Defining Efficient Water Resource Management in the Weber Drainage Basin, Utah

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DEFINING EFFICIENT WATER RESOURCE MANAGEMENT IN THE
WEBER DRAINAGE BASIN, UTAH

by

Keith D. Wilde

A dissertation submitted in partial fulfillment
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Economics

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Logan, Utah

1976
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The perspectives on Western water resource problems, and on the nature, conduct, and usefulness of economic research reflected in what follows are a synthesis of ideas learned from many people. Frank Haws provided critical support for the notion of rejecting the standard economic assumption of scarcity in respect of water, through his experience in the measurement of hydrologic variables in the Weber Basin. Such order and consistency as the work possesses owe much to Frank H. Knight and José Ortega y Gasset, in whose writings I found expression and clarification of the perspective on economic problems and research implicit in procedures I had been following by incoherent instinct. A broadcast interview featuring Sir John Eccles, neurophysiologist and philosopher (which I heard one night by chance) provided vital encouragement through his demonstration of the scientific value of failure to support hypotheses. His account of Popperian methods inspired me with the notion that falsification is useful (i.e., scientific) at all levels, for empirical hypotheses as well as for theories of great generality. My understanding of Popper and the applicability of his philosophy to my problems was enhanced by many hours of conservation with O. R. Morris, my colleague at Agriculture Canada. Glen Moore, Professor of Botany at Brigham Young University and formerly my colleague there, provided a deep well of information which helped me to a perspective on the
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Keith D. Wilde
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ABSTRACT

Defining Efficient Water Resource Management in the
Weber Drainage Basin, Utah

by

Keith D. Wilde, Doctor of Philosophy

Utah State University, 1976

Major Professor: Dr. Allen LeBaron
Department: Economics

The Weber Basin Water Conservancy District is a state institution, but its primary function is collecting money for the U.S. Bureau of Reclamation, to pay for the Weber Basin Project. Different classes of water users pay markedly different fees for identical Project services. More than half of the water developed by the Project is not used consumptively, yet supply facilities continue to be built in the Basin because they are less expensive to their owners than prices charged for the underused capacity of the Project. Paradoxically, some Basin residents are bitterly resentful of both the District and the Bureau, claiming that water rights formerly their own have, by means of the Project, been stolen. That is, both the enemies and the proponents of the Project adhere to the Western orthodoxy that water is scarce and drought imminent.

The principal difficulty of this investigation lay in identifying the nature of the problem, for the situation seemed full of contradictions.
Consequently, the primary contribution of the dissertation is an explanation of Basin circumstances that accounts for arresting observations without inconsistency or contradiction. The most important hypotheses are, therefore, empirical, or historical and institutional. Economics, according to Richard T. Ely and Frank H. Knight, is a set of principles concerning what ought to be, not empirical description of what is. Consistent with that perspective, once the nature of the problem is clear, application of economic principles is a prescriptive judgment of how the problem may be resolved.

The most important empirical hypotheses are as follows: Water is not scarce in the Weber Basin; neither are storage and conveyance facilities. All are abundant, even redundant. Nevertheless, in combination with certain institutional arrangements and a sustained propaganda campaign, this very abundance contributes to persistence of the attitude that water is scarce. Redundant facilities thereby encourage even more unneeded development. What appears on first examination to be a case of misallocated water resources by discriminatory prices, turns out to be a problem of distributing the burden of paying for excessive, unwanted public works. Water itself is a free good in the Basin. Actual distribution of the repayment burden is partly ideological and partly pragmatic; partly a political choice and partly a bureaucratic decision; partly a manifestation of agrarian policy and partly what the traffic will bear.

If water is free, it is not an economic good, and not a subject for economic analysis. The Basin has an ample water supply, but water may
nevertheless be locally and periodically scarce. The water problem is therefore one of conveyance and timing. Control of timing requires storage. Conveyance requires energy, as well as aqueducts. In the Weber Basin, conveyance energy may be either the controlled flow of falling (mountain) water, or electrically powered pumps tapping abundant groundwater reservoirs. The water development problem is, therefore, an issue of alternative capital facilities for the control and delivery of water (itself abundant). Efficient resource allocation in water development is consequently relevant at the investment level; it is not a matter of pricing water. In this case, the major investment decisions have already been implemented, and the problem is one of evaluating distribution of the repayment burden.

The relevant economics literature is principles of equitable taxation, and of public utilities' pricing. Application to the Basin situation produces a conclusion that present arrangements are as equitable as could be devised. Further redundant investment (inefficient use of resources), however, could be avoided if the State Engineer's Office took a harder line on requests to drill new wells. The information provided in this work could be the basis for making such a program popularly acceptable.
CHAPTER I
INTRODUCTION

Humanity, at least in the present era, seems to gauge its level of satisfaction by progress,\(^1\) and progress by increasing ability to extract more and more desired output from fewer and less onerous or limited inputs. Progress is, therefore, synonymous with technological development, and technological progress is one way of solving what economics textbooks describe as the economic problem. From this perspective, the emergence of economics and scientific management in the eighteenth and nineteenth centuries was a further step in technological progress: it grappled with the question of how social mechanisms could be improved to induce greater output from existing resources, even without improved physical devices. Natural resource economics as a special study is an effort to extract greater social benefits from existing public resources.

Ever greater efficiency is the objective of all efforts to apply and improve technique, no matter of what variety. As an efficiency-promoting technique, natural resource economics focuses on useful substances (especially public resources) that appear to be available in smaller quantities than

people find desirable. Such a substance, in the experience of the western United States, is water. Chapters IX-XI provide some details of the influence that water scarcity has exerted on social behavior west of the Mississippi in the last 150 years. Combatting water shortage became a focus for social institutions (and for the careers of many people) in the arid West. When the United States began looking seriously at its natural resource endowment in the immediate post-World War II era, water was one of the critical materials on which attention was concentrated. Extensive application of economics to water policy issues stems from that period of time. Given the background of Western experience and the usual definitions of economic science, we should not be surprised to find in virtually all economic approaches to western water problems the implicit assumption that water is a scarce good.

If water scarcity is a casual presumption in western water research, it is a notion that should perhaps be challenged. For at least in Utah's Weber Basin, water is abundant. Until that fact is accepted, efficiency analysis of resource use in the basin is hopelessly complicated and replete with


frustrating contradictions. Water abundance is not a perspective that comes easily, however, because everyone "knows" the West is dry. Few water specialists will suggest, or even entertain, a contrary view. Water is obviously the subject of many problems and much effort in western states, including the Weber Basin. Nevertheless, a reasonably complete understanding of physical and institutional circumstances in the basin fully justifies the assertion of water abundance, and clarifies enormously the efficiency evaluation of its water supply resources. Like any other set of techniques, economic principles produce satisfying results only when applied to situations for which they were designed. If economics is the science of scarcity and water is not scarce, then economic analysis of the water situation in the Basin must be premised on the scarcity of some other resource(s). The chapters that follow will demonstrate that water is abundant in the Weber Basin; it is storage, energy potential, and conveyance facilities that are fit subjects for economic analysis.

Utah is universally acknowledged to be one of the arid states; husbandry of its water resources has long been a major preoccupation of its people. Application of scientific research to State water management, however, is primarily a phenomenon of this century. At first, such efforts focused on physical relationships of water, soil, topography, vegetation, population centers, etc., and on engineering projects to increase the work done by available water. More recently, attention turned to the effect of human institutions on the productive and desired uses of water. Examples of
the latter interest are the following graduate studies completed at Utah State University:


All three students devoted a major share of their attention to the Weber Basin. And all three theses contain the presumption that water is a scarce resource needing efficient management. McLean illustrates the pervasiveness of the water scarcity notion in the most striking fashion because two members of his graduate committee were co-authors of the study that quantified the abundance of water in the Weber Basin.¹

The two agricultural economics theses approached from the perspective of economic efficiency in the pricing and distribution of water. Webb catalogued all significant types of water allocating institutions in the state and

¹Frank W. Haws, Roland W. Jeppson, and A. Leon Huber, Hydrologic Inventory of the Weber River Study Unit (Logan, Utah: Utah Water Research Laboratory, Utah State University, 1970). Haws and Huber were members of McLean's committee.
concluded that the conservancy district had the greatest potential for economic efficiency because of its relative flexibility. Pendse followed this with a closer examination of water conservancy districts, paying particular attention to the Weber Basin District, headquartered near Ogden. In the course of his investigation, Pendse found that although the Weber Basin Water Conservancy District (WBWCD hereafter) does indeed have some allocative virtues, it falls down in other important respects, among which are the following:

1. It is a price discriminator, charging a higher price to urban residents than to farmers for the same product.
2. In the face of a water supply more than twice current delivery contracts, and an apparently elastic demand, it charges a prohibitively high price to municipal users.
3. The District has no power to be flexible in its prices, which are cost-determined.

---


2 There is a degree of inconsistency between (2) and (3). Pendse evaluated the elasticity of municipal demand on the basis of an actual price reduction by the WBWCD. After demonstrating that the District clearly does have an element of pricing flexibility (in respect of fixed costs for treatment and distribution facilities for municipal water), and that demand is elastic, Pendse contradicted himself by saying that the District can't lower its prices because it would then lack sufficient revenue to meet all of its fixed costs. Pendse, p. 80.
(4) It requires long term (60 year) contracts.

(5) It cannot sell water for farms larger than 160 acres (320 acres if jointly owned) by Federal Reclamation law.

Pendse's conclusions also allow the easy inference of two other defects: Sluggish sales threaten the ability of the District to meet its repayment obligation to the Bureau of Reclamation; the WBWCD is a public utility, not a profit-maximizing monopoly, and public utilities' pricing prescriptions ought to be applied, but apparently are not.  

This list of blemishes suggested the following problems for further research: Given that the policies of the WBWCD are less than optimal, can a figure be attached to the social loss incurred as a consequence? What are the managerial objectives of the WBWCD, and could they be realized simultaneously with some or all of lower prices, non-discriminatory prices, and greater flexibility in contract arrangements? If the managerial objectives of the WBWCD are simply incompatible with an efficient pricing and contractual policy, what would be the social consequences of overriding those objectives and forcing the District to operate in the more truly public interest?

Appendices I and III expand on these questions. Both are approaches to an efficiency evaluation of the Weber Basin situation, and both are premised on water scarcity. Appendix III is a revised version of Appendix I, attempting to incorporate the evidence revealed in Appendix II that water is not scarce.

\footnote{Price equal to marginal cost.}
The emancipation was not complete, however, and the analysis and research objectives of Appendix III have a vague, unrelated and scattered-purpose appearance. Much material in the present text is the fruit of investigations suggested or specified by the Appendices. The investigations uncovered more difficulties: The discriminatory pricing policy is the outcome of an explicit and legitimate design for distributing the burden of repayment to the United States government for capital facilities operated by the WBWCD (the Weber Basin project). Estimations of demand elasticity effectively eliminated the hope that significantly lower prices could solve simultaneously the problems of repayment, water surfeit, and discrimination. Without such a solution, a more efficient price policy necessarily conflicts with considerations of equity in the repayment burden. (The foregoing discussion is in terms of water as the subject of pricing policy.)

Still another problem emerged in connection with the finding that municipal demand is not elastic: Most towns in the WBWCD service area can develop well-water of good quality at a significantly lower cost than buying it from the District. Although water supply facilities are already in surfeit, therefore, new ones continue to be built.

The list of problems has grown quite long, but the issues can be grouped into three types:

1. Inefficient pricing and contractual policies,
2. Redundant investment, and
3. Wealth and income redistribution.
Although they are thus separable by class, none of the problems can be resolved in isolation from the others because they are interconnected. Price discrimination cannot be eliminated without contravening a legitimate redistributive decision. Redundant investment is a consequence of that distributive decision (wells are a cheaper source of water than the WBWCD). Further unneeded investment could be avoided by lowering the District's price of municipal and industrial (M&I hereafter) water. To do so, however, would involve the same kind of interference with an accomplished distributive decision as would correcting the discrimination problem. And the distributive decision was not simply an intra-basin one; it involved a transfer of resources from United States taxpayers generally to residents of the Weber Basin. That transfer was justified on the basis of a firm repayment contract, and prescriptions for efficient pricing in the basin would, if applied, almost certainly entail a repudiation of the contract. Such a policy recommendation could not be entertained seriously by a responsible decision-maker.

The legacy of Pendse's report, amplified by the results of several months of further investigation, has the appearance of a hornets' nest of irreconcilable conflicts. Very little, if anything, can be recommended as a clear improvement of the total policy mix. Understanding can be enhanced significantly, however, and the apparent magnitude of the problem thereby diminished several fold, by taking a different perspective.

Water is not scarce in the Weber Basin; it is abundant. Because it is not scarce, water is not an economic good and consequently has no price.
Such statements have a ring of lunacy to Western ears. They are quite supportable nonetheless. And their acceptance casts quite a different light on the complex of economic problems described above. If water is free, then the costs and prices associated with systems like the Weber Basin Project are applicable solely to the dams, aqueducts, canals, pumps, etc., which control and deliver the water. The water problem is, therefore, more accurately seen as a transportation problem. Relevant questions concern the optimal use of storage and conveyance capacity, the investment decision, paying for the facilities, and charging for their use. When viewed from this perspective, it suddenly appears that the pricing policy of the WBWCD follows widely accepted principles of public utilities' pricing and just taxation.  

Although this vantage point suggests a more favorable evaluation of WBWCD policies than seems to follow from Pendse's analysis, it accentuates doubts about the wisdom of the investment decisions that produced the Weber Basin Project. Many parts of the Project are in fact redundant. The problems associated with it relate to its capital facilities, not to the water that flows in them. Even though water abundance in places like Willard Reservoir (see map, p. 28) catches the eye of an interested observer almost immediately, accepting the notion that water is free requires an effort. Perhaps it is especially difficult for an economist. If scarcity is one's specialty, and water his assigned subject, it does not seem unreasonable that he should assume water

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1This will be demonstrated in Chapter XI.
to be scarce. He will not run into many established water specialists with an interest in or capacity for disabusing him. Water Hustlers\(^1\) cannot accept the notion that water is abundant, or that the cost of any investment in conveyance facilities is not amply justified by its benefits.

Water scarcity is a faith in reverse. Chapters IX to XI demonstrate that the origins of what has grown into a water development fraternity lay in a real need to have better control over the water resource in states west of the 100th meridian. The attack on drought was eminently successful, but necessarily entailed the creation of a set of techniques. Since effective technical capacity resides in human beings, the successful attack also entailed development of a technical fraternity with a vested interest in preserving in Western people an attitude that water is scarce and drought is imminent. Members of the fraternity threaten water shortage at every opportunity, even in connection with the ludicrous over-capacity in the Weber Basin.\(^2\) In an assignment of responsibility for overinvestment in Weber Basin facilities,

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2 See statements attributed to Wayne Eldredge (U.S. Bureau of Reclamation, Provo) and Wayne Winegar (WBWCD), in "Boat Paradise at Willard Bay," *Deseret News*, 9 September, 1975. See also Appendix II.
therefore, a significant share should go to the complex of values, expectations, and behavior that Ellul characterized as the Technological Society.¹

Technical progress in the abstract is the increase of power to effect human desires. Power is the control and direction of energy. Energy is the ultimate stuff of purposive human action. Everything desirable is the outcome or product of controlled, directed energy. The ultimate cost of everything is the alternative uses of the energy foregone by its creation. Materials, such as concrete, steel, and water, may be abstracted from because mass and energy are interchangeable, according to 20th century physicists. Controlled energy (of which capital of all kinds is a form) is a vital input to technological progress itself. The only element of progress that cannot be abstracted to an issue of controlled energy is human intellect.² But the stuff to which the human intellect applies itself may all be subsumed under a quest to exert power over the environment (including the imposition or impression of order and understanding).³

¹Jacques Ellul, The Technological Society, trans. John Wilkinson (New York: Alfred A. Knopf, 1965). Technical interest and the personal investment required to acquire technical skills is probably as strong an influence in the widely observed self-generating activities of scientific bureaus as is the political theory proposed by other authors. See Appendix II.

²Not to be confused with knowledge, which is an accumulation of capital and definitely is affected by technical progress in energy control.

³Although the idea of this paragraph does not seem to be widely applied in economics discourse, it is by no means novel.
Water is critical to plant and animal life. It is one of the most abundant substances on earth. Water does not appear always in the forms and locations most useful to man, however. But it can be transformed and transported for desired purposes if techniques of energy control are sufficiently advanced. Given that condition, any amount of fresh water could be imported to the arid West from the oceans. A lesser effort could bring water to the region from other parts of the continent, as visioned in schemes like the North American Water and Power Alliance.

More modest projects propose the total use of intrastate waters to serve arable lands within the state. Such has been the objective of water planners in Utah. Potentially arable lands have been exhaustively catalogued, and work has been in progress for several decades to make a comparable inventory of the State’s water resources. The Central Utah Project is an interbasin transfer of water, representing a major outlay of energy to take water from where it is available to where it is most easily used—or wanted.

The next lower level of energy expenditure is intrabasin development, using the energy potential of water in mountains and high valleys to push it to where there are lands and people to use it. It is the level of the Weber Basin Project, and the level which John Wesley Powell urged as reasonable for

\[1\text{ As Chapter III will show, it is mainly retarded study of ground water that prevents the preparation of a complete inventory.}\]
optimum development of the United States west of the 100th meridian.\textsuperscript{1} This approach has the potential of making most efficient use of available water, land, and solar energy. It will be referred to hereafter as hydrologic efficiency. Water deposited by solar energy and atmospheric currents in high mountains is a cheap source of energy, which can be turned to useful work with relatively minor expenditure of additional energy--if institutions are well-designed. Early irrigation developments in the Mountain West were criticized by Major Powell for violating this principle. Small-scale developments, without a basin-wide plan, tended to use up the available water in high mountain valleys where small-scale diversion was easiest. Efficient basin development would first water the maximum possible acreage of lowland plains, which have a longer, hotter growing season. But such development could only be undertaken if the entire basin were under a single political jurisdiction, and it required the cooperation (or coercion) of every basin water user.

Institutions critical to application of energy to water use include political jurisdiction, property rights in land and water,\textsuperscript{2} and mechanisms for transferring abstract rights to energy control--the monetary and financial

\textsuperscript{1}See Chapter VIII for expansion of the ideas in this paragraph, and for sources.

\textsuperscript{2}Legal definitions have imposed inefficiencies in the use of energy applied to water because they have failed to recognize the nature of the water problem as described here. See Chapter VII.
system. Basin-wide control of the water resource requires cooperative effort. All of the above institutions must work harmoniously if maximum service from basin water is to be achieved with minimum additional energy input. Assuring, or attempting to improve, institutional efficiency in the use of energy resources is the intended technical contribution of social science, available energy potential and techniques other than economics to achieve maximum desired effect. In the context of intrabasin water development, this definition seems to coincide perfectly with Powell's conception of hydrologic efficiency.1

Hydrologic efficiency, however, is a macroscopic perspective which abstracts from the distribution among individuals of the power released by efficient effort. Distribution of power is affected by political and legal institutions. The issue raised in the opening paragraphs was that institutional arrangements can interfere with efficiency. This suggests a question of whether or not McLean and Haws have in mind the same view of efficient institutions as do Webb and Pendse. Assuming that McLean and Haws are thinking of hydrologic and energy efficiency, as engineers, then if Webb and Pendse are talking about something else, what could it be? That is, if economic efficiency is something different from hydrologic or energy

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1 See the careful definition of economic efficiency in B. Delworth Gardner, State Water Planning—Goals and Analytical Approaches (Logan, Utah: Utah State University, Utah Agricultural Experiment Station Bulletin, 1966).
efficiency (which Pendse seems to imply on his p. 3), economic efficiency must be directed toward a goal different from maximizing aggregate energy control. The difference, of course, is that economic efficiency is measured in money, whereas hydrologic efficiency is conceived in physical units. Economic efficiency reflects the interpersonal distribution of power in society as it is expressed through market and other institutions. If economic efficiency requires a different prescription from hydrologic efficiency, it implies a choice of less than maximum aggregate energy control. Distributive preferences, therefore, take precedence in electing economic efficiency, over maximum aggregate physical welfare. The rationality of such a choice is increased if the cost in foregone power of the distributive preference is clearly understood.

To evaluate the efficiency of resource use in the Weber Basin, therefore, and to recommend improvements if needed, the following kinds of information are essential:

(1) Hydrologic possibilities for the basin, given existing energy potentials.

(2) Distributional objectives embedded in basin planning decisions and expressed by contemporary basin residents.

If distributive goals are found to be inconsistent with hydrologic efficiency, an estimate of the energy loss would be useful. Institutional means for achieving distributive goals must also be scrutinized to assess their efficiency. Economic methods provide at least two perspectives from which the
latter assessment may be made: One approach assumes the semiautomatic and impersonal mechanism of market society; the other recognizes the deliberate and specific allocation of resources by political resolution and administrative fiat. Both approaches, price theory and public finance, must provide answers to questions relating to physical efficiency (aggregate expendable energy), and to distributive efficiency. The decision over which approach is most appropriate will be more obvious after full exposition of the problem situation, and is accordingly left to the final chapter.

Several arguments have been introduced. The kinds of information required to support them, together with the chapters in which that information is found, may be itemized as follows:

1) Demonstration that water is abundant in the Weber Basin.
   (Chapters III and V.)

2) Demonstration that there is a fraternity with a vested interest in maintaining an illusion of water shortage. (Chapters VII, VIII, IX, X, and Appendix II.)

3) Inventory of the facilities available for storage and conveyance of water in the Basin. (Chapters II and V.)

4) Comparison of capacity to use for all parts of the system.
   (Chapters II, V, and VI.)

5) Identification of institutional or other constraints to full use of facilities. (Chapters II, IV, and VI.)
(6) Elucidation of the intended purposes of institutions and administrative decisions, to assess their consistency with actual results. (Chapters VII, VIII, IX, and X.)

Possession of the foregoing information will allow a reassessment of the set of problems adopted, inferred, and expanded from Pendse's thesis. It will suggest the application of different economic principles than were proposed by the arguments of Appendices I and III, and resolve the disconnected appearance of those earlier approaches. Water abundance is the integrating idea, as well as the key to solving the problem.
CHAPTER II

DESCRIPTION OF THE WEBER BASIN PROJECT AND ITS OPERATION BY THE WEBER BASIN WATER CONSERVANCY DISTRICT

The Weber Basin Project (WBP) is a network of dams, reservoirs, aqueducts, and canals constructed by the United States Bureau of Reclamation to control for beneficial use the waters of the Weber River drainage basin of northeastern Utah. The Weber Basin Water Conservancy District (WBWCD) is a regional agency of state government through which residents of the basin are committed to repay the Bureau of Reclamation for construction of the WBP. The District acts as manager of the WBP facilities, and as a collection agent for the Bureau. Geographic details and chronology of water development in the Basin are important elements in understanding the political, financial, and economic issues that revolve about the Project.

Geographical Description of the Weber Basin

The Great Basin of the intermountain west is land-locked; none of the streams rising within it find their way to the ocean. Rather, they disappear into sinks or evaporating ponds. The most spectacular of these is Great Salt Lake, into which empty three of Utah's most important rivers—the Bear, Weber and Jordan-Provo. The headwaters of all three are located in a
relatively small area of the Uinta Mountains of northeastern Utah, but each has its own distinctive drainage basin. (Refer to the map, p. 28.) The Weber River picks up several tributary streams as it makes its way down from the Uintahs through the mountain valleys of Summit and Morgan counties, finally emerging through the Wasatch Front into its delta, where it merges with its principal tributary, the Ogden River. The Ogden rises wholly in Weber County, emerges through the Wasatch Front just a few miles north of Weber Canyon, and joins the Weber immediately west of Ogden City. From this confluence at Slaterville, the Weber meanders through the flatlands of its delta in Weber County to the Great Salt Lake. The Weber Basin thus constitutes a sizable chunk of northeastern Utah. To the north of it Utah lands are part of the Bear River drainage basin, and to the south of it lies the Provo system. To the West lie the deserts of the Great Basin. On the east is the Colorado River basin.

As the map clearly indicates, by far the greater part of the Basin's territory is mountainous; only between the east shore of Great Salt Lake and the Wasatch Front (the East Shore area) is there a flat land mass large enough for a human settlement of significant size. Unfortunately, the Great Basin climate is of such a nature that a heavy proportion of its total precipitation falls on the mountains in the form of snow. People who settle on the flat lands of the Basin, therefore, depend for water on the streams that bring down snowmelt from the mountains. The East Shore is one of the most favored
locations in Utah because of its land base and water supply—both provided by the Weber-Ogden River System.

As it emerges from the mountain front, however, the Weber is enclosed by high bluffs on both sides, which it does not escape until virtually at its confluence with the Ogden. This has meant that the higher lands of Davis County (close to the mountains) could not be conveniently watered from the Weber River. The Davis and Weber Canal Company has long had a diversion near the mouth of Weber Canyon, and runs its canal long the bluff on the south (Davis) side until it finally escapes confinement near Roy (north of Hill Field), and can then turn back down into Davis County (it goes as far as Layton). But the lands in bright yellow on the map, and those in white on which Hill Air Force Base and Ogden Arsenal are located could not be served in this way. For many years the same was true of lands close to the mountains both north and south of Ogden City (part of the green portions of the map). In fact, the only lands that could be irrigated from the Weber-Ogden without a very expensive conveyance system were lowlands near Ogden City and the flatlands of west Weber County. Unfortunately, the large area of low lands near the Lake required drainage and sometimes flushing before it could be used for farming.

Further south, the Davis County portion of the East Shore area contains a large share of the best agricultural land, but can be watered from the river only by means of a long canal, as explained above. Hence, the early development of Davis County depended on the small mountain streams that
rise on the west front of the Wasatch Range and drain directly into Great Salt Lake. Lower lands were settled first and the available water appropriated for them, leaving the higher foothills without a source of water, even though the mountain streams crossed them. ¹

South Davis County is geologically distinct from North Davis. Between the two Farmington Bay, an arm of Great Salt Lake, pushes almost up to the mountain front, dividing the county into two sections just below the town of Farmington. South Davis has a few mountain front streamlets of its own, and also could conveniently divert water from the Jordan River, which it did through the Bonneville Canal. But it suffered from the fact that most of the lands that could be served by this gravity canal were water-logged, or very easily could be by a few seasons of irrigation. Later on, a higher canal was built and water pumped into it to extend the area of irrigated agriculture (Bonneville Pump Canal). This was expensive, of course; it still could not serve a lot of good arable land higher up, and there were complaints over the quality of Jordan River water, which, by the time it reached South Davis, had been used and re-used all the way through Utah and Salt Lake Valleys.

Chronology of Water Development in the Basin

Irrigation has been a cooperative venture in Utah from the beginning of its modern history. Fairly long canals were needed to bring water from a

¹By the doctrine of prior and beneficial appropriation.
22

high enough diversion point to get it onto the best agricultural lands. Streams were diverted by a weir; the system depended entirely on water that happened to be in the streams at a given time. As long as there was water in the stream, it worked well enough, but stream flow was always highest in early season when needed least, and very low in late season when needed most. Only the very earliest appropriators would have water in late season, by the prior appropriation doctrine. Thus there was ample water for everyone's diversion works in the spring, but as the season wore on, more and more appropriators were forced to close their headgates.

Since late season water is vital to many crops, this put a severe constraint on the expansion of irrigated agriculture. The only way of getting a greater irrigation supply for late season was to store it up from the unappropriated early season flows. Such an effort was expensive beyond the financial resources of most cooperative ditch operators. Furthermore, any undertaking of this kind intended for agriculture had to compete with farm products grown elsewhere without the need for such expensive water. Assuming the best reservoir sites to be used first, every time an additional increment of the unappropriated early season flow was stored, the energy expenditure per unit rose higher. If such water was to be used profitably in agriculture, it had to mean either that agricultural prices were rising, other production costs were going down, or that profit margins in agriculture were already comfortably large. As long as Utah was relatively isolated, with a growing population, some or all of these conditions may have prevailed.
Nevertheless, it was several decades after Brigham Young established settlement before economic conditions in Utah (mostly a matter of population pressure, probably) justified major water storage investments.

Until the later years of the 19th century, then, the extent of irrigated agriculture in Utah was limited by lands that could be watered by simply diverting a stream to fields through a canal. Possibly the first irrigation storage reservoir in the United States was constructed in Cache Valley, Utah in 1871. ¹ Although there is still a Newton Dam at the same location, the first effort was a primitive affair and washed out at its first severe test. It was rebuilt and washed out frequently in the next few years as its owner-builders learned their engineering by trial and error. By the late 1890's, it had become a fairly reliable structure.

The first storage effort on the Weber River system was less costly in terms of mistakes and failures—no doubt profiting from the experience of the Newton Dam cooperators. ² The Davis and Weber Counties Canal Company was formed in 1884 to construct the canal running from the mouth of Weber Canyon into Davis County, as described above. As a relatively late appropriator, the company had little or no water to sell by July. Consequently they


² Earl Harris, manager of the Davis and Weber Company, provided historical notes, written by himself, from which the following account is taken.
began construction of a dam on East Canyon Creek in 1896, for storage of spring runoff water. It was an immediate financial success. As a consequence of brisk sales, the height of their earth fill dam was soon raised 25 feet, increasing reservoir capacity from 3,850 to 8,500 feet. In 1902, 17 feet more were added to the height of the dam, increasing capacity to 13,800 acre feet. The combination of fertile soil, ease of working it in early spring, proximity to both Salt Lake City and Ogden, plus abundant full season water, gave farmers served by the Davis and Weber Canal Company advantages that were not enjoyed in other parts of Utah in the early part of this century. Consequently, the Company's business expanded, more land was brought under the ditch, and in May of 1916, construction began on a new, all concrete dam to replace the old earth one. It was completed in 1916, at a cost of $17,055. Its storage capacity of 28,000 feet was double that of the old one. To this point East Canyon Dam was strictly a profitable private enterprise undertaken with no assistance from state or federal governments.

The area served by the Canal continued to expand after 1916, but the continued profitability of irrigated agriculture is called in question by subsequent events. Harris says that by the mid-twenties "it was again evident that the Company still needed additional storage capacity to take care of the additional acreage that was being cleared to become part of the canal system."

Other water users and irrigation companies on the Weber system were also interested in more water. But apparently no one company or group of companies felt a want sufficiently keen to put up the necessary money. The
Bureau of Reclamation was brought in to construct Echo Dam on the Weber River. It was completed in 1931 after an outlay of $3,000,000. The reservoir it created had a capacity of 74,000 acre feet, of which 40 percent was subscribed for by the Davis and Weber Canal Company, the largest single shareholder.

Shortly after completion of Echo Dam, which it called the Weber River Project, the Bureau of Reclamation started Pineview Dam on Ogden Valley. This Ogden River Project was also undertaken on a cooperative basis, between the Bureau and the Ogden River Water Users Association. The dam and its 44,000 acre foot reservoir were completed in 1936. By 1941 the Project's other features, Ogden Canyon Conduit, Ogden-Brigham Canal, and South Ogden Highline Canal were also in place. The Weber and Ogden River Projects grew out of studies initiated about 1921 by Bureau engineers William Green and E. O. Larson. Reclamation engineers had studied the Weber Basin as early as 1903, and recommended developments not far different from what now exist on the Weber and Ogden system, after completion of the Weber Basin Project.2


2This information from the Bureau's Project History of the WBP. The History consists of a mimeographed, loose-leaf volume for every year since the project was started (1953), and was consulted in the Provo office of the Bureau of Reclamation.
There is a readily discernible continuity to water development on the Weber system: from small private diversions to large private companies and modest storage reservoirs to a combination of private and government effort on larger reservoirs, and finally to full federal government finance and control of a large network of dams, reservoirs, power plants, aqueducts, drainage ditches, etc. Active participation of the Bureau of Reclamation dates from the early 1920s and has been continuous since that time. The Bureau's oft-repeated objective, as with other water development enthusiasts in the West, has been to keep at it until every drop of available water is under control for beneficial use. The WBP was intended to be the culmination of this goal for one drainage system.

This chronology of water development is suggestive of an explanation: during the years of Utah's relative isolation from other markets, irrigation works were relatively small, but profitable. As the 20th century wore on, irrigation projects had to be larger to provide a significant increment to the water supply, and they became increasingly difficult to finance. Eventually the federal government took them over as apparently the only body with sufficient financial strength. For contemporaneously with the 20th century growth in water supply facilities, the Utah market became less and less isolated, and agricultural prices (real) generally were in a decline after World War I, although they had a temporary rise during and immediately after World War II. Since the early 1950's interest in expansion of irrigation
farming in the East Shore area had been deterred by low agricultural prices and high, non-agricultural prices for land.

**Relative Use of the Weber and Ogden Rivers**

Notice (Figure 1) that although the Weber River drains a larger basin than does the Ogden, the Weber is also more fully used to irrigate patches of land along its upper courses. The Ogden serves only one valley before reaching the East Shore area, whereas the Weber and its tributaries serve five major ones and several smaller developments before arriving at the canyon mouth. By means of the Davis and Weber Canal a major portion of the lands shown in green south of Ogden City are also served by the Weber River. Furthermore, all of the lands in yellow served by the Weber and Davis Aqueducts get their water supply from the Weber River. Lands shown in green in the Hooper area, plus all others to the north can be supplied from the Ogden River, or the combined Ogden-Weber. The green patches in Box Elder County, and those north and east of Ogden City were watered by the Bureau of Reclamation's Ogden River Project in the 1940's. They are the only lands of the East Shore area that could be served more efficiently by the Ogden than by the Weber.

As might be expected from these observations, the main pressure from water users have always been for development of the Weber River, since the best lands lay under it. Except for the relatively small patches north of Ogden and in Box Elder County, the only lands that could be watered
from the Ogden or combined Ogden-Weber are those of the lower delta. These lands, the orange-brown portions on the map, have a very high water table and are heavily infiltrated with salts. They cannot be used without extensive rehabilitation by drainage and flushing. As there was good land available higher up, farmers always were understandably more interested in getting water for it than for the salt marshes bordering Great Salt Lake.

The maddening feature of the situation is that it is relatively easy to get an abundant fresh water supply for the lowlands, whereas getting it to the upper benches requires very expensive diversion and transportation works. Pineview is by far the best reservoir site in the Weber-Ogden system. It stores more water than all of the other mountain valley reservoirs combined. (It also covers a magnificent artesian basin.) It is not hard to imagine the frustration that engineers must have felt in the face of such a circumstance: the most efficient dam they could build in terms of water storage per cubic foot of fill was not really in demand, whereas a whole network of dams and aqueducts are required to get a much smaller supply of water to where it was wanted.

Hydrologists estimate that over 400,000 acre feet of water is discharged into Great Salt Lake by the Weber River every year. Since the Ogden contributes only about 160,000 a.f. of this, the Weber is far from being used up.\(^1\)

\(^1\) Frank W. Haws, Roland W. Jeppson, and A. Leon Huber, *Hydrologic Inventory of the Weber River Study Unit* (Logan, Utah: Utah State
Description of the Weber Basin Project

The Weber Basin Project was authorized by Congress and the President in late 1952 and construction began early in 1953. Water deliveries through parts of the Project were first made in 1956. By 1968 most of the facilities that appear on the map (Figure 1) had been completed. Larrabee Reservoir, which appears on the map near the headwaters of the Weber in the Uinta Mountains, was not built. The map was taken from a 1963 version of the Bureau’s Definite Plan Report that the Conservancy District refused to approve. Larrabee would have been an expensive storage facility and did not seem to be needed acutely. The power plants at Wanship and Gateway were designed to provide power to pump water from the Davis and Weber aqueducts to higher lands on the benches (pumping stations on the map), and to pump water out of Willard Reservoir to serve the reclaimed lowlands (orange) through the Willard, Warren, and Layton Canals. Water for the aqueducts is taken out of the river at the Stoddard diversion and carried by the Gateway Canal and Tunnel to the west face of the Wasatch. Slaterville Diversion replaces previous diversion works and sends surplus water up to Willard Reservoir. Water was also supposed to have been diverted into the new Layton

Canal to serve lowlying lake plain lands. But when the lack of interest became apparent, the Bureau of Reclamation stopped construction of the Canal barely south of the Davis-Weber Counties boundary line. The WBP also created a new diversion and canal in Ogden Valley (see map) to carry new water made available by Causey Reservoir and to improve service to holders of existing water rights.

The credo of enthusiastic water development promoters has been "develop every last drop of water for beneficial use." That slogan was expressed frequently during the planning and investment stages of the WBP, but the actual project does not go quite that far. Some of its planned features were not constructed, as noted above, and others were built smaller than originally designed. More water could be developed, but it would be very costly as there are no more good reservoir sites available.

Control does not mean necessarily that a given unit of water is taken out of the river and used for either irrigation, domestic, industrial, or civic purposes. Maintaining a flow in the river is also productive of values, and is part of control. Part of the cost of the WBP was justified as a benefit to fish and wildlife. It is a non-reimbursable benefit, but because of it the WBWCD must maintain a certain minimum flow in the Weber River. A complementary function is the generation of electric power. The WBP itself includes two power stations, and Utah Power and Light has a major right of long standing to a minimum flow in the Weber. This means that relatively high flows must be maintained even in winter, when consumptive use is
comparatively light. There is a further, less tangible, esthetic value in the simple fact of having water running in the river, especially in the dry late season.

Relative Use of Project Facilities

Employment of WBP facilities parallels the relative consumption of stream flow from the two rivers. Note on the map that Willard Reservoir, Willard Canal, Slaterville Diversion Dam, Warren Canal, Layton Canal, and Willard Pumping Plant are all designed to use the surplus Ogden River waters. The same is generally true for the enlargement of Pineview Reservoir. These facilities represent a heavy proportion of the total cost of the WBP. They are also the features of the WBP that are used very lightly. Causey Reservoir and Ogden Canal, both above Pineview Reservoir, are the only facilities on the Ogden that are used to virtual capacity. They provide supplemental water (late season) to farmers and suburban residents of Ogden Valley. Lost Creek, Wanship, and East Canyon Reservoirs, all on the Weber, made more late season water available to lands already under the ditch. They produce all the water that can be pushed through Gateway Tunnel, and its capacity is sufficient to keep both the Davis and Weber Aqueducts full. The Davis Aqueduct runs at its irrigation capacity south of Farmington Canyon. There are potential irrigation customers in South Davis, but no carrying capacity to serve them. The remaining physical capacity is reserved for municipal water deliveries
to the Conservancy District's treatment plant in Bountiful—water which is as yet unsold.

Irrigation service to high lands in north Davis and south Weber counties (aqueduct service areas) is significantly below capacity. It is building steadily, however, on the basis of individual contracts with residential property owners rather than wholesale contracts with irrigation companies. More water could be delivered in Summit and Morgan counties, but no specific project facilities (storage capacity is general) are lying idle as a consequence. Except for redundancy in the lower lake plains system, part of which is highly visible, the only element of excess capacity which concerns Project managers is in municipal and industrial water. Subsequent chapters will verify that these two systems (M&I and Willard-Layton) are of greatest interest from the viewpoint of evaluating the efficiency of resource use in the Weber Basin.

The Weber Basin Project has a declared capacity of 50,000 a.f. per year for M&I delivery. To turn this capacity to effective use required the construction of treatment and conveyance facilities capable of delivering water of culinary quality to urban residents. Because federal law did not permit the Bureau of Reclamation to participate in operations of that kind, the WBWCD issued bonds to finance the necessary works. Accordingly, the District has treatment plants at Ogden, East Layton, and Bountiful, plus a system of water

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mains capable of delivering culinary water to every town and city in the East Shore area. To date, contracts for delivery of M&I water sum to only 31,000 a.f. compared to the stated capacity of 50,000 a.f. As will be demonstrated in subsequent sections, this fact has major financial significance for the WBWCD.

Synopsis of the Lake Plains Problem

Most of the water control capacity and over two-fifths of the total capital cost of the WBP resides in facilities designed to irrigate the lake plains region. These include Pineview Reservoir, Slaterville Diversion, Layton, Willard and Warren Canals, Willard Reservoir, and the Willard and Layton pumping plants. The whole of this system is used hardly at all, but of course must be paid for.

The intent of this Willard-Layton system was to bring new lake plains land under cultivation, and to improve the productivity of such as is already cultivated. Much of the land in this region is nonarable because of a high salt content. It requires draining and flushing. The Bureau of Reclamation constructed some large drainage ditches through the area, into which farmers could drain their own fields. Fewer of these ditches were built than planned because it quickly became apparent that almost no one was interested in reclamation farming. As a consequence, a very large portion of the water supply developed by the WBP evaporates from Willard Reservoir or flows into Great Salt Lake. Water sports and game bird hunting are turning out to be the
most significant benefits from this part of the system, and the Conservancy District and others in the state are arguing that a larger portion of the Project capital cost should be declared nonreimbursable. ¹

Part of the land that could be served by the Willard-Layton system was already under irrigation before the WBP was built. It was classed by Bureau of Reclamation planners as needing supplemental water. Very few WBWCD delivery contracts have been made with irrigation companies in this region, however. Wayne Winegar, Secretary-Manager of the WBWCD, attributes this lack of interest primarily to the fact that U&I Sugar Company has a large water right which it rents to its client farmers on a seasonal basis. ² Potential customers understandably find this arrangement more appealing than signing a 60-year repayment obligation with the WBWCD. This explanation for lack of interest in Project Water is not completely satisfying, for it suggests that the need for supplemental water was not there in the first place. (The U&I right must antedate WBP rights by several decades.) That suspicion is supported by some observations of Darrel Stokes, Davis County Agent:³ Much irrigating is done in the lake plains area using waste water


² This term is revealing. It is, of course, storage and conveyance facilities that are rented. Getting water from the river is the problem, not availability of water itself. The rental terminology is Winegar's but appears to be common usage.

³ Personal communication, Spring, 1972.
from higher ground. The major canal in the region is owned by a Hooper company. When they learned what their repayment obligation would be if they contracted for WBP water, they found it more attractive to invest in concrete lining for their canal! Thus an unneeded investment is duplicated, in part, because it was poorly designed and the potential customers can avoid paying for it directly by making yet another investment.

The lack of interest in specifically reclamation farming is not difficult to understand. Nearly all the land in the lake plains region is privately owned. The units tend to be small, even with generous portions of salt grass pasture (nonarable), and the ownership pattern is fairly scattered and complex. Most of the owners are either non-serious part-time farmers, or older operators "who have bought their last tractor and are accustomed to summering one head on ten acres of salt grass."¹ Such land owners are generally uninterested in either serious reclamation farming, or in selling to would-be farmers at a price consistent with commercial agriculture. If drained and flushed, these lands could be very productive for garden (vegetable) farming, as one or two outstanding examples demonstrate. (One showplace is the J. K. Wheeler farm at West Farmington.) Part-time or semi-retired owner-operators are not capable of the kind of effort that is required.

Serious potential farmers are deterred by effective barriers to land assembly. The current land owners, described above, are as disinterested

¹The phrase of Wayne Winegar.
in selling as they are in farming--except at exorbitant, speculative prices. Unless they can retire on the proceeds of a sell-out, making-do or off-farm employment appears to be their best alternative. There are a few owners who would be willing to sell at prices consistent with agricultural potential, but their units are too small for economic operation, and are bordered by the lands of owners who are holding out for speculative prices. County Agent Stokes estimated in 1972 that the cost of assembling an economic unit and draining it was about $1500 per acre. Irrigation water from the WBP at less than $3 per acre foot is clearly not the major deterrent to agricultural expansion under these circumstances.

Synopsis of the Municipal and Industrial Problem

Although no person or agency connected with the building or operation of the WBP appears willing to come forth with a bald statement of the fact, it is quite clear from official and published information that the municipal and industrial aspect of the Project was designed almost solely as a repayment mechanism. The repayment contracts for irrigation companies were designed to provide water at a price that commercial agriculture could afford to pay. Pre-construction agricultural economic studies were undertaken to determine the value of water in agricultural production, and the contract price

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1One such study was undertaken at Utah State University, independently from the Bureau. Walter U. Fuhriman, George T. Blanch, and Clyde E. Stewart, Economic Analysis of Agricultural Potentials of Weber Basin
established accordingly by Bureau of Reclamation fiat. The remainder of the repayment bill is designed to be met by a combination of ad valorem property taxes and sales of M&I water. The contract price for M&I was set to make up the difference between estimated revenues from the sum of irrigation fees and property taxes,¹ and total costs of the Project. Pendse provides pricing details,² but in general irrigation companies pay about $3 per acre foot, while M&I customers (towns) are assessed $15 per acre foot. Operation and maintenance costs (a charge by the Bureau against the WBWCD) are also born disproportionately by towns and cities. The 1959 DPR estimated O&M charges for irrigation at $1.40 per a.f., and at the same time proposed an assessment of $10 per a.f. against M&I users. (The latter figure was up to $12.50 by 1973.)

Part of the operation and maintenance for municipal water must be allocated specifically to WBWCD treatment and distribution facilities. And to pay off the bonds which it issued to construct its treatment and delivery facilities, the WBWCD lays on another $16.00 per a.f. to M&I users. This means that municipalities buying culinary water from the WBWCD face a total

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Reclamation Project, Utah, Special Report No. 7 (Logan, Utah: Utah Agricultural Experiment Station, Utah State University, 1952).

¹There is a one-mill levy on all real property within the boundary of the WBWCD (see map). There is legislative authority for expanding this by 1/2 mill if necessary.

²Pendse, circa p. 70.
assessment of $43.50 per acre foot, composed as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repayment to the Bureau</td>
<td>$15.00</td>
</tr>
<tr>
<td>Repayment of WBWCD bonds</td>
<td>$16.00</td>
</tr>
<tr>
<td>Operation and maintenance</td>
<td>$12.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$43.50</strong></td>
</tr>
</tbody>
</table>

By contrast, most municipalities in the East Shore can develop ground water sources for $12-15 per acre foot. It is hardly surprising, therefore, that the Conservancy District's M&I contracts have expanded only very slightly since before construction of the WBP commenced.

Cheap ground water is the obvious cause of sales resistance to M&I water from the WBP. It is a major manifestation of water abundance in the Weber Basin, and in the East Shore area particularly. Knowledge of the region's ground water was slow to develop, and emerged only after the WBP was under way. Such information as there was had been developed by hydrologists of the U.S. Geological Survey and Bureau of Reclamation. Federal government officers knew more about ground water resources of the region than virtually any state or local functionaries. Circumstantial evidence suggests they may have found it advantageous to sustain a degree of knowledge monopoly.

The WBP could not be paid for without major financial support from sources other than commercial agriculture. That meant enterprises and individuals to whom water was not a major productive input to profit-oriented operations. Municipal and industrial customers were the obvious answer,
given that major hydroelectric development—the traditional paying partner of Reclamation—was not feasible. M&I contracts at high prices would not be possible if knowledge of ground water potential was generally available. Hydrologists in the State Division of Water Resources and the Utah Water Research Laboratory suspect the Bureau and U.S.G.S. of having been less than frank with state and local people about ground water resources in the East Shore area prior to 1966, and even in the official report published in that year.¹

On the other hand, hydrological investigations of south Davis County did suggest meagre ground water resources in that region, and as will be shown, south Davis was the principal source of popular support for the WBP. Furthermore, it is quite clear that promoters of the WBP, both in and out of the Bureau of Reclamation, were not interested in looking at ground water as an alternative.

It is interesting that the Bureau of Reclamation would not begin construction on certain parts of the Project until the Conservancy District had signed firm, long-term contracts with customers. Although applied to both irrigation and municipal users, this policy did not affect all parts of the Project with equal force. It seems to have been applied most rigorously in respect of the high-line project on the Davis and Weber benches, and not at all in the case of the Willard system. A certain proportion of the anticipated

¹P. P. 518.
cost of the high-line system had to be covered by binding contracts before the Bureau would begin construction. When some anticipated customers in that region demurred, the Bureau scaled down its plans accordingly, so that the existing facilities are not as large as intended at one point in the pre-investment stage. It is therefore possible to say that, as signed up for in advance, the Weber Basin Project is virtually fully used.¹

The previous section noted that rational cost calculators have found it advantageous to make further investment in water control and conveyance facilities rather than to contract with the WBWCD for delivery of irrigation water. The same is true to an even greater degree in respect of M&I supplies. Instead of expanding their contracts with the WBWCD, towns and cities in the East Shore area have been meeting increased water requirements by developing new wells. Already redundant water delivery facilities therefore continue to be duplicated in the WBP service area.

**Major Conjectural Conclusions about the Weber Basin Project Purposes and Operations**

Special technological interests and chamber of commerce growth promotion were prime movers in creation of the WBP. A reasonably demonstrated need for imported water in south Davis County was the plausible excuse. Costs of the high-line aqueduct system for Davis County (and the

¹Information in this paragraph from Wayne Winegar, personal communication, Spring 1972.
Uinta Bench in Weber County) were very high in proportion to potential irrigation benefits, and to potential repayment capacity. Benefits and payment capacity were expended by means of the Willard-Layton reclamation scheme in the first case, and by high-priced M&I contracts in the second.

Actual beneficiaries of the WBP are primarily residents of the upper bench lands of the East Shore, and they tend to be concentrated heavily in south Davis County. Benefits from land reclamation have proved to be ephemeral. The burden of repayment is falling disproportionately on people living in parts of the Basin that were not even intended to receive major benefits from the Project.

The assertion of this section will be supported in the pages that follow, and reviewed again in the concluding chapter.
CHAPTER III
HYDROLOGIC BACKGROUND OF WEBER BASIN PROBLEMS

The problems of the Weber Basin Water Conservancy District are intimately related to various kinds and degrees of hydrological ignorance. The state of professional knowledge was backward when the Weber Basin Project was in its formative stages, and public awareness was naturally much farther behind. Legal institutions and interpretations based on obsolete notions of hydrology probably had as much influence in spurring local desire for the WBP as did physical conditions of water supply. The financial problem of the Conservancy District, mainly a failure to sell enough municipal and industrial water, is a direct consequence of a change in water knowledge during the decade of the 1950s. Several other resentments and misgivings about the WBP and WBWCD that came to light in the course of this investigation are explained by the same general problem of hydrologic innocence. Because they play so prominent a role in the political-economic issues surrounding the WBP, selected details about water presence and movement in the Basin are presented in this chapter for the benefit of readers with no hydrologic background.
General Significance of Groundwater

Of the total world supply of water, 97 percent is in the seas and of little or no practical value for human consumption. Of the remaining 3 percent, hydrologists estimate that 75 percent is bound up in glaciers and ice sheets. Only three-tenths of 1 percent of the remaining 25 percent of fresh water is in the form of surface water in lakes and rivers. Except for small amounts of atmospheric and soil moisture, all the rest is groundwater. 1

Another authority puts it this way:

Water is the most abundant substance on the earth . . . Scientists estimate that the water in the earth's crust and in its atmosphere amounts to three times the quantity of all other materials combined . . . The seas and oceans contain about 97 percent of all the water on earth. Snow, glaciers, and the polar ice caps account for about 2 1/4 percent. Water in rivers and lakes and the ground water below the earth's surface, taken together, represent about six-tenths percent of the total. Water vapor in the atmosphere accounts for only a small fraction of a percent . . . Actually, less than 3 percent of the fluid fresh water available at any given moment on our planet Earth occurs in streams and lakes. The other more than 97 percent--an estimated 8 trillion acre-feet is underground. 2

This same source adds that groundwater reservoirs constitute the largest storage of fresh water in virtually any country. Underground water in U.S. reservoirs exceeds by many times the capacity of all surface reservoirs, including the Great Lakes. A U.S.G.S. hydrologist has estimated that total


2 Ground Water and Wells (Saint Paul, Minnesota: Johnson Division, Universal Oil Products Co., 1972), Chapter 1.
groundwater is about ten times annual precipitation, or equal to total surface runoff to streams and lakes for 35 years. ¹

Utah and the Weber Basin are no exceptions to these general statements. "The water stored underground in Utah is more than enough to fill all of the existing man-made reservoirs several times over. The Milford-Beryl-Enterprise Basin alone probably contains about 25 million acre feet of water, more than enough to fill Lake Mead."² Hydrologic studies that will be cited extensively below suggest that enough water could be withdrawn from aquifers in the East Shore area of the Weber Basin every year to equal the total production of the WBP—without even drawing down the underground reservoir significantly.

Another significant feature of groundwater is its generally low bacterial content. In Sweden, groundwater sources are "very much limited both as regards number and capacity," yet the Swedes seek them out and take elaborate measures to replenish them for the treatment effects alone.³ For the same quality of water, measured by temperature, bacterial, chemical, and physical factors, highly developed replenishment and recovery techniques cost less than treatment plants for surface water. "It may in general be said

¹ Ibid., Chapter 2.


³ Material in this paragraph from G. Winqvist, "Artificial Replenishment of Ground Water," in Eriksson et al.
that wherever ground water of good quality exists in sufficient quantities, it is preferable to surface water for drinking purposes." As it moves through the ground to the subterranean reservoir the quality of water improves. "Unfortunately little is known of the essential details of this process and the subject is doubtless a large and important field for investigation and research." Some things are known, nevertheless: There is intensive biological activity in the sand surface of the infiltration (recharge) basin. "Below the surface of the sand . . . the number of bacteria decreases rapidly. At a relatively short distance from the infiltration surface no bacteria can be found and the ground water is sterile from there on . . . We are not quite sure what happens to viruses under the same conditions . . ." Virologists are unable to make proper investigation with available techniques. "The general impression nevertheless is that a long detention time in the ground is more favorable than the short treatment time in a surface water treatment plant." Physical-chemical changes also occur, especially reduction in odor and taste. This is attributed mainly to biological activity in the filter beds. The "treatment" is obviously affected by the distance the water flows and the time it remains underground. Heat capacity of the gravel and sand obviously affects the rate of temperature equalization. Detention time is considered to be the most important factor in quality improvement, however, and the author gives 200 days as a general guide to most satisfactory results, provided that the raw water is of "normally good quality."
A Utah expert on groundwater, the late Dr. Ray E. Marsell of the University of Utah and the State Water and Power Board, made the following observations about the advantages of groundwater development in 1962:

In the most instances ground-water reservoirs are much larger than most surface reservoirs, and they hold in storage large volumes of water that can be drawn on as a reserve supply during dry cycles when surface supplies are depleted (the summer of 1961, for example). Thus ground-water reservoirs can be regarded as an insurance policy against drought! This water stored underground is not subject to loss by evaporation as is the case with surface reservoirs. For example: Utah Lake (a surface reservoir) loses as much water by evaporation as is used from the Lake both for irrigation and industry combined, amounting on the average to over 300,000 acre-feet annually.

The large initial capital outlay required to build a surface reservoir, often amounting to many millions of dollars, is unnecessary for a ground-water reservoir. Nature has provided the latter type practically free! The land covered by the body of water of a surface reservoir, except for recreation, is withdrawn from other uses and is generally very costly to acquire; on the other hand, the land surface above a ground-water reservoir can be fully developed for other purposes. Several of Utah's largest cities occupy much of the surface of their respective ground-water reservoirs. No silting problem exists for ground-water reservoirs. There are no dams to give way with the possible attendant great loss of life and enormous damage to property. The quality of ground water is less variable and the temperature more uniform. These are only a few of the advantages of ground-water reservoirs over surface reservoirs.¹

Retarded Development of Underground Hydrology

Although wells and springs have been used by man since prehistoric times, only very recently has technology been available to extract an

understanding of what groundwater is where it occurs. One prevalent idea in the past was that sea water flowed in underground caverns to springs and wells, and that it was converted to fresh water in the process. Successful wells were thought to intercept one of these underground streams. The general ignorance about groundwater has hampered the physical problems of finding and using groundwater. It has also helped to perpetuate many arbitrary, inappropriate legal definitions.

Ground water has been divided into many legal classes, including underground rivers, underground lakes, percolating water, diffused water, defined underground channels, and springs. Classifying water by inaccurate legal terms appears to be the principal cause of failure of many attempts to regulate ground water use or to promote conservation measures. Some judicial decisions resulting from this situation rest upon erroneous assumptions contrary to well-known facts about ground water... Ground water law has been confused and inconsistent.¹

Until 1700 it was believed that precipitation alone was not sufficient to account for all the water flowing in rivers—some of it must come from sea water that moved inland underground to reappear through springs to supplement the fresh water in lakes and rivers (it was presumed to be desalted by some unknown process in the transition). In the years just before 1700 Pierre Perrault undertook studies of precipitation and runoff in the watershed of the Seine River. He found that precipitation was six times the outflow of the river, proving that rainfall could easily account for stream flow, water used by plants, and water percolating down beyond the reach of plant roots.

¹Ground Water and Wells, p. 11.
Perrault's work was essentially the beginning of the modern study of hydrology.

Hydrologic investigation depends heavily on the technique of well-drilling. Drilled wells, as contrasted to dug ones, were an innovation of the 12th century. In 1126 a successful well was drilled in Artois, France. The term "artesian" derives from the name of that community. Significant progress in well-drilling was retarded for obvious reasons until well into the Industrial Revolution. According to Johnson Company, the most significant strides have been made in France, England, Germany, and the United States.

Systematic study of groundwater began only after well-drilling technology was fairly common. The first undertaken in the United States was in Wisconsin, between 1873 and 1879. The U.S. Geological Survey was organized in 1879, but although it recognized water as a mineral resource within its domain, the Survey did not begin groundwater investigations until 1890. Vigorous groundwater investigation and development in the United States did not begin until about 1915. In Utah it has been even more retarded.

In the article cited above, Dr. Marsell gave an historical sketch of groundwater development in Utah: It has been mostly a matter of trial and error, he said, and most of the work was undertaken and financed by individual water users and well-drillers. Such development "is always slow,

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1Information on the history of groundwater investigation is mostly from the Johnson Company handbook, *Ground Water and Wells*. 
haphazard, inefficient, expensive, and wasteful. The many costly failures inherent in this method, tended in many instances to discourage further development. However, well-drillers gradually acquired a store of useful knowledge about those areas with which they were most familiar, and they became the "expert" consultants on all matters of developing the client's well: location, depth, size, pump, etc. Nevertheless, "Utah has been slow--very slow--to develop her ground-water reservoirs. In large part, this has been due to an almost complete lack of hydrologic and geologic data upon which systematic and efficient development must depend." Marsell makes the observation that while the discovery and development of groundwater in Utah has been in the tradition of individual freedom and enterprise, it has also, for that very reason, been inefficient.

As consultant to the Water and Power Board, Dr. Marsell noted the problems created for the Board by the paucity of information about ground-water in the state:

The water supply in a ground-water reservoir is like a bank account and the water administrator, like the banker, must know: (1) the capacity of the reservoir; and (2) the amount of useable water in storage from which safe withdrawals can be made; (3) the pumpage by wells and natural losses by evaporation and transpiration (withdrawals); and (4) the most difficult of all hydrologic factors to determine is the annual recharge to the reservoir--the deposits in our "water bank account." For the 56 known and probably ground-water reservoirs in Utah, complete data covering these four hydrologic factors are practically nonexistent! In the absence of such absolutely essential information, the administrator of Utah's vast ground-water resources has been severely hampered
in discharging his duties, and thus the development of our ground-water resources has been seriously retarded.¹

Had it not been for the U.S. Geological Survey, Marsell continued, the State would have practically no basic information regarding its groundwater supplies. U.S.G.S. began investigations in Utah early in this century and between 1906 and 1913 published five hydrologic-geologic reports on the occurrence of groundwater in large areas of western Utah. These laid an excellent foundation for more detailed investigations that followed. As of 1962 there had been published thirty-five investigations of groundwater in Utah, virtually all of them prepared by personnel of the U.S.G.S. Furthermore, although there are fifty-six known or probable groundwater basins in the State adequate and relatively recent studies were lacking for forty-one of them as of 1962. Most investigations up to that time had been limited to areas where groundwater was already being actively used for irrigation or municipal supply.

Marsell insisted that while progress had been made, it was not enough. Vital information about pumpage and recharge was still (1962) unknown for virtually all of the state's ground water reservoirs. Well records have little significance unless the time span of the record covers about 100 years.² He spent a career urging the state to increase its effort in ground-water investigation.

¹Ground Water and Wells, p. 6.
²Personal communication.
After 1935 the U.S.G.S. matched funds with the State Engineer in groundwater investigations. In 1935 the amount put up by each side was $5,000. By 1962 it had grown only to $66,500. According to Bob Murdock of the State Water Resources Division, a colleague of the late Dr. Marsell, these investigative resources compare to those expended by the state on surface water "as horses to frogs in favor of surface water."¹ He emphasized, however, that this comparison applied to investigation only, not to development.

¹Personal communication.

All groundwater, of course, originates in precipitation. Only a fairly small portion of total precipitation finds its way into the groundwater reservoir. Some becomes surface runoff immediately. Another part soaks into the soil only to be drawn up by plant roots or soil capillarity and thereby lost through evaporation and transpiration. The remaining portion, which soaks below the plant root zone, keeps moving under the influence of gravity until it enters the groundwater reservoir or zone of saturation. Once in the zone of saturation water moves laterally through the pores of the subsurface

¹The Johnson Company volume cited earlier in this chapter is the source for these notes. It provides illustrations which interested readers will find very helpful.
materials, and may reappear as surface water at elevations lower than where it entered the groundwater reservoir.

Geologists refer to the earth's crust as the lithosphere. Lithology is, therefore, the study of the various layers that occur in a cross section of the crust, or lithosphere. (All of these materials are called rocks, whether they be sand, clay, or granite.) The outer part of the crust is normally porous to a greater or lesser depth, and is called the zone of rock fracture. At greater depths lie consolidated rocks which are under such great pressure that no space exists for water. Within the zone of rock fracture the pores of the lithosphere may be wholly or partially filled with water. The lower portion of the zone is obviously the most likely to be saturated with water, and does constitute the groundwater reservoir. The upper surface of the saturated zone is called the water table. Above the water table there is water in among the rocks, but they are unsaturated. This is called the zone of aeration or vadose zone. Water gradually percolates down through this zone to the water table, cut capillary and molecular attraction work counter to gravity to retard its descent. In cases where the water table happens to be near to the surface (as by a stream which is fed from groundwater discharge) the roots of some plants extend all the way down through the vadose zone to tap the groundwater reservoir. These are phreatophytes, which grow without dependence on the belt of soil moisture, as the upper most level of the vadose zone is called. Water in lower levels of the vadose zone, below the belt of soil moisture, is
in dead storage. It cannot be used by plants (except phreatophytes, of course), nor can it be recovered by wells.

Only that water in the zone of saturation (below the water table) is properly referred to as groundwater. "The saturated zone may be viewed as a huge natural reservoir or system of reservoirs whose capacity is the total volume of the pores or openings in the rocks that are filled with water. Groundwater may be found in one continuous body or in several separate strata." The zone of saturation may vary in thickness from a few feet to many hundreds of feet, and usually contains several formation or strata within it. These strata will have differing degrees of permeability for water. Those with pores large enough to yield water to wells or springs at a sufficient rate to serve as a practical water supply are called aquifers. Clay, for example, may be thoroughly saturated with water but cannot qualify as an aquifer because water cannot move readily through its tiny pores. The presence of impermeable or very slightly permeable strata at particular elevations can have a confining effect on the water table, which is controlled to a degree by topography. In fact, the water table tends to follow, generally, the shape of the land surface. If the water table should happen to occur within a permeable layer, that layer is said to be an unconfined aquifer, and the water in it is said to occur under water table conditions. Hydraulic pressure in a water table aquifer is equal to the depth in feet from the water table to the point in question. It is expressed as hydraulic head in feet of water.
Water in an aquifer may become confined under an impervious layer, below the water table. By the definition of the previous paragraph, such water has an hydraulic head. If the confining layer were punctured, water in the confined aquifer would tend to rise up to a level that is analogous to the water table is an unconfined aquifer. The height to which it will actually rise in a pipe is called the piezometric level. Groundwater reservoirs of this description are called artesian aquifers, and wells tapping them, of course, are artesian wells. "An imaginary surface representing the artesian pressure or hydraulic head throughout all or part of an artesian aquifer is called the piezometric surface." If this surface happens to be above the land surface, than a well tapping the artesian aquifer below will result in the water rising well above the land surface--a flowing well. If the well casing (pipe) is extended high enough to stop the flow, the water level in the pipe will be, of course, the piezometric level.

Sometimes a localized, impervious layer (such as consolidated rock or tight clay) occurs in the vadose zone, thereby preventing percolating water from reaching the zone of saturation below. A saturation will, therefore, develop above the impervious layer and a condition analogous to a water table aquifer obtains. Such phenomena are called bodies of perched water.

In the place already cited, Marsell made some observations about stages in the development of groundwater reservoirs that can be seen as easy inferences from the foregoing technical account. Marsell described these stages as typical of the pattern followed in all of Utah's groundwater reservoirs:
In the initial stage, wells are few in number and practically all wells flow at the surface, indicating that the aquifers or water bearing layers of gravel and said slope basinward and are fully saturated, thus producing the hydrostatic pressure that brings the water, when tapped by wells, to the surface. Some of the larger diameter wells, at this stage, may flow with relatively large volume. As many additional wells are drilled, the next stage is reached where the pressure is sufficiently reduced so that some of the former "flowing" wells of stage one fail to flow, particularly in the upper margin of the reservoir. This does not mean that the available water supply is being depleted! It merely indicates the loss of head brought about through lowered pressure. The bodies of gravel or sand (aquifers) that contain the water are still fully saturated! The lowering of a few inches of the water level in a given well, when a nearby well is pumped, both wells tapping "confined" or "artesian" water in the same aquifer or aquifers, may indicate the removal of less than a bucket of water from within the casing of the affected standing well, so sensitive is the water level under hydrostatic pressure. In the third stage in the evolution of development of our ground water reservoirs, the number of wells that cease to flow increases rapidly and pumps are installed to lift the water to the surface, which also greatly increases the amount of water obtained from the well. Wells under four inches in diameter cannot be equipped with deep well pumps so new wells of larger diameter must be drilled . . . In the final stage of complete development no wells flow and the ground water reservoir becomes a "pumping field." Now that the "pressure" has greatly diminished, natural losses are correspondingly greatly reduced and the reservoir will now safely yield four to fives times as much water as in any of the earlier stages in the development of the basin. 1

Marsell used the example of the Bountiful district to illustrate these principles. At the time of writing (1962) Bountiful was in stage three of development. We will see later that a significant part of the consternation that led to the WBP was due to popular fear that mistook stage two for impending exhaustion of the groundwater reservoir. Perhaps more important even than that,

1Ground Water and Wells, p. 10.
however, was obsolete legal terminology which interpreted stage two as exhaustion.

A macroscopic perspective on Utah geology is highly useful to understanding the reports of hydrologists: water runs downhill, except as lifted by evaporation or transpiration. It is deposited as precipitation. In Utah, most of it falls on the mountains. From the mountains it flows downhill, over the surface and through anything permeable in its course. It will flow into bedrock if there are cracks, but there are limits to the depths water can reach because the rocks of the earth’s crust become more dense with increased depth, and eventually plastic in the mantle. Some water is trapped at great depths in bedrock chasms and will never reach the sea unless there is a major geologic upheaval. The Great Basin is a similar kind of trap. By moving water can and does flow over and through the upper part of the zone of saturation.

Bedrock is buckled and folded in Utah, and its broken edges project above the earth’s surface on mountain peaks. Between these broken edges, softening the relief, is a great mass of unconsolidated (loose) fill. When rain and snowmelt runs down the tilted bedrock, most of it runs through this permeable fill rather than over it. Much of it, therefore, winds up in the mass of sediment that partially fills the troughs between the ranges of bedrock peaks. When the level of saturation is high enough in these sediment-choked troughs, the upper layer of water seeps through cracks and openings in the jagged bedrock upthrusts, and makes its way into lower valleys until it
reaches either a conduit to the sea or an inland evaporating pan like the Great Basin.

From this perspective we should not be surprised to find that the mountain valleys of Utah have excellent groundwater reservoirs. One might also predict that waters below the desert floor of the Great Basin are of poor quality, but perhaps relatively abundant. The margins of Great Salt Lake represent the emergence of the water table, or zone of saturation, above the surface of the Basin fill. ¹

**Groundwater Investigations in the East Shore**

Geologists define the East Shore area as the low-lying lands west of the Wasatch front, bordered on the north by the Lower Bear River Valley. It is a well-defined groundwater unit, with three identifiable districts: Bountiful district includes the area south of Farmington Bay; the Weber Delta district extends to Bear River Bay; above that is the Brigham district.

The principle service area of the Weber Basin Water Conservancy District is the region described above as the Weber Delta and Bountiful groundwater districts. The WBWCD is essentially coterminous with the Weber River drainage basin, with the addition of what is here called the Bountiful

¹There are desert valleys in Utah, defined by lower mountain ranges that receive relatively little precipitation. These valleys do not have good groundwater reservoirs because of this low precipitation, and for other reasons explained by Marsell. Eleventh Biennial Report of the Division of Water Resources (State of Utah, 1968), pp. 67-73.
groundwater district. The East Shore area of the WBWCD is, therefore, the land lying west of the Wasatch Front between the City Creek spur and the Pleasant View salient of the Wasatch Range. This East Shore area is the most important groundwater resources which are a major factor in the WBWCD's problems.

Serious hydrologic study of the East Shore area did not get under way until after World War II. It has been more or less continuous since that time. The first major investigation was by Thomas and Nelson, who confined their efforts to the Bountiful District, and reported their results in 1948.\(^1\) A team from the Bureau of Reclamation and the U.S. Geological Survey carried out an intensive cooperative study of the Weber Delta District in the early 1950's. Although their operations were terminated in 1956, their results were not published until 1966.\(^2\) In the meantime a smaller scale study of groundwater conditions in the whole East Shore area was published as a cooperative effort between the U.S.G.S. and the State Engineer of Utah.\(^3\) In 1970 a group from

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\(^1\) H. E. Thomas and W. B. Nelson, "Ground Water in the East Shore Area, Utah," Twenty-sixth Biennial Report of the Utah State Engineer (1948). (This document if out of print and scarce. I used an onion-skin carbon of the original report in the State Engineer's Office.)

\(^2\) P. P. 518. Some interim internal reports were produced, one of which is the subject of Appendix IV.

Utah State University published some more recent data about the East Shore as part of a larger study.¹ And in 1971 an exhaustive report on groundwater in the East Shore was prepared by two hydrologists at the Salt Lake office of the U.S. Geological Survey.² Since 1964, groundwater conditions have been monitored constantly in connection with developing a State Water Plan.

**Hydrology of the Weber Delta District³**

The District is like a bathtub containing a gigantic sponge whose contours fit exactly into the tub, except that it is too large in some dimensions, so that part of the sponge sticks up out of the tub and spreads over the western side. The tub is made of consolidated rock--bedrock, through which water can penetrate only if there are fissures. The sponge is loose or unconsolidated material, such as gravel, sand, silt, and clay, with varying degrees of permeability.

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³ The description of the Weber Delta District is drawn mostly from the fundamental work of Feth et al., P. P. 518.
Geologists believe that surrounding fault lines allowed the bedrock floor to drop like a trap-door hinged near Farmington, thus forming a bathtub-shaped depression which is filled to overflowing with unconsolidated material. The Wasatch Front is one obvious fault line; a north-south line from the south end of Promitory Point to the southern boundary of the Pleasant View salient and up Ogden Canyon. Inside these fault lines there has been a vertical, downward displacement of bedrock, leaving bedrock walls along the fault lines. These walls extend above the surface along the Wasatch Front and at Little Mountain, but at other places are not high enough to completely contain the unconsolidated fill which, therefore, spills over the side as in the sponge analogy. Bedrock slopes upward gradually to the "hinge" near the latitude of Farmington. It also slopes up somewhat toward the north end (Pleasant View salient) as well as toward each side. Except at Little Mountain and along the Wasatch Front, consolidated rocks forming this trough are not exposed.

Thickness of unconsolidated fill in the trough is estimated to range from 9,000 feet at its greatest depth to a featheredge adjacent to the mountains. The trough is 25 miles from north to south, and 15 miles wide at its greatest extent (north of Ogden). Its southwestern portion is presumed to extend under Great Salt Lake. By these dimensions, the volume of unconsolidated and poorly consolidated material deposited in and overflowing the bedrock basin is estimated to be approximately 200 cubic miles. This sponge and bathtub contain the groundwater reservoirs of the Weber Delta District.
The unconsolidated material constituting the sponge has been laid down over several millenia in interfingering wedge or lens-shaped layers of sand, silt, gravel, and clay. Some of the layers have been deposited by streams, others by lakes. Lacustrine (lake) deposits tend to be of finer, less permeable materials than fluvial (river) deposits. (Alluvial fan reservoirs are especially significant in Utah according to Marsell.) Some of the layers of unconsolidated fill (formations in geologic terminology) are exposed at different levels along the mountain front. Some of the formations are permeable and allow passage of water; others are not. Formations containing coarse materials absorb water that falls on or runs across their surface. The water percolates down through these permeable formations until it reaches the fine and less permeable clay and silt formations, and then moves along the top of them laterally to a point of discharge (a spring or lake). Other more recent layers, often quite impermeable, lie above. Impermeable layers blanket the surface in areas of artesian discharge. A puncture in the impermeable layer releases an artesian flow as the reservoir seeks to stabilize itself. Only the more permeable layers of fill (sand and gravel), even in the saturated zone, can be considered as groundwater reservoirs, because water moves too slowly through clay and silt to be extractable in useful quantities.

Layers in the Weber Delta fill-body all tend to slope downward away from the mountain front. This means that the water in reservoirs is confined, as explained above. Such confinement creates artesian pressures at points where the land surface is at a lower elevation than part of the reservoir.
In the Weber Delta district the approximate upper limit of artesian flow is 4,300 feet. Many rural homes below that level have flowing wells in their yards. The 4,300 foot contour excludes most of the urban area of Weber County except a part of northwest Ogden City.

Authors of the Feth report estimated that the "sedimentary prism," which is the sponge of our analogy, contains 170 million acre feet of water. Precipitation is, of course, the ultimate source of water in the reservoir. However, only a small proportion of the precipitation falling on the surface area of the fill finds its way into high-yield aquifers. This is, of course, due to impermeable layers separating artesian aquifers from the surface, as well as to losses from runoff and evapotranspiration. The main areas where recharge takes place are a narrow belt running the length of the district along the foot of the mountains, plus about 1 1/2 miles of the Weber River channel beyond the canyon mouth. In these areas a layer of coarse material is exposed which then submerges and is covered by impermeable layers. On bench lands along the mountain front, therefore, some precipitation percolates directly to artesian aquifers—the excess after evapotranspiration and replenishment of soil moisture. Direct precipitation on flatlands west of the mountain front contributes little or no recharge to deep aquifers, but probably does to shallow, unconfined ones.

Precipitation on other areas can reach the reservoir, however. As noted, 1 1/2 miles of the Weber River channel are a major recharge area; hence precipitation falling as far away as the Uinta Mountains at the eastern
edge of the Weber Basin can recharge the Delta aquifer by means of the river. Snow and rain falling on the Wasatch Range eventually contribute large but unmeasured volumes of water to the basin by percolation through fractures and joints in the rocks of the range. Rocks of the Wasatch Front near Willard and Pleasant View are of Cambrian limestone, which is cavernous and holds large quantities of water which discharge into Willard Bay and into wells in the area. "The Cambrian limestone, where present, . . . undoubtedly is recharged with water from snowmelt and transmits it to the unconsolidated aquifers in the Willard area and probably also in the Weber Delta district."¹

Some Precambrian metamorphic rocks outcrop in the Wasatch Range just east of the Wasatch Fault zone where they constitute a major part of the eastern boundary of the groundwater basin. They "probably contain and conduct large volumes of water which recharge the aquifers of the Weber Delta district."²

Conceptions of the possible extent of this percolation from the mountains are enhanced by the theory of geologists that the Wasatch fault is likely not a single break, but a zone of shattering, movement, and slippage a mile or more in width. In some places the frontal-fault zone serves as a channel for warm, mineralized water which rises from great depths.

Although the bathtub and sponge of our analogy do extend under the bed of Great Salt Lake on the west and south, the main artesian aquifers

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¹P. P. 518, p. 13.
²Ibid., p. 12.
apparently are not recharged with salt water. The western side of the Weber Delta district has a bed of clay deposited by Lake Bonneville. Although estimated to be less than 10 feet thick, upward leakage of artesian water through this clay is very slow, as it extends many miles westward under the present basin of Great Salt Lake. Geologists believe it is a seal separating lake brine from artesian aquifers under the lake. In some cases, however, when artesian pressures have been reduced by wells near the lake, salt water brine has backed up into some of the shallower aquifers. These may be unconfined aquifers, however, which are not the principle groundwater reservoirs of the district.

Feth et al., estimated the volume of annual recharge at about 70,000 acre feet, from these sources:

<table>
<thead>
<tr>
<th>Source</th>
<th>Volume (acre feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weber River</td>
<td>16,000</td>
</tr>
<tr>
<td>Ogden River</td>
<td>2,000</td>
</tr>
<tr>
<td>Mountain front streams</td>
<td>3,000</td>
</tr>
<tr>
<td>Mountain front subsurface</td>
<td>30,000</td>
</tr>
<tr>
<td>Precipitation</td>
<td>10,000</td>
</tr>
<tr>
<td>Irrigation on flatlands</td>
<td>4,000</td>
</tr>
<tr>
<td>Canal seepage</td>
<td>2,000</td>
</tr>
</tbody>
</table>

These figures are estimates calculated from past records. Therefore, while the average annual recharge from the Weber River may be only 16,000 acre feet, it was estimated at 100,000 acre feet in 1952, whereas the lowest value
known was 9,000 acre feet in 1934. Thus the average value estimated is certainly a long way from the median of the highest and lowest values on record.

The greatest significance, however, attaches to the fact that in a flood year, when the river overflowed its banks onto the surrounding recharge surface, its capacity to recharge the main aquifers amounted to 100,000 acre feet. (Estimated average annual yield from the entire Weber Basin Project was projected to be 210,000 acre feet.) This suggests that deliberate efforts to recharge the aquifers through the 1 1/2 miles of the Weber channel below the mouth of the canyon might produce some spectacular results. In 1953 the Bureau of Reclamation conducted a recharge experiment in this area. A pit 30 feet deep with an area of 3 1/4 acres received surplus flow from the Weber River over a continuous period of 7 weeks. It absorbed water at a rate of 7 cfs. per acre. ¹

A problem with recharge pits is that they can be filled in or surfaced with silt. They need scraping out from time to time, and turbid water (flood season) is a problem. However, 1952 was a year of major flooding, hence turbidity, yet a remarkable quantity of recharge took place in spite of it.² A deliberate effort to build a catch basin by means of scraping up clay beds,

¹Ibid., p. 44.

²E. J. Fjeldsted recalls that flood waters ran into a gravel pit near the canyon mouth, but never did completely cover the bottom. This led to the test described in P. P. 518. (Interview with E. J. Fjeldsted in 1969.)
building a dam across the channel, and moving out the residential and farming area would surely result in a far more significant amount of addition to groundwater reservoirs than the equivalent expense could provide in surface water. On the other hand, flood control provided by the WBP makes recharge a more attractive proposition due to fewer silting problems in flood season. This benefit must be weighed in evaluating comparative costs.

When it is noted that the 100,000 acre feet of recharge in 1952 was from the Weber River alone, there must have been a total of at least 150,000 acre feet of recharge in that year when the other sources are accounted for. Some hydrologists believe that deliberate recharge efforts of the kind described above could provide an increment to East Shore groundwater reservoirs that would equal the water supply potential of the entire Weber Basin Project. Furthermore, the aquifers of the Weber Delta district have ample reserves that could have been drawn down in seasons of low precipitation for many years before a surface project of WBP magnitude was ever needed.

Feth et al., estimated that 100,000 acre feet of water (a conservative figure, they say) could be withdrawn from Weber Delta aquifers without any dewatering (just reducing artesian pressure). Dewatering the Delta aquifer to 50 feet below its upper surface (its about 250 feet thick) would produce another 300,000 acre feet. Dewatering other aquifers of the district to the same extent (50 feet below their upper surfaces) would produce another 400,000 acre feet (again on conservative estimates). Thus 700,000 acre feet of groundwater could be withdrawn from the Weber Delta District aquifers without seriously
depleting them. In 1974 the consumptive use of water generated by the Weber Basin Project was 115,000 acre feet, of which nearly 10,000 came from wells in the East Shore area. In 1971 total use was only 84,000 acre feet.  

Readers may find water budget figures for the Weber Delta District useful for context. The water budget was estimated by Feth and company, and appears on page 33 of their report (see Table 1).

One item of income in the water budget merits special comment. The Ogden City wells at Artesian Park are under Pineview Reservoir. New pump wells were drilled by the Bureau of Reclamation in connection with the expansion of Pineview, and the pump house is at the edge of the reservoir. There is a contractual agreement between the city and the Bureau to empty Pineview for regular inspections and maintenance. Feth et al., noted that there is no connection between the aquifers of Artesian Park and those of the Weber Delta district. Ogden City has been using this source for a long time, and expects to supply most of its requirements from them for an indefinite time to come. Hence, Ogden City does not figure as a competitor for the groundwater resources of the Weber Delta District. As Ogden is by far the largest city in the District, the groundwater supply left to other municipalities is truly abundant.

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**TABLE 1**

WEBER DELTA DISTRICT WATER BUDGET

<table>
<thead>
<tr>
<th>Entering</th>
<th>1,000's of A.F.</th>
<th>Leaving</th>
<th>1,000's of A.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weber River</td>
<td>360</td>
<td>Weber River</td>
<td>330</td>
</tr>
<tr>
<td>Ogden River</td>
<td>160</td>
<td>Canals</td>
<td>10</td>
</tr>
<tr>
<td>Mtn. front streams</td>
<td>35</td>
<td>Drains and sloughs</td>
<td>20</td>
</tr>
<tr>
<td>Mtn. front streams</td>
<td>35</td>
<td>Mt. front discharge to GSL</td>
<td>15</td>
</tr>
<tr>
<td>Ogden City Wells from Artesian Park</td>
<td>15</td>
<td>Runoff from precip. on salt barrens</td>
<td>35</td>
</tr>
<tr>
<td>Precip. below 5,000 feet</td>
<td>350</td>
<td>Evap. and evaportrans:</td>
<td></td>
</tr>
<tr>
<td>Groundwater inflow from mountain front</td>
<td>30</td>
<td>Irrigated crops</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Saltgrass pasture</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cattail areas</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dryland crops</td>
<td>45</td>
</tr>
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<td></td>
<td></td>
<td>Salt barrens</td>
<td>40</td>
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<tr>
<td></td>
<td></td>
<td>Water surfaces</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lawns, townsites, etc.</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subtotal</td>
<td>930</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discharge unaccounted for--leakage to GSL</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>950</td>
</tr>
</tbody>
</table>

Source: P.P. 518, p. 33.
Some hydrologists believe that the authors of the Weber Delta study were deliberately extreme in the conservatism of their estimates of groundwater potentials, especially in respect of recharge. The investigation was sponsored by the Bureau of Reclamation as part of the Weber Basin Project, and was made between February 1953 and July 1956, prior to the completion of any of the major elements of the WBP. This acknowledgment appears on page 3 of the report. But publication was delayed until 1966, by which time most of the WBP structures had been completed. Senior author J. H. Feth was a staff member of the U.S. Geological Survey, but all the others, D. A. Barker, L. G. Moore, C. E. Veirs, and R. J. Brown, were employed by the Bureau of Reclamation. L. G. Moore is still with the Bureau, doing groundwater studies for the Central Utah Project at the Bureau's Provo office. He confirms that data for the report were generated in the 1940's and 1950's.

Hydrologists in Logan and at the State Capital have expressed sympathy for the hypothesis of Bureau of Reclamation duplicity expressed in Appendix II. Frank Haws of the Utah Water Research Laboratory worked for the Bureau in the early 1950's and was acquainted with J. H. Feth. He says that Feth was concerned at that time about the evidence of abundant groundwater and its potential effects on the Weber Basin Project. The Utah Water Lab received pre-publication copies of the report and Haws says that virtually none of the figures on groundwater from those early versions found their way
into the final product. A suggestion that the Bureau possibly sat on the Feth study until the WBP was complete, and then cooked the figures, has been made to a few hydrologists at the State Capitol. Their response was a shrug and a comment that such practice would be "nothing new for the Bureau."

Haws suggests that the State government does not believe much of what it is told by the Bureau anymore, and cites as evidence its duplication of investigations already done and published by the Bureau (particularly in respect of the Bear River basin).

Throughout the 1966 version of the Feth report, repeated emphasis is given to the notion that groundwater conditions change as man alters the natural flow of water. The preface notes that the groundwater conditions reported show the situation after modification by man—namely irrigation recharge, well-drilling, drainage of land. Twice in the text of the report the authors observe that their exposition of groundwater status as of 1953-1956 will serve as a benchmark from which to demonstrate increases in groundwater availability as the WBP progresses. Alongside this forecast of increased groundwater is the disclaimer that their knowledge of aquifer capacities and recharge is incomplete and subject to change.

When evaluated in light of other circumstances surrounding the WBP, these confessions and professions of ignorance and expectation are suggestive. Why was publication withheld for 10 years if it was intended to demonstrate

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1 P. P. 518, pp. 3 and 33.
increases in groundwater as the WBP was completed? Did someone fear that such honesty might catch them by surprise—with no substantial increase in groundwater? Earlier versions had the annual average groundwater recharge at a considerably higher level than the 60-70,000 acre feet reported in the published form. Without further testing, the estimate was rounded down to the published figure. L. G. Moore noted in 1971\(^1\) that large new wells in the Weber Delta District have altered the understanding of its groundwater resources from that presented in the Feth report. No one can argue very successfully against this position that the Bureau and Geological Survey have drawn for themselves. It has to be true, in general, that knowledge is incomplete, and that even if it were perfect at one point in time, knowledge of things as fluid as water must be subject to change. Nevertheless, defenders of the WBP such as Wayne Winegar, DeLore Nichols, and Rex Greenhalgh\(^2\) must be grateful for the argument provided by the Feth report when they are challenged on the inconsistency of such an expensive construction project with the abundance of groundwater with which the East Shore area is so obviously endowed. They are quick to respond that the abundance is only a facet because of recharge provided through WBP facilities. They may be right.

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\(^1\)Personal communication.

\(^2\)Nichols will become more familiar to readers in Chapter IV. Greenhalgh was, at the time he provided information for this investigation—1969—senior officer in charge of the WBP at the Bureau of Reclamation's regional office in Salt Lake City.
Nevertheless, even without a conscious desire to have a demonstration of Project recharge, there was plenty of reason to sit on the report for 10 years, for even the modified figures finally reported would have cast serious doubt on the economic wisdom of going ahead with the WBP had they been public information in 1956 or 1957.

The Feth report was generated completely from within the Reclamation--Geologic Survey bureaucracy. It provides no counter-evidence against the hypothesis of Appendix II that bureaucratic self-interest was a principal source of the WBP. On the contrary, it lends plausibility. Documents prepared by the Bureau of Reclamation and found in the State Engineer’s Office provide explicit confirmation that the Bureau had ample knowledge of groundwater abundance. The same material confirms an inference made in Chapter V from the 1959 CPR about municipal and industrial water supply. These documents were discovered after the conjectures which they support had already been written into the text and appendices. Because of their importance as evidence, major portions of the documents are reproduced as an Appendix to this chapter (see Appendix III).

Knowledge of East Shore groundwater is very recent, nevertheless, and from the evidence available in 1949 the WBP would not have appeared as redundant as it did in 1959. It was the south end of the district that feared a water shortage, and hydrologic study of the Bountiful District during the 1940's had not yielded an optimistic forecast of groundwater potential. The
conclusions of Thomas and Nelson were no doubt an important element in the
selling of the Weber Basin Project.

Bountiful District in 1948: Thomas and Nelson

The groundwater situation that emerges from this report is quite
different from what we have seen of the Weber Delta District. In the first
place, there seems to be no bedrock trough comparable to the bathtub north
of Farmington. Bedrock appears to slope away from the Wasatch range
toward Great Salt Lake with no significant barriers in the form of fault lines
in bedrock. The sponge of unconsolidated materials is, therefore, free to
drip away toward the western side. The materials of the sponge are not so
favorable to water retention as those of the Weber Delta District either.
Especially in the eastern portion of the district they are mostly an undiffer-
entiated mixture of coarse gravel, rocks, boulders, sand, and clay. This
material becomes progressively better differentiated into layers of coarser
(permeable) and finer (less permeable), but the layers themselves are far
from being the even strata portrayed in the pictures of the Johnson text
(referred to above). Instead, they are inclined to be lens-shaped and
irregularly defined, both vertically and horizontally. Furthermore, even in
the western part of the district the impermeable layers are permeable in part,
allowing groundwater to filter upward to be lost through springs and evapotrans-
piration. Thus, although Thomas and Nelson identify shallow, intermediate,
and deep artesian aquifers, they are of the opinion that confining layers
between the three are permeable in varying degrees throughout the district.

The authors say the district is divisible into two main portions by
the upper Bonneville Canal, which pumps water from the Jordan River to
about the 4,500 foot level in South Davis (about 8th Street East in Bountiful).
Water spread by this canal recharges the shallow artesian aquifer, and is,
therefore, withdrawn in part by wells in the western portions of the district.
Above the Canal, groundwater occurs under water table conditions, and wells
in that region, in the 1940's, did not tap artesian aquifers (in spite of efforts
to develop such wells before and during the period of the Thomas and Nelson
study). Water-spreading experiments by Bountiful City over a few years
preceding the report led the authors to conclude that such water percolated
down to an impermeable layer, ran along over top of it, and surfaced again
in springs, water tunnels, and shallow wells in and around Bountiful City
before it had got as far as the recharge area for the shallow aquifer just below
the Bonneville Canal. This means, they infer, that water in the deeper
aquifers of the district enters through a recharge area that is above the re-
charge basin of the Bountiful experiment and then moves down and westward
under the confining layer referred to in the previous sentence. Even though
under a confining layer, however, water in this region is not readily develop-
able because it occurs in a large mass of unarticulated debris—mud and rocks
of the kind deposited by some spectacular floods and mud-rock slides in Davis
County during this century. As noted earlier, good wells require a bed of relatively clean gravel.

The best part of the Bountiful District aquifer runs generally north-south at the longitude of Woods Cross where there are several alluvial fans from mountain front streams. West of this good section the groundwater reservoir suffers from lack of definition; small pockets of good water-bearing strata are connected poorly with each other through layers of semi-permeable fine sand and silt. This general but poor permeability means that water is lost from the reservoir by seepage, and also that water moves slowly through it. The latter fact accounts for a high degree of well interference in the district. Discharge from one well can have a marked effect on the water level in neighboring wells, leading to conflicts over water rights and fears that the district is running out of water. In the region of the good alluvial fan aquifer, described above, there is little well interference. The largest and deepest wells in the region further west have the least interference problem, probably because they tap several water-bearing strata, and also because the intermediate aquifer is a better one than the shallow one. (The deep one is only inferred by the authors. Only a few wells were deep enough to suggest its existence at the time of their study.) Well interference is even worse in the eastern region of the district. Some wells that flowed strongly when new later had their water level drop to 23 feet below the surface after other wells were opened around them. This is consistent with the authors' conclusion that the shallow wells in that region are tapping a reservoir that has very little
confinement pressure. Bountiful City was thus presumed in 1949 to be located over a major recharge area, but able to tap only an indifferent aquifer.

Thomas and Nelson concluded that the strata underlying South Davis County constitute an inefficient groundwater reservoir. There is not much recharge to it directly from the mountain front streams. Its aquifers tend to be small, poorly confined, and interconnected. Water, therefore, moves through it slowly, and then escapes. "Westernmost wells may be discharging water which entered the artesian reservoir half a century ago." Changes in the amount of water in storage are transmitted quickly to other parts of the reservoir by means of changed hydraulic pressure. This is not indicative of a large highly permeable fill. Quite a lot of water is lost through springs and evapotranspiration in the far west, where the depth to water is only 5 feet. Artesian aquifers do extend under Great Salt Lake, but not much water moves into them. "Thus most of the water entering the ground water reservoir of the Bountiful District is discharged within that district by natural and artificial means." ¹

The problem was compounded by inefficient use of such groundwater as was available. Development of artesian wells started in 1885 with a 10-inch diameter, wooden-cased well augured to a depth of 58 feet. Several others were developed in the same way, but practices soon changed to

¹ Thomas and Nelson, p. 164.
incorporate the use of 1 1/2 to 2-inch iron pipe as casing material. By 1891 a Census of Irrigation reported 53 artesian wells in the district, all of them 1 1/4 to 2 inches in diameter. None was deeper than 170 feet. In 1904 the region of flowing wells was described as a belt 1 to 2 miles wide and 3 miles long, between the Woods Cross and Centerville Post Offices. One quarter-section is described as containing 30 flowing wells running 20 to 100 gallons per minute from 2-inch casings, at depths of 100 to 175 feet. Piezometric surface was 1 to 12 feet above the ground. This surface was lowered if all the wells were kept running. This describes precisely the kind of situation defined as inefficient in the long statement from Marsell quoted earlier. Fewer and larger wells would allow for pumping, eliminating seepage losses from excessive artesian pressure. By 1946 the number of wells had grown to 1,310, of which 930 were used for irrigation, 200 for domestic purposes, 4 for municipal supplies, 40 for industrial supplies, and 50 for stock.¹ About 1,040 of these flowed at the surface. About 680 had diameters of 2 inches or less, 520 of 2 1/2 to 4 inches, and 20 cased wells had diameters of 5 to 12 inches.

Nearly half of the wells in existence at the time of the Thomas and Nelson study were drilled prior to 1910. But use of groundwater east of the artesian area described in the previous paragraph did not really get under way until after 1900. Pumped wells did not appear until after 1920. Thomas and

¹Ibid., p. 178.
Nelson estimated that since 1932, the discharge from all of these wells together was two to three times what it had been in 1890, when there had been about one-fifth as many wells. They estimate the average annual discharge from artesian wells at 11,000 acre feet, and that from pumped wells, drains and tunnels east of the artesian area at 2,000 acre feet. Total average annual draft on the groundwater reservoir was, therefore, estimated to be 13,000 acre feet.

Inflow of water to the district was estimated to be an average of 31,000 acre feet per year, from these sources:

- Tributary stream flow: 18,000
- Bonneville Canals: 4,000
- Precipitation over recharge area: 9,000

Total: 31,000

When the discharge from wells is subtracted from this supply figure, the 18,000 acre feet remaining is about the same amount as the authors estimate to be consumed by irrigation from streams plus wastage to Great Salt Lake and evapotranspiration losses:

- Surface water irrigation: 12,000
- Discharge from wells in irrigation season: 11,000
- Discharge from wells in non-irrigation season: 2,000
- Discharge from springs: 1,000
- Stream outflow to Great Salt Lake: 3,000
Other losses, including evapotranspiration 2,000
Total 31,000

If the last four items are considered as wastage, then the potential for increased supplies from sources within the Bountiful District appears limited to 8,000 acre feet. The authors infer that since water levels in observation wells were about the same in 1946 as they had been in 1936, storage in the groundwater reservoir had not been drawn down over the intervening period. (See quotations from Marsell. As long as some wells are flowing, the reservoir is not being depleted.) Nevertheless, during prolonged dry periods, such as the early 1930's, the yield from flowing wells was considerably reduced, due to less recharge and hence to less water storage in the reservoir. But the fact that artesian flows and well yields increase in good water years is evidence, said the authors, that the groundwater reservoir was not over-developed. In dry years, however, some wells would have to be pumped.

Thomas and Nelson conclude their report with observations about the future of water supplies for the Bountiful District: Bountiful City cannot expect to develop good wells in or near the town, they said. Increased water for the industrial area growing in the Woods Cross region can be obtained from the artesian aquifer, but it will probably have to be pumped, and that will draw down the hydraulic pressure and reduce the flow of nearby wells. That would not please existing well-owners, and the State Engineer has already discouraged the drilling of large new wells, under the assumption that the groundwater reservoir is approaching the limit of its "economic" development.
The water wasted from wells in the non-irrigation season could be eliminated by plugging uncappable wells. Natural losses from springs and evapotranspiration could be mostly eliminated by pumped wells in the far west region. Because of the inefficiencies of the reservoir, already recited, pumpage as recommended might not increase appreciably the amount of water storage, although it would eliminate some waste. Increasing the storage would depend on being able to increase recharge by artificial means.

One of the inefficiencies of the reservoir noted by the authors is that the streams that bring water to the district do not pass over a very large or very permeable recharge area. Improvement of this situation calls for artificial recharge. There had been two major efforts at this in the previous decade, one near Centerville, the other at Bountiful. The one at Centerville coincided with an increased flow from wells below it, but nothing could be proved conclusively about recharge. In the Bountiful case recharge could be demonstrated, to the water table aquifer only. Recharge to the shallow artesian aquifer occurs from irrigation out of the upper Bonneville Canal.

For artificial recharge of deeper aquifers, water should be spread somewhat farther east, perhaps in areas as high as 4,600 feet in altitude. These areas include much of the city of Bountiful and the residential areas farther south, near Val Verda; water spreading in the part of the recharge area above 4,600 feet altitude will serve chiefly to increase the water supplies available from the Provo shore gravel, as shown by the experiment of the City of Bountiful.\(^1\)

\(^1\)Ibid., p. 187
The authors note that Bountiful City made provisions for obtaining the evidence that the increased water in the aquifers tapped by their wells did in fact come from their own recharge efforts.

If all of these efforts were undertaken, said Thomas and Nelson, the increment to water supply in the Bountiful District would still not likely surpass 5,000 acre feet per year. The district was already using 70 percent of the water that it received from all sources every year. Conservation measures could not be expected to eliminate all natural losses, and even with outstanding success could not increase the available water supply by more than 20 percent, or 5,000 acre feet. Furthermore, the City of Bountiful and 45 other applicants had already filed for permission to develop more water than that in the immediate future. Thus Bountiful District had no more than enough water for its immediate requirements, even if it could implement immediately a first-rate conservation program. They concluded that for its future requirements, if the district has to have any growth, South Davis County must import water from outside its drainage basin, and noted with approval that the Bureau of Reclamation had plans under consideration to bring in surplus water from the Weber River system. The first paragraph of the Thomas and Nelson report merits quotation in full:

The Bountiful district in Davis County, Utah, which is less than 10 miles from the heart of Salt Lake City and is rapidly becoming an integral part of the Salt Lake metropolitan area, cannot achieve the development that its location merits unless its present water supplies are increased. The district is a fertile agricultural area favorably situated between the largest cities in the intermountain area and athwart the major routes of transportation and
communication, but development of its residential, industrial, and agricultural potentialities will be restricted until existing water resources are supplemented by importation from other drainage basins which now have surplus water supplies. This conclusion is reached in the accompanying report by the Geological Survey, prepared in cooperation with the Utah State Engineer and the Davis County Water Users Association, based on a two-year investigation of the existing water supplies.¹

As may be imagined, this conclusion has key significance for the history of subsequent water development in the East Shore area.

**Monitoring Groundwater in the East Shore Since 1953**

The reports on the Weber Delta and Bountiful districts discussed thus far were fundamental geologic documents. Since that time groundwater investigations have been confined to reporting on changes in water level or quality, and to such changes or additions to the geologic description of the region as are revealed by recent well-drilling activity. The Smith and Gates study cited above was published in 1963, and reviewed groundwater conditions for the whole East Shore between 1953 and 1960. Starting in 1964 the State's Division of Water Resources (formerly the Water and power Board) has published an annual review of groundwater conditions in the known reservoirs of the state, in connection with the program of developing a state water plan. The Bolke and Waddell report, also cited above, presents a summary of changes over the decade 1960-1969, and also records the results of recent experimental well-drilling by the Geological Survey in the East Shore area.

¹ Ibid., Summary.
Smith and Gates make some general observations that have not been established clearly from other sources: U.S.G.S. began regular observations in the East Shore area in 1935. Most of the actual measurement since 1952 (to 1961) has been done by the Bureau of Reclamation in connection with the Weber Basin Project. Precipitation in the mountains of the region is three times that which falls on the level or inhabited portion. Seventy percent of the total precipitation falls between October and April—which means that most of it is snow. Evapotranspiration in the mountains is as little as one-quarter of the total precipitation, whereas it is as much as three times the precipitation at the lower levels. This gives a perspective of the importance of mountains and of snow to the water budget of the East Shore—and by extension, to the whole state. Smith and Gates also note that the as-yet-unpublished Feth report attributes one-half of total recharge to the Weber Delta reservoir to seepage from bedrock of the Wasatch Range. They suggest this is probably a good guess for the whole of the East Shore area, while noting that Thomas and Nelson did not discuss in detail the recharge area of the Bountiful District.

From the measurement data supplied by the U.S.G.S., the Bureau of Reclamation and the State Engineer, Smith and Gates present a hydrograph of groundwater levels from 1936 to 1960. From 1936 to 1953 there was no significant upward or downward trend in groundwater levels. But from 1953 to 1960 there was a definite downward trend. This they attribute to two causes: in the first place, the period coincides with a drought. This would account for a diminution in recharge, but not for lower water levels unless withdrawal
exceeded recharge. The authors therefore attribute most of the decline to pumpage from large diameter industrial and municipal wells. The drought would account in part for heavier than normal pumping. There were two areas of especially heavy pumping, and it was in those areas where the water level showed the most significant decline—the Woods Cross region and the area surrounding Hill Air Force Base (including Sunset, Clearfield, West Point). An area of noticeable but lesser decline was the North Ogden–Plain City region. There were no large pump wells in that area, but there were large concentrations of flowing wells (always of small diameter). This experience demonstrates the effects of pumped versus flowing wells on the water level, say the authors. During the long period of stable water levels there were no or very few pumped wells. Pumps draw down the water table or artesian pressure. Smith and Gates cite Marsell's argument that efficient use of the groundwater reservoir required its conversion to a pumping field, eliminating all flowing wells, and conclude that the recent decrease in hydraulic pressure indicates better use of the reservoir. It was not accompanied by diminution of yield from the large pump-well fields.

The data comparisons provided by Smith and Gates are nicely designed to show the influence of water deliveries to the East Shore by the Weber Basin Project. The benchmark data are from 1955; the WBP started major water deliveries to the area studied in 1957, and the check-point data were collected as of 1959. They divide wells in the region into three types, and then lump two of them together. Flowing wells of the 2-inch casing variety and small
diameter (less than 6) pump wells together discharged about 40,000 acre feet annually between 1955 and 1959. This information was provided to the authors by F. M. Warnick of the regional Bureau of Reclamation office in 1960. Any significant difference in groundwater use must, therefore, have to be from the third type of wells—large diameter pump wells used for municipal, industrial, military, or irrigation supply. That difference turned out to be negligible, however. Discharge from large pump wells was estimated at 12,400 acre feet in 1955, and at 12,700 in 1959.

The location of discharge changed over the period, however. The Davis County share of large diameter pumpage increased from 9,600 acre feet to 11,800, while the Weber County portion dropped from 2,800 to 900 acre feet. Of the 2,200 acre foot increase in Davis County, 1,700 was attributed to the Woods Cross-Bountiful area, while 1,400 of the 1,900 acre foot change in Weber was due to decreased use in the Hill Air Force Base region. Ogden City started receiving water from the WBP in 1957, and from that time to 1959 accounted for 1,300 acre feet of the diminution around Hill Field. The Bountiful District also started to import major quantities of Weber Basin water during this period, but augmented them with groundwater rather than substituting one for the other. The authors quote F. T. Mayo of the State Engineer's Office to the effect that in areas where good groundwater is available, pumpage from large wells for municipal and industrial supply will probably increase as long as the cost of developing and producing it is less than the cost of treated water from the Weber Basin Project.
Use of groundwater in the East Shore after the introduction of a significant increment of surface water from the Weber Basin Project is therefore about the same as before--between 52,000 and 53,000 acre feet per year. In Weber County there appears to have been substitution to one for the other, at least in respect of municipal-industrial supplies, but in South Davis there was greater use of water from both surface and underground sources. Smith and Gates note that Jordan River water via the Bonneville Canals fell off rapidly after the introduction of Weber Basin water in 1957. Use of these canals was discontinued entirely in 1958. Thomas and Nelson had estimated the inflow from them at 4,000 acre feet in 1948, and Smith and Gates say that it declined gradually from that figure between 1948 and 1956. One of the complaints of South Davis County had been that the Jordan water was of poor quality, and, after the Thomas and Nelson study added a degree of confirmation to this, they apparently began to substitute more and more groundwater for it, until the Davis Aqueduct brought them a better surface supply. Deliveries of irrigation water to the Bountiful district through the WBWCD have amounted to 14,000 acre feet in recent years, so that the increment to surface water, net of the discounted Bonneville supply, is no more than 10,000 acre feet, as of 1974.  

Since there has been considerable suburban expansion in South Davis since 1960, it seems safe to infer that the net increment to surface water in that area in 1960 was less than 10,000 acre feet. One of the most significant

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1 See annual reports of the WBWCD.
uses of Weber Basin Project water has been an urban irrigation system in
and around Bountiful. Project waters have been spread over surfaces
described by Thomas and Nelson as important recharge areas for aquifers
of the Bountiful District.

The 1971 report by Bolke and Waddell provides a perspective on the
use of groundwater in the East Shore area from 1939 to 1969. Their investi-
gative results are combined with those of earlier studies in Table 2. Several
inferences are possible from the table, although it lacks some of the poten-
tially most interesting data. The trends in groundwater use that were isolated
by Smith and Gates have not been carried forward by Bolke and Waddell. They
do tell us, however, the groundwater levels in the Bountiful District rose over
the period of their study by about 5 feet, while declining an average of 10
feet in the Weber Delta District. They attribute the difference to decreased
withdrawals in Bountiful, combined with Weber Basin surface recharge, and
to increased pumping in the Weber Delta District.

The following paragraph is paraphrased closely from the Bolke and
Waddell report: In the Bountiful District, water levels in 1969 showed a
general recovery from low levels reached in 1961. Water levels declined
nearly 40 feet from the early 1950's to 1961 in parts of the district, but they
have since recovered about 30 feet. Large fluctuations of water levels are
characteristic of areas in the Bountiful District where withdrawals from wells
are greatest. The rapid rate of recovery in the first half of the decade was
due to decreased pumping, which in turn was due to the importation of water
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<tr>
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<td>52,400</td>
<td>52,700</td>
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</tbody>
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a Bolke and Waddell, citing State Engineer  
All from Thomas and Nelson  
c Feth et al. (P. P. 518) cited by Bolke and Waddell  
d Smith and Gates  
e By inference (calculation) from 2 and 3  
f Adding 2 and 3  
g Smith and Gates, citing F. M. Warnick, in 1960  
h Bolke and Waddell  
i Bolke and Waddell. This includes 5,500 from wells used mostly for irrigation. Smith and Gates gave a figure of 100 a.f. for this classification.  
by aqueduct from the Weber River. The rate of recovery was slower during the latter part of the decade because the pumping again increased to about the same level as that prior to 1960.

The low water levels in 1961 occurred after a long period of below average precipitation, as well as after a period of heavy withdrawal from 1957-59. In 1969, after 3 years of withdrawal about equal in amount to that for 1957-59, and only a slight increase in annual precipitation, water levels remained considerably above the 1961 levels. This may be due in part to urbanization in the recharge zone of the aquifers in the eastern part of the Bountiful district. Urbanization has resulted in a large amount of lawn watering, predominantly with surface water brought in from outside the area. This has very likely increased the amount of recharge from the surface, because the area previously was not irrigated and the only source of surface recharge was from precipitation directly on the area. Elsewhere in the district, water level fluctuations coincide more closely with changes in precipitation.

Bolke and Waddell conclude that the general decline of water levels in the Weber Delta District from 1960 to 1969 was mostly attributable to a drought that lasted from 1952 to 1962. Most of the decline occurred in the first half of the decade of study, and slowed almost to a stop after above average precipitation began in 1963. These influences were combined with a general decrease in groundwater withdrawals and the plugging of some old flowing wells. The period of heavy groundwater use withdrawals noticeable in
Table 1 in Appendix IV, therefore, coincides with a drought, as well as a time of rapid urbanization. Even through the dry period, however, many wells continued to flow, as did springs, and discharge through phreatophytic vegetation actually increased. This means that the groundwater reservoir is still being used inefficiently—i.e., it is over full. The same is apparently true of the Bountiful District, for none of the investigators has ever reported a cessation of leakage through springs, flowing wells, and phreatophytes in that region.

For the whole East Shore area, about one-third of the total groundwater discharge was still through small diameter (flowing) wells in 1969.

Since 1939 the flow from these inefficient artesian wells has been cut in half. There are about 1,300 fewer such wells in service, and flow from them has been decreased by about 30 percent in the Bountiful District and by 60 to 75 percent in the Weber Delta District. This reflects an improvement in efficiency of reservoir use that is due at least in part to deliberate efforts of the State Engineer and the Division of Water Resources (Water and Power Board). New wells tend to be large, pump wells. Well construction declined annually from 1964 to 1969. The amount of water discharged from pumped wells hit its peak in 1967 and declined in 1968 and again in 1969.

The Bolke and Waddell report is based primarily upon investigative drilling. They learned that the artesian aquifers of the East Shore area extend under Great Salt Lake at least as far as Antelope Island, tending to confirm the supposition of Feth et al., that 20–70,000 acre feet annually leaves the area as underflow to the lake. Their results also confirm the
opinion of earlier investigators that the quality of the groundwater reservoir deteriorates as its distance from the mountain front increases. Aquifers are smaller, less well-defined, and of finer, less permeable materials. These factors inhibit the flow of water through the reservoir and make it difficult to develop high capacity wells.

The most spectacular news the authors have to report, however, is the development of a major artesian well east of Bountiful in the region where Thomas and Nelson presumed groundwater to occur only under water table conditions. This well had a head of 51 feet above the land surface and flowed at 1,000 gallons per minute. Bokle and Waddell presume that water comes from precipitation on the mountain front and is confined beneath "poorly permeable mud-rock flow deposits." Similar conditions may occur locally at other places along the mountain front, they add. They specifically rule out any possibility that aquifers tapped by this well are recharged by surface irrigation or artificial spreading.

Thomas and Nelson concluded that the Bountiful District must have an augmented supply of water from outside. That supply has been provided, but discovery of new aquifers suggests it may not have been needed, or that less was needed than is available. The extent of the District's internal resources has not yet been measured. Until the costs of developing and operating wells go up significantly, however, it is not likely that Bountiful will be a customer for more M&I water from the WBWCD.
The *Hydrologic Inventory* of the Weber Basin by Haws et al., agrees in essential details with what has been reported here from other sources. It is the best single source of information pertinent to the thesis of water abundance.¹

¹ Haws, Jeppson, and Huber.
CHAPTER IV
WHENCE CAME THE WEBER BASIN PROJECT?

The previous chapter has presented evidence that water, especially groundwater, is abundant in the East Shore area. Subsequent chapters will detail some cases of misallocated resources in the Weber Basin that stem directly from over-investment in water-controlling facilities. Still later, an effort will be made to explain why problems of the Weber Basin variety exist. This chapter has the more limited objective of proposing an explanation of how a mammoth facility like the WBP came to be built over an area that already had abundant alternatives at lower cost.

Historical, institutional, and ideological background are an essential element in the transformed perspective of Western water problems proposed in Chapter I. Identifying the problem is an essential part of economic practice, and cannot be taken for granted. Economic principles have been developed and refined to prescribe efficient policies for many of the economic problems that commonly arise in western democratic societies. It is necessary only for the practitioner to apply the appropriate principle. Selecting the principle to be applied is primarily a matter of interpreting the subject problem. (Assuming that the examinations and certification of schools of economics assure competence in economic principles among their graduates, the major hurdle to developing professional skill lies in the identification,
selection, and interpretation of economic problems.) Because the interpretation of a water problem is the principal issue of this dissertation, supporting arguments must be selected for their bearing on that interpretation. If a common perspective can be established, selection of the relevant economic principle(s) should be obvious.

Readers conditioned by experience to expect a format in which problem interpretation is handled briefly in the introduction, while the text is devoted to technical application, may taste a strange flavor in the approach taken here. It can be defended as sound scientific procedure, nevertheless. The following idea may be useful: Psychologists, neurophysiologists, and philosophers of science are asserting with increasing clarity and confidence that our perceptions of empirical reality are governed to a significant degree by preconceptions in the mind of the observer.¹ Karl Popper's description of the pattern of growth in objective knowledge is this tetrad:

\[ P_1 \rightarrow TS \rightarrow EE \rightarrow P_2 \]

where \( P_1 \) is an initial problem, TS a trial solution, EE a process of error elimination, and \( P_2 \) the resulting situation with new problems. Problems, says Popper, are observations that conflict with our notions of the way things

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are or ought to be. This conflict causes us to ponder why, and to postulate hypotheses that suggest possible explanations. These hypotheses, to be useful, must be worked into a form which allows them to be tested by further observations. This process of logical criticism of hypotheses and empirical testing, is the stage of error elimination. Reality is too enormous to be encompassed by any one observer, or to be described by any one scientist. No account of empirical reality can be complete or unbiased by selection criteria, therefore. Hypotheses do not arise from gazing at the whole of reality and endeavoring therein to perceive regularities, in the tradition of Francis Bacon and the inductionist-empiricist school, but as an effort to explain disturbing observations. Data selection by innovative scientists is governed by tests they devise to check the adequacy of their new explanations.

Several seeming aberrations provided problems that were examined in the investigation reported here. One of them was an apparent surfeit of water in a region that is supposed to be water-short. Another, closely related to the first, was a notion that revenues of a particular firm (the WBWCD) were not greater than or equal to its costs. Previous investigations by economists had found evidence of price discrimination, and of inflexibility in the pricing and transfer of water to and among users. These observations conflicted with certain principles of economic efficiency. An usual and accepted practice would have been to call attention to these violations of principle, and to recommend appropriate policy changes. An estimate of the social costs of such departures from efficiency might also have been made, as a means of
evaluating the potential importance of policy change. As Appendices I and II illustrate, attempts such as these were made in respect of the Weber Basin case. Successful resolution was frustrated, however, because prescriptions deemed adequate to solve some of the inefficiencies were seen to exacerbate others. Nothing short of the explanation presented in this work has been found adequate to account for all of the anomalies (violations of principle) observed in the case. The hypothesis to be tested is the explanation of what is in the Weber Basin case, and others similar to it.

Sources for Background to the Weber Basin Project

The Bureau of Reclamation apparently keeps a formal, written history of its major projects. A copy of the Project History of the WBP is located in the Provo Office of the Bureau, in the custody of Wayne Eldredge, project historian. It is a mimeographed document, occupying multiple loose-leaf binders (one volume for each year during the construction period). Mr. Eldredge and other staff of the Provo Office were very cooperative in making it accessible for this investigation.

E. J. Fjeldsted of North Ogden–Pleasant View has custody of minutes and correspondence of the Davis-Weber Counties Municipal Water Development Association (D-WCMWDA, hereafter). He was secretary to the organization and became secretary-manager of the WBWCD when the D-WCMWDA realized its objective of winning federal approval of the WBP. Mr.
Fjeldsted kindly loaned his records and provided verbal testimony about origins of the Weber Basin Project. They were the primary source for Appendix II.

The third important source was DeLore Nichols of Farmington, and files of the Davis County Agent. Nichols was Davis County Agent during the 1930's and 1940's, and led the campaign among county water users to get the Davis Aqueduct system. He acted as secretary to the Davis County Water Users Association (DCWUA), and left its traces in the office of the County Agent when he retired in 1956. Through the cooperation of the current Agent, Darrel Stokes, such of those traces as apparently survived were gleaned from various repositories in the Davis County Court House and used as an auxiliary to the verbal and written recollections of Mr. Nichols. They are the source for developments in the Weber Basin Project promotion prior to formation of the D-WCMWDA.

Other sources were personal recollections of District, Bureau, and State officials, newspapers, and files of the Utah Water Users Association. There is a distinctive difference in perspective on the WBP, depending on whether the observer is a state or local person or a Bureau official. Local people see it as not only a great event (which in local terms it undoubtedly is), but also as a unique one. Nichols' testimony and papers especially and to a lesser degree those of Fjeldsted, reveal a feeling that there were extraordinary hurdles to be overcome in winning the WBP, and that to do so required heroic efforts on the part of local people to make Bureau officials
take an active interest in the Project—even to the extent of tricking them into it. Several people in the State with first-hand knowledge about the WBP profess to believe that the Bureau had to be cajoled and goaded into taking on a project with the vast interlocking dimensions of the Weber Basin Project, because its previous experience had been limited to "building a dam and a ditch." Juxtaposing that point of view to the blase, business-as-usual interpretation of the exact same events in Bureau reports, reinforces an observation made by a former Bureau employee at the outset of this investigation:

The Bureau is very skilled at getting big projects authorized by inducing local people to agitate for them as if they were their own idea, and desperately needed for local survival. ¹ This is an important conjectural hypothesis in building toward an interpretation of the Weber Basin case.

The following account is a brief summary of conclusions reached in writing a draft history of the Weber Basin Project from sources described above.

**Genesis of the Weber Basin Project**

Serious efforts to build the WBP did not begin until very near the end of World War II. At that time the Utah Water Users Association was organized, with the stated objective of coordinating and spearheading water

¹Harold Hiskey, currently Dean of the College of Business and Technology at Southern Utah State College, Cedar City, Utah, and, at the time he made this statement, a fellow student of the author at Utah State University.
development in the State (see Chapter X). It was a tax-supported lobby and think-tank, including as members the State's senior water experts and enthusiasts. The Utah Water and Power Board, and the Division of Water Resources were its child and grandchild. The main theme at initiatory meetings of the Association was how tough it is to get money for water development projects, and how important it is, consequently, to work together in getting financial assistance. A clue which may reflect the most important proximate stimulus to a sudden burst of water development interest in northern Utah is this statement which occurs several times in papers of the UWUA and the Davis County WUA: "The Bureau of Reclamation is going to be spending half a million dollars annually, and we have got to be organized so that we can get our fair share." The plans for Bureau spending were almost certainly public information--quite possibly announced as part of a post-war economic stabilization policy to absorb workers released from the war effort. Not only would reclamation projects absorb workers directly, they were also expected to provide new farms for veterans. The ideals of agrarian democracy, and the old tradition of free land for veterans were still operative in post-war America. The potential of such a program for local development was obviously not lost on the UWUA, whose members included

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1 See Chapter IX, and issues of Reclamation Era from the mid-1940's.
dedicated technicians like John A. Widtsoe,¹ and civic growth promoters like E. J. Fjeldsted.²

Regardless of budget generosity, the Bureau would not have been able to construct vast projects without state and local cooperation. If an enthusiastic clientele was not ready and waiting, the Bureau would have needed to create one. Such measures were not likely necessary, for a water development lobby has been in existence since the 1890's (see Chapter X). But there can be little doubt that word of new Bureau spending capacity rejuvenated interest among the old campaigners. Thus at least part of the inspiration for the WBP must be attributed to federal government initiative, if only in a very general way.

One of the first actions of the UWUA was to organize for rational water development. The state was divided into districts according to geographic and hydrographic characteristics. UWUA members then took responsibility for initiating and fostering water user associations in each county of their respective districts. The Weber Basin lies in what was District No. 2 of the UWUA. Among UWUA members from District No. 2 were E. J. Fjeldsted, manager of the Ogden Chamber of Commerce, and Orson Christensen, manager of the U&I Sugar Co. refinery at Garland. (Their

¹ A soils and irrigation specialist, dedicated to "making the desert blossom as the rose," and president during his career of both Utah State Agricultural College and the University of Utah.

² Manager of the Ogden Chamber of Commerce.
influence on the WBP will be noted in later pages.) The UWUA was formed with the assistance of enabling legislation. Its legal status was not clearly understood even by its own members, but it was expected to be an advisor to the State, and did receive State support. The enabling legislation probably included a State law, extant in 1945, permitting county commissioners to allocate money to their county water user association. Budget support for UWUA activities came at least in part from dues paid by counties. County associations were expected to see that their respective county commission paid up. If they did not, the UWUA threatened to withdraw its support for county water development programs that depended on State or federal aid.

The Davis County WUA was formed in February of 1945, at the initiative and with the assistance of the UWUA. Its antecedents as described thus far clearly suggest an element of paternity from outside the county. All county water user associations were requested by the UWUA to make an inventory of their water resources and requirements, to make a list of potential development projects, and to give them priority rankings. The new Water and Power Board would consider the top-ranking projects from each county, and, if possible, provide supplementary financing for them out of its state fund. There was a clear understanding among UWUA people that if state resources proved inadequate, there was no recourse but to the federal government. In

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1Evident from statements in minutes of the UWUA, 1945.

2A representative of the UWUA was in charge of the first meeting, according to minutes of the DCWUA.
fact, one of the chief reasons for organizing as they did, and for creating the Water and Power Board, seems to have been a felt need to demonstrate that since state resources were exhausted, desperately needed water development must be financed federally. This is consistent with the notion quoted above, that federal agencies have money to spend, and we must assure ourselves of a fair share. This motive coincided nicely with the interest of dedicated water evangelists, and the fact that the Bureau of Reclamation was one of the well-endowed agencies.

As represented in its minutes and correspondence, activities of the DCWUA were consistent with the above interpretation of post-war events. Once organized, its first move was to take inventory of its water resources, declare them inadequate, and cast about for alternative sources of extra supply. They considered more conservative use; they considered spreading surplus (?) water to recharge groundwater reservoirs. They even helped finance a groundwater investigation of the Bountiful district by the U.S. Geological Survey. But by early 1946 they had, to their own satisfaction at least, eliminated every possibility but one: they had to have an extra supply of water, and the only place to get it was from the Weber River. This would require an investment greater than what local property could support, and greater than what could be financed as a small project through the Utah Water
and Power Board. Thus, within a year of its organization, the DCWUA was knocking at the door of the Bureau of Reclamation.¹

Although this account reveals clear elements of promotional activity by a lobby with interests much broader than the Weber Basin, many, if not all, of the participants had (and continue to have) an interest in making it appear that the WBP was built in response to urgent need expressed by popular demand at the grass roots. Unfortunately, this desire conflicts with another of comparable intensity: the craving to be recognized as far-sighted leaders who fought for and won a great civic improvement in the face of popular apathy and the misgivings of budgetary authorities. Different individuals feel these two emotions to differing degrees, a circumstance which fractured what might otherwise have been a common front, and led to important information about what really went on in the creation of the WBP.

Coincident in time with the writing of Appendix II, DeLore Nichols came to Logan looking for the D-WCMWDA records on which it is based. Nichols wanted to have a history written of how the WBP came to be built, and was more than willing to assist in locating sources for anyone willing to undertake the writing. He was especially anxious to give verbal testimony in respect of events which he said were likely not available in any written traces. Nichols made little effort to conceal the fact that one of his chief motives was personal

¹They did not wait for the report of the groundwater investigation, which was due in 1947.
vanity. He believes the Weber Basin Project to be a great net benefit to the East Shore area, and wishes to have the contribution made by him and his associates adequately recognized. No reason has emerged to cast doubt on his claim to an important paternal role in the WBP. The fact that the most vocal popular support for it came from south Davis County had an important influence in shaping the Project. Nichols was an undisputed leader in organizing and articulating that support. Nevertheless, the written evidence he was able to dig out from the Davis County Court House does not always agree with the interpretation of events that his memory prefers.

Although the Davis County Water Users Association has clear and obvious antecedents as reported above, Nichols would have its origins in the grass roots of Davis County during the drought and depression years of the 1930's. Traces found in the County Agent files do demonstrate that there was a bona fide interest in water development within Davis County dating to at least the mid-1930's. They do not suggest that it amounted to anything close to desperation, however. Furthermore, it was an agricultural interest exclusively. There was ample water for the part of the county served by the Davis-Weber Canal, but very little for the higher bench lands. According to Nichols, a group calling itself the Davis County Correlation Committee was formed in the mid-1930's to increase the efficiency with which various public agencies could provide service in the frequent personal crises that accompanied the drought and depression. Out of that experience, says Nichols, a
conviction was formed by the group that one of the critical needs of the County was a more abundant and reliable water supply.

While this story is certainly plausible, it is not inconsistent with the conjecture that the idea and any action that stemmed from it was contaminated by sources outside the County. (Nichols insists that the Davis group has precedence in the idea of the WBP. While acknowledging the importance of the D-WCMWDA in the lobbying campaign, he believes his own group should get credit for initiating the Project, which he unquestionably views as a grass roots phenomenon.) The Weber River Project was built by the Bureau of Reclamation in the middle '30's--about the same time as Nichols says he and his buddies became interested in their project. ¹ A water committee persuaded the County Commissioners to buy rights to 5,000 a.f. in the new Echo Reservoir for Davis County. As Nichols tells it, this water committee had to urge the commissioners to act, and they were not fast enough to get the 10,000 a.f. they had wanted because of competition from other water users. They couldn't even use the 5,000 a.f., however, because there was no way of transporting water to the upper part of Davis County where it was wanted.

Getting a water supply was the first part of his campaign, according to Nichols. The next part was obviously a transportation facility. Accordingly, so he says, he consulted Bureau of Reclamation engineer H. E. Wilbert about the possibility of constructing a system similar to the one built by the Bureau

¹Chapter II describes both of these projects.
at the mouth of Ogden Canyon, as part of the Ogden River Project. This would swing water across the mouth of Weber Canyon onto the Davis Bench, from whence a canal parallel to U.S. Highway 89 could carry it at least as far south as Farmington Canyon. Nichols implies that this proposal was his own idea, and that he solicited Wilbert's help as a technical expert to assess its feasibility. It is certainly not an impossible direction of causation, but circumstantial evidence suggests it is implausible.

One argument against it is that Nichols also claims that he and his group "made Oly a big man." Reference is to E. O. Larsen, Director of the Bureau's Salt Lake office during the initial stages of the WBP. Nichols maintains that his group had to wheedle, cajole, and browbeat the local Bureau people into taking on the Davis project. He says its magnitude frightened them, but that by allowing themselves to be pushed into it by the DCWUA, Larsen and his staff was able to greatly expand the sphere of their activities, and thus became fat and influential bureaucrats (lots of trips to Washington). While this account is consistent with Nichols' version of the source of the WBP idea, it is not consistent with widely recognized facts about the Bureau of Reclamation, or even with other parts of his own testimony. He knew, for example, that the Bureau had its eye on the much larger Central Utah Project, and says that one of the arguments he used in persuading them to take on the WBP was that they could build this much smaller one while they were waiting

1 Chapter II describes both of these projects.
for resolution of interstate conflict over the Colorado River to clear the way for the CUP. Nichols' claims to influence over the Bureau are far out of proportion to any incentives that he would have been able to offer them. It is clear from the Bureau's records, and even Nichols' own, that they had far bigger ideas for the Weber Basin than his, and that their plans preceded his in time.

While the facts of Davis County water rights in Echo Reservoir, and of communication between Nichols and Wilbert on a means for transporting water to the Davis bench need not be disputed, the limitations of Nichols' memory and his evident interpretive preference make it just as plausible that the direction of causation was opposite to the way he sees it in retrospect. Selling Davis County a batch of water it could not use was certainly a way to get its residents thinking about a transit system that Bureau engineers already had in mind.\(^1\) Having planted the seed, the Bureau let it germinate during the war and then came back to reap the harvest.

The above conjecture about the origins of Davis County interest in a system similar to the Davis Aqueduct and Gateway Tunnel is not essential to the hypothesis that the Bureau was prime causative agent in the Weber Basin

\(^1\) Vol. I of the WBP Project History says they had it planned since early in the century.
Project. It is consistent with Nichols' own statements. Quite possibly there are elements of truth in both views.¹

According to Nichols, pre-war plans advanced to the stage of proposing an import of 15,000 a.f. from the Weber River to serve bench lands in north Davis only, and the development of mountain front streams and groundwater for south Davis. Post-war thinking, under the stimulus of UWUA and the prospect of large federal expenditures, soon graduated to grander designs.

One year after their organization was launched, the small group of men who met as directors of the DCWUA had drawn up a set of eight alternatives for Davis County water development. Two of these were known to be under study by the Bureau of Reclamation: One of the two was a huge canal along the shore of Great Salt Lake, to intercept fresh water seepage and reroute it to south Davis County where it would be used to improve the quality of water in the Bonneville Canals.² The other was a high canal from the Weber River to serve the upper part of Davis County, from Weber Canyon to North Salt Lake. Although the organization did make occasional statements that all water needs, city included, were part of their concern, none of the

¹ There is some support for the notion that water was truly scarce in south Davis County. See especially the section on Prior Appropriation and Artificial Shortage in Chapter VII.

² According to Darrell Stokes, Davis County Agent, a lot of irrigating is done in the lake plains region with waste water. Compare the testimony of F. M. Warnick in the Appendix to Chapter III included in Appendix IV.
eight alternative programs had anything to do with culinary or industrial water. One of them was the development of groundwater in South Davis County, however. The County and the City of Bountiful were at that time giving financial support (matching funds) to the Thomas and Nelson U.S.G.S. investigation. Nevertheless, without waiting for the hydrologists' report the DCWUA selected another of their eight alternatives and set out to get it.

By April of 1946, they had selected the high line canal from the Weber River as their favorite project, and called a mass meeting (enough to fill the Davis County courtroom) to present their conclusions and ask Bureau representatives to take on their project (which the Bureau, of course, already had under study). Nichols insists that this meeting (May 3, 1946) was a signal event (no minutes have survived), and that it was designed to draw the sympathetic interest of the Bureau. The correspondence and minutes that have survived do support his belief that he and his chief cohort, Jos. W. Johnson of Layton, were wooing the Bureau. His records contain ample evidence (but no realization) that it was a courtship of the kind in which the pursued party thinks he is the pursuer. The Bureau proved to be an overwhelming lover.

Apparently there was no response from the Bureau for some time, and early in 1947, Nichols and Johnson began writing the Utah Congressional delegation for assistance in prodding the Bureau. Shortly thereafter, they had an appointment with the president (Wm. A. Wallace) and secretary (Tom Jensen) of the UWUA at the Reclamation Office in Salt Lake City (January 22, 1947). Immediately thereafter they called a mass meeting (February 3, 1947)
with some prominent water promoters as guest speakers. At the meeting a petition was drawn up requesting the Bureau to "begin immediately a detailed and complete study to obtain a feasible water supply from the Weber River."

After a few days of gathering signatures, the petition was sent to H. E. Wilbert of the Bureau, along with a letter thanking him for having been present at the meeting to explain the county water development program to the people! "Comments were favorable," said Johnson. Clearly, the Bureau had been working on a plan. They then went up to Davis County, presented their plan, and asked the county residents to ask them to carry it out.

Immediately thereafter Nichols and Johnson began to worry about getting assistance from people in Weber County and in the lake plains region. Their correspondence from that time is suddenly cognizant of a "need" for culinary water as well as irrigation. Meetings were called with people "below the bluff"\(^1\) to talk about reclamation and drainage--another new interest--and they attended a meeting of the Weber County Water Users Association to try for their support. Nichols began worrying about the kind of local organization "acceptable" to the federal government for repayment of reclamation projects--and how people who did not want water could be excluded from repayment. (Apparently the "water shortage" was a few buckets short of desperation.)

The evidence is quite clear that when Davis County asked for a conveyance facility of the kind they now have in the Davis Aqueduct, the Bureau came back

\(^1\) Lands of the lake plains region.
with a proposal to develop the entire Weber Basin—a project they had been contemplating for some time, by their own records. But they then got the DCWUA to ask them to make necessary preliminary investigations for the WBP—probably even told them how many signatures the petition had to have.

The Davis County promoters continued to view themselves as fortunate but unsecured suitors. They were anxious to please, aware that they had a big selling job to do. Instead of simply watering the Davis bench, a project to which they had long been committed, they now had to sell reclamation of low-lands, and municipal water supplies. Furthermore, they had to get the cooperation of people in three other counties.

Nichols and Johnson were now in the company of big thinkers. A feeling emerges from the traces that they were not completely at ease in this company. They seem to have worried a little about the giant size their project was taking, and make repeated reference to the possibility of building it piece by piece. That is, "it is alright to make plans for the WBP, but we want to get our aqueduct first; other groups can lobby for their own benefits."

For reasons detailed in Chapter VI, that attitude must have been distressing to the Bureau people.

In a letter to their Congressman in November of 1947, Nichols and Johnson expressed their sense of awe and pride in the direction and dimension their project had taken:

When we first started on this water program for Davis County, we did not vision that it would develop into a five-county program [to] . . . develop the entire water resources of the Weber and Ogden Rivers . . . The plan is to develop a full water supply for the cities and towns and also for irrigation.¹

They added, as in nearly all letters of that period, that not all of the program had to be developed at once; they could get their piece first and the other parts could come along as wanted. The same letter makes it clear that the DCWUA was the only active lobbying group for the WBP at that time. The Weber County Water Users Association never did take an active part, although there was a little show of support from the association in Morgan County.

The letter to Dawson also notes that Region 4 of the Bureau had by that time thrown its full resources into the Weber Basin Project--but that even so it was short of sufficient resources to complete the preliminary investigation. The Department of Interior was having a hard time with Congress over its budget at that time. Also, work on the Central Utah Project, the favored Reclamation baby, was bogged down in a hassle over interstate rights to the Colorado River. Thus the Weber Basin Project was an excellent opportunity to keep the Regional Office at full strength, and even to expand it. Bureau officials nurtured the Davis County interest carefully, suggesting that they send petitions to Washington to demonstrate their desperate need for the Project. This was done on several occasions. The arguments in the petitions do not have the ring of true desperation, however. They claim that more water

¹ Ibid.
is vital to local growth, and prove it by claiming that if they had another dry
year like 1934, half of their lawns would dry up. (Later they accentuated the
severity of this problem by claiming that all their lawns and shrubbery would
dry up.) The local Bureau further strengthened their base of political sup-
port by saking the lobby for money to finance its investigative program in the
winter of 1947-48. The DCWUA persuaded its own County Commission to put
up $2,500, and tried unsuccessfully to get the other three counties to do the
same. (The Bureau spent $1,100 of the local money and returned the rest.)
The Bureau threatened to take away some of the drilling machines for work
on another project; Nichols and company alternately begged and demanded
that the machines stay put. They did.

While the South Davis group were fixing themselves ever more
firmly on the hook, working themselves into a thirst they could really taste,
the Bureau was making careful plans for a much larger project in which their
clients really had only a marginal interest. Nichols and Johnson complained
about the length of time the investigation was taking, and were told that it
really was not feasible to build what South Davis wanted without going ahead
with the full project at once. The Davis group did not like this, and com-
plained. They wanted their own part of the project, now.

In these circumstances, bigger-thinking lobbyists were required, and
soon appeared. In October of 1947, Orson Christensen, a director of UWUA,
chairman of the Reclamation and Irrigation Committee of the Associated Civic
Clubs of Northern Utah, and manager of the Garland U&I Sugar Company plant,
invited members of his committee in each of the northern counties to a planning meeting to discuss their program. One of the letters went to Jos. W. Johnson, as president of the DCWUA. Johnson missed the meeting but wrote back to Christensen suggesting that the Civic Club's Reclamation and Irrigation Committee might consider the promotion of culinary water supplies for Davis County and the Ogden area: "It's an urgent, acute need," he said. A copy of Johnson's letter was also sent to E. J. Fjeldsted, manager of Ogden Chamber of Commerce, secretary of the Weber County WUA and a director of the UWUA, with a request that Fjeldsted consider Ogden's culinary needs and suggest a program to "solve the acute problem." Christensen gave his blessing to this idea, as chairman of the committee, and Fjeldsted sprang into action. As it happened, Ogden City Engineer Win Templeton had a report all ready on the "acute needs" of Ogden City. Fjeldsted invited Johnson to bring "two or three key men in Davis County" up to Ogden for a strategy meeting.

Such was the genesis of the Davis-Weber Counties Municipal Water Development Association (D-WCMWDA). It leaped into existence and took off like a shot. Nichols and Johnson were almost immediately left in the dust, protesting plaintively from time to time about the scope of the big WBP and its retardant influence on getting their project built. The D-WCMWDA did things in a bigger way; it got tax support from cities and financed its own

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1 This is the point at which Appendix II become chronologically relevant.
"investigation" of culinary needs.\(^1\) Such an investigation, said the Bureau, was essential to getting approval of the Project, for M&I supplies could not be provided as a part of it unless by specific request and documented need. Predictably, Templeton's report claimed to demonstrate urgent need, but its arguments are not very persuasive (see Chapter VI).

The D-WCMWDA, like the WBP, is supposed to have originated out of "dire need" for more water in the East Shore. The concern of agriculturalists like Nichols and Johnson in south Davis seems to have been genuine enough, but the origins and tactics of the D-WCMWDA frequently appear staged. The exchange of letters between Fjeldsted, Christensen, and Johnson has a phony ring. Why did chambers of commerce—and Joe Johnson—realize so suddenly that they were in desperate need of more culinary water supply facilities? Part of the answer is found in their propaganda, which they may have partially believed: "The Bureau of Reclamation is going to develop the full resources of the Weber and Ogden Rivers for agriculture. If we don't get a share for municipal and industrial use, it may be forever too late and urban growth will be strangled." There is ample evidence that such a perspective was never justified. But it was such a large element in the WBP promotion that Bureau of Reclamation officers have to have been aware of it.

\(^1\) Win Templeton, Consulting Engineer, Davis-Weber Counties Water Development (Salt Lake City, 1949). Although a printed report, copies are not easy to find. The copy used for this project was found in files of the State Engineer.
While no written confirmation has turned up, circumstantial evidence suggests that the Bureau may well have been the source of the idea.¹

On the other hand, chamber of commerce promoters like Fjeldsted and Christensen would not likely have been averse to colluding in a little exaggeration to forward their virtuous cause. Both of them were prominent in the Utah Water Users Association. As such, they were big thinkers, growth promoters, and zealous believers of the doctrine that water resource development is an unmitigated good. Their preoccupation was snaring a large chunk of federal spoils for the state. "Utah must get its fair share" is a recurrent phrase in UWUA minutes.

By Nichol's admission and the evidence of his files, the DCWUA had run out of gas. It was small, had little or no financial resources, and was really not very interested in features of the WBP other than the Davis Aqueduct and its necessary adjuncts. Their interest was in irrigation, whereas even at that time it must have been clear that the East Shore had a promising urban-industrial future. As Chapter VI will demonstrate, the Bureau had to have political supporters with more financial muscle. It had identified municipal and industrial water sales as the feasible means of paying for the Project, which meant they had to have strong urban support. Chamber of Commerce interest must have been an obvious target for a merchandising effort. The exchange of letters which provides the only apparent record of D-WCMWDA

¹Chapter VI presents the argument for this conjecture.
origins is not believable as it stands. It is probably a cosmetic performance, reflecting decisions already made in verbal consultations among Bureau, UWUA, and DCUWA representatives.

The story about dire and urgent need for culinary water, and the fear that Weber Basin development would leave no allowance for urban-industrial expansion, appears from the records of both the D-WCMWDA and the Bureau to have been a complete fabrication. Furthermore, it can also be shown that civic (chamber of commerce) support was vital if the project was to succeed. As this realization was forced upon them, the Davis group may have conceded a prominent role to the D-WCMWDA as the only means of achieving their own limited objective. Consistent with his paternalistic perspective on the WBP, Nichols says of the transfer of lobbying responsibility to the D-WCMWDA, "we let them in."

Lobbyists need every potential supporter they can muster. Nichols and Johnson, and their DCWUA, were accordingly treated politely by Fjeldsted and company. They were informed of Association activities, consulted from time to time, and encouraged to maintain letter-writing to the Utah Congressional delegation. But it is quite obvious that Nichols and Johnson feel that they were left on the sidelines of the promotional campaign, and that their role as initiators is not adequately recognized. Neither has ever been asked
to serve on the WBWCD Board of Directors.\textsuperscript{1} As a possible explanation for this obvious slight, Winegar proffered the following: "Joe was a ditch-rider all his life!" The implication seemed to be that Nichols and Johnson were not big leaguers. Their attention was riveted so tightly to building an ambitious irrigation ditch that they were unable to grasp the vision shared by Bureau engineers and sophisticated water hustlers--except in retrospect. As Nichols reported to his Extension Director at the end of 1950, "We started out merely to secure 20 to 25 thousand acre feet of water for the county, and are ending up by planning to store all the water of the Weber River to supply our counties and a part of the fifth . . . I feel that this is a great accomplishment." (As reported, it was also an exaggeration of Nichols' initial plans. He has been reported already as having written in terms of 10 to 15 thousand acre feet in the mid-1940's. In fairness to Nichols it should be emphasized that as County Agent his freedom to engage in political activities was somewhat constricted. As it was, he apparently took an early retirement because of disagreement with his Director over the legitimate scope of his politicking.)

All the evidence examined seems to be consistent with the following explanation for the origin of the Weber Basin Project: It was a successful effort by a small group of civic and state growth promoters to carve out as

\textsuperscript{1}Wayne Winegar volunteered this information in a discussion with the author after a meeting with the DCWUA had clearly revealed Nichols' and Johnson's desire to be recognized for their contribution to the WBP. Nichols and Johnson had called the meeting to discuss the possibility of using DCWUA funds to pay for writing a history of the Project.
large a share for Utah as they could of national resources. They attached special importance to water. They knew that the East Shore was not dying of thirst, but were confident that the easy conveyance of water to all parts of the region would stimulate growth. They seem deliberately to have averted their gaze from the possibility of piece-meal development via groundwater. It could always come later; the opportunity for a major Reclamation Project was now. (Once retired from the WBWCD, Fjeldsted turned his attention immediately to groundwater development, and manifests absolutely no embar- rassment over the now apparent fact that groundwater could have been de veloped first.) They used scare tactics to drum up the necessary public support, and, as with most salesmen, talked themselves into believing their own propaganda. (Thus Fjeldsted could speak of the WBP as a response to "dire need" for more water at the very time he was having trouble getting towns to take water from the Project because they could drill wells less expensively.)

At the level of the state organization the water hustlers were aware that they were in a contest with other states over federal spoils. The Davis group seem, by contrast, to have looked on the Bureau as a gold-bearing eagle to be tricked or cajoled into dropping a little on them. For people in organizations like the Bureau and the UWUA it was a case of scratching each others' back.

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1 Fjeldsted is presumptive author of Weber Basin Water Conservancy District: Seven Year Summary, which was published by the District in 1957. That publication, which was the apparent jumping-off place for several investigations of the WBP, this one included, stressed that the Project was built as a dire necessity.
If they could jointly sell a project to Congress, both gained. That is the change in perspective that seems to have occurred as the conduct of lobbying activity passed from the DCWUA to the D-WCMWDA. The traces suggest, nevertheless, that Bureau people understood the process more clearly than the most sophisticated of the local spoilsmen, whose zeal for growth made them willing tools.

The self-serving instinct of government bureaucrats is not hard to understand; neither is the chamber of commerce fervor for local expansion. Nor is the probably genuine concern of a county agent for a water supply to some of the potentially most desirable lands in his district (in this case the Davis bench). But there is something more at work in affairs like the Weber Basin Project. It is commitment to a kind of secular religious movement whose members share a special technologic interest in water development. Reference has already been made to the Sierra Club publication which labelled them The Water Hustlers. Promotional tactics used in the Weber Basin case follow exactly the pattern identified in that book as the usual program of water hustlers. One of their chief mottos is to "make the desert blossom as the rose." Another is that "water is the life-blood of the land." Their frequently stated objective is to "put every drop to beneficial use for man." Disciples of this movement are found in many places throughout the United States. Many of

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them are in agencies like the Bureau of Reclamation (Ellis Armstrong who served briefly as Commissioner during the Nixon administration, is a good example); many others are in lobbying organizations like the National Reclamation Association (of which the UWUA is an affiliate). The problem with the water coterie is the same as with many others in this age of overspecialized barbarism: they believe that their own special interest and competence is a panacea. To them, water development is good, period.

The origins of this secular religion, and its significance to the Weber Basin case and efficient resource management generally, will be examined in Chapters VIII, IX, and X. The intent of this chapter has been to show that the WBP was authorized and built on a flimsy foundation of local support, dredged up by means of poorly demonstrated claims that desperate water shortage was imminent. (Even Bureau of Reclamation officials acknowledge the narrow base of support. Director Rex Greenhalgh of the Salt Lake Region volunteered that only about 1 percent of eligible voters cast ballots in any of the plebescites that committed Basin property owners to pay for the Project.) The water hustling theme was brought in here as a suggestion of why a small group of people would work with obvious dedication for a questionable cause. Appendix II should be read in connection with this chapter, as it provides examples of flimsy and devious arguments.

1 For an explanation of this term, read Jose Ortega y Gasset, The Revolt of the Masses (New York: W. W. Norton and Company, 1932). Of related interest are Jacques Ellul's The Technological Society, and C. P. Snow's lectures on The Two Cultures.
Nevertheless, although thick varnish is evident on the story told by WBP supporters, there is a small kernel of truth. There was some concern over water scarcity in south Davis County, although it may have been artificially created (see Chapter VII). Initial support for the WBP did come from south Davis, and it is the region that has benefited most from the Project. The next two chapters will demonstrate that this outcome is the result of deliberate design.
CHAPTER V

WHO GETS THE WATER?

Previous chapters have presented arguments to support the proposition that water and waterworks are generally plentiful in the Weber Basin. This one will provide more details of the nature, location, and dimensions of water abundance, and demonstrate that benefits of the Weber Basin Project tend to be concentrated in one corner of the region. The following chapter uses planning documents and operating reports of the Bureau and Conservancy District to show that the repayment burden is also highly concentrated--but not in quite the same way as benefits. Chapter VII will restate and interpret the political and economic problems of the Weber Basin case.

Irrigation Service to Project Lands

Table 3 presents a 1959 inventory of land resources in the Weber Basin, with plans to serve a portion of that land with water from the Weber Basin Project. Although preproject aspirations were for developing the total water resources of the Basin for beneficial use, later reports, such as this one, claim only that "almost all" the water was actually being developed.

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1 Bureau of Reclamation, "Weber Basin Project Utah, Supplement to Definite Plan Report, December 1959," Salt Lake City, p. 17. This source is referred to hereafter as "1959 DPR."
## TABLE 3

PROJECT LAND SUMMARY (ACRES)

<table>
<thead>
<tr>
<th>Region and Land Class</th>
<th>Total Area Classified</th>
<th>Irrigable Area</th>
<th>Full Service</th>
<th>Supplemental Service</th>
<th>Total</th>
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<td>Mountain Valleys</td>
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<tr>
<td>Classes 1-4</td>
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<td>23,095.3</td>
<td>23,095.3</td>
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</tr>
<tr>
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</tr>
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<td>23,095.3</td>
<td>23,095.3</td>
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<tr>
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<td></td>
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</tr>
<tr>
<td>Classes 1-4</td>
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<td></td>
<td>16,699.0</td>
<td>14,801.7</td>
<td>31,500.7</td>
</tr>
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<td>Class 6</td>
<td>8,446.8</td>
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<tr>
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<td>31,500.7</td>
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<td>Classes 1-4</td>
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<td>32,858.3</td>
<td>58,143.8</td>
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<td>25,285.5</td>
<td>32,858.3</td>
<td>58,143.8</td>
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<td>Total Project Area</td>
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</tr>
<tr>
<td>Classes 1-4</td>
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<td>Right-of-way</td>
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<td></td>
</tr>
<tr>
<td>Subtotal, rounded</td>
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<td></td>
<td>41,990</td>
<td>70,750</td>
<td>112,740</td>
</tr>
</tbody>
</table>

Source: 1959 DPR, p. 17.
The 1949 Bureau report which won Congressional approval for the WBP had projected that 285,000 acre feet of water would be developed, 245,000 of which would provide irrigation to 70,400 acres of new land and supplemental water (late season) to 30,800 acres already under partial irrigation. The remaining 40,000 acre feet was to be for municipal use. Of the lands to be irrigated with the augmented water supply, 39,000 acres required draining and/or leaching before they could be used for agriculture. (Thirty-two thousand acres of delta lands were contaminated with salt.)

Table 4 summarizes the acres of classified farmland that were to be irrigated through facilities of the completed project. No new lands were to be irrigated in the upper valleys by this plan, and of lands to be benefited in the East Shore Area, more than half lay in the Willard and Layton blocks (48,300 acres compared to 41,340).

Table 5 shows Bureau estimates of how much water the irrigable lands "should" receive (presumably based on calculations of maximum physical productivity) compared to the capacity of the WBP to serve them.

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2 Bob Hensley, WBWCD engineer, April 11, 1973. Plans for the Riverdale block have been cancelled.
<table>
<thead>
<tr>
<th>Area and Block</th>
<th>Full Irrigation Service Lands</th>
<th>Supplemental Irrigation Service Lands</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain Valley area</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Weber River Valley service area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oakley block</td>
<td>4,110</td>
<td>4,110</td>
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<tr>
<td>Summit blocks</td>
<td>7,290</td>
<td>7,290</td>
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</tr>
<tr>
<td>Morgan blocks</td>
<td>6,710</td>
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<tr>
<td>Huntsville-Eden service area</td>
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<td></td>
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</tr>
<tr>
<td>Huntsville-Eden block</td>
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<td>4,990</td>
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</tr>
<tr>
<td>Subtotal</td>
<td>23,100</td>
<td>23,100</td>
<td></td>
</tr>
<tr>
<td>East Shore area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davis-Weber service area</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Riverdale blocks</td>
<td>860</td>
<td>2,730</td>
<td>3,590</td>
</tr>
<tr>
<td>Aqueduct service area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Davis blocks</td>
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<td>680</td>
<td>5,680</td>
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<tr>
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<td>Woods Cross No. 1 blocks</td>
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<td>1,410</td>
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<tr>
<td>Uintah Bench blocks</td>
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</tr>
<tr>
<td>South Ogden blocks</td>
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<td>3,420</td>
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<tr>
<td>Willard-Layton service area</td>
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<tr>
<td>Willard blocks</td>
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<td>11,050</td>
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<tr>
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<td>112,740</td>
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</table>

Source: 1959 DPR, p. 18.
### TABLE 5

**SUMMARY OF PROJECT IRRIGATION WATER REQUIREMENTS AND SUPPLY**

<table>
<thead>
<tr>
<th>Location</th>
<th>Diversion requirement (acre-feet per acre)</th>
<th>Project water requirements (acre-feet annually)</th>
<th>Average project supply (acre-ft. annually)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Diversion</td>
<td>Full service</td>
<td>Supplemental service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lands</td>
<td>lands</td>
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<td>Mountain Valley area</td>
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</tr>
<tr>
<td>Weber River Valley service area</td>
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</tr>
<tr>
<td>Oakley block</td>
<td>4.36</td>
<td>1,700</td>
<td>1,700</td>
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<tr>
<td>Summit blocks</td>
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<td>2,600</td>
<td>2,600</td>
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<tr>
<td>Morgan blocks</td>
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<td>5,300</td>
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<td>Huntsville-Eden service area</td>
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<td>4.36</td>
<td>6,400</td>
<td>6,400</td>
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<tr>
<td>Subtotal</td>
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<td>16,000</td>
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<tr>
<td>East Shore area</td>
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<td></td>
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<tr>
<td>Davis-Weber service area</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Riverdale blocks</td>
<td>3.27</td>
<td>2,600</td>
<td>2,600</td>
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<tr>
<td>Aqueduct service area</td>
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<tr>
<td>North Davis blocks</td>
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<td>14,500</td>
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<tr>
<td>Kaysville-Farmington blocks</td>
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<td>2,100</td>
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<tr>
<td>South Davis blocks</td>
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<td>3,400</td>
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<td>Uintah Bench blocks</td>
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<td>300</td>
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<tr>
<td>Ogden service area</td>
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<tr>
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<td>1,800</td>
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<td>Willard-Layton service area</td>
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<td>Willard blocks</td>
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<td>8,800</td>
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<td>Total project area</td>
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<td>52,800</td>
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</table>

More than half of the Project water is slated for the Willard and Layton blocks (82,100 a.f. compared to total supply of 162,800). The requirement for lands served by the Davis and Weber Aqueducts (including the Ogden Service area) is low relative to others because of the hilly terrain of bench lands. A discount for lands too uneven for farming is more important to this calculation than the porosity and absorptive capacity of the soil on bench lands as compared to lake plains.  

Table 5 shows how much water the Bureau planned to develop as of 1959, whereas Table 6 shows how much capacity was actually in place by the time construction ceased in 1970. Some comparisons are in order: Note that the Oakley block was not built, but that Summit block is larger than planned. Constructed supply for the Huntsville-Eden block was built larger than projected requirements in 1959—and it is virtually all sold. The Riverdale block was not built, but the Roy block has been added. Kaysville-Farmington has larger capacity than projected in 1959, while West Farmington is smaller. Centerville capacity is larger than planned, as is South Davis,

1 Ibid.

2 This may have something to do with Larrabee Reservoir, which appears in Figure 1. That map is 1963 vintage, prepared for another revision of the Definite Plan Report which the WBWCD refused to approve. It revised costs upward to over 105 million dollars and included Larrabee. I have another map (B. of R. Region 4 Map No. 526-412-1) which shows Larrabee as a "future extension." It is dated 1951. This set of circumstances suggests to me that the Bureau planned Larrabee all along, if they had time on their hands, and that the Oakley block really depended on it, although Larabee did not appear in the text or on the map accompanying the 1959 DPR.
TABLE 6

WEBER BASIN PROJECT STATUS OF IRRIGATION WATER CAPACITY PLANNED, CONSTRUCTED, SOLD

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Upper Valleys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weber River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oakley</td>
<td>1,700</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Summit</td>
<td>2,600</td>
<td>3,500</td>
<td>3,500</td>
<td>3,190.0</td>
<td>310.0</td>
<td>3,467.0</td>
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<td>Morgan</td>
<td>5,300</td>
<td>5,300</td>
<td>5,300</td>
<td>3,961.2</td>
<td>1,338.8</td>
<td>4,300</td>
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<tr>
<td>Subtotal</td>
<td>9,600</td>
<td>8,800</td>
<td>8,800</td>
<td>7,151.2</td>
<td>1,648.8</td>
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<tr>
<td>Ogden River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huntsville-Eden</td>
<td>6,400</td>
<td>6,900</td>
<td>6,900</td>
<td>6,817</td>
<td>83</td>
<td>6,043</td>
</tr>
<tr>
<td>Causey</td>
<td>(6,025)</td>
<td>(6,025)</td>
<td>(6,025)</td>
<td>(6,025)</td>
<td>0</td>
<td>6,043</td>
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<tr>
<td>Pineview</td>
<td>(875)</td>
<td>(875)</td>
<td>(792)</td>
<td>(83)</td>
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<td>1,247.0</td>
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<td>15,700</td>
<td>15,700</td>
<td>13,968.2</td>
<td>1,731.8</td>
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<td>------</td>
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</tr>
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</tr>
<tr>
<td>Weber River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Riverdale</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>Roy</td>
<td>0</td>
<td>200</td>
<td>149</td>
<td>149</td>
<td>0</td>
<td>0</td>
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<td>North Davis</td>
<td>15,400</td>
<td>15,400</td>
<td>15,400</td>
<td>11,414.4</td>
<td>3,985.6</td>
<td>12,007.7</td>
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<td>8,500</td>
<td>9,400</td>
<td>9,400</td>
<td>9,238.0</td>
<td>162.0</td>
<td>9,368.4</td>
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<td>West Farmington</td>
<td>6,400</td>
<td>5,700</td>
<td>5,700</td>
<td>3,605.2</td>
<td>2,094.8</td>
<td>5,694.9</td>
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<td>Centerville</td>
<td>3,100</td>
<td>4,000</td>
<td>3,965</td>
<td>4,006.0</td>
<td>-41.0</td>
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<td>Woods Cross No. 1</td>
<td>2,800</td>
<td>2,800</td>
<td>2,800</td>
<td>2,429.9</td>
<td>370.1</td>
<td>2,597.6</td>
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<td>Woods Cross No. 2</td>
<td>7,900</td>
<td>3,800</td>
<td>3,660</td>
<td>4,261.7</td>
<td>-601.7</td>
<td>3,649.5</td>
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<tr>
<td>South Davis</td>
<td>18,000</td>
<td>20,775</td>
<td>20,775</td>
<td>20,653.3</td>
<td>121.7</td>
<td>20,602.3</td>
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<td>1,300</td>
<td>1,300.0</td>
<td>0</td>
<td>1,300.0</td>
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<td>Uintah Bench</td>
<td>9,500</td>
<td>10,200</td>
<td>10,200</td>
<td>9,171.7</td>
<td>1,028.3</td>
<td>9,240.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td>77,100</td>
<td>73,575</td>
<td>73,349</td>
<td>66,229.2</td>
<td>7,119.8</td>
<td>73,649</td>
</tr>
<tr>
<td>Ogden River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Ogden</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>0</td>
<td>1,000.0</td>
</tr>
<tr>
<td>North Ogden</td>
<td>2,000</td>
<td>3,705</td>
<td>3,705</td>
<td>3,705</td>
<td>0</td>
<td>3,705.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td>3,000</td>
<td>4,705</td>
<td>4,705</td>
<td>4,705</td>
<td>0</td>
<td>4,705.0</td>
</tr>
<tr>
<td>Subtotal Foothills</td>
<td>80,100</td>
<td>78,280</td>
<td>78,054</td>
<td>70,934.2</td>
<td>7,119.8</td>
<td>78,354</td>
</tr>
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<td>-------------------</td>
<td>----------------------</td>
<td>-----------------------</td>
<td>---------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Lake Plains</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layton</td>
<td>39,100</td>
<td>6,000</td>
<td>1,000</td>
<td>0</td>
<td>1,000.0</td>
<td>700</td>
</tr>
<tr>
<td>Willard-Warren</td>
<td>43,000</td>
<td>8,000</td>
<td>5,660</td>
<td>2,041.1</td>
<td>3,618.9</td>
<td>2,995.1</td>
</tr>
<tr>
<td>Subtotal</td>
<td>82,100</td>
<td>14,000</td>
<td>6,660</td>
<td>2,041.1</td>
<td>4,618.9</td>
<td>6,360</td>
</tr>
<tr>
<td>Total Project</td>
<td>178,200</td>
<td>107,980</td>
<td>100,414</td>
<td>89,943.3</td>
<td>13,470.5</td>
<td>100,414</td>
</tr>
</tbody>
</table>

Sources: 1971 Annual Report, WBWCD, Table 12  
1974 Annual Report, WBWCD, p. 28  
1971 Status Summary of irrigation plan, supplied by Tom Cook, WBWCE
but Woods Cross No. 2 is smaller by more than enough to compensate. A similar transfer has occurred between the Uintah Bench and South Ogden block, served by the Weber River. North Ogden block has been built larger than planned using slack resources from other parts of the project.

In both the Upper Valleys and the East Shore Foothills, the quantity of water sold as of July 1971 was about 90% of constructed capacity (89 percent for upper; 90.6 percent for foothills). Comparing the Ogden and Weber Rivers, above Slaterville Diversion in 1971:

<table>
<thead>
<tr>
<th></th>
<th>Capacity</th>
<th>Sold</th>
<th>Percent Sales/Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ogden River</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper</td>
<td>6,900</td>
<td>6,847</td>
<td></td>
</tr>
<tr>
<td>Foothills</td>
<td>4,705</td>
<td>4,705</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11,605</td>
<td>11,522</td>
<td>99%</td>
</tr>
<tr>
<td><strong>Weber River</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper</td>
<td>8,800</td>
<td>7,152.2</td>
<td></td>
</tr>
<tr>
<td>Foothills</td>
<td>73,575</td>
<td>66,229.2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>82,375</td>
<td>73,381.4</td>
<td>89%</td>
</tr>
</tbody>
</table>

Before considering the highly significant Willard and Layton portions of the Project, there are some noteworthy observations that may be inferred from a comparison the 1974 portions of Table 6 with the 1971 columns: When water is under Unit Notice, it means that the Conservancy District is obliged to pay for it (see Chapter VI). Payments to the Bureau of Reclamation are on
the basis of Unit Notices, therefore, rather than on physical capacity of Project facilities. The Bureau has no interest in bankrupting the WBWCD, on which it depends for repayment, and therefore cooperates by delivering Unit Notices at a rate consistent with the District's ability to sell the water. It does keep the pressure on, however, as can be ascertained from the excess of Unit Notice availability over actual sales. The column of Changes in Unit Notice, 1974 shows how the Bureau helps the District shift its payment burdens to accord with sales potential. The Morgan block, for example, had its Unit Notice reduced by 1,000 acre feet from 1971 to 1974, while that of Huntsville-Eden was raised by the same figure. There is still significant excess capacity in Morgan, but the WCD is under less pressure to sell it because District management was able to arrange for sales out of Pineview in Ogden Valley. The expansion of sales in this valley is due to suburban residential growth, and many contracts are of the relatively remunerative Class D variety explained by Pendse. A similar switch of payment obligation occurred between the Layton and Centerville blocks, with the latter taking over 300 acre feet from the former. In this case the change put the Centerville unit notice higher than its constructed capacity. This probably means that Centerville irrigators are paying the M&I repayment price (or Class D) for the extra water, since it is using aqueduct capacity that was reserved for that purpose. ¹ One further item of note is the sale of over 2,000 acre feet in

¹Inferred from comments of Wayne Winegar in 1972.
the West Farmington block between 1971 and 1974. Winegar said in 1972 that that quantity was sold, but the 1974 annual report implies that the Bureau does not agree with the sale. This may mean that the water was sold by the WCD to the Farmington Bay Bird Refuge while the Bureau thinks it should be reserved for agriculture. If so, it reflects, perhaps a remnant of Reclamation ideology (see Chapter IX) in conflict with reality as seen by a beleaguered business manager.

A comparison of constructed capacity with sales suggests that the only weak points, except for the Willard–Layton system, are the Morgan and North Davis blocks—assuming the Bureau eventually accepts the West Farmington sale. The Uintah Bench surplus is expected to be taken up gradually in Class D residential contracts—although full use might be threatened by paving over large areas for parking lots. The new surplus in Pineview is no doubt welcome slack, and will be taken up by suburban expansion. A similar fate probably awaits the Woods Cross No. 1 excess in light of Winegar’s statement, cited in the previous chapter, that there are only two commercial farmers left in the Woods Cross district, whereas there were two rural wards there in the 1930’s. The large surfeit in North Davis is due to the rental water of U&I Sugar Company, noted earlier. The WCD is buying, or plans to buy, this water from the company. District officials claim they are not

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anxious to sell the water in this block for irrigation as they see more lucrative opportunities for it in pressurized lawn-watering systems like that of Bountiful. (They are obliged to sell it as irrigation water, at the low agricultural prices, if anyone wants it before it is sold for something else.)

The surfeit in Morgan seems to be real and relatively permanent, a conclusion reflected by the Bureau's decision to reduce the unit notice by 1,000 acre feet. Morgan County is rural, isolated, and stagnant. It will be some time before it feels the pressure of suburban or recreational expansion, and it does not have a flourishing agricultural economy—a status it shares with many Utah counties. WCD water is competitive in price with private sources, but no one is interested. Some of the capacity available to Morgan could probably be transferred to Summit, where there seems to be more concern over potential shortage. Summit, although further from the East Shore, may have better prospects for recreational development than Morgan, and therefore faces a more dynamic situation in respect of water demand.

It is noteworthy that the only one of the irrigation blocks considered thus far that is seen as a problem by WCD management (Morgan) is also the one that is most exclusively agricultural. The malaise of agriculture is also the culprit in the truly surplus portion of WBP—the Willard-Warren-Layton system. Other portions of the Project have escaped serious embarrassment because of recreational, industrial and suburban development close to the Wasatch Front (or to Uintah's in the case of Summit County). We will see in Chapter VI that current plans for using the water developed by the Willard
system also depend on non-agricultural uses. The fortunes of the WBP have obviously been heavily influenced by the transformation of the Utah economy during and after World War II, from rural-agricultural to urban-industrial. There is some evidence that promoters of the WBP saw this transformation coming, although many of them clearly had an almost single-minded agricultural perspective. It will appear in retrospect that the post-war period was a unique opportunity for the Bureau to build the WBP--one that had not existed before, and would be dead before the end of the 1950's. "Times changed" for agriculture with the dawn of the 1950's. So said a veteran farmer in the Lake Plains district when asked why there was not any interest in irrigation water from the Willard system. But before awareness of this transformation could permeate the consciousness of public decision-makers, construction of the WBP was under way.

Readers will note that water under unit notice for the Upper Valleys is equal to constructed capacity, and that it falls short of capacity by only 226 acre feet (0.3 percent) in the East Shore Foothills. This suggests that the comparisons above of sales to constructed capacity are an indication of the degree of persuasion imposed by the Bureau of Reclamation on its sales and repayment agency--i.e., full pressure. Reduction of the Morgan notice by 1,000 acre feet is an exception to that rule, however, which is obscured in the totals by the creation of a unit notice for Pineview in Ogden Valley. What does this change do to the comparison by river basin?
<table>
<thead>
<tr>
<th>Capacity</th>
<th>Sold (1974)</th>
<th>Percent Sales/Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ogden River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper</td>
<td>6,900</td>
<td>7,289.5</td>
</tr>
<tr>
<td>Foothills</td>
<td>4,705</td>
<td>4,705.0</td>
</tr>
<tr>
<td>Total</td>
<td>11,605</td>
<td>11,994.5</td>
</tr>
<tr>
<td>Weber River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper</td>
<td>8,800</td>
<td>7,407.2</td>
</tr>
<tr>
<td>Foothills</td>
<td>73,575</td>
<td>68,792.0</td>
</tr>
<tr>
<td>Total</td>
<td>82,375</td>
<td>76,199.2</td>
</tr>
</tbody>
</table>

Obviously it does not change capacity at all. It does make more sales possible out of the Ogden system, enhancing somewhat artificially its sales/capacity ratio.

Figures in Table 6 for Upper Ogden are given in the fashion of their presentation in the source documents. This presentation suggests that the intended (1959) water supply for Huntsville-Eden was strictly a matter of surface water from Causey Reservoir. By the late 1960's that capacity was used up. Water can be taken from Pineview Reservoir for use in Ogden Valley either by pumping, or by diversion of surface or groundwater that would or could have been used below the dam. That is, as long as there is water in Pineview Reservoir to serve rights holders below the dam, the Conservancy District can divert and sell as much as it pleases out of the Ogden River above the reservoir. It can therefore hold storage in Causey for late season supply.
only, and divert the Ogden directly to serve Huntsville-Eden at all other times of the year. It is quite conceivable that this pattern of development could be extended well beyond the current unit notice of 1857 acre feet.

**Pineview Occupies the Only Good Reservoir Site**

Chapter II contained a statement that there is plenty of unused water in the Ogden River, and that Pineview is the only big mountain reservoir in the whole WBP. Table 7 shows that Pineview develops 110,000 acre feet of water (a net of 66,000 a.f. over the 44,000 a.f. capacity of Old Pineview built in 1941), whereas delivery capacity of the irrigation blocks below it is only 4,705 acre feet (Table 7). M&I use out of Pineview is negligible. Total consumptive use of existing Pineview storage is well under 10,000 a.f. of the 66,000 of hitherto unappropriated water. There are no Project power plants on the Ogden River, although preproject plans estimated that up to 10,000 a.f. might be used to increase generating capacity of Utah Power and Light’s Pioneer plant. Deducting these maximum releases from Pineview still leaves almost 50,000 a.f. for residential and recreational expansion in Ogden Valley, almost certainly more than it can ever use. The data in Table 6 suggest,

1 Demonstrated below.

2 Demonstrated below.

3 S. Doc. 147, p. 54, and 1959 DPR, p. 9.
### Table 7

**Capacity and Estimated Costs of Project Features**

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Total Estimate</th>
<th>Previous Official Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESERVOIRS AND DAMS</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Pineview Dam and Reservoir (enlargement)</td>
<td>110,000 ac. ft.</td>
<td>4,600,000</td>
<td>4,422,000</td>
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<tr>
<td>Wanship Dam and Reservoir</td>
<td>62,100 ac. ft.</td>
<td>6,836,000</td>
<td>6,821,000</td>
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<td>Willard Dam and Reservoir</td>
<td>215,000 ac. ft.</td>
<td>15,774,000</td>
<td>10,387,000</td>
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<tr>
<td>Lost Creek Dam and Reservoir</td>
<td>20,000 ac. ft.</td>
<td>5,824,000</td>
<td>4,064,000</td>
</tr>
<tr>
<td>East Canyon Dam and Reservoir (enlargement)</td>
<td>52,000 ac. ft.</td>
<td>3,548,000</td>
<td>2,283,000</td>
</tr>
<tr>
<td>Causey Dam and Reservoir</td>
<td>7,500 ac. ft.</td>
<td>4,950,000</td>
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</tr>
<tr>
<td><strong>DIVERSION DAMS</strong></td>
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</tr>
<tr>
<td>Stoddard Diversion Dam</td>
<td>700 c.f.s.</td>
<td>373,000</td>
<td>373,000</td>
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<tr>
<td>Slaterville Diversion Dam</td>
<td>1,150 c.f.s.</td>
<td>750,000</td>
<td>744,000</td>
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<tr>
<td><strong>PUMPING PLANTS</strong></td>
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<tr>
<td>Willard pumping plants</td>
<td>500 c.f.s.</td>
<td>6,334,000</td>
<td>2,512,000</td>
</tr>
<tr>
<td>Layton pumping plant</td>
<td>260 c.f.s.</td>
<td>512,000</td>
<td>388,000</td>
</tr>
<tr>
<td>Lateral system pumping plants</td>
<td>100 c.f.s.</td>
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<tr>
<td><strong>DEEP WELLS</strong></td>
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<tr>
<td>26 c.f.s.</td>
<td>804,000</td>
<td>685,000</td>
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</tr>
<tr>
<td><strong>CANALS AND CONDUITS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gateway Canal and tunnel</td>
<td>11.8 mi.</td>
<td>7,600,000</td>
<td>7,800,000</td>
</tr>
<tr>
<td>Weber aqueduct</td>
<td>5 mi.</td>
<td>1,533,000</td>
<td>1,490,000</td>
</tr>
<tr>
<td>Davis aqueduct</td>
<td>23 mi.</td>
<td>10,547,000</td>
<td>9,322,000</td>
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<tr>
<td>Layton Canal</td>
<td>18.4 mi.</td>
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<td>1,817,000</td>
</tr>
<tr>
<td>Warren Canal (enlargement)</td>
<td>15 mi.</td>
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<td>697,000</td>
</tr>
<tr>
<td>Willard Canal</td>
<td>11 mi.</td>
<td>3,413,000</td>
<td>3,479,000</td>
</tr>
<tr>
<td>Ogden Valley Canal and Diversion Dam</td>
<td>8.6 mi.</td>
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<td></td>
</tr>
<tr>
<td>Description</td>
<td>Quantity</td>
<td>Total Estimate</td>
<td>Previous Official Estimate</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------</td>
<td>----------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>LATERALS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layton Canal lateral system</td>
<td>13,500 ac.</td>
<td>1,496,000</td>
<td>1,102,000</td>
</tr>
<tr>
<td>Warren Canal lateral system</td>
<td>5,500 ac.</td>
<td>267,000</td>
<td>257,000</td>
</tr>
<tr>
<td>Weber aqueduct lateral system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uintah Bench laterals</td>
<td>3,000 ac.</td>
<td>1,141,000</td>
<td>1,210,000</td>
</tr>
<tr>
<td>South Ogden laterals (supply lines)</td>
<td></td>
<td>187,000</td>
<td>70,000</td>
</tr>
<tr>
<td>Davis aqueduct lateral system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Davis laterals</td>
<td>4,850 ac.</td>
<td>2,489,000</td>
<td>2,212,000</td>
</tr>
<tr>
<td>West Farmington laterals</td>
<td>2,890 ac.</td>
<td>840,000</td>
<td>688,000</td>
</tr>
<tr>
<td>Ricks Creek laterals</td>
<td>495 ac.</td>
<td>150,000</td>
<td>86,000</td>
</tr>
<tr>
<td>Bountiful Subdistrict Reservoirs</td>
<td></td>
<td>775,000</td>
<td>618,000</td>
</tr>
<tr>
<td>Woods Cross laterals</td>
<td>4,100 ac.</td>
<td>1,780,000</td>
<td>1,239,000</td>
</tr>
<tr>
<td>DRAINS</td>
<td></td>
<td>7,060,000</td>
<td>5,626,000</td>
</tr>
<tr>
<td>POWERPLANTS--HYDRO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gateway powerplant</td>
<td>4,275 kw.</td>
<td>1,066,000</td>
<td>1,039,000</td>
</tr>
<tr>
<td>Wanship powerplant</td>
<td>1,425 kw.</td>
<td>481,000</td>
<td>520,000</td>
</tr>
<tr>
<td>GENERAL PROPERTY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreational development</td>
<td></td>
<td>2,545,000</td>
<td>1,375,000</td>
</tr>
<tr>
<td>Operation and maintenance housing</td>
<td></td>
<td>92,000</td>
<td>88,000</td>
</tr>
<tr>
<td>Operation and maintenance equipment</td>
<td></td>
<td>200,000</td>
<td></td>
</tr>
<tr>
<td>TOTAL CONSTRUCTION COST</td>
<td></td>
<td>97,350,000</td>
<td>73,413,000</td>
</tr>
<tr>
<td>Future year capacity</td>
<td></td>
<td>158,000</td>
<td>100,000</td>
</tr>
<tr>
<td>TOTAL PROJECT COST</td>
<td></td>
<td>97,500,000</td>
<td>73,513,000</td>
</tr>
</tbody>
</table>

however, that planners did not foresee as late as 1959 the coming change from agricultural to residential use of Ogden Valley.

The unused storage capacity of Pineview Reservoir changes the image suggested in previous comparisons of capacity use between the Ogden and Weber Rivers. If Willard Reservoir is the embarrassment of the WBP, which it undoubtedly is, Pineview is the irony. Consider the comparison of costs and capacities of Project reservoirs available in Table 8. These data demonstrate effectively the superiority of the Pineview site. The irony lies in the limited application possibilities for Pineview water. Table 6 reinforces an obvious inference from the map, that between Pineview Dam and Slaterville Diversion there is little but canyon and city, leaving very limited land resources for expansion of irrigated agriculture. The Ogden River Project of 1941 diverted Pineview storage north to Box Elder County via the Ogden-Brigham Canal (along the Wasatch Front and around the Pleasant View Salient) and to South Ogden via Ogden Canyon Conduit and South Ogden Highline Canal. Diversion north along the Wasatch Front is easier than diversion south, because of the Uintah Bench which lies between the mouths of Ogden and Weber Canyons. But either direction requires an expensive aqueduct because of high, porous, and hilly terrain. Diversions are obviously limited by the capacities of such conveyance facilities as exist, unless more are built. No new ones were planned for this area as part of the WBP. The capacity sales of irrigation water in the North and South Ogden blocks (Table 6) suggests this may have been a mistake. But planners probably estimated that potential use was too
TABLE 8

RELATIVE EFFICIENCY OF WBP RESERVOIRS

<table>
<thead>
<tr>
<th>Name</th>
<th>Height (ft.)</th>
<th>Length (ft.)</th>
<th>Type</th>
<th>Reservoir Storage Capacity (a.f.)</th>
<th>Combined Cost ($)</th>
<th>Cost per a.f. of WBP Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>Active</td>
<td>WBP Share</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wanship</td>
<td>156</td>
<td>2,100</td>
<td>Earth and Rock</td>
<td>62,000</td>
<td>59,000</td>
<td>6,836,000</td>
</tr>
<tr>
<td>Lost Creek</td>
<td>220</td>
<td>1,100</td>
<td>Earth and Rock</td>
<td>20,000</td>
<td>19,925</td>
<td>5,824,000</td>
</tr>
<tr>
<td>East Canyon</td>
<td>245</td>
<td>400</td>
<td>Concrete Arch</td>
<td>52,000</td>
<td>48,000</td>
<td>3,548,000</td>
</tr>
<tr>
<td>Causey</td>
<td>200</td>
<td>800</td>
<td>Earth and Rock</td>
<td>7,500</td>
<td>6,400</td>
<td>4,950,000</td>
</tr>
<tr>
<td>Pineview</td>
<td>91</td>
<td>520</td>
<td>Earth and Rock</td>
<td>110,000</td>
<td>110,000</td>
<td>4,600,000</td>
</tr>
<tr>
<td>Willard</td>
<td>34</td>
<td>76,560</td>
<td>Earth</td>
<td>215,000</td>
<td>195,000</td>
<td>15,774,000</td>
</tr>
</tbody>
</table>

Sources: 1959 Supplement to Definite Plan Report, WBP, Tables, pp. 6, 69, 86, Summary Sheet 7
Back End Paper, 1974 Annual Report, WBWCD
limited to justify an investment in new conveyance capacity. Of course, the water is there to sell out of the river if any group wishes to arrange their own conveyance.

Consumptive use of less than 5,000 a.f. does not make a very large dent in a water supply of 66,000 a.f. Pineview Reservoir was clearly not authorized primarily to augment the water supply to existing irrigation facilities between the mouth of Ogden Canyon and Slaterville Diversion. Although they had other uses in mind for the Pineview water, Project planners did not call attention to relative magnitudes, suggesting they may have felt some embarrassment. In contrast to their grand designs for shifting water from here to there in the Weber system, and for the combined Weber-Ogden below Slaterville, this is their meek comment on the Ogden below Pineview: "Water from Pineview Dam would be released as needed in the Ogden River channel and used for irrigation downstream in the area west of the Wasatch Front. Some of this water would also be utilized to provide part of the exchange water for lands in the delta area."1 (Emphasis added.) Ten years later the situation was much the same, if a little more specific:

The enlarged capacity of Pineview Reservoir will be operated to increase the irrigation supply for lands both north and south of Ogden River in the service area of the Ogden River Project. It will also provide irrigation water for diversion from the lower Weber

1 S. Doc. 147, p. 25.
River at the Slaterville Diversion Dam and will make additional water available for municipal and industrial purposes in the Ogden area.¹ [Emphasis added.]

The latter source confirms that the supplemental irrigation supply to the Ogden River Project (see Chapter II) was planned to flow through existing pipelines and canals to areas in the South Ogden and Weber-Box Elder Conservation Districts.

These Bureau statements invite an inference that diversions at Slaterville are to be secondary to those at the canyon mouth. In fact, that has turned out to be very nearly true, but it is hardly an accurate description of the authorized Project's real intent.

The additional M&I water mentioned in the quotation above is released from Pineview dam.² Given that Ogden City has a 10,000 acre foot contract for M&I water, by far the largest of such WBWCD contracts, one might reasonably expect that it is delivered from Pineview as just described. Such is not the case, however. Ogden City buys 8,500 a.f. of treated water from the WBWCD's Plant No. 2 on Old Post Road in Ogden--water that comes across the Uintah Bench via the Weber Aqueduct!³ Furthermore, more than half of the irrigation water delivered to the conveyance system of the South

¹ 1959 DPR, p. 8.
² Ibid.
³ By inference from tables on pp. 12, 18, 24, 29 of the 1974 Annual Report (WBWCD).
Ogden Conservancy District comes through the Weber Aqueduct. In 1974, Ogden City used only 10 a.f. of its contracted 1,500 a.f. of untreated water (versus 429 a.f. in 1971), so not much was released from Pineview for that purpose.

The intended use of Pineview storage can be inferred quite easily by looking closely at the map. Note that water was to be diverted both north and south from the Slaterville dam. Broken red lines identified as Layton and Willard Canals run fairly closely along the boundary line between Foothill and Lake Plain lands as classified in Table 6. The irrigable acreage in the Lake Plains region is given at over 58,000 acres in Table 4, of which over 25,000 was not receiving water as of 1959. Water from Pineview could obviously run by gravity to lands under either the Warren or Willard Canals, and could be pumped into the Layton Canal directly from the river. Without Pineview, any surplus flow of the Ogden could only be stored in Willard Reservoir, from which it must be pumped to the Willard, Warren, and Layton service areas. And, of course, total storage would be less in the absence of Pineview, limiting the Lake Plains acreage that could be irrigated.

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1 1959 DPR, p. 9 and Table 3 of this paper. Note that in Table 3 South Ogden appears under both the Weber and Ogden Rivers.

2 1974 and 1971 Annual Reports, WBWCD.
Location of WBP Irrigation Service

It is instructive to look at Figure 1 in connection with Tables 5 and 6. The Oakley Block that was not constructed (probably in connection with the rejection of Larrabee Reservoir) extends from north of Kamas to about Peoa. The Summit Block includes the lands in green below Wanship and Lost Creek Reservoirs. The Morgan Block is obvious, as is Huntsville-Eden.¹

In the East Shore area, the Riverdale Block was to have included the river valley area from the mouth of Weber Canyon, around the bend below Roy and Ogden Airport to the boundary of Riverdale with Ogden City. This region has long been served by the Davis-Weber Canal, and residents would not have had much interest in more irrigation water in the face of rapid suburban growth. The Uintah Bench Block is the yellow area north of the Weber River, served by the Weber Aqueduct. Adjacent to it is the South Ogden Block, which receives WBP from both the Weber Aqueduct and the South Ogden Highline Canal (Pineview water). The South Ogden Block starts at the mouth of Ogden Canyon and runs in a wide belt around the east and south of Ogden City, encompassing South Ogden and Washington Terrace. The North Ogden Block is a slightly narrower belt running north from the canyon mouth against the Wasatch Range, bulging as it reaches the North Ogden area, and continuing in a wider belt to the west of Pleasant View.

¹ These details are confirmed by Map No. 526-412-5871 in 1959 DPR. The next three paragraphs use Map No. 526-412-4836 from the 1959 DPR.
North Davis block is the area in yellow south and east of Hill Field. It extends south to the latitude of Layton (north of Holmes Creek) where it is bounded by the Kaysville-Farmington Block. Note that the great bulk of Davis County farmland, the green area between the broken red line denoting Layton Canal, Hill Field, and the yellow lands along the mountains, is not included in the WBP irrigation blocks. The Kaysville-Farmington block covers a small part of the area, south of a line running roughly northeast through the center of Kaysville. From that line south, all of the irrigable and potentially irrigable lands of Davis County are included in the remaining Foothills blocks (see Table 5). The big green area of North Davis County is served by the Davis-Weber Canal, and other companies, who could, of course, buy WBP water and divert it through their own facilities. (They do not, in fact.) The big yellow patches, Uintah and North Davis blocks, are the only parts of the East Shore Foothills where irrigation sales are lagging behind delivery capacity.

Some further comparisons from Table 6 are enlightening: current irrigation capacity of the total aqueduct system appears to be 73,375 a.f. (subtracting 200 a.f. for Roy Park, which is served by a well, from the East Shore Foothills Weber River subtotal). Of this capacity, 26,900 a.f. is allocated to the North Davis and South Weber bench lands (summation of South Ogden, Uintah Bench, and North Davis blocks), and 46,475 a.f. to South Davis

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1 Frank Haws suggests that the Davis-Weber Canal Company could compete with the WBWCD for M&I sales. It has an ample water supply, which is increasing as land is taken out of agriculture for other purposes.
County. Thus, South Davis has access to the lion’s share of the water, and also makes more complete use of its larger portion.

**Willard-Layton System for Use of the Ogden River**

The Willard block includes lands lying west of Willard Canal and north of the Weber River. Those lying west of Layton Canal and south of the Weber River, to the latitude of Kaysville, are in the Layton block. It was land in these two relatively huge blocks that was to be reclaimed by drainage, and irrigated by trapping the surplus flow of the Weber and (especially) Ogden Rivers. Recall from Table 4 that of total land to be benefitted by the WBP in the East Shore area, 48,300 acres lay in the Willard and Layton blocks, compared to 41,340 acres in all other blocks combined. Consistent with that was the calculation that more than half (82,100 a.f.) of the East Shore water supply to be developed by the WBP (162,200) was designated for the Willard-Layton blocks. Planning documents understandably did not emphasize that this half of the Project water would be of no use to any lands other than the Lake Plains. And we have already seen that both the 1949 and 1959 planning documents quite clearly down-played the fact that Pineview Reservoir was useful almost solely as a supply of water for the Lake Plains. The actual consumptive use of Pineview is shown in a subsequent section to be limited to about 5,000 a.f. annually. Since active WBP storage in Pineview is given as 66,000 a.f. (Table 8), about 60,000 a.f. of it per year has nowhere to go but down the river to either Willard Reservoir or Great Salt Lake.
With the obviously limited potential of Pineview in mind, the overcapacity in the Willard-Layton system takes on an even more ridiculous aspect. Note again in Tables 4 and 5 that the potential for use of irrigation in the Lake Plains was estimated by Bureau planners to be limited to 82,100 a.f. per year. That included both supplemental services and the biggest estimate they could make of reclaimed lands. To meet that need they constructed reservoir capacity of at least 250,000 (215,000 in Willard; 66,000, less other uses, in Pineview). Notice from Table 5 that estimated total irrigation requirements for the entire WBP were 178,200 a.f. Compare that to the 366,325 a.f. of active WBP storage capacity in Project reservoirs, reported in Table 8. (The amount under unit notice as of 1974 is given in Table 6 at 100,414 a.f.) A subsequent section of this chapter will demonstrate that facilities for use of the Weber River are employed to virtual capacity, so that the bulge of storage over use is located in Pineview and Willard. Furthermore, even if the lake plain lands had been developed as intended, the water storage developed to serve them was three times their estimated maximum requirement (250,000+ compared to 82,100).

The standard reaction of water hustlers to this kind of argument is, "but when (if) a dry year comes, etc." As will be shown in the next paragraph, that is the line they are using to minimize the apparent surplus in Willard Reservoir. Table 6 shows constructed capacity in Lake Plains blocks to be only 14,000 a.f. in contrast to 1959 plans for 82,100 a.f. If legitimate, this figure means that of planned conveyance facilities, only enough were actually
constructed to handle 14,000 a.f. in a season. That constructed capacity compares to a unit notice of only 6,360 a.f. (And it has been reduced from 8,000 a.f. by increasing the unit notices of other blocks. Notice in Table 6 that several blocks have higher unit notices than their planned capacity as of 1959.) The unit notice figure compares to irrigation sales contracts of 2,995.1. None of that contract amount is sold to irrigation companies, according to the 1971 and 1974 Annual Reports of the WBWCD. The only other consumptive use made of Willard water is about 1,000 a.f. per year to Great Salt Lake Mineral and Chemical Company. (Their contract as of 1974 was for 2,000 a.f., but they do not yet use all of it. The company's operation is located near Little Mountain, and a special canal had to be constructed to deliver the water.) Remunerative, consumptive use out of Willard Reservoir, for all purposes, therefore, appears to be less than 5,000 a.f. per year.

In spite of these figures, which are gleaned from its own publications, Bureau spokesmen were claiming in 1972 that only 56,500 a.f. of Willard system water was regarded as "not under unit notice." In a footnote to the figure of 14,000 a.f. for constructed capacity (see Table 6 and its sources) of the Lake Plains block, the Bureau's "Status Summary" acknowledged that there was "an additional supply of 56,500 a.f. available in the Slaterville Diversion Service Area for irrigation, low priority municipal and industrial, and fish and wildlife purposes." The Bureau therefore acknowledges only 70,500 a.f. of the Willard Storage as part of the WBP supply. When asked why this reported supply was so low in comparison to Willard capacity, Wayne
Eldredge responded that it was because of "exchanges" with other parts of the system. Ogden River water, he said, is diverted to the Weber side.  

Recently a newspaper reporter was successful in drawing a more detailed explanation from Eldredge: Forty-four thousand acre feet in Willard Reservoir is reserved for these exchanges in the event of a drought year. This amount of water can be pumped out of the reservoir to serve farms in the Plain City, West Warren and Hooper areas which are entitled to upstream water. The upstream water can then be diverted to the areas which would be hard-hit by dry spells—mainly in southern Weber County and northern Davis County. Due to an almost constant succession of good water runoff years since the reservoir was built, there has not been too much occasion to crank up the ponderous machinery for water exchange purposes. But the storage is there when needed.  

Wayne Winegar admitted in 1972 that water had never yet been pumped backward in Willard Canal. Use of the 44,000 a.f. of "exchange reserve" as described by Ellis is not very probable. The lands it would serve are already irrigated using non-WBP facilities. The figure of 44,000 is probably calculated by adding up all of such lands in the areas named (see map) and multiplying by the estimated requirement per acre for a full water supply. Willard water

1 Eldredge is located in the Provo office of the Bureau of Reclamation. Ellis (see next footnote) calls him "contract repayment specialist for the Bureau." I talked with Eldredge on July 21, 1972. Because he was apparently being deliberately vague, and because more assistance might be wanted from his office in the future, the issue was not pursued further at that time.


3 Personal communication in reaction to my written account of statements he made in February 1972 interview.
could reach the areas named by Eldredge, via WBP facilities. His explanation visions diverting the entire available flow of the Weber into the Davis-Weber Canal (and to any other rights-holders with diversion works above Slaterville, with the exception of the Hooper canal) to serve the main agricultural region of Weber-Davis counties (the large, central green area on the map). Ogden River water could then reach the Hooper area by way of Slaterville and the Layton Canal. Assuming that the Hooper Canal does take its water from the Weber above the confluence at Slaterville, this is the one way in which Ogden River water can reach lands normally served by the Weber. To suggest that Plain City and West Warren could be similarly rescued from a drying up of the Weber is misleading at the very least. Both of those regions are obviously on the Ogden side of the river system, and the only way in which it may be said that they are watered by the Weber is that the surplus flow of the Weber mixes with the virtually unused Ogden at Slaterville, so that some Weber water reaches the Willard-Warren region through facilities designed to divert the Ogden. Because it is only the Weber River that is heavily used, it is only the Hooper area that should be counted in adding up the potential for exchanges. Furthermore, even if the full 44,000 a.f. were allowed as exchange, it is unlikely that Willard water would need to be pumped back. There is the regular flow of the Ogden, plus 60,000 a.f. of unused storage in Pineview Reservoir. Of course, there might be a series of really dry years, which would mean less storage in Pineview. Experience of the past 4 decades, including recent fluctuations in the level of Great Salt Lake, suggests that normal facilities are
quite adequate without such exchanges during most of the drier years. For disasters of the kind visioned by water hustlers it is probably necessary to look for a drought cycle with more than 150 years between peaks.

The Willard Reservoir situation may be summarized in this way: Constructed capacity was 215,000 a.f., of which 195,000 a.f. was described (Table 5) as active storage. Because the dike has sunk by 4 feet, current capacity is only 189,000 a.f. For some reason the amount of dead storage has also decreased to 16,900 a.f. (perhaps due to sedimentation), so that 172,100 a.f. could be pumped out of the reservoir in one season, if it were full at the beginning. But even if all other irrigation sources were suddenly cut off entirely, the most it could deliver for beneficial application would be 44,000 a.f. As we have seen, the likelihood of that event, which would include no flow in the Ogden River (as well as the Weber) at Slaterville, is extremely remote.

Sales of Storage Directly from Rivers

WBP storage does not have to be sold through WBP canals and aqueducts. Some of it is sold from Project wells (see map) and some directly from streams via the diversion works of old rights holders. The figure of

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1 In 1972 Winegar and Eldredge were giving Willard a capacity of 196,000 a.f., because the dike has "settled a little."

2 The figure Eldredge gave to Ellis.
336,325 given above suggests there is capacity for a lot more sales directly from streams than does disappear that way. A table in the 1974 Annual Report of the WBWCD provides a helpful perspective. The following data, which report actual deliveries or disposition of water, are drawn from it.

### TABLE 9

#### 1974 WATER SOURCES

<table>
<thead>
<tr>
<th>Source</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway Tunnel</td>
<td>73,862</td>
</tr>
<tr>
<td>Gateway Canal Deliveries</td>
<td>1,207</td>
</tr>
<tr>
<td>Great Salt Lake Minerals and Chemicals</td>
<td>1,314</td>
</tr>
<tr>
<td>Ogden Valley</td>
<td>5,394</td>
</tr>
<tr>
<td>Wells</td>
<td>9,452</td>
</tr>
<tr>
<td>Roy Well</td>
<td>149</td>
</tr>
<tr>
<td>Stream Inlets</td>
<td>4,212</td>
</tr>
<tr>
<td>Plain City Laterals</td>
<td>3,568</td>
</tr>
<tr>
<td>Weber River Irrigation</td>
<td>6,944</td>
</tr>
<tr>
<td>Ogden River Irrigation</td>
<td>6,515</td>
</tr>
<tr>
<td>Weber River Misc. M&amp;I</td>
<td>1,759</td>
</tr>
<tr>
<td>Ogden River Misc. M&amp;I</td>
<td>856</td>
</tr>
<tr>
<td><strong>Total, All Sources</strong></td>
<td><strong>115,232</strong></td>
</tr>
</tbody>
</table>


This gives an indication of what facilities were used to deliver Project water. The use of that water is broken down as follows:

<table>
<thead>
<tr>
<th>Source</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>M&amp;I Replacement</td>
<td>2,615</td>
</tr>
<tr>
<td>Wasatch Front M&amp;I</td>
<td>29,498</td>
</tr>
<tr>
<td>Irrigation, Operational Spills and Losses</td>
<td>83,119</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>115,232</strong></td>
</tr>
</tbody>
</table>
The list of sources actually tells a great deal about the locations to which water was delivered by the WBWCD, and even what much of it was used for.

The sum of Ogden River and Weber River Misc. M&I is the same figure (2615) as is given for Total M&I Replacement. This water, therefore, represents upper valley sales of WBP rights to groundwater.\(^1\) Gateway Canal deliveries are to high lands in Morgan County between Stoddard Diversion and Gateway Power Plant. GSL Mineral and Chemical is water from Willard Canal through a special canal to the company's operation near Little Mountain. Water to Plain City Laterals no doubt goes through Willard Canal also, and is part of the irrigation sale from the Willard unit. Ogden Valley is the WBP Eden Canal service system. Stream Inlets feed the Davis aqueduct. Weber River and Ogden River Irrigation are a little more difficult to identify, but in general it can be shown that Weber River Irrigation is almost solely an upper valley use, while Ogden River Irrigation is mostly delivered at high levels along the Wasatch Front. There is no significant withdrawal of irrigation water from either river after it emerges from the mountain front, until Slaterville.\(^2\)

\(^1\) See Pendse for explanation.

\(^2\) Readers may wish to skip this next section, which justifies conclusions reported in Table 11 below.
The WBWCD publishes an itemization of its deliveries to irrigation companies. Once these companies are located it is quite easy to infer the point of origin of their WBP water. By grouping the companies according to selected geographic areas, it is possible to sum the amounts of water delivered to each into a pattern of regional water distribution. The results are reported in Table 10.

Table 10 suggests that there are no significant sales to irrigation companies out of the Ogden or Weber Rivers between the Wasatch Front and Slaterville Diversion. Companies served out of the Ogden River are located either in Ogden Valley or along the high line canals that run north and south from the mouth of Ogden Canyon. The sum of deliveries to these companies (8,483.0 a.f.) is greater than the figure of 6,515 a.f. given in Table 9 for Ogden River Irrigation. This means that a part of the deliveries to companies necessarily came out of the WBP Huntsville-Eden Canal. Total irrigation out of the Ogden River above Slaterville was 11,909 a.f. Since companies took

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2. Companies were located geographically on the assumption that their address is a reliable indication of the area they service. Sources employed to locate company headquarters were as follows:
   (1) Stuart Richards, Lynn Davis, and Richard Griffin, Irrigation and Canal Companies of Utah (Logan, Utah: Utah State University, Agricultural Experiment Station). No date attached, but Stuart Richards estimates "about 1965."
   (2) A list of WBWCD client companies provided by the District, about 1969.
   (3) Ogden City telephone directory, 1968.
3. Table 9; the sum of Ogden Valley and Ogden River Irrigation.
TABLE 10

IRRIGATION COMPANY USE, BY REGIONS, 1974 (ACRE FEET)

<table>
<thead>
<tr>
<th>Region</th>
<th>Use (ACRE FEET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Valleys</td>
<td></td>
</tr>
<tr>
<td>Summit County</td>
<td>1,122.00</td>
</tr>
<tr>
<td>Morgan County</td>
<td>2,612.50</td>
</tr>
<tr>
<td>Weber (upper Ogden)</td>
<td>3,891.00</td>
</tr>
<tr>
<td>East Shore High Line Diversions(^a)</td>
<td></td>
</tr>
<tr>
<td>Ogden River</td>
<td>4,592.00</td>
</tr>
<tr>
<td>Weber River</td>
<td>29,353.17</td>
</tr>
<tr>
<td>East Shore-Lower Diversions</td>
<td></td>
</tr>
<tr>
<td>Roy Park Well</td>
<td>149.00</td>
</tr>
</tbody>
</table>

Total: 41,719.67

\(^{10\%}\) Loss: 4,636.22\(^b\)

Total: 46,355.89

\(^a\) South Ogden Conservation District receives water from both Pineview and the Weber Aqueduct. Its contract with the WBWCD is for 2,300 acre feet, of which 1,300 is designated as Weber River water (see Table 6 and F. Haws, *A Study of Water Institutions in Utah* (Logan, Utah: Utah State University, Utah Water Research Laboratory, 1973), p. 35). Deliveries to the District in 1974 were 2,070 acre feet. Using the 13/23 ratio suggested by the information here provided, 1,170 a.f. of that total have been assigned to the Weber River in this tabulation.

\(^b\) This figure is copied from the 1974 Annual Report, not calculated.
8,433 a.f., individuals must have taken the other 3,426 a.f. The most likely place for them to have gotten it is out of the Ogden Valley (Huntsville-Eden) Canal of the WBP. There are no sales to companies between the mouth of Ogden Canyon and Slaterville, therefore, and sales to individuals in that region are highly improbable and certainly negligible. There are no Project diversion or delivery works in that region, so that individuals would have to have their own.

Irrigation companies served out of the Weber are located either in Summit and Morgan Counties, or in the service area of the Davis-Weber Aqueduct. Weber River Irrigation (Table 9) cannot include sale to companies in the East Shore area because there are no such sales except to companies served by the aqueduct, the water for which is included under Gateway Tunnel in Table 9. All water in this classification must therefore be sold to companies in upper valleys, or to individuals. Summit and Morgan sales to irrigation companies in 1974 summed to 3,734 a.f. (Table 10), compared to Weber River Irrigation of 6,944 a.f. in Table 9. This implies deliveries to individuals of 3,209 a.f. Most of this is probably absorbed in Summit and Morgan. The only opportunity for irrigation sales directly out of the river below the canyon mouth is in the South Weber-Riverdale area. As noted earlier, there were plans for a WBP irrigation block in that region. Any individuals who do buy WBP water in that area must pump it directly from the river, or have their own weir and canal—an unlikely or at least infrequent event.
Table 10 accounts for only 46,355.89 a.f. of the total of 83,119 a.f. given in Table 9 for all irrigation and losses. This means that 35,000 a.f. of irrigation water must be accounted for in sales to individuals. In 1968 the total of Class D (individual) contracts in Davis, Weber and Morgan Counties only, was 32,103.1 a.f.¹ This is quite consistent with the total figure of about 35,000 a.f. for 1974. Except for landowners living right on the river or reservoir, the only way the WBWCD can deliver on such contracts is through its own constructed facilities. This means that nearly all individual irrigation contractees are served by the Davis-Weber Aqueduct and its laterals, or by the Ogden Valley Canal. The previous paragraph attributed 3,209.5 a.f. to individuals in Morgan and Summit, however, where there are no WBP delivery facilities. The source cited here gives a total of 2,360.2 a.f. for Class D contracts in Morgan County as of 1968. That leaves less than 1,000 a.f. (compared to 3,209.5) to be made up by Class D contracts in Summit County and increments since 1968.

The foregoing arguments account fully for all water deliveries through WBP facilities. More specifically, they justify a conclusion that any irrigation sales directly out of the rivers between the mountain front and Slaterville Diversion are negligible. Weber River Irrigation is consumed by companies and individuals in Summit and Morgan Counties, while Ogden River Irrigation

¹Obtained from "Minutes of the Special Meeting of the Board of Directors of the WBWCD for the Purpose of Hearing Class D Assessments for Davis, Morgan and Weber Counties, May 24, 1968." Each individual assessment is itemized and described.
is divided unequally between high line diversions along the Wasatch Front, and Ogden Valley. The data of Table 9 may now be rearranged as follows in Table 11.

### TABLE 11

**WBP WATER USE BY REGIONS, 1974**

<table>
<thead>
<tr>
<th>Region</th>
<th>WBP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mountain Valleys:</strong></td>
<td></td>
</tr>
<tr>
<td>Gateway Canal</td>
<td>1,207</td>
</tr>
<tr>
<td>Ogden Valley Canal</td>
<td>5,394</td>
</tr>
<tr>
<td>Ogden River Irrigation</td>
<td>1,923</td>
</tr>
<tr>
<td>Weber River Irrigation</td>
<td>6,944</td>
</tr>
<tr>
<td>Weber River Misc. M&amp;I</td>
<td>1,759</td>
</tr>
<tr>
<td>Ogden River Misc. M&amp;I</td>
<td>856</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>18,083</td>
</tr>
<tr>
<td><strong>East Shore Foothills:</strong></td>
<td></td>
</tr>
<tr>
<td>Ogden River Irrigation</td>
<td>4,592</td>
</tr>
<tr>
<td>Gateway Tunnel</td>
<td>73,862</td>
</tr>
<tr>
<td>Wells</td>
<td>9,452</td>
</tr>
<tr>
<td>Roy well</td>
<td>149</td>
</tr>
<tr>
<td>Stream Inlets</td>
<td>4,212</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>92,267</td>
</tr>
<tr>
<td><strong>Lake Plains:</strong></td>
<td></td>
</tr>
<tr>
<td>Great Salt Lake Min. &amp; Chem.</td>
<td>1,314</td>
</tr>
<tr>
<td>Plain City Laterals</td>
<td>3,568</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>4,882</td>
</tr>
<tr>
<td><strong>TOTAL, All Regions</strong></td>
<td>115,232</td>
</tr>
</tbody>
</table>

---

*a* Ogden River Irrigation (6,515 in Table 9) is here divided between the mountain valley and the mountain front in the way suggested by Table 10 and the accompanying text.

*b* Includes Pineview water released directly to Ogden City treatment plant—only 10 a.f. in 1974.
Table 11 shows that of all water delivered by the WBP in 1974 (the total for 1971 was 83,878 a.f.), 80 percent went to the East Shore foothills, 16 percent to upper valleys, and only 4 percent to the lake plains. None of the irrigation water goes to the large green area of agricultural land (see map) in north Davis and south Weber Counties. Total use of the Ogden above Slaterville is in the order of 12,000 a.f. per year, and more than half of that is used above Pineview Reservoir. Between Pineview and Slaterville, use of the Ogden is virtually limited to the 4,705 a.f. of constructed capacity given in Table 6.

Weber River Facilities Used at Virtual Capacity

By contrast with the gross overcapacity of the Ogden River system, the Weber facilities are being used almost as was expected. Notice in Table 8 that combined storage attributable to the WBP reservoirs at Wanship, Lost Creek and East Canyon is 98,925 a.f. Table 6 reveals that constructed capacity for irrigation use of this storage is 82,375 a.f. (8,800 in upper valleys; 73,575 in the East Shore). Comparing storage to capacity for irrigation delivery leaves a margin of 16,550 a.f. available for M&I deliveries—if reservoirs filled to capacity every year. Irrigation contracts currently sum to 7,407.2 a.f. in upper valleys of the Weber, and to 68,792 a.f. in the East Shore (Table 6), leaving margins of 1,392.8 a.f. and 4,783 a.f., respectively.

Of the East Shore surplus, 3,392.2 a.f. is designated for the north Davis block. The only other large block of surplus is 960 a.f. for the Uintah
Bench (see Table 6). This Uintah Bench surplus is gradually being taken up in Class D contracts as suburban expansion takes over the bench. The north Davis surplus is less likely to move, however, although some of it will gradually be taken up with suburban expansion. (There are limits to this, as residential and commercial use of land is less water-consumptive than agriculture.) The excess in upper valleys seems likely to be relatively permanent also, as Chapter IV suggests. It should be noted here that the irrigation capacity of upper valleys cannot be transferred to the East Shore, and vice versa. This is because capacity refers to conveyance facilities, not to a quantity of water. On the other hand, the excess of storage capacity over total irrigation deliveries, 22,725.8 a.f. could be delivered to the East Shore area. This could be arranged because irrigation is a seasonal use, and there is ample capacity in Gateway Tunnel and Canal to deliver any excess storage to the East Shore during winter months.

Perusal of WBWCD annual reports reveals that full storage capacity is not achieved every season. This could be delierate in part, since full capacity is not needed. Nevertheless, it seems reasonable to conclude that

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1 This figure is calculated as follows:

| Excess of storage over irrigation capacity | 16,550 |
| Unused irrigation capacity: Upper Valleys | 1,392.8 |
| East Shore | 4,783 |
| Total | 22,725.8 |

2 Capacity of Gateway Tunnel is 435 c.f.s., which works out to almost 315,000 a.f. per year, if run to capacity 365 days.
at the present time there is about 22,000 a.f. of storage capacity that is not being used for irrigation. It is therefore available for municipal and industrial purposes.

Prior to the 1959 revision of the Definite Plan Report, official Bureau of Reclamation plans had called for an ultimate M&I delivery of 40,000 a.f. per year, all of it to come through the Davis-Weber aqueduct system to the East Shore. The 1959 DPR revised the target upward to 50,000 a.f. Part of the increment, 7,500 a.f., was to come from the Ogden system, released directly to the Ogden City treatment below Pineview Dam. To date, that use has not materialized beyond a few acre feet per year, and Ogden takes most of its WBP water from the Weber Aqueduct. Thus the Ogden is not a significant source of M&I water at the present time. Total M&I sales by the WBWCD have passed 30,000 a.f., however. Comparing that figure to the plus or minus 22,000 a.f. of the previous paragraph suggests that facilities on the Weber system are virtually used up. (The implied deficit is made up by wells, as explained in the next section.)

**Municipal and Industrial Water Use**

The previous section has noted that official plans of the Bureau of Reclamation have always called for M&I water to be produced primarily out of the Weber system. That is consistent with the location of the Davis-Weber Aqueduct in relation to towns and cities of the East Shore. From the 1955 to the 1959 versions of the Definite Plan Report, however, total estimated cost
of the Project increased from $70,340,000 to $97,500,000. \(^1\) At the same time it was discerned that more M&I water was also going to be required than had previously been calculated. Instead of 40,000 a.f., it was estimated that M&I use would rise to 50,000 by 1975. \(^2\) By 1959 there was fairly clear evidence that the East Shore was changing from an agricultural to a residential and commercial region. No doubt it was also evident that interest in Ogden River water for irrigation was not high. The 1959 DPR therefore projected that of the 10,000 a.f. increment to M&I sales, 7,500 a.f. would be taken from the Ogden, released directly to Odgen City's treatment plant at the foot of Pineview Dam. (That is the only way of expanding M&I sales out of the Ogden system without building new conveyance facilities.) The remaining 2,500 a.f. would be run through the regular WBWCD treatment and distribution facilities, from Weber storage.

Bureau plans therefore call for 42,500 a.f. of water to be available for M&I use "from the Weber River and from independent small streams along the Davis aqueduct . . .".\(^3\) The previous section noted that only 16,550 a.f. of storage capacity was left over for M&I after projected irrigation capacity was fully used. That leaves 25,450 a.f. to be made up from


\(^2\) Based on an estimate of per capita requirements, plus population growth estimates of the Bureau of Economic Research at the University of Utah.

\(^3\) 1959 DPR, p. 42.
"independent small streams" along the Wasatch Front in Davis County. In a chapter on "Water Supply" the 1959 DPR says that 8,700 a.f. of rights in these streams is to be purchased or otherwise appropriated and either diverted into the Davis Aqueduct, or used above it. ¹ The 1974 Annual Report of the WBWCD shows that the actual increment to its supply from those streams was 4,212 a.f. ² Available storage on the Weber, plus the small Wasatch Front streams, therefore, do not come close to the total projected deliveries of M&I water from the Weber system. While a perfectly valid inference from the Bureau's own planning documents, this conclusion seems to be deliberately obscured, or even denied, in the chapter on Municipal and Industrial Water from which the first quotation in this section was taken. The amount of water that seems to be available for M&I use does not even come up to the total of current contracts, as summarized in Table 12.

The solution to this riddle is tucked away in another chapter of the 1959 DPR, called "Designs and Estimates." A portion of that chapter discusses Project Wells. ³ These wells, of which there are eight, are all located in the East Shore area and are explicitly designated as suppliers of M&I water. They have a combined capacity of 48 c.f.s. If pumped constantly, those wells could therefore deliver 34,750 a.f. per year. Added to this, the

¹ Ibid., p. 23.
² Ibid., p. 25.
³ Ibid., p. 85.
TABLE 12

MUNICIPAL AND INDUSTRIAL WATER SALES, BY REGION

<table>
<thead>
<tr>
<th>Region</th>
<th>Acre Feet Contracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis County, Kaysville South</td>
<td>6,511\textsuperscript{a}</td>
</tr>
<tr>
<td>Hill Field and West Layton</td>
<td>288</td>
</tr>
<tr>
<td>Northwest Davis County</td>
<td>5,509</td>
</tr>
<tr>
<td>Roy</td>
<td>3,200</td>
</tr>
<tr>
<td>Ogden City</td>
<td>10,000\textsuperscript{b}</td>
</tr>
<tr>
<td>Other Weber County</td>
<td>5,365\textsuperscript{b}</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>30,873</strong></td>
</tr>
</tbody>
</table>

\textsuperscript{a} Includes 2,750 a.f. to Chevron Oil.  
\textsuperscript{b} Includes 2,000 a.f. to Great Salt Lake Mineral and Chemical Company.

16,500 a.f. of storage capacity left over from irrigation is just about right to make up the 50,000 a.f. total projected for M&I sales. It is also noteworthy that project wells are capable of fulfilling the entire current contract requirements for WBWCD M&I. Indeed, they frequently do. According to the manager of the WBWCD, Gateway Canal is frequently closed down during winter months for repairs. (It is located on a mountainside which shifts fast enough to cause perennial problems with fractured lining in the canal. Annual reports of the District often show pictures of the repair operations.) Mr. Winegar says that water customers never know the difference.

The previous section noted that WBP storage capacity on the Weber system is 98,925 a.f., and that 68,792 a.f. of that is under contract for irrigation. This section has revealed that current M&I contracts total to
30,873 a.f. Virtually none of this M&I comes from the Ogden side. Therefore, current contracts, ostensibly for Weber River water, sum to 99,665 a.f., or more than the storage capacity of project reservoirs. Were it not for wells, the Weber side would be short of water, even for current sales. Pump wells do not represent a potential energy or delivery capacity in the same ways as water behind a dam. Presumably wells are not pumped unless to do so is less costly for some reason than to release water from a reservoir into a delivery system. From this reasoning it is justifiable to conclude that WBP storage on the Weber River is very close to being fully used. Expansion is possible, but only because of project wells.

The Location of M&I Use

Please refer again to Figure 1, and to Table 12. Note that the first entry in the table includes the areas of South Davis that is blanketed by WBP irrigation blocks. The second corresponds roughly to the North Davis WBP irrigation block. Northwest Davis includes towns in the green area of the map which does not receive WBP irrigation water. Roy City is really a part of this area. Except for the Roy Park well (149 a.f.), this green area is not part of the WBP irrigation service at all, yet it buys 8,709 a.f. or 28 percent of the M&I water. Ogden City buys a third of the M&I water, but gets none of the irrigation. There are some M&I sales in the area of the South Ogden and Uintah Bench irrigation areas, but none to North Ogden. South Davis
County, which has 63 percent of the irrigation capacity of the aqueduct system, buys only 21 percent of the Project M&I water.

While the map is still handy, notice that several WBP wells are located in the green area of the Weber Delta District—where there are M&I sales but no irrigation deliveries. The 1959 DPR\(^1\) remarks that groundwater development had figured in the 1955 version only in connection with drainage. Now, however, it was planned to develop six deep wells (combined capacity, 26 second-feet) as standby capacity for municipal use. The map used here is from a 1963 revision of the DRP (never approved), and it shows eight wells. The 1974 Annual Report of the WBWCD lists eight wells (not all in the same locations as on the amp) with a combined capacity of 48 c.f.s. Apparently the consciousness of groundwater has been developing gradually.

The information provided to this point makes possible some inferences about the contest between the WBWCD and area municipalities over groundwater development. We know that there is abundant, high-quality water in aquifers of the East Shore area. We also know that knowledge of this resource has had a retarded development, but that the Bureau of Reclamation was privy to the most advanced information on the subject. The Bureau changed its plans for M&I development in 1959 to include high capacity wells. The stated capacity of WBP wells in 1974 is sufficient to meet current M&I contracts. Some of these wells were developed right next door to towns in

\(^1\)Ibid., p. 85.
the green area (Figure 1) which had already bought much more expensive M&I water from the WBWCD—on a long-term contract. When the towns decided to duplicate this inexpensive source themselves, the District tried to block them. It is hardly surprising that some town officers thought they had been cozened. Furthermore, municipalities such as Roy, Clearfield, Sunset, Layton, and Clinton are buying 28 percent of the expensive M&I water which subsidizes the cheap irrigation water of the WBP, yet none of the cheap water is delivered in the region that surrounds them.
CHAPTER VI

WHO PAYS THE BILL?

Summary

Appendix II demonstrates that Congressional authority to build the Weber Basin Project was based on a presumption that municipal and industrial water users would pay for a major share of the total costs, while using a relatively minor portion of the water. Examination of the various revisions of the WBP Definite Plan Report verifies that this intention has been maintained in practice. Subsidization of irrigators by industries and householders was critical to getting the Project authorized. Warne\textsuperscript{1} acknowledges this as usual practice in Reclamation projects.

Ability to pay on the part of the whole project area is the first criterion for the Bureau in serious evaluation of prospective developments. The next problem lies in assessing relative shares of the repayment burden. This is also done on the ability to pay principal. Careful studies of the agricultural economy are made to assess the repayment capacity of irrigators.\textsuperscript{2} As much


\textsuperscript{2}This was the explicit purpose of a study by W. Fuhriman, G. Blanch, and C. Stewart, \textit{An Economic Analysis of the Weber Basin Proclamation Project, Utah} (Logan, Utah: Utah State University, Agricultural Experiment Station, 1952).
of the total cost as possible is attributed to federal benefits—hence non-reimbursable. The remainder must be borne in some other way. First hydroelectric power generation, and then municipal and industrial water sales were the methods devised by the Bureau of Reclamation to handle the balance of the repayment burden. The ability and willingness to pay of power and domestic water users is, therefore, critical to the success of Reclamation projects.

In the Weber Basin case, success was jeopardized from the start by the availability of groundwater in the East Shore area. All available evidence suggests that the Bureau of Reclamation knew more about the groundwater situation than anyone else, at least as much as did U.S.G.A., since Bureau staff did most of the U.S.G.S. work. Certainly not as much was known of groundwater potential in 1950 as in 1970—but more than enough to justify some concern. The Bureau would not commence construction until the WBWCD was in place and had signed up a minimum quantity of M&I sales under firm 60-year contracts. When the WBWCD tried to block municipalities from drilling wells in the East Shore area it was behaving in perfect consistency with a time-honored Reclamation principle that M&I and power users should subsidize local agriculture. Application of the principle was complicated in this case because most of the irrigation benefits were going to South Davis County, while municipalities in North Davis and Weber Counties were getting stuck with most of the bill. Many water managers in those municipalities are resentful, and believe they (the municipalities) were hood-winked or railroaded
by promoters of the WBP—including representatives of the Bureau in the
latter classification. The personal files on which Appendix II were based
provided the first suggestion of this, and pertinent sources examined since
have all tended to reinforce rather than refute. The question is not whether
a snow job actually took place, but whether the ends justified the means.

One of the more anomalous features of the whole situation is the
attitude of Bountiful City. According to published reports and statements of
District officials, 1 almost 20,000 acre feet of irrigation water is supplied
to the Bountiful area every season by the WBP and WBWCD facilities. Much
of it is spread directly over what is believed to be a major aquifer recharge
area, by resident irrigation. Because groundwater is abundant and cheap in
the area, Bountiful City is understandably reluctant to buy more Weber Basin
M&I water at $43.50 per acre foot. The city signed up for 1,000 acre feet
M&I in the preconstruction sales campaign, and has not subscribed for a
gallon more since then. It is resentful even of that contract. The WBWCD
built the largest of its three treatment plants in the area, anticipating that it
would be the most active purchaser of water. (A very reasonable supposition,
as Chapter III suggests.) Because of its greater capacity it costs a third
more to operate than either the Ogden or Layton plants—yet runs at one-third
of capacity. To summarize, the Bountiful City area gets up to 20,000 acre
feet per year of the subsidized irrigation water, and buys 1,000 acre feet of

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1 WBWCD Annual Reports, 1971 and 1974; interviews with Wayne
Winegar, Secretary-manager, in February and May of 1972.
the M&I water that was supposed to pay the bills. For the irrigation water, which is pumped to it by the WBWCD, it pays only $2.23 per acre foot as its repayment assessment. In percentage terms, Bountiful gets 18 percent of the goodies (cheap irrigation) but buys only 3.4 percent of the M&I water that carries the burden of repayment (based on current total sales contracts for both kinds of water). By contrast, Ogden City buys one-third of the subsidizing commodity and gets none of the subsidized one. Ogden also has plenty of water of its own—and furthermore, knew it in 1948, when South Davis County was presumably dehydrated.

These relationships have apparently never become widely understood. Winegar said in 1972,¹ that Jay Bagley, an experienced Utah hydrologist, had recently castigated the WBWCD publicly for holding Bountiful so tightly to its M&I contract in the face of abundant groundwater. Bagley's criticism was based, said Winegar, on a just-completed thesis by a Utah State hydrology student. He (Bagley) charged that Bountiful was being forced to subsidize Kamas Valley farmers. Evidence presented here, combined with that of Chapter IV, suggests that, if reported accurately, Bagley's perspective is too narrow. The upper valleys did receive some benefits, but they have not been without some compensating costs—if only psychic pain. And Bountiful is hardly in a position to be casting stones.

¹ Personal communication.
Evidence presented in Chapter V demonstrates that south Davis County has been a chief beneficiary of WBP water. On the other hand, municipalities in North Davis and Weber buy most of the M&I water which foots the repayment bill. Chapter IV showed that it was south Davis that was short of water in the first place, and it was south Davis people who initiated the agitation that culminated in authorization of the Weber Basin Project. They thought they had to have water from the Weber River, knew it was expensive, tried to get State help, were turned down and referred to the Bureau of Reclamation. The Bureau, always anxious to get a new job, went to work immediately. They already had plans on the shelf—bigger plans than just a pipeline to south Davis. They also had an Act and a history to live with. They had to have land reclamation, big benefits, an ironclad repayment obligation and capacity. The Willard-Layton system provided the potential benefits, but they had to go after municipalities for the repayment money. They got that support by going to chamber of commerce boosters and other local promoters with a zealous interest in water development generally. The idea was sold on the basis of its stimulation to local economic growth—combined with threats that water and growth would soon run out.

There is little reason to doubt that the WBP has stimulated growth. But the evidence is clear that Davis County (particularly the South) has been the major beneficiary, while at the same time finding it possible to justify refusal to pay a fair share of the bill. The Bureau of Reclamation has probably refrained from making a big issue out of this because it allowed the
Project to proceed while sitting on the knowledge that it was at least premature and quite possibly redundant.

Details of the Argument

The remainder of this chapter has two objectives: to present further evidence about the proposed and actual beneficiaries and sponsors of the WBP, and to assess the financial status of the WBWCD. The latter objective is significant because it was thought at one stage of this investigation that the District was in financial difficulty, and that economic analysis might be of service to its management in optimizing net revenues. Variations on that theme occupy a major portion of Appendices I and III. It now appears that that objective was based on ignorance of important institutional details.

Experience after 1920 with water users who defaulted on their repayments to the Reclamation Fund, forced the Bureau of Reclamation to evolve more careful means of financial control. One of their major instruments is the water conservancy district law. Bureau lawyers drew up the essential features of this law and through the influence of water development lobbies had it incorporated into the Water Conservancy Acts of all the Reclamation states.¹ All of these acts are designed for the establishment of local government bodies with power not only to enter contracts with the federal government

(read Bureau of Reclamation), but also to raise the money from within their boundaries for the repayment of those obligations. Bureau representatives guide the establishment of these Districts and take care to assure that they are able to perform the necessary function of keeping the Bureau in business. The Bureau is a very patient finance company, but also very firm.

By the terms of the contract between the Bureau and the WBWCD, repayment obligations start at various times and run for 60 years thereafter. The full WBP will not be under repayment obligation until at least 1990, and perhaps not even then. Construction of Project facilities was begun in 1953 and continued to 1969. Different facilities, therefore, have become available for use at different times. As they become available, the District and the Bureau, by terms of the contract, agree jointly on the location and extent of a development unit. This unit is made up of blocks or districts in which either irrigation or M&I water is available for distribution. The Bureau then issues a unit notice, describing the locations, the amounts of water available, the assignment of repayment obligation to each of the two classes of users, and a 60-year repayment schedule for the unit. The first unit notice became effective in 1956, and the most recent (No. 7) in 1970. Once the WCD receives a unit notice, it does not have to immediately begin making repayment for the full amount of water that is available to it by means of that notice. Each block within it can have a development schedule of up to 10 years before it must be paying for its full allotment. That is, the Bureau tells the District that it was 10 years to sell a given amount of water in certain areas. Once
that objective is well on the way to being achieved, the Bureau gives it another 10-year (or less) selling job, going on in this way until the full capacity of the Project is sold. The Bureau wants to collect its money; it wants repayment to be quiet and relatively painless; it does not want to bankrupt its repayment agency or stir up resentment headlines because such events would threaten the future of Reclamation.

Terms of the contract required that if the project were terminated before completion, the District would be handed the full bill, to be paid in 60 installments. Nevertheless, in 1970, the Bureau and District came to a much softer arrangement. It calls for repayment of a smaller total ($78 million versus $81 million) than projected in the 1959 DPR, because construction was halted before all planned features had been built. But instead of having to start making payments on the full quantity of water in the notice, the District gets 20 years to build up to the full annual payment. By the terms of the District-Bureau agreement, the District becomes responsible for an additional 1,000 a.f. of M&I and 1,500 a.f. of irrigation water every year until the full allotment is sold. In the case of M&I, that condition will not be met until 1990, when the full 50,000 a.f. projected in the 1959 DPR will finally come under repayment. The final installment on that last 1,000 a.f. of M&I will not be due until 2050.

According to Wayne Eldredge, historian for the Weber Basin Project, when the repayment bill hits its peak, the WBWCD will be turning over about

1Provo Office, Bureau of Reclamation.
$1.5 million per year. On the basis of current sales as given in the 1974 Annual Report, the present repayment is about $1.1 million annually. Several things are working in favor of the District. Inflation is making its prices look much better in comparison to alternative sources. (See the contrast in well costs between 1972 and 1975 in Chapter XI.) The agricultural payments it is not getting from the Willard-Layton area seem likely to be replaced by industrial sales, and allowances for recreation and wildlife. Irrigation sales in north Davis and Weber are expanding via contracts with city subconservancy districts. Irrigation contracts in other parts of the Basin are increasingly of the Class D variety—a retail contract which brings the District a much higher price than wholesaling to irrigation companies. ¹ In 1970, Class D contracts accounted for more than a third of total irrigation sales. All of these reflect the transformation of important parts of the Basin from an agricultural to a residential, industrial-commercial, and recreational region. These uses, while not more consumptive of water, are easily capable of paying higher prices than farming. The increased property valuation works in favor of the District, for it gets a 1-mill levy on the total assessed value every year. From 1965 to 1969 that increase brought an average annual increment of $14,500 to District revenues. The 1960 agreement to start paying for an annual addition of 1,000 a.f. of M&I and 1,500 a.f. of irrigation water means about $18,750 per year. The increased tax revenue is,

¹ See Pendse's thesis for pricing details.
therefore, almost enough by itself to make the additional payments, even if the water is unsold. Inflation alone, through increased property values (tax revenues) and costs of alternative M&I supplies is probably enough to keep the District on easy street.

The contract between the District and Bureau is a very paternalistic document, reflecting the Bureau's half century of experience preceding the WBP. It does not just call for repayment; it specifies exactly how the money is to be obtained and handled. It allows the Bureau to specify prices, in unit notices, and tells the District what it must do to water users who default on payment. It also directs the District to set up special funds for emergency repairs and rebuilding worn-out parts of the Project, and allows the Bureau to overrule the District on the investment management of these funds. The Bureau appears to have some element of veto power over the agencies to which the District sells water, and the uses for which the water is intended.

While it may have other uses, the water conservancy district as a western institution apparently owes its birth to the Bureau of Reclamation, who designed it for their own purposes. Once such a district has a contract with the Bureau, that district is a repayment tool of the Bureau. It should hardly be looked upon as an agency of the state government, responsible to the state for its allocation decisions. This research project was initiated out of a general effort to improve the allocation of Utah water resources, to develop a state water plan. Specialists employed by Utah have been frustrated in this objective by constraints on the freedom of the state to control what
appear hydrologically to be its own waters. Those constraints are mainly imposed by the Bureau of Reclamation. A water conservancy district with a Bureau of Reclamation contract has federal water to sell. It is only nominally an agency of the state.

Appendices I and III assumed a stance of helping a state water institution solve some of its financial and merchandising problems. That perspective was inadequate, based on ignorance of the institutional facts. The Weber Basin Water Conservancy District has not been and likely never will be in serious financial difficulty. It is only a tool of the Bureau of Reclamation for getting back part of the money it invested in the Weber Basin Project. Similarly, it has been the Bureau that was stuck with an inventory it could not sell, not the WBWCD. It is the Bureau's water; they developed it, they are financing it, and it is they who must live with the consequences of redundancy.

Appendix II provides some details of the Bureau's method of financing the WBP, as revealed in Senate Document 147, Weber Basin Project, Utah, 1949. It shows that promoters of the WBP justified it on the basis of large benefits to swamp land, and intended that it be paid for by urban residents. Written in 1970, Appendix II cast doubts on the reliability of official statements about why the WBP had been built at all, and suggested that the Bureau of Reclamation used a small and gullible chamber of commerce group to win

authorization for a project that the Bureau wanted to build. The idea had been sold on the basis of a flimsily demonstrated "dire need" for water. Further investigation revealed that there had been a reasonably intense concern over water scarcity, but that it was confined (except for a few individuals) to the southern half of Davis County.

A group from south Davis approached the Bureau; the Bureau wanted to build the WBP and seized upon this opportunity to get support for it. But they had to have more support, for what they wanted to build was far larger than what a few promoters in Davis County even dreamed of. To get its project, the Bureau had to have a major benefit to reclamation of land for farming, and it had to have repayment capacity. It may be that under the circumstances of the late 1940's it simply would not have been able to help south Davis unless reclamation on a fairly significant scale were involved. Regardless of intentions, however, there is clear evidence that they proceeded as if this were true. The 1949 benefits to reclamation agriculture were high, swamping all other features. Every revision of the Definite Plan Report scaled down the significance of agriculture in comparison to other features. Swamp land reclamation provided the benefits, city water users and property owners provide the repayment revenues (most of them in North Davis and Weber Counties) and South Davis gets the most significant increment of benefits. The Bureau's own publications provide the figures to support these assertions.

Appendix II shows that in 1949 benefits to the Willard-Layton irrigation blocks were projected to be at least half of total project benefits. At the
same time, irrigation benefits were projected to be $5,979,000 out of an annual benefit of $6,995,000 for the total project. Layton-Willard was to have half the land and half of the water in the intended reclamation project.

In the 1959 DPR, total irrigation benefits were estimated to be only $3,600,600 annually, and of that total $1,539,900 were to be "indirect." Total project benefits, on the other hand, were calculated to be $9,128,900 in 1959. Thus the ratio of irrigation (reclamation) to total annual benefits dropped from 6/7 to 1/3 in the decade between authorization and completion of the first phase of the Project. ¹

The annual benefit/cost ratio is also more modest after 10 years. In 1949 it was 3.35 to 1.0. In 1959 it was down to 2.8 to 1.² Over that period of time, the nature of benefits had also changed significantly. In 1949, direct benefits to agriculture compared as 0.8/1 against costs. By including indirect benefits this was brought to 1.6/1. Also in 1959, the benefit/cost ratio for M&I was 1/1. This discouraging performance was made up in huge benefits against low costs for fish and wildlife management, and recreation. The change reflects both an acknowledgement that the agricultural "benefit" (to swamp lands) was somewhat ephemeral, and the success of the Bureau in getting Congress to authorize some new kinds of (nonreimbursable) benefits to water development.

¹ See Chapter XI, "Financial Analysis," 1959 DPR.
² Same sources as for previous paragraph.
The problem of the Bureau was complicated over this period by inflation of construction costs, while agriculture was stagnant at best. Total costs of the Project in 1959, as shown in Table 13, were estimated to be $97,500,000. In 1949, they were projected to be $69,534,000 for features similar, although not all identical, to those in Table 13. Table 14 shows how the Bureau worked around the problem of rising costs and flagging agricultural interest. Virtually every item in the table merits comment: notice first of all that these figures are cost allocations to the various uses. No pretense was even attempted that these allocations reflect the cost of specific facilities for specific uses. The facilities constructed are listed in Table 13. They are used jointly for all the purposes suggested in the allocation of costs. If a cost can be tied to a specific use, such as recreation, it is. Otherwise the Bureau uses an internal method of legerdemain called "separable costs-remaining benefits." Although not explained in the Definite Plan Report, it seems to be based on a calculation of what the costs would be if the facilities were constructed for one purpose alone, and a conclusion that that figure represents the alternative cost of the benefit provided by the Project. Hence, that amount of cost should be fairly borne by the beneficiaries of that particular water use. This is a variation on the method reported in Appendix II and

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1. Table 13 is from 1959 DPR Summary Sheets, p. 2. A corresponding table appears on p. 39 of the 1949 S. Doc. 147.

2. 1959 DPR, p. 105.
<table>
<thead>
<tr>
<th>Construction</th>
<th>Costs $a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineview Dam and Reservoir</td>
<td>4,600,000</td>
</tr>
<tr>
<td>Wanship Dam and Reservoir</td>
<td>6,836,000</td>
</tr>
<tr>
<td>Willard Dam and Reservoir</td>
<td>15,774,000</td>
</tr>
<tr>
<td>Lost Creek Dam and Reservoir</td>
<td>5,824,000</td>
</tr>
<tr>
<td>East Canyon Dam and Reservoir</td>
<td>3,548,000</td>
</tr>
<tr>
<td>Causey Dam and Reservoir</td>
<td>4,950,000</td>
</tr>
<tr>
<td>Stoddard Diversion Dam</td>
<td>373,000</td>
</tr>
<tr>
<td>Slaterville Diversion Dam</td>
<td>750,000</td>
</tr>
<tr>
<td>Pumping plants</td>
<td>7,030,000</td>
</tr>
<tr>
<td>Deep wells</td>
<td>804,000</td>
</tr>
<tr>
<td>Gateway Canal and tunnel</td>
<td>7,600,000</td>
</tr>
<tr>
<td>Weber Aqueduct and laterals</td>
<td>2,861,000</td>
</tr>
<tr>
<td>Davis Aqueduct and laterals</td>
<td>16,581,000</td>
</tr>
<tr>
<td>Layton Canal and laterals</td>
<td>3,393,000</td>
</tr>
<tr>
<td>Warren Canal and laterals</td>
<td>1,069,000</td>
</tr>
<tr>
<td>Willard Canal</td>
<td>3,413,000</td>
</tr>
<tr>
<td>Ogden Valley Canal</td>
<td>500,000</td>
</tr>
<tr>
<td>Drains</td>
<td>7,060,000</td>
</tr>
<tr>
<td>Power plants</td>
<td>1,547,000</td>
</tr>
<tr>
<td>Recreational facilities</td>
<td>2,545,000</td>
</tr>
<tr>
<td>Operation and maintenance housing and equipment</td>
<td>292,000</td>
</tr>
<tr>
<td>Future year capacity</td>
<td>150,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$97,500,000</strong></td>
</tr>
</tbody>
</table>

*aBased on actual cost of work completed, bid prices of work under way, and estimates for work yet to be undertaken on the basis of October 1959 prices.*
TABLE 14
COST ALLOCATIONS AND REPAYMENT, WBP

<table>
<thead>
<tr>
<th>Item</th>
<th>Construction Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1949</td>
<td>1959</td>
</tr>
<tr>
<td>Cost Allocation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td>$40,234,000</td>
<td>$56,251,000</td>
</tr>
<tr>
<td>M&amp;I Use</td>
<td>18,744,000</td>
<td>25,405,000</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$58,978,000</td>
<td>$81,656,000</td>
</tr>
<tr>
<td>Flood Control</td>
<td>5,900,000</td>
<td>6,558,000</td>
</tr>
<tr>
<td>Recreation</td>
<td>4,656,000</td>
<td>4,738,000</td>
</tr>
<tr>
<td>Fish and Wildlife</td>
<td>---</td>
<td>4,548,000</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$10,556,000</td>
<td>$15,844,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$69,534,000</td>
<td>$97,500,000</td>
</tr>
<tr>
<td>Payment of Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Users</td>
<td>$30,102,000</td>
<td>$24,456,600</td>
</tr>
<tr>
<td>Interest Component&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9,372,000</td>
<td>18,714,500</td>
</tr>
<tr>
<td>Sales of Surplus Energy</td>
<td>1,626,000</td>
<td>2,417,800</td>
</tr>
<tr>
<td>Tax Revenue</td>
<td>---</td>
<td>10,662,100</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$41,100,000</td>
<td>$56,251,000</td>
</tr>
<tr>
<td>Municipal and Industrial Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Users</td>
<td>$18,744,000</td>
<td>$24,515,100</td>
</tr>
<tr>
<td>Tax Revenue&lt;sup&gt;b&lt;/sup&gt;</td>
<td>---</td>
<td>889,900</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$18,744,000</td>
<td>$25,405,000</td>
</tr>
<tr>
<td>Flood Control</td>
<td>Nonreimbursable</td>
<td>Nonreimbursable</td>
</tr>
<tr>
<td>Recreation</td>
<td>Nonreimbursable</td>
<td>Nonreimbursable</td>
</tr>
<tr>
<td>Fish and Wildlife</td>
<td>Nonreimbursable</td>
<td>Nonreimbursable</td>
</tr>
</tbody>
</table>

<sup>a</sup>See explanation in text.

<sup>b</sup>Tax revenues left over after WBWCD has made its bond retirement payments.
repeated in the 1959 DPR\(^1\) of estimating the benefit to municipal water supply by using as an alternative cost the price of building the same facilities for M&I use only. (There is not a word in Bureau benefit/cost analyses about groundwater development as an alternative.)

The 1949 document made this comment about relative allocations:

"The allocation to municipal use was based on the assumption that municipal use would have a prior right to a firm water supply and thus would require greater proportionate use of storage and conveyance facilities than irrigation."\(^2\) Thus, says the 1949 report, each purpose will pay according to its proportionate use of project facilities. Table 14, by its allocation of costs, presumes the ratio of use to be 1:2 (roughly) in favor of irrigation. On the other hand, total M&I water was projected to be 40,000 a.f. in 1949, while irrigation water developed would amount to 245,000 acre feet—a ratio of 1:6 in favor of irrigation. Chapter V shows that the actual plans of the Bureau had an even worse ratio than this: M&I capacity of the Weber storage and delivery system was planned to be only 16,500 a.f. It is true that any foreseeable demand for M&I water could be met out of Pineview, but little was foreseen for the Ogden side, and all the treatment facilities were designed to use water from the Weber. To say that M&I use was even expected to employ

\(^1\)1959 DPR, p. 43.
\(^2\)S. Doc. 147, p. 108.
project facilities to one-third of their capacity, as cost allocations in Table 14 clearly imply, does not seem justifiable from the Bureau's own documents.

The cost allocations of Table 14 are purely arbitrary, designed to pay for the project and at the same time keep the price of irrigation water low enough to justify its use by commercial farmers. Notice that although the cost allocated to irrigation went up from $40 to $56 million, the repayment obligation of irrigation users went down from $30 to $24.5 million—a reflection of cost inflation combined with agricultural decline. The increase in total costs from 1949 to 1959 was $28 million, whereas the calculated ability of agriculture to pay had declined by $5.5 million. A net increase in revenue of $33.5 million, therefore, had to be found from other sources. They found $5.3 million more of nonreimbursable benefits, and close to $12 million in property taxes. They also squeezed a little more out of energy sales—possibly because they foresaw little use of the Layton-Willard pumping plants. That gave them at best a little over $19 million against their deficit of $33.5 million. The only available source was M&I users. Their burden was, therefore, increased from $28 to $43.2 million—just a little more than enough to cover the deficit ($15.2 versus $14.5 million).

These figures for M&I payments are calculated by adding the explicit figures allocated to M&I the item called interest component in the table. Under the 1949 plan, M&I users would pay off their $18,744,000 allocation in 40 years, at the rate of $468,600 per year. After that, they
would go right on paying at the same rate for 20 more years, generating an additional $9,372,000 to be applied against the irrigation allocation. This was justified in Senate Document 147 by a comment about the M&I investment being paid for out of a fund that was designed to provide interest-free capital investments for agriculture. In 1959 there is an explicit interest charge to M&I users, and it is turned back to help pay the cost allocation to agriculture. That is not in lieu of the 20 years of extra payments in the 1949 report, however. M&I users still must pay for 60 years. Furthermore, the amount of M&I water "needed" was revised upward by 10,000 a.f. to a total of 50,000 a.f. in 1959.

The tax portion of the repayment burden will fall most heavily on municipal residents as well, because it is a 1-mill levy on the assessed value of all property in the District. And that is not all. In order to sell the water designated as M&I by the Bureau, the WBWCD had to construct treatment plants (at Ogden, East Layton, and Bountiful) and water mains at its own expense. These facilities are in place, and the District can deliver treated water to any municipality in the East Shore area. It issued $5,400,000 in bonds to pay for this construction. Principal and interest payments on this part of the M&I water are high enough that the District must charge as much for repayment of its own facilities as it pays to the Bureau. That is, the Bureau repayment is $15 per acre foot. The District lays on another $16 for bond payments, and then must get an additional $12.50 in operation and maintenance and delivery cost could have been avoided if groundwater had been
developed for municipal use. This system was built to process and distribute a water supply limited by official estimate to 16,550 a.f. (Chapter V).

The method of Bureau planners is quite clear: irrigation water at a price farmers can (and will) pay is a necessary condition. Other water users and beneficiaries of water abundance can pay the bill. A major irony of the WBP situation is that urban residents of south Davis County are getting a large share of the cheap water, while refusing to pay for the expensive stuff. They can thumb their noses at the Bureau because they have been able to develop their own groundwater instead of having to buy it at three or four times the price from wells developed by the Bureau and the WBWCD. The Bureau knew better than any other group (except its parent and guardian, the U.S.G.A.) the groundwater situation in the East Shore. It clearly intended to sell groundwater to municipalities, because it did not even plan to meet more than a third of its projected M&I contracts with surface storage. This implies that Bureau officers based their plans on hydrologic studies showing poor groundwater potential in south Davis County. That being the case, the WBP could be paid for by gouging suburban residents of an area that was bound to grow if water could be supplied. The initial strategy depended on support from Ogden City, which did not really need Weber River water, but which did have a large urban population. South Davis municipalities could be counted on to sign up for increasing quantities of high-priced WBP water as they grew with Salt Lake City. The plan backfired when the hydrologic studies proved to be inadequate. Wells continue to be developed in south Davis County, and
Bountiful City has never been interested in expanding its pre-project contract for 1,000 a.f. of M&I water.

There were a reasonable number of people in south Davis who were concerned to get an augmented surface water supply for the county. Events in Davis County since the WBWCD commenced operations do lend credence to the argument of those people that water was a constraint to further growth of the county. Recent growth is apparent to anyone who keeps his eyes open while driving along U.S. Highway 89 from Salt Lake City to Ogden (the Davis Aqueduct is visible along the mountainside just above the highway), but Table 15 provides some figures to add a degree of precision to the impression. Assessed valuation figures in the table demonstrate that although it is avoiding payment for part of the benefit it receives from the WBP, south Davis County will pay an increasing share through the growth of its property values.

**Subsidization of South Davis is Probably Intentional**

As shown in Chapter IV, popular support for the WBP originated in south Davis County, the only part of the Basin for which a plausible argument of water scarcity could be made. This section will show that the system desired by a group in Davis County was not economically or financially feasible. It had to be subsidized in some way.
TABLE 15

COMPARATIVE GROWTH INDICATORS FOR THE WEBER BASIN

<table>
<thead>
<tr>
<th></th>
<th>Davis</th>
<th>Morgan</th>
<th>Summit</th>
<th>Weber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>30,867</td>
<td>2,519</td>
<td>6,745</td>
<td>83,319</td>
</tr>
<tr>
<td>1974</td>
<td>112,550</td>
<td>4,600</td>
<td>6,500</td>
<td>134,500</td>
</tr>
<tr>
<td>% Δ</td>
<td>265%</td>
<td>83%</td>
<td>-3.6%</td>
<td>61%</td>
</tr>
<tr>
<td>Personal Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Δ 1960-69</td>
<td>121.0%</td>
<td>57.3%</td>
<td>57.2%</td>
<td>67.8%</td>
</tr>
<tr>
<td>Assessed Valuation ($000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>25,745</td>
<td>6,797</td>
<td>12,731</td>
<td>67,119</td>
</tr>
<tr>
<td>1955</td>
<td>38,207</td>
<td>7,029</td>
<td>11,954</td>
<td>80,382</td>
</tr>
<tr>
<td>1960</td>
<td>55,972</td>
<td>7,121</td>
<td>13,200</td>
<td>105,102</td>
</tr>
<tr>
<td>1965</td>
<td>74,944</td>
<td>8,151</td>
<td>16,264</td>
<td>118,141</td>
</tr>
<tr>
<td>1970</td>
<td>105,345</td>
<td>10,204</td>
<td>20,747</td>
<td>148,773</td>
</tr>
<tr>
<td>1974</td>
<td>133,466</td>
<td>12,582</td>
<td>29,112</td>
<td>170,285</td>
</tr>
<tr>
<td>% Δ 1950-74</td>
<td>418%</td>
<td>85%</td>
<td>129%</td>
<td>154%</td>
</tr>
</tbody>
</table>

The map on the next page (Figure 2) is taken from a pre-project study of agricultural potentials in the proposed service area of the WBP.\(^1\) As it shows, lands served by the Davis and Weber Canal were already fully served and were not in the project. (Compare this non-project area to the green areas of Figure 1.) It was mainly bench lands that were dry, plus the low-quality lands of the lake plain. Farmers in the far south of the county were not happy with the Jordan River waters supplied by the Bonneville Canals (see Figure 2 and Chapter III), and so were interested in a higher level supply of better quality.

The County had recently acquired rights to 5,000 acre feet of storage in Echo Reservoir through financial support of the Weber River Project of the 1930’s. (See Chapter II.) But they had no way of getting it to the unwatered bench lands and to the south end of the county. Prior to World War II, a representative of the Bureau of Reclamation, Harry Wilbert, had shown Davis County Agent, DeLore Nichols, the physical possibility of a high level aqueduct, similar to the one that was eventually built as part of the WBP. Building such an aqueduct and getting water into it at the rugged mouth of

\(^{1}\)W. Fuhriman, G. Blanch, and C. Stewart, *An Economic Analysis of the Agricultural Potentials of the Weber Basin Reclamation Project, Utah*. Agricultural Experiment Station, Utah State Agricultural College, Logan, Utah, December 1952. The map is on page 6. One of the authors, Walter Fuhriman of Brigham Young University, says that the principal objective of the study was to assure that irrigation prices for WBP water would not be set at a level too high for commercial agriculture in the region. (Personal communication.)
Figure 2. Location of the Lake Plain and Foothill areas, Weber Basin.
Weber Canyon would be a very expensive means of transporting only 5,000 a.f. of water, however. If such a conveyance system were to be constructed at all, the cost of building it large enough to handle any potential need for water in the area it could serve would be marginal compared to later duplication. On the other hand, such an extensive system for only 5,000 a.f. of water would be hard to sell to budget scrutineers, regardless of its potential capacity. (Nichols says that the County had to fight to get a share in the Weber River Project. Judging by the evidence from the WBP, however, it is not implausible that the Davis water in Echo Reservoir was in fact another skillful sale by Bureau representatives. It certainly provided a goad or irritant to help stir up interest in the WBP, which by its own admission had been part of Bureau plans for decades.)

A feasible high level conveyance system for Davis County required additional storage on the Weber River. Just how much storage depended on the potential of Davis lands to use more water. Lands under the Davis and Weber Canal needed no more. Higher lands in north Davis, and most of south Davis could use more, however, and the aqueduct was the most plausible way of getting it to them from the Weber River. The lands were accordingly surveyed and tested, and it was determined that they could use 62,100 a.f. of water if fully employed in agriculture.¹ (That would entail replacing waters of the Jordan River supplied through the Bonneville and Bonneville Pump

¹See 1959 DPR, p. 39. Also Table 16.
Canals. Since the county already had a right of 5,000 a.f. in Echo Reservoir, something on the order of 57-60,000 a.f. of additional storage was needed to serve all the agricultural potential of eastern and southern Davis County. And that was the carrying capacity (adjusted for peak season use) that should be built into the aqueduct.

Notice from Table 8 that the increment to storage capacity is provided precisely in Wanship Dam (Rockport Lake). A reasonable project to provide a full water supply to south Davis County and the whole of the Davis high lands might have included these features on the existing WBP:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Actual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wanship Dam and Reservoir</td>
<td>$6,836,000</td>
</tr>
<tr>
<td>Stoddard Diversion</td>
<td>373,000</td>
</tr>
<tr>
<td>Gateway Canal and Tunnel</td>
<td>7,600,000</td>
</tr>
<tr>
<td>Davis Aqueduct</td>
<td>16,581,000</td>
</tr>
<tr>
<td>Total Actual Cost</td>
<td>$31,390,000</td>
</tr>
</tbody>
</table>

Something like this system was what south Davis water enthusiasts wanted, and its components were the first ones built. Water was flowing in the Davis Aqueduct by 1956, 3 years after construction commenced.

As an irrigation project it did not make economic sense, however. The Bureau's own calculation of the construction repayment capacity of irrigation blocks under the Davis Aqueduct were as shown in Table 16.² The ability

---
¹ From Table 13.
² Except for the third column, this information is from the 1959 DPR, p. 96. "1970 Constructed Capacity" is from Table 6.
### TABLE 16

**DAVIS AQUEDUCT IRRIGATION**

<table>
<thead>
<tr>
<th></th>
<th>1959 Estimated Requirement</th>
<th>1959 Average Annual Supply</th>
<th>1970 Constructed Capacity</th>
<th>Total Repayment Obligation</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Davis</td>
<td>15,400 a.f.</td>
<td>14,100 a.f.</td>
<td>15,400 a.f.</td>
<td>$2,931.0 mil.</td>
</tr>
<tr>
<td>Kaysville-Farmington</td>
<td>8,500</td>
<td>7,800</td>
<td>9,400</td>
<td>1,078.9</td>
</tr>
<tr>
<td>West Farmington</td>
<td>6,400</td>
<td>5,800</td>
<td>5,700</td>
<td>836.4</td>
</tr>
<tr>
<td>Centerville</td>
<td>3,100</td>
<td>2,800</td>
<td>4,000</td>
<td>446.6</td>
</tr>
<tr>
<td>Woods Cross No. 1</td>
<td>2,800</td>
<td>2,600</td>
<td>2,800</td>
<td>1,175.4</td>
</tr>
<tr>
<td>Woods Cross No. 2</td>
<td>7,900</td>
<td>7,200</td>
<td>3,800</td>
<td>707.4</td>
</tr>
<tr>
<td>South Davis</td>
<td>18,000</td>
<td>16,400</td>
<td>20,775</td>
<td>2,962.8</td>
</tr>
<tr>
<td></td>
<td>62,100 a.f.</td>
<td>56,700 a.f.</td>
<td>61,875 a.f.</td>
<td>$10,138.2 mil.</td>
</tr>
</tbody>
</table>

Of agriculture to repay construction costs, even over a 60-year period, was thus only 1/3 of the system's cost. The Davis Aqueduct system, even as rationalized by additional storage capacity, had a benefits-to-costs ratio of only one-to-three! And it was the only part of the WBP which can possibly be said to have sprung from unsolicited popular request. If the additional storage capacity of Wanship Reservoir were left out of the calculation, total costs would have been reduced to about $24 million, but irrigation capacity would have been limited to the 5,000 a.f. of storage rights which the County already
had in Echo Reservoir—less than enough for the projected demand from the
two Woods Cross blocks. Repayment capacity would, therefore, have been
less than $2 million (sum of repayments from the two Woods Cross blocks).
Without the additional storage, therefore, the benefits-to-costs ratio of a
water supply system which might legitimately be said to have originated from
popular demand was something like one-to-twelve. ¹

The Bureau of Reclamation had learned in the 1920's (see Chapters
IX and X) that one answer to this kind of problem was to find a paying partner
for irrigation. The best one was hydro-electric power, but they had also used
municipal and industrial water supplies. In the Weber Basin case, Bureau
planners calculated that their best alternative, although far from perfect, was
M&I contracts. But this meant that M&I users along the upper Davis bench
and in the southern communities would have to pay over $20 million if the
Davis project were to be paid for by residents of its service area. Was it
plausible to expect that towns and farms above the Davis and Weber Canal
(see Figure 2) and south of Kaysville could repay over $31 million if farms
could provide only one-third of the total?

Existing towns in the area were few and puny, with a combined popula-
tion of less than 10,000 people. ² They already had a collective water supply

¹ South Davis origins of the WBP are the subject of Chapter IV and
Appendix II.

² Win Templeton, Davis-Weber Counties Water Development, a report
submitted to the Davis-Weber Counties Municipal Water Development Associa-
tion, February 1949. Templeton was a Salt Lake City consulting engineer and
of at least 4,277 a.f. per year. If the proposed aqueduct system were built, further urban expansion could use water relinquished from irrigating farm land. Once full-service capacity was developed, therefore, full-supply would remain a relatively permanent condition.

In circumstances of ample supply it is difficult to gouge consumers. Since 10,000 M&I users were consuming less than 5,000 a.f. per year in 1948, the potential for major M&I contracts at high prices was severally limited. They were only possible if M&I were currently in significantly short supply, and if an expanded M&I clientele could be forced to pay a much higher price for water released from agricultural use. Bureau tactics were aimed at getting maximum pre-construction commitments for M&I payment, but they also tied every water user to a 60-year contract. Substitution of irrigation for M&I contracts would, therefore, be impossible. Long-term contracts would not prevent actual physical substitution, however, for contractees pay for 60 years regardless of whether or not they use their water. Once an area has been clearly and irreversibly converted from farming to residential, one of his major clients was Ogden City. His report is further described and evaluated in Appendix II.

1 Ibid. Extrapolated from Templeton's figures for August, the month of lowest stream flow.

2 Bureau planners calculate a full-service water supply for M&I to be roughly the same as for the same area in agriculture. Utah State hydrologists, however, say that residential and commercial development are less consumptive, per acre, than agriculture. This information from Frank Haws, Utah Water Research Laboratory, Utah State University, Logan, Utah.
commercial, or industrial use, therefore, the water that is unused for agriculture can be sold again for M&I. Repayment contracts accumulate, therefore, rather than substitute, and any time the use of water shifts permanently the Bureau can gouge—so long as it is in control of the only available water.

Although the Project's promoters tried to make a strong case for imminent municipal water shortages in the area, their arguments must have been a little forced. The Templeton report cited above estimated existing supplies of at least 4,277.5 a.f. of municipal water in the agricultural service area of the proposed aqueduct. In the pre-construction sales campaign, municipalities in that area signed WBWCD contracts for an additional 2,409 a.f.\(^1\) (see Table 19). By the time the Davis Aqueduct was in service, therefore (1956), the water supply to communities in its irrigation service area was at least 6,686.5 a.f. The State Engineer's Office calculated 1960 municipal water use in that area to be about 5,000 a.f. (Table 18). Over the same period of time, population in the area had jumped from 10,000 to 25,000 (Table 18)—a growth of 150 percent. If 25,000 people used 5,000 a.f. in 1960 (0.20 a.f. per person), it is unlikely that 10,000 people were using more than 2,500 a.f. (0.25 a.f. per person) in 1950, for the same purposes. Supply must have exceeded use in 1948 by a ratio that was close to 2:1.

It is clear from the figures of the previous paragraph that municipal water supplies in the proposed aqueduct irrigation service area were more

\(^1\)There were no additions to this total until 1964.
## TABLE 17

**URBAN RESIDENTIAL POPULATION OF DAVIS AQUEDUCT AGRICULTURAL SERVICE AREA**

<table>
<thead>
<tr>
<th>Place</th>
<th>1948&lt;sup&gt;a&lt;/sup&gt;</th>
<th>1950&lt;sup&gt;b&lt;/sup&gt;</th>
<th>1960&lt;sup&gt;c&lt;/sup&gt;</th>
<th>1970&lt;sup&gt;d&lt;/sup&gt;</th>
<th>1975&lt;sup&gt;e&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bountiful</td>
<td>5,500</td>
<td>5,969</td>
<td>17,039</td>
<td>27,865</td>
<td>30,800</td>
</tr>
<tr>
<td>Centerville</td>
<td>1,100</td>
<td>1,267</td>
<td>2,361</td>
<td>3,247</td>
<td>4,366</td>
</tr>
<tr>
<td>East Layton</td>
<td>210</td>
<td>216</td>
<td>N.A.&lt;sup&gt;g&lt;/sup&gt;</td>
<td>714&lt;sup&gt;e&lt;/sup&gt;</td>
<td>884</td>
</tr>
<tr>
<td>Farmington</td>
<td>1,600</td>
<td>1,468</td>
<td>1,951</td>
<td>2,534</td>
<td>3,870</td>
</tr>
<tr>
<td>Fruit Heights</td>
<td>150</td>
<td>124</td>
<td>N.A.&lt;sup&gt;g&lt;/sup&gt;</td>
<td>355&lt;sup&gt;e&lt;/sup&gt;</td>
<td>495</td>
</tr>
<tr>
<td>North Salt Lake</td>
<td>300</td>
<td>261</td>
<td>1,655</td>
<td>2,133</td>
<td>3,121</td>
</tr>
<tr>
<td>West Bountiful</td>
<td></td>
<td>684</td>
<td>945</td>
<td>1,268</td>
<td>2,102</td>
</tr>
<tr>
<td>Woods Cross</td>
<td>300</td>
<td>264</td>
<td>1,098</td>
<td>3,132</td>
<td>3,217</td>
</tr>
<tr>
<td>Val Verda</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5,900</td>
</tr>
<tr>
<td>(Uninc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7,050</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>9,160</td>
<td>10,253</td>
<td>25,049</td>
<td>47,148</td>
<td>55,905</td>
</tr>
<tr>
<td><strong>Total South Davis</strong>&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td>51,176</td>
<td>60,506</td>
</tr>
</tbody>
</table>

<sup>a</sup> Templeton.


<sup>c</sup> U.S. Census figures published by Bureau of Economics and Business Research, University of Utah, on preliminary results of 1970 Census of Population.

<sup>d</sup> Ibid.

<sup>e</sup> Davis County Population Projection, prepared by Davis County Planning Commission in 1967.

<sup>f</sup> Not incorporated in 1948.

<sup>g</sup> Census data for incorporated places over 1,000 population only.
### TABLE 18

**AVAILABLE SUPPLY AND WATER USE, MUNICIPALITIES IN DAVIS AQUEDUCT AGRICULTURAL SERVICE AREA (ACRE FEET)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bountiful</td>
<td>2255.8</td>
<td>2478</td>
<td>980</td>
<td>1000</td>
<td>6920</td>
<td>1000</td>
</tr>
<tr>
<td>Centerville</td>
<td>774.2</td>
<td>N.A.</td>
<td>200</td>
<td>225</td>
<td>2120</td>
<td>450</td>
</tr>
<tr>
<td>East Layton</td>
<td>78.0</td>
<td>16</td>
<td>58</td>
<td>5.1</td>
<td>130</td>
<td>63</td>
</tr>
<tr>
<td>Farmington</td>
<td>483.9</td>
<td>844</td>
<td>200</td>
<td>200</td>
<td>990</td>
<td>200</td>
</tr>
<tr>
<td>Fruit Heights</td>
<td>48.4</td>
<td>22.5</td>
<td>35</td>
<td>36</td>
<td>125</td>
<td>66</td>
</tr>
<tr>
<td>North Salt Lake</td>
<td>121.0</td>
<td>275</td>
<td>--</td>
<td>715</td>
<td>995</td>
<td>100</td>
</tr>
<tr>
<td>West Bountiful</td>
<td>N.A.</td>
<td>191</td>
<td>191</td>
<td>136.6</td>
<td>640</td>
<td>250</td>
</tr>
<tr>
<td>Woods Cross</td>
<td>516.2</td>
<td>190</td>
<td>100</td>
<td>431</td>
<td>505</td>
<td>100</td>
</tr>
<tr>
<td>Val Verda (SDWID)</td>
<td>N.A.</td>
<td>987</td>
<td>360</td>
<td>299</td>
<td>3280</td>
<td>360</td>
</tr>
<tr>
<td>Hill A.F.B.</td>
<td>N.A.</td>
<td>225</td>
<td>3760</td>
<td>225</td>
<td>N.A.</td>
<td>225</td>
</tr>
<tr>
<td>Totals</td>
<td>4277.5</td>
<td>5003.5</td>
<td>2294.5</td>
<td>9692</td>
<td>2276.7</td>
<td>15,705</td>
</tr>
</tbody>
</table>

*Unincorporated suburban area between Bountiful and North Salt Lake. The South Davis Water Improvement District buys both irrigation and M&I water from the WBWCD; 360 a.f. was its original contract for M&I.

T. Templeton.


Municipal reports to State Engineer (incomplete obviously) plus personal communication with city water managers. Research conducted in 1969.

From WBWCD sources--actual M&I contracted amounts.

State Engineer's projection. Mostly for irrigation.

An equivalent figure can realistically be inserted for other years.
<table>
<thead>
<tr>
<th>Place</th>
<th>Pre-Construction*</th>
<th>1974** Contract Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bountiful</td>
<td>1000 a.f.</td>
<td>1000 a.f.</td>
</tr>
<tr>
<td>Centerville</td>
<td>200</td>
<td>450</td>
</tr>
<tr>
<td>East Layton</td>
<td>38</td>
<td>63</td>
</tr>
<tr>
<td>Farmington</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Fruit Heights</td>
<td>36</td>
<td>66</td>
</tr>
<tr>
<td>North Salt Lake</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>West Bountiful</td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td>Woods Cross</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Val Verda (SDWID)</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Hill A.F.B.</td>
<td>225</td>
<td>225</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>2409 a.f.</td>
<td>2814 a.f.</td>
</tr>
</tbody>
</table>

*a From "Municipal Water Allotments under Contract." Personal communication from WBWCD, January 30, 1969.

than adequate in 1948. Ardent water promoters might argue against this that it is peak season water supply that counts. That is true, but the Templeton figures cited were based on August supplies. This means that the actual annual supply was greater than calculated above, for August is the month of minimum stream flow (possible exception of September, a month of lighter use). The higher flows of other months could be held in reservoirs for summer use, if surface flows were the only source of water. Investment in municipal catchment basins and/or reservoirs would have been significantly less costly than the Davis Aqueduct system, if municipal supply had been the primary consideration.

Per capita use for 1968, the year for which the most reliable data are available, was about 0.34 a.f. (using Table 18, exclusive of Hill A.F.B., and a population of 47,000 extrapolated from Table 17). In preparing the projections of 1975 municipal water use in the area, State hydrologists appear to have used a figure of 0.28 a.f. for per capita water use (Table 18).\(^1\) Compared to the 1968 figure of 0.13 a.f. per capita for actual municipal use, a projected requirement of 0.28 seems a little excessive. Even the 1960 figures which showed per person use of 0.20 a.f. were inflated by non-culinary use in several instances (note the 1948 and 1960 columns in Table 18). Since 1956

\(^1\)Lawrence P. Beer, "Projected 1975 Municipal Water Use Requirements, Davis County," Water Resources Branch, State Engineer's Office, Salt Lake City, Utah, 1962. Mimeographed. The water use projection given by Beer for the relevant municipalities has been divided by the 1975 population total for those communities listed in Table 19 to get the quotient of 0.28 a.f.
several of the communities have segregated culinary from yard and garden use. In part, this has been due to their contracts with the WBWCD. Because of the high fixed cost of WBP water, the towns have used it first, keeping their own resources in reserve. Also, since the WBWCD water is treated, they use it for culinary purposes and their own water for yard and garden irrigation. In several cases it is quite clear (Table 18) that towns were able to substitute WBP water for their own supplies completely in early years of the Project's service. Overall, and in individual cases, there was no pressing need for augmented supplies of municipal water in the Davis Aqueduct irrigation service area in 1948. This is clear from figures supplied by the WBP promoters themselves.

Davis County was obviously in a favorable location for urban growth, from both the north and the south. Nevertheless, total M&I requirements as a net addition to irrigation use could not in 1950 have been expected to grow very much over what the WBWCD was able to sell in the pre-construction campaign, in the Davis Aqueduct's irrigation service area. Project plans called for full irrigation service. That means roughly 3 acre feet per year in Utah. Land taken over for urban development can no longer be used for agriculture; hence, its water supply becomes available for M&I purposes. In the South Davis communities, figures provided by a water demand study in the mid-1960's show an average lot size of 0.086 acres per capita. Using

\[1\] B. Delworth Gardner and Seth H. Schick, Factors Affecting Consumption of Urban Household Water in Northern Utah, Bulletin 449,
the figure of 0.13 a.f. per capita from the previous paragraph, municipal use was about 1.5 a.f. per acre in 1968. The excessive figure of 0.28 a.f. per capita, attributed above to the Beer projection, works out to a per acre requirement of 3.3 a.f. The Bureau of Reclamation used 3.08 a.f. per acre as the agricultural requirement for lands in the Davis Aqueduct service area (Table 5). The agricultural supply is, therefore, ample for conversion to M&I use.

As demonstrated in Appendix II, the promotional campaign for the Weber Basin Project was fought mainly by people of the chamber of commerce type on the presumption that municipal water supplies for urban and industrial growth would be a net addition to irrigation requirements. Their initial rallying cry was that the WBP would develop all available flows of the Weber and Ogden Rivers for agriculture, leaving none for urban-industrial expansion. It seems likely that hydrologists of the Bureau and U.S.G.S. could have disabused them of this notion had they wanted to. Once the East Shore was provided with full delivery facilities and storage capacity, it would have a full water supply. Urban-industrial expansion would necessarily come at the expense of agriculture, and would use the water released from irrigation duty.

Agricultural Experiment Station, Utah State University, Logan, Utah, 1964. The average per capita lot size for the towns in Tables 17, 18, and 19 is 0.086.
Bureau planners must have known this. Since they could not realistically expect to sell much more total quantity of water in the aqueduct service area than the full irrigation supply, their hopes for growing M&I contracts must have been based on the presumption of monopoly power. If they controlled the only water supply, then urban-industrial expansion would allow them to re-sell former irrigation water as high-priced M&I. If they could not count on such monopoly power (i.e., if they recognized that groundwater was a realistic alternative source), then the amount of M&I contracts they could sell in a pre-construction campaign would be just about all they could count on until other sources of water became at least expensive as their own.

As already noted, the pre-construction M&I campaign realized contracts for 2,409 a.f. in the Davis Aqueduct irrigation service area. If the Project for upper and southern Davis County were to be self-sustaining, its few small towns would have to pay $21.2 million (see above, pp. 195-196, of this section) over the next 60 years, or more than $350,000 per year. At a volume of 2,500 a.f., that implied a repayment assessment of $140 per a.f. before treatment, conveyance, operation and maintenance costs. It is a ludicrous figure beside the agricultural repayment of about $3 per a.f. Furthermore, no interest has been included with the calculations above. Reclamation law is very liberal with agricultural users; they usually pay no interest on moneys advanced by the Reclamation Fund. But non-agricultural portions of Reclamation projects are generally required to pay interest; they are the "paying partners" of reclamation, and must keep the Fund replenished.
Actual terms of the WBWCD's contract with the Bureau of Reclamation call for M&I payments to extend over 60 years, although the principal amount is supposed to be paid off in 40 years. The remaining 20 years of payments are explicitly designated as an interest equivalent. If a similar kind of calculation had been made above, the M&I repayment assessment would have been a third greater, or $186+. Such heavy and obvious subsidization of one group by another as these hypothetical conditions clearly imply, might be difficult to sell. Certainly someone would ask for cost justification for the difference in price. (The truth is that there is little or no cost difference between WBP water delivered to the three WBWCD treatment plants and water delivered elsewhere along the aqueduct for irrigation. A Bureau spokesman argued that Project facilities had to be built more strongly for M&I use, because winter operation is required. Wayne Winegar scoffed at this, and added that parts of the system should have been built more heavily than they actually were.)

If the M&I contract price had been $186 instead of $15 per a.f., it is doubtful that the pre-construction campaign could have garnered commitments to 2,000 a.f., given the evidence presented above that the situation of towns was far from desperate.

To get the necessary total revenue of $21.2 million, plus interest, the Bureau had to have either high price or high volume. An initial volume of

1 Personal communication with officers of the WBWCD and Salt Lake Regional Office, Bureau of Reclamation.
only 2,409 a.f. and 10,000 people placed them in a very awkward spot. It called for a price so excessive that expanded sales would almost certainly be deterred by the development of alternatives about which the Bureau was at least as well-informed as anyone else. At a price more competitive with long-run alternatives, high volume was the only way of making the Project feasible, and with a start of 2,409 a.f. it would take a long time to build up to the necessary annual revenue of about $470,000 (adjusted for interest as above). If it could depend on absolute control of incremental water supplies, so that any M&I expansion must be served by the WBWCD, the Bureau could expect 1975 deliveries of less than 11,500 a.f.¹ (based on a 1975 population of 60,000, per capita use of 0.15 a.f., and the initial 2,409 a.f.). To raise a revenue of $470,000, this quantity would have to be priced at about $41 per a.f.--still excessive, especially in terms of 1950 general price levels. At 410 per a.f., which is a figure Bureau planners seem to have believed they could realistically count on,² total revenue would only be approaching a fourth of the annual requirement 20 years into Project operation. Even if the full capacity of the Aqueduct were devoted to M&I service to a completely urbanized upper and south Davis County, the 61,000 a.f. so supplied would have to bring $7.70 per a.f.--and would imply a population of 400,000 people! (At 0.15 a.f.

¹Note in Table 19 that the actual contracted amount in 1974 was only 2,814 a.f.

²S. Doc. 147.
per person. Using the 1964 density of 0.086 acres per capita, reported by Schick, and the area of 27,740 acres reported in Table 4, the population calculates to about 323,000.) As the repayment fee of $15 which was eventually established for M&I, volume would have to be 31,333 a.f. per year for 60 years. To get that volume on per capita use of 0.15 a.f. would require a population of 209,000. But there were only 10,000 people in the area in 1950, and to build up to 200,000 would realistically take longer than the 60 years of the required repayment period. Furthermore, neither local promoters nor the Bureau intended to convert the county into a completely urbanized region.

Long-term Bureau objectives were agricultural development. Even the local chamber of commerce promoters foresaw an agricultural future for the East Shore. The Templeton report, cited earlier, noted that although water for urban-industrial expansion could be obtained from irrigation water source, "it would result in a loss of irrigated acreage, which cannot be afforded." They wanted industrial growth with no loss of agricultural production. This greedy and unrealistic perspective is no doubt what led them into the error of assuming that M&I water must be a net addition to irrigation use. It is possible that Bureau personnel shared the same misapprehension. It seems to have been part of an American ethos that has not been severely challenged until the last decade.

The Davis Aqueduct project, as envisaged by the original local promoters of the WBP (see Chapter VII) was not financially or economically feasible, even assuming an absolute monopoly over future water supplies.
This suggests that at least one reason why Bureau planners transformed the south Davis "request" (Chapter VII) into the behemoth that emerged, was that they had to disguise its high cost and get financial support from outside the region that would gain most from the project. ¹

¹This account has ignored an industrial contract with Chevron Oil Company for 2,750 a.f. The company operates a refinery in the south end of the county. While this contract is an important source of revenue to the WBWCD, and was one of the pre-construction commitments, it could hardly be used for extrapolating water use based on suburban expansion. It is probably regarded by the company as a form of local taxation, since cheaper water was almost certainly available even in 1950. One possibility was the Jordan River water from the Bonneville Canal, which was to be discontinued as an irrigation source as soon as WBP became a reality. Only 750 a.f. of the company's contract amount is for treated water.
CHAPTER VII
RESISTANCE TO HYDROLOGIC EFFICIENCY IN THE WEBER BASIN

The introductory chapter called attention to the idea that technique is the ultimately limiting resource, because matter and energy are transformable into each other. Applications of energy can transform and transfer materials from one thing to another and from place to place. The most daunting challenge to human ability to exert power over energy-matter transformations appears at present to be the limitations of human physical structure which confine us to the biosphere in which we have evolved. Nevertheless, significant applications of controlled energy to the transportation of water are possible without going to extremes in creating water out of energy and elementary materials. Water is one of the most abundant substances on earth, a fact which no doubt had a great influence on the evolutionary direction of plant and animal life. Life is dependent on water because it is premised on water, which means necessarily that there is lots of water around. While it is slightly odd to say we are fortunate to have water abundance, therefore, it is true that without technological mastery of energy sources humans must not stray far from where water of appropriate quality is accessible without the interposition of tools.
Arid regions may be defined by the reasoning above us areas where water is not easily accessible in abundance without the interposition of controlled energy. Much of the United States west of the Mississippi fits this description. A great deal of scientific and technical effort has been exerted to make water more accessible in this region. Given that controllable energy is the limiting resource, those efforts have, in general, been directed toward getting the greatest water accessibility per unit of energy expenditure.

One of the most obvious sources of energy has been the hydrologic cycle in combination with high mountains. Water is deposited by solar energy mostly in the highest elevations of the Mountain West. From the glaciers and mountain valleys it moves at varying rates through or over the unconsolidated valley fill to the oceans or to continental evaporating pans. Elevated water represents an energy potential. That potential can be controlled for beneficial use by arresting the normal downward flow of mountain water, and by diverting and storing it for use at other times and other places. Diversion and storage themselves require purposive effort and adequate techniques of energy control, but maximum use of the energy potential represented by mountain water is obviously one of the least expensive ways of augmenting accessible water in terms of actual expenditure of other sources of controlled energy.

This fact was recognized clearly by John Wesley Powell, who defined efficiency in the use of western water resources as making optimum use of the energy potential of mountain water. This idea, which is termed hydrologic efficiency in this work, has maximum application at the level of drainage
basins. Inter-basin transfer of water requires energy expenditure other than that provided by the potential of a body of elevated water to move itself to a lower place through humanly contrived alternative channels. It is true that the energy potential of a rapidly falling river can, in the twentieth century, be harnessed to lift a portion of the river flow into another drainage basin, via hydro-electric power. Nevertheless, there are other uses for hydro power, and it is energy-inefficient to use such sources for pumping before the full intra-basin hydro potential is used.

In recognition of this principle, Powell advocated that political boundaries in the West be conterminous with boundaries of hydrographic basins. As Chapter VIII recounts, he was successful, for a time, in getting Western settlement arrested while the Geologic Survey attempted to map all the water courses and drainage basins of the arid region. His objective was to have settlement and political jurisdiction consistent with maximum hydrologic efficiency. He failed, of course, but the crazy quilt of water management problems that have plagued Western development provides ample confirmation of his foresight. Efforts of the State of Utah to develop a Water Plan are a tacit recognition of the chaos he predicted.

Planning efficient use of hydrologic potential is a complex and ambitious undertaking. Water location and movement depends on a great many variables, including climate, topographic and geologic structure, soils and vegetation. Application of these elements of physical hydrology is hampered, since the failure of Powell's ambitious plan, by political, legal, and economic
institutions. Even conducting the requisite investigations, let alone implement-menting a hydrologically efficient plan, has proved to be very difficult because of opposition from individual or special-group interests, and sometimes from popular opinion. It would be hard to devise a better example of divergence between individual and collective interest than a drainage basin in the arid Mountain West. As Powell saw it, a collective approach to western settlement was a technological necessity, if energy efficiency and hence maximum aggregate wealth were the objective. Attitudes and institutions in 19th century America favored laissez-faire, however, and the cost of this preference was a decrement to hydrologic efficiency.

Commitment to a State Water Plan in the last decade was probably symptomatic of a resurgence of interest in technical efficiency as against laissez-faire. (It can hardly be said that voters of the Mountain West are insensitive to the creeping collectivism that is implied by state planning in respect of any resource.) The recent preference for technical (hydrologic) efficiency may reflect a real need for access to more water if every member of a larger population is to consume water at the same per capita volume as formerly, or it could be the manifestation of political success by a technological interest group. A society that places its faith in technical progress, and accepts the specialization that seems to attend it, is vulnerable to the interests of the groups in whom it recognizes special expertise. Utahns may have been sold on greater hydrologic efficiency, therefore, without really needing it. More likely, they have committed themselves to the idea somewhat
unwittingly. They have generally endorsed economic growth with the population expansion which it both entails and permits. Given that frame of mind, they will have gone along easily with arguments that progress requires more water supply development. Economic growth in recent American experience has meant industrialization and urbanization. These changes necessarily entail changes and improvements in water conveyance facilities, but it is far from axiomatic that they require development of more controlled water (see Chapter VI).

Laissez-faire in the American system of resource allocation has frequently meant lobbying and influence peddling in various legislative bodies. The rise of government-supported science and technology (for which Wallace Stegner gives John Wesley Powell major credit—see Chapter VIII), added to the number and variety of special interest groups looking for a share of the national wealth. (This is not to say that technological interest groups have not augmented the national wealth.) As a fraternity of water development specialists has grown in the U.S., its objectives have meshed, in part, with those of local people who favored water development for personal or group reasons other than professional purposiveness or technical interest. The outcome has not always been as perfect as hydrologic purists would like, so that there always seems to be room for improvement. In the historical traces of the Utah water development group a common theme is disdain for the piece-meal nature of past developments and the need for comprehensive water
planning. (The WBP was seen by this group as a properly comprehensive
development.)

Incremental development of water supplies need not violate the objec-
tive of hydrologic efficiency if it is based on the adequate knowledge of water
movements in the basin, and a hydrologically competent plan for ultimate use
of water and related resources. Probably the most significant barrier to
achieving planned efficiency through incremental development has been igno-
rance of the groundwater portion of the hydrologic cycle. Chapter III has
shown that knowledge of groundwater in general is a recent phenomenon, and
that Utah has been very backward in applying its techniques to her own ground-
water resources. Several of the obstacles to efficient water use recounted in
this chapter will be easily recognized as stemming from ignorance about
groundwater, and failure to recognize the principle that it is not water, but
techniques, energy, and instruments of control that are scarce.

Water enters an intermountain drainage basin from above. Much of
the basin supply is deposited as snow in the mountains. From snowbanks and
glaciers, water moves downward over bedrock to a sink. Water development
means arresting and changing the natural direction of that flow, whether it is
above or through the unconsolidated fill of the basin. Development requires
purposive effort and controlled energy expenditure of varying quantities. If
readers keep this in mind, it will be apparent in what follows that popular
conceptions and judicial interpretations of water and water rights in Utah
have been inaccurate. There has been no shortage of water. It is easy access
to water that has become scarce as the region became more heavily populated.
If access is not easy, greater effort must be expended in transporting water to where consumers want it. Few people prefer more to less effort. Hence inequality of access has been a source of conflict, and a reason for rationing.

The Prior Appropriation Doctrine and Artificial Shortage

By the 1930's groundwater development in Utah had reached a stage where it was taken seriously, and rights to its use were being contested. Adjudicating these disputes was difficult in the absence of information about the location, extent, and nature of such water. Accordingly, a state law passed in 1935 provided that: (1) all waters of the State, including groundwater, belong to the public, subject to existing rights; (2) these rights are based on the principle that first in time is first in right; (3) claimants of rights to the use of groundwater must file notices of such claims with the State Engineer; (4) new rights can be initiated only upon application to the State Engineer; and (5) the State Engineer is responsible for administrative supervision of all public waters. ¹

Thomas and Nelson found that the number of claims to artesian flow filed under this law exceeded by three times the number of flowing wells reported to the 1891 Census. Many of the claims were based on memory without supporting records. The 1891 census could easily have missed some wells, and some owners may have been claiming on the basis of dug (water table)

¹Reported by Thomas and Nelson, p. 166.
wells that had existed in their vicinity. Several claims to artesian flow antedated by decades the earliest documented record of flowing wells in the Bountiful District. Some of these claims, say Thomas and Nelson, were no doubt "in error." Nevertheless, they do demonstrate that groundwater was serious business to residents of South Davis County in 1935 (by contrast to 1891) and that contests over its use could be expected.

When Utah groundwater development reached the point that rights to it were contested, the prior appropriation doctrine was interpreted to mean the right to a particular hydraulic head that may have obtained when the well in question was first developed. In effect it protected well owners against increased pumping costs rather than actual loss of water. This must have been recognized by at least a few people. The principle that seepage and artesian flow means underdevelopment must have been fairly widely understood at that time, at least by specialists. There was justifiable uncertainty, however, over just how great a volume of water was contained in a given reservoir, and how much could be drawn from it each year without encroaching on that volume. The Thomas and Nelson study of the Bountiful District suggested that the fully developed stage might be imminent, even though there was still a significant artesian pressure. According to DeLore Nichols the prior appropriation doctrine began to be clearly and deliberately applied to artesian pressure after the drought of 1934 (presumably in connection with

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1 Personal interview. Nichols is introduced in Chapter IV.
the law of 1935 referenced above). Ten years later, however, residents of South Davis County were fighting with the State Engineer to have it applied more forcibly. As might be expected, they wanted to protect their own economic interests (avoid pumping costs), which required maintenance of artesian head. State Engineer Ed Watson, on the other hand, was trying to promote efficient use of groundwater, and was not inclined to favor the old owners' cause. The old owners had judicial precedent to lean on, and Watson was opposing a lay misconception, shared by judges, in asserting that new wells did not take away any prior well-owner's water. The law has been used to protect the economic value of a misconceived property right (like grazing permits or market quotas) rather than the right to a given volume of water. By this means, the law contributed directly to the water "shortage" in South Davis County that was, in turn, one of the proximate causes of the Weber Basin Project.

Stanley Green, a veteran observer of the East Shore hydrologic picture from the vantage of his position in the State Engineer's Office and also his residence in Bountiful, provided some perspective on the South Davis County water "crisis" of the 1940's:¹ Water rights were being poorly administered, he said. Philips Petroleum in South Davis, and Union Stockyards in Weber County had each bought up many old flowing well rights. They were demanding full artesian pressure, and getting it. Each was a major water

¹Personal interview, 1969.
user; Union Stockyards had considerable farm land and Philips operated a refinery. They demanded their "accustomed rate of flow," based on the claims of their old well rights. This was not very reasonable to expect in a dry period, but the courts upheld it in a judgment between Ogden City and Union Stockyards. Green described the atmosphere in Davis County (South) as tense, anxious, and fearful. To many residents it appeared that indigenous water supplies had been stretched to capacity. Indeed they had been if the administrative practices described above were to continued.

Green's recollection of the situation in South Davis is embellished by two letters found scattered among old papers in the office of the Davis County Agent. The first in time is from a group calling itself the South Davis Water Users Protective Association, to the State Engineer.\(^1\) They complain that recent practice of the State Engineer in granting temporary permits for new wells constitutes a threat to the water right of prior appropriators. The group say they cannot accept the argument that a temporary permit will prove whether or not existing artesian rights are being violated and, therefore, contribute to more efficient development of the groundwater resource. In the first place, there are too many new wells for the Engineer's test to be conclusive. One well probably does not have much effect on prior appropriators, but several are bound to have an effect. In that circumstance the prior appropriator has no recourse. He can prove that his artesian pressure is

\(^1\) Merrill Parkin, Secretary to Ed. H. Watson, August 5, 1946.
going down, but he cannot identify the villain. Furthermore, temporary permits tend to become permanent. It is hard to tell a man he will have to plug a well when he has just gone to the expense of drilling it, and the petitioners doubt that the State Engineer has the intestinal fortitude to do it. It is better to grant no temporary permits, they say. Consider each application on its own merits and in light of any challenges to it. The petitioners acknowledged that State law permitted the issuance of temporary permits,\(^1\) if the State Engineer believes there is unappropriated water and no likelihood of impairing existing rights. Nevertheless, they assert, we know that our underground basin is already over-appropriated from our own experience, and we have the support of a study by the U.S. Geological Survey. (This was 1946, and the Thomas and Nelson investigation was not published until 1948.)\(^2\)

The other letter is dated 6 months later and expresses the attitude of Bountiful City Council towards the petition described in the previous paragraph:

It is the opinion of the City Council that it is the office and duty of the State Engineer to report and act upon findings in the underground water basin and that it would be foolish for him, or any other individual or group to issue statements or make demands, until all the facts are presented. That is the purpose of the underground water survey now being conducted by the U.S.G.S. and in which the City of Bountiful and the County of Davis are participating. To ask the State

\(^1\) They cite Section 100-3-5 of the 1943 Utah Code.

\(^2\) Informants at the State Capitol said that most of the investigative work for Thomas and Nelson report was done by Thomas and Ray Massell in the early forties.
Engineer to refuse to consider new applications for water in one part of the basin, when there are at least 8 second feet running to waste in another part, would seem to us rather inconsistent.\footnote{Wilfred H. Williams, Recorder, to DeLore Nichols, Davis County Agent, February 6, 1947.}

This exchange does support the idea that there was a real concern over water shortage in South Davis, but it also demonstrates that at least some people viewed it as an irrational phobia.

The South Davis "water crisis" of the 1940's was, therefore, a judicial creation, but did impose some real costs. The problem was not a shortage of water, however. Veteran well drillers\footnote{Consultants were J. S. Lee and his son, Kenneth, of Salt Lake City, J. Virgil Stoddard of Hooper, and Hugh Wheelock of the consulting firm Templeton, Linke, and Alsup.} have apparently never experienced a drying up of the groundwater resource, and they have a very good idea of where to drill and what to expect.\footnote{Groundwater experts at the State Capitol seem to agree that because of the retarded development of groundwater studies in Utah, well drillers are the best source of information about the location and extent of such water. This advice was given by Ray Marsell and Bob Murdock of the Division of Water Resources and by Harold Donaldson of the State Engineer's Office. Well drillers have, individually, important personal knowledge of where and how to develop a well, but the synthetic services of hydrologists are indispensable to infer from that atomistic knowledge the boundaries and content of groundwater reservoirs. Thus, Virgil Stoddard recommended Dr. Marsell for such knowledge, saying that he would like to read Marsell's book himself.} J. S. Lee, now retired, says it is possible to get a good well in almost any region of Utah, including the desert floor. (That does not mean any given 4 x 4 spot, of course.) Efficient
procedure for those times would have been major efforts in groundwater research and law reform. More enlightened legal interpretation would have relieved the anxiety in South Davis while the true extent of its water resources was being gauged more accurately. Once reasonably complete knowledge of hydrologic patterns is known, water and land development can proceed on a piece-meal, incremental basis. In the absence of State action to reform its laws and explore its water resource, water resource, water development promoters in Utah have gone to federal agencies for surface water and hydrologic surveys. As Dr. Marsell said in the 1960's, Utah would have virtually no groundwater information were it not for the U.S.G.S.

While there has been significant progress in hydrologic studies over the 3 decades since the south Davis "water crisis," the legal interpretation that caused it is yielding only very slowly. A decision by the State Supreme Court in 1969 (Louis Wayman, et al. vs. Murray City Corporation and State Engineer) endorsed a "rule of reasonableness" in adjudicating disputes over loss of artesian pressure. The lower court ruling which was over-turned had required Murray City to, in effect, guarantee the plaintiff a certain flow of water from his wells. This, said the high court, is as unreasonable as to say that the plaintiff should guarantee the flow of Murray City because they both tap the same groundwater reservoir. The action arose out of the fact that the flow of Murray City's wells had fallen to about 220 gallons per minute from the 750 gallons per minute to which the City was entitled by established rights. The City had, therefore, with the permission of the State Engineer, plugged
its old flowing wells and drilled a new well which produced an excellent flow, but from which it extracted no more than its old right of 750 gallons per minute. Development of the new well coincided with a noticeable decrement to the flow of the plaintiff's wells. To have upheld the lower court decision would have, in the opinion of Chief Justice Crockett, enforced a penalty on anyone who took pains to maintain his wells in good condition, since there is abundant evidence that the groundwater reservoir in question is by no means fully developed.

While this ruling is a step in the right direction, it does not clear the way for efficient development of groundwater reservoirs completely. It applies directly only to action on the part of existing rights holders to preserve the full amount of those rights, even if the effect of such action may cause discomfort to other rights holders. It does not say that the courts would uphold the granting of new rights that had an exactly similar effect on old rights holders. The Chief Justice did cite a decision in Colorado which ruled that the priority of appropriation does not give a right to inefficient means of diversion (Crockett's emphasis), and did suggest that the court recognized the necessity of developing groundwaters efficiently for the public benefit. He made special note that rights of the individual sometimes must yield to the rights of the group, and implied that in cases of the kind before him the interest of the State in making efficient use of its water resources should prevail over protecting inefficient appropriators from having to pay a share of the cost of State-wide development.
Application of this "rule of reasonableness" could solve the problems of equity involved in more vigorous groundwater development. Existing well owners are probably protected by law from suffering an extreme loss of artesian pressure, but this new ruling seems to open the way to gradual development of the groundwater reservoir toward the point where it becomes a pumping field. Nevertheless, as of 1972 no one had brought a suit to test how far the courts are willing to go in the direction inferred here, and would-be groundwater developers appear to be just as intimidated as if nothing had happened.  

Basin-Wide Planning and Upper Valley Resentment

Efficient development of a drainage basin requires, among other things, near-perfect knowledge of the basin's hydrologic cycle plus legal authority to guide the pattern of land use and water diversion. That principle was enunciated by John Wesley Powell (see Chapter VIII). Policies and programs of the State Engineer and the Division of Water Resources (formerly Water and Power Board) have been nudging Utah in the direction of conformity to that principle. Utah's Water Conservancy Act was intended to be a major step in that direction. The conservance districts which the Act provides for

1. This is the observation of Bob Murdock, Utah Division of Water Resources.

2. Section 73-9-1, Chapter 9 of Title 73, Utah Code Annotated, 1953.
have received the approbation of economists for the flexibility which they allow in the transfer of water from one use or location to others. Since peak efficiency requires management of the complete water resource, groundwater as well as surface, the potential contribution of basin-wide conservancy districts depends to a significant degree on the extent of their investigative and developmental resources and their authority over water rights. In Utah those powers are shared among several agencies. Such powers as it does have have provoked controversy for the Weber Basin Water Conservancy District, and it has incurred some ill-feeling in efforts to have the scope of its powers defined.

Proximate reason for the Weber Basin Project was the transfer of water from the Weber River to parts of the East Shore Area—particularly South Davis County. This had to be flood storage water, since all other was assumed to be appropriated. Putting storage reservoirs in the mountain valleys made it possible, by building greater storage than was needed by the East Shore area, to provide additional water to usable lands in the mountain valleys. Such lands situated below a reservoir could receive late season water through pre-existing irrigation company canals. These areas are shown in green on the WBP map. The legend calls such spots "irrigated land,

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1 Pendse, "Introduction."
part of which requires additional water." Some new lands might also receive a water supply, such as in regions below Lost Creek or Causey Reservoirs.¹

All of the green-colored areas are potential beneficiaries of the project.² Some of them would have to receive the benefit by means other than surface water, since they lie above project reservoirs. Such lands are the Park City region in the headwaters of East Canyon Creek, Upper Chalk Creek, Echo Creek, and, in the absence of Larrabee Reservoir, the Rhodes Valley region.³

Precipitation that falls on the upper drainage basin must eventually find its way to the creeks and river beds, following them down the valleys, through the canyons and eventually into Great Salt Lake. Water moves through the earth as well as over it. In the absence of man, the saturation of groundwater aquifers and the rate of evapotranspiration will remain roughly constant as a long-run average. This means that streamflow at a place like the mouth of Weber Canyon should be roughly a constant annual average. When man interferes with this cycle, by extracting water from streams or aquifers

¹This section and the following one draw heavily on information provided by Wayne Winegar, Secretary-Manager of the WBWCD. An interview in February 1972 was recorded on tape. A draft interpretation was submitted to him for correction and comment. A second interview filled in gaps, corrected inaccuracies, and verified that interpretations, while not necessarily shared, were not based on false impressions of what Mr. Winegar said.

²Not all of them were expected to take water from the WBP, however. As Figure 2 makes clear, major portions of the East Shore were not in the Project, since they already had adequate supply facilities.

³Local road signs refer to this area as Kamas Valley.
for any use within the upper basin, he reduces the flow at the mouth of Weber Canyon by increasing the total evapotranspiration, and dilutes the water by increasing its biological and mineral content. But the flow is reduced by much less than the total volume of water that has been used in the upper basin because some of it seeps back into the stream.

If a man diverts part of a stream for some consumptive, beneficial use, the doctrine of prior appropriation protects his right to that original quantity. When subsequent appropriators drill wells (or divert the stream) at a point above the prior appropriator, their activity must eventually encroach on the streamflow to which his original right entitled him. State law forbids this, and the State Engineer is empowered to decide when a right is in danger of being infringed and to disallow any further rights. However, original rights to surface water were based on the normal stream flow. Since the river does not flow at flood stage all year, water rights had to be based on late-season flows. This means that flood stage waters were essentially unappropriated, and a right to them could be granted to someone willing to provide storage. Such a storage facility would make it possible for new rights to be issued without infringing the rights of prior appropriators. For the water extracted by new rights holders could now be replaced out of the flood waters held in storage above prior appropriators.

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1Thus, even as applied to surface water, the prior appropriation doctrine guarantees ease of access, or a certain level of energy expenditure, rather than a certain quantity of water.
In the context of the Weber Basin Project, this means that storage in Wanship Reservoir makes it possible to issue new rights to water in the Peoa or Oakley area—water which if extracted before such storage existed would have dried up the river in the area above Coalville. Pumping new wells near Oakley still has the effect of reducing the groundwater that would normally find its way into the river above Coalville, but that water is replaced, and the streamflow maintained, by the floodwaters stored in Wanship Reservoir.

A problem could conceivably arise, however, that existing storage facilities could not resolve. No doubt there are several surface water diversion rights of long-standing in the Rhodes Valley area. The granting of new rights for wells in this region could conceivably dry up the river in that very location to the extent that the prior surface rights are infringed. In such a case there is no possibility of replacement since there is no storage facility higher up from which to release water into the river. This is the function that Larrabee Reservoir was designed to serve. The possibility of such a circumstance has not been lost on residents of the Kamas-Oakley region who do claim to have lost water to new right holders. The State Engineer, however, has ruled that they haven’t lost any of the water to which their rights entitled them. What they have lost, or could lose if there is more groundwater development, is ease of access to their water. This does or will impose real costs on them, and is an understandable cause for resentment.
Landowners in Rhodes Valley must pay the WBWCD's 1 mill levy\(^1\) on the assessed value of their land; there is no storage reservoir above them, and they could face increased costs of water diversion as a consequence of the Weber Basin Project. Nevertheless, if the State Engineer's measurements are reasonably accurate, the existence of downstream flood storage does increase the amount of water available for diversion in this upper valley. If an increment to available supply was not really needed, on the other hand, the WBP represents a needless expense to Valley residents. In that respect, they are not worse off than other taxpayers in the Basin, however.\(^2\)

If Larrabee Reservoir (Figure 1) had been constructed as planned, and its cost spread over the entire basin (falling most heavily on urban residents of the East Shore--see Chapter VI), farmers in Rhodes Valley might be happier. They would then have an obvious increment to surface supplies and would never have to worry about increased diversion costs (i.e., drilling and pumping). While this might have advantages for favored individuals (Rhodes Valley farmers), however, it would be a foolishly expensive way of developing a water supply equivalent to what may be had via groundwater development.

\(^1\) This levy is one of the District's principal revenues; it is considered at length in Chapter XI.

\(^2\) An attribute of the WBWCD which causes some understandable but unjustifiable resentment is the fact of its holdover storage, according to Winegar. It is able to provide a better supply to its customers than is available to senior rights holders, yet its rights are of the lowest priority.
Furthermore, as the next section demonstrates, it is far from certain that Larrabee would in fact dissipate resentment of the WBP in this valley.

The idea of Larrabee Reservoir has an esthetic appeal to proponents of water conservation and hydrologic efficiency. It would constitute a satisfying element in the water hustler's quest to develop every drop of water for beneficial use.¹ Rex Greenhalgh of the Bureau's Salt Lake office said that Larrabee was one of his favorite features of the whole Project.²

Below Wanship Reservoir, valley lands along the Weber are clear beneficiaries of the WBP. More water than before is available to them, at a heavily subsidized price. (Winegar says the average cost of water developed by the Project is $8.00 per acre foot. The repayment assessment to irrigation users, however, is only $1.10 in Summit County, and $1.40 in Morgan and upper Weber counties.) Most of the new water developed for upper valleys is a late season supplement to lands already irrigated. Because of the shortness of the growing season, there is some question that it was needed.³

Summit County residents generally do not hold warm feelings for the WBWCD. Wayne Winegar attributes a major share of their resentment to the increased precision of water use measurement which has accompanied the

¹See Chapters IX and X.

²Greenhalgh, interviewed in 1969.

³This is the opinion of Frank Haws. Sluggish sales of the water reinforce this view.
creation of a water conservancy district. Efficient management requires careful measurement. Winegar says that one of the consequences may be that water users are held to the amount of their right, whereas they have been accustomed to lavish and unrestricted use. This interpretation is consistent with the water hustler's credo that water is scarce and drought imminent. It implies a need for conservation and efficient use. Frank Haws doubts that water measurements (a function of the State Engineer) since 1950 are significantly more accurate than they were before the WBWCD commenced operation. Whatever its real source may be, Summit County resentment of the District and the Project does not appear to be based on economic loss, such as can be shown for Ogden City, for example.¹

Similar feelings prevail in the upper valley of the Ogden River, with even less apparent reason. Causey Reservoir, high on the South Fork of Ogden River, provides the WCD with 7,000 a.f. of annual storage. The WBP replaced an old canal with the new Ogden Valley Canal which extends from its diversion point on the river across the valley to Eden. The irrigation water, provided at $1.40 per a.f. repayment, has made a significant contribution to lands served by the canal. There is no complaint over the price. There ought not to be. The reservoir and canal cost over $6 million and develops only 6,000 a.f. of irrigation water to be sold at $1.50 per a.f., plus 1,000 a.f. of M&I water to be sold at $15. Over 60 years, total repayment at this rate will

¹See Chapter VI.
by only $1,404,000. In spite of this subsidy, the old residents of Ogden Valley are resentful instead of grateful. The WBP dedication was held in Ogden Valley, and as major beneficiaries of it, a considerable turnout of local residents was expected. Only a handful appeared.

Before the Bureau would begin constructing any portion of the WBP, it insisted on having a certain proportion of long-term contracts for the water to be developed. A few years later, when the Project was nearing completion, Ogden Valley farmers complained that they had been sold too much water, and asked to be released from part of their contractual obligation. By this time, the residential potential of the valley was becoming apparent and the Conservancy District indicated a willingness\(^1\) to rewrite some contracts if the petitioners would make formal application to the Board of Directors. Apparently this flexible attitude satisfied the protesters, and none made application to be released from part of his obligation. In 1970, the WCD declared all irrigation water in Causey to be sold, reserving the remainder for M&I contracts, which are increasingly in demand. At the present time, only 300 a.f. of M&I water is left to be sold.

From the facts above, it seems reasonable to conclude that Causey Reservoir and Ogden Valley Canal have been a clear benefit to valley land owners and residents. Available surface water is augmented by Causey Reservoir. Groundwater can now be developed at elevations where it previously

\(^1\)Based on the expectation of higher revenues from residential contracts.
would have infringed prior rights, because of the possibility of replacement with former waste waters stored in Causey and Pineview reservoirs. Because Pineview is a large reservoir, and because the lower basin has surplus water, the WCD naturally wishes to replace as much groundwater as possible out of Pineview. This could lead to a complaint similar to that expressed in Rhodes Valley, were it not for the existence of Causey Reservoir. With Causey in place far above any projected areas of settlement, any threat that groundwater extraction above Pineview might infringe older surface rights in the same region is immediately quelled by the certainty that replacement water is ready and waiting. Thus, Ogden Valley water users not only have a considerably enhanced water supply, but also every reason to consider it a very secure one. Furthermore, it is there by virtue of a substantial transfer payment from other water users of the Weber Basin, and the U.S. Government.

However, they are neither grateful nor contented. And in spite of the safeguards recited above, the ostensible issue is replacement of water granted to new rights holders, according to Winegar. They claim their water is being sold out from under them—water that cannot be replaced by means of the Ogden Valley Canal. This is not very consistent with their protest of a few years ago that they had been sold too much water. They profess to believe that more rights to water will be granted than is available in their part of the basin. If the State Engineer’s Office and the courts perform their proper function, this is an irrational fear. Because of Causey Reservoir, they do not
even stand to lose by increased diversion costs (drilling and pumping), as may happen in Rhodes Valley.

It may be that the real source of resentment is the suburbanization of Ogden Valley. Both Causey and Pineview reservoirs add to the attraction of the Valley as a residential area, as does the availability of ample subsidized water to residential lots. Winegar says that when old rights holders in the Valley are reminded of the ways in which they are subsidized by the WBP, they pass it off as an unintended bonus. They profess to believe, he says, that Causey Reservoir was created specifically as a fish, game, and recreation resource.

Whatever its source, Ogden Valley resentment of the WBP does not appear to stem from direct economic losses to individuals that are attributable to the Project. Water is clearly abundant in this valley, as it is in upper valleys of the Weber. WBWCD delivery contracts in Ogden Valley have exceeded expectations, and not much was expected in Summit County. Upper valleys of the Basin are, therefore, not a subject for serious concern from the viewpoint of either water scarcity or sluggish sales (the perspective of Appendices I and III.

Resentment in the East Shore Area

Municipalities in the East Shore area have not been anxious to buy their incremental culinary water supplies from the Conservancy District. They have preferred to drill their own wells, where possible. The reason
given most frequently by municipal officers for this preference (next to price) is fear of being dependent on a centralized organization that is dependent in turn on an aqueduct, tunnel, and dams. "Where would we be," they ask, "if some of those facilities were to fail?" Winegar's response is that this has already happened, but that few people were aware of it. In 1971, for example, the Gateway Canal and Tunnel and the treatment plants were closed down for 6 weeks while fractures in the canal were repaired. The District's delivery commitments were fulfilled by pumping water from its eight deep wells in the East Shore area. ¹

Winegar claims that more irrigation water is not sold in the East Shore area partly because farmers are not very good cost and utility calculators. Several farmers have expressed an interest in more water than they can get from their irrigation company, he says, but refuse to buy it from the WBWCD because they feel the price is too high. Winegar responds by taking the potential client through an alternative cost calculation, based on the fact that they own marketable shares in their irrigation company—a capital value on which they are getting no interest. By this means he can demonstrate that water from the WCD costs less than what they are already paying. It is not an argument that wins him many sales. Probably the Conservancy District's

¹ While Winegar cites the wells as a counterargument to municipal sales resistance, they are not a subject that supporters of the WBP should find comfortable to explore thoroughly with critics. As will be seen in the next section, they provide best evidence of the redundancy and high cost of the WBP, as well as the arbitrary and inequitable way in which it is being financed.
requirement of a 60-year contract is the real deterrent. Why make a commitment to 60 years of payments when the extra water may not be wanted 10 years from now? This is a perspective which water hustlers cannot entertain, for to them it is axiomatic that water will be even scarcer tomorrow than it is today.

There are several irrigation companies that could serve residences built right next to the company ditch (the 1-acre, semirural lot) if only they had the extra water to sell. Winegar says there are a great many such potential customers, but they cannot get water because companies refuse to contract with the WBWCD for the necessary supply. They cite the long-term commitment as their reason. Winegar points out to them that the potential new customers are willing to buy shares in the company, pay the same assessment as old customers, even sign long-term contracts. The company could then use the money received from sale of new shares to improve the quality of service to its old customers. Everyone would be better off. But not one company will do it. This example, and the one of the previous paragraph suggest that East Shore residents in general do not share the water hustlers' conviction that water is running out. They buy houses on long-term mortgages, as a hedge against inflated costs, but apparently are not convinced that water is a nonrenewable resource whose price can only go up. That is, popular opinion seems to accord with the view taken here that water is still a free good.

Original plans of the WBWCD called for purchase of Mill and Barton creeks, consistent with the objective of macroscopic basin management for
hydrologic efficiency. Negotiations were proceeding as planned, and the deal about to be consummated, when rights holders abruptly changed their minds and sold the streams to the City of Bountiful. Bountiful has ever since held them in reserve, and Winegar is not aware of any beneficial use that has been made of them.\footnote{Depending on the price offered by the WBWCD, this may have been a perfectly rational decision. It would make no sense to sell the creeks and buy water at arbitrary high prices from the District.} WBWCD management has attempted to re-negotiate the issue from time to time, without success. Winegar regards this attitude as dog-in-the-manger, citing the remark of a Bountiful attorney: "We might make a deal with the WCD if the District can guarantee that none of the water from the Bountiful creeks will ever be used in Centerville." This attitude is anathema to water specialists, who are committed professionally to hydrologic efficiency. The purpose of large management organizations like conservancy districts is to shift water around from where it is not wanted to where it is, and back again if occasion demands (or, as economists might say, from lower to higher uses). Pragmatic water users, from the perspective of self—or narrowly defined group interest—may be justified in taking the cautious view that once used in another place, water is a hard thing to get back. Water hustlers cannot consistently fault them for this, for it has been the standard line of Utah water promoters when speaking of Utah's rights to the Colorado River versus its actual use by California.
Winegar sees a dog-in-the-manger attitude also in the failure of some irrigation companies to shut down their canals during prolonged rainy periods. By diverting water through their canals that runs unused to the sink, they are reducing the quantity of floodwaters available to be trapped in WBP reservoirs. This is, of course, inconsistent with conservation and hydrologic efficiency. (The WBWCE always shuts off its canals during a rain.) The companies do have rights to the water they waste in this way. Because of the limited size of their reservoirs they cannot store water for late season delivery. They gain nothing by dumping and flushing their reservoirs in this fashion, but neither would they lose anything by shutting off their diversion works once reservoir was filled. If they gain anything at all, it can only be the satisfaction of knowing they have diverted a flow of water that would have gone to the WCD.

Winegar acknowledges that people in this area have long been accustomed to using water lavishly—a partial explanation for what appears above, through his eyes, as pure meanness and antisocial behavior. He cites, as an example, an experience of the U&I Sugar Company. The Company has a large water right, and offers water to its client farmers on an annual rental basis. For a long time, however, it had trouble getting paying customers. The problem was found to lie with ditchmasters employed by irrigation companies. As long as the companies' shareholders were getting their full right, the ditchmasters would pay no heed to anyone who took water not his own. Few farmers were interested in paying U&I Sugar for water they could take for free.
Ditch control was tightened and the Company is now renting successfully. This example is not suggestive of scarcity, but of the necessity of exerting an unusual effort to contrive scarcity so that the product may command a positive price. It is certainly symptomatic of an easy attitude toward water, an attitude which ardent water conservationists and developers abominate.

The examples of this section and of the previous one are all consistent with the perspective of water abundance. The Conservancy District is committed to the ideal of hydrologic efficiency, of water conservation. This ideal necessarily entails a significant degree of centralized, macroscopic control (true of technological development in general). Residents of the Weber Basin are suspicious of big, remote government, and they know the Conservancy District to have close connections with Washington, D. C. They resent its attempts to control Basin water resources, and clearly do not feel a need for more water that is sufficiently acute to be worth submission to central direction. Winegar attributes their resentment to precise measurement of water rights and use. It seems more probable that the real source of resentment is the implication of central planning and control that measurement represents. When water is abundant, why bother with big, bureaucratic organizations to ration it? In other words, the Weber Basin does not heed hydrologic efficiency, water specialists to the contrary notwithstanding.
Hydrologic Efficiency and the East Shore
Groundwater Controversy

All available evidence suggests that the extent of groundwater resources in the East Shore area was poorly understood at the time the Weber Basin Project was authorized. Major groundwater investigations were conducted as part of the Project, with consequences as reported in Chapter III. Initial planning projected minor well development, to be used solely for local irrigation. The Bureau of Reclamation would hardly have premised the financial feasibility of the WBP on M&I sales (as it most definitely did--see Chapter VI) if it had known in advance the potential for well development.

Once the program of investigative drilling was underway, however, the evidence was apparently very clear. "In 1954, when the District realized the threat of these wells to the sale of their [sic] own water, it petitioned the state for the right to draw 330 c.f.s. from the ground in an effort to tie up the remaining unappropriated water." District and Bureau management must have been truly alarmed, for 330 c.f.s. is the equivalent of almost 240,000 a.f. per year--roughly the same figure as the projected surface supply to be developed by the entire Weber Basin Project! (See Chapter V and Appendix II.) By 1960 municipalities were into the act, and found they could develop

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2 Ridd, p. 9.
groundwater for about one-quarter the price of District water, "often taken from the ground water basin at or near the same point."¹

The District's 1954 effort to appropriate groundwater was not in vain although not entirely successful either. The State Engineer approved thirty wells at that time, to be developed as part of the Weber Basin Project.² But the Engineer's Office refused to acknowledge the District's claim to be manager of all unappropriated water in the basin.³ Utah water rights have been premised on beneficial use since the days of Brigham Young. The beneficial use principle was designed to prevent monopolizing by prior appropriators with greedy intentions. The State Engineer applied the principle to the Conservancy District: it will be granted rights only to such unappropriated waters as it can demonstrate physical capacity to control for beneficial use.

Apparently the management of the WBWCD in its first decade of operation viewed the Conservancy District as a kind of water czar, or in more self-serving terminology, the arbiter of efficient allocation. Such an idea does follow from the principle of hydrologic efficiency within drainage basins, as advocated by John Wesley Powell. Furthermore, the WBP has been touted as the last word in water development for the basin: the frequently announced

¹Ibid.
³In 1974 the District had eight deep wells in operation, with a combined capacity of 48.1 c.f.s. By that ratio, thirty wells would produce 180 c.f.s.
objective of its promoters, in and out of the Bureau was to bring every drop of unappropriated water under control for beneficial use. It was to be government by drainage basin, so far as water was concerned, as Major Powell had urged (see Chapter VIII). An ardent water hustler like E. J. Fjeldsted, first Secretary-Mananger of the District, would have viewed this kind of political power as the benign use of modern technology in the service of progress and a better life for all. Had it not been for the groundwater embarrassment, this image might have been more salable.

As events transpired, the District made a grab for the newly discovered groundwater. It was a rational action, from the perspective of its own financial solvency, and was not inconsistent with long-held tenets of hydrologic efficiency. But under the circumstances it looked greedy, unwarranted, and ominously autocratic. Furthermore, the District was understandably reluctant to divulge the real reason why it felt such an acute desire to control the abundant groundwater. Its management problems would be increased several fold if the details of financing the WBP became widely understood. ¹ The willingness of urban residents to pay for the Project would not be enhanced by the discovery that it was a grossly expensive facility to provide water that might have been developed at a ridiculous fraction of the cost, via pumped wells. The Project's operators could hardly admit that they needed a

¹For details see Chapter VI, and Appendix IV.
monopoly on groundwater in order to repay construction costs. The best they could do was try to bluff basin residents and the State by speaking in lofty tones about conservation and efficiency. There is little doubt that their ultimate aspiration of hydrologic efficiency has its virtues, but their short-run necessity was nasty, monopolistic power, nonetheless.

Under E. J. Fjeldsted’s leadership, the District was aggressive in pursuit of hitherto unappropriated waters. It tried to buy streams; it applied for well development rights; it tried to block municipalities from developing their own well-water supplies. By 1961 the District and the Project were on the way toward an unsavory reputation with city managers—probably due in large measure to somewhat desperate efforts to cope with the dilemma posed by the newly discovered groundwater. Its protest of a well application by Clearfield raised so much indignation that the protest was withdrawn. "We did it," Fjeldsted explained to Bountiful City Council,1 "because a survey shows there is between 25,000 and 30,000 acre feet of available water on the Wasatch front.2 If we go beyond this, we will be mining water—taking it from others, who now have an established right." That is the orthodox line of

1Reported in the Davis County Clipper, 10 February 1961.

2Compare this to the 240,000 a.f. of groundwater for which Ridd claimed the District petitioned in 1954, and to the thirty wells (approximate capacity, 180,000 a.f.) which were approved.
water hustlers, but is obviously lame (and most likely mendacious) in this application\(^1\)--a frustrating retreat.

As a result of this confluence of errors and gaffes, basin residents and state officials were becoming aware of another side of the situation, which was no less unsatisfactory. Not only was the Conservancy District trying to claim governmental powers in the basin, a thrust which could be parried with relative ease, but it was also a stalking-horse for the federal government. As Fjeldsted told the Bountiful City Council, "the District does not own a drop of water. It does not have the money. All the water belongs to the federal government. If the water rights in this area are not bought by Bountiful, or some other local group, they will be purchased by the government, not the district."\(^2\) Fjeldsted added, however, that "when the system is paid for, the district could own the water if it wants to, and if Congress agrees. No one has ever asked for the water because they would have to bear all maintenance costs."

If reported accurately, Fjeldsted's statement is a slight distortion, but it certainly makes admirable use of the bad news to support his own position. Since Utah water rights are premised on capacity to control for beneficial use, the Bureau of Reclamation has the rights in the Weber Basin

\(^1\) Contrast it to the 1959 testimony of F. M. Warnick, included in Appendix IV, for example.

\(^2\) Davis County Clipper.
case because it owns the facilities. Once the facilities are paid for by Project beneficiaries, it is reasonable to expect that possession of rights would pass to them also. However, the Bureau has always taken a very paternalistic view toward its projects, and there are few, if any, cases where it has actually turned the project over to its users once fully paid for.

This implies that hydrologic efficiency, if pursued with the assistance of Major Powell's offspring, the Bureau of Reclamation, entails some surrender of state autonomy to an agency of the federal government. The practice of water management by drainage basin, as enunciated by Powell and asserted by Fjeldsted, can conflict with the objective of a State Water Plan if the water control facilities are built by the Bureau. Planning implies a preference for efficiency, but planners may disagree on the objective that is to be pursued efficiently. The WBWCD is locked into a preference for revenue maximization because of its contract with the Bureau. As Pendse and others have observed, this objective is not necessarily shared by State and basin planners.

Major Powell argued that the residents of hydrologic basins should manage their own affairs, water included, cooperatively. His ideological heirs, probably in honest pursuit of this same goal, have succeeded in wresting water control away from local groups, away from drainage basins, away even from states, and have placed it in the hands of a federal bureaucracy. In retarded and perturbed recognition of this fact, State government
has put forward an interpretation of its Water Conservancy Act that is quite
different from the one held by old-line water evangelists like Fjeldsted. 1

1 One of these old-line evangelists was John A. Widtsoe, who freely
and unashamedly acknowledged that "life under the ditch" entailed a significant
degree of regimentation and surrender of individual liberty. In his view the
potential rewards were well worth it. See reference to his contributions to
Utah water development in Chapter X.

Fjeldsted retired as chief executive officer of the WBWCD in 1964,
and was succeeded by Wayne Winegar. Although he hews to the official
orthodoxy of water hustlers that water is scarce and dessication imminent,
Winegar is less dogmatic, and even admits in private that the East Shore could
have survived without the WBP. His more flexible attitude probably had sig-
nificance for his appointment after Fjeldsted's outwardly autocratic policies
had won some enmity for the WBWCD among its intended clients. This con-
jecture is reinforced by Fjeldsted's opinion in 1969 that Winegar would not
remain long at the helm of the WBWCD. "Its merely a stepping-stone for
him; he's a politician, not a dedicated water man." (Personal communica-
tion.)

Winegar's personal interpretation of circumstances significant to
the WBP were elicited in a 1972 interview, the transcription of which he later
checked for general accuracy: "In the days immediately prior to authoriza-
tion of the WBP, there was a genuine and widely recognized need for more
water in south Davis County. It's true there were flowing wells, but they were
flowing less freely than in earlier days, and many people had been forced to
pump their wells. Well technology was backward, and existing wells were
mostly of very small diameter. The population had been growing, contributing
to the apparent draw-down of the water table. In spite of this growth, however,
population was then only one-third of its present level--but a large proportion
of family heads were farmers. In the 1930's there were two rural wards in
Woods Cross, both of them consisting almost entirely of farm families. There
are now only two commercial farms in that district. The movement out of
farming was caused more by higher costs and greater land requirements than
by scarcity of water. Furthermore, the change from an agricultural to a
residential area has probably contributed to a net decline in water require-
ments. The change in land use patterns was not foreseen, however, and there
was real concern to find more water for agriculture and for expected urban
growth. Had there been no importation of water, the district may have been
able to support its present urban population with water released from a
declining agriculture, but it would have been a marginal support. Water would
have been scarce and expensive, making south Davis a much less attractive
place to live."
Dallin Jensen, legal counsel to the State Engineer's Office says that a water conservancy district is just another water company licensed under state law for a particular purpose. Its water rights are granted only on the basis of a petition to the State Engineer, using the same criteria as apply to all other petitioners. A conservancy district is not superior in water rights to any other water user organization. It cannot interpose itself between other users and the State Engineer, as the Weber Basin District tried to do in asking for rights to all unappropriated waters. A conservance district, says Jensen, has no authority to dictate to the State Engineer in respect of water rights. It is just another canal company with water to sell from company reservoirs.

What is unique about conservancy districts, in Jensen's view, is that they are the only kind of water users association with legal authority to negotiate repayment contracts with the federal government for the construction of large water supply projects that are beyond the capacity of local resources. That is, the chief purpose of conservancy districts, as the Assistant Attorney General interprets the Water Conservancy Act, is to provide a means for local groups (as opposed to the state government) to enter direct contracts with the Bureau of Reclamation. To revise the conclusion of the preceding paragraph slightly, a conservancy district is a canal company whose water right is based on such expensive storage and diversion facilities that it has to incur a

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Dallin W. Jensen is an Assistant Attorney General. He was interviewed at his office in the State Capitol in October 1969. His writings on State water law were also consulted and are cited where appropriate.
three-generation debt (well over 90 years in the case of the Weber Basin Project) to have them built.

To protect the future of its water development activities after the first 2 decades of experience showed Reclamation to have a shaky economic foundation, the Bureau has had to devise careful methods of financial control. One of these appears to have been the idea of water conservancy districts. Investigations by civil engineers at Utah State University in recent years, of which the McLean thesis cited in Chapter I is an important product, have led to the observation that officers of the Bureau of Reclamation practically wrote the water conservancy acts of all the western (Reclamation) states. Dallin Jensen's interpretation (above) of the Utah Water Conservancy Act is certainly consistent with this assertion. So is the Bureau's confidence that once its clients sign on the dotted line as a bona fide conservancy district, "we've got 'em." Rex Greenhalgh expressed that confidence when interviewed as part of this investigation in 1969. "The Project was built for residents of the Weber Basin," he said, "and there is no way they can avoid paying for it."
Thus the pursuit of hydrologic efficiency in the Weber Basin has led to ridiculous inefficiencies of energy application, and a loss of control over basin water supply resources by residents of the basin and the state. What might have happened if Major Powell’s prescription of political boundaries by drainage basin had been followed from the start is an interesting speculative exercise. What has in fact occurred seems to be the outcome of two widely shared goals of occidental peoples, working in opposition to each other. One of these goals is material progress; the other is individual liberty. Material progress is premised inescapably on the expansion of controllable energy resources and the more efficient use of such resources as exist. These two premises imply improvements in technique. Technique is not apart from or independent of social organization. The development of technique and its application are social functions. If material progress, or even the pursuit of technology on which it is based, become an overriding goal, then social organization is significantly constrained by the demands of technique. If the implicit trade-off between liberty and technological advance is not clearly recognized and deliberately coordinated (thus planning is itself a constraint imposed by our state of technological development), the outcome may be a jumble of contradictions in which neither material progress nor individual liberty is served effectively or efficiently. Such seems to have been the outcome of a combination of water development enthusiasm and conservative state
government in Utah. If the State government had spent more on investigating its own water resources it might not have let itself get sucked in so far on federal goodies and easy time payments, with the result that today it would have greater control over its own resources and be able to use them at less expense.

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1 Incipient recognition of this problem is reflected in the following excerpt from the Davis County Clipper article of February 10, 1961, cited above: "Councilman Kenyon Gurr, who was not present, left his sentiments in a letter. He believes the city should purchase the canyon streams because no community has ever had too much water. Future development of the city will depend on it. The Weber water is the most expensive, and if the district gets control of all the water it will be even more expensive. Costs multiply when the federal government is involved, he said. We must keep the federal government from assuming obligations we should assume ourselves if we are to slacken the pace down the road to socialism."
CHAPTER VIII
THE ROOTS OF AMERICAN PUBLIC RESOURCES POLICY

Preceding chapters have described the Weber Basin Project, and some details of its operation and management that have attracted the attention of critics. A partial explanation of why the Project exists in the present form, with its attendant problems, has been suggested through examination of historical traces from the period of its construction. The intent of research and writing has been to identify as accurately as possible the nature and dimensions of such allocation problems as may exist. The endeavor seems to justify, inter alia, the following general inferences: there is no significant problem of water scarcity, but there is one of distributing the burden or repayment for water controlling facilities. Use of the facilities does not seem to be pressing on capacity, so that neither water nor control facilities represents a case problem in the use of scarce resources. Any problems obviously involve the investment decision. Nevertheless, it cannot be reasonably said that the repayment issue has no effect on the use made of either Basin water or Project facilities. The high price of using the WBP certainly deters its use by municipalities in the East Shore, and encourages the development of redundant facilities. The fact that WBP facilities were constructed by the Bureau of Reclamation has given an agency of the federal government control over a large share of the water resource of the Basin—at least until such
time as the Project is paid for. This circumstance, which is repeated several times over in the East Shore alone, as well as in Utah's other drainage basins, presents a major barrier to the implementation of a State Water Plan. The state cannot control the use of its own water because a heavy proportion of the facilities that make control possible are owned by the federal government. Since it is academic (in the worst sense) to deliberate over water use in the arid West in the absence of requisite control works, Utah must live with the fact that it only shares jurisdiction over water use with the Bureau of Reclamation.

The task for natural resource economics is presumably to prescribe an efficient policy for this situation, consistent with the definitions of science, technology, and purposive effort presented in the Introduction. Chapter XI will argue that a clear, simple, and scientific prescription for economic efficiency in the Weber Basin case cannot be found in standard economic theory.¹ One reason, of course, is that the theoretical premise of scarcity is missing in this case, or at least that it applies in a fundamentally different context than theoretical applications normally assume. The scarce resource in this case was capital. Capital was provided out of national resources. The consequent issue is whether that capital provision was a gift to the State of Utah (Weber Basin residents in particular) or a loan. The Bureau of Reclamation insists that it was a loan, but claims the right to operate as if it had been

¹This assertion will be explained in Chapter XI.
a sale of water rights. (For reasons that may be inferred from later chapters, the Bureau may regard itself more like a receiver in bankruptcy.)

The critical point for devising an efficient policy prescription in this case is that it involves a federal-state conflict over a portion of the national wealth. ¹

The conflict is clearly distributive, and is therefore a political issue involving moral and value judgments. Chapter XI will argue that natural resource problems similar to the Weber Basin case are not susceptible to clear-cut prescriptions for efficiency, of the kind implied in the Introduction, but that they must be analyzed with careful attention to the values that are supposed to be served by public resource management policies. Presumably its designers intend any program to achieve its policy objective efficiently.

The next three chapters are devoted to support of arguments in the preceding paragraph. They will present explanations and evidence for various policy objectives, at both federal and state levels, that have apparently had an influence on the Weber Basin case. Chapter XI will draw on this evidence to argue that natural resource problems of this particular kind are ultimately ethical and political, and that prescriptions for efficient management policy cannot be made in isolation from explicit value judgments. Among the sometimes conflicting value systems that have affected water development investments, at least the following will be identified and defined: belief in an

¹It might be argued that the federal interest presumed here is really the interest of a particular technological interest group--Bureau engineers.
orderly, knowable, clock-like world in which technological and material progress are virtually assured, given purposive effort; agrarianism and equalitarianism; a water-promoting establishment (The Water Hustlers). All of these disparate elements must be considered in evaluating the effectiveness of the WBP as a use of public resources.

This is a long chapter and the following three pages are a summary of its principal arguments: Democratic and egalitarian ideals were encouraged by physical-geographical-economic conditions in colonial times. The Revolution was a democratic-egalitarian movement within the colonies as much as it was a revolt against Government from England. The frontier of virtually free land through the colonial period and in early republican days fostered expectations of equality that were frustrated when the frontier reached the Great Plains. Inability of frontiersmen to use the Plains successfully with farming operations familiar to them contributed to social pressures that culminated in Civil War. For 2 decades before the war, the Great Plains and Intermountain Region was looked upon as a great and inhospitable desert, an insurmountable barrier to the quest of many frontiersmen for freedom and independence. Frustration and despair gave way, probably due in part to the shaking of society by civil war, to a period of fresh energy and optimism. It was partly justified by the arrival of new technology as railroads opened up the Plains. But part of the energy and optimism was also based on myth. People who desperately wanted cheap land were an easy mark for promoters who told them the climate of the Plains was changing for the better. At the same time as
these false hopes were feeding a vigorous expansion into the Plains, John Wesley Powell and others of his kind (like Mark Twain) were making methodical and objective assessment of the climate, geography, and resources of the arid region and coming to conclusions about how it could be most successfully exploited for human use. There is not enough precipitation in the region to make all of the land productive, they said. It is therefore necessary to concentrate what water there is on the best lands by means of irrigation. This would require special institutions that could hardly be set up after all the land was alienated in the traditional fashion of homesteading. Furthermore, Powell warned that current settlement on the eastern Plains was proceeding on false expectations. The early 1880's was the wet end of the rainfall cycle. He was ignored, of course, but the last half of the 1800's proved him to be correct, and thousands were driven out of the Plains by drought and harsh winters. These hardships were accompanied by political unrest and resentment on the part of the yeoman farmer class against the powerful and wealthy interests. It was the era of trusts and Populism. Americans appear to have wanted desperately to believe in the Horatio Alger myth that anyone could make it big by himself. The disappearance of free and unalienated public resources was therefore a severely frustrating event. The dream was transformed, under the guidance of Major Powell's imagination, into a technological utopia that necessarily entailed group action, cooperation, and solidarity. Irrigation began to be discussed seriously in the 1890's.
These strands of aspiration (freedom, independence, equality), resentment (Populism), frustration (inability to cope with climate and geography), and Newtonian faith (belief that science and technology could conquer all) came together in the Progressive Era, and the U.S. Reclamation Service was born in 1902. Its purpose was to promote the objective of independent farmsteads for vigorous, enlightened, cooperating people by means of carefully planned and executed feats of engineering prowess. A critical side effect of Major Powell's vision was to turn most of the arid West into a perpetual public domain. People could have homesteads on Reclamation projects, but they would have to be amenable to cooperation and subject to a reasonably high degree of control by managers of public resources. The United States Department of the Interior was a creation, in large measure, of John Wesley Powell. Its purpose was to manage and conserve the natural resources of the U.S. West in the public interest. Its creation represented a major turnaround in U.S. policy, away from alienation to the private interest of whoever came first, and toward management of a community property for the common good. Would-be exploiters have naturally resisted this policy. These are important points to keep in mind when evaluating the management of public resources.

**Influence of the Frontier on American Aspirations and Institutions; the Colonial Period**

That egalitarianism and faith in democracy are typical of Americans seems to be the consensus of historians, sociologists and popular opinion.
R. A. Billington says no single force has been more influential in shaping the distinguishing characteristics of the American people than the westward movement of the frontier.¹

The pattern of frontier expansion was explorers and adventurers first, speculators and squatters next, then substantial farmers followed by their suppliers—merchants, lawyers, millers, editors, etc. The frontier then merged with settled lands to the east. One thing the pioneers shared in common was a weakness for the lure of adventure or the magnet of opportunity. "Self-improvement, economically or socially was the incentive that lured most men westward, and the hope of self-improvement has bulked large in the American dream from that day to this." Most who answered the urge lived close to the frontier. They wanted homes of their own but could not afford to buy in settled areas.

Experience at Jamestown (1607) proved to colonizers that they could not force men to work in the same way as at home, where people were abundant and land scarce. Workers refused to labor on company farms as servants to produce things just because they were wanted at home in England. Production improved when 50-acre private plots were offered as an incentive. "Thus did Englishmen respond to the frontier environment by recognizing that

individual enterprise provided the best inducement for workers in areas where natural resources were abundant [my emphasis], and that land grants were the surest magnets to attract settlers."

The first East-West conflict on record came to a head in Bacon's Rebellion in 1676. Poor tobacco farmers along the Virginia fall line bitterly resented the refusal of relatively affluent tidewater planters to let them have a voice in government or church. Besides suffering this social and political snobbery, poor farmers were forbidden by the government from expanding further west into Indian lands. Nathaniel Bacon led the ensuing revolt. It was savagely repressed, according to Billington, but the spirit lived on. Turner says that several times from then until 1776, small landowners, newer immigrants, and indentured servants rose up against entrenched interests. 1

The pattern of settlement was different in New England. Instead of behaving individualistically, the Puritans were forced by physical conditions to cooperative effort. They laid out communities and built towns in an orderly pattern of settlement featuring group effort and fairly rigid, Puritan control. Profits were subordinated to the perpetuation of God's true faith. But strong though religious ties may have been "frontiersmen able to profit by exploiting nature's riches could never be kept in check." The thin and rocky soil of New

England was all that made the Puritans content with "self-sufficiency and salvation in lieu of wealth."\textsuperscript{1} By the mid-1700's, however, "the acquisitive instinct so usual on all frontiers" disrupted even the well-disciplined Puritan church. People would no longer hold to the town plan, but began speculating in land.

Expansion into the West disrupted colonial harmony from North to South, according to Billington. The Westerners were arrogantly aware of their ability to tame stubborn nature and hence sure of their superiority over the rest of mankind. Democratic, poverty-ridden and infinitely proud, the frontiersmen looked on easterners as grasping aristocrats whose control of the colonial legislatures threatened the natural development of American civilization.\textsuperscript{2}

Land acts in 1800 and 1804 were passed by Congress in response to western pressure. They allowed the purchase of a minimum of 60 acres of public domain at $2 per acre, one quarter down. It was, therefore, possible to buy a farm for $80. This is when "doing a land office business" entered the national vocabulary. In 1820, eastern pressures forced an abandonment of credit, but a compromise lowered the price to $1.25 and the minimum

\textsuperscript{1} Billington, p. 17. The parallel with early Utah experience is striking. Brigham Young, an old New Englander himself, enforced a rigid, disciplined, cooperative effort. But the mining frontier and the railroads eventually put so much pressure of individual opportunity on the system that the Church reversed its self-sufficiency and salvation policy and gave its blessings to the acquisitive ethic of the 19th century. The Utah pattern of settlement was also very similar to what Billington describes for New England. See Lowri Nelson, \textit{The Mormon Village}.

\textsuperscript{2} Billington, p. 21.
purchase to 80 acres, so that one could still buy a farm for only $100. "Good lands, easily secured, were the magnets that drew men westward."

Billington makes this significant observation about the socioeconomic system of the old south: great planters, with an average of 1,000 acres and fifty slaves, dominated social and political life, yet were never more than 3 percent of the free population. Far below them were small planters who owned a few slaves and toiled beside them endlessly. They made up 20 percent of the free population. The other 77 percent were yeoman farmers (no slaves) and poor whites, relegated to poor lands that no one else wanted. "Despite their miserable, culturally barren lives, they were the staunchest defenders of the slave system, for all dreamed futilely of becoming great planters themselves when fortune smiled at last." The dream and the situation appear to be persistent. Lundberg said in 1968 that most Americans today are peasants, but cling to the romantic notion that they are incipient capitalists. ¹ Billington concluded that two social orders were spawned by the westward moving frontier: one was dedicated to an aristocratic, rigid class structure and an inhuman labor system; the other to human equality, social mobility, and political democracy. The outcome of the Civil War was presumably a victory for the latter of these attitudes.

Political Attitudes in the Revolution

J. F. Jameson noted that the Revolution was not just a political maneuver to take the seat of government away from London and transfer it to Philadelphia.¹ That may have been the original intent of some of the aristocratic colonialists who supported it, but Jameson demonstrated that the Revolution was taken over by more radical leveling elements as it became more broadly based. This is the natural history of revolutions, says Jameson, and cites the English Revolution of the 19th century, the French Revolution of the 18th, and the Russian Revolution of the 20th. In each of these, the lead was initially in the hands of moderate statesmen but moved rapidly through successive stages in which control was exercised by a group more radical and extreme than its predecessors.

In 1774, the partisans of American independence were very few, says Jameson, although in the years after 1776, they were the great majority. Tories either left the country or conveniently changed their minds. The principal secret of Whig success was that they tended to be younger men and more fired by ardor and enthusiasm for their cause than were the older conservatives for theirs:

All things considered, it seems clear that in most states the strength of the revolutionary party lay most largely in the plain people as distinguished from the aristocracy. It lay not in the mob or rabble, for American society was overwhelmingly rural and not urban, ... but in the peasantry, substantial and energetic though poor, in the small farmers and frontiersmen. ... In the main we must expect to see our social changes tending in the direction of levelling democracy.  

Elevation of whole classes of people to the status of voters through expansion of suffrage elevated them also in social status. "American society in the colonial period had a more definite and stable organization than it ever had had since the Revolution." Jameson quotes several contemporaries on the effects of the Revolution, all bewailing the repression of the aristocratic spirit and the deficient qualifications of people who had moved into government positions. "In our high republican times there is more levelling than ought to be, consistent with good government."

A sense of social change pervaded the country. Jameson cited a writer in South Carolina:

There is nothing more common than to confound the terms of the American Revolution with those of the late American war. The American war is over, but this is far from being the case with the American Revolution. On the contrary, nothing but the first act of the great drama is closed.  

There was a popular sentiment in favor of equality in the ownership of land, and a widespread recognition that slavery was inconsistent with the ideals of
the revolution. The Revolution was not merely a series of political or military events, but a levelling in the social structure, a rejection of the aristocratic, social, political, and economic hierarchy of colonial times in favor of much more extensive equality. It was fueled not by a propertyless proletarian class, but by peasants, small farmers, and frontiersmen whose ideals we should expect to see emerging in social institutions after successful completion of the revolution.

One of the ideals circulating in the intellectual atmosphere of colonial times was that of natural rights. One of the rights claimed by westerners, according to F. J. Turner, was that of a people to establish their own political institutions in the area they had claimed from wilderness and Indians. Colonial frontiersmen denounced the control exercised by landholders of the coast and demanded possession of the lands they had reclaimed through their own labor. Their political position was defended in the writings of Tom Paine and Thomas Skidmore, ¹ who based their arguments in turn on philosophical foundations laid by John Locke.

**Resources and their Distribution in the New Republic**

According to Adams, the United States in 1780 possessed an immense natural wealth and was occupied by a people whose leaders had a vision of the

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¹Thomas Skidmore, The Rights of Man to Property (New York: Burt Franklin, American Classics of History and Social Science Series 3, 1829).
greatness that was possible for their country but had few of the resources at hand that were necessary for exploitation of its great opportunity. ¹ Except for the eastern seaboard, it was mostly still an untamed wilderness. Only half a million people had penetrated into lands beyond the Allegheny Mountains, and they "were struggling with difficulties all their own, in an isolation like that of Jutes or Angles in the fifth century." "Nowhere did eastern settlements touch the western." Communication between the states was as slow and almost as irregular as in colonial times. "Nature was rather man's master than his servant," and little progress had been made on the problems of physical geography in the previous 50 years. They had no adequate waterways, and the experience of Europe suggested it would take centuries of labor to construct a reasonable system of roads and canals. "No civilized country had yet been required to deal with physical difficulties so serious, nor did experience warrant conviction that such difficulties could be overcome." "The machinery of production showed no radical difference from that familiar to ages long past." "The backwardness of remote country districts could hardly be exaggerated," writes Adams, yet even New England, which claimed to be the most civilized province, was still poor, plagued by filth, disease, and the ravages of liquid solace after more than 1 1/2 centuries of incessant industry,

intelligent labor, and pinching economy. Her population increased very slowly. New York was a frontier state, New York City a 100-year-old local market town. "Great accumulations of wealth had hardly begun."

Pennsylvania had gone furthest in the exploitation of her natural wealth, according to Adams, but only in proportion to her population. To make progress, it was necessary for power over nature to grow more rapidly than number of people. There was recognition of both the potential and the vastness of the undertaking, says Adams, but also a degree of hesitancy in plunging ahead. The situation was symbolized for Adams by the magnificent plans for the federal capital, which in 1800 featured an unfinished White House and Capitol, standing naked in two fields separated by a swamp—grandiose in conception but grotesque in appearance.

A government capable of sketching a magnificent plan, and willing to give only a half-hearted pledge for its fulfillment; a people eager to advertise a vast undertaking beyond their present powers, which when completed would become an object of jealousy and fear—this was the impression made upon the traveller who visited Washington in 1800, and mused among the unraised columns of the Capitol upon the destiny of the United States.¹

In this view, the United States in 1800 was a people poised on the threshold of an immense granary of natural wealth, smacking its lips over the anticipated pleasures of exploitation.²

¹ Billington, p. 19.

² Adams' interpretation of this period is supported by one of the major themes that Joseph Smith wrote into the Book of Mormon in 1830. America, he said, was greatly blessed in natural resources and would become the mightiest nation ever known by man.
The people so poised were accustomed to a rough degree of equality in resource endowments, if not in social standing. Adams suggests a valuation of the United States in 1800 of $1,800,000,000. This amounted to $418 for each free white human being, and Adams says that deviations around this average were fairly narrow. Excepting a few of the southern states, a private fortune of $300,000 was great wealth. Such inequalities as existed were chiefly those of a landed aristocracy. Furnas has shown very graphically that these were primarily of a social nature and had to be maintained by artifice, so narrow were the actual differences in personal material wealth as between classes. \(^1\) Equality was so far the rule that every white family of five persons might be supposed to own land, stock or utensils, house and furniture, worth about $2,000; to pay little or no taxes, and to earn wages of about $1 per day.

Adams noted that not only were these personal resources slender, but they were also not easily converted to the purpose of rapid exploitation of the hinterland. The rough equality of distribution was also a hindrance to accumulation of capital pools for the major investments required. The limited extent, nature, and distribution of capital, therefore, put fairly severe constraints on the directions that could be taken in efforts to subdue the vast

\(^1\) J. C. Furnas, *The Americans: A Social History of the United States* (New York: G. P. Putnam's Sons, 1969). One of his points is that the landowning aristocrats had one set of fine clothes each. They dressed up in it about once a year, for an appearance and a portrait, just for a demonstration of their distinction from the peasantry, who otherwise were about as well (or rather ill) clothed as their masters.
potential wealth the United States had rather suddenly taken under its political and military control.

When these circumstances are viewed along with the egalitarian sentiments encouraged by the recent Revolution, it is not hard to understand the Jeffersonian policy of opening the public domain to individuals in farm-size plots. That policy institutionalized an ideology. The only major change in this ideal that would emerge in the subsequent "age of Jackson" was a recognition of some facts of life: great fortunes and inequalities were a fact, and the country was not turning out to be agrarian. Jacksonian democracy was militant Jeffersonianism; a more strident variety, because endangered, of an aspiration that had been around for some time. By the 1850's, when the assault on the Great Plains began, a popular sentiment for freedom, independence, and equality of opportunity as well established.

The Jeffersonian Ideology and its Institutional Expression

Jefferson's person and the program of the Jeffersonians display some interesting ambiguities, as well as some clear preferences. "The leisure that made possible his great writings on human liberty was supported by the labors of three generations of slaves." He did not feel that men are equal, but

reasoned that they must be so. He was aloof from the masses. "He had no system and lacked the doctrinaire's compulsion to be consistent." "There were deep ambiguities in his thinking, which made any effort at consistency impossible." He circulated among men of wealth, learning, and distinction all his life, and absorbed the most liberal and questionable opinions of his age. He was a congenial associate of men like Thomas Paine and Joel Barlow. He became a leader of yeoman farmers, but also of great planters. "He wanted with all his heart to hold to the values of agrarian society, and yet he believed in progress." He was head of a popular faction against commercial interests--but it was also a propertied faction with acquisitive aspirations of its own.

While Jefferson was in France, reinforcing his republicanism, his friends were at home worrying about political advances of the dirt farmers. He was appalled at social conditions in Europe and described treatment of the English laboring classes in the bitterest language. "Europe fortified his conviction that America, with its republican government, broad distribution of landed property, agrarian economy, and oceanic isolation, was the chosen spot of the earth."¹ "A lifelong prejudice is summed up in a few words from one of his letters to Lafayette: "The yeomanry of the United States are not the canaille of Paris."²

¹ Ibid., p. 22.
² Ibid., p. 37.
When Jefferson spoke of the merits and abilities of "the people," he meant "the farmers." He did not see a town until he was 18, and "believed deeply that rural living and rural people are the wellspring of civic virtue and individual vitality, that farmers are the best social base of a democratic republic." "Those who labor in the earth are the chosen people of God, if ever He had a chosen people." "Corruption of morals in the mass of cultivation is a phenomenon of which no age nor nation has furnished an example."

"Governments will remain virtuous as long as they remain chiefly agricultural; and this will be as long as there shall be vacant lands in any part of America."

"Farmers, whose interests are entirely agricultural, are the true representatives of the great American interest, and are alone to be relied on for expressing the proper American sentiments." "The American economy should be preserved in its agricultural state."

He disliked city mobs, "but believed they would not emerge in the calculable future because America's lands would be open to make substantial farmers of the ragged and discontented. In his First Inaugural he said that the land would last the American people "to the hundredth and thousandth generation."¹ The United States would be a nation of farmers, tilling their won soil, independent, informed, unexcitable, and incorruptible. Such a national destiny, he must have felt, would be secured by the Louisiana Purchase.

¹ He could not have planned on very liberal immigration laws.
Jefferson believed that the working class is corrupt; merchants are corrupt; speculators are corrupt; cities are "pestilential;" only farmers are dependably good. He was later forced to give up many of his agrarian prejudices by the march of history. Modern capitalism has sundered four-fifths of society from the soil, separated the masses from property, and made city working class mobs of them. The process was underway in his own lifetime.

In Jefferson's view the future would be founded on a propertied class. He never advocated universal manhood suffrage—but he did propose to grant every white man of full age at least 50 acres. This was his vital link between landed property and democracy. "Jefferson's Federalist opponents feared . . . power lodged in the majority. Jefferson feared power lodged anywhere else." Bad decisions of a majority would be less injurious than self-interested decisions of kinds, priests, and aristocrats. He looked to mass education to solve the problem of democratic-republican government: how can it resist corruption and decay? He favored maximum individual development without limitations of class.

But Jefferson was not completely at odds with the Constitution makers. He admired The Federalist. He did not think political constitutions could rely on man's virtue. He differed in thinking it was the upper, not the lower, orders of society that are especially unregenerate rogues. He accepted the idea of checks and balances in government to avoid the concentration of powers. He did not approve of simple majority rule. He did not look at government as a means of directly helping the poor, but wanted to get it out of the business of
helping the rich through interest-bearing debts, taxes, tariffs, banks, privileges, and bounties. Just take these away and "natural economic forces" would restore freedom and equality. Politically, he rejected the notion that one man has intrinsic superiority over another, but he accepted laissez-faire with the assumption that if government played no favorites, wealth would be distributed in accordance with 'industry and skill'—not equally, presumably. He apparently failed to foresee the role of capital in production, plus the enormous power conferred by huge hereditary fortunes.

In Jefferson's presidency, the division between democratically minded Americans was between two different kinds of property, not two philosophies. Hamiltonians were devoted to the mercantile and investing classes, throwing as much of taxes as possible on planters and farmers. Jefferson's party defended landed property. But Hamilton's system was already entrenched and the Jeffersonians' had to live with it. He did buy Louisiana to widen the area for agrarian expansion, reduced expenditures and the public debt, thereby reducing, somewhat, government service to capitalists and merchants. The Jeffersonians' purpose was to destroy the link between the federal government and the investing classes. They were antimercantilist rather than anticapitalist. Jefferson was a convert to Adam Smith and J. B. Say. He believed in "natural law" and in laissez-faire—self-regulation except for laws to prevent men from injuring each other. "Hamilton had set the government to helping the capitalists at the expense of the agrarians. The Jeffersonian
response was not to call for a government that would help agrarians at expense of capitalists, but simply for one that would let things alone."

Jefferson was not aggressive about redistributing property.

To take from one, because it is thought his own industry and that of his fathers has acquired too much, in order to spare others, who, or whose fathers, have not exercised equal industry and skill, is to violate arbitrarily the first principle of association, "the guarantee to everyone a free exercise of his industry and the fruits acquired by it."¹

He added that if an individual's wealth becomes so overgrown that it becomes a danger to the State, the best corrective would not be discriminatory taxation, but a law compelling equal inheritance in equal degree by all the heirs. Consistent with this view, Jefferson was instrumental in having primogeniture and entail outlawed, but he was inconsistent with his democratic views in countenancing inheritance at all. However, as Adams pointed out, there were few great fortunes then existing in America, and Jefferson did not foresee the enormous ones that would arise. Furthermore, he expected the frontier to hold out free homesteads for a thousand generations. It lasted barely four.

Jeffersonian laissez-faire eventually became the political-economy of conservatives and was used by them to defend the robber-barons of the late 19th century from government reform (for the Jeffersonians finally accepted the whole program of the Hamiltonians). The U.S. had to give up agrarianism and become self-sufficient in manufacturing because of the Napoleonic War.

¹ Hofstadter, p. 36.
By 1820, the Jeffersonians had driven the Federalists completely off the field, but only at the cost of taking over their entire program: manufacturing, banks, tariffs, army and navy, etc. This capitulation set the stage for the rise of the Jacksonian movement, which was essentially a reversion to Jeffersonian principles, with a little more realism: they gave up the notion of a wholly agrarian society.

The original Jeffersonian ideal was an agrarian society based on a large class of small property owners educated for effective democracy. They believed in roughly equal opportunity and thought they had made adequate provision for it. As events turned out, they had not. The Jeffersonian party gave up this platform in favor of mercantilistic laissez-faire, but the ideal lingered on in the minds of a great many people. There were ambiguities in Jefferson's attitudes: he wanted both equal opportunity and vigorous growth. Apparently he hoped it was possible to have both. The key to this hope was a great national endowment of land that could provide a roughly equal freehold to every white man.

**The Age of Jackson: Fixation of the Ideology**

After Jefferson's party had capitulated to the Hamiltonian program, the popular egalitarian sentiment became associated with Andrew Jackson.
The conclusions of several historians are presented in this section, beginning with Hofstadter.  

Jackson was a propertied frontiersman and represented that class of people, says Hofstadter. He was nurtured on Jeffersonian ideals. His politics "chiefly resembled agrarian Republicanism of the old school, which was opposed to banks, public debts, paper money, high tariffs, and federal internal improvements." His people were not given to levelling equalitarianism. Their ideal was the self-made man. But they resented the "help" of banks which foreclosed on them in depression periods. They did not like working for "foreign" monopoly power in the form of eastern banks that controlled the money supply.

The people who elected Jackson, however, were the newly enfranchised propertyless masses. Between 1820 and 1821, six new states entered the union with universal white manhood suffrage, and four old states dropped property qualifications. This was the first time there had been a role for politicians who cater to mass sentiment—for technicians of mass leadership. The original program of the Jacksonian movement was for political equality. They wanted access to government offices on an equal basis—the opportunity to get rich through politics.  

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2 As examples, see Lundberg, and W. L. Riordan, Plunkitt of Tammany Hall (New York: E. P. Dutton & Co., Inc., 1963).
The panic of 1819 set class against class for the first time since the Jeffersonian era—a result of reckless speculation in land and wildcat banking. There was much resentment against banks who were forced to foreclose to pay their eastern owners. Debtors rushed into politics to defend themselves. There was a popular demand for laws against imprisonment for debt, a national bankruptcy law, new tariff and public land policies. "For the first time many Americans thought of politics as having an intimate relation to their welfare." Jackson's election was more a result than a cause of the rise of democracy.

The flowering of manufacturing in the east, and rapid settlement of the west, gave the spirit of enterprise a large measure of fulfillment. The typical American was an expectant capitalist, ambitious, hardworking, for whom enterprise was a kind of religion. He resented the restraining influence of banks which prevented new men from getting a start, thereby restricting competition. The method of granting corporate charters he saw as special privilege and monopoly. Exclusive corporate privileges, such as the power exercised by the U.S. Bank independently of government, were viewed as government-in-favor-of-the-few, and a menace to democracy, freedom, and economic independence.

Jacksonianism stood for equal protection—not privileges for the rich and powerful. If legal and political equality were assured, the poor could take care of themselves. It was "the philosophy of a rising middle class; do not throttle, but liberate business, to open every possible pathway for the creative
enterprise of the people." The core of the Jacksonian and Jeffersonian philosophies are the same: take the grip of government-granted privileges off the national economic order.

Daniel Webster said at the beginning of the Jackson era that "society is full of excitement: competition comes in place of monopoly; and intelligence and industry ask only for fair play and an open field." Originally a movement for political equality, it gained the support of "rural capitalists and village entrepreneurs." Jackson became the hero of the lower and middle classes who believed in expanding opportunity through equal rights. By the time of his death (1845) they had achieved; America was a nation of self-made men.

Potter and Grant observe that between the War of 1812 and the firing on Fort Sumter, the institutions developed which Americans ever since have regarded as characteristic of a democratic society. By the time of the Civil War the economy had manifest the free-wheeling, individualistic traits that make the U.S. living standard unique in the world.

Turner's thesis was the first comprehensive explanation for the growth of American democracy. He attributed it to the frontier experience, culminating in the influence of Andrew Jackson—a triumph of Western Egalitarianism over Eastern Conservatism. The frontiersman was individualistic, self-reliant, and roughly equal, because he had to be. Frontier society

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was competitive. It was based on a fair chance for all, not on levelling by arbitrary methods. The vast extent of unexploited resources prompted frontiersmen to look upon equality and competitive individualism as completely consistent elements of democracy. Competition, in fact, tended to check rising inequalities; it provided new opportunities. The election of Jackson meant that a new, aggressive, expansive democracy, emphasizing human rights and individualism as against the old established order which emphasized vested rights and corporate action, had come into control.

Historians since 1945 have rejected Turner's emphasis on the West as a unique source, but accept completely the identification of Jackson's party with the growth of egalitarianism.

A. M. Schlesinger, Jr., identified the issue of the Jackson era as one between producers and nonproducers. Producers did all the work for the benefit of nonproducers (the wealth owners). Jacksonians urged, says Schlesinger, that social order depends on laws regulating distribution of wealth as well as on political organization. Their program was to resist concentration of wealth and power in a single class (to control the power of capitalists for the benefit of noncapitalist farmers and laborers in all parts of the country). It was a revival Jeffersonianism, but accepted industrialism as a fact of life. The struggle was between the rich and the poor, not between frontiersmen and easterners.

The fears of Jeffersonians had become actualities to the Jacksonians: banks and corporations had proved to be inimical to freedom of action and initiative of the average poor but ambitious man.
Jeffersonian democracy looked wistfully back toward a past slipping further every minute into the mists of memory, while Jacksonian democracy came straightforwardly to grips with a rough and unlovely present.

But although Turner emphasized farmers, Schlesinger labor, and others pointed to individualistic enterprisers seeking government support against powerful rivals, all historians have recognized close connections between Jacksonians and the emerging era of egalitarianism and democracy.

Lee Benson said (1961) that it was just plainly a very widespread egalitarian trend, and that to call it Jacksonian is misleading. There was no causal relationship between Jacksonianism and egalitarianism. So he would discard "Age of Jackson" and substitute "Age of Egalitarianism." The latter expresses, he says, the ideology of an age. "After 1815, not only in politics but in all spheres of American life, egalitarianism challenged elitism, and in most spheres and places, egalitarianism won." In the 1830's and 1840's, political battles were less over ends than means. All parties accepted egalitarianism as the ideology of the Good Society.

The conclusions of these historians suggest that the Jacksonians faced a fundamental problem. They wanted cheap land, and they got it, but they soon discovered that land and hard work were not enough. They needed development capital as well. Without "eastern and foreign moneymen" they could not get it. Wildcat banking contributed some illusory help through inflation, but ended up in destructive panics. The same problem faced farmers on Reclamation projects in the 20th century; they had no capital to
finance improvements, and so had trouble even meeting payments on their cheap land. Competitive production in an industrial society requires significant amounts of capital in addition to land. But the aspiration is clear, even if its implications were poorly understood. Equal opportunity was the goal—an endowment for poor people without servitude to the proprietors of hereditary wealth. An expert manager can always get his hands on the necessary capital and extract a good income for his efforts, but he remains essentially a peasant, plowing someone else's field. The Jeffersonians and Jacksonians wanted the operator to own the field. It was their intent to use the national wealth in natural resources to endow individuals with a roughly equal capital base. If they could not abolish hereditary fortunes, they could at least try to give every family a leg up on accumulating their own fortune. But the national endowment ran out more quickly than expected, producing severe frustrations, and forcing significant changes in American society around the turn of the century.

Frederick Jackson Turner published his seminal essay, The Frontier in American History, in 1893. It was stimulated by the announcement in the 1890 Federal Census that the frontier was finally closed. The First National Irrigation Congress was held in 1891. In the early 1890's, Populism was


\[2\] In Salt Lake City.
approaching the highest pitch of its reaction against the corrupt and unjust exercise of entrenched powers that arose out of railroading and exploitation of natural resources after the Civil War. A large number of Americans were frustrated by powerlessness in the face of monopoly power, the end of cheap or free land, and drought. The context of his times, expanded upon in later sections, lends special significance to this long passage from Turner [my emphasis]:

Quite as deeply fixed in the pioneer's mind as the ideal of individualism was the ideal of democracy. He had a passionate hatred for aristocracy, monopoly and special privilege; he believed in simplicity, economy and in the rule of the people. It is true that he honored the successful man, and that he strove in all ways to advance himself. But the West was so free and so vast, the barriers to individual achievement were so remote, that the pioneer was hardly conscious that any danger to equality could come from his competition for natural resources. He thought of democracy as in some way the result of our political institutions, and he failed to see that it was primarily the result of the free lands and immense opportunities which surrounded him. Occasional statesmen voiced the idea that American democracy was based on the abundance of unoccupied land, even in the first debates on the public domain.

This early recognition of the influence of abundance of land in shaping the economic conditions of American democracy is peculiarly significant today in view of the practical exhaustion of the supply of cheap arable public lands open to the poor man, and the coincident development of labor unions to keep up wages.

Certain it is that the strength of democratic movements has chiefly lain in the regions of the pioneer. "Our governmants tend too much to democracy," wrote Izard, of South Carolina, to Jefferson, in 1785. "A handicraftsman thinks an apprenticeship necessary to make him acquainted with his business. But our backcountrymen are of the opinion that a politician may be born just as well as a poet."

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1 See John D. Hicks, The Populist Revolt (Lincoln, Nebraska: Bison Books III, University of Nebraska Press, 1961).
The Revolutionary ideas, of course, gave a great impetus to democracy, and in substantially every colony there was a double revolution, one for independence and the other for the overthrow of aristocratic control. But in the long run the effective force behind American democracy was the presence of the practically free land into which men might escape from oppression or inequalities which burdened them in the older settlements. This possibility compelled the coastwise States to liberalize the franchise; and it prevented the formation of a dominant class, whether based on property or on custom. Among the pioneers one man was as good as his neighbor. He had the same chance; conditions were simple and free. Economic equality fostered political equality. An optimistic and buoyant belief in the worth of the plain people, a devout faith in man prevailed in the West. Democracy became almost the religion of the pioneer. He held with passionate devotion the idea that he was building under freedom a new society, based on self government, and for the welfare of the average man.

And yet even as he proclaimed the gospel of democracy the pioneer showed a vague apprehension lest the time be short—lest equality should not endure—lest he might fall behind in the ascending movement of Western society. This led him on in feverish haste to acquire advantages as though he only half believed his dream. "Before him lies a boundless continent," wrote De Tocqueville, in the days when pioneer democracy was triumphant under Jackson, "and he urges forward as if time pressed and he was afraid of finding no room for his exertions."

Even while Jackson lived, labor leaders and speculative thinkers were demanding legislation to place a limit on the amount of land which one person might acquire, and to provide free farms. De Tocqueville saw the signs of change. "Between the workman and the master," he said, "there are frequent relations but no real association. . . . I am of the opinion, upon the whole, that the manufacturing aristocracy which is growing up under our eyes is one of the harshest which ever existed in the world; . . . . if ever a permanent inequality, of conditions and aristocracy, again penetrates into the world, it may be predicted that this is the gate by which they will enter: But the sanative influences of the free spaces of the West were destined to ameliorate labor's condition, to afford new hopes and new faith to pioneer democracy, and to postpone the problem. 1

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1 Turner, pp. 6-8.
A whole generation of historians set to work developing the implications of Turner's thesis. By 1920, it had gained almost universal acceptance. Criticism of it began almost immediately thereafter, and in 1936, the foundations of Turner's thesis were given a damaging blow by F. A. Shannon, who demonstrated that the Homestead Act, "the legislative epitome of free land," had actually been of small benefit to land-hungrily migrants.¹ But in the early years of Reclamation, the Turner thesis was at the height of its acceptability among historians. Acceptance by the general educated public may be assumed to last considerably beyond the time it was called in question by professionals (1936). The Turner thesis may, therefore, quite plausibly be assumed to have played a major role in the political acceptability of Reclamation. Its sentiments are reflected in every issue of the Reclamation Record and Reclamation Era, house organs of the U.S. Reclamation Service and its successor, the Bureau of Reclamation.

This section has shown the roots of a Reclamation ideology in American political tradition. The next sections show what happened when people inflamed by that ideology found their hopes crushed by physical obstacles and an end run by big capitalists in the era of the "robber barons."

¹Berky and Shenton, p. 461.
The Great American Desert: Ideology Frustrated

Except for the northwest coastal region and East Texas, the seventeen states west of those that touch on the Mississippi Valley suffer from aridity in varying degrees. A line running roughly through Winnipeg and San Antonio divides the United States into two very distinctive geographical and climatological regions. East of this line the rainfall-temperature combination provides ample moisture for most agricultural purposes; to the west of it, rainfall-temperature combinations are such that a crop is not assured for every year, and over a large portion of the region extreme aridity precludes a successful crop in any but the most unusual seasons--without supplemental water. ¹

This climatological boundary has had profound effects on United States history and institutions. Until the 1850's, westward expansion of the frontier had always been within the well-watered eastern region. The frontiersmen had learned to farm where abundant rainfall supplied all the needs of their crops; their ancestors, from Northern Europe, had always been accustomed to plenty of water. "But when the pioneers crossed the

Missouri River, they came to an arid country where water was more precious than land; its presence meant life, its absence death.  

Webb noted that westward movement of indigent homesteaders up to that time had been possible because of the abundance of free land, timber, and water. Once the frontier emerged onto the Great Plains not just one, but two of these props were suddenly jerked away, and carving a homestead out of the wilderness took on a new, harsher meaning. As a consequence, the agricultural frontier was held virtually stationary along the 98th meridian from 1840 to 1875. Efforts to cope with the vast, treeless plain and desert are the focal point of Western history.

Long before the frontier emerged from the trees it was generally understood that the region between the Missouri River and the Rocky Mountains was a great desert. Coronado was the first European to report it. The fur trapping mountain men and traders of the Santa Fe Trail reinforced the image, and scientific expeditions confirmed it. Starting just after the report of Major Stephen Long's expedition in 1819-20, the Great American Desert appeared on U.S. maps until 1858. Webb says that the notion of the Great Desert as an uninhabitable waste and absolute barrier to westward expansion was at its height in the decade 1850-1860.

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The pressure of an expanding population with land hunger and high expectations mounted steadily through the 1840's and 1850's, along with the ascendant tradition of the Great American Desert. Webb urges convincingly for it as a major source of the Civil War. The desert was a worse problem for the South than it was for the North, because the whole Southern socio-economic system depended on a warm and humid climate. The Northern system, based on individual ownership and free labor could be modified to cope with the Great Plains; the Southern cotton kingdom based on plantations and slavery could not. Webb demonstrated that from 1789, the South was able to dominate national politics, or at least hold its own with ease. But beginning about 1850, says Webb, it must have become increasingly apparent to thoughtful observers that the arid region set a definite limit to expansion of the Southern system, while only temporarily retarding that of the North. Southern politicians fought for and won the right to introduce slavery in all the unadmitted territory of the United States. (This was established by the elections of 1853 and 1856.) But the climatological barrier made it a hollow victory. All the new states would be free because no southerners were interested in the new lands, and the South must therefore be overwhelmed. There was no choice but to secede after the election of 1860 proved that Southern political dominance was at an end.

Prior to the Civil War the Great Desert image discouraged all but a few efforts to settle the arid region. Instead of coping with the desert, some settlers preferred the discomfort of crossing it—to Oregon territory where a
more familiar climate prevailed. The Oregon Trail was well established by 1843. Only one major settlement effort was successful before the Civil War—that of the Mormons in Utah after 1847. Their success with irrigation was predicated on cooperative effort, a complex social organization, and other accoutrements of oriental civilizations based on irrigation, including a significant degree of despotism. None of these are palatable to the prevailing taste for laissez-faire in America, and given the additional reinforcement of the desert image, the Mormons were probably justified in thinking they would have the whole intermountain region to themselves for as long as they wanted it. They had not planned on gold fever, however, and a miner's frontier advanced steadily eastward from the coastal ranges after 1849, establishing camps which drew workers and farmers, until by 1860 a string of settlements dotted the intermountain region.\(^1\) In a sense, the whole arid region became the frontier. Instead of moving steadily along through the trees, as it had done east of the Mississippi, the frontier of settlement jumped back and forth, in and out (many efforts failed). It leaped clear across to the Pacific slope, into the Great Basin, and began slowly to erode the open country from both sides and the middle.

\(^1\) Billington.
The Civil War seems to have catalyzed and invigorated efforts to conquer the desert, and to have contributed part of the elements necessary for success. At least in part it was a test of the ideals of Jacksonian democracy which, on the testimony of historians, pervaded in the northern and western states. The outcome of the War was a triumph for these ideals. The West was to be nonslave, based on atomistic agriculture and independent freemen. Even during the war, the Homestead Act of 1862 promised free land in the West to settlers. After the war, the Industrial Revolution asserted itself with a vigor that transformed the physical conditions of life in America, and with them, the zeitgeist of its people.

The pessimistic desert image was rejected in favor of a vision of the West as a lush, green garden. Six-shooters, saddle horses, barbed wire, windmills, and railroads made possible at least a partial fulfillment of the vision. After the war, ambitious men, fired by vision, swarmed over the West. Some brought new tools forged by the Industrial Revolution and were bent on exploitation for personal gain. Others, no less visionary but motivated more by dreams of utopia, made quieter efforts to unlock the secrets of the desert, that through understanding they might subdue it permanently to the pleasurable uses of man. For although spectacular, the stampede of exploitation was, as already noted, accompanied by much hardship, misery, and failure.
Successful domestication of the land resources of the Great Plains required physical and social techniques specific to its conditions. Until those techniques were available, says Webb, the Plains Indians had made the most successful adaptation possible of the region. The first successful venture by Europeans was the cattle kingdom. It was made possible by copying the use made of horses by Mexicans and Plains Indians, and by development of the six-shooting revolver. But it was also based on open range and free access to such water sources as were available. The land was owned by the United States government, whose agents and custodians refused to alienate it in the large chunks required for ranching, much less extend rights to use the whole area without boundary identifications. The cattle kingdom burst forth out of south Texas after the Civil War, and by 1876 had taken over the entire Plains area. It suited the technological conditions of its time, but never achieved the social sanction required to legitimize it as part of the American way.

Webb places blame for this on the easterners who dominated legislatures and who did not understand technical, geographical, and economic conditions in the West, which most of them had never seen. Legislatures, however, are not motivated solely by what makes technological sense. In this case, there was the long tradition of yeoman farmers, plus the constant pressure on legislators to provide more free land for small farmers. Government policy of long standing, reinforced only recently by the Civil War, favored the disposal of public lands in relatively small, family-farm size plots, not baronial estates. Aristocratic and conservative interests feared the inception
of democratic governments in the 17th and 18th centuries on the ground that if the masses were given political power (domination in fact) they would use it to redistribute wealth on egalitarian principles also. Western experience shows this view to have been well founded. Great fortunes have been accumulated, but their builders have not been allowed to dominate completely as long as the issues were fairly clear to the voting masses. The issue was clear in the case of the frontier, and the democratic ideal of independent free-holds carried the day against the would-be land and water barons. Against railroaders and oilmen the democrats did not fare so well; exploiting those opportunities took a different kind of vision than was shared by the masses and a different quality of effort. Against cattle barons the farmers felt they were fighting on ground they understood, and they successfully defended their territory.

Although the voting masses could prevent the establishment of feudal estates, they could not, however, assure the success of the family farm ideal. Wave after wave of settlers tried to farm the plains in the old ways and were finally driven off in desperation by drought. But the relentless pressure of land hunger spawned myths to sustain hope and fed the search for new techniques.

Barbed wire and windmills made a major contribution to the war with cattlemen and climate in the eastern portion of the Plains. Use of barbed wire fences kept ranchers' cattle out of farmers' crops (and also frequently out of the all-important watering holes). The windmill and well-drillers made
farmsteads viable away from the banks of a stream by tapping underground reservoirs for domestic water and farm gardens. With these innovations, grain crops with relatively low water requirements could be grown in good water years using cultural techniques little modified from those employed further east. But it was still a tenuous venture and completely dependent on the wet end of the rainfall cycle, as the late 1880's proved. A solid basis for agriculture even in this region had to wait upon scientific understanding of the principles on which dry farming can be successfully practiced—as well as on technological development of the tools to do it on the large scale required. Barbed wire was one of these, allowing large areas to be fenced economically; special tillage and seeding equipment were others, and draft equipment powered by the energy of fossil fuels made possible a further giant stride. But much of the Great Plains and intermountain region has too little rainfall even for dry farming. In those areas supplemental water is essential. Experiments with irrigation, therefore, went on concurrently with efforts to farm with available moisture. The major onslaught of irrigation came later, however, after all other efforts had failed to open up the remaining lands. In the meantime, hope was sustained and ideology maintained by faith in myths.

As already noted, a flood of capital and new techniques was poured into the West after the Civil War. Railroads soon connected the West Coast to the Trans-Mississippi East, crossing more than half a continent of virtually empty land between. Huge grants of this empty land had been used as security to finance the roads, and both railroad operators and their creditors had a
common interest in getting settlers on that land. They mounted a gigantic
and sustained propaganda campaign to bury the notion of a Great American
Desert and establish the myth of the Garden of the World in its place.¹

The Garden myth already had at least one proponent before the
Mexican War. He was William Gilpin, an old Western hand who had been a
friend of Andrew Jackson. Although he had traveled the length and breadth of
the West and lived in it, he kept up a constant barrage of milk and honey non-
sense about the arid region into the 1890's. Wallace Stegner used Gilpin with
great effectiveness to represent "the blooming desert" faith, as a foil to the
scientific approach, in his biography of John Wesley Powell. Of Gilpin,
Stegner says:

> He saw the West through a blaze of mystical fervor, as part of a grand geopolitical design, the overture to global harmony; and his conception of its resources and its future as a home for millions was as grandiose as his rhetoric, as unlimited as his faith, as splended as his capacity for inaccuracy . . . The Great American Desert . . . was waved away with a gesture. The semi-arid plains between the 100th meridian and the Rockies, plains which had barred settlement and repelled Spaniard and Anglo-American alike, were no desert, nor even a semi-desert, but a pastoral Canaan . . . Gilpin joined the politicians and the railroads, eager for settlers, in finding most of the plains region exuberantly arable.²

Gilpin and his kind believed there must be ample artesian water under the
prairie grass, that settlement improved the climate, that rain followed the

¹Hicks.

plow. Although there was little surface timber, the root system of the low growth was so abundant that one could easily dig for firewood and find plenty. Once the wild herds were exterminated, three domestic animals could be pastured on ground that previously supported one wild one.

The great intermountain plateau region was even more salubrious in Gilpin's view. Even houses were unnecessary, so temperate were the seasons. Agriculture was effortless: no forests needed clearing, even plowing was not essential. Ample water from mountain snow was available and setting up for irrigation no more difficult than fencing. On any patch of ground that might be unfit for raising crops, there was sure to be a rich deposit of mineral wealth. The Mississippi Valley and its adjacent plains could support 18 hundred million people, said Gilpin, and the intermountain plateau region far more than that.

Owning a territory that stretched from sea to sea . . . ; possessed of unlimited gold and other resources; endowed with a population energetic and enduring, which the peculiar geography of the continent would soon blend into one people; blessed with a political system divinely appointed to emancipate the world's oppressed millions and set an example that would recreate the globe . . . , America lacked nothing for the most extravagant future. ²

That this kind of extravagant nonsense was the substance of a propaganda campaign is thoroughly documented by Hicks. ²

¹Hicks, Chapter I.
²Ibid.
The campaign was a huge success; Billington says it "convinced half the people of the world that the American West was the poor man's Eden."\textsuperscript{1} Floods of settlers moved into the Great Plains. Even after the disastrous winter of 1886 and the burnouts of 1887, '88, and '89, the belief lived on.\textsuperscript{2} Its ability to obliterate the Great Desert image, and its persistence in the face of repeated and brutal refutations is a testament to the significance of freedom and independence as human values of very high priority. As Webb noted, "whatever man desires, he attains--if not in reality, then vicariously through his imagination." Major Powell sounded a strong warning in 1878 that settlement was pushing into dangerously arid territory during the wet and of the rainfall cycle; people preferred to believe the prophets like Gilpin, who promised them a Garden of Eden. In a century of explosive population growth, the constraints to agriculture and human habitation imposed by aridity were unacceptable to land-hungry immigrants. They came full of hope and optimism and ambition to transform the desert into "a land flowing with milk and honey," to make it "blossom as the rose," as the Children of Israel hoped to do with old Jacob's arid fields. In time, science and technology would achieve a significant measure of success in realizing the blooming vision. In the interval, poor men had to be content with dreams.

\textsuperscript{1}Billington, p. 81.

\textsuperscript{2}See Stegner, Chapter V, for a graphic recital of the tragic events.
To a people desperate for independent homesteads, with nowhere to get them but the desert, the dream understandably turned to belief that water was on the way. Webb provides the poignant summary of the thirst that haunted western attitudes.

Men in the Great Plains, or the arid region, have wanted rain more than they have wanted anything else. The shadow of the drought hangs over them constantly—whether they admit it or not; and when they meet, much of their talk is of the last rain and its effects or the prospect for the next one. This primitive and elemental desire for rain... is ever present in the mind of the farmer, the ranchman, the merchant, and the banker. ¹

Once the hope that the arid plains was a Garden of Eden was shattered, its bearers transformed it into a myth that the climate of the arid region was changing for the better. U.S. government officials issued persistent warning that there was no basis for this belief, starting with the Powell Report on Lands of the Arid Region, in 1878, but to little avail.

Men must have their myths to make life worth living. The fact of cycles in precipitation fed the notion that "the country is becoming more seasonable," and to assure themselves it was true, people sought reasons. Powell noted some of them in Chapter V of his report:

An increase in the water supply, so universal of late years, has led to many conjectures and hypotheses as to its origin. It has generally been supposed to result from increased rainfall, and this increased rainfall now from this, now from that, condition of affairs. Many have attributed the change to the laying of railroad tracks and construction of telegraph lines; others to the cultivation of the soil, and not a few to the interposition of Divine Providence in behalf of the

¹Webb, p. 375.
Latter-Day Saints. If each physical cause was indeed a *vera causa*, their inability to produce the results is quite manifest.  

After showing why none of the supposed causes is competent to produce the effects noted, Powell made this pessimistic but prophetic comment:

But if it be true that increase of the water supply is due to increase in precipitation, as many have supposed, the fact is not cheering to the agriculturist of the Arid Region. The permanent changes of nature are secular; any great sudden change is ephemeral, and usually such changes go in cycles and the opposite or compensating conditions may reasonably be anticipated. If it (the increased water supply) is due to a temporary increase of rainfall . . . we shall have to expect a speedy return to extreme aridity, in which case a large portion of the agricultural industries of the country now growing up would be destroyed.  

Powell did not personally believe that rainfall had increased by very much, even cyclically. Instead, he attributed most of the observed increase in stream and lake levels (based mainly on measurements in Utah) to destruction of beaver dams, clearing of driftwood from stream channels, draining upland meadows, and other effects wrought by man which increase the proportion of precipitation that finds its way into streams before being evaporated or sinking into groundwater reservoirs.  

While some men’s myths relied on hope alone, others resorted to techniques which had just as little basis in scientific knowledge, variations on

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1 Powell, pp. 90-91.

2 Ibid.

3 Ibid. Webb incorrectly attributed the quoted statements to Powell’s colleague and coauthor, G. K. Gilbert, who made the measurements. See Webb, p. 378.
Alchemy. As Webb puts it, they hoped to twist Nature's ear--force it to rain.1 Many theories were concocted of why tree planting would include rain, and many trees were planted. Others placed their faith in a means with less salutary side effects. They tried to blow rain out of the sky with gigantic explosions. None of these efforts met with any perceivably consistent success, and the time, work, and money invested in them underscores the dogged perseverance of people who wanted water for their farmland desperately, but were at their wits end over how to get it. Scientific and technical help was becoming possible, but it would take a political explosion to get it.

Populism and Progressivism: Political Expressions of Frustrated Ideology2

In the words of Russel B. Nye, "the triple alliance of railroads, banks, and tariff-protected industry dominated the Midwestern economy after the Civil War." Free land was gradually disappearing and westerners were forced to face a new condition: there was no place to move to. After 1865, the primary problem of America was "to resolve the clash between the old ideals of agrarian democracy with the new industrialism, to reconcile political liberty with economic expansion." American business had never accepted laissez-faire whole-heartedly, had only used it to silence opposition. Its real

1Webb, pp. 378-382.

attitude was Hamiltonian: government should protect and encourage industrial prosperity. "The laissez-faire theories of Adam Smith and the economists were well enough in the books, but the slogan of "free enterprise and individualism" that had grown naturally out of the eighteenth century no longer really fitted the new nineteenth century industrial economy."

As industrialism grew during this period people began to notice a growing discrepancy between the nation's traditional beliefs and its socio-economic conditions. In 1890, economist Charles Spahr calculated that 125,000 men controlled at least half the national wealth. People still believed in freedom, equality, and opportunity, but many were wondering if they actually possessed any of them. "Obviously the wage earner was not his own master, nor was the farmer. The traditionally independent American yeoman was now in debt to a bank, his selling prices controlled by buyers and his buying power controlled by sellers." Class divisions as clear as those of Europe were emerging. Political bosses and industrialists formed a natural alliance. Gnawed by a feeling that their behaviour was a violation of Christian ethics, the power brokers adopted Social Darwinism to reconcile spiritual ideals with social practices. It sounded scientific and laboratory tested, and to the popular mind, therefore, trustworthy. But after 1870, "there was growing conviction that old-style democracy was gone, or was going fast."

The Spencerian variant of Darwinism flourished and its proponents argued that liberty never did imply equality. By 1899, President George Haws of Amherst could say, "We have outgrown the crude notion that democracy is equality."
By 1870, American democracy had reached a turning point:

The nation still paid its respects to the traditional concepts of liberty and equality expressed so brilliantly by the eighteenth century, but at the same time developments in economics and politics... pointed away from them. The amassing of huge fortunes, the stifling of individual opportunity by monopoly, the corruption that inevitably followed politics-in-business and business-in-politics, the stratification of society that economic consolidation seemed to bring about—all these made it extremely hard to adjust old democratic ideas to contemporary practice. Yet the "struggle between democracy and plutocracy," as William Graham Sumner called it, had to be resolved.¹

While the ideal of an agrarian democracy lived on, the difficulty of realizing it in industrialized America became more and more pronounced.

Disgruntled westerners of the late 19th century believed that if the promise of American democracy was not being realized, there must be a reason for it. They had ideas of where to lay blame and turned to government for assistance in adjusting their grievances. Progress was slow because they found government to be in the control of the enemy. Hence, their program was to take control themselves of the political-economic system:

Ideas of exactly how to gain this control took different forms. The Greenbackers and free-silver men once thought it might be done by tampering with the currency. The Grangers and the Populists thought monopoly should be smashed and governmental authority extended over economic affairs. Twentieth century progressives instead advocated reformations of political machinery... to make government more responsive to popular will and less vulnerable to organized wealth. Theirs were for the most part attempts to tinker with the mechanics of government, reforms based on the progressive faith in the ability of the people to rule if given the proper tools. Their aim was to retain the form and direction of capitalistic

¹Ibid.
democracy while attempting to change its spirit. "Don't rant at the individual," said Tom Johnson. "Get after the system." They did.

The spiritual heirs of Jefferson and Jackson, struggling with drought, debt, and railroads on the agricultural frontier of the 1880's and 1890's, were unsuccessful in their bid for control. They were too scattered and their energies too dissipated. Perhaps in their frustrated rage they also failed to understand fully the nature of their problem, and hence suffered from a lack of coherence and unity in articulating it. As Nye says, their revolt never came to a full boil although the elements for a real political consolidation were there. The ideas just did not crystallize into a coherent social or political movement.

A significant part of their problem may have been ideological blinkers. To get what they wanted, the agrarians would have to change their principles. They were in process of shifting from a philosophy of self-reliance and laissez-faire to one of social cooperation; from individualism to social control through the regulation of law. The Jeffersonian system of limited government was in process of being exchanged for the Hamiltonian one of powerful government; Jeffersonian ends were being sought by Hamiltonian means. With benefit of hindsight this interpretation is not particularly obscure, but to people in process of ideological change, the world is in disarray. It is probable that

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1 Ibid.

2 Hicks is the standard work on this subject.
many people in the United States are still suffering from the same internal confusion over Jeffersonian ends versus Hamiltonian means, and it may well be a significant factor in issues of natural resources management.

William Jennings Bryan represents the culmination of Populist aspirations and efforts. With him, according to Nye,

the Democratic party picked up the Jeffersonian-Jacksonian tradition it had dropped before the Civil War, the tradition that the Populists, Greenbackers, and Anti-Monopolists barely kept alive. . . . Notably, Jefferson and Jackson were the only two statesmen Bryan ever quoted consistently, and it is equally notable that after 1892 the Republicans stopped celebrating Jefferson's birthday and organized Hamilton clubs.¹

The agrarian crusade blew itself out in Bryan's 1896 defeat. The Populist Revolt was crushed, but the old issues still remained, and it was the political movement that died not the ideas.² For the American dream, says Nye, simply was not coming true.

The Progressive movement of the early 1900's regrouped the army and mounted new offensives. Muckrakers exposed fraudulent, misrepresentative government, monopoly, industrial immorality, trusts--the same elements criticized by the agrarian radicals of the 1870's.

The Grangers, and their descendants, the Populists, had said the same things in a general way. The muckrakers offered proof and gave dates, names, places. The Grangers and Populists turned to government for help with little success. Now it was clear why.

¹ Ibid.

² Hicks has documented the lasting significance of the issues they raised in his concluding chapter, "The Populist Contribution."
Government itself was under the thumb of the very forces they were fighting, as the Midwestern farmer and small businessman suspected all along. Like Populism, and later Progressivism, muckraking was an attack on privilege, on the exploitation of the many by the few, on social and economic malpractice. (Progressivism was the) lineal descendant of nineteenth century agrarian revolt, ... traveling in the same direction ... (it) attacked capitalism, not in its essentials but in its operations. ... The drift of Progressive thought ... was away from its Jeffersonian-Jacksonian-frontier sources. The ends remained the same, but the methods changed ..., for in the industrial nineteenth century individualism by itself was hardly enough to secure democracy. ... The Granger and Populist ... found paradoxically that preservation of individualism required the introduction of certain restraints upon it.¹

Progressivism shifted away from individualism toward social control; restrictions on laissez-faire were looked upon as a means of preserving laissez-faire itself.

Twentieth-century Midwestern progressivism operated mainly within the Republican party. Populism in its later phase had been a manifestation of much the same spirit within the Democratic party. ... The new Republican progressives ... grafted Populistic and Bryanistic principles on the Hamiltonian-Republican tradition. In the process they exchanged the Jeffersonian concept of limited government for the Hamiltonian concept of strong government as the tool by which to fashion Jeffersonian ends.²

William McKinley died in 1901. Federal Reclamation was born in 1902. "The assassin's bullet that cut down McKinley put a man already committed to progressivism into the White House."³ Until well after World War II, official

¹ Ibid.
² Ibid.
³ Nye, p. 224.
publications of the Bureau of Reclamation continued to reaffirm its allegiance to the modified Jeffersonian ideals of the progressive movement.

The major theme of Nye's book, reiterated over and over again, is expressed compactly in this statement:

Progressivism was considerably more than a swing toward honest government. It was a definite, and coherent political philosophy, a concept of democracy that grew out of Grangerism and Populism. Behind it... (was) a distinctively... agrarian, Jeffersonian, frontier tradition.¹

Professional historians do not appear to have quarreled seriously with Nye's interpretation. John D. Hick's comments on it are reproduced in the Harper Torchbooks edition cited here. He says simply that most of it is not new.

Gabriel Kolko has argued that Progressivism was in fact a triumph of political-capitalism: the Hamiltonians won.² Ferdinand Lundberg's, The Rich and the Super Rich, Galbraith's, New Industrial State, and Estes Kefauver's, In a Few Hands,³ all support Kolko's position. Big business reaped most of the dividends, it is true, says Kolko, but the aims of the movement were genuinely "progressive"--to improve the welfare of the masses as against business; nonbusiness supporters of the movement were just naive about the probable outcome.

¹Ibid., p. 209.

²Potter and Grant, Issue 6, "The Progressive Movement."

Nye's comments under "The Capture of the Ivory Tower" are significant in a consideration of the importance of ideology: both religion and scholarship were drawn into the struggle between plutocracy and democracy, he says. The "social gospel" arose to do battle with the "gospel of wealth" in the field of ethics. In the social sciences, post-Civil War economists simply reapplied laissez-faire economics of the 18th and 19th centuries to the new industrial age. That people are happiest when they get what they want, that only an individual knows what he wants, and that no government should interfere with the pursuit of happiness, were preached as Holy Writ in textbooks of economic theory. But there were dissenters such as Richard T. Ely, John R. Commons, Thorstein Veblen, Lester Ward, and Simon Patten. They founded new organizations for the exchange of information and to attack social and economic problems from a new viewpoint—the American Historical Association, the American Economic Association, the American Political Science Association, the American Sociological Association, and others. What they had to say squared not at all with the older prevailing theories. They attacked the right of individuals to hold and bequeath great fortunes, and argued strongly for governmental supervision and control of wealth.

The key to Ely's economic thought was his belief that economics was a humane, ethical study, not "a science to be used as a tool in the hands of the greedy and avaricious for keeping down and oppressing the laboring classes." Once ask the question "What is the purpose of economic life?" he said, and its ethical basis becomes clear. Economics concerns itself not with what is, but with what
ought to be. 1 "The ethical school of economists," he once wrote, "aims to direct in a certain definite manner, so far as may be, the most perfect development of all human faculties in each individual which can be attained in harmony with the ethical ideal of Christianity. 2

The same ideals were carried forward to the New Deal era by the students and intellectual heirs of Ely, Commons, Veblen, and company--Rexford Guy Tugwell, Henry Wallace, Isadore Lubin. Assuming these ideals of the founders of AEA to have been built into Reclamation as part of the Progressive program, and reinforced during the New Deal era, they are the ends that must be kept in mind by those who would evaluate the efficiency of Reclamation in reaching social goals--unless the evaluators can either demonstrate that goals have changed, or make a powerful case that a different set of ends should be adopted on purely ethical grounds.

The goals of Reclamation were slightly more complex than simply government promotion of Jeffersonian freedom, independence, and equality, however. There were (and are) strong elements of Manifest Destiny, a dream of making desert wastelands bloom, and an urge to engineer the last drop of water and the last grain of sand into producing an abundant living for the ultimate number of people. We turn finally, therefore, to further consideration of John Wesley Powell and his vision of technological utopia.


2 Nye, p. 227.
John Wesley Powell: Synthesis of a New Ideology

Previous sections have established the existence of a political and ideological commitment in America to rough equality in wealth distribution, and a policy of alienating the public domain in small parcels to individual farmers as a means to achieve that end. They have also demonstrated the frustrations engendered when Nature proved uncooperative, and suggested some of the directions in which frustrated energy was vented. They have pointed to the staying power of myths and ideologies, even in the face of stunning refutations, and have also indicated more rational, problem-solving approaches to the dilemma of western aridity. Most significant of the latter were shown to be scientific efforts to conquer the desert by technology, and political movements designed to achieve the old aspiration of freedom, independence and equality in spite of uncooperative Nature. This section will demonstrate the fusion of those two ideas in the broad, synthetic vision of John Wesley Powell. The next chapter will document the partial institutionalization of his grand design in the United States Reclamation Service, and its successor, the Bureau of Reclamation.

His interest in the West, stimulated by experiences there during service in the Civil War, led shortly after the War to Major Powell’s exploration of the Colorado River and its canyon lands.¹ By this service and his

¹Biographical information is from Stegner.
perceptive and analytical reporting of it, Powell won government and institutional support to continue his studies of the region. His major purpose, according to Stegner, was "to guide the development of agriculture in the greatest practical area, and to prevent hardship from ill-considered settlement and the failure of homesteaders on family-sized farms." His Report on Lands of the Arid Region was published in 1878. In it he predicted decline of the cattle companies, the drought, floods caused by denuded watersheds, and subsequent clamor from settlers for government assistance. He was made a good prophet by the winter of 1886 which destroyed the cattle kingdom, the droughts that followed, and the Johnstown flood. In 1888 he was appointed head of the U.S. Irrigation Survey, a position giving him great power over the use of natural resources. He was already head of the Geological Survey and the Bureau of Ethnology. His powers were curtailed sharply after 1890, and he retired in the mid 1890's.

While the Major was at the height of his power he published a series of three articles in Century Magazine\(^1\) in an effort to rally public support for his programs. Entitled "Irrigable Lands of the Arid Region," "Non-Irrigable Lands of the Arid Region," and "Institutions for the Arid Region," they were a major source for Walter Prescott Webb's view of the significance of the Plains and Plateau regions to American history. Together with Powell's 1878 Report, they demonstrate a fertile imagination, wide breadth of vision, great synthetic

\(^1\)March, April, and May of 1890.
power in analysis, and ample rhetorical skill. They are fundamental to an understanding of institutions affecting natural resources management in the West.

The other major source for material in this section is Wallace Stegner's biography of Powell's career.\(^1\) Stegner used William Gilpin (see the sections on the desert barrier) as a buffoon to dramatize the contrast between the rational, methodical approach of Major Powell and the extravagant nonsense preached in the name of Manifest Destiny and the Garden of the World. Powell was a scientist; but he had dreams as well. It is true that he established a firm foundation for management of natural resources; it is also true that his purpose in so doing was to make it "blossom as the rose." The flavour of his commitment is revealed in the following series of statements from his first "Irrigable Lands" article:

Why should the naked plains and the desert valleys of the far West be redeemed? Why should our civilization enter into a contest with nature to subdue the rivers of the West when the clouds of the East are ready servants? Gold is found in the gravels of the West; silver abounds in the cliffs; copper is found in the mountains; iron, coal, petroleum, and gas are supplied by nature. The mountains and plateaus are covered with stately forests; the climate is salubrious and wonderfully alluring.

Arid lands are not lands of famine and the sunny sky is not a firmament of devastation. Conquered rivers are better servants than wild clouds. The valleys and plains of the far West have all the elements of fertility that soil can have. As the blood in the body is the stream which supplies the elements of its growth, so the water in the plant is its source of increase. As the body must have more than

\(^1\) Stegner.
blood, so the plant must have more than water for its vigorous growth. These conditions of plant growth are light and heat. [My emphasis.]\(^1\)

It is noteworthy that the water hustlers in Utah seem seldom, if ever, to have held a meeting without one or more solemn intonations of "water is the life blood of the land." And a slogan identifying water as our "life blood" was adopted for the masthead of the Utah Water News (publication of the Utah Water Users Association) which began publication in 1954.

The arid lands of the West, last to be redeemed by methods first discovered in civilization, are the best agricultural lands of the continent. Not only must these lands be redeemed because of the wants of the population of that country, they must be redeemed because they are our best lands. Ultimately the whole region will be covered with a mosaic of ponds fringed with a rich vegetation; and crystal waters, and green fields, and blooming gardens will be dotted all over the burning naked lands, and sand dunes, alkali stretches, and naked hills will be decked with beautiful tracts of verdure.

By the use of all the perennial streams during the season of irrigation, by the storage of the surplus water that runs to waste when irrigation is not practised by the impounding of the storm-waters, by the recovery of the floods accumulated in valley sands, and by the utilization of the artesian fountains, a vast area of the arid lands will ultimately be reclaimed, and millions of men, women, and children will find happy rural homes in the sunny lands.\(^2\)

Later sections will demonstrate that the U.S. Reclamation Service and Bureau of Reclamation have hewed closely to these aspirations of their ideological parent.

In his "Irrigable Lands" article Powell described the drainage basins and irrigation districts of the West and pointed out problems of allocation that

\(^1\)Ibid. \(^2\)Ibid.
had already arisen in them because of premature development and illogical political boundaries. He had predicted in his 1878 Report that unless strong government measures were taken before settlers moved in there would be wastage of both water and the best lands—plus an eternity of senseless strife over water rights. Individual settlers could not afford major irrigation works and so would divert streams at high elevations where they were manageable. If unchecked, this would eventually lead to the full appropriation of late season flows to irrigate upper valleys, leaving unwatered the broad valley below, where climate and topography held out by far the greater agricultural potential. Development of the full potential of the arid region must be done on a collective basis and with federal adjudication of drainage basin districts based on an exhaustive topographic and hydrographic survey. If the piece-meal, incremental, individualistic procedure of previous frontier settlement was followed, the result would be a tragic waste.

He outlined the steps that must be taken to realize the full potential of the arid region, as follows:

1. Select the land to be redeemed.

2. Select reservoir sites.

3. Select canal sites. (Both canal and reservoir sites should be declared public lands that cannot be sold to individuals or groups.)

4. Determine the extent of flood waters in valley sands, and a method for using them.
5. Discover the extent and value of artesian basins.

In order to make the above determinations, an extensive program of scientific investigation is necessary, said Powell. There must be:

(a) A topographic survey.

(b) A hydrographic survey—to measure rainfall, streamflow and the "duty" of water (the amount of water needed to service an acre of land).

(c) An engineering survey—to locate reservoir and canal sites and estimate their cost.

(d) A geologic survey—to explore the nature and extent of groundwater reservoirs.

In 1888, when he was invited to head the new Irrigation Survey, he had been chafing to put his program into effect for 10 years. He knew that unless action was taken quickly to stop unguided development, it would become impossible to effect the institutional reforms necessary to make the most of the arid lands. Pressure from the far West finally gave him the opportunity—but only after it had been proved over and over that irrigation was the only reliable way to farm the desert. As Stegner has it, when the opportunity finally appeared, "Powell rose to the Secretary's letter like a starving cat to a sardine."

1 Its essentials appeared in the 1878 Report.
The mandate of the Irrigation Survey included authority to examine:

that portion of the United States where agriculture is carried on by means of irrigation, as to the natural advantage for the storage of water for irrigation purposes with the practicability of constructing reservoirs, together with the capacity of streams, and the cost of construction and the capacity of reservoirs and such other facts as bear on the question.\(^1\)

An amendment tacked onto the appropriation bill withdrew from settlement "all lands made susceptible of irrigation" by the reservoirs and canals which could be built. The effect was to suspend all existing land disposal laws for the irrigable region.

Powell was now "the most powerful man in the United States, so far as development of the West was concerned." He "had despotic powers over the public domain." "He could practically distribute the nation's remaining resources of soil and water according to this own plan and philosophy." The Irrigation Survey was "more explosive in its social and political implications than all his other work combined." It gave him authority to remove public lands for settlement. One of his first acts was to close down the government land office.

Major Powell now proposed the end of laissez-faire, the beginning of government supervision to prevent not only land and water monopolies but the danger of individual failure among settlers. In 1878, he had advocated cooperative control of irrigation by the settlers within a natural district. Now he appeared to assume that only federal intervention could be effective. Government should now say to pioneers what lands they could settle, and enforce its directives by control of the water. Settlers should now be limited in

\(^1\)Stegner, Chapter IV.
their anarchic personal rights and brought up sharp against a thing that until now few had bothered to consider: the common interest. The justification was the abiding aridity of the West. Indian and Spaniard and Mormon had all been ultimately forced to community morality. Mutuality was a condition of survival. But community morality, especially if it was to be enforced by federal law, was a new and alarming notion in 1889, and especially in the West. ¹

Powell did not make these plans public at first, but they became apparent in the behaviour of his bureaus.

Powell had a grand design, a General Plan, as Stegner has named it, to manage all the land, range, forest, and water resources of the West from a central authority with regulations based on hydrologic principles. ² He proposed that political divisions should correspond to drainage basins, not arbitrary lines, because timber, grazing, and agriculture are all tied together by the controlling element of water. The purpose and justification for this ambitious design was "to guide the development of agriculture in the 'greatest practical area' and to prevent hardships from ill-considered settlement and failure of homesteaders on family-sized farms." From the great mass of articles, speeches, and correspondence turned out by the Major in 1890, Stegner has summarized his, by that time, thoroughly consistent views about the arid region:

His plan reached to embrace the related problems of land, water, erosion, floods, soil conservation, even . . . hydroelectric power.

¹ Ibid.

² Hence my earlier (Chapter I) terminology of hydrologic efficiency.
Behind the plan was a settled belief in the worth of the small farmer and the necessity of protecting him both from speculators and from natural conditions he did not understand and could not combat. The key ideas were hammered at over and over in an attempt to break down tradition and the feeling that it was unpatriotic in a Westerner to admit that his country was dry. The best and safest agriculture, and the oldest, was irrigation agriculture. And it was fatal to believe that tillage altered the climate. . . . Climate depended on meteorological forces too sweeping to be changed by any local expedients. And no one should expect to reclaim all the western lands. . . . Water would have to be available, and most of it would have to come from the large rivers. Dams on these rivers would have far-reaching effects. Properly engineered, they would protect from floods—instead of causing them as at Johnstown. They would allow the reclamation of arid lands on the headwaters and swamp lands near the mouths, and they would permit a controlled flow that would prevent wasteful runoff. Also, one of the first needs in the utilization of these great rivers was a legal one, for rivers were an interstate, sometimes an international, matter and as yet there was no clear body of law covering their ownership and use. The best way to approach that legal question was by first organizing the West into hydrographic basins which would be virtually self-governing . . . Inter-basin water law would offer a sound basis for the development of interstate water law, whereas to permit development of water by local franchise was to permit monopoly and waste and peonage of the small farmer. Moreover, no individual or company could afford the enormous engineer-works that were necessary for proper development of the great rivers and the maximum use of water. The ideal way was cooperation: he would have supported federal construction only as a preventive of local grabbing . . . Over and over he repeated and explained and illustrated his thesis that the new conditions of the West demanded new institutions. 1

But the national ideological pendulum had not yet swung far enough.

As Powell's intentions became clear, opposition to them mounted rapidly from the very sources that had brought him to power. Realization dawns that he was not going to release any lands for settlement until the West

1 Stegner, Chapter IV.
had been completely surveyed, and, extrapolating from its current pace, it looked like the survey would take forever. The western politicians who had created his Irrigation Survey now found that

by their own act they had instituted federal planning on an enormous scale, put one man in almost absolute charge of it, and totally fouled up the local and water interests to whom they were all bound to give a polite if not obedient ear.¹

In spite of an intense campaign by Major Powell to win people to his cause, of which the three articles in Century Magazine were a part, Congress stripped him of the power to restrain settlement of public lands.

Without that power he could not implement the General Plan. It was the major defeat of his life and the beginning of the end of his career. Bernard de Voto assessed the consequences in these words:

"Powell's 1878 Report" is a tragic document... if we could have acted on it in full, incalculable loss would have been prevented. ... We did not make an effective effort to act on it till 1902. Half a century after that beginning, we are still far short of catching up with it. The twist of the knife is that meanwhile irreversible actions went on out West, and what we did in error will forever prevent us from catching up with it altogether.²

Part of the fault seems to be a human weakness for ideological commitment³ that retards needed changes in attitude until the period of their maximum potential has passed.

¹Ibid.

²In his "Introduction" to Stegner's book.

With a little more luck in timing or perhaps only with the assistance of some shrewd pollsters, political analysts, and organizers, existing elements of support might have been marshalled into an effective coalition. As Stegner says:

It would be a mistake to assume that Powell's notions could have found no popular support. They might have found a good deal in 1889, for... the Populists were beginning to mutter in terms close to Powell's in their political and economic significance. Those "cranks" and "radicals"... were already turning for help to the only power which was apparently able to resist or control the railroads and the trusts. Precisely at this time as Frederick Jackson Turner points out, "the defense of the pioneer democrat began to shift from free land to legislation, from the ideal of individualism to the ideal of social control through regulation by law." But this influence, after a brief triumph in the election of 1892, would be considerably delayed in its effects, and for a long time the man who thought in these terms would remain a crank and a crackpot.... The myths surrounding free land were among the most durable the nation ever developed.\(^1\)

Powell's General Plan could have easily fit into the Populist platform of 1892:

Certainly its purpose of relieving and preventing agricultural distress, extending scientific government aid to farmers, and protecting small landholders against monopolistic practices and the inequalities or inadequacies of the laws, were completely in harmony with what (Hamlin) Garland had preached from soapboxes in Nebrasks and Dakota. It is an index of how little Powell's ideas had been able to enter the public consciousness and how intracongressional a matter his defeat really was, that even an aware and militant and experienced agrarian like Garland had apparently never heard of them.\(^2\)

Unfortunately for the Plan, Populism tended to be mostly a movement of the semiarid plains, whereas Powell's grand design was intended for the arid

\(^1\)Stegner, p. 275.

\(^2\)Ibid., p. 285.
Plateau and Intermountain region. The Populists would have been with him in spirit; their frontier was essentially closed. But in the far west the spirit of speculation, exploitation, and rugged individualism still reigned, and it was the far western politicians who defeated Powell's program. It took them another decade to realize what midwestern farmers already knew—that Laissez-faire as practiced in the late 19th century did not yield liberty, equality, and fraternity in a satisfying degree. "The American yeoman might clamor for governmental assistance in his trouble, but he didn't want any that would make him change his thinking." 1

It would be a mistake to attribute defeat of Powell's General Plan to a simple matter of wickedly stupid ideology against pure, neutral, and holy science. Stegner says "Science and Reason have always been on the side of Utopia; only the cussedness of the human race has not." This statement is acceptable only if it is true that there are objective standards of human values, that they are the only goals pursued by Science and Reason, and that the "cussedness of human nature" is in large part a refusal or inability to recognize the "true goals" and accept the word of scientists on the most efficient means for reaching them. Many notions of utopia are possible; Powell's vision was of a technological utopia. It incorporated as Stegner says, Powell's whole knowledge, experience and faith, which was that

all science must eventually be practical; the Science of Earth and the Science of Man led to the same end, the evolving and developing of better political, artistic, social, industrial, and agricultural institutions, "all progressing with advancing intelligence to secure justice and thereby increase happiness."¹

This describes a kind of Newtonian vision, very similar to that held by Brigham Young and his Utah cohorts of the 19th century. It seems to have been a popular sentiment of that period--a residual of the Age of Reason in combination with the materialistic optimism of America. But in John Wesley Powell it was combined with a conviction that its realization required particular economic and political institutions. His point of view was none the less ideological for being a technological one--a faith in reason and science.

¹Stegner, p. 298.
Unfortunately, the required institutional arrangements clashed with the popular preference for laissez-faire. Stegner says that somewhere in Major Powell's small, maimed, whiskery person there burned some of the utopian zeal of Brook Farm and New Harmony. His vision of contented farmers controlling their own timber, grass, and water clear to the drainage divides, and settling their problems by an extension of the town meeting, is touched with a prophetic, perhaps a pathetic, piety.¹

In his essay on "Institutions for the Arid Lands" Powell said that the federal government should make complete and thorough topographic, hydrographic, geologic, and engineering surveys of the West; then establish local (and state) governments by hydrographic basins.

Residents of the basins could then organize themselves and cooperatively build the necessary dams and canals, borrowing outside capital if necessary. The rate of return on investment would surely justify it, in Powell's opinion, because lands of the sunny West are the most productive in the nation--once they can be watered. He said of the people already living in the West that they

are intelligent, industrious, enterprising, and wide awake to their interests. Their hearts beat high with hope, and their aspirations are for industrial empire. . . . Their love of liberty is unbounded, their obedience to law unparalleled, and their reverence for justice profound; every man is a freeman king with power to rule himself, and they may be trusted with their own interests.²

¹Ibid., p. 307.
²Ibid. p. 311.
The critical point in his technological utopia was that it required the engineering of people as well as nonhuman Nature. He fully recognized, from the model he had seen in Utah, that the kind of West he foresaw required the individual will to be subordinated in part to that of the group. Institutions for the arid lands must provide the machinery to ensure conformity.

Powell predicted that unless the machinery of government were inserted to assure cooperative effort by atomistic units, the future of the West would be one of gigantic corporate farming enterprises, because of the necessity of controlled water supplies for irrigation. The following series of statements from his "Institutions" article provides the essence of his argument and ideological commitment:

In the practice of agriculture by irrigation in high antiquity, men were organized as communal bodies or as slaves to carry on such operations by united labor. Thus the means of obtaining subsistence were of such a character as to give excuse and cogent argument for the establishment of despotism. The soil could be cultivated, great nations could be sustained, only by the organization of large bodies of men working together on the great enterprises of irrigation under despotic rulers. But such a system cannot obtain in the United States, where the love of liberty is universal. [My emphasis.]

The history of two decades of (irrigated agriculture) exhibits this fact: that in part the irrigated lands are owned and cultivated by men having small holdings, but in larger part they are held in great tracts by capitalists, and the tendency to this is on the increase. . . . The farming industries of the West are falling into the hands of a wealthy few.

The people of the West are entering upon an era of unparalleled speculation, which will result in the aggregation of the lands and waters in the hands of a comparatively few persons. Let us hope that there is wisdom enough in the statesmen of America to avert the impending evil.
Under free governments the tendency is to transfer power from hereditary and chosen rulers to money kings, as the integration of society in industrial operations is accomplished through the agency of capital.

Farming corporations and water corporations of the West have often failed to secure brilliant financial results. . . . Thus there is war in the West between capital and labor. . . .

I love the cradle more than the bank counter. The cottage home is more beautiful to me than the palace. I believe that the school house is primal, the university secondary; and I believe that the justice's court in the hamlet is the only permanent foundation for the Supreme Court at the capital. Such are the interests which I advocate.¹

Thomas Jefferson would have been proud to acknowledge the father of Reclamation as his own ideological progeny.

Although his technologically utopian program did not become a reality, Powell's influence on U.S. institutions and attitudes has been significant—and in the direction he seems to have approved. During his later years in Washington he was the High Priest of Science, to use Stegner's term. His administrative energy was responsible for getting the government deeply involved in science. It was not a move welcomed by proponents of laissez-faire, according to Stegner:

The concept of the welfare state edged into the American consciousness and into American institutions more through the scientific bureau of government than by any other way, and more through the problems raised by the public domain than through any other problems, and more through the labors of John Wesley Powell than through any other man. In its origins it probably owes nothing to Marx, and it was certainly not the invention of Franklin Delano Roosevelt and theBrains Trust. It began as public information and extended gradually

¹"Institutions for the Arid Region," Century Magazine, May 1890.
into a degree of control and paternalism increased by every national crisis and every step of the increasing concentration of power in Washington. The welfare state was present in embryo in Joseph Henry’s Weather Bureau in the eighteen-fifties. It moved a long step in the passage of what Henry Adams called America’s "first modern act of legislation," when the King and Hayden Surveys were established in 1867. It had come much further by ... 1890, and it would assume almost its contemporary look in the trustbusting and conservation activities of Theodore Roosevelt at the dawn of the next century. But what Powell and the earlier Adams and Theodore Roosevelt though of as the logical development of American society, especially in the West, was by no means universally palatable by 1890—-or by 1953. It looked dangerous; it repealed the long habit of a wide open continent; it recanted a faith. ¹

Ideologies change slowly; history provides ample evidence that people would rather suffer physically than give up the comfort provided by their mental image of what the universe is or ought to be like.

This chapter has shown gradual alterations in a national ideology during a dynamic century. It has concluded with exposition of a fairly dramatic change promulgated by one man of extraordinary vision, and the rejection of that ideological alteration by a people who, though quite accustomed to changes, were not prepared to keep in step with so bold a leader.

A new perspective on familiar phenomena, sometimes even a coherent explanation for the diverse phenomena of everyday experience, takes time to become a popular outlook. More than a century has elapsed since Charles Darwin created a consistent explanation for diverse and hitherto anomalous observations about the variety of living things and the relationship

¹Stegner, pp. 320-321.
of man to other elements of his environment. In spite of extensive testing and overwhelming success in applications since then, the consequences of his essential ideas for values and social policy have still not become part of the world-view of Western peoples.¹ The idea of energy as the ultimately scarce stuff of the universe and of its control as the common objective of most purposeful, scientific activity, has been shared by physicists for over a half a century, yet in spite of its obvious relevance to their subject, has not been adopted by economists.² And although the passage of 200 years and an industrial and technological revolution have wrought fundamental changes on socio-economic and political institutions, a large proportion of North Americans, some economists included, still speak as if they believe Adam Smith's explanation of economic society to be an accurate description of reality—or at worst an ideal of what ought to and easily could prevail.³ Because most people have


³Lundberg's book, cited earlier, is a best source for this idea. Contemporary discussion of economic policy in Canada centers around implications of the explanation of economic organization proposed by J. K. Galbraith. After several weeks of hot air, neither press analysts, politicians, business leaders, nor directors of economic bureaus seem to have grasped that a testable explanation lies at the root of the dispute. All treat it as a matter of social values and political preference, with only the faintest glimmer of recognition that it involves looking at the same old contemporary events with a different perspective—not necessarily with different values.
fixed their outlook on an explanation they wish to believe by the time they are 30, it takes a whole new generation, and sometimes several, to effect a change in popular perspective. ¹

CHAPTER IX
THE BUREAU OF RECLAMATION: A PRODUCT OF TECHNOLOGIC
AND DISTRIBUTIVE IDEALISM

By 1890, there were over 3,000,000 acres under irrigation in the
West. 1 It began, of course, with the Mormon settlement of Utah in the late
1840's. The next extension was the Union Colony in Northern Colorado,
established in 1870 under sponsorship of Horace Greeley. Major irrigation
efforts on the Santa Ana River in Southern California began shortly thereafter.
Golzé estimates that total irrigated land in the Western States in 1870 probably
did not exceed 250,000 acres, of which two-thirds was in Utah. By 1880 this
had expanded dramatically to about 1,000,000 acres—all of it in the river
bottoms of western streams.

From 1880 to 1890 there was a speculative boom in irrigation, parallel-
leling the boom in the Great Plains following the Desert Land Act of 1877.
Stocks and bonds were sold to finance irrigation works, 2 some of which
succeeded after mortgage foreclosures and refinancing. Along with the expira-
tion of the general speculative boom, this period of irrigation development
ended in the early 1890's. The census of 1890 was the first to gather figures

1 Alfred Golzé, Reclamation in the United States (New York: McGraw-
Hill, 1952), Chapter 1.

2 See Hicks on the speculative fever that made it easy.
on irrigation. It reported 3,361,381 acres irrigated. By that time private financing of irrigation works was in trouble—partly, of course, because of the general depression of the 1890's. It was an age of great faith in laissez-faire, however, and promoters of irrigation were generally not ready to ask for federal financing (and its concomitant control) of irrigation projects. They asked instead for public lands to be turned over to the states, who could then operate their own reclamation and resettlement (see the Carey Act of 1894). Irrigation remained a strictly private undertaking until the end of the century, however.

John Wesley Powell's prescriptions and warnings for successful use of the arid region were made when American faith in laissez-faire (and greed for unexploited resources) was riding high. His warnings of 1879 went unheeded. But disaster struck both cattlemen and farmers in 1886. A fierce winter killed 30 to 40% of some herds and was followed by a drought that lasted a decade. As a consequence of the drought and his earlier work, Powell found himself in a position to implement his comprehensive plan for land and water management. But before he could get it fairly launched, he had been stripped of authority by the enemies of planned settlement and government involvement. Irrigation they wanted, but not if it meant smaller profits for land speculators.¹

Nevertheless, irrigation's time had come. The drought crisis of the late 1880's coincided with the official end of the frontier. It was quite clear

¹See the previous chapter.
that beyond the 100th meridian agriculture was impossible without supplemental water. Yet there was still abundant land available and neither land speculators nor believers in the "Garden" myth could stand to admit that it was useless for agriculture. The recent drought and the short-lived prominence of Powell's Irrigation Survey had convinced both classes that the remaining frontier belonged to the irrigator. In 1891, just 1 year after the demise of Powell's grand plan, the First National Irrigation Congress was held in Salt Lake City. Major Powell was invited to address the Second, held in Los Angeles in 1893. To his dismay, however, Powell found the delegates "talking as if the whole billion acres of public domain could be irrigated, as if the whole West could be reclaimed. The ancient myth of the Garden of the World, dimmed by drought and hot wind and dust storms, came back green and lush at the first irrigation of hope." Powell set aside his planned speech and told them they were mad. No more than 12 percent of the remaining land could be irrigated; there simply is not enough water to supply the land. He was booed. Both of these first Congresses went on record favoring state control of irrigation. This could be accomplished, they said, if the federal government would turn over large amounts of public land to the states. This position was quite opposed to that of Powell, who maintained from the start

1 Stegner, p. 343.

that rational development (hydrologic efficiency) depended on being able to
direct whole watersheds from one center of government. It also conflicted
with Powell's democratic ethic, which favored federal control over public
lands to achieve the Jeffersonian ideal.

Powell's foresight has been amply demonstrated, by the Colorado
River hassle alone, and he lived just long enough to see passage of the New­
lands Act, creating the U.S. Reclamation Service. ¹ Its objective and methods
were those he had proposed with his Irrigation Survey, and its operations
covered the seventeen states of the arid region. Old Powell colleagues and
disciples such as Frederick Haynes Newell, Arthur Powell Davis, and Elwood
Mead were the guiding hands of Reclamation until Mead's death in office (Com­
missioner of Reclamation) in 1936. The Bureau's purposes, as seen by these
men, were Powell's ideals of relieving and preventing agricultural distress,
extending scientific government aid to farmers, ² and protecting small land­
holders against monopolistic practices and the inequalities or inadequacies of
the laws.

¹ In spite of its disagreements with Powell's ideas of hydrologic
efficiency, the National Irrigation Congress was used by the Powell disciples
to win passage of the Newlands Act of 1902.

² The Bureau had a paternalistic extension service before the Smith­
Lever Act of 1914 which enabled USDA cooperative extension.
Conservation Ideology

The 19th century was a great Age of Expansion. From the Age of Enlightenment, it inherited a glowing faith in science, technology, and democracy. It discovered major bodies of resources in hitherto unknown places and created the technical means for exploiting them—including transportation, communications, and international trade mechanisms. Populations expanded rapidly in response to resource availability and better sanitation. Resource use was profligate. But the discovery and exercise of this heady power over the earth was followed very shortly by a growing realization that there were limits to the earth, and that human action, as aided by the new techniques, was causing very noticeable and long-lasting alterations in the earth and its desirable resources. The previous chapter has documented the thinking along these lines that was occasioned in the United States by the Great American Desert. In retrospect, the Conservation Movement seems inevitable. It was the reaction of people imbued with faith in science and democracy to profligate and damaging resource use and to growing inequity of resource control. Reclamation in the United States was part of the outcome of this growing concern. We have already seen the combination of faith in science and zeal for democracy that motivated John Wesley Powell, a leading light in the formative stages of the Conservation Movement, and the founding father of Reclamation.
Interpreting conservation in the era of the WBP

The Progressive Conservation Movement, of which Reclamation was the first major component, reintroduced the element of scientific planning and bureaucratic control that had been the objective of Major Powell's Irrigation Survey in the late 1880's.¹ Its clearly avowed and constantly reiterated purposes were the scientifically efficient planning for maximum use of all the resources of the United States, and the distribution of control over resources according to the precepts of Jeffersonian-Jacksonian democracy. The Progressives' macroscopic, multipurpose approach to resource management and their commitment to atomistic distribution of rights to resource use and control does not appear to be contested by any of the major writers on the Progressive period.²

There is a curious element in the product of post-War writers on Conservation, however (except Stegner). They appear reluctant to acknowledge or discuss the very broad range of objectives pursued by the Conservationists, as if they do not really believe that all of them were part of a consistent program. Samuel P. Hays, for example, discounts the ethical-political

¹ See previous chapter and Stegner.

² There were dissenters to this point of view, led by John Muir, who promoted nature for nature's sake, for natural beauty and mysterious values, akin to orientalism—quite different from Newtonianism. But they were not in power. See the collage of views in D. Potter and C. Grant, Eight Issues in American History (Glenview, Illinois: Scott, Foresman & Co., 1966).
distributive element as mere rhetoric and window dressing. "Its essence was rational planning to promote efficient development and use of all natural resources."¹ "One must discard completely the struggle against corporations as the setting in which to understand conservation history." "It is from the vantage point of applied science, rather than democratic protest, that one must understand the historic role of the conservation movement." "The political implications of conservation . . . grew out of the political implications of applied science rather than from conflict over the distribution of wealth." Hays asserts that his point of view is a new approach, one that must be distinguished sharply from the traditional view of Conservation as a struggle for individual freedom and independence against the rising tide of corporate giantism—the Robber Barons who threatened to turn American democracy into a new form of Oriental Despotism. This prevailing theory, he says, has been recently restated by J. Leonard Bates.²

Turning to Bates, we find him making the opposite claim. Conservation in the 20th century has meant to average citizens and government administrators the careful management of natural resources with emphasis on efficiency of use. This is an inaccurate representation of the actual Conservation


Movement, says Bates. "The organized conservationists were concerned more with economic justice and democracy in the handling of resources than with mere prevention of waste." They repudiated laissez-faire and Social Darwinism and attempted to build a social conscience. "They had a program which may be described as limited socialism in the public interest."

Judgment on which of these writers is more accurate in his assessment of the view of Conservation that prevailed in the immediate post-War period requires more evidence than was readily available for this investigation, but the distinction they are trying to draw may be futile and pointless. The Progressive Conservation Movement was comprehensive. It included both social conscience and technical efficiency, and one need go no further than these two sources to be convinced. Bates acknowledges the importance of the applied science aspect in his opening paragraph, and Hays admits Bates' critical points in his final chapter on "The Conservation Movement and the Progressive Tradition." As he will see, leaders of the movement, especially in Reclamation, were as zealous for democracy as they were for scientific management.

The tone of resource management discussion since 1950 lends more credence to Bates' claim than it does to Hays'. The emphasis is all on the social use of resources for man and society in the abstract and collective sense. Distribution of control and ownership privileges to resources is discussed only as it affects the abstract questions of what use, how much use, and when. The whole modern literature treats national resources as a
collective endowment which must be managed, in the aggregate, for the common benefit of all the people. But explicit discussion of individual ownership or control of resources seems to be studiously avoided. Instead of wrestling with individual rights of access to resources, contemporary authors consider only the use that is made of those resources by the agencies or individuals who in fact do have control. They may recommend government policies to change the use patterns, but not ownership or use privileges. Instead of rights to the actual resources, citizens are viewed as having rights to the collective product of those resources. That is, they have rights to income and employment. There is tacit acceptance, apparently, of the existing distribution of ownership or use privileges. This approach is typical of natural as well as social scientists.

It would be interesting to investigate how, when, and why this transformation in perspective took place, for a transformation there has certainly been. From a vigorous faith in and policy for democracy in the early part of the century, the U.S. emerged from World War II with what Ferdinand Lundberg has aptly described as a feudalistic outlook. Ownership and control of resources is reserved for a few; the great mass of peasants and serfs is cared for paternalistically. They may work on the resources owned by the wealthy and receive a share of the output in return. This is a far remove from the philosophy of John Locke, Adam Smith, Tom Paine, Thomas Skidmore, and

1 See Lundberg.
others, who argued that mixing one's labor with land or resources is the origin and justification for title of ownership to those resources.¹

Hays argues that the Conservationists (the Roosevelt group) believed that efficient use of resources for the greatest benefit of mankind lay in a particular kind of social organization that included atomistic units of resource ownership within a larger, scientifically planned system of control. Such was precisely the kind of organization that the Reclamation Service instituted, invoking the precepts of John Wesley Powell, who had observed the operation of such a system under Brigham Young in Utah. That is, the Progressive Conservation Movement, of which Reclamation was a major part, regarded a particular distribution of resource ownership as important to their grand objective of the efficient management of natural resources in the interest of natural resources in the interest of the nation and its people. It was an ethical and political judgment, necessarily, but it was also a theory, an hypothesis. It was also a legitimate political decision with the venerable tradition of Jeffersonian democracy behind it. Hays' argument does not provide sufficient reason to ignore the remnants of Jeffersonian-Jacksonian tradition; he, therefore, fails to establish that efficient use of resources (in

¹The experience of the Great Depression and the emergence of Keynesian-type aggregate economic analysis may have played a key role in the transformation. Keynesianism as a step forward in technology, in energy control, carried with it the usual concomitant of more comprehensive organization and, thus, less independence. Survival, or at least physical comfort, was purchased at the expense of some individual freedom.
the aggregate, abstract sense) was the only objective of the Conservationists' preference for atomistic ownership.

Hays acknowledges that Theodore Roosevelt had an agrarian bias that bordered on mystical faith. He feared social unrest and class struggle and felt that "independent, property-owning farm families were the major source of social stability and a bulwark against internal conflict." Roosevelt also had "an almost unlimited faith in applied science."

He faced two directions at once, accepting the technical requirements of an increasingly industrial society, but fearing its social consequences. In this sense, and in this sense alone, Roosevelt sought Jeffersonian ends through Hamiltonian means. ... He considered his irrigation program as one of his administration's most important contributions. It expressed in concrete terms his own paradoxical nature: the preservation of American virtues of the past through methods abundantly appropriate to the present.¹

In this statement Hays has encapsulated the early Reclamation program very tidily. He leaves open, however, an inference that it was only Roosevelt who had this combination of faith in technology and commitment to Jeffersonian values. In fact, it was the faith of the whole corps of prominent Reclamationists from John Wesley Powell through at least Elwood Mead, the first Commissioner of Reclamation, who died in office in 1936 (Golze). And the Bureau of Reclamation, through its official publications, was still emphasizing the importance of the small family farm, and antimonopoly in land ownership as

¹Hays, pp. 268-269.
late as 1946.¹ (Faith in technology burns as brightly as ever in the speeches of Ellis Armstrong, a very recent Commissioner of Reclamation.)²

Contemporary writers on resources management are clearly more comfortable with the Hays interpretation than with the openly ethical and political judgments that come through so very clearly in the writings of pre-Cold War years. It is as if Hays were performing a task for his whole generation in putting down or explaining away the side of Conservation that the post-War generation of positive science specialists does not care to look at. Certainly the efficient use theme, in its aggregate and abstract sense, is the one that pervades the literature of the last 3 decades (almost). Hays is referenced frequently; Bates and Stegner hardly at all. A popular textbook of this period is that of Guy-Harold Smith, Conservation of Natural Resources. Now in its fourth edition (1971), the book first appeared in 1950. The first chapter discusses the history of Conservation in the United States, ignoring completely the distributive, democratic element. The author, Harold Rose, says there has always been a dualism in Conservation philosophy but identifies the two sides as those who promoted development and use, and those who favored nonuse. He calls these the ecological and the economic–technologic


²Ellis Armstrong, "Wake Up, America!" Remarks delivered at 28th Annual Convention, the National Limestone Institute, Washington, D.C., January 1973.
schools of Conservation. Another established text defines Conservation as an endless program of stewardship—the maintenance and improvement of the fundamental capital of a society. Neither of these general approaches to the subject includes mention of what Hays identified as one of the key programs of the Progressive Conservation Movement—the promotion of efficient use by means of atomistic ownership. Biologists, geographers, and others interested in conservation voice varying degrees of criticism of private ownership in general, as it applies to resource use, but neither they nor economists grapple with the positive issue raised by Hays. That is, modern writers ignore the purely distributive implications of the Progressive Movement, citing Hays as an excuse, but fail to consider seriously the issue that acceptance of his viewpoint necessarily entails: does atomistic ownership promote efficient use of resources, or does it not?

Conservationists had a utopian vision. They wanted to plan on a huge scale for the best interests of all the people. This necessarily involved ethical and aesthetic judgments as well as technological ones. They favored atomistic ownership of resources, in line with Jeffersonian democracy, plus overall guidance and planning by bureaus of government scientists. As one

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1 Highsmith, Jensen, and Rudd.

2 Very few conservation writers of the post-War II era seem to have a clear idea of their objective. They speak of efficiency but do not specify the goals they wish to pursue efficiently. H. Barnett and C. Morse complain of this also. See Scarcity and Growth (Baltimore, Maryland: Johns Hopkins Press, 1963), pp. 95-97.
would expect, they were opposed by special interest groups who lobbied and schemed to have their particular interests advanced regardless of the effects on society in general. This was expected by the Conservationists; it was one of their principal reasons for instituting central government planning and control. They asserted an ethic where there previously had been none. (Unless essentially amoral laissez-faire, or might-is-right be regarded as ethics.) They believed government should attempt to reconcile conflicting interests by means of a consistent ethic—an overall, collective goal. They recognized that resource allocation inevitably involves distribution among people, and they fearlessly announced the distributive ethic they preferred. It was a positive, democratic ethic.

The choice of a distributive ethic is not easy. It is the great problem of human relations. The Progressive Movement asserted an ethic. It is an arguable one as all ethical judgments are. Against this, special interest lobbies tried to pry a bigger or different share for themselves through political means. There was compromise, logrolling, a power struggle, indeterminately bounded by the thin veneer of custom, tradition, and constitution that we call civilization. When civilization breaks down completely, there is nothing but an amoral struggle for the spoils. Sooner or later, however, from either fatigue, stand off, or the emergence of a clear victor, institutions re-emerge to put limits on the struggle, to give it some system. The Progressive Movement was an effort to add a larger element of system and ethics to the amoral laissez-faire that typified America in the last half of the 19th century. Its
success represented a political decision by voters that the revolutionary atmosphere of constant struggle was not good for man nor the earth.

Hays says the Progressive Conservationists aimed for efficiency. He did not identify with precision, unfortunately, just what goal they were trying to achieve efficiently. On one thing there does not appear to be serious dispute among historians, nevertheless. One clear goal that the Progressive Conservationists repeated over and over again was Jacksonian, Jeffersonian democracy. They wanted to assure equal opportunity to every family, to every young male (white?) American. One of the means they saw for accomplishing this was the great, but limited and perishable, U.S. resources endowment.

Conservation as seen by a contemporary

Walter Weyl, described by Walter Lippman as "by far the best-trained economist of the progressive movement," clearly identified conservation with the main objective of progressivism, which he identified as socialized democracy. According to Charles Forcey, The New Democracy, summed up progressivism's main drift more thoroughly than any other work of the time. . . . The first half of his book described in detail the way the United States . . . Had fallen firmly into the hands of what he called "the plutocracy" . . . .

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2See the various interpretations of Progressivism represented in Potter and Grant's textbook treatment.
Democracy argued that the frontier experience had greatly accentuated a rapacious materialism that had been part of the American character from the beginning and, in so doing, had prepared the way for the lawlessness and greed of the tycoons of the late nineteenth century.  

Weyl said,

Some men believe that an eventual democracy . . . will come as a free gift from omnipotent millionaires. . . . This theory is idyllic. There is a spirit in America. The new spirit is social. . . . It involves common action and a common lot. It emphasizes social rather than private ethics. . . . Individualism struck its frontier when the pioneer struck his, and society, falling back upon itself, found itself. . . . In obedience to this new spirit we are slowly changing our perception and evaluation of the goals of life. . . . We are ceasing solely to adore successful greed, and are evolving a tentative theory of the trusteeship of wealth. . . . The inner soul of our new democracy is not the unalienable rights, negatively and individualistically interpreted, but those same rights, "life, liberty, and the pursuit of happiness," extended and given a social interpretation. . . . Today no democracy is possible in America except a socialized democracy. . . . In the socialized democracy towards which we are moving, . . . [government] will be used to accomplish great social ends, among which will be the more equal distribution of wealth and income. . . . Today the chief restrictions upon liberty are economic, not legal. . . . The democracy of tomorrow, being a real and not a merely formal democracy, does not content itself with the mere right to vote.  

Absolute socialism, of the kind that abolishes all private property, is not on the horizon for America, said Weyl, because American socialists recognize that the group of small farmers and shopkeepers is larger than the industrial proletariat and is not on the decline. Farm ownership is not being

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2 Weyl, pp. 8-10.
supplanted by tenantry; the small farms are not being absorbed by large ones. Socialists know they must have the support, or at least the nonopposition of this class of property owners. Nevertheless, said Weyl, the goal of the new democracy is the socialization of industry.

In Weyl's analysis, democracy is not possible without a social surplus. An example of his reasons argues that "in earlier ages, when population pressed sharply upon the means of subsistence, inequalities of wealth were often the truest national economy. Wealth more evenly divided would simply have meant more babies." This is a similar argument to one attributed to an oriental potentate, and to that of J. M. Keynes in "Economic Possibilities for Our Grandchildren." It is a variant of the argument that inequality in wealth and income is necessary for economic growth—one that received important support from the consuming and saving behavior studies that followed in the wake of the Keynesian Revolution. From his perspective in Britain, in 1930, Keynes believed that "the time for all this [equality] is not yet. For at least another 100 years we must pretend to ourselves and to everyone that fair is foul and foul is fair, for foul is useful and fair is not. Avarice and usury and precaution must be our gods for a little longer still."

But the light Keynes saw at the end of the tunnel was Weyl's social surplus,

1Weyl cites John Spargo, who wrote an interpretation of Socialism for America, published in 1909.

combined with population control, to produce a per capita wealth that could usher in a golden age of equality, decency, and moral, aesthetic and intellectual advancement. Weyl believed, in 1912, that the time had already come to begin making the change to more equality in wealth and income. "For the individual man . . . the goal of profits (within bounds of law and decency) is legitimate. For the nation the conception is self-destructive . . . . The instinct of individual gain is individually an end, but socially, only a means."

The Progressives, of whom Conservationists and Reclamationists made an important part, had their eye on a social goal. They were not willing to wait as long as Lord Keynes for a share in the great social surplus of America.

Weyl's definition of the emerging democracy encompassed Conservation. Opposition to Conservation, he said, arises from fear of government ownership and operation of resources. But the threat of exhaustion of critical resources like timber and coal forced a socializing outlook.

Yet despite this threatening dearth, public foresight is so utterly at variance with our former free-handed American practice that thousands of our conservatives were found to be bitterly antagonistic to conservation. Intrinsically, conservation is nothing but saving; it is the common lot against the looters. . . . In reality Conservation is opposed, not to use, but to private appropriation, or at least to unfair, unequal, and wasteful appropriation. Conservation is merely a policy of protecting the public interest in our national forests, policy, mines, and water powers. 1

As a consequence of the Progressive Movement, major portions of natural

1Weyl, p. 49.
resources were returned to or retained in public trusteeship, and controls over use were imposed.

Readers will have noted that Weyl's analysis contradicts Hays' theory directly. The "best-trained economist of the progressive movement" (also a founding editor of The New Republic) definitely did not support atomistic ownership because he thought it would promote the growth of total social resources. He seems, on the contrary, to have shared the view of Keynes that inequality was an engine of growth. But he disagreed with Keynes in thinking that the time had already come to share the wealth among the present generation and with future ones.

The perspective of a post-war politician

Most writers on conservation acknowledge that it is a difficult conception to pin down precisely. Prominent place has been given to Hays' treatment because of its proximity to the rise of natural resource economics in the post-War period. Barnett and Morse seem to have accepted his interpretation as authoritative. At least as convincing, however, is the perspective of Frank E. Smith. ¹ Smith describes himself as having spent 20 years inside conservation as journalist, legislator, and agency director. He says his book is the first outline of the political history of conservation, and no one appears to contest the claim. Smith says that during the 12 years he spent in

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Congress (covering the fifties), there were more legislators working on
natural resources than ever before:

Each of us had his own motivations, part innate idealism, necessarily
part self-serving. Mine was the driving need to improve the economy
of the South. Few of us had a really coherent understanding of the
growth of conservation doctrine and philosophy in the United States,
but most of us rapidly learned that to achieve anything we would have
to master the multiple art that is pork barrel politics.¹

Pork barrel has become a term of opprobrium, says Smith, but
virtually every conservation success in U.S. history is the outcome of pork
barrel politics. Smith declares a decided bias in favor of viewing conserva-

tion as an essential element of the democratic faith of America.

The great conservationists of our history—both the technicians like
Powell, McGee, and Pinchot, and the politicians like the two
Roosevelts and Senators Newlands and Norris—have been more con-
cerned with economic justice in the handling of resources than with
the mere prevention of waste. . . . It is not coincidence that most
major conservation achievements have been associated with political
movements labeled progressive or liberal.²

It is noteworthy that Smith, whose book comes closest to those
examined to an explicit recognition of what is going on in resources manage-
ment, still finds it necessary to speak in almost apologetic terms about the
process, and to reveal through terms like pork barrel and logrolling the sense
of distaste that Americans feel for the way in which they allocate resources.

¹Ibid., all quotes from the "Introduction."

²Ibid.
Smith complains that pork barreling was the only way to get results because of the "haphazard handling of resource development in both the executive and the legislative branches of our government." I suggest that the meaning of this phenomenon is that the United States has never had an accepted system for handling resource allocation decisions in the sense with which Edmund Burke, for example, might view a system. Democracy probably implies a ceaseless struggle for precedence and control, or at least for equality of use privileges. It does, after all, promise equality. Openly aristocratic systems have quite a different resource ethic, and most members of society understand and accept it. Democracy must perhaps be perpetually uncivilized in the American laissez-faire and pork barrel sense until the implied promise of democratic equality is fulfilled. As many observers have noted, consistent thinking has to link democracy with some form of socialism in wealth or income distribution. The Jeffersonians tried to make this link through atomistic landownership. It is abundantly clear that the goal of the original Reclamationists was Jeffersonian, egalitarian, agrarian democracy. But that goal has never coalesced into a system. Neither has any other, although we may be approaching one that resembles feudalism in its critical features. That is, control of resources in the hands of a relatively few families, with a relatively large number of small, peasant freeholders, a large professional caste (the clergy of medieval Europe), and a great mass of serfs with a paternalistic
guarantee of a certain income as their democratic right. But this system is not firmly in place either. The proletariat is large, vocal, and militant. It makes demands, and, if well organized, gets them. The situation is still fluid; resources are still allocated by means of a naked political power struggle.

Economic analysis to help resolve allocation contests in such circumstances cannot help but be misleading. For analysis based on market data implies an accepted system when in fact there is none. It is not uncommon for decision-makers to react with frustrated rage to the conclusions and recommendations of economists (Ellis Armstrong and Eugene Whelan are good examples). The reason for their frustration is that their opponents are not fighting fair, but neither seems to understand just what the problem is. Economists try to shift grounds, to conduct the debate within the narrow confines of their own reasoning, which presumes an accepted political economic system—i.e., a market system and given resource endowments. Politicians and lobbyists are trying to change the situation that economists wish to assume as settled.

Land Use Policy in the Age of Expansion

The past two hundred years have been an absolutely exceptional period in the million-year history of Homo Sapiens. It has been an orgy of expansion and exploitation of irreplacable environmental

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1 See Lundberg.
riches. We are only a few moments away from the end of the orgy... which will never be repeated. The rich mineral deposits lying near the surface, the apparently boundless virgin forests, the incredible concentration of marine fishes—all, all will be gone, never to return. The openness of the world will be gone.¹

The industrial and technological revolution has coincided with the opening up of major new resources in the Americas, Africa, Australia, and Central Asia. One of the effects of the revolution is to make it possible for fewer and fewer farmers to feed more and more people. This fact is the single most significant sociological phenomenon of modern times. It has not only provided the leisure and resources to fuel the knowledge explosion, but has also yielded urban blight and proletarian dissatisfaction, dissidence, violence, and despair. Rural poverty has also been one of its concomitant circumstances. The change in man-resource relationships has been so dramatic and dynamic, that social and political institutions have never really been able to cope with it. Edmund Burke was trying to sandbag a tidal wave; it was vain to hope that old institutions could make sense of the new realities. It is in this context that we must examine efforts to handle the ethical problem of resource allocation.

British and French antecedents of American attitudes

The Age of Enlightenment gave birth, along with economics, to the dream of a rationalist, technological, utopian society. The American and

French Revolutions gave political expression to these ideals. In both countries, a major plank in the utopian platform was the roughly equal distribution of landed property. In Britain, the democratic revolution was resisted. Instead of extending landownership to the poor, as in France and America, the process of enclosure that had been going on for hundreds of years, was accelerated at an alarming rate, along with the application of science to farming. This produced, in Britain, an efficient agriculture and a tide of displaced, impoverished proletariat. As the enclosure movement coincided with industrialization, this army found employment in mines and factories. The greed of the landed aristocracy created the urban proletariat and the wealthy bourgeoisie. The latter two then combined their forces to repeal the Corn Laws, removing the privileged position of the agricultural aristocracy and setting Britain clearly on the road to dependence on non-domestic food and fibre. Instead of plant energy, Britons burned coal. By means of the free trading area which she set up, plus her colonial empire, Britain enjoyed her days of dominance in the energy binge. Her problem was always the employment-dependent proletariat. Small wonder that Britain inspired Marx, the socialist-labor movement, and Keynes.

France, inspired by the radical rationalists and supported by the conservative authority of an overwhelmingly agrarian society, elected instead to

Information for this section is mostly from A. Whitney Griswold, Farming and Democracy (New York: Harcourt, Brace, and Co., Inc., 1948).
preserve democracy by means of near equal distribution of land. Democracy, said the philosophers, can only flourish in a nation of small farmers. France pursued this policy at the expense of productive efficiency, and in the mid-20th century, was still a nation of small farmers. It was also democratic.

Britain, in the 20th century, was also democratic. It had become so in spite of aristocratic landownership. The sheer weight of her urban proletariat forced democratic reforms out of her ancient institutions. Britain pursued efficiency; while France opted for equity. At the dawn of the 20th century it seems safe to say that Britain's aggregate wealth exceeded that of France. In the third quarter of that century, the comparison is not so sure. Perhaps it was not so much the efficiency of her factory system and the skill of her people that made Britain wealthy as the coal that is now depleted, the cheap surplus food from Canada and Australia, and the industrial raw materials from colonies who accepted a monopsonistic price.

The reaction of two other European peoples to the filling up of their lands is well known. The Dutch employed reclamation of land from the sea on an heroic scale. The Germans, in good Malthusian form, tried to exterminate some of their neighbors and take over new territory.

American political institutions were founded on the utopian rationalism of the French Enlightenment, with the important addition of Locke's views on the ethics of landed property. Jefferson was in full agreement with the French that an agrarian society is the vital basis of a democratic society. Democracy was the goal of the Jeffersonians, and they considered the family farm to be a
critical means to the achievement and preservation of that end. Locke pro-
vided the philosophical basis for their ethical position that one man is entitled
to only as large a portion of the earth's resources as he can effectively hus-
band. The United States was launched with a commitment (on the part of an
important portion of its people at least) to democracy, to small property
ownership and to farming as the indispensable basis of a free, independent,
and intelligently self-governed people. Griswold's book, Farming and Democ-

racy, demonstrates how that ideal was maintained right into the post-World
War II era. Others have reviewed its relevance and persistence in the decades
since then,¹ and Harold Breimyer observed in 1975 that it is still with us.
The United States commitment to the family farm is still strong and will
probably continue, he said at an Agriculture Canada seminar in Ottawa,

Griswold does not conclude that Jefferson was right about democracy
being dependent upon a society of independent, landowning farmers. He cites
the British experience as a refutation of that theory. But he does demonstrate
that American society is devoted to the idea of family farming, and that it has
repeatedly committed itself to preserving the family farm as a higher goal
than economic expediency or efficiency. The British experience shows what

¹John M. Brewster, "The Relevance of the Jeffersonian Dream
Today," in Land Use Policy and Problems in the United States, ed. Howard
W. Ottoson (Lincoln, Nebraska: University of Nebraska Press, 1963). Also
Harold E. Breimyer, Individual Freedom and the Economic Organization of
happens if maximum efficiency is pursued, says Griswold, while France illustrates the extreme opposite policy of subdividing land to the ridiculous extreme where even a single vine is regarded by its owner as his "farm." American experience has been different from either of these. Most importantly, its conditions have been vastly different, until the frontier disappeared at least, and American policy has tried to find a point between the two extremes. There must be family farming, but it must be on an efficient scale.

The rushing tide of technological development, resource exploitation, population expansion, and the social changes they entailed was so rapid that Jefferson modified some of his own ideas. But neither he nor his ideological heirs gave up the ideal of independent family farms as the vital base of democratic society. This included an implacable opposition to absentee ownership and tenant farming.

Griswold demonstrates that from the days of Jefferson, the goals of farm policy have subordinated economic efficiency to social and political objectives. He recites the roll of government measures from the abolition of primogeniture and ential, through the Homestead Acts, to the multifaceted programs of the New Deal. Reclamation fits into this evolutionary pattern perfectly. Its objective was to extend the frontier of land available for small farmers after it had apparently run out in the deserts of the West. Strangely, however, and perhaps significantly, the word reclamation appears only once in Griswold's text, and not at all in his index. And in that one case, it is not Griswold who brings up the subject, but Agriculture Secretary Henry Wallace,
whom Griswold is quoting: "Our homestead and reclamation movements were aimed primarily at putting the agricultural land of the Nation into the hands of owner-operators." Wallace made this statement while testifying before Congress in favor of New Deal legislation aimed at encouraging and promoting the ownership of farm homes.

Technological, demographic, geographic, and social changes have made agriculture an altogether different kind of thing from what it was when Jefferson first idealized the family farm. Before the full weight of the Industrial Revolution had made itself felt, the family farm was a subsistence-plus-surplus operation. From it directly the family drew virtually all of what it consumed and sold or bartered only a relatively small surplus. Technological and commercial development forced a gradual but inexorable shift away from subsistence and toward complete commercialization, to the point where most farm families produce neither their own eggs, milk, and butter nor, in many cases, even their own garden vegetables. Growth of industry-provided markets, an opportunity for commercial farming. Those who wished could make money from farming. Those who may have wished (if there were any) to have stayed with subsistence, would have found themselves at a distinct socioeconomic disadvantage not in keeping with Jefferson's ideals. It is unlikely they would have wanted, therefore, to resist the trend to commercial farming, but even if they had, they would have found it almost impossible because of the rising value of their property and the necessity of paying taxes
on it in money. This is a necessary consequence of industrialization within a given geographic region with its concomitant population growth.

New Deal policies

During 1939, under the leadership of Secretary Henry C. Wallace, the United States Department of Agriculture undertook a major assessment of the social and economic state of agriculture, including a review of agricultural history and government policy. It was published as the 1940 Yearbook of Agriculture, *Farmers in a Changing World*. In his foreword, Secretary Wallace identified the objective of the Roosevelt administration as economic democracy and notes that the yearbook is dedicated to presenting facts that are essential to achieving that end.

In his introductory summary of the Yearbook, editor Gove Hambridge noted that the 1930's had been a decade of unprecedented change in U.S. agricultural viewpoints and policy.

Yet this decade does not stand alone as something cut off from the past. It simply felt the cumulative effect of the longer period of change, beginning near the turn of the century, during which agriculture has been virtually revolutionized by modern science.... In the last few years Americans have become aware of a rather startling fact: A third to a half of the farm families in the United States contribute little to our commercial supply of food and raw materials. They have little to sell; they are unable to compete in the commercial market; they live for the most part in great poverty; many of them are homeless migrants. They seem to have little economic function. But they produce relatively more children than any other social group.  

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Hambridge and his contributors credit technological development for this change (along with sociological problems). Notice the tone of surprise in Hambridge's revelation that so great a proportion of farms were subsistence rather than commercial operations. It suggests that the transition from the Jeffersonian ideal to commercialization had hardly been recognized in the 19th century binge of private gain and rugged individualism. Griswold's references suggest that no major efforts to explore Jeffersonian democracy as it applied to agriculture had been attempted by social philosophers or historians before the 1940's--during which time there were several. But events of the 1920's and 30's, says Hambridge, made Americans much more conscious of the word democracy. "Americans are re-examining their origins and looking into the meaning of democracy more intensively than at any time since the Republic was founded." Griswold's treatment demonstrates that the soul-searching carried through to the end of the decade.

Hambridge identified the fundamental problem for farm policy and noted that it pervades the text:

On the one hand we push forward agricultural efficiency, with the inevitable consequence that fewer people are needed for production; on the other, we advocate inefficiency, or at any rate tolerate it, by an extension of subsistence farming as a way to take care of those who are displaced by improved techniques. 1

Throughout the yearbook this inconsistency is acknowledged clearly as a significant problem that must be resolved. The editor and contributors call

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1 Ibid., p. 3.
frequent attention to the need for an explicit policy. Judging by Breimyer's remarks in 1975, that clear policy has never yet emerged.

One of the contributors, Harvard philosopher, Wm. Ernest Hocking, observed that

We have thought we knew what we anted; but we have not always known what we wanted most: we have lacked a scale of values. We have been wobbly in our principles--by the way, what are our principles? We have in short, been in need of a philosophy.¹

While no explicit philosophy has come forth, as Breimyer noted, we have had policy, and we have had economists. The policy seems to have been to prop up commercial family farms with subsidies, export people from farms to employment in the cities and, as Michael Harrington would insist, try to ignore the squalid subsistence group. The right to an education and to a job replaced the right to propertied independence. By an ironic twist of fate (and fossil fuel technology), a property-less, urbanized, dependent proletariat became representative of the American way of life, and the advocates of freedom and independence through preservation of roughly equal property rights for all, instead of being conservatives of old American traditions, were branded as radical socialists and communists (Henry Wallace and Rexford Guy Tugwell among them). In the great mass-consumption orgy of the 1950's and '60's, economists and laymen alike seem to have convinced themselves that Keynes and technology assured us of a Golden future--so long as we could

¹Ibid., p. 49.
avoid nuclear war. And the policy inconsistency that bothered authors of the 1940 Yearbook seems to have been buried in the same way: make farms efficient, whether they be family farms or corporate farms. Export surplus farmers to the city and either give them a job or a handout. Concern for individuals was lost in a rush of numerology—people were shuffled around and aggregated into statistics. The grave concern expressed in the 1940's over the importance of property ownership as a source of the stable and enlightened citizenry necessary for the preservation of democracy seems to have died away. So long as people had jobs, they were reasonably content, and the property issue flickered out.

In 1940, the Keynesian prescription had not been thoroughly tested, although the authors of the Yearbook were fully aware, as one of them noted, that both classical economists and Marxists prescribed that surplus agricultural labor should be employed in industry. They were not quite sure how to provide jobs for the surplus farmers when there was general unemployment. Several contributors, therefore, speculated on the possibilities for a return to subsistence agriculture—of a modern variety. Their comments are in the same vein as articles in early extension publications of the Bureau of Reclamation. Farm families should provide as much of their own living as is consistent with a desirable life style directly from the farm.¹ One author noted

¹See, for example, M. L. Wilson, "Beyond Economics." Wilson was Director of Extension Work, USDA.
that in the context of surplus farm products, further reclamation would hardly be advisable if agriculture was to be a predominantly commercial venture. ¹ However, if farming was to be a place for the self-sufficiency economy of redundant population, reclamation at public expense took on quite a different aspect.

The Reclamation Experience

Reclamation was clearly a land use program, initially, not a corps of consulting hydrologic engineers or a construction company. Its identification with water was inevitable because the land it wished to provide to the landless was useless without artificial provision of water. This fundamental fact is quite transparent in early publications about reclamation and in the house organ of the Reclamation Service. Elwood Mead, one of the most prominent of the second generation of Reclamationists (he died in office as Commissioner of Reclamation in 1936), wrote a book on the subject of Helping Men Own Farms in 1920, ² in which he analyzed deliberate government programs in Europe, North America, and Australia that were all aimed at assisting propertyless people to landed independence. This idea was maintained, with difficulty, during the long agricultural depression between the world wars and


seems to have come back rather strongly toward the end of World War II, as Griswold's book and his reference demonstrate. An intensive study of British experience with such efforts was published in the United States while Griswold was writing his book. It shows the origin of the sentiment for such policy in mid-19th century movements, especially on behalf of soldiers returning from war, and assess the success of the effort. 1 The author concluded, like Griswold, that the experiment (1860–1937) had been less than a brilliant and demonstrable success. After Griswold's 1948 book the subject seems to have attracted little interest. John M. Brewster revived it in an article written for a volume commemorating the 100th anniversary of the Homestead Act of 1862. 2 He concluded that Jefferson's ideal is fulfilled by providing opportunities for people, regardless of whether they are in farming, commerce, or professional sport. Essentially, this means providing educational opportunity for rural people. Brewster's program, therefore, is efficient farming, education for potential urban employment, and economic growth to provide jobs. It is the standard post-Keynesian formula. Instead of trying to distribute a limited quantity of resources in an equitable fashion, it focuses on increasing the aggregate income from that resource base and


ignores the issue of ownership control. The distributive problem is handled under the head of employment.

**Initial period**

A variety of forces contributed to the Reclamation Act of 1902. The outcome, nevertheless, was clearly the establishment of agrarian democracy supported by benevolent, scientific planning as a goal of policy. Reclamation was for homes. In its early years, the Reclamation Record bore a shield on its front cover showing small homesteads with farmers irrigating their fields. After 1914, the Record became a very comprehensive farm journal containing everything its editors could think of to support the ideal of farm home and community development. This pattern continued without abatement until the close of World War I.

**After World War I**

At that time, Reclamationists proposed a major expansion of the program to make it national rather than regional. It would move into cutovers,

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swamp lands, and abandoned farms east of the Mississippi and reclaim these lands as farms for veterans.\(^1\) Money was appropriated for an investigation of this project by the Reclamation Service, and it got as far as a message to Congress from President Wilson in 1920.\(^2\) Then, in the summer of 1920, agricultural prices fell and continued to fall. This was a severe shock because there had been a general expectation throughout 1919 and the first half of 1920 that the wartime market for American goods and produce would continue and even increase. Effective demand proved to be feeble, however, and there followed 2 decades of agricultural depression and apparently surplus farm population.\(^3\) In spite of this unexpected setback, dedicated Reclamationists kept reminding themselves that their first goal was farm homes for people; expanding the national wealth was explicitly and repeatedly relegated to second place behind this sociological objective.\(^4\)

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\(^1\) C. A. Bissell, "Progress in National Land Reclamation in the United States," *Annual Report* of the Smithsonian Institution, 1919. See also issues of *Reclamation Record* for this period.

\(^2\) Hays explains its demise in his Chapter XI, "Congress Rejects Coordinated Development."


\(^4\) See, for example, F. H. Newell, "National Efforts at Home Making," *Annual Report* of the Smithsonian Institution, 1922. "Too much agriculture as a business, and too few farm homes are not necessarily incompatible conceptions," he said. Production of men is more important than production of money, within reasonable limits.
It was not long after the summer of 1920 before cries were heard of "surplus farmers." Farmers on Reclamation projects were having trouble making their repayments to the Reclamation Fund and were discontented with the Service. They resisted collection efforts, hoping for a write-off of their obligations. They claimed that Reclamation Director Arthur Powell Davis wanted fast payment so he could finance more dams. There was, no doubt, an element of truth in this.\(^1\) The nature of the Reclamation Fund put a clear constraint on expansion of the work, and its continuation depended on repayment. In a decade of declining farm prices, financing was a critical problem. It was this dilemma, says Smith, that "finally pushed the reluctant bureau into recognizing the value of hydroelectric power as a product of reclamation dams."\(^2\) Boulder Dam, authorized in 1928, was the first to make open use of the idea that power users could pay for reclamation of land for farmers. From that point it was a relatively short step to municipal water sales, conservation, recreation, etc., as paying partners for the principal objective of making farm homes through reclamation of arid lands.

After the collapse of farm prices, "the whole status of farming as a business and a way of life became a matter of serious public concern." The outcome, according to Griswold,\(^3\) was a strong reinforcement of the

\(^1\) Smith, pp. 167-168.

\(^2\) Ibid.

\(^3\) Griswold, Chapter 5.
Jeffersonian ideal. Even the National Industrial Conference Board and the National Chamber of Commerce concluded in 1927 that farming is far more significant to the nation than a mere industry. It is a public function, they said, and farmers are the "custodians of the basis of national life." Agriculture was accepted as a "special national interest requiring a special public policy." These decisions were taken during the Harding-Coolidge-Hoover era with the leadership of industrialists, who noted that government had assisted commerce and industry; now it was time for the nation to help its farmers. Until the New Deal era, that help was mostly in the form of parity price supports and the Smoot-Hawley tariff.

An exception to this general rule was the Reclamation program. It maintained its dedication to the ideal of land for the small man through the post-War agricultural depression, through the Great Depression, and into the present era. (Wm. E. Warne gives Stewart Udall major credit for "holding the original reclamation line as originally laid down by Theodore Roosevelt and Frederick Haynes Newell." \(^) Even before World War I, it was recognized that the ability of farmers to make repayment of construction costs in 10 years was unrealistic, and the Reclamation Extension Act of 1914 extended the repayment period to 20 years. During the post-War and 1930's depressions, there continued to be defaults and there were many moratoria on annual payments. The Fact Finders Commission of 1923-24 was a step towards relinquishing the Jeffersonian dream, because it imposed selection standards on reclamation settlers--including a minimum amount of capital. It also
closed loopholes that had previously allowed speculators to get rich at the expense of a program designed to promote small family farms. In 1938, a Repayment Commission made recommendations that lead to the Reclamation Projects Act of 1939, which is still a basic part of reclamation law. By that statute, there is a 10-year development period during which no payment on construction is required, and after that there is a 40-year repayment period. Since that time, there have been no defaults in water-user payments, according to Warne. ¹

In the Great Depression

In the New Deal era there was a great expansion of reclamation activity, which was due only in part to the pump-priming objectives of the Public Works Administration. The idea of reclamation as land for the small man was also given strong and explicit support by Franklin Roosevelt and his new generation of democratic idealists. The Jeffersonian family farm was an explicit ideal of this group, which included Henry Wallace, Jerome Frank, Thurman Arnold, Abe Fortas, Alger Hiss, Adlai Stevenson, and Rexford G. Tugwell. ² Land reform, says Baldwin, was one of their chief objectives.


The Farm Security Administration (Farmers Home Administration after 1946) was established as the agency responsible for coordinating the national effort to preserve the family farm. Griswold says that the establishment of the FSA (1935) and passage of the Bankhead-Jones Act (1938—loans to farm tenants and dispossessed owners) confirmed in both law and political philosophy that the United States had elected to defend that agrarian way of life and the family farm against economic pressures. The goal of FSA was social rehabilitation. "It represented a decision not to let economic and technological trends run their course, as the British had done, but to resist them." Griswold quotes Agriculture Secretary Henry A. Wallace, testifying before Congress in favor of the Bankhead-Jones Act:

Our homestead and reclamation movements were aimed primarily at putting the agricultural land of the Nation into the hands of owner-operators. . . . But we failed . . . to such an extent that a large proportion of our best farm land fell into the hands of speculators and absentee landlords. Today we are faced with the problem of stemming the tide of tenancy, and reconstructing our agriculture in a fundamental manner by promoting farm ownership among the tillers of the soil. 1

The bill's title said that its purpose was "to encourage and promote the ownership of farm homes and to make the possession of such homes more secure."

In 1943, the Administrator of FSA told a House Committee that the one central purpose of the agency was "fostering property ownership by family-type

1Griswold, p. 165.
farmers and thereby preserving and strengthening the traditionally American family-type of farm operations."

Holding the line

Although the powers of Reclamation to promote agrarian democracy were checked in the early 1920's, its objective did not change. It was reaffirmed in the 1946 Survey of Landownership on Federal Reclamation Projects (Bureau of Reclamation). In the year that the Weber Basin Project was authorized, Harry Truman said that "irrigation waters should serve family farms and not land speculators."¹ As already noted, Stewart Udall gave strong support to the 160-acre limitation. In his commentary on current challenges to Reclamation, Warne made this observation:

The federal reclamation program was adopted in 1902 because private and state irrigation developments were absent or failing. . . . The 160-acre limitation was the price the federal government exacted in the interest of its homemaking policy for providing irrigation projects in the West. To sacrifice the 160-acre limitation . . . would be a complete negation of national policy.²

The same is true of the subsidization of irrigation by hydro power and municipal water users. Reclamation alone was unable to meet the Jeffersonian objective, and other measures like FSA, administered by the Department of Agriculture, were brought in as supplements to it.

¹Warne, p. 19.
²Ibid., p. 225.
"Times changed" in the early 1950's, however, with the advent of renewed agricultural surpluses, McCarthyism, and a Republican administration. Support for the ideals of Wallace, Tugwell, and their cohorts of the New Deal withered away in the face of unsalable commodities and the Red scare. USDA programs of the 1950's took on a quite different complexion. Reclamation clung to the old Jeffersonian idea, however, if only because it was written into its enabling legislation.

Public awareness of the Jeffersonian intent of Reclamation seems to have declined to such a degree in the post-Truman era that it is not even a part of the standard literature of natural resource economics.  

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1 This was the explanation given by a veteran farmer of the Lake Plains region when asked why there was no interest in reclamation farming there (with water from the Willard-Layton system).

2 Contrast the well-known views of Ezra Taft Benson, for example, to this statement of one of his church colleagues, who made it in the days of Chamber of Commerce support for assistance to agriculture, just a few years before the inauguration of FSA: (Levi Edgar Young on "Irrigation" in The Improvement Era 31, No. 12 (October 1928): 999.)

The work of the Reclamation Service is founded deep in democracy and the needs of the common people, for it gives the lowliest, poorest, and humblest the opportunities to have homes and the comforts of life for themselves and their children. The reclamation work, as fostered by government, is the first example in the history of the world where irrigation works of gigantic magnitude have been built for the benefit and profit of the people. The people are to own and maintain them. Land is not to be the property of the few, but of all the people. Herein is American democracy expressing itself as never before in history.

3 I talked about this with A. N. Halter in February of 1975. He professed genuine interest, and said he had just learned that the same distributive element was the primary purpose of TVA—a fact not normally accounted for in economic analyses of the TVA.
the Future, as a major contributor to the field, has perhaps been responsible for part of this shift in interest. As its title suggests, the focus of RFF has been quite different from the Jeffersonian, distributive ideals of the Progressive Movement and the New Deal with which Reclamation is impregnated. When a perspective typical of the RFF approach is brought to bear on a situation like that of the Weber Basin Water Conservancy District, the outcome is proposals for action like those of Appendices I and III.

Although evidence for the redistributive thrust of Reclamation is abundant and widespread,¹ a succinct but comprehensive review is available in Part 3 of Landownership Survey on Federal Reclamation Projects. The relevant section is entitled "The Historical Background of Reclamation Law and Policy with Respect to Excess Land Limitation."

Distributive idealism has not been the only motivation behind reclamation, however. Part of its appeal has been an optimistic vision of technological utopia and a liberal element of interstate greed, logrolling, and pork barrel politics. These elements have already been foreshadowed in Chapter VIII. Chapter X will expose them a little more completely in examining the political lobbies that have been associated with reclamation.

¹See, especially, Smithsonian Annual Reports and the house organ of the Bureau of Reclamation (progressively titled Reclamation Record, New Reclamation Era, and The Reclamation Era).
CHAPTER X

THE RECLAMATION LOBBY

A Western Organization

The National Irrigation Congress was introduced in Chapter IX as an important Western lobby for Reclamation. It was composed of western boosters, men whose interest in seeing the desert blossom was at least as fiscal as it was esthetic or technologic. They wanted public lands turned over to the states, where it was easier for local interests to control them. When they could not get that control away from the more powerful eastern establishment, they settled for federal reclamation as next best. George H. Maxwell, an Arizona-bred lawyer, is credited by historians for having guided the National Irrigation Congress to this position.

The leading Reclamationists, and their Conservationist allies, were visionary, zealous do-gooders. The rank and file of the lobbies they organized had understandably narrower, self-interested perspectives. Western interests wanted federal investment because it was necessary to make western resources valuable. They supported the visionary leaders whose objective was a technological and humanitarian utopia. Those leaders were able to sell Western reclamation to the controllers of the nation's purse-strings, at least in part on the strength of their democratic and self-help ideals. The price that Western interests had to pay for this transfer of wealth was the 160-acre
limitation. That limit was imposed by the eastern establishment to conform with the vision they bought from Powell and his heirs—a vision that conformed to a long-cherished Jeffersonian ideal.

George W. James included a dedicatory page (see p. 371 of this paper) in his 1917 book, Reclaiming the Arid West. This effusive tribute epitomizes the attitude of the people it praises, who were the first generation of reclamation boosters. They did not stop with passage of the 1902 Newlands Act. Their goal was human control over the total fresh water resources of the nation. They extended Powell's notion of hydrologic efficiency to the whole continent.

Senator Newlands worked tirelessly toward coordinated, multiple-purpose river development until Congress finally gave it a firm rejection by adopting the Water Power Act of 1920. George Maxwell organized people interested in controlling the lower Mississippi (flood control and swamp reclamation) into the Louisiana Reclamation Club, in 1912. Hays says that this organization was the seed that grew into the National Reclamation Association, which carried the fight for the Newlands proposals. Especially after 1914, the Reclamation Record featured many articles by Newell, Davis, and

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1 This is an hypothesis suggested by what I have read. Warne supports it explicitly. It needs to be tested by historians.

2 See Hays, Chapter XI, "Congress Rejects Coordinated Development."

3 His only support for this is 1912 minutes of the group. It is probable he has made a mistake on the NRA connection.
TO

JOHN WESLEY POWELL
The Father of the U. S. Reclamation Service,
Who planned the campaign, trained the first officers,
and put confidence into the hearts of the first army of
workers in the field of irrigation

TO

FRANCIS G. NEWLANDS
The Constructive Stateman,
Whose clear-acting, loyal mind smoothed the legislative
path and made possible congressional action upon
this difficult subject

TO

CHARLES D. WALCOTT
The Enthusiastic Organizer,
Who gave up a loved profession that he might devote
his genius to the organization of the Reclamation Service

TO

FREDERICK H. NEWELL
The Scientific Leader,
Who, as tireless engineer and administrator did much
to draw together the earlier workers of the Reclamation Service

TO

WILLIAM F. SMYTHE
The Eloquent and Convincing Orator,
Who by pen and voice sought the education of the people

TO

GEORGE H. MAXWELL
The Energetic and Tireless Advocate,
Who interested capital and brains in the irrigation of
arid lands

TO

ARTHUR POWELL DAVIS
The Practical Engineer,
Whose ability and knowledge have ever counseled the
project engineers in their problems

TO

FRANKLIN K. LANE
The Sympathetic Secretary of the Interior,
Whose breadth of mind has visioned the possibilities of
this great movement of triumphant democracy and led
him to enlarge its plans until now the arid deserts of the
western United States are being made to blossom as the
rose

TO THESE,
AND TO ALL THE FAITHFUL OFFICERS
At Home and In the Field, who have carried out the
great plans of the originator of the Service I cordially
dedicate this account of

THE MOST BENEFICENT GOVERNMENTAL
WORK OF ALL HISTORY

1George W. James, Reclaiming the Arid West (New York: Dodd, Mead, and Company, 1917), Dedicator page.
other prominent Powell disciples about extending the democratic reclamation idea to swamps and cutovers, to provide farm homes for the sturdy and independent people on which the national life was deemed to depend. Soldiers returning from the World War were one of their principal concerns. Veterans deserved a grant of land--by an old European-American tradition. But there was no more to be had, except as Reclamation created it. Rejection of the Newlands measure seems to have been a defeat for the democratic aspirations of the promoters on James' list. Given the pork barrel nature of such decisions, it is possible that the equalitarian ideals lost out in the collision of private interests.

There is an element of confusion, or at least inconsistency, between Hays and Warne. As noted in the previous paragraph, Hays said that the Louisiana Reclamation Club was the nucleus of the National Reclamation Association and that the NRA spearheaded lobbying support for the Newlands bill. Warne's treatment, which is more consistent with other evidence examined, portrays the NRA as a western organization put together by western governors to support the Bureau of Reclamation projects. Warne says that Elwood Mead took a leading part in organizing the NRA because the National Irrigation Congress, which played a major role in winning the Reclamation Act of 1902, had by the 1920's become fractionated and divided to the point that it was no longer an effective support for reclamation in general. It is quite evident from Reclamation Record that the same old private interests that had inspired NIC members in the first place destroyed its support of the
Reclamation Service. Instead of helping to expand the reclamation program, the Irrigation Congress turned its attention to destroying it by calling for cancellation of the indebtedness of reclamation farmers to the Reclamation Fund.

As the National Irrigation Congress declined in interest and potency, other reclamation boosters came forward. Warne says they included railroads, chambers of commerce, newspapers, irrigation project developers, and various civic and political clubs with local boosterism as their aim. "These groups frequently shifted their interest from the general philosophy of federal support of Western development through the construction of irrigation projects to the promotion of specific project proposals in their sectional spheres of influence."¹ Reclamation has been a high priority for many Western senators, says Warne, and he gives a list of names. The importance of senatorial support for reclamation is reinforced by the records of Utah water promotion organizations.

Warne says that when Elwood Mead, as new Commissioner of Reclamation in 1924, found that he could not count on effective support from the National Irrigation Congress, he "called upon Western governors to help him organize the National Reclamation Association." The railroads, chambers of commerce, and other boosters rallied around, Warne adds. New

¹Warne, pp. 190-191.
Reclamation Era supports Warne on this.\textsuperscript{1} As Warne suggests, support for reclamation was available but was not represented in the National Irrigation Congress. Evidence for this other support is provided in the Reclamation Record, house organ of the Bureau. It reported a meeting in November of 1919,\textsuperscript{2} just as the agricultural and reclamation crises were getting well under way. Delegates from thirteen western states (excluding North and South Dakota, Kansas, and Oklahoma) met in Salt Lake City at the call of David W. Davis, governor of Idaho. They formed a "permanent" organization to be called the Western States Reclamation Association, and assessed dues to each state, ranging from $1,000 for Nebraska to $4,000 each for Utah, California, and Texas. Perhaps not all of the delegates were governors and so could not actually commit funds for their states, for not many traces remain of the Western States Reclamation Association. Shortly thereafter, Reclamation went into eclipse and was almost terminated. That the WSRA had some effect, however, seems probable from the fact that David W. Davis was appointed Commissioner of Reclamation as of July 1923.

The 1920's agricultural crisis hit reclamation farmers very hard. Their fixed payments were relatively high compared to those of other farmers because their lands were recently and expensively acquired. As the depressed

\textsuperscript{1} See issues of 1929 through 1932, New Reclamation Era replaced Reclamation Record as house organ after the 1924 reorganization of the Bureau.

\textsuperscript{2} January 1920.
level of commodity prices most of them simply could not meet a 20-year repayment schedule. In January of 1923, the Federated Association of United States Reclamation Project Water Users was formed at a meeting in Salt Lake City.¹ They were one of several groups whose purpose was relief from payments, either by moratoria, longer repayment schedules, or other schemes. There were some temporary moratoria granted during the early 1920's, but by 1923 it was becoming clear that the agricultural depression was not going to fade away in the near future. The idea of reclamation was challenged because it was an expensive duplication of already redundant agricultural resources. Reclamationists responded to this by insisting that the products of reclamation farms were not the commodities affected by farm surpluses, and that besides, Reclamation was of overriding importance as a home builder, as a breeding and training ground for the class of people on which the national life depended. Economic efficiency, in their view, must take a back seat to the higher values of Jeffersonian, Jacksonian democracy.²

¹Reported in Reclamation Record, February 1923.

²Reclamation Record for July 1923 reported a speech given by President Warren G. Harding in Spokane: Wise development of natural resources does not result in disastrous diminution—it expands them. This is especially true of water resources, he said. The public domain should, therefore, not be thought of as a treasure house of potential wealth to be locked up against the day it is needed. Such a policy would prevent it from being ready when needed. (There are many statements associated with Reclamation that imply a refusal to accept the idea of scarcity.) Harding affirmed that his party stood for independent family farms as the proper use of Western land. It was not to be the prey of bonanza corporations seeking to exploit it for stockholders living elsewhere.
Early in 1923, Albert B. Fall fell from grace and was replaced as Interior Secretary by Hubert Work. By June, Work had persuaded Reclamation Director Arthur Powell Davis to resign, and installed David W. Davis as the first Commissioner of Reclamation. Work then called together a group of sympathetic, well-informed agrologists, politicians, and promoters to help him find a way to save Reclamation. Called the Fact Finders Commission, its members included:

Julius Barnes, president United States Chamber of Commerce
Oscar Bradfute, president American Farm Bureau Federation
James R. Garfield, former Secretary of Interior
Elwood Mead, engineer and author of books on irrigation and reclamation
Thomas E. Campbell, former governor of Arizona
David W. Davis, former governor of Idaho and Commissioner of Reclamation
Dr. John A. Widtsoe, former president of University of Utah and Utah State Agriculture College

The Fact Finders made their report in April of 1924, and Elwood Mead was named Commissioner of Reclamation immediately thereafter. In the meantime, after a stormy career with Reclamation, Frederick H. Newell retired in November 1923. He and A. P. Davis had opposed repayment extensions, moratoria, etc., and after 1912 were frequently under fire for being more interested in building dams than in forwarding the Jeffersonian ideal of Helping Men Own Farms (the title of one of Elwood Mead's books). Hays says that the Wilson administration was more sympathetic to water users' problems than the Bull Moosers had been. Wilson's Interior Secretary,

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1 The Reclamation Record, September 1923.
Franklin K. Lane praised the construction work accomplished by the Roosevelt crew, but accused them of callousness toward the "human problems" involved. "They did not realize that, primarily, these lands were being reclaimed for human occupation. They were interested in making wonderful dams and reservoirs—not in making the people industrious and contented." The Wilson administration extended the repayment time from 10 to 20 years and removed F. H. Newell from the Reclamation Service (a nonpermanent change, as it turned out).

Either there were some communication problems (or simple political hay-making) or Newell was a smooth liar, because some of the most fervent statements in support of the Jeffersonian ideal were written by him—including one of the best of those quoted in the 1946 Landownership Survey on Federal Reclamation Projects (cited above). Regardless of reasons, the first generation of reclamation leaders was out, in 1924, and Elwood Mead, who had been waiting all the while in the wings, was in. The major change in reclamation that followed the Fact Finders Commission was greater care in selecting projects and settlers. It was the beginning of benefit-cost analysis, however primitive, in preproject planning. The ideal of helping men own farms was not muted in the slightest degree. There was an admission, however, that not

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1 Hays, quoting Lane, p. 248.

2 Articles on reclamation economics and project feasibility begin to appear in New Reclamation Era immediately after Mead's installation.
all men are capable of the entrepreneurial effort required to succeed on a high-cost reclamation farm in an age of commercial (as opposed to subsistence) agriculture. Creeping technologic necessity was starting to nose out atomistic idealism.

By 1929, reclamation was under attack as a "racket," and in July of that year western governors, congressional delegations, and Interior Department representatives met in Boise to plan a defense. The next month Western governors called a conference in Salt Lake City, inviting interested people from all over the West. They made a propaganda counterattack, aimed at eastern and midwestern business interests whose market included western farmers. Similar conferences were sponsored by the Western governors in 1930 (Salt Lake City) and 1931 (Portland). Their efforts were not meeting with much success, as they depended on the proselyting efforts of individual delegates. The Reclamation Fund was virtually exhausted and more aggressive action was imperative. In 1932 they met again in Salt Lake City and committed themselves to state financial support of a national lobby—the National Reclamation Association was born in Utah in 1932.¹

Now that the seventeen states of the arid region were committed to a group effort, supporting paid lobbyists no doubt, they had to fight within the organization for NRA support of their own state programs. They were already

¹Information in this paragraph is mostly from Golze's Reclamation in the United States, p. 84.
locked in conflict over allocation of the existing water supply among themselves, so it is not difficult to understand why a clear threat of losing federal reclamation altogether was necessary to bring them together in a united effort to salvage their common pork barrel. Instead of fighting openly among themselves before Congress, they hoped to further their cause by presenting a united front. This meant bashing out some common recommendations among themselves. Each state would have to lobby with the NRA, as well as with Congress, if they were going to get anything out of the common effort. That is why local promoters have been heard frequently emphasizing that Utah must hustle to make sure of getting its fair share (Benefit-cost analysis of potential projects is more a method of ranking projects than an either/or decision. It is a question of when rather than whether, and even then, as Warne acknowledges below, lobbying strength is the most significant element in the final decision.)

Several kinds of motivation have clearly been a part of Reclamation. There are the democratic-egalitarian-yeoman farmer ideal, technological purposiveness or the dream of the blooming desert, and interstate conflict over water rights and federal resources (with which may be included chamber of commerce growthmania and other manifestations of economic self-interest.) If technological purposefulness may be expanded to include a measure of self-interest, one can infer a theory of behavior for scientific bureaus (including universities).
All of these motivations are evident in the history of Utah water development, although the Jeffersonian ideal is very well muted in the post-World War II traces. The hypothesis about bureaucratic behavior suggested in Appendix II finds support in other Utah experience. Technological purposefulness in the urge to make the desert bloom has been strong. Interstate conflict over the Colorado River has been a major preoccupation of Utah water hustlers in this century. The background of most Utahns made them particularly susceptible to success on reclamation projects because they were already accustomed to the degree of regimentation and cooperation necessary for "life under the ditch." A curiosity is that Mormons emerged from a highly centralized environment and embraced the 19th century ethic of rugged individualism at the precise moment when the reclamation movement was accepting the necessity of government sponsorship and control.¹ In fact, the social program of reclamation as set out by Major Powell was borrowed from what he observed of the Mormon experience in Utah, according to Wallace Stegner.

The Utah Lobby

As with other states of the arid Mountain West, most of Utah's precipitation falls on her mountains (80 to 90 percent).² Climate and

¹ I have commented more extensively on this anomaly in a paper prepared for the 1975 conference on Economics and the Mormon Culture at Brigham Young University: "The Nature and Significance of Mormon Political Economic Thought."

² Information in this paragraph is from a report tabled by George D. Clyde at the September 1949 convention of the Utah Water Users Association.
topography of the high mountain valleys limit their agricultural applications severely, and heat and aridity constrain the uses of the lower valley floors. But water from the mountains plus the dependable sunshine and flat alluvial plains of the valleys make a highly productive combination. Early Utah settlers therefore looked for a permanent stream issuing from the mouth of a canyon. There they laid out fields and built a town. Late season flow dictated the maximum acreage of crops requiring full-season irrigation. Small groups cooperated to build ditches and divert the stream for their mutual use. Such projects were not terribly expensive (but wasteful, in upper valleys, said Powell) and could be built and maintained by the efforts of the cooperating farmers, their animal power, and equipment. Irrigation companies in Utah are still dominantly small, cooperative, mutual companies (1949).

By 1900 all such easily exploitable water sources were used up where suitable land was available. Further expansion of irrigated acreage or a full-season water supply to currently irrigated acreage would require entrapment of early season flows for release in late season (or development of ground-water, which UWUA minutes rarely mentioned). This would require building large dams in the mountain valleys or canyons, and was too ambitious for all but a few hardy groups. Consequently, there was very little expansion of irrigated acreage in Utah between 1900 and 1949. What little there was came about through federal reclamation projects.
Compared to some of her neighboring states, Utah had very little action in the early years of the Reclamation Service. Strawberry Reservoir was one of the earliest Reclamation projects, begun in 1906, but except for the Weber River dam begun in 1927, it was the only one started in Utah until after the depths of the depression. Perhaps it was because Utah felt no pressing need for more land or water; no doubt a good many of her native sons took on new homesteads in neighboring states with large Reclamation projects. Whatever the reasons, perhaps obsolescence and decay of existing irrigation works, Utah began to take an active interest in the 1930's. Judging by the sudden accretion of reclamation projects at that time, Utah found its dues to the NRA worthwhile. Interest in rehabilitating, improving and increasing water supply facilities picked up. Dry years in the 1930's, a water shortage in Salt Lake City, and some bad spring floods caused by overgrazed watersheds probably contributed to it.

Some lobbying groups no doubt got underway in the 1930's, but effective organization for action was not really operative until the end of World War II. By that time inadequacies that began to appear in the 1930's may

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1 Hyrum -1934  Provo R. -1938
Ogden R. -1934  Newton -1941
Sanpete -1934  Scofield -1943
Source: Reclamation Project Data, 1948.

2 When this era for the founding of the UWUA was mentioned to him, DeLore Nichols snorted that "it's a lot older than that." He also says that the DCWUA was born out of the Davis County Correlation Committee of the 1930's. While technically inaccurate, his view of the antiquity of a group
have become more generally obvious. Before the war was finally over (late 1944) the Utah Water Users Association (UWUA) had been created by an act of the State legislature. It was the successor to an earlier organization called the Utah Water Storage Commission, and was charged with promoting and coordinating water development activity in the State of Utah. An accompanying law enabled county governments to appropriate money for the support of the UWUA and its activities. There was also a special fund for use of the UWUA set up in the State Engineer's Office. The first objective of the UWUA was to organize a water users association in every county so that the State would have recognized groups to work with in every political jurisdiction of the State. Counties having common water interests were grouped together into districts. Originally there were six districts, each of which elected at least one director of the UWUA (note that the Davis County Water Users Association dates from 1945. Davis County was in District 2 of the UWUA, along with Weber, Box Elder, Morgan, and Cache). The twelve-man Board of Directors had an advisory committee of twenty-five prominent Utah water promoters. The tax support for the UWUA had to come directly from the boards of county commissioners. If the commissioners tended to forget, (and even in counties like Davis and Weber where considerable water development was taking place, the commissioners were not always enthusiastic supporters) the county water

similar to the UWUA (no doubt composed of the same people) is consistent with the nature and origins of the NRA in 1932. (Personal communication, 1971.)
users association was expected to apply pressure on the commissioners to pay up.

Once county water users were organized, each was assigned to make an inventory of water resources in its county and a priority list of development and conservation measures needed to achieve more efficient use of the available water. "Orderly development, control and use of the State's water resources" is an obligation of State government and the UWUA was recognition that some action was needed to discharge it. ¹ Many old water supply facilities were badly run-down, obsolescent, inadequate. The urban area along the Wasatch Front had begun to grow rapidly, and municipal water works were also run-down and inadequate. A resolution of the UWUA in 1950 declared that three-quarters of the state's irrigated land needed supplemental water (mainly for the late season). These supplies could be made available through medium sized construction projects such as lining canals, installing pipelines, building small reservoirs, and other salvage and conservation operations. Such rehabilitation and improvement projects were beyond the reach of private capital resources and were not eligible for Bureau of Reclamation development.

With its inventory of projects in hand the UWUA designed an agency to build them and lobbied it through the state legislature. It was called the

Utah Water and Power Board and was given a $1 million revolving construction fund. Water and Power Board members were nominated by the State Water Users Association, and the UWUA made the priority ranking of projects for the Board to undertake. Water users from every county were therefore required to thrash out some agreements on priorities at the level of the state association. The UWUA lent a strong guiding hand to the UW&PB in its early years--several men sat on the Boards of Directors of both organizations simultaneously. It was eventually decided (on the advice of Judge J. A. Howell of Ogden, a founding member) that the UWUA was a lobby while the UW&PB was an arm of the state, and the practice was terminated.

We have seen that the DCWYA was given birth through the UWUA, the UWUA through the State of Utah, and both through concerns of national (at least western) scope. Records of the DCWUA and the D-WCMWDA contain little indication of the philosophical position of participants, although they are valuable for the day-to-day operations and tactics of a water lobby, as demonstrated by the use made of them in Chapter IV and Appendix II. But the ideals

1It is interesting that most of these projects were designed to rehabilitate old irrigation structures. This suggests a question about how the structures were financed originally. Was it by private savings, cooperative effort, or state funds? If they were not state-financed initially, why was state effort necessary to rehabilitate them? Had the real cost increased beyond the scope of private effort, or had the return on additional investments in more water facilities fallen below that of other opportunities for private savings? That is, was the UW&PB a manifestation of creeping technological necessity, or of water hustling insistence in spite of redundant facilities?
and attitudes of the local obbyists can be read out of minutes of the UWUA, for they were essentially the same people (E. J. Fjeldsted, J. A. Howell, DeLore Nichols, and D. D. Harris, for example, are names that frequently appear in all three records), and the state association frequently served as a forum for policy deliberations.

According to Clyde's report of 1949, irrigation efficiency then averaged only 25 to 30 percent. One-half of the water diverted from streams was being lost before it ever reached farmers' headgates. Raising efficiency by only 50 percent, said Clyde, would be the equivalent of adding 1,000,000 acre feet per year to the water supply. This could be accomplished by means of concrete linings, covers, pipelines, etc., and further efficiencies could be realized through applied research into plant, soil, and water relationships, drainage, and distributional institutions. Beyond these efforts to make better use of existing supplies, the only way to get more water, said Clyde, is through massive federal reclamation projects. The Utah Water and Power Board was designed to promote larger effective water supplies through efficiencies in transportation. Funds for research into the other areas for increased efficiency would have to be sought from state and federal agencies, according to Clyde. And for major increases in the absolute supply of controlled water, promoters would have to lobby at the federal level for Bureau of Reclamation construction. Clyde's recommendation to the UWUA and its adopted policy, was ever to press forward on all three levels at the same time.
It is again noteworthy that in his catalog of water possibilities, Clyde made no mention of groundwater.

Adoption of this broad program was a secondary development, however. The proximate reason for initiating the UWUA was quite clearly to get the Water and Power Board established. By mid-1947 that mission had been successfully accomplished, and members of the UWUA asked themselves if they should disband. Among UWUA members, however, were some veteran campaigners and specialists in the cause of more water—men like Wm. R. Wallace (President), John A. Widtsoe, George D. Clyde, E. J. Fjeldsted, J. H. Howell, Gus Backman, Wm. Peterson, Orson Christensen, D. D. Harris, and several state engineers. Their aspirations were ambitious and far-reaching. They convinced the rest of the group, with no apparent difficulty, that they should continue to operate as a promotional organization and as Utah's representative to the National Reclamation Association (UWUA paid Utah's dues in the NRA out of its budget from the State). The comprehensive program outlined by G. D. Clyde in 1949 was not well defined until that time, but the Association was active in the interim supporting the UW&PB, which continued to need lobbying efforts on its behalf and in making brave talk in support of the Central Utah Project. Wm. R. Wallace, president of the UWUA, had been actively interested in Colorado River development for all

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1 Reclamation News (organ of the NRA) reported his death at age 91 in the January 1957 issue. He resigned as president in 1956, after 50 years of fighting for reclamation.
his adult life. The UWUA minutes make reference to several major reports (published and otherwise) he made on the subject, including the very first annual report of the UWUA. The Association went on record in its first year of life in strong support of the C.U.P., and of efforts to assure Utah of its full "share" of the Colorado.

The objectives in the late forties and early fifties, therefore, were at least four-fold:

(1) Increased transport efficiencies through the UW&PB.

(2) Increased efficiency in application through government support of university research.

(3) Lobbying effort on behalf of greater Reclamation effort in Utah.

(4) Assuring a liberal share for Utah in bargaining and adjudication with other states over river basin rights.

A special committee (E. J. Fjeldsted, G. D. Clyde, J. A. Howell) was appointed in 1949 to draw up a formal program for the UWUA that could be endorsed by the group. Their general proposal was that the UWUA should serve as an effective spokesman for all water users in the state (i.e., a lobby).

They made the following specific recommendations:

(1) Active participation in legislative programs involving water and water rights.

(2) Affiliation with and active support of the National Reclamation Association. Mentioned specifically were contacts with Congress and the Bureau of Reclamation on the Bear, Weber, and Colorado river problems, and lobbying pressure in favor of the Central Utah Project. All projects of the UW&PB and the Bureau of Reclamation were to be actively supported.
(3) Study and check court decisions affecting water both inter- and intrastate.

(4) Support research in water, soil, and plant relationships, about which Utah water users presently know very little. "Water is a limiting factor in Utah's agricultural development. The state must not only develop all [emphasis added] of its undeveloped water resources, but must use more efficiently the waters that are now appropriated." Research on water supplies, requirements, methods of application, drainage, and irrigation institutions are all urgently needed. The UWUA should lobby for funds for these kinds of research.

(5) Keep water users informed on issues affecting them. "The UWUA is organized for the purpose of securing unbiased information on all water matters. Where huge reclamation projects are proposed, the people involved who will use and must pay for the water must be advised as to the effect of such projects on their welfare. Such projects will help some and hurt others." To help explain these and other matters the proposed program suggested that the UWUA conduct a two-day conference every year to disseminate available information to all water users in the state. ¹

The report of the policy committee was adopted by the Board of Directors as the program of the UWUA on July 22, 1949. Copies of a resolution based on the accepted program were sent to press and radio and to all water user organizations. Later that year the directors eliminated the third function, reviewing court decisions, and substituted "active cooperation with the State Engineer and USAC in all matters related to water development."

The present investigation did not include a search for precise origins of the UWUA or the identity of its prime movers. It is reasonable to suppose

¹UWUA policy statement, pp. 7-8.
that men like Wm. Wallace (president), John A. Widtsoe, J. A. Howell, and E. J. Fjeldsted were influential in getting the state legislature to call it together. They may have been trying for years to get some kind of action, but found their efforts futile without government muscle. It is quite certain that many of the group had been virtually professional water promoters for their whole adult lives (Wallace, Widtsoe, and Clyde, for examples). Conditions during the depression and war years aroused a public interest in the water situation and paved the way for legislative action. The legislators apparently did not feel a great degree of competence in the area of water development, but because of some evident interest (or perhaps persuasion) appointed an advisory council consisting of men with the longest records of harping on water resources development. They charged the Association to come up with a program for the State government. Conceivably the legislators assumed the advisory committee (UWUA) would fade away once favorable action had been taken on their proposals. The UWUA carved out a more expanded role for itself than had been anticipated originally, and made a considerable effort to fill it. DeLore Nichols credits Wm. Wallace with an important contribution of influence in winning final approval of the Weber Basin Project. (See Chapter IV.)

Members of the UWUA were clearly active supporters of the NRA before the UWUA was ever formed. Several members of the latter group had served as officers in the NRA, and continued to do so. D. D. Harris, president of the Davis-Weber Canal Company, was prominent in the NRA, as was
Wm. R. Wallace. Once the UWUA was formed, there was a period of slight uncertainty over relationships with the national organization, but they were soon clarified. Discussions of the issue revolved about whether or not the UWUA was the official representative of the State of Utah in the NRA, and whether the UWUA should pay Utah's dues to NRA directly out of its own budget or apply lobbying pressure on the state government to pay. It was decided that UWUA would pay the dues, making it essentially the official Utah representative of NRA. Utah's representatives on the NRA Board of Directors were thereafter nominated by the UWUA, out of their own membership. Judge J. H. Howell of Ogden, prominent in the D-WCMWDA and the WBWCD, served one or two turns as an assistant director (to Wm. Wallace) of the NRA.¹

The NRA held its 1949 national convention in Salt Lake City, and the UWUA took advantage of the opportunity to make a strong case for Utah's

¹The UWUA minutes of October 3, 1951 record passage of a motion approving a report by the Basin Development Committee of NRA (delivered at a meeting at Spokane in November of 1950) so far as it dealt with irrigation. The Utah motion added a proviso, however, that federal practice should be changed so that projects are operated by water users once paid for, rather than remaining in the hands of the Bureau. (This rule still stands according to Warne, and Rex Greenhalgh, but Wayne Winegar claims that the WBWCD is almost unique in having almost full operational control of the WBP—which is not even paid for.) Is it possible that Utahns are more insistent than most in grabbing at federal resources as if they were their own? They certainly seem loath to acknowledge federal dependence. Such behavior is consistent with the kingdom-building aspirations of Brigham Young and the early Mormon Church, and especially with the 20th century transformation of that aspiration. See Leonard Arrington, Great Basin Kingdom (Cambridge, Massachusetts: Harvard University Press, 1958); and my "Interpretation of the Nature and Significance."
interest in the Colorado River, and especially for the Central Utah Project. They combined their efforts with the State Engineer’s Office and the local offices of the Bureau of Reclamation to be assured of a strong united front. As suggested above, interest in Colorado River development was a major concern for at least several prominent members of the group (Wm. R. Wallace especially), and none appear to have dissented. Discussion of interstate litigation over the Colorado, or progress on securing approval of the C.U.P., were a prominent part of virtually every meeting. In June of 1947, at the meeting when they raised the issue of whether or not they had a function now that the UW&PB was launched, the UWUA voted to spend $500 on folders advertising the C.U.P.--at the request of the Bureau of Reclamation.

The UWUA counted among its membership and advisors some extremely knowledgeable men who had made water resources a lifelong study, including several scientists, such as Wm. Peterson, Wynn Thorne, and G. D. Clyde of USAC. They were intellectual heirs of John Wesley Powell. The hypothesis of Appendix II, that promoters of the WBP had only a dim view of what they were doing, and that they were, therefore, unwitting tools in a kingdom-building operation by the Bureau, must be heavily modified to be consistent with evidence from the UWUA records.

A Technological Imperative

The Utah water promoters displayed prominently an attitude which, it is probably fair to infer, was shared by their counterparts in other
Reclamation states: "There is unused land available; there is unused or wastefully used water that could be irrigating land. We cannot rest until all the available moisture is completely used up in the most efficient manner, watering the maximum amount of land and the maximum number of people."

Their faith in a technological utopia is expressed in the final sentences of a book by one of their most influential members, John A. Widtsoe:

Man, by his intelligence, compels the laws of nature to do his bidding, and thus he achieves joy. "And God blessed them—and God said unto them, Be fruitful and multiply and replenish the earth, and subdue it. [Widtsoe's italics.]" 1

Members of the engineering faculty of Utah State Agricultural College read much of the following information into the minutes of the UWUA: (George D. Clyde and William Peterson were the major contributors, but non-university people made occasional contributions.) There are roughly 52,500,000 acres of land in Utah. Of that total, the cultivated acreage consists of 1,324,000 irrigated acres and 400,000 acres dry farmed. However, of the irrigated

1L. H. Bailey, ed., Dry Farming, The Rural Science Series (New York: The MacMillan Company, 1911), p. 416. The following quotation from Widtsoe's Introduction is even more utopian:

The possibilities of dry-farming are stupendous. In the strength of youth we may have felt envious of the great ones of old; . . . We need harbor no such envyings, for in the conquest of the non-irrigated and non-irrigable desert are offered as fine opportunities as the world has known to the makers and shakers of empires. We stand before an undiscovered land; through the restless, ascending currents of heated desert air the vision comes and goes. With striving eyes the desert is seen covered with blossoming fields, with churches and homes and schools, and in the distance, with the vision is heard the laughter of happy children. The desert will be conquered.
acreage, only 250,000 acres have a full-season water supply. In an average year there is 7,500,000 acre feet of water in Utah streams, of which only 4,000,000 acre feet are allotted (1950). The 3,500,000 acre feet not being used is mainly flood season flow. If this unused water could be captured, it would fully irrigate another 608,000 acres of land. There are about 340,000 acres of land in Utah not now irrigated that could be if water were available. To the UWUA this appeared as a great waste of Utah's most important resource (next to people, they always hastened to add), and to them it implied a clear directive to make great efforts to control spring floods for delivery of stored water in late season.

Controlling floods for late season use implies more than dams, reservoirs, and canals. It means further study of plant, soil and water relationships, and the implementation of what is already known of these into policies that prevent overgrazing, overcutting, and other damage to watersheds. Some of John Wesley Powell's studies had shown in the late 1870's that the reason for the rise in stream flow to Great Salt Lake (which the Mormons attributed to divine intervention in their behalf--God has moderated the climate) was due to the grazing, cutting, clearing, straightening channels, etc.--all measures that lessened the power of soil to retain moisture (see Powell's Report on Lands of the Arid Region, 1879). Furthermore, the extension of such studies could provide more exact information on just how much
water it takes per acre of ground to yield the maximum crop. ¹ It would also provide information necessary to get policies enforced that could alleviate the eroding of lands, silting up of irrigation works, and water-logging. Further studies are needed, argued the university people, to measure ever more accurately the exact extent of Utah's water resources (little or no mention was ever made of groundwater, however) and arable lands. ²

It is interesting that a catalog of arable lands was recommended, since the Powell principle was that there is vastly more land in the arid region than there is water to go with it. But figures given above suggest there is enough water in Utah to supply about twice as many acres as there were (1950) unused acres of potentially arable land. The Wilson report cited above gives figures of 5,629,200 acres for total arable lands, however, and 2,219,000 acres for current croplands. Another 2,159,000 acres of salt and alkali lands could be irrigated with installation of drainage and leaching. The research program suggested 20 years earlier by the UWUA is vindicated, therefore, in an engineer's eyes. There is more usable land than the State has water to service.

¹ Powell had estimated that far less water was needed than early irrigators were actually using. See also the article by Wm. Palmer about an early incident in Utah demonstrating excessive water use--"Utah's 'Water Courts,'" Reclamation Era, November 1947.

² See L. Wilson, T. Hutchings, and P. Shafer, "Arable Land Resources of Utah," Utah Resources Series 42, Utah Agricultural Experiment Station, Utah State University, Logan, Utah, in cooperation with SCS, USDA, and Bureau of Reclamation, February 1968.
As noted above, the initial thrust of the UWUA program was to cut down the "lavish" (Clyde's word) use of water in Utah by improving conveyance facilities. By Clyde's figures in 1949, enough water could be saved through a 50 percent increase in water use efficiency to almost double the 1950 irrigated acreage of the state. (Darrel Stokes, Davis County Agent, says that when owners of low lands in the county found out how much the WBP was going to cost, they lined their ditches and started recapturing waste water.) Their research program did not end with the natural sciences. Powell's warnings of legal, sociological, and political-economic snarls had been amply demonstrated. The program of the UWUA, therefore, included research to unravel the legal and institutional knots that impede maximum efficient use of land and water resources, and, of course, more effort on the political front to push through necessary reforms. The water research program at USU in recent years has reflected the sociological concern. (The McLean thesis cited in Chapter I is a good example.)

There is a compelling and unmistakable consistency in this technological approach. The goal, in a vast semidesert, is to use every available drop of water on every level piece of ground in just the right way to produce the maximum of luxuriant vegetation. In a well-worked phrase, water hustlers aim to make the desert "blossom as the rose." If it takes dams, reservoirs, turbines, generators, concrete-lined canals, and pipelines, they will build them. If it requires a knowledge of soil, plant, and water relationships, they will petition legislatures for appropriate research grants. If
it means studying political, economic, and legal institutions, they will either undertake it themselves or get larger grants to hire appropriate specialists. The combination of desert sun, sand, water, and fertilizer is an entrancing one. It does produce even more abundantly than the humid region. If, therefore, it turns out that there is still desert land left over, unwatered, after all the efforts to squeeze the last ounce of "duty" from the last drop of moisture falling on the arid region, the engineering attitude does not blench at devising even more spectacular projects like Rocky Mountain Trenches and North American Water and Power Alliances to bring water from areas of surplus to where desert sun and sand can really make it fruitful. ¹

The real reasons underlying the urge to ultimate hydrologic efficiency are no doubt complex and at least partly subliminal. The simple desire to "do some engineering" is no doubt a part of it. That is an attitude that local hydrologists will have shared with Bureau engineers. In an age of specialization, one must do his thing in order to survive--and to feel useful and fulfilled. Reclamation appears to be a striking example of a problem that has concerned many social philosophers of this century: technology rather than a means to human ends, becomes an end itself, and we lose sight of any ends except

¹ Urban sprawl on some of the continent's best agricultural lands is painful to this engineering point of view, and it is quite consistent with the general approach to urge that cities be moved away from prime agricultural lands to places less suitable for tillage and irrigation.
technologic possibilities. This ethical emptiness is expressed in the excuse some water hustlers give for their activities: the reason we need more water on more land, said William Wallace, John Widtsoe, and company, over and over again, is to support a larger population.

Population growth was at the same time their goal and their excuse. As local promoters they wanted an expanding population of industrious homesteaders in the blooming desert. The need for water to feed an expanding population was their major argument in lobbying for a larger share of the Colorado River and for federal funds to bring the water to the Wasatch Front. Although the Weber System is completely contained within the state,

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they used the same argument for the Weber Basin Project (encouraged by Bureau representatives): if we don't get these resources someone else will. Alfred Golze's 1952 textbook, Reclamation in the United States, used the same argument to justify reclamation as a national policy: it contributes to population and economic growth of the West. G. D. Clyde urged the support of the water research program of the UWUA by asserting that they were necessary to establish Utah's claim to larger shares of the Bear, Columbia, and Colorado Rivers. That concern for pork barrel spoils and a permanent share of major interstate rivers no doubt goes far toward explaining why "farsighted" water promoters of the 1950's found it easy and expedient to ignore groundwater exploration and development.

Utah water promoters, no doubt, shared the dream of technological utopia with Bureau engineers. It is also reasonable to presume that they derived the same sort of personal advantages from water research and development programs as did Bureau hydrologists. It meant more and better laboratories, research grants, graduate students, and publications in their field of special training. Engineers in the Bureau get similar advantages from every project. The Bureau is an important source of jobs for students trained at schools where water research grants provide the resources to support specialized hydrologic activities. Warne's book provides a matter-of-fact documentation of the "old school tie of reclamation" which "binds together a loyal but unorganized clientele" of considerable importance to the
It is hardly a startling revelation, or should not be, considering the necessarily reciprocal relationships of technologic and economic interest that draw together agencies like the Bureau, irrigators, chambers of commerce, engineering firms, university faculties, state departments of water resources, and water user associations.

In explaining the proliferation of surface water developments in the West (certainly in Utah), therefore, it is quite easy to see that a common technological interest, closely tied to a common economic self-interest, can account for a significant part. The Bureau would be glad to cooperate with other members of its brotherhood [Warne's term] in any state, so long as appropriations could be obtained. Appropriations were the real hurdle (as commentators like Warne and Frank Smith freely acknowledge), and therefore depended on Congressional politicking. Warne, himself a member of the brotherhood, unabashedly confirms the horrified suspicions of Appendix II:

Hounded by theoretical economists who would reduce most political considerations to mathematical formulas, the Bureau of Reclamation has fled from one benefit-cost ratio to another in justifying its project proposals and has produced a series of methods of calculating the repayment of project costs. Since June, 1902, however, new projects have been undertaken where a sufficient number of representatives and senators desired them and when the congressmen who wanted the work done were strategically placed on committees in which authorizations or appropriations were originating in order to get the necessary actions.  

\[1\] Warne, p. 196.

\[2\] Ibid., p. 218.
Clearly, it would be naive to expect that economic calculus has ever had much influence on reclamation investment decisions.

**Jeffersonian Dreams as a Pork Barrel Tactic**

How is it that seventeen sparsely settled western states could get massive infusions of federal funds out of a House dominated by the trans-Mississippi East. Answer: By upholding the ideal of the Jeffersonian homestead, including the 160-acre limitation and subsidized irrigation. (The books of Stegner and Webb, cited in Chapter VIII, document the persistent Eastern opposition to liberalization of acreage limitations on new rights to public lands.) The Jeffersonian objective is a national interest; very little is heard about the redistributive aspect of reclamation in Western circles. The people directly involved with either building or using reclamation projects have professional and economic self-interests at heart. Selling the program in the national interest requires a broader allocative principle, and that principle has traditionally been an equalitarian one.

During the early 1970's the Utah press gave quite a lot of coverage to the Central Utah Project. It featured the same old arguments about "dire need" that were commonplace in meetings of the UWUA in the late forties, and that were used by the Weber Basin lobby in the same period. The need is supposed to be obvious to any Westerner. Water is a constraint to population expansion and economic growth. Speaker after speaker, report after report, press release after press release repeat the same theme: We must develop
and conserve every drop of water. Progress toward this goal has been systematic, at least in the postwar period. It has been carried on with the cooperation of engineers, hydrologists, geologists, agronomists, foresters, and other specialists in universities and state agencies, and with federal agencies like the Soil Conservation Service, Geological Survey, Forestry, even the Corps of Engineers. The goal of organizations like the UWUA has always been local water abundance. Individuals have also been concerned with hydrologic efficiency, but until recently efficiency seems to have taken a back seat to getting a share of the federal spoils. Probably the distinction between the two has been blurred for most people most of the time. Joseph Tracy, State Engineer at the time, told directors of the UWUA in 1952 that if the federal government would just hold back on its extravagant spending, both foreign and domestic, there would be ample funds for important projects like Colorado River development! This kind of statement seems to have been made and accepted in complete sincerity. The water lobbyists do not seem to have recognized their own projects as a transfer of national resources to the interest of a single state. To them, reclamation was a self-supporting investment that was clearly in the national interest. At the same time, they also had at least a dim awareness that it did not pay well enough to attract private or state financing.
The UWUA was vigorous in the late forties. It began with a part-time secretary to the president, and his duties expanded to secretary-treasurer and then to full-time secretary-manager before 1950. In 1952, the group decided to issue a newsletter. It was designed to be a quarterly publication, and the first number appeared in 1954. Along with its title it carried the slogan "water is the life-blood of the land." As time passed there were problems of maintaining enthusiasm among the grassroots county organizations. Leaders of the organization were concerned that it be a lobby for the real interests of all people in the state. They manifested a sincere concern over water and did feel that more of it was vital to everyone in the state. Minutes show a more or less constant problem of arousing the same feeling among the population at large. A major source of funds to the UWUA was the dues of counties—which had to be voted by county commissions. For the UWUA to get its money, the county association had to lobby with its county commissioners to get them to pay up. They were frequently reluctant, even in counties that had ongoing water supply construction projects. The policy committee of the UWUA resolved in 1951 that the Water and Power Board should not endorse projects for investigation or construction in any county that had not paid its dues in full to the UWUA. In 1954, DeLore Nichols appeared

1 Wm. Wallace and John Widtsoe are both on record with this sentiment in the minutes for December 9, 1949.
in the minutes with a proposal to force a little more enthusiasm among members of the association. County associations should appoint delegates to the annual meeting of the UWUA.

The problem of less-than enthusiastic local support was apparently not unique to Utah. At a UWUA Board of Directors meeting in December of 1954, H. T. Godfrey reported on a recent NRA convention he had attended at Portland: "California had as many delegates there as the other sixteen states combined" he said. Judging by California's success in snaring water development projects, the local hustlers had reason to worry about the paucity of support they were able to generate. It was one of their never-ending concerns that "if we don't get our share of interstate rivers now, someone else will."

Given the prior appropriation and beneficial use principles, they may well have been right. They seem to have been haunted by the threat of California's thirst.

Evidence from the records of the Utah Water Users Association is consistent with that presented earlier from minutes and correspondence of the Davis County group and the Davis-Weber Municipal Water lobby. All three provide plenty of suggestions that the water hustlers were (are) a relatively small group who see themselves as saviors to a somewhat unappreciative and blind clientele. While they may have truly benevolent, public-spirited intentions, it is also clear that many of them derive a livelihood from water development activities. They are frequently disappointed by the lack of response from the general public. Reclamation projects seem to have been
promoted on the basis of very little popular demand--and only slight awareness of what was really going on.

The "old school tie" of reclamation appears to be a case of supply creating its own demand. This is certainly not the first observation of an occupational group that builds a market for its skills by merchandising efforts. Lawyers are frequently charged with creating work for themselves. Feather-bedding in the railroads was a blatant example. The education establishment made a major sale in the postwar era. Economic research is funded out of the same pork barrel, by a merchandising effort. 1 It is quite conceivable, in fact, that the expansion of economic research into water resource phenomena after 1950 was due as much to the purposive, zealous snooping of economists-looking-for-a-research grant as it was to a sudden recognition on the part of old water development hands that some economic advice was indispensable to their dream of technological utopia.

On the other hand, a hostile demand for critical evaluation of reclamation might reasonably have originated east of the Mississippi with groups who gained very little from western water development. That, in turn, would have stimulated a demand for "professional and objective" evaluations on the part of reclamation beneficiaries and supporters. Regardless of the source of interest in economic evaluation of water resources management, however,

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whether from inside or outside the profession, the actual activity is still tied to the same pork barrel for funding. Public resource allocation in the United States is inescapably political. To perform as an objective critic of this essentially distributive issue is the self-assigned role of natural resource economists. Their activity is, consequently, fraught with pitfalls of value judgment and conflict of interest. The task of the final chapter of this work is therefore to determine what kind of contribution economics can or ought to make toward an evaluation of situations similar to the Weber Basin reclamation case. What does the pursuit of efficiency through science and technology mean in the context of pork barrel allocation of natural resources?
CHAPTER XI

RETROSPECT, ANALYSIS, AND CONCLUSIONS

Several hypotheses have been proposed in preceding chapters. All of them are designed to expand understanding of the Weber Basin situation and to identify the nature and extent of economic problems relating to water control and delivery. Assuming a plausible case to have been made for these explanatory hypotheses, the task for this concluding chapter is to draw together a description of the situation, abstract the issues, and assess alternative prescriptions for social action.

**Situation: Specific Hypotheses**

The Weber Basin Project seems clearly to include many water controlling facilities that were not needed, and may never be needed. It is quite plausible that no part of the Project was really necessary. The latter assessment is made from benefit of hindsight and greater hydrologic information than was available to decision-makers in 1950. Nevertheless, the WBP was not a judicious investment.

Fault in the affair cannot be assigned to a single group. Probably the self-interest of Bureau engineers led them to encourage the building of facilities which they must have known were a questionable use of public funds. The evidence suggests, however, that a motive quite distinguishable from pursuit
of pecuniary and symbolic power (the trappings of position, etc.) was operative among the engineers. For want of a better name, it has been labelled technological purposiveness in foregoing chapters. It has to do with what Veblen called the "instinct of workmanship," with the human urge to simplify and control the environment, and with the correlated desire to simplify matters even further by assuming that the tool, technique, or idea at hand is the one that will solve all important problems. (At an even more fundamental level, as Knight, von Hayek, and Georgescu-Roegen have shown, it is related to the philosophic notion that the universe, including social phenomena, operates according to discoverable principles akin to Newtonian mechanics.)

A similar attitude of faith in a single idea seems to have been a principal motivation of the water lobbyists. Their objective was lofty and idealistic—to make the desert blossom into a technological utopia. Their accomplishments leave something to be desired. As Koestler said, "On the historical scale, the damages wrought by individual violence for selfish motives are insignificant compared to the holocausts resulting from self-transcending devotion to collectively shared belief-systems."
Voters and taxpayers, who must now pay for the Project, cannot lay total blame for their burden on others. Their own disinterest in the implications of the Project made it possible for 1 percent of eligible voters to commit all Basin residents to repayment. This was true not only for the initial phase of the Project, but also for its expansion at significantly higher cost, even after negative publicity occasioned by the discovery of abundant groundwater and the Conservancy District's clumsy effort to monopolize it.

A plausible case for need or desire for more water supply facilities can only be discerned in respect of the small southern portion of Davis County. It is equally clear that most of the repayment burden was intended to be borne by urban and suburban residents of other parts of the Basin. Less clear, but potentially quantifiable, is a share of the cost borne by the Reclamation Fund and U.S. taxpayers in general. One reason for building such a huge project when only South Davis was demonstrably interested, was to spread the costs around. The South Davis features alone were prohibitively expensive. By expanding the Project in every direction, Bureau engineers were able to make the average cost per unit of delivery capacity look much lower. Furthermore, it allowed them to claim nonreimbursable federal benefits, and to use subsidized capital from the Reclamation fund, by appealing to an old egalitarian ideology.

The extent of the Project's redundancy, and the extent of discrimination in respect of its benefits and repayment burden, have been obscured by the Bureau and Conservancy District in their public statements, although as
public agencies their books have been open. Quite a different explanation of the water situation can be put together using the water promoters' own documents, but their version has generally sounded plausible to Western ears, and its challengers have been few and unheeded. This is not to say that the Project and its operators are regarded with approbation and gratitude by Basin residents. With a few exceptions, the WBP and the WBWCD are resented by people with strong interests in water management. The source of the resentment is rarely given coherent expression (although one clearly justifiable reason is now apparent in the hitherto obscured subsidization of south Davis County). There does seem to be a common element in all grumbles about the Project, nevertheless, and it concerns autocratic behavior and the loss of individual and local control over water supply resources. There is also an increasingly apparent conflict of interest between federal agencies and the state government over control of Utah waters.

Explanation: General Hypotheses

The previous section summarizes the historical or empirical hypotheses of the text. Those hypotheses explain observations encountered in the course of the investigation. They are specific to this case, and have little or no useful application outside it. Their level of abstraction and vulnerability to refutation is, therefore, quite low. Correspondingly, their explanatory power is very limited, and not much can be gained by refuting them either. At a higher level of abstraction are explanatory hypotheses which have been
proposed and defended at various places in the text. These are the more interesting and powerful hypotheses because their generality makes them more vulnerable to refutation. Because they are more general, they have application outside the Weber Basin and Reclamation, which increases the probability that they will have been proposed before in respect of other observations—if they are reasonable explanations.

The most general theme is so well-known as to be almost a truism, yet it is a respectable scientific proposition, nonetheless. It may be called, for short, The Idea of Progress.¹ According to this view, the notion that progressive improvement in the human condition is possible is a fairly recent attitude of Western civilization (contemporaneous with the rise of Science, and Newtonian mechanics especially). Belief in Progress has become a cultural faith, but a few hundred years ago the very idea was novel. From this general idea it is possible to formulate more specific statements that may be tested by observations encountered in the course of the Weber Basin investigation. One such proposition has been referred to as a Newtonian or mechanistic faith—a belief that the universe operates like a clock (Georgescu-Roegen might add that the clock never needs winding). Adherents to this faith believe that any problem can be solved by finding out the operational secrets of the clock and then engineering them to serve human purposes. Previous chapters

have shown this attitude to be personified in John Wesley Powell and his ideological heirs, right down to John A. Widtsoe, George Dewey Clyde, E. J. Fjeldsted, and Ellis Armstrong.¹

Another variation on the Idea of Progress is the long-held American faith in economic growth, or increasing individual and aggregate wealth. Closely associated with this has been the concern that growth was retarded, in the West, by the absence of water in the places and times where it is most needed for agriculture. A drought phobia has been proposed by some historians as an explanation for many important phenomena in the history of Western America. Zeal for growth, drought phobia, and faith in mechanistic science combined to produce an attitude epitomized in the title of a book cited several times, The Water Hustlers. This attitude has been proposed as an explanation for the observed behavior of local and regional water development promoters.

A related but separable phenomenon is noted in the text as a partial explanation for the behavior of technical specialists in water supply development, as distinguished from its non-technical supporters. Technical training is necessarily specific, and specificity increases with complexity and difficulty. It is hardly surprising to find that people who have mastered difficult

¹Some readers will recall the amusement engendered among members of the USU economics faculty by Armstrong's simplistic endorsement of this view in his January 1973 speech, "Wake Up, America!" Essentially the same attitude has prevailed in the social science outlook of Resources for the Future.
technical skills wish to use them, and to be compensated for the effort they expended in acquiring mastery. They may be expected to take deliberate efforts to find employment for their specialist skills. (The recent introduction of very liberal unemployment benefits in Canada has encouraged workers with even very easily and quickly acquired skills to refuse work unless it is in their "chosen field.") The more complex and slowly acquired the skill, the more strenuously and ingeniously will its possessors resist change and the suggestion of technological redundance.

The Phenomenon described in the previous paragraph is a transition point from the Idea of Progress, to manifestations and consequences of it. The rule of Science, and faith in the possibility of unlocking the secrets of Nature, has led to enormous progress in technical mastery by Man over his environment, in the last 300 years. One of the consequences, especially in the last century, has been the phenomenon of specialization. Closely interwoven with specialization, as social science writers have noted since Plato at least, is interdependence, and large, complex social organization. The techniques developed by science, as well as the pursuit of new techniques via scientific effort, require greater and greater applications of capital, energy, and technical skill. This has been postulated as a partial explanation for the control over Utah waters that is currently exercised by the Federal Bureau of Reclamation.
Along with technological progress via increasing scientific knowledge, the conception of energy has been developed. Lynn White, Jr., has said that the idea of a power technology to apply natural energy to human purposes first appears in traces from the 13th century. At that time several active minds "were coming to think of the cosmos as a vast reservoir of energies to be tapped and used according to human invention." Since that time, progress has meant, to an important degree, the development of technical mastery over natural energy sources. Material progress is increasing net surplus of controllable energy. As currently understood by physicists the conception of energy is a development of the last century, beginning with Rudolf Clausius' introduction of the idea of entropy and receiving its keystone in Einstein's statement of the potential interchangeability of matter and energy. A new branch of physics, thermodynamics, took its place alongside—or rather in opposition to—Newtonian mechanics. Thermodynamics began as a physics of economic value. Only in recent decades have anthropologists and social and economic historians taken up the idea of technological progress as a process.


2 The Encyclopedia of Philosophy. See the article on "energy."

3 Ibid.

of releasing and controlling a net surplus of natural energy.¹ From this point of view, economic growth, or progress in aggregate economic welfare

¹Technological history is very recent. As late as 1931 Charles A. Beard could say that "technology has received very little attention from historical thinkers." (Introduction to Bury, p. xxi.) White (Preface) said that this was still true in 1962. Wm. H. McNeill, author of The Rise of the West (Chicago, Illinois: University of Chicago Press, 1963), argued in his 1947 Ph.D. dissertation ("The Influence of the Potato on Irish History," Cornell University) that technological and economic influences should be considered as more powerful than political and military plans in interpreting the past, as they underly social, cultural, and political events. This perspective illuminates his book, which, he says, was conceived in 1936 and commenced in 1954 (Preface). Best statements of the idea of energy control as it is used here are Carlo Cipolla, The Economic History of World Population (Baltimore, Maryland: Penguin, 1962), and V. Gordon Childe, Man Makes Himself (Mentor Books; original published in 1936. Also see Childe's Penguin book, What Happened in History). The idea was first given a reasonably clear statement in Malthus's Essay on the Principle of Population. Malthus credited David Hume and Adam Smith for the germ of the idea. Malthus' statement was a major source for Darwin's interpretation of the origin of species, their success and disappearance. (The evolution of special adaptations explains both initial success and eventual failure. V. Gordon Childe demonstrated that man, on the other hand, has been successful because his brain and hands enabled him to be adaptable to many environments, and to gradually accumulate technical mastery over it. Arthur Koestler suggests in The Ghost in the Machine that man's downfall will probably be caused by a defect in the brain which leads us to endow initially rational explanations with a kind of infallibility. This explains misplaced devotion to causes and the resistance to changing cherished ideas about the way things are.) The reason why Malthus was right came out only with Clausius' statement of the Entropy Law, in the same year that Jevons published The Coal Question. (See Georgescu-Roegen, pp. 295-296.) Jevons worried about the implications of reliance on fossil fuel, but understandably did not grasp the Entropy Law. Instead, he founded the mechanistic perspective of standard economics, building on the static analytical perspective of Ricardo rather than the historical one of Malthus. Contemporary with Jevons was the historical school in economics, which began focusing on the kinds of questions that led to the conception of agricultural and industrial evolutions—to the importance of technological development in releasing controllable energy. Biologists and anthropologists have been leaders in emphasizing the importance of energy control to the use of civilization. Alfred Marshall emphasized biological analogies in economics, but his lead seems not
means increasing the net surplus of usable energy, and depends critically on technological development. Ultimately, usable energy is the scarce resource. The economic problem, therefore, includes increasing the usable energy supply, making the existing supply do more work, and distributing the right to power over controllable energy among individuals. \(^1\)

This perspective on technological progress and the idea of energy is exemplified in the history of Western water development (Chapters VIII to X). Along with the discovery by hydrologists that fresh water is abundant all over the continent (if sufficient energy can be applied!), it justifies the hypothesis announced in Chapter I that water is not the economic good in the Weber Basin to have been followed. Instead of the biological model, with its affinity to the physical Entropy Law, economics has tended to be patterned after Newtonian mechanics. Although resisted strenuously by such economic philosophers as Frank Knight and F. A. Hayek, the mechanical analogy has prevailed in standard economics—even in the study of natural resources where the subject matter itself might have been expected to suggest a perspective more like that of Georgescu-Roegen's.

\(^1\) As Georgescu-Roegen takes pains to demonstrate, increasing the supply of usable energy is only possible for a limited period of time; the total supply is finite. John Wesley Powell may have perceived this dimly (his objectives for hydrologic development were limited), but his successors appear to have leaned more to the rosette views of William Gilpin (see references to him in Chapter VIII) and the faith in Newtonian mechanics to make every desert a rose garden. The engineering perspective of the Bureau of Reclamation has consistently been one of rolling back the frontier, of making desert lands into farms just as productive as those of the trans-Mississippi East. Although economists have had sharp differences with Reclamationists over how this should be done, few appear to have disagreed with the fundamental notion that it is possible. The very idea of economic growth implies a denial of scarcity, if carried far enough, and when stabilization policies are premised on maintenance of growth, faith in never-never land is implicit.
case. Water is naturally abundant; what is scarce is energy applied to its control and transportation. Water problems, at least of this kind, may, therefore, be looked upon as identical to transportation problems. Hydrologic efficiency, as the term was introduced in Chapter I, means making water available at places, times, and rates of flow desired, using the least possible expenditure above that represented in the gravitational potential of mountain water.

As noted above, part of the problem of dealing with scarcity is the distribution of scarce things among the members of society. Several chapters of the text explored what appear to have been distributive preferences in United States resource disposal policies, as well as the outcome of distributive decisions as they seem to have obtained in the Weber Basin. Overall, it appears that a strong agrarian, egalitarian sentiment has pervaded Reclamation, and that its promoters have found justifiable the taxation of urban water and hydroelectric users to pay for the high energy cost of reclaimed desert land. This decision has been ratified repeatedly by Congress, in authorizing Reclamation projects and in appropriating resources to build them.

Abstracting the Issues

Two large questions about the WBP remain to be resolved, and the answers depend on the outcome of some issues with far broader application. The first question concerns the series of investment decisions that led to creation of the Weber Basin Project. Was it a bad use of resources, all
things considered? Regardless of the answer, its water controlling facilities are in place. The second question, therefore, concerns improvement of their effectiveness.

Taking the questions in order, it does not seem that a very good case can be made for the wisdom of the investment decision. The Project cost was almost $100 million, in prices of the 1950's and 1960's. Its intended delivery capacity was less than 180,000 a.f. per year (see tables in Chapter V). Calculations presented below indicate that the same amount of water could be developed from underground reservoirs at a cost of $6 million (in 1975 prices). Furthermore, construction of the WBP by an agency of the federal government has effectively taken away control of what the State regards as its own water resources (Chapter VII). Since water management is virtually meaningless without physical water controlling facilities, water management, a State Water Plan, really means management of the control facilities. State water planning is therefore frustrated, even presumptuous, because a heavy proportion of water controlling facilities within the state are federally owned. Thus the urge for technological progress, unwisely directed perhaps, has led to a large element of central direction and a concomitant loss of local and individual autonomy. A third important and unfortunate consequence of the investment decision is that individuals, companies, and municipalities persist in duplicating already redundant water supply facilities. They do this because of the two consequences already cited: well water costs
less than WBP water, and they want to retain local control of their water supply resources.

Central direction of large organizations seems to be an ineluctable consequence of technological development, which is in turn the price of greater efficiency in the use of available energy. Thus a trade-off between technical energy efficiency (economic growth) and individual and local liberty or autonomy is one of the large philosophic issues which is relevant to the Weber Basin case. This particular investment decision does not appear to have been at that level of inevitability, however. It is true that technological development entailed loss of local autonomy, but it is also reasonably clear that the loss was avoidable. Furthermore, the development itself was grossly inefficient. Groundwater development would have been much less expensive in terms of both energy and local autonomy.

Assigning blame for poor public decisions is difficult because they are made almost anonymously by a multitude of persons and impersonal influences. Nevertheless, it does seem reasonable to suggest that the Weber Basin fiasco could have been prevented if people with sufficient influence had been asking the right questions in post-depression Utah. One of the ineluctable consequences of technological development and the age of the technical specialist seems to be that fewer and fewer public decision-makers can stand up against the pressures of special interest groups and assure that the right questions have even been asked in respect of particular decisions. If a majority of hydrologic specialists say we need more water development, what
politician or budget manager is going to say they are wrong? Publicly controlled resources seem to become a larger and larger share of total or national resources, concurrent with technological progress, which means that more and more resources are allocated by bureaucratic technicians and legislative bodies. The Bureau of the Budget may employ specialists in benefit/cost analysis to evaluate and rank proposed projects, but ultimately the decisions are made via the political pork barrel. Thus the urge to "get a fair share" of national spoils has the effect, as in Utah, of tying state and local resources to centralized, federal control.

The second question identified above concerned what can be done, if anything, to improve the effectiveness of existing WBP facilities. The answer to this question obviously depends a good deal on what is wanted from the Project. Just as obviously, it depends on what is physically possible. Any proposals that would entail significant incremental investment cannot be considered as an improvement in resource allocation because there is over-investment in the Basin already. Improvements must therefore be effected through institutional change alone.

On the question of wants, water delivery (at the lowest possible price) is an obvious selection. A satisfactory policy should also discourage further investment in water supply facilities. Strengthening of local and state control over water resources seems to be a widely held objective. Unfortunately, the preference for local self-government conflicts in this case with national interest in recovering at least a part of the national resources that went into
the creation of the WBP. Another national interest that may require consideration is agrarian, economic democracy—the ideal of land endowments to help preserve a semblance of equality in wealth.

The issues of local control and wealth redistribution via land disposal policy could be handled rather summarily: if residents of the Weber Basin, or the State of Utah at large, do not like federal operation of local water works, they might buy the WBP (and any other federally-constructed works) and operate it according to their own preferences.¹ Such an action would make possible the implementation of a state water plan. The issue of agrarian democracy would then be subsumed under policy objectives of the local water plan and could be rethought or totally obliterated with no violence to national objectives. A similar outcome would be possible if the Conservancy District, with backing from the State, repudiated its debt to the Reclamation Fund. Appendix II contains a similar proposal, made when available evidence suggested that the WBP had been imposed on basin residents by the Bureau. It is obviously not an alternative to be entertained seriously.

A Stake take-over would not make an essential difference in the nature of the first two problems identified above. Sunk costs would still have to be paid some way. The following sub-sections demonstrate that the burden of

¹ Suggested by Frank Haws in "A Study of Alternative Methods to Modernize Water Institutions and Eliminate Problems of Multiple Jurisdiction and Conflicting Objectives," a project report of the Utah Water Research Laboratory, Utah State University, Logan, Utah, September 1975.
repayment is the chief barrier to more effective use of the water supply facili-
ties, regardless of who holds the mortgage.

**Allocative efficiency in the WBP**

The economic principle of efficient resource allocation is that every
resource should be employed in functions and quantities so that the value of the
marginal unit (whether as a productive or consumptive good) is the same in
every use. If no scarcity rent is involved, the price of each unit of the
resource should be the cost of providing the marginal unit, because that is the
price that would prevail under the conceptual model of ultimate efficiency--
perfect competition. The literature of public utilities pricing generally
presumes that the allocative optimum will be approached as closely as is
practically possible if the service is provided at a price equal to the cost of
the marginal unit. Consumers will then, in their own interest, use the ser-
vice (if it is not scarce) up to the point where its value to them (for either
consumption or production for resale) is just equal to its cost--the price they
pay.

Principal empirical hypotheses of this study are that neither water
nor the means for its conveyance are scarce in the Weber Basin. This means
that whether we focus on the water or the conveyance works, allocative effi-
ciency requires a price equal to marginal cost.

Although water is free and abundant, storage and conveyance works
may be scarce in specific locations. In arid regions, therefore, water
resources may be defined to include catchment basins in appropriate places, and control and conveyance works to transport water to places where it may be used. Piles of earth and rock, ditches and pipelines, no matter how marvellously constructed, do not constitute water resources unless they are so located that they trap available water and are capable of carrying water to where it may be beneficially applied. Intent and design are therefore critical to the definition of a water resource. They are also critical to its effectiveness, because once in place such a resource is very restricted in application.

The Weber Basin Project, as constructed, is a water resource. From the evidence of Chapters V and VI, no part of it is so fully used that scarcity rents are in order. As a public utility, therefore, the price of its service to each water user should be the cost of providing it to him (preferably the cost of the marginal unit, if such precision were feasible).

The water supply of the WBP is costless. It falls, literally, as the dew from heaven. Owners of the Project pay nothing for this water, to either the state or federal government. Water rights are granted by the state of Utah to individuals or groups able to demonstrate that they can control and put to beneficial use a quantity of water to which no one else has been given the right. Water rights may acquire a marketable value, but it is quite consistent with observable circumstances to interpret that value as pertaining to the relative ease with which the water may be conveyed to the desired location of use. Thus it is the time, location, and rate of flow that are the elements of the
water right that have value, not the water itself. The State Engineer stands ready to grant new water rights at zero price to anyone who can demonstrate that he has the water under control and plans to use it. Getting such a right is far from costless, but the expense lies totally in designing and building the control system. It is that expense, in precisely analogous fashion to Ricardo's marginally productive lands, that endows less costly diversion works with a marketable value—a site rent.

There is a temptation, stemming no doubt from the understandable presumption that water is scarce in the arid region of the U.S. West, to look upon water in reservoirs as a scarce resource which it is somehow wasteful to use for nothing but recreation. Nevertheless, the water in any reservoir is part of an annual supply that has been roughly constant for centuries, even millennia. If it is not used beneficially and consumptively now, it was not previously either. The difference between now and then is the interposition of dams, spillways, canals, etc. The only scarce resources in the reservoir are therefore the energy and materials that went into its construction. Control and conveyance works represent the scarce resources in respect of which concern for effective use is appropriate.

Once control and conveyance works are in place, effective use is simply a matter of keeping them busy. Assuming the storage reservoirs to have sufficient capacity to keep the delivery system full during the peak consumption season, efficient use of water works means keeping the pipes full. The water is free; the works are a sunk cost, and the only additional expense
of keeping them full is operation and maintenance. Therefore the price of water service, assuming excess capacity as in the WBP, should be a proportional share of the operation and maintenance costs incident to the actual delivery of water to a customer. If there is excess capacity at this price, it simply means that the system is larger than it needs to be, given the current uses for water in the delivery area.

The rule for efficient use of the Weber Basin Project is therefore as follows: the price for each unit of water delivered to a customer should approximate as closely as possible the cost actually incurred by delivering the marginal unit to that customer. Actual practice of the WBWCD is to charge "a fair proportionate share" of annual operation and maintenance charges to each customer. This charge is calculated on an acre-foot basis, and is added into the customer's total contract payment. That is, a customer pays a share of O&M based on his contract amount, rather than on the amount of water he actually uses. No effort has been made as part of this investigation to make actual calculations of marginal cost. The practice of charging O&M for water not actually used is a violation of the efficiency rule, however. Efficiency in the use of WBP resources could therefore be improved by efforts to calculate the marginal cost of operation and maintenance, and then charging it only for water actually delivered. Although the expense of making and enforcing such a calculation may be high, it is probable that some net benefit

\[1\] See Pendse.
could be gained, especially because current practice does not restrict the O&M charge to water actually delivered.

The fixed cost problem

The previous section demonstrates that except for the practice of assessing O&M charges on contracted rather than delivered quantities of water, WBWCD pricing policy is not far from the allocative rule. Nevertheless, management of this and other water supply networks had been criticized by several analysts because they charge prohibitive prices, require very long contracts, and consequently inhibit the transfer of water among uses and users. This, say the critics, is inefficient because it does not allow water to be used in accordance with the principle stated at the start of the previous section. From the perspective made possible by the hypotheses proposed and supported in this work, that criticism seems unjustified. It tends to ignore the inescapable fact that shifting water to and fro is impossible without expensive storage and conveyance systems.

The situation does become confusing unless one focuses steadfastly on the fact that the conveyance facilities represent the scarce resource, not the water. It is true that many of the conveyance facilities would not be needed if rainfall were abundant, and if no one wanted delivered water. Thus it is reasonable to argue that the demand for delivery systems is derived from a demand for water. It may also be reasonably asserted that people do not want to wash, they just want clean clothes; they do not necessarily want to
drink, just not to be thirsty; above all, farmers do not enjoy irrigating, but they do like to get a crop. Similarly, people do not necessarily want to cross a bridge, they just want to be on the other side of the chasm. Assuming uncrowded public lands on both sides of the chasm, the state of being on one side or the other is free; building a bridge to exercise the choice is decidedly expensive. Nevertheless, water is more tangible stuff than the state of being free to move about (to people with functional legs living in an open society, at least), and given American experience with the West as described in Chapters VIII and IX, it is hardly surprising that most analysts focus on water as the scarce good, rather than the conveyance system. Excusable or not, failure to distinguish between the free and the scarce resources in water supply systems is a barrier to clear thinking about them. It does not follow necessarily from the fact that water is useful and desirable that it is also scarce, and hence an economic good.

Reclamation engineers and their like-minded friends and associates go only half-way toward recognizing the point of the last paragraph. They know it is the conveyance and storage works that are critical, but they cannot bring themselves to say the words "water is abundant." The pricing structure imposed by the Bureau to get its money back is a tacit recognition of the facts, as we shall see, but Bureau spokesmen are obviously not accustomed to thinking of it that way. Bureau practice clearly distinguishes a repayment assessment from an operations and maintenance charge, but then lumps them both together and refers to the sum explicitly as the price of water.
Discussions with Wayne Winegar of the WBWCD exposed some suggestive terminology used by water professionals. Reference has been made in previous chapters to a large agribusiness firm that rents its substantial water right to its client farmers, on a yearly basis. In a slightly different context, Winegar mentioned that a source of revenue to the WBWCD is wheeling the water of other companies in WBP facilities. It is quite clear that wheeling amounts to the rental of WBP facilities for the transportation of water to which other persons have the right. The fees derived from this are perfectly analogous to a bridge toll or a railway freight or passenger charge. When its facilities are not needed by its own long-term customers, the WBWCD increases its revenues by renting them to someone else. It is quite conceivable that the very water referred to above as being rented by U&I Sugar Company to farmers passes through some WBWCD facilities. On the surface, this usage of rental seems peculiar, for it appears rather that the company is selling water on a short-term basis. (This was given by Winegar as a reason why farmers in the area west of Ogden do not feel a need to sign 60-year contracts with the WBWCD.) The usage is correct, however, for the subject of this transaction is not water per se, but the right to a flow of water at a particular location. It is really kinetic energy in the form of moving water that is the substance of a right. This has been the position of Utah rights adjudicators and the courts up to the Murray City well decision reported in Chapter VII, although the courts as well as the engineers (and latterly economists) have obviously been troubled by an inability to distinguish clearly
between water itself and the power to apply it where desired. The energy of mountain water is constantly renewed in the hydrologic cycle by solar energy. It is not exhausted by using it, and the rental terminology in respect of the sugar company is, therefore, appropriate.

This brings us, at last, to the question of why the WBWCD cannot operate in the same way as U&I Sugar Company. Why does it not "rent" water on a yearly basis instead of requiring 60-year contracts? And even though it does require long-term contracts, why can it not allow contractees to rent their rights to others? Such practices, if permitted, would obviously allow a closer approximation to the allocative rule.

There are at least three parts to the answer. In the first place, the WBP was an enormous expenditure of energy and materials, which was financed out of the Reclamation Fund and must be repaid. Some criticisms of the consequent allocative constraints on efficient use of Utah water resources seem to ignore this fact. A second reason for the long-term contracts is evident from reading the history of Reclamation in the U.S. Beneficiaries have always wanted to avoid paying for project construction, and in several cases they have been successful. The Bureau relies on Congress for its resources, however, and building water works for the benefit of western farmers at the expense of eastern industrial, commercial, and labor interests is not easy to sell. In order to maintain Congressional support,

1 This policy constraint is identified by Pendse, pp. 72-73.
therefore, the Bureau has had to maintain at least an appearance of getting its money back. The Reclamation Fund was built with revenues from the sale of public lands and other public resources, and was intended to be maintained intact by the beneficiaries of reclamation projects. It has not been easy to do, because reclamation farming tends to be energy inefficient compared to rain-watered farming, and because the United States has generally been glutted with agricultural produce throughout its history. The Bureau has had to devise default-proof contracts to maintain its own viability, and as the cost of projects (net energy expenditures) has gone up, the term of the contracts has had to get longer and longer. As noted in earlier chapters, the Bureau has sometimes been able to avoid the worst consequences for water users by paying for most construction costs from the sale of hydroelectric power. For reasons not explored here, that method of repayment was not elected for the WBP, and the Bureau cast the burden on municipal water users instead.

A third reason for holding users strictly to their contracts and not allowing them to rent their rights to neighbors is the abundance of water in the Weber Basin. If the Conservancy District did allow this practice which critics advocate in the name of allocative efficiency, it would jeopardize District chances of selling a long-term contract to the renters. If services of the WBP were truly needed, its managers would not have to worry about losing revenues through interpersonal transfers of water service. Thus a chief cause of the transfer restrictions which critics deplore as allocative inefficiency is the abundance of water supply facilities. This is paradoxical
because efficient allocation is only supposed to be a problem in respect of resources that are scarce.

The enormous fixed cost of water works like the WBP clearly complicates the use of the facilities once constructed. The most ludicrous of these complications is the compound redundance in municipal and industrial water supplies (see details in Chapter II). The patent reason for developing groundwater instead of buying WBWCD contracts has been that such supplies were much less expensive. The reason for the high WCD price is, of course, the necessity of paying the sunk cost of water works. If previous investments had been efficient, there would be no cost incentive now in developing further resources. Thus bad investment decisions in the past are now the cause (aided by ineffective financial institutions) of creating even more redundant facilities.

The Probable Effects of a Marginal Cost Pricing Policy

The previous section detailed a problem, but proposed no solution. The necessity of paying fixed costs is the source of transfer restrictions, price discrimination, and continued redundant investment, all of which constitute violations of efficient allocation principles. This section explores the possibility of improved resource use via pricing changes.

Chapter V identified the kind and location of unused capacity in the WBP system. Since use of none of its facilities is pressing hard on capacity, there is no significant scarcity of either conveyance or storage. As already
suggested, this calls for marginal cost pricing to increase the use of redundant capacity. The following discussion of the probable effects of such a policy assumes that only the currently unused capacity would be offered at marginal cost.

The effects in Ogden Valley would be negligible, since facilities are already used to virtual capacity. Upper valleys of the Weber might use more, although it is by no means certain. More use probably depends on younger and more aggressive farmers—to whom the present price of water is not likely a constraint. In the service area of the Davis and Weber aqueducts the outcome is uncertain. It is unlikely that present prices are a constraint to commercial agriculture. The North Davis and Uinta blocks have probably been unresponsive because they are shifting out of agriculture into suburban use. Current WBWCD prices for individual (Class D) contracts are not likely a serious deterrent to would-be home builders. It is more likely that municipalities would be interested at the low price—especially if the WBWCD also treated the water and delivered it through its own system, also at marginal cost. Furthermore, from the evidence in Chapter V (see Weber River Facilities Used at Virtual Capacity) it may be that winter-time expansion of M&I sales is the only possible expansion of use for these facilities. (The Davis aqueduct may actually be at summer capacity.) Except for winter use, expansion of M&I service is predicated on well development. (Remember that M&I sales were designed to raise money; the price is hardly related to the cost of providing the service.) If there is in fact more M&I capacity, however,
marginal cost pricing would almost certainly use it up, since falling water requires no pumping.

Nevertheless, even if marginal cost pricing could get rid of all excess capacity on the Weber system above Slaterville, it could not move any more than about 20,000 a.f. (see Chapter V), compared to idle storage in Pineview and Willard Reservoirs of 250,000 plus. The major obstacle to moving the Willard and Pineview water is that there is no place for it to go except into Great Salt Lake. Pineview water could be squirted through Ogden City water mains at almost no additional cost to the WBWCD, merely be releasing water into the Ogden River. But Ogden has only one water system, which must carry potable water. This means the city would have to treat the water even if it were delivered free to its treatment plant. That fact, plus the physical constraints of the City system, make the prospects for expansion very slight in comparison to the unused storage. Since there is excess water in the Ogden River anyway, the unused storage in Pineview has to go down the river and Ogden could take as much as it wanted for free whenever the flow was higher than required to serve downstream rights holders. The cost of taking it is obviously higher than the benefit to be gained. As noted in Chapter V, the only other diversions from the Ogden between Pineview and Slaterville send water north and south from the mouth of Ogden Canyon in conveyance systems that are already full.

At Slaterville, water can be diverted to serve lands in the lake plains. If water were priced at marginal cost to irrigation companies in this region (a
very low cost because it is simply a matter of releasing water into the river at Pineview dam, and shifting headgates at Slaterville), it is reasonable to expect them to take some. It would be a strictly marginal increment, however, since no new lands would be served, and most irrigated farms no doubt have close to a full season water supply already. The objective of irrigationists has always been a full water supply, by which they apparently mean application to the point where the marginal physical product of water goes to zero. Judging by the practices described in Chapter VII, it is highly unlikely that many farmers have a very precise notion of the value of the marginal unit of water in terms of saleable product. The purposive, technological instinct in many farmers probably impels them to prefer maximum total product over maximum net revenue, even if they understand the difference. There are several indications that, at least in the past, water has been applied beyond the point of maximum total productivity. These considerations are grounds for believing that not much scope exists for an expansion of water deliveries to irrigation companies in the lake plains region.

Pineview and Willard reservoirs were designed for a major expansion of irrigated farm land via reclamation of waterlogged and salt-impregnated lake plains. It was never intended that existing irrigation companies would take more than a miniscule portion of the water in those reservoirs. The land

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has not been reclaimed; the proposed delivery system to the lands has not been completed. No water can be delivered to such lands, therefore, without a significant additional investment of energy and materials. For reasons that are abundantly clear in Chapter II (Synopsis of the Lake Plains Problem) reclamation farming is not going to become popular in the East Shore under immediately foreseeable economic conditions. And since it cannot without further investment, the question is not even properly considered in the present context of pricing changes to effect better allocation of existing resources.

(The recurring urge to do something with the store of water is a consequence of slipping back into the frame of mind that sees water as the economic good instead of the works that store and transport it.)

The outcome of this thought experiment appears to be that the only significant benefit to be gained by giving away WBP surplus at marginal cost is a reduction in the price of municipal and industrial water (on a limited scale), and a cessation of the ridiculous practice of drilling for even more water. Now let us consider some costs.

In the first place, we did not propose giving away all WBP services at marginal cost; only the currently uncontracted portion. Such an action would inevitably raise howls of protest from holders of long-term repayment contracts. Since the major proportion of their assessment is a fee for repayment of capital costs, they would have a legitimate complaint that they were being forced to subsidize a class of free- loaders who have hitherto steadfastly refused to help pay for the WBP. Thus it is probably a politically impossible
policy. Furthermore, it would put an end to any hope of selling more high-priced repayment contracts, and therefore jeopardize the WBWCD’s ability to meet its obligation to the Reclamation Fund.

The crux of the problem is, of course, the sunken cost of building the WBP. If the investment had been an efficient allocation of resources on strict economic principles, then it would now be possible to sell all the water the Project can deliver, without discrimination, long-term contracts or transfer restrictions, at a price that would cover full costs, including a market rate of interest. The principal reason that such an efficient allocative policy cannot be instituted now is that water and water works are abundant, and it is necessary to clutch paying customers with grim tenacity.

Is A Compromise Solution Possible?

Because of the fixed cost problem, the only hope of achieving a more nearly efficient allocation of existing resources is to find that demand for delivered water is elastic, or at worst, of unitary elasticity. That hope has already been blasted in respect of the redundant storage in Willard and Pineview, because of the high investment requirement in land reclamation. The only other place where significant improvements could be hoped for is in respect of M&I water. As Appendices I and III argued, the elasticity of demand for Weber Basin M&I water depends on the cost of alternative supplies. The main alternative in the East Shore area is well development. Therefore, the cost of well development and operation is the principal determinant in
predicting what kind of revenue changes could be expected from lowering the WBWCD price of M&I water.

The cost of constructing a well is roughly constant, no matter where it is located (speaking of the East Shore area).\(^1\) The procedure is routine. Regardless of the flow desired, the same diameter of hole is drilled (about 1 foot). That allows the most efficient size of well screen to be installed, assuring maximum flow of water to the well regardless of how much pumpage is desired. If full capacity is not required, a smaller well casing and pump can be installed, depending on the rate of flow desired. Drilling and development costs are the same, therefore, regardless of the capacity desired. Differential costs are the well casing and pump. The only other capital expenditure is a pump house. A well lasts as long as its casing—60 to 100 years. The wellscreens are stainless steel and so last indefinitely. Pumps are pulled on an average of every 10 years for an overhaul—a process which currently costs about $5,000.00. With this kind of maintenance a pump will last 40 to 50 years. An excellent well can produce 2,000 g.p.m. at capacity, and a good one 1,500 g.p.m. Actual pumpage from these would be 1,600 and 1,200 g.p.m. respectively, however, because capacity pumpage could draw down the well and force a lower yield for a time. Capacity pumpage also increases the flow of sand and silt into the pump, reducing its life. Pumping

\(^1\) Information on well costs from Hugh Wheelock of Templeton, Linke, and Alsup, Consulting Engineers, Salt Lake City, Utah. Personal communication, September 1975.
costs $15 to $20 per acre foot, depending on the hydraulic head of the well and the pressure desired. Except for hardness elements, no treatment is required for groundwater from deep wells, so that this completes the catalog of costs associated with getting a well-water supply to a city's water mains. (Unless the well is a long way from town!) This is how Wheelock compares the costs of well development over the past 15 years:

<table>
<thead>
<tr>
<th></th>
<th>1960</th>
<th>1965</th>
<th>1972</th>
<th>1975</th>
</tr>
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<tbody>
<tr>
<td>Drilling and development</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Pump</td>
<td></td>
<td></td>
<td>25,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Pump House</td>
<td></td>
<td></td>
<td>15,000</td>
<td>18,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>40,000</td>
<td>45,000</td>
<td>55-60,000</td>
<td>80-90,000</td>
</tr>
</tbody>
</table>

In 1969 Bountiful City's pumping cost was about $10 per acre foot.¹ (Compare to 1975 figures from Wheelock above.) The yield from an excellent well, if pumped constantly, amounts to about 2,580 acre feet per year. If the entire capital cost were paid off in the first year of operation, it would require a charge of only $31.00 per acre foot of water (assuming an $80,000 well). After that, the only cost would be pumping and occasional maintenance. In 1960, of course, when the problem of groundwater competition was just becoming obvious, the charge per acre foot to pay for the well in 1 year was only $15.50. The comparison is so pathetic that there really is not any point in amortizing the cost of well development over 60 years to make a parallel

¹ According to Wayne Carlson, City Engineer. Personal communication.
comparison of annual costs with Weber Basin Water. The only really significant factor is pumping costs, which are rising.

There is a difference in the cost per unit of water depending on the productivity of the well. But the figures above show that it really is an insignificant difference, compared to WBWCD prices, because the whole capital cost can be repaid in 1 year anyway. Pumping costs vary according to the amount of water lifted, not the flow to the well screen. Nevertheless, groundwater conditions do make a difference. As Chapter III explained, aquifers in the western parts of the East Shore are less efficient than those closer to the mountains. The sediments are finer and the waterbearing strata thinner and poorly interconnected. This means that although plenty of water may be present, it is not easy to develop a high-capacity well. Water does not flow to the well casing fast enough even when it is perforated at many levels. Thus, although the cost of wells is the same no matter where they are drilled, the probability of getting one worth pumping varies from place to place. Sometimes a city will try drilling in a different location if a first well is disappointing. Not enough observations are available to make reliable estimates of probability in the questionable parts of the region. They are the sparsely settled areas anyway, and the total significance of their water requirements is quite minor compared to the total. The WCD can reasonably expect to sell their future water requirements, as it already does provide a growing proportion of their current consumption. Its principal customer in this category is Roy City.
Sales prospects for the WBWCD are not as bleak as this suggests, however. It is selling more and more water for industrial purposes, for which it requires only $15 as capital repayment since the water is not treated. Thus, it can compete quite favorably with pumping costs. The fact that the District was recently willing to take on repayment responsibility for 1,000 a.f. of M&I and 1,500 a.f. of irrigation water annually until the full allotment is sold is a reasonable sign that they believe it can be done.¹

The information about well costs helps further to understand what has happened in the Weber Basin. The WBWCD was expected to sell 50,000 a.f. of M&I water and turn over $15 per acre foot per year to the Bureau as repayment for the WBP. At 2,580 a.f. per year per well (see above), the total 50,000 a.f. could be produced by fewer than twenty wells. Even at 1975 prices ($80,000 per well) the total investment to provide this amount of M&I capacity would be only $1.6 million. By contrast, the figures of Table 1 in Chapter VI show that municipal and industrial residents and taxpayers are expected to come up with close to $50 million as their share of the WBP repayment burden (including direct payments, 20 years of overpayments, interest and taxes).

One hundred wells of this kind (or larger), at a total capital cost of $8 million (1975 prices) could produce 258,000 a.f. of water per year. That

is more than the developed capacity of the entire WBP (see Chapter V), which cost $100 million. Of course, it might not be quite that simple. It might be necessary to make some deliberate capital expenditures for spreading water over recharge zones, perhaps involving the removal of some lands from private use. But the issue is probably academic because there is no foreseeable use for that much water. Half that many wells would produce all that is used from the WBP. Nevertheless, wells must be pumped, and the energy cost rises constantly, whereas inflation constantly reduces the real price of the energy supplied by water in WBP mountain reservoirs.

Thus it appears that if there was any wisdom in the decision to build the WBP, it was based on the expectation of inflation. Not only does the relative cost of WBP water go down, but revenues of the Water Conservancy District go up, thanks to its 1-mill levy on the assessed value of all real property in the Basin. ¹ As energy prices get higher, elasticity of demand for M&I water will probably increase because more and more firms and municipalities will find it worthwhile to cease pumping, or at least to buy their incremental requirements from the WBWCD. As that stage develops, it may actually become possible for the WCD to increase its revenues by lowering its price. It is far from certain, however, because there is so much water around in the East Shore area.

¹ For financial details see Chapter VI, and Pendse.
As already noted, increasing population does not necessarily increase the demand for water, because suburban land use is less consumptive of water than agriculture. This means that irrigation companies like the Davis and Weber Counties Canal Company are going to have idle capacity on their hands, which they could sell very cheaply to municipalities and suburban residences. (Their control and delivery facilities are much older than those of the WBP, and the fixed cost in current dollars is consequently much lower.) Frank Haws suggests that the company already has surplus delivery capacity, and wonders what deters its operators from competing directly with the WBWCD for the M&I business in the Canal Company's service area.¹ (Recall from Chapter VI that its service area is the intended victim of the WBP.) Wayne Winegar provided a possible explanation, unintentionally, while trying to make points in the Bureau's favor: "They are good guys," he said, "always wanting to help. They fixed up the Davis-Weber Canal Company's East Canyon Dam (built a brand new concrete-arch dam) and called it a necessary part of the WBP." That is, the Bureau developed 20,000 a.f. of unneeded water at a cost of $3.5 million and charged it to Weber Basin residents. The chief beneficiary is the Davis-Weber Counties Canal Company. If this circumstance is not the full or exact reason for the Company's reluctance to undercut the WBWCD's price for M&I water, it comes close to being sufficient.

²Personal communication, 1975. This would have to be untreated water, of course.
Paying the Fixed Cost

Previous sections (and chapters) have devoted much space to demonstrating that the price discrimination, transfer restrictions and long-term contracts which engineers and economists alike have deplored as hindrances to the efficient use of Utah water resources, are virtually inescapable effects of paying the capital cost of storage and conveyance works. Although water is fluid, water works are very specific to certain locations, and the limits to water distribution are likewise quite restrictive. Once the works are in place, possible allocative decisions with respect to water are narrowly defined. As has been shown, the marginal cost pricing rule is not capable of effecting large allocative changes in the post-investment stage. Because it is surplus energy that is scarce and expensive, rather than water, the important allocative decisions in respect of water supply are virtually all at the investment level. Once the works have been built, the economic resources have already been allocated; water itself has become incidental.

In the post-investment stage, the resource to be allocated is energy potential and pipe space, both of which are essentially constant in quantity and location. The efficiency principles for that situation have been explained, applied, and found to be virtually impotent to correct the frustrating impediments seen by critics of State water management. Planners and critics are frustrated because they have traditionally focused on the wrong part of the water supply problem. Once the relatively minor adjustment toward marginal
cost pricing has been made (see above) further efforts to improve the situation must focus on the fixed cost. Since the investment cost is already sunk, arrangements for repaying it are a purely distributive problem.

Thus the WBP problem, as viewed in the 1970’s, is only an issue of efficient resource allocation in respect of the investment decisions made in the 1940’s and 1950’s. The allocative questions are historical, therefore, and have been treated as such. Issues for the present time are almost entirely distributive, an ethical and political problem of who should pay for the WBP. (Distribution of benefits is not amenable to much debate, because of their fixed and permanent nature.) The relevant economics literature, therefore, concerns the equity problems of taxation and the pricing of high-overhead public utilities.

Two widely applied principles of taxation are that beneficiaries should pay, and that the burden of distribution should take account of ability to pay. Knut Wicksell suggested as a further consideration of justice that whenever possible, persons likely to be taxed should be given the opportunity to submit voluntarily.¹ All of these considerations have been accounted for in distributing the repayment burden for the WBP. The 1-mill levy on all real property in the Basin satisfies the benefits principle probably as well as any tax could, since available water has an obvious beneficial effect on land values. The

repayment assessments (that is the word used by the Bureau of Reclamation), while arbitrary, certainly do discriminate between users and non-users.

Furthermore, they were submitted to voluntarily, because they appear as the price of a long-term contract for delivery of a specific service. In combination with the marginal-cost pricing principle, which is approximated in the separate O&M charge, these levies and assessments amount to a voluntarily accepted two-part tariff,\(^1\) plus an arbitrary tax on beneficiaries who might otherwise escape payment.

This arrangement is hard to fault on principle, although there may be many cogent arguments against the way in which it currently distributes the burden. We have seen that an agrarian democratic bias has no doubt had something to do with its design. It also seems that south Davis County is being subsidized deliberately by Ogden and other cities (not necessarily by conscious, voluntary choice). The evidence examined would also support a conclusion that the Bureau's primary distributive criterion is what-the-traffic-will-bear.

It is conceivable that if the State had complete control of the WBP (and all other works constructed by federal agencies), it could effect several distributive changes that would allow for more efficient allocation of water works. But it could not, barring the highly improbable event of successful

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\(^1\) A standard practice in public utilities' pricing, as explained in E. A. Phelps Brown, and J. Wiseman, *A Course in Applied Economics* (London: Sir Isaac Pitman and Sons, Ltd., 1964), Chapter VI.
theft, avoid the problem of making repayment somehow. The principles of benefits, ability to pay, and voluntarism would no doubt be operative in the State decision on distributive burden, just as they were for the Bureau. Quite possibly, Utah's preference in distributive arrangements could be worked out with the Bureau, so that the Chief benefits of a State takeover might be psychic.

**Recommendations**

The most important step that can be taken toward improving the efficiency of water management in the State of Utah is to increase public knowledge of the current water resource situation. That will be difficult until the fraternity of water specialists itself begins to tell the truth, or face the truth, or even learn the truth. The public record of the Weber Basin Project, as examined for this investigation, is replete with obscurantism from earliest promotion to current operations. It is hard to believe that some of the evasion is not deliberate, but it is abundantly clear that honest self-deception has played a major role in obscuring the facts and the issues.

The goal of re-education must be to get rid of the notion that water is scarce, along with its corollary that more water development is an unqualified benefit. The natural but unfortunate tendency to focus on water seems to get in the way of understanding that the expensive resources in water development are the control and conveyance works. If the necessity of paying for these works, long after their completion, and the problem and details of distributing
the burden were made clear to the public and decision-makers, the economic rationality of future water works investment would have to improve. Very likely, such investment would also diminish.

The necessity of making some distribution of the repayment burden after the fact of investment can hardly be prevented altogether from effecting the allocation of resources, especially if the benefits principle of equity and fairness is to have any part in the decision. In the Weber Basin case, the distributive burden does not appear to conform to most peoples' notion of justice. Economic rationality (as well as political heat) could be served by publicizing the explicit details of how the benefits and burdens are actually spread around. A major portion of the actual burden was incurred by the building of Pineview and Willard dams, neither of which was needed or wanted by the local promoters. It may be that administrative rules or legislative acts forced the Bureau to build these white elephants in order to have sufficient paper benefits to justify building the aqueduct for south Davis County. Or maybe they just wanted to build a dam. Either way, it was a bad allocative decision, and the necessity of paying for it perpetuates and induces even more inefficient allocation of water supply resources in the Weber Basin.

Nevertheless, the WBP is an accomplished fact, and if the State really wanted to prevent further misallocation of resources in water supply, it should have followed the lead of E. J. Fjeldsted when he opposed the first post-project well developments at Clearfield. Certainly it would not have been fair to individuals and groups who can get cheaper water from wells than from the
WBWCD--especially in places like Clearfield and Ogden which pay for more than they get--but it would be more efficient allocation of aggregate resources, nonetheless. Straightforward pricing policies have been unable to rectify the situation precisely because the WBP was such an egregious allocative decision. If the circumstances had been understood more clearly, however, some other means might have been devised to keep the repayment problem from causing even more inefficient investment. All well development should be prohibited in the WBWCD service area until its M&I facilities are fully used. The repayment burden should then be redistributed to accord more closely with actual benefits received. The share of cities like Ogden and Clearfield should be reduced via a general reduction in the price of M&I water. Revenues should then be replenished by higher taxes on suburban irrigators, especially in the Bountiful subconservancy district, and by high user fees for recreational facilities associated with Pineview and Willard Reservoirs.

Changes of this nature are unlikely to be initiated by the Bureau of Reclamation because they would entail admission of unpleasant facts that it has apparently preferred to disguise, ignore, and obfuscate. Forcing the Bureau to acknowledge the distributive and allocative abuses in its operation of the WBP might be difficult, because it would entail an acknowledgement also that many of its Projects are unwise investments. It might, therefore, be more effective to follow Haws' suggestion of having the State of Utah assume all Reclamation indebtedness. State water planners could than rearrange payment burdens to cause the least possible interference with efficient allocation
of existing waterworks. The problem of efficient water management cannot be solved until the facts of heavy fixed cost and repayment distribution are squarely faced.
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APPENDICES
Appendix I: Water Prices, Misallocation of Water Resources and the Public Interest: The Weber Basin Water Conservancy District
WATER PRICES, MISALLOCATION OF WATER RESOURCES AND THE PUBLIC INTEREST: THE WEBER BASIN WATER CONSERVANCY DISTRICT

by

Keith D. Wilde and Allen LeBaron
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WATER PRICES, MISALLOCATION OF WATER RESOURCES,
AND THE PUBLIC INTEREST: THE WEBER BASIN
WATER CONSERVANCY DISTRICT

by

Keith D. Wilde and Allen D. LeBaron*

A general concern over "water shortages" has partially obscured the arguments of a number of economists that more rational pricing policies would temper needs for new facilities. This view holds that water pricing policies and certain transfer restrictions are responsible for misallocation of this scarce resource. A corollary is that concentration on water "needs" has sometimes led to creation of excess supplies. As yet this form of misallocation has not caught the attention of economists to any great degree; yet examples are not unfamiliar. In our region the Weber Basin Water Conservancy District comes most readily to mind.

According to statements found in the District's Seven-Year Summary, the Weber Basin project was initiated in 1949 under the stimulus of "dire need" for domestic water, and with the intent of reclaiming all the waste water in the Weber drainage basin. Anticipated benefits were summed up under the headings of municipal and irrigation water supply, flood control, recreation, water fowl refuge, and expansion of arable irrigated farmland. Construction of dams, reservoirs, tunnels, aqueducts, pumping stations, and drainage of marshlands were undertaken by the Bureau of Reclamation. Work is to be concluded in June of this year with the original objectives

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In 1969, 20 years after initiation, it appears that the project has been seriously overbuilt. The "dire need" for domestic water expressed in pre-project justifications has been replaced by a restiveness on the part of municipalities who wish to get out of their contracts with the WBWCD. Town councils and city managers have discovered it is less expensive to create and operate their own water supplies than to buy from the District. In addition, many thousands of acre feet of water are evaporated and drained from Willard Bay Reservoir each year because landowners in the area do not find it in their interest to have their land drained free of charge by the Bureau of Reclamation on the sole stipulation that they buy irrigation water from the WBWCD.

It is irrational and wasteful of resources to construct depreciating assets such as dams, canals, and tunnels before there is a demand for them as manifested by a willingness of the people to pay for their services. Willard Dam, it now appears, could have been postponed for many years. It traps unwanted water that remains unused except for recreation and as a water fowl sanctuary (neither of which leads to direct reimbursement of project costs). Part of the expense of dams and aqueducts on the Weber River could have been postponed simply by creating a recharge area at the mouth of Weber Canyon and developing the underlying aquifer to its full capacity.

Insufficient information, no doubt, made a significant contribution to project misplanning. An over-optimistic view of the value of agriculture

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1The major exception is the drainage of marshlands and creation of canals in the Willard-Warren area (due to lack of interest).
in the Utah economy seems to have inflated the estimate of water demand in the marshlands of the Willard-Warren District. Had the study of the Weber Delta District by the U.S. Geological Survey been completed by 1950-51 the observed 'need' for domestic water supplies may have been quite different. Results of that survey have since shown that the market area of the WBWCD is underlain by a large aquifer which is capable of a sustained yield of over 60,000 acre feet of good water per year. (The total projected supply of WBWCD domestic water was 52,000 acre feet.) Only 25,000 acre feet are being extracted from the aquifer at the present time. Furthermore, it can be recharged very rapidly from an area at the mouth of Weber Canyon.

However, now that the facilities are in place, the economic problem is one of deciding how to use this publicly-created resource in a way that will either maximize social benefits or minimize losses. The object of our proposed research is to devise alternative pricing policies for the WBWCD that can best meet either of these goals.

Under its present price structure, which was largely imposed by the Bureau of Reclamation, the WBWCD is able neither to pay for the project comfortably nor to meet satisfactorily the demands of would-be customers. The theory of price asserts that profits are maximized (or losses minimized) at the level of output where marginal cost is equal to marginal revenue. The same body of theory defines the optimum for society as the level of output at which price of the product is just equal to the marginal cost of production. I.e., since the costs of impounding the water are mostly
sunk, why not move all the water possible if operating costs are at least covered? These two optima do not coincide except for firms in "perfect competition." Public utilities are monopolies by nature, so we must expect that the pricing policy that maximizes profits (minimizes losses) for the WBWCD will not be the same as the one that maximizes social benefits.

Without further research all that may be said is that the present discriminatory price structure does not maximize social welfare, for the price to all categories of users is higher than marginal cost, according to the breakdown of its costs and prices as published by the WBWCD. And whether the WBWCD comes anywhere near maximizing its returns (minimizing losses) is completely unknown.

An estimate of the marginal revenue function facing the Conservancy District is essential for describing and evaluating the proposed policy manipulations. Determination of marginal revenue requires knowledge of a functional relationship between price and potential water sales. This same knowledge is required before it is possible to ascertain the prices and water sales that would lead to a social optimum. Therefore, a fundamental objective of the proposed research is to develop potential marginal revenue schedules for municipal-industrial and agricultural water use as faced by the WBWCD. Detailed research procedures are spelled out in subsequent sections.

Once such schedules are in hand, it is a straightforward matter to predict the sets of prices which will be necessary to achieve each of the goals postulated earlier. Marginal cost data for each of the products which it sells (irrigation water, untreated municipal and industrial
water, and treated water for domestic and industrial use) are available from the WBWCD. Since the District sells essentially three distinct products, having three distinct marginal cost functions, it is not possible to use the textbook model of the discriminating monopolist who equates a point on his single MC function to the sum of the MR functions facing him in separate markets. But we can equate MC to MR in each of the three markets to find a set of prices and outputs that will maximize revenues. Using the same information the "social optimum" set of prices and outputs may be found by observing the intersections of the demand functions and marginal cost curves in each of the three markets. As present prices are all higher than marginal cost, the "social optimum" implies an increase in sales (assuming a negatively-sloped demand curve). This potential increase may then be compared with the available supply facilities. And finally, the net effect upon revenues of WBWCD may be related to adoption of one or the other water allocation goals.

Since there is at least a possibility that, at lower prices, the present excess supply in the Weber Basin would be considerably diminished, foreknowledge would be of immense value to the Utah Water Resources Committee, which is charged by law to develop and implement a state water plan by 1970. In addition, certain chemical companies are interested in magnesium extraction from the brines of Great Salt Lake. Large quantities of fresh water will be required. The state engineer will be in a better position to rule on permits for new wells vs. conservancy district water if the WBWCD has any effective means to set prices to achieve the desired amount of water movement.
A Utah State University agricultural economist, Dr. B. Delworth Gardner, provided the Utah Water Resources Committee with a philosophical position that might govern development of a master water plan. Other research conducted in the Economic Research Center has been directed towards estimates of the value of water in various uses, but the research proposed herein will be essentially the first attempt to work out a systematic way of helping a complex water supply institution, a conservancy district, better achieve some clearly defined economic goals.

CONCEPTUAL SOLUTION

At some point in time, during the organization of the WBWCD, there existed an aggregate demand for treated water in the Weber Basin. Let this be shown as DD in Figure 1. Existing supplies were equal to ON. Various increments of treated water could be supplied to users at ever-increasing costs, SS. Town councils and city managers, envisioning future shifts in demand (D'D'), recognized that they could obtain an equilibrium of supply from traditional sources only at cost OX. This amount was necessarily greater than the proposed conservancy district price of $42.50 since, in fact, the cities chose to buy amount NM from the district. Thus we say that Point A must lie on some demand curve where the marginal value of the Mth unit of water was $42.50, otherwise more than NM would have been purchased. Since the municipalities do have alternative supply sources, it is almost certain that the WBWCD cannot take D'D' as an indication of demand for its water. This poses a problem: is Point A really on D'D' as shown or is it on some other demand curve, one strictly associated with WBWCD selling possibilities? In fact
it turns out that Point A is on both demand curves simultaneously, i.e.,
they intersect at Point A.

$42.50$ was somewhere near the intersection DD and SS, near enough
that city authorities could not get the amount they wanted for the future
at less than $42.50$. Thus at the time they contracted with the WBWCD
their alternative new sources constituted a schedule over and above their
existing stock (represented by Vertical Line RN). We know that at $42.50$
they bought all the difference in demand, D'D' less DD, from WBWCD (NM).
On the other hand, if the District had charged any price higher than OX,
the city authorities would have relied upon their alternative sources
completely. Thus we obtain the flatter derived demand for WBWCD water
(dw) that the district faced when it first entered the water market. The
intersection of D'D' and dw at Point A is now apparent.
We can use analogous reasoning to evaluate their situation at the present time (Figure 2). Demand (total) has increased over time and the new function may be represented as D"D". But costs of creating new additional facilities have fallen (new and better drilling and pumping, higher water table, more geological information, etc.). The municipalities continue to make use of some existing stock of water provided by their own facilities. Their supply of new sources is a schedule of increasing costs per acre foot rising from a point on the vertical line representing their stock. (This will actually be somewhat greater than ON since some wells have been drilled in the interim.) NM (WBWCD water) is the same as before but ON is larger. RN represents municipalities' existing stocks. S'S' represents their new supply capacities. Intersection of S'S' and D"D" gives an equilibrium price of \( P_1 \) if we ignore the WBWCD water. The municipalities will not be willing to pay a higher price than \( P_1 \) because they can satisfy their total demand at that price by producing their own
water. But, they will be willing to buy all their requirements at a price as low as \( P_2 \) since it is below the cost of producing their own. So the derived demand curve, \( d'_w \), under present circumstances is given by subtracting the \( S'S' \) from \( D''D'' \) between \( P_1 \) and \( P_2 \).

The relevant demand curve that we desire for purposes of predicting WBWCD sales is the kinked function represented by \( d''w'' \). The elasticity of this function plus those for other uses, when combined with cost data from the WBWCD, comprise all that is needed to predict the prices that will maximize profits (\( MC = MR \)). The demand curves for various uses, \( d''w'' \), when combined with cost data, set the social optimum output where \( P = MC \).

**Initial Conditions**

The initial conditions fall under two headings:

1. **Model parameters.** Location of functions requires a number of observations on current and historical costs faced by municipalities in attempts to supply their customers with water. These data will provide a basis for estimating the locations, slopes, and elasticities of the total demand and alternative supply functions in the model.

2. **Institutions.** Other initial conditions, such as the cost structure of the conservancy district, the amount of its potential water supply, and its installed facilities, are taken as given and appropriate allowances made for their effects.

**Predictions**

The combination of the estimated model and initial conditions provide the means whereby the necessary prices to achieve postulated goals
can be predicted. The test of the overall hypothesis requires that the specified prices be offered; either the predicted amount of WBWCD water is taken off the market or it is not. The results cannot be exact in such work, so it is difficult to say just how much error would constitute a refutation.

The predictive model requires the locations and elasticities of the total demand curve and supply curve of alternative sources that are taken as initial conditions. A reasonable method for ascertaining the alternative supply curve comes to mind readily enough, but the demand curve is less tractable. As in previous sections the case of treated municipal water will be used to illustrate.

(1) The supply curve of alternative sources: Data for this function come from cost estimates of providing a new source of given capacity. Several municipalities have constructed new facilities in recent months, and nearly all have examined the prospects. Regardless of the exactness of such estimates, they represent Weber Basin water users' understanding of the cost situation they face with respect to new sources of supply. These estimates are those which city authorities use to compare with the cost of WBWCD water.

Once the data on costs for given quantities are in hand, they may be ranked by price level and the quantities in each rank summed. At a low price (or cost) per acre foot the total of expected potential supply in the region will be less than if a higher per-unit cost is allowed. At a price significantly above $42.50, say $100 per AF, a great deal of water could be provided from sources other than the Conservancy District, and there is some price below which no town can produce a supply of its
own. It is clear that this procedure will produce an upward-sloping curve that may be reasonably labeled a "supply function."

(2) A satisfying conception of the total demand function is more obscure. Several alternative procedures have been rejected in favor of the following: From municipal water authorities we will obtain a weighted average of the price paid for the average amount of treated water purchased per customer. Repetition of this in each town will produce a scatter (more likely a cluster) of points to which a species of cross-section demand curve may be fitted. If the resulting "curve" is then multiplied by the number of customers in the region, the result should be an approximation of total demand for treated water in the Weber Basin.

Several qualifications and refinements may help to improve this result. Other studies have shown that indoor use of water is virtually constant in all seasons, thus allowing isolation of demand for water used in lawn and garden irrigation.\(^1\) Indications are that these two uses of treated water have different price elasticities. The procedure described above can be applied in both cases to get two aggregate demand curves whose sum may be taken as the total demand for treated water. If the scatter of points is so clustered as to throw doubt on the shape of the line fitted to it, elasticities reported from other studies may be used for comparison and perhaps even borrowed. One such study was conducted here in Northern Utah\(^2\), and its results should be most relevant to our

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area of study. Unfortunately the elasticities reported in the various studies range from zero to -1.0. The value of our study will obviously be enhanced if sufficient spread can be obtained in the data to produce a convincing slope coefficient. The presence of two kinds of demand for treated water, with presumably higher elasticity in the case of sprinkling demand, should prove helpful.
Intelligent choice among price-policy alternatives is impossible without an understanding of demand elasticity in the pertinent market. Reference has been made to evidence suggesting that WBWCD prices for municipal water are too high. The requirement of repaying fixed costs constrains the water authority from lowering its price in fear that total revenue will be reduced. Such an eventuality would be intolerable, as the Conservancy District is just barely able to meet its obligations to the Bureau of Reclamation under the present pricing policy. However, if it can be shown that the demand curve facing the WBWCD is elastic, both the Conservancy District and the Municipalities it serves can benefit from lower prices.

A priori considerations and the few water demand studies extant indicate an inelastic demand for water (especially treated domestic water). Because it is not the sole source of supply, however, it is not unrealistic to hypothesize that the derived demand facing the WBWCD is elastic. In figures 1 and 2 above the derived demand, \( D_w \), is defined as the difference between total demand, \( D_T \), and alternative supplies, \( S_A \), of potential WCD customers:

\[
D_w = D_T - S_A
\]

As all components of this equation are functions of the price of water, it may be differentiated with respect to price, \( P \):

\[
\frac{dD_w}{dP} = \frac{dD_T}{dP} - \frac{dS_A}{dP}
\]
multiplying both sides by \( \frac{P}{D_w} \),

\[
\frac{P}{D_w} \cdot \frac{dD_w}{dP} = \frac{P}{D_w} \cdot \frac{dD_T}{dP} \cdot \frac{P}{D_w} \cdot \frac{dS_A}{dP} \cdot \frac{D_w}{P}.
\]

The term on the left-hand side is equivalent to the relative change in quantity over relative change in price, \( \frac{dD_w}{D_w} \div \frac{dP}{P} \), or price elasticity of derived demand, \( \gamma_{D_w} \).

Now if the right-hand terms are multiplied by unity:

\[
\gamma_{D_w} = \frac{D_T}{D_w} \cdot \frac{P}{D_w} \cdot \frac{dD_T}{dP} - \frac{S_A}{P} \cdot \frac{dS_A}{dP} \]

\[
= \frac{D_T}{D_w} \cdot \frac{P}{D_T} \cdot \frac{dD_T}{dP} - \frac{S_A}{D_w} \cdot \frac{dS_A}{dP} \]

\[
= \frac{D_T}{D_w} \cdot \frac{dD_T}{dP} \cdot \frac{P}{S_A} \cdot \frac{dS_A}{dP} \cdot \frac{P}{dP}
\]

or \( \gamma_{D_w} = \frac{D_T}{D_w} \cdot \frac{dD_T}{dP} - \frac{S_A}{S_A} \cdot \frac{dS_A}{dP} \) and \( \gamma_{D_T} = \gamma_{S_A} \) are the elasticities of total demand and alternative supply, respectively.

This result requires that if \( \gamma_{D_T} \) and \( \gamma_{S_A} \) have the usual signs (+ and - respectively), \( \gamma_{D_w} \) must be more elastic (more negative) than \( \gamma_{D_T} \), no matter what the other magnitudes may be. The value of \( \frac{D_T}{D_w} \) is greater than one for all prices higher than the one at which \( D_T \) and \( D_w \) become coincident (P₂ in Figure 2), and the higher the price, the greater is \( \frac{D_T}{D_w} \). If Figure 2 is a realistic representation of the present situation, the current price is high and \( \frac{D_T}{D_w} \) is at its maximum value. \( \frac{S_A}{D_w} \) varies from a figure equal to \( \frac{D_T}{D_w} \) (at P₁) to less than one as price gets closer to P₂.

At the present time, \( \frac{D_T}{D_w} = \frac{S_A}{D_w} > 1 \), according to the model implied by Figure 2.
Investigations conducted to this date permit only very tentative assignment of numerical magnitudes, but the attempt may give some indication of what to expect. The WBWCD has contracted to sell 26,000 acre feet of treated municipal water. As they must pay for their contracted amount, municipalities use all of their WCD water before tapping their own supplies. Ogden City has contracted to buy 8,500 acre feet, or 1/3 of this amount. It can deliver 25,000 acre feet more from its own sources, but rarely requires this much. In recent years it has supplied about 16,000 acre feet from its own sources, for a total consumption of 24,500 acre feet. Other communities in the region have generally less than proportional supply capacities compared to Ogden. On the purely arbitrary assumption that they get 3/4 of their domestic supply from WBWCD (17,500 acre feet), their total consumption is 17,500 \( \cdot \frac{4}{3} \) = 23,333 acre feet. With its current price structure, therefore, the WCD sells a total of 26,000 acre feet, and its customers supply themselves an additional 21,833 acre feet for a total water consumption of 47,833 acre feet, or \( \frac{D_T}{D_W} = \frac{47,833}{26,000} = 1.8 \), and \( \frac{S_A}{D_W} = \frac{D_T}{D_W} \). Consequently:

\[
\gamma_D \approx \frac{1.8}{D_W} = 1.8 \gamma_D \approx 1.8 \gamma_D T - 1.8 \approx S_A
\]

Results of other demand studies suggest an \( \gamma_D T \) of between -0.5 and -0.7. \( \approx S_A \) will vary from one community to another, depending on their proximity to a good source of supply. It could vary from almost zero to well over one. If it is given a conservative estimate of 0.4 and one of -0.5, the calculated value of \( \gamma_D \) is:

\[
1.8 (-0.5) - 1.8 (0.4) = -0.9 - 0.72 = -1.62
\]
These preliminary and tentative calculations suggest that our research may well lead to a prediction that the WBWCD could reduce its present price for treated water without suffering a decrement in revenue.
Appendix II: Historical Notes on the Weber Basin Project, Suggesting Possible Origins for Allocative Inefficiencies
HISTORICAL NOTES ON THE WEBER BASIN PROJECT,
SUGGESTING POSSIBLE ORIGINS FOR ALLOCATIVE INEFFICIENCIES

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Economic Research Center Study Papers are produced in mimeographed form to facilitate discussion of ideas and interests found within membership of the Center. Opinions are the sole responsibility of the authors and must not be construed to reflect in any way an official position of the Center or of Utah State University.
Beginning in 1952, the Bureau of Reclamation (United States Department of the Interior) spent sixteen years constructing a large system of dams, reservoirs, aqueducts, power plants and pumping stations on the Weber River and its tributaries (Weber Basin Project, Utah). With cooperation of business and civic leaders in Davis and Weber counties the Bureau created a local organization that had to shoulder the responsibility for reimbursing the U. S. Treasury for construction costs. This institution, the Weber Basin Water Conservancy District (WBWCD), is an official arm of the State of Utah, and can raise the necessary money by selling reclaimed water and by taxing water users and landowners. Water sales were expected to be brisk and few worried about taxing power (which, in any event are limited by state law). Expectations have not been realized and the Conservancy District's financial position is very tight.

Under its current price structure, dictated by the Bureau of Reclamation, the WBWCD is unable to meet price competition from local culinary water supply sources. Furthermore, irrigation demand has not met 1950 expectations. Consequently, facilities of the Weber Basin Project (WBP) are used well below capacity and municipalities are simultaneously investing in new sources of supply. This waste is expensive to Weber Basin residents. If the WBWCD is forced to default on its scheduled payments, a 1939 amendment to the Reclamation act will allow their contract to be re-written for a longer repayment period.
The original period was sixty years, with no interest, and that was twenty years longer than authorized by reclamation law at that time. If it is extended further, with no interest, the waste of resources will spread beyond the Basin to affect the state and nation.

At least two problems for economic analysis are suggested by this inefficient allocation of resources: (1) How may further waste on the WBP by prevented? (2) What can be learned from the WBP to guard against poor planning on similar projects in the future?

A conceptual solution to the first problem is quite simple: reduce the Conservancy District price to a level necessary to prevent any further duplication of facilities. The empirical problems involved seem to be manageable, but there are some policy alternatives that must be weighed. Total revenue would vary according as the district discriminates or sets a common price for all users. Unless demand turns out to be elastic, the drastic fall in price required to meet competition would cause a significant drop in revenue. This reduction could be minimized by discrimination, since alternative supplies vary in cost from town to town. If revenue is reduced, more or higher taxes will be necessary to meet the repayment obligation - unless the excess of costs over revenue is to be absorbed by the federal government, which has already paid for the project.

The issue of taxes reveals that the innocent-sounding solution to problem (1) really involves the whole set of allocation, welfare, and financial dilemmas that plague public sector economics: Should Weber Basin tax-payers be forced to pay the whole cost of the WBP? Are the
benefits they receive greater than or equal to the costs they must pay, or do non-residents reap a substantial portion of benefits? If so, how far should the repayment obligation be extended? to the state, the region, or the nation? Are total benefits as great as costs? If not, should some group of people be required to pay the costs all over again (the federal government paid initially), or should the excess of costs over benefits be written off like a bad debt? What are the total benefits anyway? How do you calculate the recreation benefits, the insurance-against-drought benefits, the value of new industry attracted by availability of water, and the population-attracting influence? Is some income redistribution toward Weber Basin residents a desirable national objective? If a regional group makes a bad investment, should they be allowed to spread the burden to those innocent of the mistake? Who made the mistake anyway? Should they be liable for special assessments?

The question of mistake leads directly to the second general problem. Why does this undesirable situation exist, and what can be done to prevent its repetition in other places? Answers to these questions can only be found through historical study of the institutions involved. Utah groundwater laws had an influence on the decision to build the Weber Basin Project, and on its subsequent difficulties. Inadequate study of alternatives led local chambers of commerce to favor the WBP. Part of the inadequacy may be attributed to state laws which had retarded measurement of Utah's groundwater resources. The nature and disposition of government bureaus must carry a large share of blame for resource waste in the Weber Basin. Preliminary investigations
indicate that significant improvements could be made in the planning of large, integrated water developments such as the WBP.

A. The Weber Basin Water Conservancy District is a smokescreen to hide bureaucratic expansionism.

In the popular ideal, a federal agency such as the Bureau of Reclamation is a service like a water pressure system, ready to deliver at the turn of a faucet, and just as convenient to shut off. Just as water pressure involves costs, even when the tap is turned off, non-free Bureau of Reclamation research projects provide a pressure potential for immediate action when the government tap is turned for an extreme local need, income redistribution, or compensatory fiscal policy.

The Bureau's existence may be justified therefore, even when it is not engaged in construction of reclamation facilities. The great weakness of this analogy is that whereas the pressure behind a tap is from water, the pressure in a government service agency is from people. Unlike the water behind a faucet, a government agency has ways of reaching around to turn the tap and let itself out, and it is inordinately difficult to turn off.

It is more accurate to view the Bureau as a gigantic construction firm, bidding aggressively for a contract. In its case, however, the contractor is the only bidder, and in addition is

1. The principal sources for this history were files loaned by E. J. Fjeldsted, a prime mover in local water development. He served as secretary-manager of the WBWCD until 1965, and was simultaneously manager of the Ogden Chamber of Commerce from 1929.
trying to sell its intended customer (Congress) a construction project generated in the mind of the contractor instead of the customer's.

The ideal has it that Congress innovates and agencies are its passive servants; in reality it is often the other way round. Government agencies have a built-in ratchet effect. Universal abhorrence of unemployment gives them a cushion against constricting their level of operation. The natural instinct of people, and managers especially, for expanding their own importance and influence provides an upward impetus. If a manager's imagination is limited, the easiest way to puff his own importance is to get more people doing more of the same thing that is already familiar from the manager's experience.

In 1958 a "Seven Year Summary of the Weber Basin Water Conservancy District" ascribed initiative for the Weber Basin Project to local civic leaders. The "Summary" states baldly that "dire need" for domestic water "started the ball rolling" on the Project, and that the Davis-Weber Counties Municipal Water Development Association (D-WCMWDA) was formed in 1945 and 1946 to cope with an urgent culinary water shortage. "They were forced to act immediately," goes the report, and through their organization consisting of municipal officials raised enough money by a fractional mill levy "to make a full engineering and factual study of water requirements in the area." (This impressive-sounding project was conducted and written by engineer Win Templeton over a period of less than six
months and will be analyzed in another place.)

Armed with this data and with the support of all water groups, they requested the Bureau of Reclamation in 1946 to make a comprehensive study of the water resources of the Weber Basin. The study was completed early in 1949, and a report prepared outlining and recommending a comprehensive reclamation project in the Weber Basin. (My italics)

It is clear that this publication of "historical" details conforms to the "spigot" image that people expect and which a government bureau tries to project. But, it is a story involving chronological inversion of some key facts.

It is partially true that the Bureau of Reclamation began an investigation of the Weber Basin in 1946, but it is not true that they were there at the request of the D-WCMWDA. They had been "investigating" the Weber Basin since 1904. The current spate of "investigations" had begun in 1942, were discontinued during the war years and resumed in 1946. A bureau report in January, 1946, entitled The Bonneville Basin, "outlined potential projects, including the Weber Basin Project, that may be coordinated into a comprehensive plan for...beneficial (water) use...in the Bonneville Basin. It must have been quite a feat for the D-WCMWDA to have initiated the whole thing 1946 when the Bureau had already made a report on the project in January of that very year! The story that the D-WCMWDA "started the ball rolling" is demolished completely by the fact

that the D-WCMWDA was organized on April 8, 1948. Isolated municipal officials may have been concerned about their culinary supplies as early as 1946, but they were working individually. (In late late 1947 Win Templeton had been studying Ogden's water situation for 1 year). The Weber Basin Project was a living thing inside the Bureau of Reclamation before the D-WCMWDA was even conceived.

Late in 1947 one man (Joseph Johnson of Davis County Water Users Association) suddenly perceived that the Weber Basin Project would appropriate all the surplus (flood) water of the Weber River System into an irrigation supply, leaving none for municipal purposes. (How the idea came into his mind is not known as yet, but some are noted later). From this genesis in the mind of one man the Davis-Weber Counties Municipal Water Development Association came into being within a period of five months. It was founded on the firm belief that the Weber Basin Project was a "sure thing" and that municipalities must get their fair share now or be thirsty ever after. Civic leaders appear to have been in a virtual panic that the Project would deprive them of something to which they had a sort of "natural right" unless they arranged at the outset to protect "their share." Instead of a "dire" or "urgent" need for immediate increments of culinary water, minutes and correspondence of the D-WCMWDA reveal that every town could report at least a "potential" need for more water.

After assuring each other that every town would need more water soon, if not a present, civic leaders from Davis and Weber Counties
agreed at a meeting in December, 1947 to ask the Bureau of Reclamation to include a culinary supply with the on-going irrigation project. They approached Bureau officers and asked for a study of their culinary requirements and resources. They were told they would have to conduct their own study, and in a hurry, since the Bureau planned to submit its own proposal to Washington in a few months, and expected prompt approval. The regional Office of the Bureau was already fully extended and had no funds for the desired municipal investigation. In fact, they had already arranged to borrow money from the Davis County Water Users Association to finance part of their pre-existing Weber Basin study. Subsequently they did borrow several thousand dollars from the new D-WCMWDA to pay for geological tests at proposed dam sites.

The Bureau was by no means cold toward the proposed municipal water development; they fostered it in every way they could. In fact they rushed it, as suggested above, by making assurances that the WBP would be passed into law, and feeding the fear of local advocates that it might be passed without the culinary features if the proper study was not completed in time. It is certain that the civic leaders had a hat-in-hand attitude toward the Bureau. They were concerned that the Bureau would not be interested in their needs, since agriculture was the "top item on the Reclamation program."

It was at the suggestion of Bureau officials that they formed themselves into the D-WCMWDA and persuaded their respective municipal and county governments to give them the proceeds of a small mill levy to finance the engineering study recommended by E. O. Larsen, Regional Director of the Bureau. Their consulting engineer, Win Templeton, warned that their report must have "sales appeal" to be sure of acceptance by the Bureau. (He made this remark as justification for the magnitude of the bid he submitted for the job). Minutes and correspondence of the Association reflect a constant feeling that the Bureau's project was virtually certain to come off, and that the Association report had better be fast and effective if the boon of municipal water was to be granted by the Bureau.

It is difficult to assess motives in these initiatory proceedings. But good intentions are not enough to assure efficient allocation of resources, and neither is an engineering study of the kind conducted by Win Templeton. Fjeldsted's interests in water development may conceivably have been so strong, and his involvement so intense that he saw himself and his organization as having a proprietary and initiatory role in the Weber Basin Project. It certainly could not have become a fact without them.

The Bureau of Reclamation had every reason to encourage the D-WCMWDA and its quivering-suitor attitude. Bureau officials must have known that they had a long way to go to get approval for an irrigation project of the magnitude of the WBP, and that passage was not imminent. It would be unfair to their professional
competence to suggest they didn't know they had to have something like a municipal project in order to have even a prayer for passage. But, they were in a bind for grass-roots political support for the project. It is true they borrowed a few thousand dollars for seismic studies, and got the Association to conduct and pay for their own culinary study; but very little reference to Templeton's study appears in their project proposals and reports, and Templeton in fact used data the Bureau had already collected in making his report!

The only real need for the local study was to arouse local enthusiasm for the Project and to give evidence of that enthusiasm to Bureau officials in Washington, to Congress, and to the President. Without local support for the proposal to push it through Congress, and a local organization to pay for the Project once constructed there wasn't a chance for it to become a reality.

The D-WCMWDA started with the modest ambition of getting 40,000 acre feet of municipal water from a 300,000 acre foot irrigation development which members thought was already assured. They wound up bearing responsibility for having pushed a huge and questionable reclamation project through Congress and with the burden of paying for the whole of it. For all of this trouble and pain their reward was a covered ditch instead of the open one planned by the Bureau! The Weber and Davis aqueducts were originally planned (said Bureau spokesman) as open canals. When culinary water was added, the plan was changed to call for pipelines. Except for some additional expense for winter operation, this
is the only material change in the Weber Basin Project that can definitely be attributed to inclusion of culinary water. The WBWCD was forced to issue bonds in its own name to pay for constructing treatment and delivery facilities. A portion (about 1/3) of the price charged municipalities by the WBWCD (about $42.50 per acre foot) for culinary water goes toward payment of interest and principal on those bonds. Many towns can create their own culinary supplies from groundwater reservoirs for less than $15.00 per acre foot. Thus, even economies of large scale cannot overcome the cost advantage of ground over surface water in the Weber Basin.

It may not be a great exaggeration to say that culinary water users in the Weber Basin have been trapped into paying for a huge white elephant subsidy to farmers, and gotten nothing but an inefficient culinary supply in return. Not only do they pay an excessive price for expenses that are definitely assignable to culinary water, but they also pay an enormous sum toward repaying government costs for building an egregiously under-used irrigation project. To put it still another way, they pay an excessive price for benefits received, and an even larger price for benefits not received. The intended beneficiaries of this largess are farmers, but they don't appear to be interested in more than a fraction of the irrigation supplement.
A copy of the original WBP plans was submitted by the Salt Lake Regional Office to the Washington head office in early 1949. The original plans should make it possible to determine exactly what extra costs were incurred by the Bureau in adding a culinary supply to their project. There are reasons to suspect the added features did not come as a shock to Bureau planners. It has already been suggested that they urgently required the sponsorship of a local organization if they were to get approval for construction. The next section will present reasons for believing that Bureau planners know that without culinary features the Project could in no way produce a benefit-cost ratio greater than unity. Surely it was clear to them that even if irrigation benefits were large, agriculture alone couldn't afford to pay for the Project. The creation of a municipal water users association solved all of these problems.

There does seem to have been some degree of local concern about water supplies in the Basin generally. Some towns had had to resort to rationing in summer months. But, whatever the source of their idea of "need" it didn't have the kind of consequences they expected. Once expressed, it was virtually taken over by the Bureau of Reclamation and used to the Bureau's purposes.

Accusing the Bureau of Reclamation for being pushy does not absolve local leaders and residents from all responsibility for the existing problem. Members of the Association were probably not as
careful as they might have been in examining the true status of their water situation. The engineering study by Templeton may be read to sound like the WBP was essential for municipalities. For example, it did not consider either alternative sources of supply or examine the merchandising techniques used by the various municipalities. A little attention to pricing policy could have made the rationing problem disappear. They were bent on getting a share of the big Project, and didn't want to think about anything that might detract from its virtues.

This attitude toward anything that looks like a booster for the local economy was shared by officials at other levels. Ed Watson, State Engineer, at one of the early meetings, in December, 1947, is reported to have urged those present to pursue their culinary interest in the Weber Basin Project with all haste. "If Utah doesn't develop these waters, someone else will get them. We must hurry to get them before they do."

Bureau and Association officials pushed ahead vigorously through 1948 and early 1949 until the Weber Basin Project, Utah, was signed into law, with a provisional veto, by President Truman. Suddenly the "urgent" need that had fired all their proceedings to

5. This same argument is being made today by the Bureau of Reclamation for pushing ahead with the Central Utah Project. "If Utah doesn't take her share of the Colorado River, California will get it." There may be a degree of plausibility in the case of the Colorado, but it certainly seems absurd to invoke such an argument in the case of the Weber or Provo Rivers which rise and sink entirely within the State of Utah.
that date seemed to subside. The Bureau had money to do research. It took three more years to make its final plans. No one is reported to have died from thirst between 1949 and 1956 when the first phase facilities went into operation. It should have been time enough for the local folk to do some reconsidering about the marriage they were contemplating; but love it blind. In December of 1952, the month construction began, the Weber Basin Water Conservancy District, child of the D-WCMWDA, signed a contract that committed municipalities to bear most of the repayment burden of an agricultural reclamation project. Only 1% (one percent) of the eligible voters cast ballots for or against this $80 million obligation.

Possibly the basin municipalities deserved what they got. Local officials allowed themselves to be overcome by a water scarcity hysteria. Bureau officials just may have sparked it; they certainly fanned the flames. The D-WCMWDA didn't look carefully enough at alternatives to the WBP--mainly ground water. The Bureau apparently ignored most of the evidence Templeton's report did turn up about ground water sources. Local leaders were not motivated so much by efficient allocation of their resources as they were by the prospects of the growth expected from a large construction project. (In the long run, perhaps their instincts were good). They leaned on the Bureau for guidance; local bureaucrats led them by the nose. Every step in the evolution of the Weber Basin Water Conservancy District was dictated by the Bureau of Reclamation. Bureau officials said a report of municipal water needs would have to be done
independently; civic leaders scraped up the money and made the study. Bureau officials said local people would have to apply political pressure in order to circumvent the normal scrutineers and get the project passed by the House and Senate. Pressure was applied. Pressure was required again to get the President's signature. Again it was applied. President Truman signed reluctantly—there were serious reservations about the economic feasibility of the projects. "This bill really has an interesting history," wired Congresswoman Reva Beck Bosone after Truman had signed.

While waiting for the President's signature, the D-WCMWDA was busy forming itself into the WBWCD—with Bureau officials leading all the way. Every time the Association did something on its own, a Bureau spokesman showed up to recommend a change. If the change was not made exactly as outlined, the Bureau man was back at the next meeting. The local men were anxious to please. The attitude of supplication appears to have prevailed through it all. The Bureau had its way on the kind of organization, the name of the District, its political boundaries, and its political structure—usually against the original decision of a majority of the local leaders.6

With this evidence of Bureau of Reclamation domination of the WBWCD, it is hard to suppress a suspicion that the reversal of facts in the "Seven Year Summary" was dictated, perhaps even written

6. I do not mean to suggest that Bureau suggestions were not superior—only that they were the guiding hand, not the obedient servant.
by the Bureau. Or perhaps it didn't need to be at that date (1958), by that time it may have been more damaging to the image of the WBWCD to admit error than to adopt an attitude of misunderstood saviors beset by ungrateful municipalities.

This is not to say that there are no positive elements in the Weber Basin Project, or even that benefits do not exceed costs. But most benefits are of the "intangible" variety that have so far proved nearly impossible to measure with confidence.

The history of the WBP should be written as a revelation of what can happen with inadequate economic study of reclamation projects, and as a case study for future projects. Its lessons should certainly be applied to the Central Utah Project. As I understand it, one of the chief arguments of the Bureau for going ahead now with CUP is that if it is postponed Southern California will get accustomed to using Utah's share of the Colorado River and will then block appropriation of funds for construction when the time comes that Utah needs its water! That amounts to an admission that the project is not needed yet. Regardless of the size of California's House delegation compared to Utah's, surely there are other states who could be induced to vote for fair play for Utah. California doesn't control the Appropriations Committee.

B. The Bureau of Reclamation pushed ahead with the Weber Basin Project in spite of ample warnings that it was economically unsound as planned.

The previous section demonstrated that to members of the D-WCMWDA the culinary water supply they wanted was merely an appendage to an
irrigation project that was "sure" to become a fact, with or without facilities for municipal water. There are clear suggestions in the Fjeldsted files that Bureau of Reclamation planners were primarily concerned with irrigation until 1947. (Talk of changing the project, agriculture a "top item" to the Bureau of Reclamation, etc.) At least they gave that impression to the civic leaders who formed the D-WCMWDA. The Bureau did urge the D-WCMWDA to make the Templeton report ("Davis-Weber Counties Water Development," Feb., 1949) and send it along with the Regional Office's Interim Report to the Bureau's head office in Washington. Why the Bureau urged this study is not absolutely clear. They had already made similar investigations, for Templeton used their results in his own report. And in the Report of the Regional Director of July 15, 1949, that became Senate Document 147, it is admitted that Templeton's study produced results essentially the same as investigations conducted by the Bureau. Were local Bureau leaders grasping for some sign of local support for their project?

7. Page 59 The first Bureau reported to Washington was about March, 1949. It is generally referred to as the Bureau's "Interim Report". The Templeton study was submitted by the D-WCMWDA as a "supplement" to it. After perusal by Bureau chiefs in Washington the Interim Report was sent back to Salt Lake City and the Regional Director prepared the Report dated July 15, 1949 that was the basis for legislation authorizing the Weber Basin Project and became Senate Document No. 147, 81st Congress 2nd Session, entitled "Weber Basin Project, Utah."
Bureau planners had to know that the municipal water features were vital to their project. It would have neither adequate benefits nor repayment capacity without. There had to be a manifest demand for culinary water to get the project off the ground. The very document on which the enabling legislation was based contains the evidence of an uneconomic proposal (Senate Document 147). Costs were allocated to the various features as follows (p. 11):

<table>
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<th>Reimbursable</th>
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<td></td>
<td>$40,234,000</td>
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<td>18,744,000</td>
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<tr>
<td>Municipal</td>
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<tr>
<td>Sub Total</td>
<td>$58,978,000</td>
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<tr>
<td>Flood Control</td>
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<tr>
<td>Sub Total</td>
<td></td>
<td>$69,534,000</td>
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<tr>
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Thus costs attributable to irrigation were estimated to be a little more than twice those for the municipal supply. Nineteen million dollars is a big figure for converting an open canal to a closed canal. There were some other costs added by the municipal supply, however, most of them stemming from the fact that irrigation is strictly a summer use, while municipal supplies must be delivered during the cold of winter as well. This requires heating equipment to keep gates and aqueducts free from ice in the winter. Whether or not these added features justify all of the added expense is something that might be investigated further. Figures given in the next paragraph make it plain why Bureau officials should have been interested in any higher costs that could be attributable to municipal water.
Page 12 of Senate Document 147 gives the breakdown of anticipated payment as follows:

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While municipal costs are less than half those due to irrigation, users of municipal water are expected to repay equally with irrigators. Perhaps the explanation is that benefits greatly exceed costs in the case of municipal water, thereby justifying the heavy repayment obligation. But the project's annual benefits are segregated this way:

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<tr>
<td>Municipal</td>
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<tr>
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<tr>
<td>Total</td>
<td>$6,995,500</td>
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</table>

The estimated benefit to agriculture is 9.4 times as great as the estimated benefit to municipalities! Municipal benefits were calculated on the estimate of an alternative supply costing $23,300,000. This alternative consisted of three of the project reservoirs (Pineview, Perdue, and Jeremy) an aqueduct from Pineview to the Ogden treatment plant, and the Davis and Weber aqueducts proposed for the Weber Basin Project plus all the treatment and delivery facilities to be locally financed. In other words, the only alternative considered was a duplication of the proposed project, leaving out some features particular to irrigation. The annual benefit was determined by calculating the annual payment required
over 100 years to equal a return of 2.5% on the investment of $23,300,000. The use of such a low interest rate makes a modest estimate of the benefit so calculated, because the annual payment increases with higher values of the interest rate. No attempt was made to justify this $23,300,000 expenditure--it was just ruled "indispensable" to the communities that would be served (p. 107). Even on this calculation benefits to municipal users were less than their assigned share of the costs.

Although benefits were calculated over 100 years, plans called for repayment to be made in 60 years (the Interim Report had called for 65 years). This caused some consternation among the few Washington officials outside the Bureau of Reclamation who caught a glimpse of the report. Existing reclamation law called for repayment in 40 years (statement of President Truman to the Senate in reluctant approval of S. 2391). However, municipal and industrial users were expected to repay their cost allocation within the forty-year period and then keep on paying for twenty years more to help irrigation pay their portion of the costs. This is roughly the equivalent of allowing the irrigation portion eighty years, or double the time called for by law. It seems to be an unequivocal admission that the Weber Basin reclamation project, even as originally conceived, was only half as sound financially as "normal" reclamation projects. If such a project were to be justifiable one would expect a very convincing demonstration of secondary benefits and intangibles attributable to irrigation water.
There is no demonstration, but there is a pretty bold claim to such benefits. Of the total annual irrigation benefit of $5,979,000 only $2,686,000 was expected as increased earnings from agricultural production. The remaining $3,293,000 was an indirect benefit from stimulating industrial processing, wholesale and retail trade. Combine this large figure for "intangibles" with the excessive repayment period and the implication seems to be that the secondary benefits from the irrigation portion alone must be double those of reclamation programs authorized prior to 1949. What is unique about agriculture in the Weber Basin that makes it so stimulating to processing and merchandising? And if these extremely high secondary benefits were actually there, should there not have been some attempt to assign repayment obligations to the beneficiaries?

As things stand in the planning report on which the Weber Basin Project became law, municipal water users are to pay as much as irrigators for benefits less than 1/9 as large as those supposed to go with agricultural water. In the perspective of hindsight, the projected cost of municipal water exceeded alternative costs by a substantial margin, even by the low figures of 1949. Page 112 gives municipal repayment at $11.72 per acre foot and the cost of treatment and delivery facilities created locally at $31 per acre foot, for a total of $42.72 per acre foot. (That's about what WBWCD charges now). Most towns can create their own facilities for less than half that figure. So benefits to municipal water are significantly less than costs.
The allocation of costs among various purposes of the project has been given above. It is enlightening to note how the $59 million reimbursable portion of the total cost was allocated between irrigation and municipal use ($40 million vs. $19 million).

The allocation to municipal use was based on the assumption that municipal use would have a prior right to a firm water supply and thus would require greater proportionate use of storage and conveyance facilities than irrigation. By the use-of-facilities method both irrigation and municipal use would share in the economy of the multiple purpose development, each purpose realizing a saving over the cost of its cheapest alternative development. Each purpose would pay in accordance with its proportionate use of project facilities and no one purpose would be allocated more than the capitalized value of its tangible benefits.

By this principle municipal water was assigned at least half the cost of every part of the WBP that could conceivably be said to contribute to the municipal supply. That is 40,000 acre feet of water used over 12 months was considered the equivalent of 25,000+ acre feet used over seven months. The $19 million of costs allocated to municipal use was less than the $23,300,000 million calculated as a benefit. But how by any stretch of imagination can the repayment of $29 million by municipal users be said to be "in accordance with its proportionate use of project facilities" and "no more than the capitalized value of its tangible benefits?"

Regardless of the justice of equity of such a large assignment of cost and repayment to municipal water use, it does demonstrate very clearly that the whole project would be unfeasible without the culinary features. It very nearly is with them. Thus it
is hard to accept the notion (in the "Seven Year Summary") that municipal supply was an after thought or appendage to an agricultural reclamation project that was "sure" of passage.

Even in the pre-construction planning there seems to have been very little actual concern for whether or not benefits equalled costs to municipal users. Repayment assessments were based on ability to pay--not benefits. The preliminary or "Interim" report sent by the Regional Office to Washington headquarters in March, 1949 proposed the following repayment assessments:

- Dairy farms: $1.80 per A.F.
- Truck farms: 3.30 per A.F.
- Municipal: 8.80 per A.F.

(minutes, 3/7/49). Four months later the July 15, 1949 Report of the Regional Director (Senate Document 147) presented an altered breakdown of assessments:

- Foothill: $3.15 per A.F.
- Benchlands: 1.94 per A.F.
- Delta: 1.72 per A.F.
- Mountain Valleys: .92 per A.F.
- Municipal: 12.26 per A.F.

Bureau planners had shortened the proposed repayment period from 65 to 60 years, and perhaps made some upward revisions of cost. Municipal users were quite clearly stuck with the difference. Agriculture couldn't afford to pay more (the benefits weren't there), municipalities would have to pay, regardless of benefit considerations.

The following pages reproduces the breakdown and assignment of costs published in Senate Document 147. The generous allocations
## Cost allocations, Weber Basin project, Utah

<table>
<thead>
<tr>
<th>Item</th>
<th>Direct costs</th>
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<th>Joint costs</th>
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<td>Irrigation</td>
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<td>Storage facilities: Dams and reservoirs:</td>
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<td>Diversion dams:</td>
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<td>Huntsville</td>
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<td>Aqueducts and canals:</td>
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<td>Weber aqueduct</td>
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<td>Pumping plants:</td>
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1. Joint costs include flood control and recreation.
### Cost allocations continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Direct costs</th>
<th>Joint costs</th>
<th>Joint costs</th>
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<td>Recreation</td>
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<td><strong>Miscellaneous:</strong></td>
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</tr>
<tr>
<td>Drainage system</td>
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<tr>
<td>Lateral system</td>
<td>1,400,000</td>
<td></td>
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<tr>
<td>Ground-water pumping</td>
<td>300,000</td>
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<tr>
<td>Davis County storage charges</td>
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<tr>
<td>Recreational facilities</td>
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<tr>
<td>Operation and maintenance during construction</td>
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<td>$180,000</td>
<td>$180,000</td>
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<td>Investigation and surveys</td>
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<td>$19,621,000</td>
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<td>$20,613,000</td>
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</table>

1Irrigation and municipal joint costs were allocated by the use of facilities method. After flood-control and recreational allocation were deducted, use of reservoir for irrigation and municipal use on a proportionate-share basis was determined to be 50% for each purpose. Use of conveyance features for irrigation and municipal use was determined to be 55 and 45 percent, respectively.

Source: Senate Document 147
### Cost allocations continued

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<th>Item</th>
<th>Total direct and joint costs</th>
<th>Annual operation, maintenance, and replacement costs</th>
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<td>Dams and reservoirs:</td>
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Cost allocations continued

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<td>Operation and maintenance during</td>
<td></td>
<td></td>
</tr>
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<td>construction</td>
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<td>Investigation and surveys</td>
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<td>Cost of reduction in power to</td>
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<td></td>
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<td>Riverdale power plant</td>
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<tr>
<td></td>
<td>$69,534,000</td>
<td>$212,300</td>
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</table>
to municipal use have already received comment. Note however, that the nearly $10 million cost of Willard Dam is allocated entirely to irrigation. It could not conceivably contribute to municipal supply. In fact, some of the people involved in the D-WCMWDA questioned the advisability of including Willard Reservoir at all; it would be of no benefit to them. There is even evidence in Fjeldsted's files that some planners from the Salt Lake Regional Office of the Bureau were not entirely convinced of the wisdom of including Willard Dam. But it was included, and municipal users wound up paying for it: the $10 million beyond their cost allocation of $19 million that they were to repay just covers the cost of Willard Reservoir!

Why was Willard Dam included if there were reservations about it even then? A large part of the explanation must lie in the fact that a very major portion of the benefits to agriculture was to come from opening 70,000 acres of new land to cultivation by draining and irrigating it. All of this land is in the lower delta, and was to be served by Willard Reservoir. The remaining benefits to agriculture were to come from providing supplemental water to 30,000 acres already under irrigation. Of the $6,995,000 projected annual benefit, $5,979,000 was to be realized from increased irrigation (Senate Document 147, p. 13). The Willard system had to be included to have any significant "benefit" at all!

Even before construction was begun there were signs that should have caused some second thoughts. Five months after the Weber Basin Project was signed by President Truman, the Ogden River
Water Users Association asked the D-WCMWDA if the proposed Weber Basin Water Conservancy District would be able to help them extend their repayment contract with the Bureau of Reclamation from forty to seventy years (not 60, but 70). It seems a fair inference that they were suffering under their repayment contract. Apparently irrigation benefits were not so large in 1949 as they had been anticipated only ten years earlier.

Even Morgan and Summit Counties were asked to join the WBWCD. They were threatened that if they didn't join, the new water conservancy district would charge them double prices. If the Bureau was confident of easy sales, why the pressure for prior commitment? Actually it is admitted in some of Fjeldsted's recruiting correspondence that municipal contracts along the Wasatch Front were vital to financial solvency. These threats alternated with attempts to coax towns and counties to join with the argument that if they didn't the project would not be "feasible." There was quite a bit of concern that Ogden City would not participate, and a bit of surprise when she did.

All this suggests that the "dire need" for water, and the "indispensability" of the WBP were not starkly clear to everyone, even the pushers of the project. If Ogden and other municipalities were not anxious to join, what else can it mean but that they were not feeling an extreme pinch, or that they could foresee ways of handling their own problems?

Mention has been made already of the pressure that was applied to hustle the enabling legislation past the usual screening agencies and through the hands of House, Senate, and President. In the statement issued along with his signature, President Truman that the bill had circumvented examination by the government departments who were supposed to give their opinions on legislature of its kind. This apparently was exactly what Bureau spokesmen had in mind when they urged members of the D-WCMWDA to lobby their congressional delegation in the name of haste. Yet, three years elapsed between the President's signature and the beginning of construction.

In the President's statement to the senate, August 30, 1949, the Executive Office objected that the bill had been passed on the basis of a preliminary report by a regional director rather than on the recommendation of either the Secretary of the Interior or even the Commissioner of Reclamation, that there had been no opportunity to review the adequacy of the regional director's report, and that the bill represented some basic departures from established reclamation law. In particular, the Executive objected that the repayment period was longer by half than regulations called for, that the large allocation to recreation was unprecedented, that flood benefits seemed exaggerated, and that the Department of Agriculture had not been permitted to examine the irrigation potentials. However, since "there is no urgency for immediate construction of the Weber Basin Project" (plans of the Bureau
called for construction to be spread over 12 years) the President signed the bill on condition that his objections all be overcome by thorough investigations. No appropriations would be authorized until complete studies had been made by all interested government departments. "It would seem that this plan for proceeding with the Weber Basin Project is only fair to the water users who will eventually have to return to the United States the investment allocated to irrigation and municipal water supplies."

Particular reference was made to investigations by the Department of Agriculture to determine "ability of water users to repay the costs of irrigation features of the project." Some of the required studies were farmed out to other agencies, such as one on agricultural potentials which was handed over to the Department of Agricultural Economics at Utah State Agricultural College. A report was issued by Fuhriman, Blanch, and Stewart in December, 1952. But by the time the Bureau of Reclamation had submitted its Definite Plan Report, money had been appropriated, and construction was set to begin in thirty days.

Without municipal participation the project could not have been imagined to be economically or financially feasible. It had to have participation of all four counties and all towns in those counties to be sure of sufficient taxing power to finance the project. The D-WCMWDMA, ostensibly formed by people concerned with culinary water for towns in Davis and Weber Counties, eventually found itself carrying the whole load: doing its own water demand
study (a vital part of making the WBP sound feasible and necessary in Washington), urging the legislation on the Utah Congressional delegation, forming the WBWCD as a legal contracting body, recruiting members, both municipal and agricultural, raising money to help finance Bureau of Reclamation research, and finally, managing money collection and repayment for the whole reclamation project. On top of that, after paying for the irrigation oriented reclamation project, they had to issue bonds to finance their own treatment and distribution facilities after all! No wonder there is so much resentment among civic leaders against the WBWCD.

C. Part of the blame for poor planning in connection with the Weber Basin Project may be assigned to state water laws.

Water sales have not come up to preliminary expectations because the acute shortage presumed in 1948 has turned into an embarrassing abundance. What has changed the picture drastically is the discovery of ample underground reservoirs of high-quality water. Municipalities have found that they can create their own culinary supplies by well-drilling for a cost per acre foot that is significantly lower than the price charged by the WBWCD. "The water stored underground in Utah is more than enough to fill all of the existing man-made reservoirs several times over." Some of the better groundwater reservoirs of Utah lie along the Wasatch Front in Weber and Davis Counties. Why was more attention not given to these less expensive culinary water sources by

planners of the WBWCD?

Part of the answer to this question is obvious from the discussion under (A) and (B) above: The Bureau of Reclamation has a natural desire to feel that its construction projects are needed. But other alternatives could not be ignored if the extent of groundwater resources were precisely understood and the knowledge widely dispersed among concerned residents. Unfortunately the limited information available in 1948 about groundwater resources in Davis and Weber Counties was not widely dispersed. Indications are, however, that enough was known to have made a difference to the Weber Basin Project. A high quality report on Davis County groundwater was prepared in the early 1940's and was published in the 1948 Biennial Report of the State Engineer. A similar report on the Weber Delta District was not published until 1966. The research for it had been completed several years prior to that time, however, and the principal author, J. H. Feth, had been on loan to the Bureau of Reclamation from the U. S. Geological Survey.

It is unfortunate that groundwater research had not been speeded up by three or four years and promptly reported--a costly mistake for some Utah residents. But a large part of the blame for the slow pace is attributable to State Water Law.

Under water law as it developed in Utah the guiding principle for acquiring water rights was "prior appropriation for beneficial use." In the case of groundwater "prior appropriation" was applied to hydrostatic pressure as well as to particular volumes of water. That is, a person who acquired a water right by drilling a well
that yielded a certain rate of flow from artesian pressure was protected by law against pressure loss. Any other subsequently drilled well that reduced his well-head pressure had to be plugged, because it took away water that was his by right of prior appropriation.

Hydrologists had long complained that hydrostatic pressure was not the same thing as a given volume of water. What was being guaranteed to the prior appropriator by the interpretation of state law was not a given volume of water but a given amount of delivery pressure. Diminishing the artesian flow of a well does not decrease the quantity of water that can be withdrawn from it. It does increase the cost of using the given quantity, however.

As long as this interpretation was upheld by state courts, groundwater development (and investigation) was understandably discouraged. Drilling a well is not an attractive water supply alternative if there is a good chance it will have to be plugged up again, or part of its yield pumped uphill to a neighbor's well.

This situation leads to a technical problem: since hydrologic studies of groundwater depend heavily on large numbers of well-logs, cataloging of groundwater resources is retarded by a policy that discourages drilling wells. A recent (1969) decision by the State Supreme Court has reversed this interpretation in a manner that will be much more favorable to natural development of Utah's water resources.

Evaluation of groundwater resources was retarded by this policy to the degree that few people responsible for passage of the Weber
Basin Project were aware of this important alternative. Available evidence does suggest that such information was available before 1952, however, the year that work began on the Weber Basin Project. Why this information was not given more use and publicity is an unanswered question.
Appendix III: Weber Basin Overkill:  
The Costs of Anhydrophobia
The need for irrigation in Western States prompted early efforts to dam and divert existing streams. As the desire for water grew larger, more extensive dams and reservoirs were required. Eventually it became impossible for a small group to reap all the benefits from the size of project required if more land was to be brought under irrigation. The initial cost would have to be spread by borrowing social capital which could be paid back by beneficiaries over several years. In recognition of this need the Bureau of Reclamation was formed in 1902 for the purpose of building expensive irrigation and drainage projects at public expense. Originally the Bureau was required to recover all costs from direct beneficiaries in ten years. Then repayment time was extended to 20 years, and later to 40 years as the projects became more and more expensive while the repayable benefits per acre of new agricultural land made no spectacular gains.

In 1952 President Truman signed a bill authorizing construction of several dams, reservoirs, canals and aqueducts on the Weber River drainage basin in Utah. Known as the Weber Basin Project, it represents a landmark in Bureau of Reclamation history. Instead of the customary 40 years, the WBP called for a 60-year repayment period. Then, because agricultural beneficiaries couldn't hope to repay in even 60 years, the project was expanded to include a municipal water component, which was new to Bureau policy. This increased the costs, but also the prospective revenues. Enabling legislation called for municipal water users to repay their share of the costs in 40 years, then continue paying for 20 years to help agricultural users pay their share. This amounts to an admission that agricultural benefits were small enough and construction costs high enough that an equivalent of 80 years would be required to pay for the irrigation portion of the project—double the then current standard. But that was not all. Non-reimbursable flood control benefits were abnormally high compared to previous Reclamation projects. And Weber Basin was the first Bureau project to include a large recreation component among the benefits that would not have to be paid for by residents of the area most directly affected by the project.

The Weber Basin Project, therefore, represents a departure in Reclamation policy. Instead of building for an obvious agricultural need, imaginations were strained to count enough benefits to justify a large construction project. Construction began in 1953, and first water deliveries were made in 1955. By 1968 virtually all planned facilities were completed. The local organization (Weber Basin Water
Conservancy District) which contracted with the Bureau of Reclamation has been having trouble meeting its repayment obligation. Irrigation water sales have been far below original expectations. Municipalities find it cheaper to create their own water supplied (by wells, mainly) than to buy it from the Conservancy District. If payments can't be met through water sales, the Conservancy District has power to tax.

The WCD is therefore living with the prospect that it may soon have to ask for a tax levy in order to meet its repayment obligation, while at the same time it is seeing its supply potential duplicated by municipalities because its prices are higher than the cost of drilling and operating wells. (Knowledge of whether or not the demand for its drinking water is elastic would obviously be very useful to the WCD.) Furthermore, the present price structure of the WCD discriminates severely against municipal water users in favor of irrigation. Price discrimination, because it involves the exploitation of monopolistic power, is inefficient in allocating available resources to those who are willing to pay for them. It restricts output. But if discrimination were eliminated in the case of the WBWCO, there is a chance that revenues might decline sharply. Since there are a priori reasons to expect that irrigation demand is more elastic than municipal demand, revenues would be cut both ways if M&I prices were lowered while irrigation prices were put up.

On the other hand, most of the excess capacity is located at the lower end of the Basin, in Willard Reservoir. This portion of the project represents one-half to one-third of the cost of the whole, and is a white elephant of magnificent proportions. It was designed to bring new land under cultivation along the low-lying shores of Great Salt Lake. These lands are now non-arable because of drainage problems. As originally conceived, the Weber Basin Project was supposed to drain these lands free of charge to the owners, whose only reciprocal obligation would be to purchase the irrigation water provided in Willard Reservoir. Because agricultural interest in these lands proved to be virtually non-existent, the major reclamation feature of the WBP was not even undertaken. As a consequence, a very large share of the water supply made available by the WBP flows through Willard Bay into Great Salt Lake--although part of it is sold to nearby game bird refuges.

In summary, benefits to both agriculture and municipal/industrial water users have turned out to be very much lower than expected because of non-interest in agriculture and the availability of cheap
groundwater to cities. Some major benefits of the WBP must therefore be ascribed to recreational features such as water sports and game bird hunting, plus some benefits to flood control. Except for the latter, these benefits are not at all specific to residents of the Weber Basin—especially in the case of the game bird refuges. But it is Basin residents who are under obligation to repay the construction costs. And the burden falls most heavily on municipal/industrial users. The WBP therefore redistributes income and wealth deliberately from M&I users to irrigators, and accidentally from residents to non-residents.

Whether or not such redistribution is desirable is a value judgment, but it does not seem out of order to call attention to its nature and scope. The bulk of intended benefits of the WBP were planned to accrue to Basin residents, who are required to pay for them, but non-residents (and non-payers) do receive a significant portion of the lower quantity of actual benefits. Depending on the quantitative significance of this feature, it might be useful as partial justification for spreading the construction costs over a wider base than Weber Basin taxpayers and water consumers.

Another kind of problem concerns the allocation of Weber Basin Water resources over time. The service area of the WBWCD is underlain by a groundwater reservoir estimated to be capable of delivering an annual quantity of water at least twice as great as the combined facilities of the Weber Basin Project. Underground reservoirs are clearly superior to surface storage on many counts, not the least of which is cost of creation, operation, and maintenance. Furthermore, surface reservoirs lose capacity as they fill up with silt. They have a finite life, whereas groundwater reservoirs last indefinitely. And once a dam site has been used up, it is lost to human use for the present era of geologic time; good dam sites are limited in supply. From this point of view the building of the WBP appears as a grave mistake for future generations as well as a very expensive one for the present. (Instead of the complex WBP, a dam on the Weber River a few hundred yards below the mouth of Weber Canyon would keep the underground reservoir fully charged.) Surely it would have been more economical to have exploited groundwater sources fully before resorting to the construction of dams, reservoirs, and aqueducts. On the other hand, spokesmen for the Bureau of Reclamation claim that the existence of the WBP reservoirs and canals is the cause of abundant groundwater. It's a plausible argument, but still subject to the objection that specific effort to recharge
aquifers would have been much cheaper than the WBP! The reasons for this apparent misallocation over time are rather obscure and involve Utah water law, the U.S. Geological Survey, and possibly fraudulent behavior on the part of some bureaucrats. Because the result of all this has been detrimental to Weber Basin residents and taxpayers, any light that can be cast upon it would be useful in assessing the fairness of the repayment burden they bear.

Building the WBP before exploiting groundwater reservoirs to capacity was uneconomic, but it is an accomplished fact. The allocation problem now is to make most efficient use of existing resources. Since surface reservoirs have a limited life, it seems that they should be used to capacity before incurring the cost of drilling new wells. In order for water consumers to make this choice voluntarily, the price of Weber Basin water must be lowered—perhaps drastically. This may create a dangerous expectation of cheap and abundant water. If a population and industrial base were built on this expectation and Bureau of Reclamation spokesmen are correct about the source of groundwater in the Weber Basin, then a very serious problem could arise in fifty to one hundred years when the WBP loses nearly all its storage capacity and ends its recharge function as one of the consequences. Of course this would happen gradually, and price increases would probably assure a smooth adjustment over time; it does not seem to be a reasonable argument against encouraging maximum use of the Project water now. Nevertheless, it would be valuable to expand existing knowledge of the relationship between WBP water and the contents of accessible aquifers. The recharge function of the WBP may turn out to be its most significant benefit! Even so, that would not modify the argument that it should be used to the fullest extent now.

There is another major issue of fairness involved in the Willard Reservoir feature of the WBP, because it represents a major share of the total cost and also of the unused storage capacity. Reclamation law forbids the sale of irrigation rights to any individual with more than 160 acres of land, or to any married couple with more than 320 acres. Indications are that this restriction is a serious deterrent to farmers who might otherwise find irrigated farming profitable. The fairness issue is raised by recent disclosures in The New Republic that this law has been flagrantly violated in Southern California.

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1 Conversation with Frank O. Reeder, former Chairman, Box Elder County Commission.
where huge landholdings have been blessed with cheap water from the Colorado River since the construction of Hoover Dam. If this law were enforced in California, Utah farming might be more competitive and the Willard Reservoir water might be put to use by an addition to the Utah farm population. Since it is not enforced in California, why should large and profitable farms be excluded from operating in the Weber Basin?

These issues of fairness and income redistribution are important because they have a bearing on pricing policy recommendations that may be made as an application of the proposed research. A water conservancy district under Utah law is a public agency with considerable monopoly power. A large body of economic theory contains the argument that public monopolies should price their product at marginal cost, unless higher prices are needed for rationing. In other words, the price of WBP water should be set low enough that all of the yearly water supply is sold. Furthermore, price discrimination is inefficient from the standpoint of public welfare, which suggests that irrigation and municipal water should bear a common price, except for differences in cost of production and transportation. But if such a pricing change were made it is possible, and even likely, that revenues of the WBWCD would suffer, making it unable to meet its repayment obligations. In that case it would have to ask for a tax levy.

A tax levy would shift part of the repayment burden from water-users to property owners. To the extent that benefits of the WBP do not accrue to property owners in the same proportion as they do to water users, resorting to a tax would redistribute income from the former to the latter. A tax will also have inefficient allocative consequences. Policy-makers must therefore choose between the inefficiency of price discrimination or the redistribution and inefficiency of a tax. It is important to keep in mind that the WBP is far from being paid for—and that federal law requires that it be paid for by the supposed beneficiaries. For reasons alluded to in previous paragraphs, it may be possible to make a case for socializing the costs of the Project over a wider base than the one required by existing law. It's doubtful prospect politically, however.

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There are obviously several kinds of problems involved in the WBP, and they may be summarized under the following heads:

1. Price discrimination
2. Wasteful non-use of fixed assets plus duplication
3. A choice between profit maximization and taxation
4. Income and wealth redistribution

Acceptable solutions may be mutually exclusive. The following alternatives are illustrative:

1. Let the WCD discriminate perfectly among its several customers—selling to each of them at a price equal to the cost of alternative supplies. This would maximize revenues of the Conservancy District, and minimize the likelihood of having to ask for a tax levy. Possibly this method would raise more than enough revenue to meet costs and repayments so that a modification in the degree of discrimination would be possible in some of the more extreme cases. However, the objectionable discrimination would be even more severe than it is at present, there is no assurance that all the water would be used, and benefits other than water consumption would not be paying an appropriate share.

2. Set a common price (excluding cost differentials) to all users so that all available water is sold each year, with no shortages. This is the marginal cost pricing criterion, with provision for scarcity, and comes closer to meeting the requirements of a theoretical efficiency optimum. It is open to the objection that total costs are not likely to be recovered out of sales revenue, and that the difference must be made up by means of a tax which is unlikely to be allocatively optimal and redistributes income as well. The superiority of this method over the present system could be estimated by measuring consumer's surplus triangles; i.e. does the gain to municipal users outweigh the loss of irrigators? But against this benefit, if positive, must be weighed the loss imposed by a non-optimal tax. How do you measure that?

Of course, there is a possibility that the more nearly optimal price might also improve or at least not worsen the revenue situation. It's a happy thought, and an eventuality that would solve nearly all of the problems, but it's also highly improbable.
3. Follow alternative two, but remove the obligation to pay for the installation costs of the WBP. This would solve the first three of the problems, but would involve a redistribution of income and wealth from the general U. S. Taxpayer to residents of the Weber Basin. Some people, like Harold Hotelling, would argue that this is unimportant as long as there is a rough randomness in distribution of plums like the WBP throughout the country. (As suggested above, more of the benefits from the project have turned out to be non-specific to Basin residents than was planned.) Regardless of the validity of this argument, it would be very difficult to apply politically, because existing law is already against it. Furthermore, it is disturbing to think that even this check on bureaucratic expansion should be removed. It would mean that benefit-cost studies prior to project approval had no useful function at all!

4. There is a fourth course of action which may be able to achieve a solution of the first three problems while minimizing the unfairness and administrative slack implied in the third alternative above. When a private firm makes a mistake in its pre-investment benefit/cost analysis it pays the penalty of reduced profits—or even of losses. Since there is no reason to suspect that individual bureaucrats are motivated by any other than the self-seeking aspirations driving all the rest of us, it would seem to serve the cause of efficiency if they felt some pain akin to lost profits when they undertake a white elephant project like Weber Basin. Preliminary investigations suggest that the Bureau of Reclamation acted in ways contrary to the interests of Weber Basin residents in order to further interest of its own staff. Evidence presented in this proposal implies that the Bureau has imposed some positive "bads" on Basin Residents. Considerations of efficiency in government and of justice therefore suggest that the U. S. Government be sued by Basin residents for redress of wrongs committed by its agent, the Bureau of Reclamation. The amount of damages may be sufficient to allow marginal cost pricing by the WBP without having to levy an additional tax on property owners in the Basin.

This solution still suffers from the objection that it redistributes income from federal taxpayers in general to Weber Basin.

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residents, although it does cure price discrimination, non-use of water, and the necessity of choosing between the WCD's ability to pay and a tax on Basin residents. The remaining undesirable feature is mitigated by the following circumstances:

a. The original estimate of general, non-reimbursable benefits was too low.

b. Actions of the federal agency caused injury to Weber Basin residents unless the proposed restitution is made.

c. It attaches blame at the source of the mistake, giving the taxpayer to understand that he is suffering because his agent acted unwisely, if not fraudulently, and puts pressure on the bureaucrats to be more careful in assessing the consequences of their empire-building projects.

These considerations take some of the sting out of the redistributive effects, and have the positive general benefit of stimulating greater efficiency in government. It is a principle that could be applied in many branches of government.

Unfortunately, this line of action would involve the embarrassing fact that only 1 percent of eligible voters cast ballots in the plebescite that authorized the WBWCD to enter into $90 million contract with the Bureau of Reclamation, and suggests some perplexing problems about the efficiency and moral superiority of democracy as a form of government.

Research Objectives and Methods

List of objectives

1. Specify and quantify as exactly as possible the kind and degree of underuse of the Weber Basin Project, and the financial circumstances of the Weber Basin Water Conservancy District. Also identify the Conservancy District's marginal costs of providing water to its various customers—including the cost of new aqueducts.

2. Review Utah law on groundwater use as it applies to the Weber Basin problem.
3. Review the current state of knowledge about groundwater resources underlying the WBWCD service area, and estimate costs of withdrawing water in various quantities from those aquifers. How significant is the WBP as a source of groundwater?

4. Review Reclamation Law and Utah water conservancy district law to determine the exact repayment obligation of Weber Basin residents. Is there any obvious way they could avoid paying for part of the WBP?

5. Historical research to determine how the WBP and WBWCD came into being, including study of planning reports.

6. Review biological research on the environmental consequences of the WBP as a counterpoise to the intangible benefits claimed by promoters of the Project.

7. Estimation of demand relations facing the WBWCD in both irrigation and municipal/industrial water sales.

Method for estimating the demand functions

The conceptual approach to finding the demand functions is different for the two classes of municipal/industrial and irrigation water.

1. Municipalities need not rely exclusively on the WBWCD since they have the alternative of drilling wells (or developing unused rights to a few remaining streams or springs). The availability of such alternatives varies considerably from one part of the district to another, however. Each municipality may be conceived of as possessing a supply function of alternative sources that rises up to the right in discrete jerks. A town with relatively poor and expensively developed groundwater possibilities will have a function that lies above and to the left of a town that sits on abundant and easily exploited aquifers. The cities of Roy and Bountiful are illustrative of cities at the two ends of a groundwater availability continuum.

When a municipality wishes to expand the amount of water it can make available per year, it can choose between buying from the
WBWCD or drilling a new well. Other things being equal, it will select the lowest-priced alternative. This means that the WBWCD must ask a price no greater than the cost of an equivalent amount of water from a new well if it expects to sell to that municipality.

That price and increment of quantity represent a point on the demand curve for water of that particular municipality. Presumably the city would buy more water if it could get it at a lower price. (Several studies of water demand have indicated a definite negative slope to water demand.) However, there is no way of knowing for sure just how much more the city would buy for a given price reduction, and a questionnaire-type response to this kind of question is notoriously unreliable. It is bad enough to have to ask the water manager to evaluate the next needed increment and its likely cost. Little reliability could be attached to any request for a projection beyond the most immediately pending expansion of water supply facilities—which may reasonably be expected to have received some serious deliberation in a growing community.

Repetition of this procedure in all the Basin municipalities will produce an array of price and quantity data, from which an aggregate demand function may be constructed on the following principles. Each such point in a Cartesian plane represents the maximum price that a particular city will pay for water from the WBWCD. At lower prices it might be expected to buy more. Each point represents, therefore, the topmost point of a demand curve for WBWCD water in a particular municipality. (The sperm-like demand functions in Figure 5 illustrate this fertile thought.) It is well known that an aggregate demand function may be obtained by the horizontal summation of these individual functions. Unfortunately, the shape of the tail is unknown in each of these cases; the only data available are the "heads." One thing that does seem fairly certain, however, is that if a given city is willing to spend $40 per unit for a given quantity of water, it will surely be willing to buy at least that quantity at a price below $40. We may therefore assume perfect inelasticity in the individual demand functions, in which case the array of sperm cells takes on a configuration as in Figure 6. When these straight-line functions are summed horizontally the result must be a downward sloping aggregate demand function for municipal water from the WBWCD, for the following reason: Take the highest price first. Suppose that it is faced by Ogden City, and that it therefore represents the largest single quantity in the array. This means only that at the highest price it can expect to get at all, the WBWCD can sell a large
Figure 5. Conceptual approach to estimating demand for M & I water.

Figure 6. Approximation of minimum aggregate demand.
quantity of water. At the next lowest price, which might represent a very small place like West Point, the WBWCD could sell not only the full West Point increment (small though it be), but also the full Ogden amount. Continuing in this fashion a new array of price and quantity points will be generated through which a line can be fitted (or even traced, connect-the-dots fashion) that will be as accurate an estimation of the WBWCD's true demand function as is possible without experiments to measure demand in each individual city. It is quite conceivable that such a construction will be elastic. What is certain is that it will understate the true elasticity because of the unrealistic assumption of perfect inelasticity in all of the functions being summed.

2. This approach will not work for irrigation water because the WBWCD price is already lower than the cost of alternative sources of new water, which are essentially the same as those faced by municipalities. If an irrigation company needs more water, it has little choice but to buy from the WBWCD, since wells are generally quite a bit more expensive than the low price fixed for agriculture by Bureau of Reclamation policy. With irrigation water prices as low as they already are and with as much excess delivery and storage capacity as there is, it may well be that the demand for such water is very inelastic—in the downward direction. (It may be quite elastic in the other direction; several farms may cease operations if the price rose appreciably, while very few new ones would start up even with a sizeable percentage drop in price.)

In these circumstances the most reasonable approach may be to make an intuitive assessment of the MRP of agricultural water in the Weber Basin, and on that basis to import an elasticity value from some water demand study of a similar region. Interviews with farmers and irrigation company spokesmen should help in this effort, plus a review of any revenue productivity studies that have been done for areas like the Weber Basin—or even the Basin itself. With a borrowed elasticity and one-price-quantity point, an estimate of the demand function in the region of that point can be constructed. If, on the basis of policy recommendations stemming from such a function, a change in price is administered a more accurate calculation of elasticity would of course become possible.

Once these demand functions are in hand they may be used to evaluate the policy alternatives proposed above.
Appendix IV: Notes to Chapter III and Notes to Chapter VII
Notes for Chapter III

Information in this Note is taken from a manila binder found in files of the State Engineer's Office. The cover bears the following title:

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Weber Basin Project
Utah

GROUND WATER RESOURCES
EAST SHORE AREA

May, 1958

Besides the report promised on the cover (mimeographed), the binder contains water use reports and correspondence relating to ground water development within the East Shore area that were transferred between Jerry Tuttle, Water Resources Engineer in the State Engineer's Office, and E. J. Fjeldsted of the WBWCD. Included are several newspaper clippings about the WBP and ground water, dating from 1961. The binder was active only from 1959 to 1962, and was the personal copy of Jerry Tuttle.

The Bureau of Reclamation Report is produced immediately below. It has been edited slightly by excising tables and a two-page section on water quality.
Introduction

The East Shore area as far as this report is concerned is considered as the lands lying in Tps. 2 to 8 N., inclusive, and extending from the Wasatch Mountains to Great Salt Lake. Surface water supplies are being fully developed under the comprehensive Weber Basin Project but are insufficient to meet the expected near future needs.

Undeveloped ground water and return flows from irrigation captured in project drains will be needed to supplement the surface supplies. Approximately 10,000 to 15,000 acre-feet of ground water will be required annually within the area to supply the expected demands.

Present Status of Ground Water Development

Quantity--In 1955 about 52,000 acre-feet of ground water was obtained from wells in the East Shore Area of which about 12,000 acre-feet was pumped from wells of large yield owned by municipalities, industries, and the Defense Department. The other 40,000 acre-feet comes from small privately owned wells. Table 1 shows the discharge from wells in the East Shore area for several different years.

It is estimated that in 1955 approximately 14,000 acre-feet of water was used for irrigation, 12,000 acre-feet for large industrial and municipal uses and 26,000 acre-feet for private domestic uses.

Most of the privately owned wells are used for domestic purposes and stock watering on farms. These wells are of small diameter, averaging 2 inches, and ranging in depth from 100 to 800 feet. The flows range from less than 1 g.p.m. to 80 g.p.m. Generally, these wells are below the 4,300 foot land surface contour and they flow as a result of artesian pressure.
TABLE 1
Well Discharge East Shore Area

<table>
<thead>
<tr>
<th>Year</th>
<th>Acre-feet</th>
<th>Measured by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1937</td>
<td>48,900</td>
<td>State Engineer</td>
</tr>
<tr>
<td>1938</td>
<td>48,200</td>
<td>State Engineer</td>
</tr>
<tr>
<td>1939</td>
<td>45,300*</td>
<td>State Engineer</td>
</tr>
<tr>
<td>1940</td>
<td>41,100*</td>
<td>State Engineer</td>
</tr>
<tr>
<td>1946</td>
<td>46,400*</td>
<td>U.S. G.S.</td>
</tr>
<tr>
<td>1950</td>
<td>26,500</td>
<td>Estimate (excluding large pump wells)</td>
</tr>
<tr>
<td>1954</td>
<td>50,000</td>
<td>U.S. G.S &amp; U.S. B. R.</td>
</tr>
<tr>
<td>1955</td>
<td>52,000</td>
<td>Estimate</td>
</tr>
</tbody>
</table>

*Estimate. Records not complete for all areas.

In contrast to the smaller flowing wells below the 4,300 foot land-surface contour, most pumped wells are located east of the 4,300 foot contour. These wells range from 8 to 20 inches in diameter and from 300 to 900 feet in depth. Discharge ranges from about 200 to 1,800 g.p.m.

As Table 1 shows ground water uses have continually increased throughout the years. (Readers are urged to examine Table 1 carefully and to assess the validity of this inference.)

Quality.-- (This two-page portion has been omitted. It generally confirms that although not all aquifers yield water of equal quality, there is an abundant supply of excellent ground water.)

Waste--The ground water resources of the East Shore Area are not fully utilized at the present time. Points in evidence suggesting this are the following: (1) the presence of seeps into Great Salt Lake, many of which are visible along part of the shoreline; (2) springs originating at faults; (3) upward leakage in certain areas; (4) wells not capped and water flowing to waste (from many wells water wasted year around); (5) the fact that records of water levels and artesian pressures do not show net declines in the period 1937-1952; (6) the general lakeward slope of the piezometric surface, indicating water movement westward across the area; and
(7) indirect evidence from studies of Great Salt Lake that indicate estimated flows of about 60,000 acre-feet annually of ground water by direct seepage to the lake.

Hundreds of spots about 100 feet in diameter containing thick growths of salt grass dot the salt laden shores of great Salt Lake. These are fresh water seeps that have their source in the artesian basin. At least one fresh water spring has been observed in the shallow waters of the lake, which had sufficient quantity to cause a small boat to drift away from the source of flow. Near the abandoned salt plant in the lake west of Syracuse, a well 143 feet deep with a 2-inch casing flows fresh water. These are all indications that fresh water is moving westward under the lake and being wasted.

Fault zones produce large quantities of water which is generally wasted the year around. Upward leakage, uncapped and leaky wells in the East Shore Area have caused water-logged lands and drainage problems. This is true especially in the West Bountiful area near the A-1 Drain and certain parts of Farmington and Syracuse areas although uncapped and leaky wells through nonirrigation season can be found in most areas, much of the water wasted is evaporated or consumed by tules, cattails, reeds and other water-loving grasses that grow around bogs and leaky wells. That which isn't consumed, flows into drains and sloughs and is carried off to the lake.

An over-developed ground water area would show a continued lowering of the artesian pressures and water levels year after year without complete recovery the following recharge period. In the East Shore Area, however, this is not the case, with wells recovering fully each year with the exception of extreme drought years. (See hydrographs following this page.)

The piezometric surface of the water table indicates westward movement of water toward the Great Salt Lake. Further evidence that water is traveling west to the lake is that in many wells drilled adjacent to the lake shore good quality water originating from Weber River or mountain front recharge have been found.

The discharge from irrigation wells during the winter in the Bountiful district as reported in the State Engineer's report 1946-48 is estimated to range from 1800 to 2200 acre-feet per
year, of which at least 1000 acre-feet comes from wells that leak around the casing. The natural loss from the artesian reservoirs by springs along the Warm Springs fault and by upward movement and evapotranspiration has been estimated to be at least 2000 acre-feet annually and may be more than twice this great. This could be reduced further by additional withdrawals. Ground water losses and wastes by surface runoff and evapotranspiration in other parts of the East Shore Area could not be definitely determined. Although not believed to be as great per acre area as the Bountiful area, wastes are believed to be several thousand acre-feet.

Undeveloped Ground Water

The largest undeveloped aquifer in the East Shore Area lies in the previously mentioned Weber delta in the so-called 700-foot aquifer. A test well drilled 3,000 feet deep west of Roy has indicated that underground water development for irrigation can be extended to depths of about 1,300 feet. Water of undesirable quality is found below 1,300 feet. This well was drilled in what appeared to be the most favorable location in the East Shore Area. It is located within the Weber River recharge area and in the deepest fill over basement (bed) rock.

The annual recovery of the water table and pressures in the 700-foot aquifer shows that there is still undeveloped water in this aquifer. In addition, artificial recharge from the Weber River is possible and can be supplied to the aquifer at the mouth of Weber Canyon. Wells drilled anywhere within the Weber River recharge area and in the 700-foot aquifer will produce large quantities of water.

This aquifer is very permeable consisting of coarse sands, gravels, and boulders, and readily allows water to pass through. As was previously mentioned, Hill Air Force Base, Clearfield Navy Depot, and many municipalities use this aquifer to supply their needs. It is believed this aquifer extends for some distance west under the Great Salt Lake.

In the Bountiful area, a few additional large wells properly located are believed possible for development. This is supported by the fact that the three Bountiful City wells and the Woods Cross well near the center of Bountiful City, Harold Calder's well on the east side of Bountiful City, and the Salt Lake Stockyards and
Wasatch Oil Company wells on the west side of Bountiful, as well as others in the area, are successfully producing large amounts of water with negligible interference. Also, as mentioned in the section under "waste," surplus water seems to exist in the area. Wells in this area should be located with care to avoid the sodium chloride type water existing to the west. Drilling wells close to the mouth of Mill Creek and other canyons is questionable. With the exception of Harold Calder's well, other wells drilled near the mountains have failed to yield water.

The North Ogden area constitutes a small independent ground water system. The highest artesian pressures in the East Shore Area have been measured in North Ogden, the maximum head being about 80 feet above the land surface. The probable recharge source for this area is North Ogden Canyon, Coldwater Canyon, and Rice Creek. Quality-wise, this area produces the best water in the East Shore Area and can be used for any purpose. Development in this area should probably be as deep as 1000 feet. By drilling at this depth, interference with other wells seems unlikely inasmuch as most of the existing wells are at depths up to about 500 feet. Quantity-wise, sufficient information has not been available to determine the amount of surplus water in the area. In 1955, the approximate discharge of wells in this area was 2,900 acre-feet. It appears a limited amount of additional water can be developed in the presently used aquifers with larger amounts available only if aquifers are developed below 500 feet.

In the Centerville-Farmington areas, development of additional ground water is also believed practical if the wells are carefully located. Water quality samples indicate good water around the Town of Centerville and also in the Farmington area near the foot of the Wasatch Range. In the West Farmington area, due to lack of wells, only a few water samples were taken. The few samples indicate sodium bicarbonate water which may not be desirable for irrigation unless mixed with other waters containing greater percentages of calcium and magnesium and less concentrations of total solids. This water however, could be used for domestic purposes without dilution. Further studies in this area are still desirable to definitely show whether the water is of better or poorer quality than is indicated by the few samples. Wells in the Centerville area have produced large quantities of water with negligible interference. The few wells in the Farmington area have also shown no interference.
Other factors indicating available water are as follows:

1. With the introduction of the Weber Basin Project, many wells will be used only on a part-time basis or even abandoned. Bountiful City, Sunset, Clearfield, Layton, and others who have been using wells, have turned their pumps off or used them only part-time since surface water has been made available to them through the treatment plants. It is anticipated that many of the smaller communities (which will eventually have distribution systems from the treatment plants) will also abandon their wells.

2. Weber Basin Project river water applied on the East Bountiful lands and other east bench areas will lose water by deep percolation from future irrigation will also add to the ground water reserves.

Water to be developed for
Weber Basin Project

The estimated 10,000 to 15,000 acre-feet of ground water development necessary in the ultimate development of the Weber Basin Project will require wells to be used for miscellaneous purposes including irrigation, industrial, and municipal uses. They will be located where surplus water of good quality can be found and where possible near distribution or conveyance systems. In order to eventually develop the desired amount of ground water, the Conservancy District has submitted to the State Engineer for approval 34 applications for wells throughout the East Shore Area. Although all applications were submitted at one time, the actual well program will probably consist of a step-by-step process in drilling and construction. This program would cover many years under close and careful observation and wells would be drilled only when and where needed. The final location of the wells will be determined with investigation of each individual well but in general will be close to the pattern of the wells located by the Conservancy District applications. An approximate estimate of the amount of water to be developed in each area is shown as follows:
Bountiful 3,000 (acre feet annually)
Centerville 1,000 (acre feet annually)
Farmington 1,000 (acre feet annually)
North Ogden 1,000 (acre feet annually)
Willard 1,000 (acre feet annually)
Weber delta 8,000 (acre feet annually)
Total 15,000

To initiate this program, the Conservancy District drilled the Laytona Well (5 c.f.s., 800 feet deep) and purchased an existing well in Roy City. The Bureau of Reclamation is presently contemplating either purchasing a private well in Bountiful or drilling a new well under a Conservancy District application. The Bureau is also contemplating the drilling of a well in the Riverdale area. These wells will be used to supply municipalities either in lieu of or as a supplement to the water furnished through treatment plants and are expected to supply from 3 to 5 c.f.s.

**Interference**

Probably the greatest single factor which will cause difficulties in the future development of the ground water in the East Shore Area is the problem of interference with existing wells.

It is believed that the amount of water needed for project purposes can be developed without serious interference with existing wells if properly located and put down to selected aquifers.

Among several pertinent inferences that can be made from the above report, the following are especially noteworthy:

1. Ground water abundance, even in south Davis County, was well-known to the Bureau of Reclamation before 1958.

2. Development of surface water was replacing ground water sources which had been used for some time.
3. In spite of this evident abundance of water, the Bureau claimed that it must have control over major ground water resources in order to meet the service requirements of the Weber Basin Project.

The next item from Jerry Tuttle's binder is a typewritten, pencil-annotated draft, dated January 20, 1960. From the style, choice of terms and general context, it was probably written by E. J. Fjeldsted. Its location in the Tuttle binder suggests that the ground water studies to which it refers are summarized in the Bureau report reproduced above. The graph of population trends it mentions contains nothing extraordinary, and has been omitted.

(See Chapter VI for material on trends in population and water use.)

Statement of Plan for Development of Groundwater in the East Shore Area to meet future demands

The Weber Basin Water Conservancy District and the Bureau of Reclamation as a part of the Weber Basin Project will develop groundwater in the East Shore Area to supply the Irrigation, Municipal, and Industrial needs of the area. Population trends (see attached graph) indicate that all surface and groundwater available in the basin will be needed within the next 25 years to satisfy these needs.

Extensive investigations by the above-named agencies in cooperation with the Geological Survey over several years beginning in 1951, have demonstrated that substantial quantities of undeveloped groundwater are available in selected locations in the East Shore Areas. The basic data collected during these studies has been furnished to the State Engineer. The facts developed during the investigation prompted the Conservancy
District to file 34 applications to appropriate groundwater. These applications represent 61 different well sites.

Development of groundwater by the entities mentioned above began in 1957 with the purchase of a well in Roy (certificate #5145) and the construction of the Laytona Well (certificate #5710). These wells have capacities of one and five second-feet respectively. Other details regarding these wells are on file in the State Engineer's Office.

The Bureau of Reclamation is now undertaking the drilling of a well in the Riverdale area under the recently approved application No. 27,650. The details regarding plans for this well and an explanation of the availability of water is contained in a statement made by F. M. Warnick before the State Engineer at a hearing in Ogden, Utah, on October 15, 1959. Copies of the Statement have been transmitted to the State Engineer. This well will be completed and in operation by late summer of 1959.

Three more wells are planned to be drilled by the end of 1962. These wells will be located in the general vicinity of North Ogden, Clearfield, and Bountiful. Capacity of these wells will be from 3 to 5 second-feet. Applications under which these wells are expected to be drilled are 27,646; 27,636, and 27,643.

When the well now approved for the Riverdale area and the wells in North Ogden, Clearfield, and Bountiful are completed and in service, it is expected that all wells (6) of the Government District system will be capable of furnishing 20 second-feet of water when operated simultaneously and would produce an average of 1,200 acre-feet per month. Water from these wells and from surface supplies developed as part of the Weber Basin Project will be commingled and used to supply water users who have purchased water from the Conservancy District.

As the population increases additional water will be required. It is estimated that during the period 1963 to 1966, inclusive, it will be necessary to construct 5 wells. Wells would be located in Bountiful, Farmington, North Ogden, and two in the Clearfield Roy District. Like the other wells of the system, they will be interconnected with the supply system of the Weber Basin Project. Applications under which these wells are expected to be drilled are 27,635, 27,628, 27,633, 27,648, and 27,647.
During the period from 1967 to 1975, it is expected that 9 additional wells will be required. These wells would be located in Bountiful, Centerville, Farmington, Layton, Hooper, North Ogden, Willard, and two in the Clearfield-Roy district. Other wells, covered by the remaining application of the District, would be drilled after 1975 as the population and industrial demands require.

The entire well drilling program is based upon supplying water to meet the demands for all uses within the Conservancy District. It was for this purpose the District was organized and investments have been made.

The important point in the Fjeldsted brief is that the total surface and ground water resources of the Weber Basin will be needed soon to supply East Shore needs. Propaganda in the pre-authorization phase of WBP was, of course, that surface supplies were essential because there was no significant ground water resource. The WBP was explicitly designed with sufficient capacity to handle all possible future needs (see Chapter VI) from surface flows of the Weber River system. To be consistent in 1960 with the story of need, however, it was clearly inescapable for WBP promoters to elevate the now-obvious ground water resource to the status of an important element of supply.

There was also a compelling financial reason for this interest in groundwater. If they could not get control of the groundwater resource, they would not be able to monopolize the municipal and industrial water market. Without such a monopoly, the repayment
capacity of the WBP was threatened, for it depended on being able to gouge M&I customers (see Chapter VI). The commingling of surface and groundwaters mentioned by Fjeldsted is verified by the 1959 DPR, as reported in Chapter VI. In that chapter it is shown, by the inference from the DPR, that most of the proposed M&I contracts would be supplied from wells. The information reproduced in this appendix provides confirmation of that inference. The importance of this confirmation is its support of the argument that the M&I price of the WBWCD is purely arbitrary. That is, it is not intended to bear any relationship to the actual cost of providing water to M&I customers. Those customers are expected to pay for the construction of huge surface supply facilities, but the water they get comes from much less expensive ground water sources.

The following statement by an officer of the Bureau of Reclamation was found in files of the State Engineer's Office:

Statement of F. M. Warnick at Hearing on Thursday, October 15, 1959, at Ogden, Utah before the State Engineer regarding the Application of the Weber Basin Water Conservancy District to drill a well in the Riverdale Area of Weber County, Utah

Application No. 27650

As a part of the Weber Basin Reclamation Project it is planned to construct a well... in the Riverdale area...

Extensive investigations of ground water conditions have been carried on by the Bureau of Reclamation over the last seven years and the following explanation is taken from those
studies. This discussion will be treated in two parts to coincide with the protests of water users who object to the drilling of the well for two different reasons.

First, one group of protestants claim the withdrawal of water from the artesian aquifers in the Riverdale area will lead to greater losses from the surface stream (Weber River) and therefore interfere with their diversions from the river. The second group of protestants have wells which take water from the artesian aquifers in the general area and believe additional wells will deplete the supply to such an extent that these prior users will be required to go to extra expense to obtain their water.

In the first instance we have found that a continuous clay barrier separates the unconfined ground water which is fed from the river from the confined ground water (artesian aquifers) over a large area extending from a point near the mouth of Weber Canyon to and beyond the eastern shore line of Great Salt Lake. Logs from the many deep wells drilled in the area show this clay barrier and verify its continuity. The only place the Weber River contributes to these artesian aquifers is at the mouth of Weber Canyon. Here deep river gravels accept water readily and carry the water to the artesian aquifers below the clay barrier. The water table in this recharge area is more than 175 feet below the river level. An observation well (#1) more than 200 feet deep and a well on the north side of the Weber River east of Kendells Junction give evidence of this condition .... The clay barrier is not found at Observation Well No. 1 but was encountered by a well (Observation Well 3A) approximately one mile west and by other shallow wells in the South Weber area. Water table readings in Observation Well 3A and other shallow wells in the vicinity shows the slope of the ground water table to be eastward toward the mountains. Immediately west of Well 3A the slope is to the west with the slope of the river.... With the depth of water in the recharge area at or below the clay barrier at all times it is consistent to conclude that withdrawal of water from the aquifers below the clay barrier will not increase the losses in the river system. It follows then that the development of a well in the Riverdale area to take water from the aquifers below the clay barrier will not decrease the supply of water available to users of the natural flows of Weber River.
The second group of protestants imply that the artesian basin below the clay barrier is already fully developed and therefore additional withdrawals will take part of their supply. The extensive investigations of the Bureau of Reclamation show that large quantities of water from these aquifers is still leaking into Great Salt Lake. Hundreds of seeps can be identified along the shores of the lake which have been found by chemical comparison to be the same water as found in the artesian aquifers. As long as these seeps continue to discharge into the lake, water in excess of the withdrawals by existing wells is available and subject to appropriation. This fact alone should be sufficient to permit the State Engineer to approve the application being discussed. No individual or group should object to the recovery and use of water now wasting into the lake. Further evidence that the artesian aquifers below the clay barrier are not fully developed is found in the longest well records of the area. The hydrograph of the J. D. Hooper well extends over the period 1937 to date. This record while showing the effect of drought does not indicate a steady and continuous decline characteristic of over-developed ground water basins. This evidence should also indicate to the protesters and the State Engineer that undeveloped water is available for appropriation.
Notes for Chapter VII

The items in this note demonstrate the reluctance of its supporters to make a clear acknowledgment of the principles by which the WBP is financed, and the purposes and people which it serves. The first is excerpted from an article that appeared in the Davis County Clipper of February 10, 1961--part of which has already been quoted in the text. The spokesman is E. J. Fjeldsted, and the occasion was a meeting of Bountiful City Council. All emphasis and parenthetical remarks have been added:

Main problem of the district, Mr. Fjeldsted pointed out, is to repay the costs of setting up the district. (The reporter seems to have confused the District with the Project throughout--although it is not impossible that Fjeldsted was deliberately loose with his terminology, as some of the instances are favorable to the case he was trying to make.)

When it was proposed in 1949, engineers estimated it would cost $70 million, of which $57 million would have to be repaid. But expenses have gone higher than expected.

For example, the Willard Bay project, on which everything else depends, (constantly reiterated, but never demonstrated satisfactorily) was estimated to cost $7 million. It is going to cost $16 million...

Another higher cost is the increased amount of water that the district will handle. This has been raised from 178,000 acre feet to 212,000 acre feet. The amount available for municipalities has been raised from 40,000 acre feet to 50,000. (The irony of this statement will be clear after reading Chapter VI.)
This means the cost is now expected to reach $97 million, of which $81 million must be repaid.

The major part of this money is interest free. There is two percent interest on the part for municipal water, but this is plowed back into the system, amounting actually to a form of subsidy. (If they only knew!)

Where the pinch might develop is in the $5,400,000 bonds for development of the filtration plants. If we can sell more water, we will be able to pay off these bonds sooner, before enlargement of them becomes necessary. The major parts of these plants were designed for maximum development of the area (!). However, some parts will (may?) have to be enlarged in the future.

After the bonds are paid, there is a possibility the price of water could be reduced, Mr. Fjeldsted said.

There will have to be an election, also, probably this fall to approve the additional cost for the district system, he said. By 1975 we must sell 50,000 acre feet of water to pay for the system. (Presumably his audience understood that Fjeldsted had reference here to municipal and industrial water. If reported accurately, Fjeldsted made it appear that municipalities were being asked to buy water from the District to pay for its own system, i.e., the treatment and delivery facilities for M&I water. In actual fact, as Chapter VI demonstrates, municipalities are saddled with paying for more than half of the entire Weber Basin Project—including the Willard Reservoir which Fjeldsted implied was of significance to municipal users.)

The election to which Fjeldsted made reference above was the subject of another article in the Davis County Clipper, on June 2, 1961, where announcing the date of the election, the article reported reasons for the cost increase as given by Elmer Carver, chairman of the District's board of directors:
He stated that since the repayment contract was signed in 1952 by the Conservancy District the steady rate of population increase, changes from open ditch to sprinkler irrigation, more trunk lines, more land to water, inflation and other factors, increased the project cost. (Of this list, "inflation and other costs" is believable.)

Added income to pay off the project will be obtained through greater consumption and additional users who will buy the water, he said. (Although Carver was clearly making an effort to justify increased cost on the basis of larger size to satisfy greater need, what was really underway was an increase in the absolute and relative amount of total Project costs that was being shouldered onto municipalities. See Chapter VI.)

The Weber Basin project is now about 50 percent finished. A key feature yet to be built, the Willard Bay Reservoir, would enable the system to catch water now running to waste into Great Salt Lake. (Despite the rationalizing of the next paragraph the real reason why Willard was the key to the Project is shown in Chapter VI to be the big benefits from land reclamation that it promised. Without it, the overall benefit/cost ratio of the Project was dismal.)

There are now no dams on the west side of the mountains to catch and store water not held in the dams and reservoirs inside the Weber and Ogden canyons. Willard Bay...would store 215,000 acre feet of water--nearly twice the amount held by Pineview Reservoir.

By pumping, water exchanges and by use of the Davis and Weber Aqueducts and other physical facilities of the system, the additional water of the Willard reservoir would provide adequate supply for all users of the Weber Basin project, Mr. Carver said. (It is noteworthy that this list does not mention reclamation of lake plain lands. By 1961 it must have been reasonably clear that aggressive agricultural expansion was not in the cards for the East Shore area. Instead of emphasizing the enormous benefit to reclamation via Willard facilities, on the basis of which the WBP was authorized by Congress and the President, Carver talked as if it was of major significance to municipalities and lands already under irrigation. That is still the line taken by Bureau spokesmen when pressed to justify the Willard system, as shown in Chapter V.)
If voters defeat the issue, there would be restriction to some degree on construction with the result the entire district would suffer. (This sentence, as well as the headline, implies that the coming vote is a bond issue. Such was not in fact the case. The only bond issue that had ever been involved with the WBP was the $5.4 million to build district treatment and delivery facilities for M&I water. This vote was over a proposed increase of $24 million in the basin's repayment obligation to the Bureau of Reclamation. It was a major opportunity to kill the worst features of the Project before construction on them had even started. The Bureau must have been holding its breath.)

Reluctance to cast light on details of the Weber Basin investment may be responsible for the failure of Bureau and District officials to experiment with some measures that might improve both the financial status of the Project and the efficiency of basin water resources management. Joseph Sax, a specialist in water and natural resources law, says that judicial decisions suggest a right of the United States Government (Bureau of Reclamation) to recapture seepage from its projects. 1 This means that if the WBWCD (Bureau) could prove that its irrigation water is recharging aquifers tapped by municipal wells, it (the Bureau) could claim the water as its own and force the municipalities to pay for it. Both Conservancy District and Bureau spokesmen claim that the apparent abundance of ground water in the East Shore area is a direct consequence of water spread by means of

irrigation from the Davis and Weber Aqueducts. Recent U.S.G.S. investigations, cited in the previous chapter, tend to support this claim.

Seepage recapture seems to be a particularly strong possibility in the Bountiful-Woods Cross district, where drillers are prepared to guarantee a well in any locality. Thomas and Nelson made a pessimistic report on the capacity of the ground water reservoir (bedrock sloped right off to Great Salt Lake with no fault barrier as in the north; aquifers are ill-defined and poorly permeable) and described its recharge areas. Weber Basin Project water has been spread on those recharge areas, and ground water is plentiful in the aquifers they are presumed to charge.

Deliberate spreading of irrigation water combined with vigorous ground water development would be an acceptable and less costly means of providing municipal supplies than the existing treatment and delivery facilities of the Conservancy District. It would also acknowledge some of the present treatment capacity as permanently redundant. This would still be financially superior to getting no returns at all on the seepage water. When the possibility of seepage recapture was suggested to Wayne Winegar in 1972, he manifested genuine surprise and expressed an intention to pursue the matter. When questioned several weeks later, he preferred not to comment on progress, implying that
the subject was under active investigation. Since the Sax argument was based on judicial decisions involving Reclamation specifically, it is hardly believable that Bureau officials with responsibility for overseeing the Weber Basin Project could have been unaware of the seepage recapture idea. The fact that they had not pressed it, therefore, suggests there are some complications involved which diminish its worth in their eyes. The most obvious of these deterrents is the inference it allows that the municipal and industrial features of the Weber Basin Project were not needed in the first place. Another is the emphasis it would undoubtedly give to the fact that the abundant ground water was known to the Bureau long before most Project facilities were constructed.
VITA

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