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## Guidelines for Improved Institutional Analysis in Water Resources Planning

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Institutional factors are often among the most formidable obstacles to the development and implementation of feasible water resource programs. Guidelines for gathering and analyzing information on institutional factors as part of water resource planning and evaluation activities are presented. In approaching the analysis of current institutional arrangements, analysts should pay particular attention to (1) the actors and their stakes in the decision-making process; (2) the political and decision-making resources actors have available to pursue their interests; and (3) the biases of the alternative decision-making structures through which various water resource decisions are made. While institutional analysis can pinpoint important barriers and constraints to plan implementation, it is of most use when it goes beyond a description and analysis of current institutional arrangements to assess possible strategies and solutions that can be applied to the problems identified.

### INTRODUCTION

The realization that institutional problems in water resources development and management are more prominent, persistent, and perplexing than technical, physical, or even economic problems has fostered as much frustration as insight among analysts and planners in water resource agencies. While technicians are willing to acknowledge that institutional factors must be considered, they are not at all clear about just what needs to be taken into account. Although guidelines for water resource planning and assessment documents frequently call for institutional analysis, the typical discussion of institutional arrangements in such documents is brief and unilluminating, involving little more than an annotated listing of public agencies, statutes, regulations, compacts, and judicial decisions. Such a list creates the image of a lifeless maze of check stations, passageways, and barriers. Form prevails over substance in such presentations, and little understanding of the dynamics of institutional operations or change is presented.

The aim of this article is to establish some guidelines and standards for improved institutional analysis in water resources planning and analysis documents. Our intent is partly to serve the needs of practitioners in water resource planning organizations who are called upon to analyze and describe institutional factors as part of an overall assessment of water resources but who may not have any particular disciplinary background in institutions. We also hope to aid water resource teachers and researchers whose expertise is mainly technical but who recognize that they themselves and their students need to grasp institutions in order to understand and evaluate the institutional component that is commonly included in many studies.

The discussion which follows begins with a consideration of the paradox of the importance of institutions versus the paucity of useful analyses and suggests some underlying reasons and how they may be mitigated. The article then

turns to the task of preparing institutional analyses and briefly outlines some issues that the analyst must consider before beginning to compile data and information for the analysis. It identifies the kinds of information that the analyst needs to collect about current institutional arrangements for water use and management. These categories include information on actors, the resources that they have available to pursue their interests, and the biases of the alternative decision-making structures through which various water resource decisions are made. The last section of the guide points out the importance of going beyond a description and analysis of current conditions to an assessment of the possible strategies and solutions that can be applied to the problems identified.

In order to apply to a variety of situations, the discussion must, of necessity, be general. An effort is made, however, to illustrate many points with specific examples. A number of institutional analyses were conducted in connection with proposed energy development projects requiring water, and several examples are drawn from these studies. Many of the examples are related to the Colorado River basin because of the authors' familiarity with western water development.

### THE IMPORTANCE OF INSTITUTIONAL ANALYSIS

The term "institutional" is meant to include those legal, political and administrative structures and processes through which decisions are made with respect to public policy. These structures and processes consist of laws and regulations that govern the distribution of benefits and costs and set the ground rules for conflict resolution. They include also the informal procedures by which conflicts are regularly resolved when laws are unclear or are not consistent with the actual distribution of influence in the policy network. Institutional arrangements rest upon the distribution of political support for a given allocation of costs and benefits and are affected by public opinion, the attitude and preferences of interest groups, and the orientation of public officials. The process by which analysts can improve their competence to recognize how institutional factors affect water resources planning and evaluation and can manage the opportunities and barriers presented by institutional factors is termed institutional analysis.

Institutional factors can often be among the most formidable influences upon water resources programs. Yet, despite such importance, one anomaly of water resources planning

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and evaluation efforts to date has been the superficial and summary treatment given to institutional factors and arrangements. As a consequence, water resource programs which might otherwise be beneficial face poor prospects for implementation because of unanticipated and unanalyzed institutional consequences. Institutional changes often involve fundamental shifts in income, power, and prestige. These changes may carry too high a price tag and be unacceptable to affected interests. Inadequate institutional analysis may also lead to other analytic failure, since it is often the case that what appear to be hard numbers on such matters as physical availability of water, projected needs, or ability to pay for water may vary with institutional influences. Furthermore, failure to adequately analyze institutions foregoes the opportunity for creative institutional responses to problems. Since the institutional analyses that are done tend to be static rather than dynamic, often mere listings of existing organizations, little thought is given to changing behavior through changing incentives. Instead, the burden for responding to problems is placed on technology of various kinds, even though technical possibilities may have serious side effects or be inappropriate to particular situations.

The barriers to improved institutional analysis are both substantial and understandable, including (1) a reluctance to treat institutional factors because they deal with mechanisms by which society allocates scarce values and therefore deal with sensitive subjects involving political conflicts; (2) a perception by agencies that they have no mandate to change or manipulate institutions; (3) the premium placed on quantitative analytic procedures while institutional factors are less subject to quantification and arguably less predictable; (4) a tendency to build public support and enhance the agency's position by denying that institutional considerations affect agency decision processes; and (5) a lack of familiarity with institutional factors among the community of practitioners and scholars who undertake, interpret, and evaluate assessments. This last impediment, the reticence toward venturing into unfamiliar territory, can be effectively addressed and mitigated. The guidelines that follow are intended to convey in terms understandable to the non-social scientist the important institutional questions that should be addressed and the related data that should be collected.

#### THE CONTEXT OF ANALYSIS

##### *Defining the Problem and Scoping the Assessment*

The perceptions of a present or emerging set of water problems that prompt the undertaking of an assessment orient and to some extent bound what the institutional analyst should consider. Perhaps the assessment may be initiated because of a perception of impending water shortage, an energy crisis requiring water intensive development, or a desire to protect instream water uses or water quality. In each case the nature of the issue will to a large extent determine the magnitude of change associated with various solutions to the problem, who the relevant actors are and how they perceive their interests, what resources the actors have available, and the arenas in which action may take place. It is imperative that the analyst clearly specify the context of the analysis in an explicit statement of the scope and purpose of the assessment. By clearly identifying the starting point and assumptions, the analyst can avoid cata-

logging the universe and including extraneous material. Unless the analysis is properly focused and framed, there is a danger of describing institutions without considering the extent to which they may be related to the question at issue.

A clear statement of the context of analysis also provides an opportunity at some point for the analyst to consider what might happen if the context should dramatically change, perhaps by the replacement of drought by flooding, the substitution of an energy shortage by an oil glut, a change in economic circumstances, a shift in partisan power, or the development of a social or political movement. While initially the analyst must take what now exists in the institutional landscape as given, it is important to portray the institutional context as dynamic and capable of change that would alter the scope of necessary institutional considerations. Institutional analysis needs to be iterative and continuous, expanding and contracting as changes in the institutional setting occur.

##### *Understanding the Limits of Analysis*

It is also important for the analyst to realize that the process of institutional analysis is itself affected by institutional factors. What is or is not included in an assessment is in part a function of the institutional bias of the agency doing the assessment. It is also a function of institutional judgments as to the desirability of making explicit the institutional factors underlying physical estimates and projections.

The institutional analyst must not, for example, be so intimidated by the apparent conclusiveness of physical data as to overlook the institutional influences integrally involved in data collection and interpretation. An analyst assessing the Colorado River basin, for instance, will be confronted with estimates of reconstructed virgin outflow ranging from  $13.5 \times 10^6$  acre feet (tree ring data covering 400 year period) to  $14.9 \times 10^6$  acre feet (stream gauge data sets for 1906–1973) [Weatherford and Jacoby, 1975]. Different interests promote different data sets and methodologies. High flow estimates, experience has shown, are used to support water resource development projects, while low flow estimates are used to oppose further development, support augmentation, or promote conservation.

Water supply figures are not the only data that must be approached cautiously. Projections of future water demand are notoriously speculative and unreliable, in part because they exhibit the tendency of water development agencies and interests to inflate the market demand for water to justify further investment in water projects. Such projections ought to be repeated with caution and presented with qualification, i.e., institutional sources and assumptions ought to be pointed out. For example, the rate and level of projected energy development for the upper Colorado River basin has not materialized [U.S. Department of Interior, 1974]; synfuel and power plant development has been slower and more modest than previously estimated by the mission-oriented Bureau of Reclamation.

Effective institutional analysts will be sensitive to the institutional as well as the methodological limits on analysis [Cortner and Schweitzer, 1983; Fischhoff, 1977]. They will be able to relate the process of analysis to the institutional setting within which an assessment is developed and its results used.

Our discussion now turns to examine the kinds of questions to ask in assessing the actors, resources, and institu-

tional structures involved in current institutional arrangements for water resources decision making.

#### ANALYSIS OF CURRENT INSTITUTIONS

Individual actors have certain rights or values which they seek to preserve or enhance. They pursue their interests by using the resources they have available within the bounds imposed by the sociopolitical system. When change either threatens to impact adversely or to advance their interests, actors have incentives to participate in the decision process. When mobilized, they then strive to ensure that any resulting decisions are made in the institutional arenas most conducive to their interests and their available resources. In approaching the analysis of current institutional arrangements, the analyst should therefore pay particular attention to (1) actors and their stakes in decision making for water allocation and use; (2) the resources actors have at their disposal to use if sufficiently motivated to do so; and (3) the biases of the alternative decision-making arenas through which actors may try to achieve their goals.

#### *Identifying Actors and Their Stakes*

The analysis of group interests, resources, membership, and practices is a necessity in institutional assessment [Truman, 1955; Greenwald, 1977; Moe, 1980]. An important step toward identifying relevant group interests or actors is made when the analyst specifies the scope and purpose of the assessment. When properly drawn, a statement of purpose and scope also indicates the stakes, or what gains or losses may be at issue. For instance, an assessment of water availability for energy in a fully allocated river basin naturally draws the analyst to consider the stakes of established users who currently exercise water rights. Water rights are generally acquired by the act of appropriating water, the possession of riparian or overlying land, or the grant (e.g., permit) or contractual promise of a government that has assumed ownership or control of the water, depending on the circumstances and water law system of the particular jurisdiction involved. Existing allocations of water rights are a reflection of accommodations to previous claimants for water use who, in turn, currently are challenged [Tarlock, 1982].

The analyst must identify how and to what degree various uses or users will be affected by the water issues being assessed, i.e., reduced or increased quantity, degraded or improved quality, increased or decreased price, greater or lesser vulnerability to drought and other stress, deprivation or increase of opportunity to grow, changing lifestyles, etc. While economists exclude secondary impacts from their cost-benefit analyses for sound technical reasons, the incidence and magnitude of both primary and secondary impacts should be identified from an institutional perspective. For instance, the primary impact of allocating surplus water to energy in a basin dominated by irrigated agriculture may be small. Yet, secondarily, farmers may have to compete with energy developers for labor, capital, transportation facilities, and other goods and services. Assessing secondary socioeconomic impacts is essential to sorting out the stakes and actors involved in making water available to energy. The attention given to such matters as the socioeconomic impacts of energy development in a region, however, requires judgment because an assessment must not lose sight of the fact that its focus is water-related impacts and not necessari-

ly energy development impacts. As the authors of an assessment discussing the availability of water for synfuel development in the upper Colorado River basin report, dramatic changes will occur in energy-impacted communities regardless of the source, quantity, or use of water [Colorado Department of Natural Resources, 1979]. Nevertheless, location of synfuel plants in given communities in given subbasins could have dramatic impacts on employment and the general character of life and should be addressed in such assessments [Cummings and Schulze, 1978].

It is important that the analyst identify anticipated or perceived as well as scientifically predicted impacts. Water is a highly emotional and symbolic issue. One needs only to consider the public controversy that ensues whenever it is proposed to dam a river used for white water rafting or to transfer water from one region to another to recognize how volatile public feelings are on water issues. For some people the loss of Glen Canyon can never be counterbalanced regardless of the benefits of Lake Powell. Institutional analysts must invariably use judgment to distinguish between important and trivial impacts. Yet in making such determinations they must take into consideration the judgments of those impacted. Potential conflicts can be generated by those who perceive impacts as significant and are willing to take action to protect their interests.

The variability in perception of impacts is illustrated in the issue of water availability for energy. It is almost inevitable that there will be varying perceptions regarding the desirability of some aspects of any project of the dimensions of an emerging energy technology (EET) facility. The authors of the Upper Colorado River Basin Assessment, for example, explicitly recognize these sources of conflict at various points throughout their report and most pointedly in stating:

... one may anticipate that any further depletions of the streams of the Upper Colorado River Basin by EET development (or any other uses, for that matter) will be in conflict with the values and perceptions of at least some segment of the public under just about any circumstances . . .

[Colorado Department of Natural Resources, 1979]. Recognition of the potential for conflict equips the reader for an evaluation of the likelihood that there may be serious challenges focusing on water issues either to an overall basinwide plan or to a specific proposal to site plants in a given area.

The reading of contractual rights and obligations may reveal the stakes of parties to whom benefits and costs may accrue through changes being assessed. Twenty percent of the farming in the West, for example, occurs in federal reclamation projects. In these projects, rights to the delivery of stored and regulated water are defined in part by long-term contracts that provide the mechanism for the repayment, operation, and maintenance of project works. The master contracts between the Bureau of Reclamation and the water distribution districts—as well as the contracts and arrangements between the districts and the individual users—provide important sources of information concerning the identity and water entitlement of users.

The identification of primary and secondary effects is a common requirement of environmental impact statements and the previously required principles and standards; therefore the methodology is well developed. Of course, what people feel, believe, and value is likely to be more difficult to

specify than concrete physical and economic impacts. Yet the analyst usually can rely on secondary sources. Students of history and literature have documented the development and persistence of attitudes about water among groups in the population. These attitudes and values are often articulated by spokespersons in public hearings or in newspaper coverage. It is suggested that the institutional analyst become immersed in the particulars of the problem from the perspective of water users who have something at stake. The analyst should begin by learning all he or she can about the background, experience, and points of view of various interests. Early on, the analyst should begin to compile a list of key informants or contacts in the region or basin being assessed.

In identifying interests with a stake in water allocations, the analyst must pay particular attention to those that may not be readily apparent. Although often not included as interests at party to water decisions, the analyst must identify local, state, regional, and federal water and other resource agencies. While not benefiting or losing from water allocations themselves, these organizations have a stake in the distribution of authority and accompanying personnel and budget allocations [Rourke, 1969; Downs, 1967; Niskanen, 1971]. Governmental actors can be identified through a review of agency-enabling legislation and government organization manuals.

The appropriate geographical and other boundaries within which to identify interests in institutional assessments should be drawn from an understanding of the stakes rather than river basin boundaries, subject matter, or other artificially imposed limits. For instance, the analyst should not limit discussion to laws and institutions whose direction is exclusively water planning, development, and management. Other laws and institutions have noteworthy effects on water availability and use. National and regional forces which are creating new water development patterns ought to be identified. Take this example: a proposed dam project on the White River in Utah faces problems because it could adversely affect the habitat of the Colorado Squawfish. Application of the Endangered Species Act could thus influence the timing and availability of water for synthetic fuel development. Or consider this further example: restrictions on energy facility siting along the coast of California under state and federal coastal management legislation, while applicable to areas outside the Colorado River basin, have the effect of increasing power plant development and cooling water use within the basin.

It is important to look at consequences from a particularized or localized perspective as well as basinwide. Despite the fact that physical scientists describe river basins as general, interconnected systems, the experience of impacts is often discrete and localized. For example, if localized but significant shortages are likely to occur in a basin that, overall, has a water surplus, the analyst should identify the threatened uses and users.

Finally, the analyst must recognize that changes in the issue context may well affect perceptions of interests and emergence of relevant actors. The definition of interest is a dynamic process, and impacts that spark little reaction now may be the basis of political action later. Thus it is important to portray the identification of interest as a process and signal what may be only latent constituencies [Truman, 1955; Cobb and Elder, 1972]; for example, the pollution of groundwater stirs interest today where there was none a few

years ago. Also, while the problem of land subsidence caused by falling water tables where extensive overdraft occurs has not prompted a concerned constituency, one day may in areas of Arizona. Where the analyst can identify latent constituencies, it is useful to specify the barriers and incentives toward organization, such as conflicting interests, lack of information, and the costs of participation.

#### *Identifying the Resources Actors Have to Advance Their Interests*

For each of the above actors, the analyst should identify the existing and available resources or strategies which could be mobilized to affect or impede changes that are being assessed and the likelihood that those resources will be utilized. Such resources include the following.

*Legal rules and arrangements.* Legal structures define rights and obligations of various parties and procedures for enforcement of each. At the same time, they provide the strategic ground from which interests seek to negotiate, bargain, resolve disputes, and change outcomes.

Within states, individual water rights (with the exception of federal or Indian "reserved water rights") are defined by state law (statute, court ruling, or administrative ruling). Depending on the depth of analysis appropriate, the relevant features of state water law can be identified. These include the rules and restrictions on place of use, type of use, reasonable or beneficial use, reuse, diligence, forfeiture, waste water transfers, etc.

Water laws should be viewed as potentially flexible problem-solving instruments and not simply permanent impediments to change. In the world of water law, things are not always what they seem. In many arid areas the available surface water is appropriated or approaching "full appropriation," meaning that the available water supply is covered by water right filings or claims. Such a condition leads some analysts to conclude erroneously that all the available water is being consumed or that no new water uses can be accommodated. There is commonly a gap between the accumulated claims to water and the amount of water actually used. Some claims have never been "perfected" under the law or have been abandoned. Some water is wasted. And, most important, existing water rights in most settings can be purchased to supply the needs of new uses. It is generally misleading to conclude in an assessment that water supplies are totally exhausted, permitting no new uses [Tarlock, 1982].

A water compact, statute, agreement, or court decision may not be the "last word" in an operative sense, in which case relying on it can lead to faulty analysis. Such agreements and decisions can be substantially altered by legislation or changed circumstances, without any formal amendment of the agreements or decisions themselves. For example, the 1922 Colorado River Compact purported to give the upper basin, as well as the lower, a perpetual right to  $7.5 \times 10^6$  acre feet per annum. But to cite that figure, as is done from time to time, is greatly misleading, because the lower basin's share is guaranteed as a minimum, while the upper basin's is not. Moreover, the flow of the Colorado has been averaging far less than enough to meet the apparent entitlement expressed in the 1922 agreement [Mann et al., 1974].

Some court rulings become dated and irrelevant due to new legal rules made in a different forum. For instance,

Arizona prevailed over California in the latest *Arizona vs. California* [*State of Arizona versus State of California*, 1963] water suit, temporarily quieting California's claim that its users' early appropriations should be given priority over Arizonas users. In order to obtain congressional authorization to put the lion's share of its hard-won entitlement of  $2.8 \times 10^6$  acre feet to work in the Central Arizona Project, however, Arizona had to accept a subsequent congressional enactment giving California priority for its  $4.4 \times 10^6$  acre feet in the event of shortage.

Distinctions between state and federal laws and arrangements often must be drawn by the analyst. The federal and Indian reserved water rights claims, which are largely unquantified, are peculiarly relevant to the basins of the western part of the United States. The precise relevance of reserved rights cannot be expected in assessments [*Price and Weatherford*, 1976]; they remain unknowns. Nor is it possible to predict the extent to which an environmental impact statement under the National Environmental Policy Act (NEPA) may impede a given water-related development. But the applicability of NEPA should be indicated, and some judgment provided regarding its possible impact on planned development [*Anderson*, 1973; *Orloff and Brooks*, 1980].

Finally, it must be remembered that where the basis for conflict among water users or claimants exists, the water rights or claims of the parties often take on the character of chips in a poker game: they define, in part, the bargaining power, strategy, and staying power of participants in the bargaining process. Rights and claims often are modified or redefined in the bargaining process surrounding water development and management. Water rights and relations are one part rule and one part process. However static they appear for long periods, they are subject to change.

**Economic power.** Economic power has varied characteristics: market power, the power to create jobs, the power to influence legislatures and administrators, and the power to hire lawyers and engage in costly judicial proceedings. Such economic power may be found in both public and private sectors. Analysis of economic power should examine its varied manifestations and its potential for influencing decisions.

One attribute of economic power is ability to pay for water supply. The purchasing power among water users differs significantly, particularly in settings where publicly subsidized water uses (e.g., irrigated agriculture) are presented with competition from new industries (e.g., coal-fired power plants). For example, the price of water under the national reclamation program in the western United States has been based on a farmer's "ability to pay," resulting in low-priced water (e.g., \$7.50/acre foot per annum) being used on low income yield crops. Some crops become unprofitable, for example, when water prices begin to exceed \$15 or \$20/acre foot per annum. The capacity of would-be users to pay higher than customary prices for water in an area where inadequate or no unappropriated water exists can result in water rights transfers from the economically disadvantaged to the economically advantaged. This phenomenon ought to be identified by the analyst. For instance, the Intermountain Power Project (IPP) agreed to purchase stock in mutual water companies from farmers near Lynndyl, Utah, at a high price of \$1775/acre foot (for a permanent, not per annum, right to use) [*Weatherford*, 1982a].

The level of economic resources available within a water use sector partially determines the amount of political power which can be asserted to influence water allocation and management outcomes. For example, the economic/political resources represented in the city of Denver have resulted in the authorization of transmountain water diversion projects. The metropolitan centers outside the Colorado River basin but within the basin states (i.e., southern California coastal plain, Phoenix, Albuquerque, Denver, Fort Collins) have generally prevailed to have water diverted to them. The lobbying efforts of the Central Arizona Project Association, composed of various economic interest groups on behalf of the Central Arizona Project, were important to the authorization of that project by Congress. It is clear that economics motivated the strong backing from locals the Intermountain Power Project (IPP) received in Utah. Local residents anticipated that increased property values, improved local services, and new jobs would keep their young people from moving away. This support survived the rejection of one site for air quality reasons and compelled the governor of Utah to initiate a search for a new site in which a number of interests, including environmental groups, could participate and be accommodated.

While the influence of economics is often more difficult to document than the IPP case, federal and state lobbying laws that require groups who try to influence legislation to register and provide basic financial information have helped researchers. It is now possible to ascertain the size of lobbying staffs and the amount of money spent on that activity. Often it is more difficult to specify the economic resources of industrial interests whose influence is exercised in the course of doing business than it is private organizations whose main purpose is affecting governmental action.

**Prevailing values and public opinion.** An important resource that supports certain uses and users is the general and specific attitudes held by the public about the desirability of alternative uses. The analyst should assess attitudes, both their distribution and intensity. These attitudes may not be closely related to—indeed, they may conflict with—the economists' calculation of value. For instance, public opinion survey data indicate that voters in the Southwest would prefer that the same or more water be supplied to irrigated agriculture in the future. They feel this way in spite of the fact that irrigated agriculture currently accounts for as much as 90% of diversions and that other uses, such as municipal and industrial, are small, high value, and growing [*Ingram et al.*, 1980]. These people may feel that water should be used in agriculture because they prefer the environmental amenities associated with agriculture (open space, green expanses) over suburban home tracts or industrial park complexes. If so, then water in agriculture has an external value not captured in markets or entered into the economist's calculations but which should nevertheless be calculated by the institutional analyst.

There are a variety of methods through which the analyst can ascertain public opinion, some much more reliable than others. Most simply, the analyst can make a content analysis of local newspaper coverage and editorial opinion. Local histories, biographies, and other literature may also be rough indicators of public attitudes. It must be recognized, however, that local commentators, however familiar with local attitudes, may well have biases which color their expressions of view. In many cases, a survey may already have

been done by administrative agencies, private groups, or university scholars employing questions that may be useful to the analyst. Care must be taken in employing such studies to insure that sampling procedures and interpretations are scientifically justifiable. In some cases the analyst may want to conduct a survey either of elites—those most closely involved in the subject of water resources—or the mass public. However, the framing of questions and the drawing of samples are complex matters about which the nonprofessional should seek professional advice [Hennessy, 1981; Welch and Comer, 1975; Sonquist and Dunkleberg, 1977].

*Technical expertise and control of information.* Access and capacity to generate information may be important resources. Professionals with credentials have a particular claim to expertise. The analyst must be sensitive to varying capacities to generate and use information in resolving conflicts over alternative uses [Rourke, 1969; Downs, 1967; Benveniste, 1972]. Water resources is a particularly technical subject, and special knowledge is required to estimate such things as river flows, water use requirements, and water law.

Particularly because of their ability to amass a pool of experts, federal agencies have had advantages in influencing the course of water policy. For many years, most state water agencies lacked similar expertise. However, in the last decade, many state agencies have added to their capability by hiring experts from a variety of disciplines. Industrial and municipal water users frequently have sufficient economic resources to develop their own expertise. Private organizations often fare less well, although it is possible to cite exceptions. For instance, the turning point in the Echo Park controversy of the 1950's came when opponents of the proposed reservoir were able, through the analysis of their own experts, to discredit the evaporation estimates of the Bureau of Reclamation [Stratton and Sirotkin, 1959].

It is important to note here that expertise is a great deal less important in circumstances where there is technical uncertainty and disagreement. For instance, Arizonans and the upper basin states had very different estimates of the long-term average flow of the Colorado River during consideration of the Colorado River Basin Bill of 1967. As a result, the testimony of any particular set of hydrologists had minimal influence.

*Control of organizational and administrative mechanisms.* Certain users are particularly favored because of their close relations to administrative agencies. Indeed, agency missions often coincide with the interests of specific groups. The Soil Conservation Service, for instance, has a close tie to agricultural interests through its function of supplying technical information. Historically, the relation of the Bureau of Reclamation with western irrigation interests was very close. Sometimes, close relations result from overlapping memberships. For instance, high-ranking federal officials during the Carter administration held posts in environmental groups prior to 1976. These close relations should alert the analyst to the influence over both technical and political matters that can result from such alignments. Sometimes access to administrative mechanisms comes through procedures. Courts are open to cases brought by parties that have appropriate legal resources and expertise. The environmental impact statement and other processes provide opportunities for comment.

*Political resources.* The analyst may find these re-

sources difficult and even perilous to specify. At the same time, some political resources may be extremely important in institutional analysis and the absence of such analysis may make an assessment relatively meaningless. Some measures may be fairly well agreed upon, i.e., size of membership in organizations, ability to turn out membership for political activities such as voting or letter writing, and ability to influence others through the press or with campaign contributions. Since the impact of political resources often comes from the reputation for power rather than its actual exercise, the analyst can often rely on indexes of reputation. Groups that newspapers, journals, decision-makers, and students of the subject matter say have political power often do in fact have power.

It should be noted that particular resources are not always relevant, and actors do not always choose to use them. Different resources may be relevant at different stages of the policy-making process. Favorable public opinion may have a great impact upon the process of raising and defining an issue but may be less relevant to discrete administrative decisions made in the process of implementing policy, a stage at which legal authority and expertise may dominate. The deployment of resources is not costless, and there may be circumstances where an actor will judge his or her interest as too insubstantial to warrant the effort. Economists are used to talking about transaction costs in markets, and there are costs to political interaction as well. The commitment of resources will be balanced off against expected gains.

#### *Identifying Biases of Alternative Decision-Making Arenas*

There are a variety of institutional structures through which decisions about water resources allocation and use occur. These structures are likely to have different policy orientations. They are also likely to vary in their accessibility and responsiveness to particular interests, their capacity to generate the appropriate flow of information, and their preference for certain problem solutions.

In understanding institutional structure, the analyst should be aware that most decisions involving water resources are made on the basis of bargaining, negotiation, and compromise. But the character of the bargaining varies, depending on the arena in which the bargaining occurs. This is so because institutions have diverse decision rules, traditions, legal authority, and professional orientation. A wide variety of interests with varying intensities of concern are involved in legislative decision-making; consequently, the result may reflect a broad consensus but not necessarily be precisely suited to the major active interests whose stakes are significant and real. On the other hand, only the most active interests with important stakes are likely to bear the cost, both in time and money, involved in litigation. There is a major bargaining component in both the legislative and judicial arenas, but the interests represented, the focus of the issue, the evidentiary base, and the scope within which compromise may occur may be quite different in the two arenas.

Moreover, interests have differential access to given decision-making arenas, i.e., the opportunities for groups to approach decision makers to obtain a favorable hearing for their cause vary from one institutional setting to the next. Recent history has demonstrated that water development interests have had greater influence in legislatures than they

have had in the courts, where environmental groups have tended to gain advantage. Moreover, interests have quite natural advantages in various forums; given the defensive posture of most environmental groups, it is not surprising that they have tended to rely on the judicial system to prevent administrative agencies—and sometimes even Congress—from achieving water development objectives. The selection of a forum or arena in which to undertake the contest for achieving its water-oriented goals may be one of the most important strategic choices an interest group or actor may make. A decision about appropriate decision structures is not, therefore, an exercise in logic or constitutional law, but rather an exercise in political analysis and evaluation of possible consequences [Wenner, 1976].

Finally, like many issues dealt with by American government, decisions on water resources tend to be made incrementally, with partial decisions being made by various actors and institutional structures over an extended period of time. Most institutions and decision-making processes have only part of the "action," and thus final decisions resulting in dedication of a given water supply to a given purpose are often made only after numerous preliminary decisions have cleared away objections. Moreover, each of the preliminary decisions is likely to call forth opposing efforts in other arenas where conflicting interests have the advantage. Thus a water agency may allocate water to a project, be challenged in a court, whose decision, if contrary to the water allocation, may be appealed to the legislature. One-stop decision making, however attractive it may seem to those desiring quick action, has never been favored in the American political process. The analyst, therefore, must be prepared to evaluate not only the likely action of an agency directly charged with a decision on a specific issue, but the subsequent and contingent actions that are likely to be engaged by the initial decision.

The following discussion is designed to sensitize the analyst to the principal institutional structures through which decisions are likely to be made. It also examines the key orientations of these structures and how they may play a part in the determination of societal values and the allocation of those values among conflicting groups.

*Congress and state legislatures.* Congress and state legislatures are key institutions in making certain kinds of modifications and adjustments in the institutional structure and in determining the substance of water policy. Congress must authorize water projects and finance water pollution control projects. State legislatures play a key role in defining water rights; Congress may or may not play a major role in the quantification of federal and Indian water rights. Both legislative bodies may determine the influence that various groups may play in water project decision making by designing processes for public participation.

Legislative bodies are among the most "open" of public institutions in this country. Despite their openness, access is not equally available to all groups and interests. The internal structures of legislative bodies and the nexus between legislators, constituent groups, executive officials, and public opinion tend to skew the legislative process in favor of certain values and against others. In terms of water policy, Congress historically has been strongly oriented toward federal sponsorship and financing of water developments as a species of public works having great voter appeal. Opposing interests and those who sought to guard the public

treasury—such as the President—seldom had much influence over water policy making.

The incentive structure of legislative bodies has changed markedly in the past 15 years, in part because of fiscal conservatism and in part because public values associated with protecting the environment have come to play a more important part in legislators' thinking and behavior. Analysts should be aware of the attitude structure and the historical record of legislative bodies in their assessments of the role that those bodies may play in the determination of policy or institutional change [Ingram et al., 1980].

Both because of the broad distribution of agricultural groups concerned with water policy and the strong support agricultural values generally receive in the United States, legislative bodies tend to respond to organized agricultural interests on matters concerning water policy. Where those groups are powerfully organized, they can have a significant effect on legislative output. The various agricultural organizations plus the association of irrigation and water supply districts in California have been extremely influential in many recent issues; for example, the peripheral canal, opposition to changes recommended by a governor's commission on water law revision, and opposition to any controls imposed on groundwater pumping without a firm state commitment to augment current surface water supplies.

*Federal and state courts.* Another mechanism for resolving conflicts over scarce water supplies or water quality is the judicial process. The courts are open to all who can demonstrate a justiciable issue either under statutes, compacts, or common law doctrines such as liability or equity. Increasingly, legislatures have opened up the judicial process by specifically authorizing individual or group suits. The courts themselves also progressively narrowed the doctrine of sovereign immunity, making it possible for individuals and classes of individuals to sue the states or the federal government.

While access to the courts opened up considerably during the 1970's, there still remain severe constraints on utilization of the judicial process. One is clearly money. Litigation is expensive, and private groups—especially environmental groups—find it necessary to restrict the number of suits they file to those considered crucial. A second constraint is found in the nature of the judicial process itself. Decisions are made by individual judges and/or panels of judges on the basis of legal norms. Unquestionably, judges respond to broad social values and their own sense of what society needs or demands, but their decision is framed by the legal issue as it comes before them; they cannot frame the issue in some other terms. At least partially for this reason, it is difficult to come up with compromise solutions that reflect the entire complex set of values that may be involved in a given litigation. Moreover, judges are not in a position to consider side payments that may alter the judgments of the parties to the dispute. Judges also tend to be bound by certain conventions of their profession: the tendency to decide the case on as narrow a legal issue as possible and the tendency to follow precedent. Finally, decisions of courts, while framed in broad legal doctrines and precedents, establish the law of the case; others may interpret the conclusions in the light of other circumstances. Thus it may not be possible to predict outcomes of other cases where the same legal doctrines apply.

In addition to understanding how the general orientation



of the judicial system impacts the development of water policy, it is also necessary to consider the differing orientations of various judges and courts operating within the judicial system. There is clear expectation and sufficient evidence to demonstrate that state courts will tend to make decisions in favor of dominant state interests, while the federal courts are more likely to rule in favor of federal interests. These penchants are clearly demonstrated in the controversies over Indian and federal reserved rights. States clearly prefer litigating in state courts and persuaded Congress to pass the McCarran amendment requiring that suits involving federal and Indian rights will first be litigated in state courts with appeals possible to the federal courts. Moreover, environmentalists are more comfortable initiating litigation in the District of Columbia circuit court than in the other federal circuits, while in California no one can ignore the environmental sympathies of the state supreme court. In some instances, it may even be appropriate to evaluate the possibility that a particular judge may hear a case.

Some states, such as Colorado, have established specialized courts for dealing with water matters. These courts develop experience and expertise beyond that available to general courts in other states. These specialty courts provide a higher level of confidence among litigating parties as to the fairness or technical adequacy of the decisions that are rendered.

Finally, it should be understood that a judicial strategy may be part of a more general strategy that involves long delays and possible remedial action by legislatures or even voters. Dominant interests may argue that litigation that lasts 10 years—even if their position is not likely to be sustained—allows them to continue to enjoy rights to water or allows them to continue to pollute until enjoined from doing so. Moreover, they have some confidence that they may appeal to a legislature or to Congress for some remedial action, either in the form of a delay in the application of the decision or some financial assistance to mitigate the burden placed upon them.

*Federal and state administrative agencies.* Administrative agencies are both technical designers of projects and programs and advocates of those projects and programs in the political process. They are often mission-oriented agencies, authorized to pursue the achievement of certain goals such as reclamation of land, protection of fish and wildlife, and protection of the environment generally, or energy development. Because both external and internal incentive structures are geared to achieving agency missions, it is hardly surprising that the agencies' vision of the public interest is partial. Moreover, agencies work effectively with interest groups and with individual members and committees of Congress and state legislatures in carrying out their tasks. At the federal level, the tripartite relationships among agencies, congressional committees, and interest groups are sometimes referred to as "iron triangles."

When several agencies have partial responsibilities for activities affecting water management, it is often necessary for them to coordinate plans, negotiate differences, exchange technical information, and generally cooperate in the achievement of concerted policy and administration. When they cannot do so, other agencies of government—chief executives, legislatures—mediate their disputes. The resolution of the snail darter controversy by an act of Congress is an illustration of this process.

Fragmentation of administrative responsibilities and authority is inevitable in dealing with a fugacious resource like water that has impacts on a variety of public and private activities. Consolidation in large departments does not necessarily mean elimination of differences of perspective or interest, although such consolidation may change the context of bargaining and the bargaining strength of various participating groups [Mann and Anagnoson, 1979]. On the other hand, it can be argued that fragmentation often times provides opportunities for innovation and expression of diverse viewpoints that might otherwise be suppressed [Ingram and Ullery, 1980].

Administrative agencies draw their power in the political process from both their technical expertise and the discretionary authority granted them by legislative bodies. Administrators at the state level can make decisions about the allocation of water rights, transfers of rights, water quality standards and their application, pricing of water at state projects, and conservation measures, as well as a host of other matters. Federal water agencies are in a position to let contracts for water at federal reservoirs, establish national and regional water quality standards, determine minimum low flows, and set standards of eligibility for receiving water such as the acreage limitation in the reclamation acts. Their knowledge of water management matters on a day-to-day basis provides them with formidable strength in making decisions and having them accepted, if challenged, in other forums, such as administrative law courts or regular courts.

Some administrative agencies are clearly in a superior position to realize their goals. This superiority lies in greater access to political power in legislative bodies and greater support in local communities. For years the U.S. Fish and Wildlife Service has occupied a secondary position to water development agencies in the planning and development of water projects. It may be argued that the Service has now achieved greater influence in these matters owing to the strength of the environmental movement both nationally and in specific localities where the implications of these bureaucratic decisions are felt most directly. The analyst should be sensitive to these shifts in political and administrative standing.

*Local governments: Municipalities, counties, and districts.* Urban water supply is a major problem throughout the United States, with recurring severe shortages during periods of drought. Policies of local governments are therefore important factors in evaluating the institutional characteristics of a given water supply situation. This is specifically recognized in the upper Colorado River basin assessment, where note is taken of the positive benefits of conservation efforts in Albuquerque, Salt Lake City, and Denver in reducing the competition for scarce Colorado River water [Colorado Department of Natural Resources, 1979]. Similarly, it is generally recognized that the rehabilitation of leaking and inefficient water systems in the eastern states would greatly reduce water supply shortages in many river basins.

Municipal governments are largely retailers of water, although some municipalities have thoroughly integrated water supply systems. Their retailer capacity is reflected in decisions such as whether to meter water use, the extent to which water charges are hidden in the tax base, and the pricing policies adopted (flat rate, higher rates for greater use, marginal pricing, etc.). Demand for water is clearly elastic, i.e., demand is directly related to price and thus is

susceptible to deliberate manipulation by those who supply water for residential, commercial and industrial use.

Municipal water use ordinarily takes legal precedence over other uses, particularly in the western states. Moreover, municipalities have the power of eminent domain and are in a position to obtain water supplies by payment of fair compensation. With greater fiscal capacity and greater willingness to pay high prices, municipalities are in a better position to obtain water supplies in times of dire necessity. The drought of the late 1970's demonstrated the responsiveness of major wholesalers of water, such as the Bureau of Reclamation, to transfer large blocks of water away from agriculture and toward urban uses.

Urban interests, sometimes reflected in the positions taken by municipal leaders, often correspond with the interests of environmental groups. Many environmentalists live in urban areas but enjoy the natural environment, which they wish to protect against development. When supply is scarce, supporting priorities for municipal use may preclude resource development in wildland areas. On the other hand, other environmentalists may oppose urban growth with its accompanying increase in municipal water use.

The interests of smaller urban communities in largely agricultural areas may correspond with local agriculturalists. These communities may favor water development for agriculture or retention of water in agriculture rather than allowing water to be transferred to other interests, such as energy companies. They may use their influence in legislatures or act directly through their zoning powers to impede changes that threaten the agricultural base.

There are a large variety of irrigation, water supply, drainage, water conservation districts, and water companies authorized under state statutes to supply water for many purposes but largely for agricultural uses. In some, influence is broadly distributed, but in others, particularly those in which voting rights are based on the extent of property ownership, influence is highly concentrated. Such districts are jealous of their local prerogatives and resist the imposition of requirements by state legislatures or Congress [Maass and Anderson, 1978]. Opposition to the acreage limitation requirements of the Reclamation Act and resistance to groundwater control legislation are in part traceable to this strong local feeling.

Districts exist for the purpose of supplying water and are largely service organizations for their members. Under some circumstances they may have some independent influence, particularly where the price of water is high, the technology of supply and management is sophisticated, and the consequences of waste are significant. District officials may have important control and enforcement responsibilities. The organizations of water districts may be influential indeed, especially in state legislatures where water policy often is made. Their concerted influence may outweigh the influence of individuals who represent interests whose numbers are several magnitudes larger than the numbers involved in agriculture. An analyst should be sensitive to the realities of such distributions of political influence.

*Popular processes of decision making.* Another forum for decision making is the referendum and the initiative (especially in the western states but gaining popularity elsewhere). Private groups, through the circulation of petitions, can force a legislative enactment onto the ballot or can place their own initiated measures on the ballot. Such

devices have been used on measures dealing with water policy, either to facilitate or to block some proposed action. While in many instances the results clearly reflect a popular judgment, it is also clear that such devices of public participation are subject to manipulation by interest groups that have sufficient economic resources to shape public opinion on a given issue.

*Other institutions.* There are a large variety of other institutions for decision making either in existence or coming into being. These include compact commissions, some of which, like the Delaware River Basin Commission, have major responsibilities and others which have only modest powers and little influence [Derthick, 1974]. There are large wholesaling districts, such as the Metropolitan Water District of Southern California or the Northern Colorado Conservancy District. And there are new institutions, such as agencies that perform water transfer functions, that are in the process of coming into being. All have some role to play and some influence to exert but the analyst should be sensitive to the nuances in their roles and the extent of their influence. The formal authority and roles attributed to them may not reflect their true influence in political decision-making.

#### ANALYSIS OF MEANS OF OVERCOMING INSTITUTIONAL IMPEDIMENTS

Institutional analysis should not stop with institutional impediments and problems but should proceed to responses and solutions. The utility of an assessment can be greatly enhanced by a discussion of how institutional barriers and constraints might be altered or overcome by proven or possible strategies and techniques of response. Among the strategies and techniques that an analyst might identify as being relevant for any given institutional setting are the following.

##### *The Operation of Market Mechanisms*

A major method of accommodating new water uses is through the transfer of water rights from existing uses. While markets for water rights are only beginning to appear in the United States, the reallocation of water by water sales and exchanges is on the rise and can be expected to play a more important role in water management in the future. The creation of these new markets is dependent upon state legislative action to remove legal prohibitions against transfers, upon state legislative action to further define property rights in water so that they can be dissociated from place or purpose, and upon the authorization, probably by state legislature, of institutional structures to provide mechanisms for such transfers that protect the interests of third parties. Recent research has produced both criteria for identifying and evaluating water rights markets in the west, as well as case examples of proficient and nonexistent markets [Khosshkhalgh et al., 1977; Ellis and DuMars, 1978].

Market arrangements are designed to make it possible for willing sellers and buyers to exchange water at a price that reflects that commodity's scarcity value. Institutional arrangements such as these suggest that society's interest is enhanced by the heightened efficiency in use associated with having water priced at its real value. It may be expected that the creation of markets will be favored by industrial, commercial, and municipal interests, all of which have a stake in obtaining increased supplies from agriculture and who have

the capital to make purchases. Opponents are likely to be found among agriculturists and those closely linked to the agricultural industry who fear that market arrangements will result in a marked decline in agriculture and associated commercial, financial, and industrial activities. They may also be concerned that third party interests may not be adequately protected. Studies in the Tulare Basin in California, for example, revealed little support for state legislative action to remove the prohibition against transfers of water beyond the boundary lines of individual irrigation or water supply districts [Weatherford, 1982b].

While clearly not market pricing, it should be noted that both state and federal agencies, to the extent that they are engaged in water supply organizations, are moving in the direction of full-cost pricing of water. It may be expected, for example, that prices charged by the Bureau of Reclamation to reclamation customers will dramatically increase when water delivery contracts are renewed in the future.

Water pricing can be expected to facilitate entry into the market by new users—at least in the short term—and to lead to greater efficiency in use. The relative role of water markets (present and prospective) in the reallocation and conservation of water supplied ought to be then noted and, if possible, analyzed in assessments [Angelides and Bardach, 1978]. The analysis could include an examination of the legal and institutional barriers to the development and operation of water markets (such as belief in and long reliance on “free” water, legal restrictions on the sale or leasing of water, or long-term repayment contracts), as well as some of the negative variants or effects (e.g., monopolization, lack of participation by affected persons).

#### *Changes in Legal Definitions, Rights, and Relations*

Changes in water allocation, use, and management patterns can be prompted or achieved in many instances by modifying old legal rules and contracts or by creating new legal rules and contracts. A court ruling allowing a farmer who conserves water to sell what he has conserved, reversing an older line of cases to the contrary, exemplifies the way a change in legal rules can mitigate conditions of water scarcity. While there is normally considerable resistance to changes in the legal definitions of rights and duties, changes do occur in response to active pressure (e.g., lobbying of legislators, bringing of law suits, introduction of new technology). Signs of possible change can be found in proposals for legislation, pending but unresolved litigation, the appointment or election of judges with different judicial philosophies, the recommendations of interest groups, journal articles and research reports, and interviews with informed observers and commentators. Trends and developments in other states or regions often signal forthcoming change. For example, the recommendations of the Governor’s Commission on Water Law in California, which have not been implemented, could prove nevertheless to influence future legal changes in various parts of the West [State of California, 1978].

Whatever the origin of the water rights recognized under state law, assessments ought to recognize that those rights are as subject to the police power regulation of the states or to condemnation, as are rights in land. Their use can be restricted (e.g., waste prohibited) under recognized doctrines of “beneficial use” and “reasonable use,” although actual enforcement, except in fairly gross cases of pollution,

is lax. Where statutory and proper purposes exist, the power of eminent domain can be exercised to condemn water rights. The analyst should not assume, then, that a particular type or pattern of use is eternal or inevitable. Water rights can have differing duration (in perpetuity or for a number of years) and can be expressly subject to conditions concerning their limits and uses, as set out in permits, regulations or legislation [Clark, 1973; Hutchins, 1971].

Heavy reliance in assessments upon the stated rules of water law is not always justified. There commonly are gaps between legal protocols and on-the-ground practices. In other words, responses to institutional barriers may be already occurring in the field. A particular state law, for example, can prohibit the transfer of water from one farmer to another without approval of a public agency, but sub rosa transfers among neighbors still may be widespread and commonplace in practice.

#### *Changes in Government Water Management Practices*

Changes in agency practices can occur with the redefinition of mission, new financial arrangements, and altered water management techniques. The Bureau of Reclamation, for example, recently began to require water use efficiency and conservation provisions in its new contracts for water delivery to irrigation districts in reclamation projects. This represents a slight departure from a long-standing policy of not attempting to influence (except through occasional voluntary technical assistance) the internal water distribution and on-farm water use practices followed within water districts [U.S. Department of the Interior, 1978]. It represents, in one sense, a positive response to the general ineffectiveness of legislation and court-made law requiring reasonable use and prohibiting waste. Program changes, in response to institutional constraints, are ongoing phenomena which, when significant, should be noted by the analyst.

#### *Creation of New Institutions*

The analyst should be on the lookout for situations where institutions may arise or be emerging in response to a recognized water-related need or problem. Water banks and groundwater management codes are two examples of relatively new institutions that have contributed to the resolution of water use and allocation conflicts [Angelides and Bardach, 1978]. Even though state water laws might formally restrict the transfer of water from a water user in one water district to a user in another district, during drought conditions a government agency might assume the role of broker or water banker, effecting temporary exchanges of water by changing water delivery amounts and schedules. Thus new institutions can be created within old ones.

#### *Negotiated Settlements and Coalitions*

Where interests conflict, resolution can often be found in a negotiated settlement. A would-be user of water can sometimes still the fears of existing water users who perceive the new use will impinge on their rights by agreeing in advance to compensate them for injury or to take specific actions to mitigate the adverse effects. Indemnification and mitigation are techniques which have allowed oil shale companies to acquire conditional water rights on the west slope of Colorado, for example, although on the face of the record of water rights filings in the area an analyst might have concluded that

no water would have been available without a formal water rights transfer [University of Wisconsin, 1975].

Negotiation can also be prompted because institutions fear the high costs of uncertainty and protracted conflict. For instance, conflict and uncertainty over the long-term flow of the Colorado River has structured development decisions. As a hedge against uncertainty, the state of California insisted upon a guarantee of  $4.4 \times 10^6$  acre feet per year after the Central Arizona Project was built. Consequently, the burden of risk of low river flows was shifted from California to Arizona in the Colorado River Basin Bill of 1968 [Ingram, 1969]. Attempts to minimize and shift the burden of risk during negotiation are characteristic of water resource politics and can be anticipated in the assessment process.

#### *Newly Developed or Disseminated Information*

The lack of knowledge and information can give rise to conflict or prevent needed change from occurring. One group may oppose a proposed water development or management decision because its likely effects are unknown or a matter of dispute. Lack of knowledge can also spawn new institutions. Political disputes over water supply requirements and questions about the feasibility of transferring water from the Columbia to the Colorado river basin thus, for example, led to the creation of the National Water Commission and its assignment to study interbasin and interstate transfer issues and possible policy ideas. More knowledge and information can sometimes have the effect of suggesting solutions to conflict or removing the grounds for conflict. The availability and effectiveness of institutions which generate, analyze, and disseminate information concerning important water issues are therefore appropriate subjects for the analyst to address.

#### *Engineering and Technical Solutions*

Sometimes the response to an institutional problem is largely technical. The relations between the United States and Mexico have been strained over the incidence of high salinity in the waters of the Colorado flowing south of the border. The express terms of the 1944 Mexican Water Treaty allotting  $1.5 \times 10^6$  acre feet of the Colorado River flow per annum to Mexico were silent on the water quality issue. Subsequent agreements in 1965 and 1972 involving physical solutions were required to address the salinity problem. Among the hoped-for technical solutions are bypass canals, groundwater pumping, desalinization, and the control of salty point sources [Mann, 1975]. When technical approaches are taken to institutional problems, however, the costs can be high both economically and institutionally. Neither agriculture nor industrial users, for example, can afford the costs of desalted water. The institutional analyst needs to remain vigilant to the possible implications of attempts to redefine and address problems in technical terms.

#### SUMMARY AND CONCLUSION

Our goal has been to convince water resources scholars, students, and analysts that institutional analyses are (1) important and (2) feasible. They are important because institutions are important, often as important as physical conditions that constrain or make possible a given project or program. Institutional analyses are feasible—they are done all the time—but they require an understanding of the tools and the data resources that are available. Institutions are not

necessarily “black boxes,” inscrutable and mysterious, even though they may not be described with mathematical precision. They deal with choices and preferences and therefore partake of a normative element that is not altogether predictable. But the elements that influence those choices—ideology, decision-making rules, laws, regulations, traditions, and rights—can be described, evaluated, and assessed.

We hope also to have convinced our readers that institutional assessments should examine not only the statics but the dynamics of institutional arrangements. Institutions exist for making decisions, and those decisions imply changes, challenges, and new sets of circumstances and require judgment, interpretation of the past, assessment of the present, and predictions of the future. In other words, institutions tend to deal with dynamics and are themselves subject to the dynamics of the subject matter with which they deal. Institutions can and do change to meet challenges just as physical or economic arrangements can and do change.

We have argued that institutions are made up of human beings who are subject to various incentives. Some institutional assessments often favor creation of formal organizations without careful examination of the incentives to which the officers of the organization may be subjected. The result is formalism but little capacity to deal realistically with situations that invite imaginative change. The assessment that makes a contribution will be one that examines how human beings are likely to behave and not how we might hope they would behave.

Because institutions are dynamic and made up of people who make choices, the sophisticated analyst must be aware of the possibility of unintended consequences. Predictably, those who are averse to change will react, set backfires, stir up opposition. Conflict may occur in policy sectors other than that with which our analyst is dealing. The analyst is therefore careful to assess not only water policy but also the context in which water policy is fashioned and implemented.

Finally, the realistic water resource scholar and practitioner will understand that institutional analysis, because it deals with complexities and dynamics, is time-consuming, intellectually challenging, and costly. It cannot be done “on the cheap”; it cannot be done with inadequate tools; and it cannot be purchased in a “canned” form from work done elsewhere.

#### REFERENCES

- Anderson, F. R., *NEPA in the Courts: A Legal Analysis of the National Environmental Policy Act*, Johns Hopkins University Press, Baltimore, 1973.
- Angelides, S., and E. Bardach, *Water Banking: How to Stop Wasting Agricultural Water*, Institute for Contemporary Studies, San Francisco, 1978.
- Benveniste, G., *The Politics of Expertise*, Glendessary, Berkeley, Calif., 1972.
- Clark, R. E. (ed.), *Water and Water Rights*, Allen Smith, Indianapolis, Ind., 1973.
- Cobb R. W., and C. D. Elder, *Participation in American Politics: The Dynamics of Agenda-Building*, Johns Hopkins University Press, Baltimore, 1972.
- Colorado Department of Natural Resources, Upper Colorado River basin 13(a) assessment: The availability of water for oil shale and coal gasification development in the upper Colorado River basin: Summary report (draft), report, Water Resour. Council, Washington, D.C., 1979.
- Cortner, H. J., and D. L. Schweitzer, Institutional limits and legal

- implications of quantitative models in forest planning, *Environ. Law*, 13(2), 493-516, 1983.
- Cummings, R. G., and W. D. Schulze, Optimal investment strategies for boomtowns: A theoretical analysis, *Am. Econ. Rev.*, 68(3), 374-385, 1978.
- Derthick, M., *Between State and Nation: Regional Organizations of the United States*, Brookings Institution, Washington, D.C., 1974.
- Downs, A., *Inside Bureaucracy*, Little, Brown and Co., Boston, Mass., 1967.
- Ellis, W. H., and C. T. DuMars, The two-tiered market in western water, *Nebr. Law Rev.*, 57(2), 333-367, 1978.
- Fischhoff, B., Cost benefit analysis and the art of motorcycle maintenance, *Policy Sci.*, 8, 177-202, 1977.
- Greenwald, C. S., *Group Power: Lobbying and Public Policy*, Praeger, New York, 1977.
- Hennessy, B. C., *Public Opinion*, 4th ed., Duxbury, North Scituate, Mass., 1981.
- Hutchins, W. A., *Water Rights Law in the Nineteen Western States*, 3 vols., U.S. Government Printing Office, Washington, D.C., 1971.
- Ingram, H. M., *Patterns of Politics in Water Resources Development: A Case Study of New Mexico's Role in the Colorado River Basin Bill*, University of New Mexico Division of Government Research, Albuquerque, 1969.
- Ingram, H. M., and S. Ullery, Policy innovation and institutional fragmentation, *Policy Studies J.*, 8(5), 664-682, 1980.
- Ingram, H. M., N. K. Laney, and J. R. McCain, *A Policy Approach to Political Representation: Lessons from the Four Corners States*, Johns Hopkins University Press, Baltimore, 1980.
- Khoshakhlagh, R., F. L. Brown, and C. T. DuMars, Forecasting future market values for water rights in New Mexico, *Rep. 092*, N. M. State Univ. Water Resour. Res. Inst., Las Cruces, 1977.
- Maass, A., and R. L. Anderson, . . . and the Desert Shall Rejoice—*Conflict, Growth, and Justice in Arid Environments*, MIT Press, Cambridge, Mass., 1978.
- Mann, D. E., Politics in the United States and the salinity problem of the Colorado River, *Nat. Resour. J.*, 15(1), 113-128, 1975.
- Mann, D. E., and J. T. Anagnoson, Federal reorganization: Does it matter? A retrospective look, in *Reorganization: Issues, Implications, and Opportunities for U.S. Natural Resources Policy*, edited by F. J. Convery, J. P. Royer, and G. R. Stairs, pp. 7-43, Duke University Center for Resource and Environmental Policy Research, Durham, N. C., 1979.
- Mann, D. E., G. Weatherford, and P. Nichols, Legal-political history of water resource development in the Upper Colorado River Basin, *Lake Powell Res. Proj. Bull. 4*, Univ. of Calif. Inst. of Geophys. and Planetary Phys., Los Angeles, 1974.
- Moe, T. M., *The Organization of Interests: Incentives and the Internal Dynamics of Political Interest Groups*, University of Chicago Press, Chicago, 1980.
- Niskanen, W. A., *Bureaucracy and Representative Government*, Aldine and Atherton, Chicago, 1971.
- Orloff, N., and G. Brooks, *The National Environmental Policy Act: Cases and Materials*, Bureau of National Affairs, Washington, D.C., 1980.
- Price, M. E., and G. D. Weatherford, Indian water rights in theory and practice: Navajo experience in the Colorado River basin, *Law Contemp. Probl.*, 40(1), 97-131, 1976.
- Rourke, F. E., *Bureaucracy, Politics, and Public Policy*, Little, Brown and Co., Boston, Mass., 1969.
- Sonquist, J., and W. C. Dunkleberg, *Survey and Opinion Research: Procedures for Processing and Analysis*, Prentice-Hall, Englewood Cliffs, N. J., 1977.
- State of Arizona versus State of California, no. 373 U.S. 546, 1963.
- State of California, *Final Report*, Governor's Commission to Rev. Calif. Water Rights, Sacramento, 1978.
- Stratton, O., and P. Sirotkin, *The Echo Park Controversy*, University of Alabama Inter-University Case Program, University, Ala., 1959.
- Tarlock, A. D., Western coal in context, *Univ. Colo. Law Rev.*, 53, 315-346, 1982.
- Truman, D. B., *The Governmental Process*, Alfred A. Knopf, New York, 1955.
- University of Wisconsin, Oil shale development in northwestern Colorado: Water and related land impacts, *Inst. Environ. Studies Rep. 48*, Madison, 1975.
- U.S. Department of the Interior, Report on water for energy in the upper Colorado River basin, Water for Energy Manage. Team, Washington, D.C., 1974.
- U.S. Department of the Interior, Report on water conservation opportunities study, Bur. of Reclamation and Bur. of Indian Affairs, Washington, D.C., 1978.
- Weatherford, G. D. (ed.), *Acquiring Water for Energy: Institutional Aspects*, Water Resources Publications, Littleton, Colo., 1982a.
- Weatherford, G. D. (ed.), *Water and Agriculture in the Western U.S.: Conservation, Reallocation, and Markets*, Westview, Boulder, Colo., 1982b.
- Weatherford, G. D., and G. C. Jacoby, Impact of energy development on the law of the Colorado River, *Nat. Resour. J.*, 15(1), 171-213, 1975.
- Welch, S., and J. Comer (ed.), *Public Opinion: Its Formation, Measurement, and Impact*, Mayfield, Palo Alto, Calif., 1975.
- Wenner, L. M., *One Environment Under Law*, Goodyear, Pacific Palisades, Calif., 1976.
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