropological studies--This involves an examination of life styles and other community characteristics to identify non-visible interests who might otherwise go undetected.

6. Survey research—Questionnaires, interviews, etc. are used to identify affected interests and their spokesmen.

Evaluation. Manheim and his associates view "evaluation" in a broad sense. They consider evaluation in terms of: the identification of significant issues, the appraisal of alternative actions, and the establishment of priorities for additional planning activities. As indicated by Manheim and Suhrbier [1972], their evaluation approach emphasizes the following types of issues: (1) representation of various interests; (2) equity of the incidence of adverse and beneficial impacts; (3) inclusion of preferences of various community interests for different alternatives; (4) technical, legal and financial feasibility; and (5) overall desirability, in terms of the net benefits of the resulting public expenditure.

Manheim et al. [1971, p. VII-4 et seqq.] have identified the following characteristics as being basic to their evaluation method. They note that their method: is applied throughout the planning process; explicitly recognizes the "no-action" alternative; is flexible with respect to information gathering and processing; views the consequences of alternatives in terms of individuals and groups within the community; and, views community preferences as being expressed by many spokesmen.

In summary, evaluation

"is not a numerical or quantitative method, but instead is a series of steps accomplished largely by judgment through which the analyst brings to bear his understanding of the current state of the location process and focuses it to identify those issues of greatest importance to the management of the process" [Manheim, 1973, p. 18].

Community interaction. Manheim and Suhrbier have defined community interaction as "the two-way communication process through which the location team and the community learn about each other and work together to reach agreement on a course of action" [1972, p. 39]. Manheim et al. [1971a] note the following objectives of the community interaction activity: establish and maintain agency and process legitimacy; re-examine and maintain the validity of earlier decisions; establish facts (indisputable states of nature); detect and anticipate community problems; find "solutions" (i.e., help the community crystallize their ideas); explore values; establish and maintain credibility; exchange reliable information; depolarize interests; and, search for consensus.

Manheim et al. [1971a] have identified and described thirty-nine community interaction techniques in terms of the following: key features, basic principles, variations, examples, advantages, disadvantages, and highway planning applications. These techniques include such activities as hiring an advocate for the community, and using advisory committees, public hearings, surveys and opinion polls. Other techniques include the use of role playing and sensitivity training.

Manheim and his associates do not advocate a well structured, rigid community interaction program. They suggest that "a package of techniques be selected based on a review of objectives (and tasks to be accomplished), the relative potential of each technique to achieve the objectives, and the available resources for carrying them out" [Manheim et al., 1971a]. They argue that each location team must develop its own community interaction program to meet its own needs.

Some Implications of the Highway Planning Model

Manheim and Suhrbier [1972] have discussed three reasons why a highway agency might find their approach to planning "dangerous and undesirable." First, the proposed process might take longer than the time now allocated for route location and design studies. In response to this, Manheim and Suhrbier (1972) suggest that project modifications and delays may be extensive and costly where controversy stemming from poor planning leads to the mobilization of opposition. Second, the proposed process may require greater expenses than are now allocated to highway planning. Here also, Manheim and Suhrbier point to the expenses (e.g., rising construction costs) that are associated with project delays caused by an inadequate planning process. Third, the proposed process may result in some projects not being built at all. In response to this, Manheim and Suhrbier observe that the elimination of undesirable projects "is not a catastrophe; it is simply the inevitable result of the changing world we live in" [1972, p. 40].

There are many novel concepts associated with various portions of the model developed by Manheim and his associates, some of which have been tested under field conditions. In fact, the model has resulted in a number of

practical recommendations for the Division of Highways of the State of California, for the Federal Highway Administration, and for other states as well [Manheim, 1973, p. 21].

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Appendix B

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