2

The Coming Conflicts over Water

Charles W. Howe

Introduction

The reader may note that the title of this paper has omitted the word "use" given in the program. Reflection on the problems and potential conflicts surrounding our water resources convinced the writer that water use is not the only problem area, even if "use" is broadly construed. Indeed, some of the major issues arise from environmental considerations, from impacts of water development on other systems such as transportation, and from the ways in which the benefits and costs of water development and use are distributed among the population.

The 1960s and 1970s have been active and exciting times for water resource policy and practice. Until 1974 or so, there seemed to be a very gradual but quite certain trend toward the rationalization of water policy. A sequence of important legislative and administrative steps had been taken at the federal level to improve planning and evaluation procedures, to coordinate the programs of the major water related agencies, and to assist the states in developing water management capabilities. The Water Resources Planning Act of 1965 established the Water Resources Council, allowed for the establishment of a national net of River Basin Commissions, provided aid to the states, mandated a reconsideration of benefit-cost practices, and required a periodic "national assessment" of the water situation. While appearances always greatly exceeded substance, these were the foundation stones for potential policy and procedural improvements of great significance.

The states, recognizing the increasing scarcity and importance of water, made very substantial strides in developing water planning and management capabilities. The exhaustion of good, large reservoir sites and other highly productive water development opportunities appropriate for federal construction indicated an increasing role for the states and a distinctly diminished role for the federal agencies. New large interbasin transfer projects and new irrigation seemed things of the past. Policy analysts like Professor Henry Caulfield noted the weakening of the old water interest coalitions that had lobbied successfully for federal projects for many decades. This weakening stemmed partly from public concern over sharply increasing costs of federal projects and partly from the more active role being played by the states.

The Carter Administration came in with a strong intention of further rationalizing water policy, especially in the directions of environmental concern and financial responsibility. An extensive policy review process was started that promised to reinforce the trends noted earlier. However, the brash manner in which the policy reform process was announced—and especially the publication of the celebrated "hit list" of cancelled projects without adequate consultation with the affected states—caused a violent reaction *against* the Administration's basically constructive efforts, seeming to preclude attempts to reopen rational discussions between the states and the Administration.

The Administration's falling popularity served to slow and moderate the water policy revision process to some extent, while the rising prices imposed by OPEC and the Iranian political crisis in 1978–79 served to submerge water policy under the growing concern about energy. The President's energy message of July 1979 has left the future of water policy very unclear but has opened the possibility that rational water policy will be seriously impaired or abandbned in a panicky rush to develop national energy resources.

Definition of Conflict

It is probably true that most U.S. residents think of the western water situation as rife with conflicts reminiscent of the gun battles over water that occurred in the California gold camps. Those very gun battles stimulated the development of our "doctrine of prior appropriation," a form of water law that has served reasonably well to resolve water conflicts over the long run (although not so well in the short run). In addition to the saleability of water rights and the court review provided under western water law, there are many other mechanisms that serve to reduce potential conflicts, such as the organization of efficient water distribution organizations like the Northern Colorado Water Conservancy District, interstate compacts on the division of river waters, regulations limiting groundwater use, and short-term agreements to share water during drought.

If a given action (such as a policy change or a new water project) made all affected parties better off, there would be no conflict. Such an action might be labelled "socially efficient" since we can judge it to be good without having to compare the welfare of different groups.' Thus "conflict" must refer to a situation in which the perceived improvement of one or more groups is accompanied by a perceived decrease in the well-being of other groups as a result of the proposed action.

Unfortunately, the markets and legal setting within which water-related changes take place frequently either fail to compensate some groups adequately or overcompensate others. Downstream irrigators are not compensated for damages from salinity stemming from new upstream projects—a case of under-compensation. A prospective seller of water rights to a new high-value user may be prevented by the water courts from doing so because of minor damage to other users—a case of too much weight being placed on the interests of third parties. Thus, in the absence of adequate compensatory channels, potentially "socially efficient" policies and projects remain situations of conflict.

A Classification of Potential Conflicts

Taxonomy is the perpetual game of biologists and the bane of most other professions, but it seems to be necessary to organizing any topic. 1 have chosen, not totally arbitrarily, to utilize three types of potential water-related conflicts:

1. Conflicts over the use of present water supplies
2. Conflicts over future water development

3. Conflicts arising over water policies and the institutional framework for policy execution

It is clear that these categories are not clean-cut nor independent of one another. Conflicts related to the mining of nonrenewable groundwater might be placed in any of these boxes, and it is clear that the extent to which the conflicts in (1) are resolved will have an important affect on (2) and perhaps (3). Nonetheless, we proceed to use these categories.

Conflicts over the Use of Present Water Supplies

Water use can refer to withdrawals from water sources, to the quantity of water actually consumed, or to instream uses. Some economic activities withdraw very large volumes but consume only a small fraction, e.g. thermal-electric power generation. Others withdraw very large quantities while consuming a major portion, especially agriculture, which consumes over 50 percent of its large withdrawals. Other valuable activities utilize water right in the stream, usually with little or no consumption over normal evaporation, e.g. hydro-electric power, fish and wildlife maintenance, and water quality improvement through flow augmentation. We will concentrate on consumptive uses and instream flows.

Measures of Potential Water Conflicts

The dominant uses of water in the western United States that will be competing for the available water are:

- irrigated agriculture;
- energy production (other than hydro-electric) and other minerals industries uses;
- water quality and instream flow maintenance for fish, wildlife, and recreation;
- domestic, commercial, and manufacturing uses; and
- claims for water use on federal and tribal lands.

Since federal and Indian claims will be discussed by other speakers, they will not be treated further here. Note should be taken, however, of the great uncertainty and possible sizes of these claims. The domestic, commercial, and manufacturing category is typically small relative to other uses. Further, the economic (and political) values of these uses is so high that we can reasonably assume they will take precedence over other uses. Thus we can concentrate on the potential trade-offs among the large volume uses: irrigation, energy-minerals production, and instream flow maintenance.

Water supplies in several southwestern river basins are already approaching a state of full utilization, especially in the Lower Colorado, the Great Basin, and the Rio Grande. In such basins, the expansion of new water-using activities will require either the development of new water supplies (probably through very costly additional storage or long-distance interbasin transfers) or the transfer of water from present uses to the newer, growing uses. Table 1 exhibits in very aggregate terms the water supply and demand picture in the river basins of the United States as given by the U.S. Water Resources Council in the recent Second National Water Assessment (1978).

The following points are quickly observed from Table 1:

- Irrigation is by far the largest consumptive use of water in the West.
- The combination of domestic, commercial, and manufacturing water consumption is small relative to irrigation.
- Energy-related consumptive uses (represented by thermal electric plus more than 60 percent of the minerals sector consumptive use) are projected to grow substantially but remain, on the average, less than 5 percent of the irrigation consumptive use.
- Instream flows will drop substantially below the levels that are deemed desirable from the fisheries and recreation point of view in at least the Rio Grande, Lower Colorado, and Great Basins.

The degree of geographical aggregation in the Table 1 data does, however, cover up some difficulties that can occur within smaller regions (especially states) and particular basins. The actual division of the water shown as available is constrained in the following ways:

TABLE 1
Summary of Present and Projected Western Fresh Water Supplies, Consumptive Uses, and Streamflows
(in thousands of acre-feet per year)

Water Resource Region	*Year*	*Inflow + Basin Runoff*[a]	*Irrigation Consump.*	*Domestic + Commer. Manfg. Consump.*
Missouri	1975	68908	15920	523
	1985	68908	19709	531
	2000	68908	19720	652
Arkansas[f]	1975	75817	7894	575
	1985	75817	8364	682
	2000	75817	7980	861
Texas-Gulf	1975	39901	10469	1207
	1985	39901	8509	1762
	2000	39901	6832	2885
Rio Grande	1975	5946	4352	194
	1985	5946	4390	220
	2000	5946	3998	245
Upper Colo.	1975	15631	2457	34
	1985	15631	2976	36
	2000	15631	3070	39
Lower Colo.	1975	10522	4509	324
	1985	9662	4437	383
	2000	9292	4166	524
Great Basin	1975	6693	3612	192
	1985	6693	3452	237
	2000	6693	3580	310
Pacific Northwest	1975	300746	12349	665
	1985	300746	14965	870
	2000	300746	14799	1319
California	1975	76216	27196	1894
	1985	76216	28150	2223
	2000	76216	29468	2695

[a] Figures for 1985 and 2000 assume no groundwater overdrafts.
[b] Including metals, nonmetals, and fuels.
[c] Including reservoir evaporation and exports.
[d] Negative values represent amount of groundwater overdraft needed to sustain projected uses.
[e] U.S. Fish and Wildlife Service estimates for "optimal" fish and wildlife habitat conditions.

Thermal *Elec. Consump.*	*Minerals*[b]	Total *Consump.*[c]	Remaining *Streamflow*[d]	Desirable *Streamflow*[e]
76	124	22840	49392	38033
268	156	27474	41919	38033
713	183	28722	40186	38033
100	194	11960	70112	51709
265	206	13080	62935	51709
512	244	13436	62604	51709
111	622	14520	31662	25667
302	659	13554	26380	25667
1110	708	14024	25911	25667
20	115	5566	1378	2561*
10	144	5694	475	2561*
6	168	5377	792	2561*
44	53	4431	11200	8901
119	81	5291	10340	8901
169	161	5662	9969	8901
71	169	11491	1736	7688*
150	243	11267	-1605	7688*
141	314	11021	-1729	7688*
3	31	4599	2869	3796*
47	49	4588	2304	3796*
58	72	4893	2081	3796*
15	20	15598	285902	239684
116	21	18665	282134	239684
385	30	19352	281446	239684
28	205	30587	53060	36520
113	252	32044	48729	36520
271	239	34031	46531	36520

[f] Including the White and Red River Basins.
*Indicates a shortfall from desirable level of instream flows.

Source: U.S. Water Resources Council, The Nation's Water Resources, 1975-2000, Volume 1, Summary, December 1978.

- by interstate compacts among basins,
- by interstate compacts within a basin,
- by topographic features and physical distribution systems at the micro-basin level,
- by legal difficulties in transferring water rights among users.

Thus with respect to the Upper Colorado Basin, Gray, Sparling, and Whittlesey (March, 1979) state:

> However, the problem of the oil shale industry is one of water availability due to the fragmentation of the water market in the upper reaches of the Colorado River Basin. Three states hold rights to the water while the state with the greatest share of oil shale (Colorado) has the least undepleted surface water flows. While it seems likely that water rights can and are being bought from agriculture, the very localized nature of the oil shale industry seems to indicate that agricultural production in certain areas near the Piceance Basin may be drastically reduced as a result of sale of water rights to the oil shale industry.

We must, therefore, anticipate localized problems within sub-basins even where the aggregate data exhibit no problems.

The same problems can be anticipated with respect to instream flows. Table 1 shows only three regions having problems with undesirably low instream flows. There will, however, be many localized problems of instream flow deficiency and degraded water quality, especially as new pollution sources develop in connection with energy. These factors promise to interfere with recreational opportunities, too, both those activities based directly on water and those only indirectly linked to the resource. Table 2 gives an idea of the anticipated high rate of growth of water dependent and water-enhanced recreation activities.

An additional factor not exhibited in Table 1 is the uncertainty surrounding the quantities of water available. While this may not be important for some regions, it can be crucial in basins like the Colorado where surface waters are already fully used. The availability of 15.6 million acre-feet (maf) in the Upper Colorado Basin as shown in Table 1 is rather optimistic in comparison to other currently used figures. The Bureau of Reclamation has used a range of 13.0 to 13.5 maf. The average

TABLE 2
Water-Dependent and Water-Enhanced
Outdoor Recreation Activity Occasions, 1975–2000
(in millions of occasions[a])

Water Resource Region	*1975*	*1985*	*2000*
Missouri	94	103	118
Arkansas	63	68	78
Texas-Gulf	85	99	120
Rio Grande	16	18	20
Upper Colorado	4	4	4
Lower Colorado	25	31	42
Great Basin	13	16	20
Pacific Northwest	70	76	87
California	220	257	310
Totals	590	672	799

[a] An "activity occasion" is defined as participation by a person 12 years or older in an activity regardless of duration.

Source U.S. Water Resources Council, *The Nation's Water Resources, 1975-2000,* Volume 1, Summary, December 1978, p. 45.

runoff from 1954 to 1963 was only 11.6 maf.

The implications of this range of uncertainty for water availability in the several Upper Colorado River Basin states is striking, for the Upper Basin is required by compact and Supreme Court interpretation to provide 8.25 maf annually to the Lower Basin (including one-half the Mexican Treaty obligation). Gray et al. (1979), by applying the rules of the Upper Basin Compact, exhibit the results shown in Table 3.

The actual availability within this range of uncertainty will clearly be extremely important to the future of the Upper Basin states and will, in part, determine the severity of the trade-off between growing energy uses and agriculture.

The Trade-Off Against Agriculture

The usual approach of "water for energy studies" (e.g. see Gray et al., 1979, or U.S. Department of Interior, July 1974) is to extrapolate the existing trends of change in present consump-

TABLE 3
Estimated Allocation of Colorado River Water
Based on Alternative Gross River Flows
(in millions of acre-feet per year)

Annual Flow	*Lower Basin*	*Colorado*	*Utah*	*Wyoming*
18.00	8.30	5.02	2.23	1.36
15.50	8.30	3.73	1.66	1.01
14.10	8.30	3.00	1.33	0.81
13.30	8.30	2.59	1.15	0.70
11.60	8.30	1.71	0.76	0.46

Source: S. Lee Gray, Edward W. Sparling, and Norman K. Whittlesey, "Water for Energy Development in the Northern Great Plains and Rocky Mountain Regions," draft paper, Department of Economics, Colorado State University, Fort Collins, Colorado, March 1979, Table 2, p. 69.

tive water uses in the future, then to compare those projected aggregate consumption figures with anticipated water availability, taking into account physical availability and compact and export obligations. Any remaining unused water is then identified as being "available" for energy development or other new uses.

Of course, this is not the way things will in fact happen for at least two reasons. The first was elaborated in the preceding section, namely that the excess water may not be available where it can be used by the new activities. The second reason is that water reallocation will start to take place from existing uses to the new uses long before all the excess water is used up. The reason is simply that some reallocation will be less costly, both privately and socially, than developing and transporting portions of the excess waters. The more efficiently this reallocation process works, the gentler the trade-offs of new against old activities will be.

For example, it would be desirable to transfer to the growing, high-valued use water from the lowest-valued uses in the basin, taking into account the direct and indirect values involved. If the legal setting and topography permit, this is likely to happen. Water rights owners who apply water to low-income-producing activities and who are located close to the new uses will find themselves better off by selling at least part of their water. The new activities would thereby acquire water at low private and social cost. However, insofar as physical and legal barriers impede such transfers, the reallocations likely will be from higher-valued uses and are more likely to be concentrated in a small area, as noted by Gray et al.

How serious are such trade-offs in terms of social benefits lost from the old activities (usually agriculture) that sell the water? The lost benefits of importance to the region would include: (1) regional income losses, both direct and indirect; (2) loss ofjobs, both direct and indirect; and (3) loss of aesthetic amenities and the "economic balance" associated with agriculture. The last is hard to quantify but of definite weight in state water policy formulation.

A recent study by Gisser et al. (June 1979) has analyzed the direct and indirect losses of regional income and employment that are likely to occur in the Four Corners area as agricultural water is transferred to expanding thermal electric generation.[2] The analysis utilized detailed linear programming models of Four Corners agriculture, thus assuming that water generating the lowest on-farm income would be the first transferred. Both income and employment losses were then blown up by regional multipliers derived from regional input-output models. Table 4 presents the study results for both a 10 percent and 30 percent transfer of water out of Four Corners agriculture.

The results indicate a rather low cost per acre-foot at all levels of transfer up to 30 percent of the water currently used in agriculture in the Four Corners area, and the cost remains fairly steady over that range, rising from $29 per acre-foot to only $32 per acre-foot. There are certainly no possibilities of augmenting physical supplies in that area at such low costs. Naturally, if the pattern of water transfer differed from the computed least-cost pattern, then the costs would be higher.

From the national point of view, any impediments to the transfer of water out of agriculture into the new energy uses would cause higher costs to be incurred and would, therefore, be undesirable. The regional and state points of view might, however, be quite different. The income and employment losses are not insignificant relative to the low income and employment

TABLE 4
Regional Income and Employment Losses from Transferring Water out of Agriculture in the Four Corners Area

	10% of Water Transferred	*30% of Water Transferred*
Total water transferred	88,750 a.f.	266,250 a.f.
Total regional employment lost	142 man-yrslyr	416 man-yrslyr
Regional employment lostlacre-foot	.0016 man-yr/a.f.	.0016 man-yr/a.f.
Total regional income lost/year	$2,565,900/year	$8,532,494/year
Regional income lost/acre-foot	$29/acre-foot	$32/acre-foot

Source: Gisser, Micha et al., "Water Trade-off Between Electric Energy and Agriculture in the Four Corners Area," ***Water Resources Research,*** Vol. 15, No. 3, June 1979.

levels of the area. If new energy activities could be provided with water from sources other than agriculture, it might be highly desirable from the region's viewpoint, especially if the usual federal project financing with its huge subsidies were available.

Additional information on the income consequences of transferring water out of agriculture was generated by a recent study by Howe and Young (June 1978). A salinity control alternative for the Upper Colorado Basin would be to phase out irrigated agriculture in some of the less productive areas that are known to contribute large volumes of salt to the river system (through return flows). For a phase-out of 8,800 acres in the Grand Valley and 10,200 acres in the Uncompahgre Valley, the direct and indirect income losses were estimated in Table 5.

While the regional cost per acre-foot of water transferred out of agriculture appears to be substantially higher than in the Four Corners area, additional benefits are gained in the form of reduced salt loadings. Howe and Young (1978) found that a reduction of one ton of salt loading in the Upper Colorado River would result in increased agricultural yields in the Lower Colorado Basin worth at least $8 per ton (in terms of increased regional incomes). Thus, from a national point of view, any

TABLE 5
Direct and Indirect Income Losses from Acreage Phase-Out in the Grand and Uncompahgre Valleys

Direct loss in farm output ($/yr)	1,926,000
Direct + indirect regional income loss ($/yr)	2,058,000
Reduction in consumptive water use (a.f./yr)	30,800
Regional income loss per acre-foot saved ($/a.f.)	. 67
Reduction in salt loading (tons/year)	76,000 +

Source: Charles W. Howe and Jeffrey T. Young, "Indirect Economic Impacts from Salinity Damages in the Colorado River Basin," Table 7–4, Appendix 7 in Jay C. Anderson and Alan C. Kleinman, ***Salinity Management Options for the Colorado River,*** Report P-78-003, Utah Water Research Laboratory, Utah State University, Logan, Utah, June 1978.

permanent income losses to the Upper Basin would be partly offset by income gains to the Lower Basin (70,000 tons x $8).

Again, the state and national viewpoints are likely to differ. The loss of farm output and income is likely to be picked up elsewhere in the nation (especially since we still have an acreage reduction program), and thus correctly not counted as a national loss. The water saved and salt loading reduced will permit savings in the Lower Basin, even in the face of production control programs. The state is likely to be quite concerned about the income and employment losses from this acreage reduction unless it appears that the re-investment of the payments made for the phased-out land (or its water rights) will provide sufficient added income. Thus the state is likely to oppose any program of acreage phase-out and opt for salinity control measures that will be paid for largely by the federal government, such as point source controls and (horror of horrors!) desalting plants, even if those projects are much more costly in real terms.

In summary, what we have found is that the trade-offs between agriculture and newly emerging water uses (such as energy) are not likely to be at all severe from a national point of view and that little conflict is likely to be involved. The state or region, however, will see the conflict as much more severe. As a consequence, there will also be severe conflicts between state and regional interests and the federal government over the most appropriate ways of dealing with emerging problems.

Conflicts over Future Water Supply Development

Out of the many possible dimensions of future water supply development, we have chosen to discuss three: the high costs of all future additions to supply, interbasin transfers of water and interregional conflict, and groundwater exploitation as conflict between present and future.

Future Supply Developments to Be Costly

The most widely used form of supply development in the United States has been the impoundment of seasonally and annually varying surface flows. As the best reservoir sites have been used and the most regularly flowing rivers have been tapped, the marginal costs of additional reliable water supplies from surface sources have risen rapidly. Detailed analyses of these marginal costs for the major water resource regions were carried out by Wollman and Bonem (1971). The cost figures are for storage only and do not reflect distribution or treatment costs. Table **6** gives the Wollman-Bonem figures, raised by a factor of three, which is the approximate increase in the industrial construction price index since the Wollman-Bonem figures were compiled.

Marginal storage costs appear to increase quite rapidly with the state of development within each region. Agricultural distribution costs could double or treble these costs at the farm headgate. Most noticeable, however, is the absence of data from six major western water regions. In these regions, surface flows are already so highly regulated that further development is either impossible or prohibitively costly. This doesn't mean that additional supplies couldn't be developed on particular streams within each region, but the overall river system yield would not be significantly increased and might well decrease because of additional reservoir evaporation.

A second proposed source of additional water supplies for western regions is the large scale interbasin transfer. Such projects only redistribute water geographically but they can increase the locational utility of water. Howe and Easter (1971) collected data on the costs of various Columbia-toColorado transfer schemes and found a 1970 range of **$36** to $130 per

TABLE 6
Marginal Storage Costs for Western
Surface Water Development

Region	*Cumulative Developed Supply (maf/yr.)*	*Marginal Storage Costs*[a] *($/a.f.)*
Lower Missouri	6 (1970 level)	–
	10	3.3
	12	6.9
Lower Arkansas	27 (1970 level)	
	30	4.2
	45	5.4
Western Gulf	17 (1970 level)	–
	20	7.8
	22	11.7
	25	20.4
Central Pacific	29 (1970 level)	–
	42	8.7
	46	25.5
Pacific Northwest	70 (1970 level)	–
	120	4.2
	145	15.6
Upper Missouri	see text	
Upper Arkansas	see text	
Colorado	see text	
Great Basin	see text	
Rio Grande	see text	
Southern Pacific	see text	

[a] The interest rate used in computing these costs was only 3.5 percent so the costs are probably understated.

Source: Charles W. Howe and K. William Easter, ***Interbasin Transfers of Water: Economic Issues and Impacts*** (Baltimore: Johns Hopkins University Press, 1971). Original data from Wollman and Bonem.

acre-foot, a range that by now would probably be approximately three times as high. Aside from the range of costs, the main features of interbasin transfers are that: (1) there are substantial economies of scale, (2) the cost of power for pumping is a critical element in total cost, and (3) the extent to which power recovery is possible (from downhill water movement) is extremely important in determining cost.

. Desalination of brackish or ocean waters received great attention in the 1960s. Costs in the U.S. never fell below $1 per thousand gallons ($326 per acre-foot) even with low energy costs. Present costs would be prohibitive for any but domestic and high-value manufacturing uses.

Groundwater has provided a valuable supplement to western water supplies, but in many important regions there has been severe mining with resultant falling water tables and problems of surface subsidence. Energy costs for pumping have risen to nearly 10 cents/ac.ft./ft., so that a 100-foot lift costs $10 per acre-foot. Many western areas are pumping from 300 feet or more, so that costs severely restrict the crops that can be profitably irrigated.

If the sharply increasing costs of water development are borne by the water users, few conflicts would be generated. However, under existing federal financial policies, huge subsidies are provided for federal water projects. These subsidies must be covered by the federal budget and eventually by the general taxpayer. Current pressures to balance the federal budget and taxpayer resistance to increasing tax burdens thus bring future water development into direct conflict with the general taxpayer and nonwater programs vying for federal financing.

The form and extent of federal water project subsidies have been analyzed extensively. North and Neely (1977), using data on 5,000 federal water projects and programs, have shown agricultural water supply projects repay only 19 percent of real project costs, M&I projects repay 64 percent, harbor projects 16 percent, waterways 6 percent, other navigational programs 7 percent, and hydro-electric power generation 64 percent. Some of these subsidies "feed" on each other, as when an irrigation project is allowed to buy underpriced electric power from a federal hydro-electric project. Many huge subsidies are hidden from public view by ignoring the time costs of money (e.g. allowing "repayment" of capital costs over fifty years without interest or allowance for inflation) and by such gimmicks as, the "basin account" that permits power profits to repay irrigation costs.

Conflicts over Interbasin Transfers

Large-scale interbasin transfers may, at some point in time, comprise an important part of rational regional or national water plans. Naturally, all costs (economic, ecological, and social) as well as all benefits must be taken into account. To date, interbasin transfers have been a source of great inter-regional conflict. Potential exporting basins jealously guard their supplies, and perhaps rightfully so, for the importers of water generally provide no compensation to the exporting region. Opportunity costs of the exported water may be substantial, even for exporting regions having plentiful water supplies. These opportunity costs can take the forms of ecological damage due to reduced streamflow, water quality problems because of decreased dilution, foregone hydro-electric power, and foregone future economic development.

The U.S. Congress has been unwilling to have interbasin transfer conflicts faced or resolved openly. The Water Resources Planning Act of 1965 precludes the River Basin Commissions established under its authority from considering the development or movement of waters outside its jurisdictional area. The National Water Commission that was established from 1967 to 1974 to study the national water situation was expressly forbidden to study interbasin transfers. It has been speculated that the former prohibition explains the absence of River Basin Commissions across the southern half of the United States.

Future proposals are likely to include Columbia-to-Colorado transfers as energy development mounts in the Colorado Basin, and Arkansas or Mississippi River-to-High Plains transfers to alleviate the problems of exhausting the waters of the Ogallala aquifer. These transfers will surely be resisted by the proposed exporting regions because of lack of compensation or guaranteed future water supplies.

The state-regional versus federal conflict that was noted in connection with proposed transfers of water out of agriculture will recur in two forms in connection with interbasin transfers: (1) some transfers that are not desirable from a national standpoint will be strongly promoted by the importing regions and resisted by the exporting regions, and (2) transfers that are desirable from the national viewpoint will still be resisted by the exporting region.

Groundwater Use as a Present Versus Future Generations Conflict

Groundwater can be either a renewable resource (if recharge possibilities exist) or a nonrenewable resource (e.g. the Ogallala aquifer). In either case, the issue of determining an appropriate pattern of use over time is important and fascinating. Present use of groundwater can have three major effects on the future:

1. It can lower the water table, increasing future pumping costs.
2. It can deny the future the use of water now in the aquifer.
3. It can destroy the aquifer itself by allowing compaction or allowing the possibly irreversible intrusion of salt water.

In a situation of rapid recharge, none of these effects may be significant (but the recharge may be at the expense of surface water uses). In the pure mining case, all may be highly significant.

In the mining case, there is a subtle problem of balancing present generation and future generation interests. If the present generation uses up all the water, all future water-dependent activity will stop. If the present generation conserves water so severely that it becomes impoverished, then it can leave little in the way of capital and technology to future generations. Without them, the untouched water resource may be worth very little. This is the general dilemma of nonrenewable resources.

The way we manage groundwater is a measure of our concern for future generations. Recognizing the fugitive, common property nature of the resource, we know that unregulated use will result in an irresponsibly rapid depletion. Thus we must devise control strategies that will restrict the tendency toward "beggar thy neighbor and children" behavior. Indeed, most states are now developing extensive groundwater regulations to avoid extensive current and future conflicts.

Conflicts Arising from Water-Related Policies and Institutions

The closing section of this paper identifies three policy issues not specifically identified in earlier sections: (1) fairness or equity in water management and development, (2) inconsistencies between water policies and policies in agriculture, transportation, and inflation control, and (3) the form and control over the institutional framework within which federal water policy and practices are established.

Fairness or Equity in Water Policy

Fairness and equity refer to an explicit identification and evaluation of who receives the benefits and who pays the costs of water programs. The major water development programs of this country were conceived as subsidized programs for opening up and managing our western natural resources: the Corps of Engineers navigation program, the Reclamation Program, and the Soil Conservation Program. The relevant fairness or equity questions to be asked about these programs are:

- Are the programs still required, or have their objectives largely been realized?
- Insofar as the continuation of the programs is justified, are the distributions of benefits and costs consistent with the aims of public policy?

An earlier section of this paper noted that only a small part of project cost is repaid to the federal government by the beneficiaries of many water projects. Is this still intended and, if so, are the net benefits being distributed in an acceptable way?

This distribution of net benefits is an increasingly important issue in a period of budget stringency because of the huge subsidies paid by the general taxpayer. It is the essence of the famous 160-acre limitation—one of our hottest current conflicts. Seckler and Young (1978) have shown for the 527,000-acre

Westlands Project in California that the returns to land ownership of about $135 per acre per year are totally attributable to the irrigation water subsidy. With such a subsidy being paid by the general federal taxpayer, it is interesting to note that the Southern Pacific Land Company holds 80,000 acres, the Boston Ranch Company 26,000 acres, and Westhaven Farms 11,000 acres. Seckler and Young conclude (p. 580):

> In sum, it is reasonable to say that... the amounts of money being made and the distribution of public funds through the water subsidy are little short of the grotesque. The agitation against the present situation is well founded.

The question of whether or not there are significant economies of scale in irrigated agriculture has not been settled. Carter and Dean (1961) concluded that there were economies of up to 640 acres for California cash crop farms, and Martin (1978) seems to accept that economies may extend above 1,000 acres. Until this issue is settled, it is difficult to analyze the efficiency implications of enforcing the 160-acre limit, but the equity implications seem clear. It is interesting to note that neither those favoring enforcement of the limitation nor those against enforcement have advocated dropping the large water subsidies.

Discouragingly, water agency practices ignore most of the equity issues involved in project analysis, in spite of being directed by the U.S. Water Resources Council (1973) to analyze and present them as part of project evaluation.

Inconsistencies Between Water Policies and Other Policies

Federal water development has frequently been at odds with other policies being pursued by other agencies. The post-war period until 1970 saw the expansion of irrigated acreage at a time when the Department of Agriculture was trying to reduce national output and acreage. The effects of this inconsistency have been analyzed by Howe and Easter (1971). The issue remains alive since new irrigation capacity is being planned while acreage reduction programs for the same crops remain active.

The second major form of inconsistency is with transportation policy. The expansion of the inland waterways system long ago reached the point of sharply increasing marginal costs. Figure 1, taken from a very old source (1959), shows the steeply increasing investment per mile then being encountered as the inland system was extended into smaller reaches of the river system. The then-proposed Tennessee-Tombigbee Canal is currently under construction and will be by far the most costly navigation project in U.S. history, should the courts permit the project to proceed.

Of course, high costs themselves do not imply that water transport facilities should not be built. It is clear, however, that current project evaluation procedures grossly overstate the benefits from having waterway transportation, largely by ignoring the availability of and impacts on the rail system. The expansion of subsidized waterway capacity (bargelines pay nothing for the use of the channels and locks on the inland system and pay only a very nominal fuel tax) in regions where railroads have excess capacity and are failing financially indicates, at best, the absence of a coordinated transportation policy!

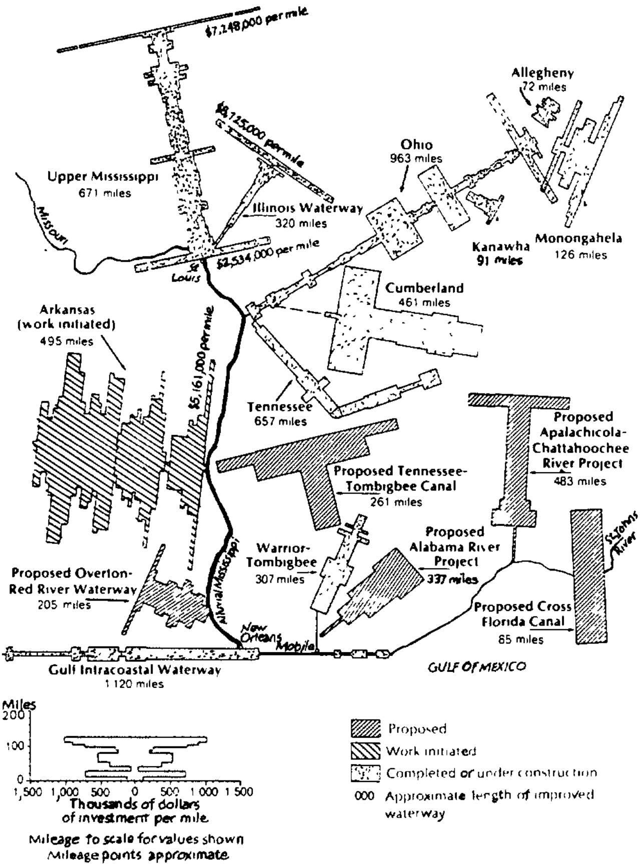
The Institutional Framework for Federal Water Policy Formulation and Execution

The introductory section of this paper mentioned the postwar attempts toward a more rational national water policy as manifested in the recommendations of the Hoover Commissions, the work on benefit-cost practices in the federal agencies, the Water Resources Planning Act, and the studies and recommendations of the National Water Commission. These efforts had to fight the political clout of established water interests and, even to get as far as they did, had to compromise with those interests. Two major policy thrusts were, in effect, stillborn: the Water Resources Council and the River Basin Commissions authorized under the same act. The Council (comprised of the secretaries of Agriculture, Army, Commerce, Energy, HUD, Transportation, and Interior) brought together all of the traditional water programs of the country that might be changed by the effective execution of the Council's charge to coordinate and rationalize the national water program. The River Basin

Figure 1

Distribution of original navigation investment expenditures on the Mississippi River System and adjacent waterways.

Source: U.S. Department of Commerce, ***User Charges on Inland Waterways*** (January 1959).



Commissions, in similar fashion, have their membership so defined that regional representation is dominated by the federal agency members.[3] As long as the traditional programs dominate the "coordination" process at both the federal and regional levels, there will be little coordination—as experience has indeed borne out.

Opportunities for redressing these particular imbalances have been created by two bills, one passed by Congress in 1978 and the other pending in the Senate. PL 95-502, authorizing the replacement of Locks and Dam 26 on the Mississippi and establishing a fuel tax for the inland waterways, directed the Upper Mississippi River Basin Commission to develop a "comprehensive master plan" for the management of the Upper Mississippi system, to identify the economic, recreational, and environmental objectives of the system, and to propose methods to assure achievement of such objectives. It is hoped that such proposals could include a more rationally representative composition of the Commission itself. Senate Bill 1241, introduced by Senators Domenici and Moynihan, proposes to reconstruct the Water Resources Council in such a way that it can more objectively pursue its coordination function. Such important institutional changes are by no means assured. One can reasonably expect substantial conflict over institutional reform.

Notes

1. Economists would call this a Pareto optimal change.
2. The same analysis of the cost side would apply independent of the nature of the new use.
3. For example, the membership of the Upper Mississippi River Basin Commission consists of six state commissioners and ten federal agency members.

References

Carter, H. O. and Dean, G. W. "Cost-Size Relationships for Cash Crop Farms in a Highly Commercialized Agriculture," *Journal of Farm Economics,* vol. 43, *1961.*

Gisser, Micha et al. "Water Trade-off Between Electric Energy and Agriculture in the Four Corners Area," *Water Resources Research,* vol. 15, no. 3, June 1979.

Gray, S. Lee, Sparling, Edward W.; and Whittlesey, Norman K. "Water for Energy Development in the Northern Great Plains and Rocky Mountain Regions," draft paper, Department of Economics, Colorado State University, March 1979.

Howe, Charles W. and Easter, K. William. *Interbasin Transfers of Water: Economic Issues and Impacts* (Baltimore: Johns Hopkins University Press, 1971).

Howe, Charles W. and Young, Jeffry T. "Indirect Economic Impacts from Salinity Damages in the Colorado River Basin." Appendix 7 in Jay C. Andersen and Alan P. Kleinman, *Salinity Management Options for the Colorado River,* Report P-78-003, Utah Water Research Laboratory, Utah State University, Logan, Utah, June 1978.

Martin, William E. "Economies of Size and the 160-Acre Limitation: Fact and Fancy," *American Journal of Agricultural Economics,* vol. 60, no. 5, December 1978.

North, Ronald M. and Neely, Walter P. "A Model for Achieving Consistency for Cost-Sharing in Water Resource Programs," *Water Resources Bulletin,* vol. 13, no. 5, October 1977.

Seckler, David and Young, Robert A. "Economic and Policy Implications of the 160-Acre Limitation in Federal Reclamation Law," *American Journal of Agricultural Economics,* vol. 60, no. 4, November 1978.

U.S. Department of the Interior. *Report on Water for Energy in the Upper Colorado River Basin,* Water for Energy Team, July 1974.

U.S. Water Resources Council. *The Nation's Water Resources 1975–2000: Second National Assessment,* vol. 1, Summary, December 1978.

U.S. Water Resources Council. "Principles, Standards, and Procedures for Water and Related Land Resources Planning," *Federal Register,* vol. **38,** no. 174, September 10, 1973, Part III, pp. 24778–24869.

Wollman, Nathaniel and Bonem, Gilbert W. *The Outlook for Water: Quality, Quantity, and National Growth* (Baltimore: Johns Hopkins University Press, 1971).