Rent Seeking, Wealth Transfers and Water Rights: The Hawaii Case

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ABSTRACT

The potential for large and questionable wealth transfers in the creation of private markets in water rights has generally been ignored in the literature, particularly that of the New Resource Economics. This oversight raises many questions in that self-serving rent seeking is an unavoidable part of the political process required for institutional development and reform. This paper examines the distributional implications of choosing between market-oriented and government directed water allocation systems, a choice posed by recent constitutional, legal, and administrative developments in Hawaii. Our case study shows that large economic rents would be recouped by a few private landowners, with little commensurate offsetting increases in wealth or efficiency (that is, "rent creation.") To avoid such undesired transfers, alternative means of achieving efficiency in water allocation in Hawaii, such as auctions, deserve consideration.

I. INTRODUCTION

The New Resource Economics (NRE) has argued that privatizing water resources and using markets to allocate water between competing uses, users, places, and times, will increase efficiency. The NRE implies that efficiency gains occur by alienating government-"owned" water rights to the private sector, and thereafter relying on market incentives and discipline to ensure maximum social benefit from available water resources. However valid this proposition may be, problems can arise from the...
manner in which alienation is carried out. A wide-spread concern is the possibility of windfall gains reaped by private owners as water is transferred into higher valued uses. How large are the economic rents\(^2\) that would be captured by private parties under a market-oriented water rights regime? Is it appropriate that private landowners recoup such rents if they have little or nothing to do with the corresponding creation of value underlying the rent? Can the efficiency benefits associated with private markets be attained without allowing large wealth transfers? These distributional issues associated with privatizing public resources have been largely overlooked in the NRE literature.\(^3\)

Hawaii provides a graphic illustration of the interaction of legal, economic, and institutional factors in addressing and resolving such distributional issues. Basic institutional design choices are determining the regime for allocating water, as well as the benefits and distribution of benefits derived therefrom. After 30-plus years of state and federal litigation, a state constitutional amendment, and a new water code, it remains somewhat unclear where water rights are vested and in particular who has the right to transfer water rights and profit thereby. The NRE has counseled\(^4\) alienating Hawaii's water use rights to private interests. The most recent court decision,\(^5\) however, affirms the state government's proactive role in water allocation. During this long period of legal uncertainty, population growth and economic change have made the value of water for urban use considerably greater than in its current agricultural use, which is primarily cane sugar cultivation. Given the value of this water, alienation without compensation could result in the transfer of considerable wealth, in the form of water use rights, to the landowners.

This paper develops a method for estimating the value of such wealth transfers. To do so, we shall assume, counterfactually, that Hawaii water rights are privately held and that a market exists for transferring such rights. Under these assumptions, we develop a model (in section II) to estimate the scarcity value of the water rights in the context of potential transfers to urban uses. This value is the amount open to rent-seeking

\(^2\) "Economic rent" is a surplus of earnings above and beyond what a resource could earn in its next best occupation; a super-normal return, as discussed in Section II below. We use the word "rent" throughout the paper in this sense.


\(^5\) Robinson v. Ariyoshi, 887 F.2d 215 (9th Cir. 1989).
activity in the process of alienation. With institutional detail and data presented in sections III and IV, we find (section V) that for the study area, an area with significant urbanization prospects, potential rents are quite significant—between $55 and $200 million in total, or roughly $700 to $2500 per housing unit to be served by the transferred water. Compensation-free transfers of such highly valuable water rights could be avoided in several ways, including auctioning them to the highest bidder as suggested by Williams.  

The issue of large wealth transfers resulting from changing water institutions is not unique to Hawaii. The “sagebrush rebellion,” for example, involves proposals for the transfer of control over large amounts of federal land in the western United States to state or private control. Historically, similar issues arose in the English enclosure movement and may be involved in the current transformations in Eastern Europe. A generalization from the Hawaii case seems in order: Extant valuable natural resources owned by the government or in common should not be alienated compensation-free to the private sector unless the efficiency gains resulting from private tenure and market control exceed the current value of the resource being alienated.

II. SCARCITY VALUE, ECONOMIC RENT, AND RENT SEEKING

Stigler defines economic rent as the “surplus of earnings over what can be earned in the best alternative.” Assuming the best alternative is priced in a competitive market, these “surplus earnings” represent a supernormal return of obvious value. As applied specifically to natural resources, scarcity rent, a form of economic rent, is simply the difference between the price of a developed resource and extraction costs.

Economic rent arises or persists through natural supply constraints and resulting scarcity, as with land, rare art works, and mineral resources; that is, inelastic supply. Scarcity value, however created, defines the upper limit to potential scarcity rent recoupment, absent market failures; scarcity value may exist even if it is dissipated and never explicitly recouped. This is true even in the case where the scarcity is engineered through government intervention such as market protection or subsidizing projects to supply scarce water to desert farms. Using the political process for such private wealth aggrandizement by diverting or claiming existing

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7. See Baden and Dana, supra note 1.
value is an aspect of economic behavior that has been called "rent seeking." Rent seeking includes efforts undertaken to insure that the institutional context is conducive for the recoupment of scarcity values by members of a specific group.

This paper concerns two types of rent seeking via some governmental process:

1. Creation or validation of private ownership claims to a resource previously in the public domain or provided below cost by government;
2. Facilitation of compensated transfers among private parties of rights to the use of existing resources.

The first type of rent seeking is reflected in the Hawaii case by private entities using the political process to validate their claims of ownership to groundwater resources. The second type is manifested in related efforts to influence the political process to permit market transfers, for monetary consideration, of resource ownership. In a sense these two aspects are two sides of the same coin. Without market transfers, any property right loses much, if not all, of its value. But without clear property rights, transferability in a market context is meaningless. Rent capture, at least in monetized form through direct sale, is dependent upon well defined property rights and markets.

Thus, the feasibility of capturing scarcity rents is predicated both on the presence of significant scarcity value, and clear ownership and transferability of the resource involved. If groundwater were available in unlimited quantities at constant cost of extraction, no scarcity value and thus no economic rent would be generated. No one would pay a premium for in situ water. However, once a finite limit on the availability of low cost water arises, users will be willing to pay a premium for the low cost water to avoid the need to resort to more expensive alternative sources. This premium represents an economic rent which could be captured in conducive institutional context.

11. We use "rent seeking" in the broad sense of activities directed at acquisition of existing wealth without quid pro quo. A narrower use of the term connotes primarily the resource cost of such activities, which are in addition to the deadweight loss usually associated with monopoly or other contrived scarcities that underly the generation of rents. See G. Tullock, Rent-seeking, The New Palgrave: A Dictionary of Economics (1987) and J. Buchanan, Rent Seeking and Profit Seeking, Toward a Theory of the Rent-Seeking Society (1980).
12. Several NRE writers have commented on the successful rent seeking associated with Federal water projects in the arid west (see, e.g., Cuzán, Appropriators Versus Expropriators: The Political Economy of Water in the West, in Water Rights 13 (1983)). However, the rent seeking associated with setting up an otherwise desirable institutional context has not received similar attention in the NRE literature.
Scarcity value and related cost concepts for Hawaii groundwater can be analytically defined in terms of Figure 1. In the figure, line $C_1C_1$ depicts marginal extraction costs for existing, conventional water sources, such as irrigation wells. If these sources were not available, the alternative would be a "backstop" source such as desalination, which we assume to be available in unlimited quantity though at the high (and constant) cost $C_2C_2$. The third line, Ebd, shows the "efficiency price" for water, incorporating extraction costs as well as in situ value, as explained below.

Suppose that, contrary to present Hawaii law and institutional trends, all rights to in situ water could be "owned" and sold independently of the overlying land. Current landowners now using water for agriculture could sell their rights to urban users as urban growth called for additional water supply. The question would then be how much must the new urban water user pay to gain access to the water now used in agriculture? Because of the indeterminacy of small number bargaining situations and related market imperfections, a point estimate of these payments is not possible. However, this payment will be bounded at the high end by what prospective buyers are willing to pay, and at the low end by what sellers are willing to accept.

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**Fig. 1. Cost, Value and Rent**

- $C_1$: Backstop Cost
- $C_2$: Efficiency Price
- $E$: Marginal Extraction Cost
- $q^*$: Capacity (mgd)
- $q_T$: $C_1$ Capacity (mgd)
- $ac$: willingness to pay at marginal capacity $q^*$
- $ab$: willingness to accept (= potential scarcity rent) at $q^*$
In Figure 1, consider a potential buyer such as the urban water supply agency contemplating a capacity addition to the level \( q^* \). Under the conditions just outlined, the buyer can either purchase water rights covering an existing source, with extraction costs \( q^a \), or develop the backstop at cost \( q^c \). Thus for the incremental source at capacity \( q^* \), the buyer's maximum willingness to pay for existing rights is represented by the distance \( ac \). Given that owners of the relatively low cost wells may refuse to sell, or will sell only at prices exceeding the urban users' willingness to pay, the cost of water from the backstop technology or more costly wells would be immediately relevant at the time of each negotiation.

The owner's willingness to accept compensation in exchange for rights to a well is also affected by the scarcity situation. If today's rate of use increases by one unit, the buyer will incur sooner the higher costs of supra-marginal wells. The resulting increase in the present value of future costs is scarcity value attached to the marginal well. Adding extraction cost to scarcity value yields the efficiency price\(^{14} \) of extracted water referred to above (line Ebd). At \( q^* \), owners of the marginal source are fully aware that any prospective buyer will have to pay more, and sooner, for even the next-least-costly well if they (said owners) refuse to sell. This awareness is the basis for determining the owner's reservation price. At (marginal) capacity \( q^* \), potential scarcity rent is the distance \( ab \) and represents the seller's minimum willingness to accept. Under perfectly competitive market conditions, a seller could not extract rents exceeding \( ab \). However, with only a limited number of landowners, additional monopoly rent of as much as \( bc \) may be extracted. Thus the upper bound of rent recoupment is \( ac \).

Section V presents empirical estimates of willingness to accept and willingness to pay, which determine upper and lower limits of a likely market price. The price in actual transactions will be determined by relative bargaining power and the extent of competition.\(^{15} \)

The costs involved in seeking rent have been a primary concern of the recent literature.\(^{16} \) Lobbying, public relations activities, legal challenges

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14. See Hanson, Increasing Extraction Costs and Resource Prices: Some Further Results, 7 Bell J. Econ. 337 (1980). Under appropriate market conditions, the efficiency price also would be the market price of extracted water.

15. An alternative approach to defining and measuring willingness to accept uses the opportunity cost of the water. Opportunity cost is determined by the value of marginal product of that water in its next most valuable use, which in this case is sugar production. However, scarcity value of the water for urban uses will exceed the opportunity cost of the water in agricultural use by a considerable margin (see R. Shrestha, An Econometric Analysis of the Choice of Adoption and Diffusion of Irrigation Technologies in Hawaii's Sugar Industry (1988) (unpublished Ph.D. dissertation, University of Hawaii).

or campaign contributions exemplify such costs. These economic rent-seeking costs only add to existing problems which result from the presence of economic rents per se. Because of the low elasticity of demand characteristic of urban water use, the conventional deadweight loss generated by restriction of water use is minor. However, potential scarcity rents remain as does the derivative policy issue of how these rents should be distributed among members of society. In this context, costs of rent seeking per se may not be important. Any resource cost involved in capturing those rents will never be likely to exceed the total potential scarcity rents available to be captured. Thus our measure of potential rents subsumes any such added transactions costs.

III. THE HAWAII WATER RIGHTS REGIME

The water use rights regime in Hawaii is presently unsettled. The situation traces at least to 1958, when a sugar plantation on the island of Kauai filed a suit involving competing claims to surface water. Fifteen years later, in *McBryde v. Robinson*, the State Supreme Court held that neither private party "owned" the water at issue. The court found that the state, rather than any private party, "owns" the water. The sugar companies then sued the state, alleging an unconstitutional taking of property without compensation. After several appeals and rehearings the legal issues are still not resolved. The most recent ruling favored the state, but further action remains possible.

During the 1960s and early 1970s, several state and county planning studies projected full development of all potable water sources in some parts of the state by the turn of the century. These projections heightened public concern and led to a search for alternative water sources and conservation measures.

In the midst of this judicial and planning activity, the 1978 state constitutional convention proposed an amendment mandating the legislature

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18. This ruling came in *Robinson v. Ariyoshi*, 887 F.2d 215 (9th Cir. 1989), which landowners originally filed in response to the unexpected and dramatic Hawaii Supreme Court decision in *McBryde* 54 Haw. at 174, 504 P.2d 1330. The 9th Circuit Court noted that "... it seems clear that the issues commented upon by the Hawaii Supreme Court substantially clouded the title of the appellees and could affect financing and transfers of property interests. ... However, we cannot say at this point that appellees 'retained [no] reasonable beneficial use' or that their 'expectation interests had been [completely] destroyed.' ... We therefore now conclude that even if the State of Hawaii has placed a cloud on the title of the various private owners, this inchoate and speculative cloud is insufficient to make this controversy ripe for review. Further, we reject appellees' argument that their claim is analogous to a physical takings claim." 887 F.2d 215, 217 (9th Cir. 1989) vacating 676 F. Supp. 1002 (D. Haw. 1987).
19. City and County of Honolulu Board of Water Supply, Oahu Water Plan (July 1982).
to designate a state agency responsible for the conservation and allocation of water. Voters approved the amendment on November 7, 1978. A series of commissions, study groups, and legislative hearings between 1978 and 1987 searched for the proper legislative response to the constitutional mandate. Fundamental legal issues about the validity of both land and water ownership claims were raised by legal scholars. The Groundwater Management Act of 1970 had given the state government considerable allocative power over groundwater supplies in designated areas of scarcity. Legislation implementing the constitutional amendment (the State Water Code) was passed by the Hawaii legislature in April 1987. The amendment and subsequent code were predicated on the belief that existing institutions were inadequate for coping with the conflicts and planning choices likely to arise out of growing demand in the face of apparent limits on new water sources.

Even if no further appeal is filed in the saga initiated by the McBryde decision, the unconstitutional takings question of Robinson may generate further litigation. The State Commission on Water Resources Management, established by the Water Code and appointed in 1987, has not taken any substantive action that would clarify the Code's rather vague prescriptions. Eventually the commission will take some action, such as denying a permit or transfer, and thus provoke a suit on grounds of unconstitutional taking of property.

20. The amendment, now Haw. Const., art. xi, § 7, says that:

The State has an obligation to protect, control and regulate the use of Hawaii's water resources for the benefit of its people.

The legislature shall provide for a water resources agency which, as provided by law, shall set overall water conservation, quality and use policies; define beneficial and reasonable uses, protect ground and surface water resources, watersheds and natural stream environments; establish criteria for water use priorities while assuring appurtenant rights and existing correlative and riparian uses and establish procedures for regulating all uses of Hawaii's water resources.


23. State Water Code, Haw. Rev. Stat. § 174C (Supp. 1989). The code establishes an agency (the Division of Water Resources) governed by a five-member State Water Commission. The Commission is given criteria by which a hydrologic area shall be declared a "designated water management area." Within such areas, all water withdrawals shall be by permit only. Permits have unlimited duration, as long as the existing use, location and times of use continue in a beneficial manner. Existing users are "grandfathered" into permits, but may freely transfer the permits only if the specified use, location and time remain unaltered. Conditions under which transfers between uses, locations or time patterns will be permitted remain unspecified in the code and will be determined as the Commission accumulates a history of actions.
In the face of this uncertainty, a range of institutional alternatives exist, depending on various combinations of permit length and ease of transferability. A market-oriented system, on the one hand, would require permits of essentially perpetual length and ready transferability between parties, regardless of changes in time, place, or use of the water. This approach is consistent with the NRE, and maximizes the possibility of rent capture by landowners. On the other hand, a government-directed mechanism would specify restrictive permitting and transfer features. Lacking transferability, current permittees could not sell their water rights and thus could not capture the associated rents. Instead, the rents would be dissipated, for example in the form of low water rates to urban users.

A continuum of possibilities lies between these two extremes. Indications are that the Water Resources Management Commission is fabricating a hybrid system, based on the Water Code, a hybrid system that tends toward the government-directed end of the spectrum, thus dampening the possibilities for rent recoupment. The Water Code itself specifies perpetual permits, but sharply limits their transferability. The permits effectively expire with the eventual withdrawal of land from sugar production. It should be noted, however, that the commission has considerable latitude on many points of its mandate, and its decisions remain open to judicial interpretation. Until the commission builds a record of decisions, and the courts interpret them, one can only conjecture as to the sort of water tenure or transfer regime Hawaii has.

Without prejudging the eventual resolution of this institutional evolution, we posit, counterfactually, a relatively straightforward market context consistent with prescriptions of the New Resource Economics: well defined, fully privatized and transferable water use rights, with government oversight only to the extent necessary to prevent third party effects. For purposes of this valuation exercise, we assume a “loose permitting” regime. The water commission would issue perpetual water use permits to landowners, thus effectively assigning ownership of water use rights to present owners of the overlying land. These assumptions establish the preconditions for recoupment of any rent by existing landowners.

Finally, note that regardless of who gets the rents in what form, the potential scarcity value still exists. It is up to the political process to
define the institutional regime which will determine the locus and form of distribution of that scarcity value. Good policy and institutional design require that this choice be made explicitly with both efficiency and equity (distributional) goals and constraints in mind.

IV. PROSPECTIVE DEMAND AND SUPPLY OF URBAN WATER

The island of Oahu, with about three fourths of Hawaii's population, has nearly reached its capacity for groundwater and surface water development. Nonetheless, the urban growth experienced on Oahu in the past several decades will likely continue. Water sources currently used for irrigation are candidates for transfer to the urban sector, but are limited in quantity. Eventually, additions to urban water supply will require desalination of brackish groundwater and, ultimately, seawater. A pilot desalination plant is currently under construction.

The water economy of Oahu consists of two sectors, agriculture and urban, as shown in Figure 2. The urban sector consists of municipal users, serviced by the Honolulu Board of Water Supply (BWS), military users, and owners of private water systems. Irrigation constitutes the largest use of water on the island, accounting in 1988 for 47 percent of all water use. Two sugar plantations account for about 90 percent of agricultural water, a portion that will decrease as land is withdrawn for urban development. Only a modest expansion in other agricultural uses is likely. Groundwater sources provide over 99 percent of the water used on Oahu.

There are several scenarios for urban expansion on Oahu, all of which foresee growth primarily in the Ewa, Pearl Harbor, and Honolulu districts (see Figure 3). The Honolulu district will grow through infilling and continued shifting to higher density housing. Ewa district, to the west of Pearl Harbor, is the site of a planned "second city" where large state, city, and private housing projects have recently broken ground or are planned. Other large landowners are pushing for development of their lands in central Oahu to the north of Pearl Harbor.

Population and water use projections summarized in Table 1 indicate that a projected 134 million gallons per day (mgd) of new urban water capacity will be needed over the next 40 years for the entire island of Oahu. About 83 percent, or 112 mgd, of this new demand will go to the

25. The Pearl Harbor aquifer, the island's primary source of groundwater, has reached sustainable yield and has been closed to further groundwater development. Indeed, a recent study (G. Yuen, J. Mink & J. Chang, Review and Re-evaluation of Groundwater Conditions in the Pearl Harbor Groundwater Control Area, (State of Hawaii Department of Water and Land Development Report R-78, 1988)) determined that the sustainable yield of the aquifer had been previously overstated. As a result, allocations to both Oahu Sugar Company and the BWS will be reduced over a five-year period, although this generally represents water allocations that are not currently utilized.

26. Data cited in this paragraph (and in Figure 2) are from City and County of Honolulu, Oahu Water Management Plan (March 1990).
Fig. 2. Oahu Water Use, 1988
Million Gallons Daily (mgd)

Private 10%
Military 6%
Honolulu BWS 37%
Agriculture 47%

Other Agr 5%
Waialua Sugar 37%
Oahu Sugar 58%

Total Consumption:
408 mgd

Agricultural Use:
191 mgd

Source: City & County of Honolulu, Oahu Water Management Plan, (March 1990).

Fig. 3. Map of Oahu
Table 1. Population and water demand projections

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</tr>
</thead>
<tbody>
<tr>
<td>Beginning population (1000s)</td>
<td>939</td>
<td>994</td>
<td>1030</td>
<td>1068</td>
<td>1119</td>
<td>1173</td>
<td>1229</td>
<td>1288</td>
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<tr>
<td>Per capita daily consumption (gallons)</td>
<td>221</td>
<td>225</td>
<td>229</td>
<td>233</td>
<td>237</td>
<td>241</td>
<td>245</td>
<td>249</td>
</tr>
<tr>
<td>Total consumption (Beginning Year)</td>
<td>207</td>
<td>224</td>
<td>236</td>
<td>249</td>
<td>265</td>
<td>283</td>
<td>301</td>
<td>301</td>
</tr>
<tr>
<td>Island-wide increase (mgd)</td>
<td>16</td>
<td>12</td>
<td>13</td>
<td>17</td>
<td>17</td>
<td>18</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Study area increase (mgd)</td>
<td>14</td>
<td>9</td>
<td>11</td>
<td>14</td>
<td>14</td>
<td>15</td>
<td>17</td>
<td>18</td>
</tr>
</tbody>
</table>

Note: Population growth beyond 2010 and per capita daily consumption beyond 2005 estimated by extrapolation.
mgd = million gallons daily.
Sources: Department of General Planning, Residential Development Implications of the Development Plans, City and County of Honolulu, 1985 (population); Board of Water Supply, Municipal Water Use Plan, 1981 (Per capita consumption.)

Varying amounts, between nine and 18 mgd of the new capacity will be needed every five years to meet urban growth projections for the study area. These increases can be visualized as movements outward along the horizontal axis of Figure 1 and amount to assuming that demand is perfectly price inelastic.

A recent development not fully accounted for in the water demand estimates is the large number of proposals for new golf courses on Oahu. In early 1989 there were 32 courses under construction or being planned. The upsurge was so great that the city council placed a 15-month moratorium on golf course approvals in order to study cumulative impacts. Should this land use alternative prevail, then our estimates of future water demand are conservative.

Transfers and desalination are two major alternatives for meeting future urban water needs. Oahu Sugar Co., the principal current water user in the study area, gets about 20 mgd from the Waiahole Ditch, an elaborate system of tunnels and ditches developed in the nineteenth century to

27. These data come from island-wide population projections (State of Hawaii, Dept. of Planning and Economic Development), with regional distributions from City and County of Honolulu, Department of General Planning, Residential Development Implications of the Development Plans (1985), and per capita water use estimates from the Board of Water Supply.
transfer water from mountain dikes and Windward Oahu valleys to sugarcane fields in the island's central plain. The company's remaining 91 mgd (as of 1985) comes from wells. Campbell Estate plans to develop brackish caprock water in a dual system for irrigating large open spaces (for example, parks, golf courses) in the planned second city. However, brackish groundwater is extremely limited and desalination of seawater eventually will be necessary.

Continued sugarcane production on Oahu is uncertain for reasons largely unrelated to water. Sugarcane will almost surely go out of production if federal price supports and associated sugar import quotas are abolished or reduced significantly. Urbanization also threatens the existence of Oahu Sugar Co., whose cultivated lands are all leased. Existing long-term leases expire in 1995 and 1996, although sugar production may continue thereafter under short-term arrangements. While continued marginal reductions in sugarcane production are still possible, at some point Oahu Sugar will no longer have enough land to maintain economies of scale necessary for profitable production.

Importing water from other areas of the island is not likely. The windward side of the island is estimated to have 37 mgd of remaining groundwater capacity, only slightly more than required to meet urban growth and maintain interconnected surface flows in that region and in the eastern end of Oahu over the next 40 years. The more remote North Shore area of Oahu is not connected to the main county system, and water exports from that region, which would require high lifting or tunneling costs, appear uneconomical at this time.²⁸

Landownership in Central Oahu is highly concentrated. Five private entities own all of the land slated for future urban development in that area: the Campbell, Robinson, and Bishop estates, Amfac Corp., and Castle and Cooke, Inc. Campbell Estate owns all of the land planned for urban development in Ewa district. Groundwater underlying its lands is best positioned to supply the water needs of the planned second city. The next largest player is Oahu Sugar, a subsidiary of Amfac. Although its property holdings in central Oahu are relatively small, Amfac owns the Waiahole Ditch system mentioned above. All five landowning trusts have major housing development plans and compete aggressively for approvals to implement their plans.

Since major developers are expected to provide the water for their projects, a variety of urban water rights buyers will be involved; the BWS will not operate as a monopsonist. On the sellers' side, the small number of landowners (and, presumably, water owners) suggests the possibility for collusion. A strong bargaining position would allow prospective own-

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²⁸ City and County of Honolulu, Oahu Water Management Plan 84, Table 7 (1990).
ers to negotiate high prices for water rights and to capture monopoly rents in addition to scarcity rents.

V. WILLINGNESS TO PAY AND TO ACCEPT

With the institutional framework specified and with water demand and supply data, we are ready now to describe data for the functions and relationships of Figure 1 and then to estimate willingness to pay and to accept. Consider first the marginal extraction cost function, labelled $C_1$ in the figure. Table 2 presents cost data covering existing water sources that might supply the study area. All wells (strictly speaking, well fields) shown here are currently used for sugarcane irrigation, and are arrayed according to estimated annual cost (for drilling, headworks, transmission, operation, and maintenance) per million gallons daily (mgd) of capacity. Presumably, BWS would want to acquire new sources in this order. Denote the extraction costs of the $j^{th}$ water source as $C_j$, and its yield as $q_j$, where $j = 1$ refers to the least expensive source. Taken together, the $C_j$, as shown in the last column of Table 2, values trace out a stepwise version of the $C_1$ curve in Figure 1.

### Table 2: Costs of water from candidate sources

<table>
<thead>
<tr>
<th>Name of Source $j$</th>
<th>Depth (feet)</th>
<th>Yield (mgd)</th>
<th>Distance (miles)</th>
<th>Well Cost $^1$ ($/yr)</th>
<th>Transmission Cost $^2$ ($/yr)</th>
<th>Operation Cost $^3$ ($/yr)</th>
<th>Total Cost ($/yr)</th>
<th>Annual Cost/mgd ($C_j$) ($/yr)</th>
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<tr>
<td>Wai $^4$</td>
<td>NA</td>
<td>20.82</td>
<td>4.8</td>
<td>489333.</td>
<td>116861.</td>
<td>0.</td>
<td>606694.</td>
<td>29140.</td>
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<tr>
<td>OS5</td>
<td>220.</td>
<td>5.66</td>
<td>1.3</td>
<td>8477.</td>
<td>29897.</td>
<td>227249.</td>
<td>265523.</td>
<td>46930.</td>
</tr>
<tr>
<td>OS3</td>
<td>226.</td>
<td>4.71</td>
<td>1.0</td>
<td>8890.</td>
<td>22998.</td>
<td>194264.</td>
<td>226152.</td>
<td>48015.</td>
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<tr>
<td>EP10</td>
<td>200.</td>
<td>5.23</td>
<td>3.0</td>
<td>7908.</td>
<td>68994.</td>
<td>190895.</td>
<td>267797.</td>
<td>51214.</td>
</tr>
<tr>
<td>OS2</td>
<td>340.</td>
<td>5.09</td>
<td>1.0</td>
<td>12404.</td>
<td>22998.</td>
<td>315835.</td>
<td>351236.</td>
<td>69005.</td>
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<tr>
<td>OS7</td>
<td>385.</td>
<td>9.82</td>
<td>1.5</td>
<td>12595.</td>
<td>34497.</td>
<td>689978.</td>
<td>737070.</td>
<td>75058.</td>
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<tr>
<td>EP15</td>
<td>400.</td>
<td>4.96</td>
<td>1.0</td>
<td>14271.</td>
<td>22998.</td>
<td>362080.</td>
<td>399349.</td>
<td>80514.</td>
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<td>EP16</td>
<td>415.</td>
<td>7.64</td>
<td>1.0</td>
<td>13881.</td>
<td>22998.</td>
<td>578385.</td>
<td>615514.</td>
<td>80565.</td>
</tr>
<tr>
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<td>475.</td>
<td>6.02</td>
<td>1.0</td>
<td>16063.</td>
<td>22998.</td>
<td>521859.</td>
<td>560919.</td>
<td>93176.</td>
</tr>
<tr>
<td>OS8</td>
<td>480.</td>
<td>6.02</td>
<td>1.0</td>
<td>16205.</td>
<td>22998.</td>
<td>527352.</td>
<td>566555.</td>
<td>94112.</td>
</tr>
<tr>
<td>EP23$^5$</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>821250.</td>
<td>NA</td>
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<tr>
<td>EP27$^5$</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>821250.</td>
<td>NA</td>
</tr>
</tbody>
</table>

Note: OS = Oahu Sugar Co.; EP = Ewa Plantation; Wai = Waiahole Ditch.

$^1$Drilling and headworks cost estimated from Board of Water Supply and Department of Land and Natural Resources data on well development. Total costs annualized at three percent interest assuming 50 year life of installation.

$^2$Average cost per mile for six main projects (BWS Annual CIP Budgets) multiplied by distance in column 4 above and annualized at three percent for 40 years.

$^3$0.50 per million foot-gallons x depth of well x yield x 365 = ($/year)

$^4$Waiahole Ditch is about 80% confined dike and 20% surface water brought through tunnels from Windward Oahu. Costs estimated from data supplied by BWS. Since this water would flow downhill, operation costs are assumed zero.

$^5$EP23 and EP27 produce somewhat brackish caprock water. Cost figure covers desalination as well as transmission and operation.
As urban capacity rises over time, so will extraction cost. The BWS eventually will find costs of the marginal conventional water source higher than for alternatives. Indeed, a demonstration plant has recently been built to experiment on a relatively large scale with various methods of desalinizing brackish caprock water. Once all transfers of potable groundwater and these brackish sources have been fully exploited, however, the ultimate backstop—desalinated seawater—must come into play. No thorough cost estimates appear to have been done specifically for Hawaii area seawater, but higher salinity would make desalination of seawater more expensive than for brackish groundwater. Published costs for plants elsewhere in the world suggest a range of $1.825 million to $3.650 million, per mgd, assuming year round, full capacity operation. These figures will serve to bracket the backstop cost $C_2$.

The water sources listed in Table 2 will supply some 96.7 mgd, thus satisfying projected demand growth into year 35 of the 40-year planning horizon covered by Table 1. These sources represent essentially all existing capacity in the study area. Water imports involve prohibitive pumping lifts, transmission costs or both. Hence 96.7 mgd serves as an estimate of the switch point, $q_T$, in Figure 1, beyond which the backstop source must be brought into production.

With marginal extraction costs, the backstop cost, and switch time, we can proceed to estimate (maximum) willingness to pay and (minimum) willingness to accept. At the margin $q^*$ in Figure 1, the BWS would be willing to pay as much as $q^*C_2$ less extraction cost $q^*C_1$ to obtain a conventional water source, rather than being forced immediately to begin desalination. This implies potential rents of $ac$ for that source. In general, this difference can be denoted $C_2 - C_1$ dollars per unit, for each of the $q_j$ units produced by the $j^{th}$ incremental source.

Discounting to time zero at rate $r$, then, the present value of willingness to pay from the $j^{th}$ source is

$$\frac{(C_2 - C_1)q_j}{(1+r)^t}$$

where $t^*$ is the midpoint of the five-year period (from Table 1) over which

29. It has been estimated that brackish water desalination costs will range from $1.25 to $2.25 per thousand gallons (Park Engineering, Brackish Water Study (1983) performed for City and County of Honolulu Board of Water Supply). Assuming year-round operation of the desalination facility, these numbers translate to $456,250 = $1.25/1000 gallons x 365 days/year x 1000) and $821,250 per million gallons daily. A more recent study (D.M. Marske, Proposed Demonstration Desalting Plant, 7-27, Division of Water and Land Development, Department of Land and Natural Resources, State of Hawaii, Report R-74, (1985)) suggests that the latter figure is the more realistic. These values are used in place of the conventional costs given for EP23 and EP27 in Table 2.


31. This figure assumes that the BWS will maintain a policy of limiting withdrawals to sustainable yield, at least over the long run, for all sources.
is brought into use. Calculating this for each source and summing over successive new sources, \( j \) yields the present value of all such potential rents, presented in Table 3. At the lower estimate of the backstop, $1.825 million, this indicates that transferrable water rights would generate total willingness to pay of $98.6 million as shown in Table 3.

<table>
<thead>
<tr>
<th>Backstop Cost ( C_n ) ($/mgd)</th>
<th>Willingness to Pay ($million)</th>
<th>Willingness to Accept ($million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,825,000</td>
<td>98.6</td>
<td>56.6</td>
</tr>
<tr>
<td>3,650,000</td>
<td>203.6</td>
<td>115.7</td>
</tr>
</tbody>
</table>

Note: \( mgd = \) million gallons per day. Values discounted to 1990 at \( r = 3\% \). Assumes brackish water in wells EP23 and EP27 desalinated at $821.250/mgd.

To estimate the corresponding willingness to accept, note that landowners, as profit seekers, have an incentive to inform themselves of the opportunity cost of water used in their operations, by considering its value in alternative uses, including the scarcity value of water sources. This opportunity cost depends on the value of water in urban use and the scarcity of low cost sources appropriate for such use. Given this information, owners form a perception of scarcity value which in turn defines willingness to accept compensation for the water rights.

This perception can be viewed in the following manner. BWS planners foresee a time \( T \) when a high cost backstop source of water must be brought into play.\textsuperscript{32} If this "switch time" could be delayed, the Board could thereby realize a decrease in (the present value of) future costs of supplying a given demand path over time. This present value constitutes potential scarcity rent on the existing marginal water source, corresponding to distance \( ab \) in Figure 1. As noted in section II, this difference between efficiency price and extraction cost represents willingness to accept by current owners for the marginal source. Aggregating over sources, as before, yields total willingness to accept.\textsuperscript{33} Based on the same data as for the $98.6 million willingness to pay estimate in Table 3, willingness to accept
to accept is $56.6 million. Bargaining between buyer and seller will establish a transaction price somewhere between these two figures.

The results of this simulation are most sensitive to the backstop cost $C_2$. If the backstop cost is set at the upper limit of estimates noted above, $3.65 million/mgd, then the willingness to pay estimate rises to $203.6 million (Table 3) and willingness to accept is now $115.7 million.

In sum, while we lack all the data for a definitive point estimate, the data in Tables 1 and 2 indicate that willingness to pay by the BWS would range between $98.6 and $203.6 million. While corresponding estimates of willingness to accept, at $56.6 and $115.7 million, overlap the willingness to pay range, there is clearly scope for substantial wealth transfers. For perspective, this range implies a premium on housing costs of $700 to $2500 per housing unit projected for the study area.

VI. CONCLUSION: INTERPRETATION AND IMPLICATIONS

Given the present ambiguity about ownership and transfer of rights to groundwater in Hawaii, it is no surprise that prospective recipients of economic rent are using the political process to shape the state's institutions for water allocation; that is, engage in rent seeking. These groups include the landowners who want privatized water rights along with market allocation so that the rents can be recouped when sugar production ceases. Others, such as the present water purveyors, urban developers, and other urban users, prefer the present system where economic rents are dissipated in low urban water prices. A variety of public interest groups object to the perceived "windfall" gains or wealth that might accrue to sugar companies or landowners whose ownership claims to both land and water are thought to be tainted by the methods used to acquire these resources. Proponents of strong state planning, a very common

synthesize it in a model paralleling that of Moncur and Pollock, supra note 13, at 62. Let $p_i$ denote the efficiency price path (of the extracted resource) comparable to line Ebd in Figure 1:

$$p_i = C_2 e^{-\sigma a} + \int_0^t e^{-\sigma a} C_{m0} dt$$  

(1)

(see Hanson, supra note 14, at 336). Our extraction cost function $C_{m0}$, corresponding to line $C_1 C_4$, takes the stepwise form. Suppose for illustration that $C_{m0}$ has only two steps:

$$C_{m0} = \begin{cases} 
C_{1a}, & 0 \leq t < t_1 \\
C_{1b}, & t_1 \leq t < T 
\end{cases}$$  

(2)

Segmenting the integral above to accommodate the discontinuities in $C_i$ and then integrating yields the efficiency price path for our specific case. Finally, subtracting $C_{m0}$ yields the path of scarcity value (willingness to accept) over time. For $t \epsilon (0,t_1)$,

$$\phi_t = p_i - C_{m0} = (C_1 - C_{12})e^{-\sigma a} + (C_{12} - C_{11})e^{-\rho t_1 a}$$  

(3)

For $t \epsilon (t_1, T)$, $\phi_t$ includes only the first term in this last expression.

Proceeding in this fashion, we obtain $\phi_t$ for each subperiod in $(0,T)$. Multiplying $\phi_t$ by the appropriate capacity $q_{m0}$, discounting back to time $t = 0$ and adding over sources $j$ yields the estimates given in Table 3. To be commensurate with the extraction cost data, time 0 may be interpreted as 1990.
predisposition in Hawaii, do not trust the market to determine the rate and extent of transfer of agricultural land and water to urban uses. Members of all groups have lobbied extensively, drafted legislation, sponsored research and public meetings, and participated in or supported lawsuits.

The objective policy analyst may have trouble picking sides. On the one hand, economists generally appreciate the efficiency enhancing features of markets once they are in place, assuming the absence of market failures. However, in this case there is doubt about the magnitude of marginal social gains to be achieved through landowners' likely responses to new price incentives, in light of incentives which already exist. Moreover, as we have emphasized in this paper, analysts must be sensitive to questionable distributional effects or wealth transfers that would result if water markets were set up in such a way as to permit concentrated rent recoupment without rent creation.

The standard prescription of the new resource economics calls for privatizing the resource and allowing the market to determine its allocation in pursuit of maximum rent creation. However, in the Oahu case, significant increases in overall efficiency or wealth will not likely occur, thus rent creation potential is small. Water will be used more efficiently when it is transferred from lower valued agricultural uses to higher valued urban uses. But this shift will happen on Oahu regardless of the extent of privatization and marketing of water, given the desire of landowners to shift land to urban use to exploit intense demand for housing. Sugar production on Oahu, accounting for the bulk of agricultural land and water consumption, is basically an inefficient use of resources resulting from quota protection and subsidies. As sugar fades away, a window of opportunity may open for alternative crops in Central Oahu, but the time frame is too short for any other major agricultural activity to establish itself before being displaced by inevitable urbanization. Elsewhere in Hawaii, much of the land retired from sugar production and not shifted to urban uses remains idle.

Moreover, the rate of urban growth on Oahu is probably independent of either the presence of sugar production or the irrigation practices of the remaining sugar plantations. The present landowners, the likely recipients of scarcity values estimated in this paper, cannot augment the values created by urbanization and thus cannot affect the amount of rents being sought. Population growth, zoning practices, and water allocation institutions will be the primary determinants of the size of the scarcity value and resulting economic rents from urbanization, not the landowners. Even before leases expire on land cultivated in sugar cane, the landowners press for urban zoning.

This scenario of potential rent seeking and recoupment without rent
creation results from a particular set of circumstances. However limited, the Hawaii case still serves as an important qualification to the applicability of one of the more central and general institutional prescriptions of the NRE. Privatization, without recognition of and compensation for existing scarcity value, and subsequent market allocation of groundwater on Oahu would be achieved only at the cost of rather significant and questionable wealth transfers.

On the other hand, potential efficiency gains in water use probably cannot be achieved under a permanent government planning and regulation process. For one thing, water is likely to remain undercosted and underpriced. Since state law and judicial decisions have placed the water rights in state hands, one possibility for realizing efficiency gains without the wealth transfers is to have the state auction the water rights to the highest bidder, as suggested by Williams. Bid prices paid by new rights holders or their customers would then fully reflect the scarcity value of the water resource, thus enhancing efficiency. Economic rents would accrue to the government, rather than private owners. Once auctioned, water rights would remain in the private sector, leaving future allocation decisions subject to market efficiency criteria.

The auction solution faces several problems of a "public choice" nature. Given interest group pressures and bureaucratic incentive structures, is the public sector capable of organizing and conducting auctions with efficient and equitable outcomes? If an efficient auction procedure were devised, would the concentration of landownership simply foil it? Would all government entities, including local water utilities, be expected to take part in the auction and pay full value?

In principle, government could retain the water rights and still achieve efficiency by pricing at full economic cost and by rationalizing land use planning. But true marginal cost pricing has seldom been achieved by public utilities, and land use planning processes invite their own rent seeking behaviors.

Nevertheless, under a "loose permitting" system facilitating privatization without compensation to the public sector, and subsequent market exchanges, Oahu urban water users as a group would be paying landowners a $55 to $200 million bonus to support the landowners' prior decision to exit from an inefficient agricultural activity, with little or no prospect of offsetting social gains. In short, when institutions have to be designed in a second-best world, prescriptions of the New Resource Economics require qualification.

34. Williams, supra note 6, at 914.
NOTATION & ABBREVIATIONS

C_2: Backstop cost
C_{ij}: Cost of the j^{th} source of transferred water, that is, of the j^{th} irrigation well
r: Discount rate
q_j: Yield of the j^{th} source (in mgd)
mgd: million gallons per day
p: efficiency price of extracted water
\phi: Scarcity rent or value: \phi = p - C_1
BWS: Honolulu Board of Water Supply, the urban water supply utility for the island of Oahu