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Economics of Water Acquisition Projects

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Economics of Water Acquisition Projects

1. Introduction

As part of its oversight and approval role over Columbia River Basin (CRB) fish and wildlife programs, the Northwest Power Planning Council (Council) receives proposals to augment instream flows for the benefit of fish. Such proposals sometimes include plans to accomplish this instream flow augmentation by the short- or long-term acquisition of water rights from existing owners.

Because such instream flow acquisition has little precedent in the region, the Council has requested the assistance of the Independent Economic Analysis Board (IEAB) to develop recommendations and guidelines for how such water acquisitions might be accomplished, and how these proposals should be evaluated. Specifically, the Council asked the IEAB to address the following questions:

a. What determines the economic value of water uses?

b. How is water use currently allocated, and is this allocation based on economic value?

c. How should the cost-effectiveness of a proposed water project be evaluated?

d. How could market mechanisms or program structures be used to increase the cost effectiveness of water projects?

A specific motivation for this report was the Council's recent experience with streamflow enhancement in the Teanaway River. As explained to the IEAB by Karl Weist, a large section of the Teanaway is dewatered every irrigation season. The intent of the Teanaway River Instream Flow Restoration Project is to restore flows to the Teanaway by purchasing land with water rights attached, by purchasing water rights outright and by doing a water conservation project. Due to landowners’ strong reluctance to sell water rights and land for streamflow enhancement, the project evolved into a water conservation effort. The Bureau of Reclamation, Bonneville and others would purchase new irrigation systems for the three main water user groups on the Teanaway, replacing the current system of push-up dams with a lower point of diversion on the river and a high-pressure irrigation delivery system. By installing this higher-tech system, and eliminating flood irrigation, it was hoped that considerable volumes of water would be saved.

For a variety of reasons, the cost of the project escalated to $5.3 million. According to Weist, the project would generate no more than 3.74 cfs during the irrigation season (which is equivalent to 7.4 acre-feet per day). If the irrigation season lasts 6 months, this conservation project would be expected to add 1,351.4 acre-feet to instream flow -- at a cost of $3,921 per acre-foot. This cost seems high based upon casual comparison to prices experienced in Idaho and Oregon water markets. So, we set out to gain some perspective on whether this cost is unreasonably high for a stream enhancement project and whether water acquisition would be an appropriate, low-cost alternative.

2. Context and broader framework

Water acquisition should be viewed within a broader framework. First, the National Marine Fisheries Service in its draft biological opinion (NMFS, 2000) lists instream flow augmentation as one among a menu of alternative actions that should be considered to assist the survival and promote the recovery of endangered and threatened anadromous fish stocks. In some circumstances this potentially could be accomplished by transferring water rights from agricultural use to instream flow.

Second, water acquisition should be viewed within the context of the Council's subbasin planning process and should be evaluated as an element of the Council's ongoing efforts to assure the cost-effectiveness of the fish and wildlife program. As the subbasin planning proceeds, we expect that some subbasin plans will give high priority to instream flow improvements, based on an assessment of the biological needs of the fish and a comparison of alternative programs to help the fish. Once instream flow improvements are listed as a priority in a subbasin plan, then there needs to be an evaluation of how such instream flow improvements might be accomplished – involving choices among alternatives such as modifying reservoir or hydropower operating rules, altering irrigation infrastructure, or acquiring water rights outright by purchase or lease. If a decision is made to acquire water, still more choices must be made to select the most cost effective way to acquire that water. Thus, once the subbasin planning process is in place, the series of decisions that might lead to a decision to acquire water will offer a number of points where economic input in the form of cost effectiveness analysis should be applied.

In the short term, however, the subbasin planning process is not yet in place, but NMFS is advocating that flow augmentation be pursued, and the Council is currently being asked to consider fish and wildlife project proposals that include provisions to augment instream flows and/or acquire water for fish. Our comments address this situation – how should the Council view and evaluate these proposals?

3. How water is now allocated

If programs are developed to acquire water for instream flow augmentation, these programs will have to be designed in accordance with the rules that govern how water is allocated. Because water law does not facilitate the emergence of water markets, water is often not allocated to the highest value uses. The value of water to water rights holders depends upon the specific circumstances of that use. Some water uses generate values of close to $100 per acre-foot per year. Other uses generate values of barely a few dollars per acre-foot. Although some differences over space and time in the values generated by water should be expected, given the cost of transport and the uncertainties of water supplies, the historic allocation rules perpetuate a much wider range of use values than would occur with more effective water markets.

The central tenet of water allocation in the Northwest states is the prior-appropriation doctrine, interpreted slightly differently by each of the states. This contrasts with the riparian doctrine of earlier eastern water law that allows landowners to make "reasonable use" of water from streams adjacent to their land, but requires them to return such water to the stream undiminished in quantity and quality. Under the prior-appropriation doctrine, a person earns the right to use a quantity of water by diverting it to a beneficial use on a specific tract of land. For a beneficial use in agriculture, the "water duty" for this right is the water needed to irrigate the average mix of crops on the "appurtenant" land with the irrigation technology prevailing when the water right was granted. The priority of the right is the date the water was first diverted. If water supplies are short, the most recent ("junior") appropriators are the first to be cut off, partially or entirely. The earliest ("senior") appropriators receive their full entitlements until no water remains at the source and all junior appropriators have been shut off. Irrigators desiring to expand their diversionary rights beyond the quantity to which their appropriation entitles them must execute a new appropriation having the most junior priority ("no expansion of use"). Even if water supplies are not short, water not beneficially used is forfeited to junior appropriators or becomes available for re-appropriation by another person ("use it or lose it"). Similar definitions of beneficial use were developed for water diversion to other uses (municipal, industrial, etc.)

The prior-appropriation doctrine developed because the western states had plenty of land, few people, and even more limited water supplies. Mining and irrigation development were expensive propositions and were feasible only if abundant and secure water supplies could be assured when and where needed. The prior-appropriation doctrine was a response to this need. If a miner or farmer could first locate an unused water supply, and then build the required facilities and beneficially use that water, the water would be his in perpetuity. No later, junior, appropriator could do anything that would diminish the senior user's water supply. Such secure water supplies were essential to attract the massive amounts of capital needed for western mining and irrigation development. While other resources were also crucial to development, they didn't pose the same physical difficulties of transportation or the institutional problems of monitoring and enforcing property right transfers as did water.

The security of water rights depends on the complicated "use-dependencies" among water users. Actual consumption of water ("consumptive use") by irrigated crops is almost always less than what is diverted from the stream ("diversion amount"). Unconsumed water returns to the stream as surface runoff, via spring flow after deep percolation to an underlying aquifer ("return flows"), or escapes by the same means to a second watercourse ("escape flows"). Return and escape flows become water supplies that enter into the water rights of other irrigators, creating a complex web of hydrologic linkages among users. These complicated user dependencies mean that water transactions by parties somewhere in the basin can easily affect third parties elsewhere in the basin. Many of the seeming rigidities of the prior-appropriation doctrine, and the barriers it seemingly places in the way of markets, are actually provisions intended to minimize third-party effects.

In most western states, waters rights are private property rights appurtenant to land. If you buy the land you also buy the water. Separating the water from the land is legally tricky but sometimes possible. This is because a water right specifies the quantity of water, nature of use, point of diversion, point of use, and a priority date. Changing any of these parameters has the potential to affect third parties through the complex workings of basin hydrology and water allocation rules. States generally allow other users to protest, and frequently to block, changes in these parameters if they expect the change to damage their rights.

This rigidity of the appropriation doctrine is especially significant because:

a. Irrigation was first in line for water. Today's irrigators now hold most of the rights to consumptively use water in the interior Columbia Basin. If water is to be reallocated to other uses, most of this water will have to be shifted from irrigation use.

b. Water supplies on many rivers have been fully or over-appropriated, meaning that the sum of the rights to divert water exceed the typical annual flow. In dry years this means that many western streams have little unappropriated water, and some streams at some times may be virtually dry.

c. State laws have only recently recognized instream flows as beneficial uses. This means that any new claims for water rights for the purpose of leaving the water in streams to augment flows would be junior to other existing water rights on the stream, and of little use for maintaining instream flows.

d. It is possible, but difficult to reallocate water among uses. This is true for reallocation from low-valued to higher-valued irrigation uses, and especially true for reallocation from irrigation to other uses.

The prior-appropriation doctrine evolved to foster reliability and security of water supplies, not flexibility. Water is allocated according to some clear and simple rules – most notably the date the water was first beneficially used – but the economic value of that use plays little role. The prior-appropriation doctrine is likely to remain firmly entrenched in western water law for the foreseeable future. Proposals to acquire water to augment instream flow will have to deal with this institutional legacy.

4. Alternative ways to augment instream flows

Suppose it has been determined that fish in a stream segment would benefit if instream flows were increased by selected amounts at given times. There may be a number of alternative ways to meet these flow targets. The Council should select among these alternatives in a cost-effective manner.

The choice is either to buy water, or to take some other action that yields augmentation water. It may be possible to buy water in the amounts and at the time needed – probably from existing irrigation use in the basin. The difficulties of this option were discussed above and will be discussed in more detail below in Section 5.

It is important, however, to weigh the cost effectiveness of purchasing water for flow augmentation against other possible flow augmentation alternatives such as changes in the operation and physical infrastructure on a stream. These might include changes in the operation of storage reservoirs or hydropower generation facilities, and physical or operational changes to irrigation diversion or conveyance structures. Since irrigation is almost certainly the main consumptive use of water in the basin, it also makes sense to consider whether changes in farmers' water delivery or application systems could meet instream flow augmentation objectives.

Although such alternative operation and infrastructure changes to meet streamflow targets would have costs (and perhaps benefits) to basin stakeholders, it might be cost effective for the fish and wildlife program to pay part of the cost of such projects if they could be shown to meet the flow objectives. The IEAB is skeptical of this approach because it will take considerable care to make sure that the hydrologic effects of such projects are correctly assessed. Because of the hydrologic linkages between water supplies and return flows, increases in conveyance and application efficiency usually don't result in additional water that can be used for flows. However, such changes do need to be considered, although very carefully, because in selected cases they can be used to meet flow amount and timing goals at critical stream locations, and perhaps in a cost-effective manner.

Both Oregon and Washington have statutes dealing with “conserved” water. Some can be sold to other consumptive uses and some must be left instream. Whether this really results in net increases in water for the new uses and the stream, or just results in net damages to hydrologically linked and widely dispersed third parties is an open question.

Idaho law is seemingly less hospitable to transfers based on water “conservation,” perhaps because of the more obvious hydrologic linkages between irrigation and the Snake Plain Aquifer. On the other hand, much of the water consigned to the Idaho water banks is surplus to irrigation needs because of the increases in irrigation efficiency (much of it brought about by conversion to sprinklers) over the last 40 years – suggesting that Idaho has in practice allowed “conserved” water to be marketed.

5. Methods of acquiring water

Suppose the Council is considering whether the appropriate way for the fish and wildlife program to augment instream flows for fish is to do so with acquired water. How might the program go about acquiring this water? Agencies, politicians and current right holders seem to concur that if water is needed it should be purchased from willing sellers, rather than rely on government regulatory powers or taking provisions. Obviously, to purchase water from willing sellers, water law must support such transactions.

Historically, discussion of water markets has followed several themes. Occasional years of drought have stimulated interest in markets and led to the creation of institutions such as the Idaho and California water banks (discussed in more detail below) to let surplus water or water from low-valued uses flow to higher-valued irrigation or municipal uses.

Regularized water markets, not just in drought years, have been promoted to encourage efficiency of water allocation among irrigation users and between agricultural and urban uses. While various kinds of water markets do exist in the Pacific Northwest, and further market innovations are regularly discussed, water markets have so far mostly failed to bring about a significant magnitude of transactions because of the geographic, technical and appropriation doctrine obstacles to such markets.

Most recently, water markets have been touted as a way to acquire water to achieve environmental goals – such as the flow augmentation for fish that is the subject of this paper.

Water markets can take a number of forms. Some of these markets already exist in the Pacific Northwest, and other forms that might augment instream flows are being proposed:

a. Western water has always been marketable in the sense that you can buy water rights if you buy the land to which it is appurtenant. Likewise, it may be possible to buy only the water rights and leave the landowner holding dry land. From the perspective of the proposals facing the Council, the hard parts of any water right purchase include the difficulty of changing the nature of the use from irrigation to instream flow, moving the location of use from the point where it was originally diverted for irrigation to where the streamflow is needed, and actually delivering this water past other would-be users in between. Fortunately, some cases are easier -- land fallow or purchase of water rights may provide more instream flows without a legal change of use if there are no present or potential junior appropriators on the stream.

Oregon, Idaho and Washington all do allow water rights to be changed from irrigation to instream flow use, subject to objection by potentially affected third parties. This means that such a change in use is not treated as an abandonment of the right, where the water would be subject to diversion by junior right holders, or new appropriation. In all three states, while instream flow rights may be brokered by agencies or organizations, the water right is eventually held in trust by the state.

b. Water transactions can also be short term (referred to variously as water sales or leases). The water right holder retains ownership of the right, but annual flows of water under that right are exchanged between buyer and seller. Water leases between farmers in drought years have occurred since the beginning of irrigation in this region, but have often been informal, unregulated, and unreported.

   The Oregon and Washington water trusts have recently brokered a number of annual water leases for the purpose of augmenting instream flows (Jaeger, 2000). These water trusts have apparently been quite successful in changing the nature and location of use to instream flows.

   Some states have placed such short-run transactions on a formal footing as water banks. Idaho bank transactions move stored water that is excess to farmers' needs to other water-short farmers, to utilities to generate hydropower, and to fish agencies for instream flow augmentation. The California drought water bank was used in two critically dry years to move water from willing seller farmers to municipal uses. The state legislation that creates a water bank generally legitimizes the change in location and nature of use for bank transactions.

c. Buying a water right gets you water every year unless a more senior user preempts the right. Water banks or other annual markets are less reliable than purchased senior water rights because the leased water may not be available in dry years when it is most needed for fish. To bridge this gap, contingent water markets are now in place in Colorado, Arizona, and California, but not in the Pacific Northwest. In a contingent water market, farmers agree, for a price, to deliver water to the buyer whenever predefined trigger conditions (low flows, low snowpack, etc.) are met. Farmers would keep their water in most years, but the water would be available for flow augmentation in years when flow is most needed.

d. Other options for short-term acquisition of water when needed include water purchase and leaseback, which also allows the seller to continue to use the water in non-critical periods for the duration of the lease, and purchase of water priority where the buyer pays the seller to accept a more junior priority date.

The various alternative forms of water markets, their advantages and complications, are described more fully in the paper by Hamilton in Appendix B, as well as in the references listed in Appendix A.

6. Water has a range of economic values in alternative uses

If water for flow augmentation is to be acquired in some sort of market (i.e., voluntary exchange), then the questions arise -- at what price and under what conditions?[1] If sellers are to be willing to part with some or all of their water, they must be offered a price that at least approximates the value of the water in their own uses. Since most such water would have to be acquired from irrigation, the question narrows down to asking how much irrigation water is worth. The answer is not straightforward, and depends on factors such as the following, which affect both farmers' willingness to offer water for sale, and the value of that water to other potential users. Values of water in alternative uses and methods for estimating these values are discussed in considerable detail in Young (1996). The range of water values is due to factors such as:

a. Variations due to land quality, region, crops grown, and irrigation system used.

Generally water is more valuable when applied to good land, in regions where yields are high, and where high valued crops can be grown. On the other hand, farmers who have a high fixed investment in expensive irrigation equipment may be less likely to lease their water (because they generally have fewer variable costs that they can avoid if they choose not to irrigate). This diversity of circumstances means that some farmers producing relatively low crop value per acre-foot might be willing to sell or lease water at relatively modest prices that would be wholly unacceptable to others. Since there are a diversity of farms and water values, higher prices would attract a greater supply of water. Within any subbasin, the amount of water voluntarily offered would increase as water price increases.

b. Variations in the nature and quality of a water right.

There is a wide variation among irrigators in the nature and quality of their right to water. Senior rights, since they are least likely to be cut off when water gets short, are most valuable -- both to irrigators considering selling water, and to anyone wanting to buy or lease their water for flow augmentation. A junior water right that is frequently cut off to meet the needs of more senior rights would be much less valuable to both seller and buyer. Farmers with ample water to meet their current irrigation needs may also hold additional water in storage as insurance against water shortage in future years. In some cases, this surplus stored water could be marketed with little risk of water shortage in subsequent years. Farmers without such rights to carryover water might need much higher prices to cover income lost through actual reductions in consumptive use before they could participate in a water market.

c. Variations in the condition of the farm economy, in the economic outlook for particular commodities, and in the situation of each farm operator.

Water is more valuable in good times, and the prospect of selling can look attractive during times of depressed commodity prices. If the farmer is aging or in ill health, selling water can be an attractive way to retire.

[1] In addition, both buyer and seller must be assured of the terms and conditions of the transaction, including the allocation of the risks of supply (timing, quantity, and quality) and the consequences to third parties, if any. Many, if not most, of these transactions will and should be governed by contracts, which are an important determinant of the economic consequences of the deal.

d. Variations due to amount and frequency of water delivery in a contingent market.

The lost farm income, or "opportunity cost", of moving water out of irrigation use will normally increase as the amount and frequency of delivery increases. For individual farmers, improving water management and concentrating available water on high valued crops will help handle small cutbacks in consumptive use. If more water is needed from the market, this must come at the expense of reducing higher-valued uses, and enticing the participation of better farmers. Occasional market deliveries, say one year in ten, may be tolerated without destroying the infrastructure of a farm. As the delivery frequency increases, the increasing cost of keeping the farm together as a functioning enterprise (e.g., assuring a reliable supply of occasional labor) means that farmers would demand a higher price to cover these costs of market participation. At some delivery frequency, perhaps one year in two, it would become more attractive to just sell and retire the land. At that point it might be cheaper to obtain augmentation water from land retirement than from frequent irrigation interruptions since retired land needs no irrigation system or other infrastructure, and may qualify for lower property taxes and other overhead costs.

e. Flexibility of response to water shortage.

The degree of latitude that irrigators are given in responding to market-induced water shortage will affect the price they will ask. If irrigators are free to concentrate what water they have on high valued uses, then the cost to them will be lower than if they are required to idle specific fields, adjust all crops in proportion, or idle the entire farm. If retirement of whole farms is required, then there is obviously little scope for adjustment. On the other hand, some possible responses to water shortage (such as adopting more efficient irrigation technology or substituting groundwater for marketed surface water), while they might be done at little cost or might even be profitable, might also have little or even negative effects on the amount of water that ultimately is made available for flow augmentation.

f. Timing.

As a farmer calculates whether to lease water, he will consider the crop revenue he will loose because he has less water, how much of his production costs he can avoid if he has less water, and the revenue from leasing the water. Farmers might be willing to settle for a lower price early in the season, before they have invested in seed, fertilizer and tillage operations. After the crop is in the ground, it would take a higher price to induce the farmer to lease water. As the crops approach maturity, almost all of the production costs are sunk, and the marginal value of the last increments of water get even higher. For a contingent water market, it is important to notify farmers early of impending interruption, before they incur unrecoverable costs for land preparation and other input costs.

g. Nonfarm alternative uses of the water.

In some cases irrigation water rights may already be under pressure from possible or anticipated alternative uses. The most obvious example is irrigated land in the path of residential development. In cases where there are few alternative sources of water, competition between agencies trying to purchase water for fish and developers trying to supply the needs of the residential development can easily push the price of water to higher levels.

h. Some water available for flow augmentation may be valued by its owners at close to zero.

Examples might include small or hobby farmers, perhaps in marginal crop areas, who want to retire, fallow a field, take a sabbatical from irrigating, or weather a health problem. They may be willing to sell or lease such rights cheaply, or even give them away, especially if they view their contribution to flow augmentation as an altruistic act. There may also be tax incentives for such transactions. In some cases landowners may have already fallowed previously irrigated land. If they do nothing, in a few years they will have abandoned their water right to junior right holders or new appropriation. If they lease the water cheaply for instream flow, they can retain ownership of the water right.

Given all this variability, how can one predict the market price of water sought in a particular proposed transaction? There are a number of possible alternatives:

a. Evidence from water market transactions.

If water acquisition for streamflow augmentation becomes more routine, the process itself will generate a track record of water prices under various situations. In fact, recent transactions brokered by the Oregon and Washington water trusts have already started that record. The recent draft report by Jaeger (2000) documented 10 water rights purchased in Oregon for an average price of $9.16 per acre-foot per year. This compares to 23 single year-water acquisitions in Oregon for $23.19 per acre-foot. Jaeger lists seven recent acquisitions in Washington (six water right purchases, one single-year lease) averaging $57.51 per acre-foot per year.

b. Surrogate market values.

Because sales of water are not yet common, it may be useful to turn to other market information that can serve as a surrogate for water value. Land and water are commonly sold together, so the sale price of land includes the value of the appurtenant water. In fact, if one can find information on sales of comparable land with and without water, the difference between the land prices, less the value of improvements, can be used as an estimate of the value of the water itself. Jaeger quotes such a recent study in eastern Oregon (Faux and Perry, 1999), which estimated the annual value of water as $9 per acre-foot if applied to the poorest soil, $19 per acre-foot if applied to median-quality soil, and $44 per acre-foot if applied to the best soil.

Land without water has little value in some areas of the interior Columbia Basin because use of the land is limited to, perhaps, a little dryland grazing. In such cases, almost all of the value of irrigated land consists of the value of irrigation improvements and the value of the water itself.

Another market that may yield useful water value information is the land rental market. The difference between the rental price for comparable irrigated and non-irrigated land, less the annualized value of the improvements, is an estimate of the annual value of the water. If the dryland is only useful for extensive grazing, at a low rental value, then most of the rental price of irrigated land consists of the value of the water and irrigation improvements. Hamilton and Whittlesey (1996) reported 1996 land rents of $50 to $200 per acre in southeast Idaho, $100 to $350 in southcentral Idaho, and $175 to $200 in southwest Idaho, depending also on whether the offered parcels were suitable for particular crops. They concluded that in 1996 some water had an annual irrigation value below $40 per acre-foot of consumptive use in southeast, $60 in southcentral and $95 in southwest Idaho.

c. Estimates based on economic modeling.

A number of studies have used economic modeling to estimate the value of water to Pacific Northwest irrigation. Generally these are mathematical optimization models that simulate how farmers can best "make do" with the water supply they have. When faced with supply shortfalls, farmers may improve their water management, change their crop mix, shift water to their highest-valued crops, leave some land fallow, etc. The change in resulting farm income per acre-foot of water shortfall yields an estimate of the value of the water. A number of the studies listed in Appendix A summarize model results of this type. See especially Jaeger (2000); Frederick, VanderBerg and Hanson (1996); and Hamilton and Whittlesey (1996).

d. Estimates based on engineering cost studies.

In some cases flow augmentation may be accomplished by changes to water infrastructure. For example, redesign of water diversion and delivery structures may, in carefully selected cases, actually release water to augment instream flows in a critical stream segment or at critical times. An estimate of the cost of the acquired water is the cost of these system modifications. The engineering cost estimates for irrigation system improvements proposed for the Teanaway River and Salmon Creek are examples of this approach.

7. An Example of the reallocation of water - Streamflow Augmentation in the Deschutes River Basin

In the Deschutes River Basin, the Oregon Water Trust and the Deschutes Basin Resources Conservancy have cooperated in pursuing streamflow enhancement projects. These efforts illustrate several of the points we have been making. They have been successful in acquiring water from irrigators through both purchases and leases as indicated in the table below.

Table 1. Water Acquisitions in the Deschutes River Basin

Deschutes Sub-basin	Current Use of Water	Contract Type	Total Acre Feet (af)	Price or Lease Amount/af
Squaw Creek		1-year donation	465.54	$ 0
Squaw Creek	Pasture	Purchase	878.14	$124.58/af
Buck Hollow Creek	Hay	1-year lease	984	$32.03/af/year
Trout Creek		1-year donation	204	$ 0
Trout Creek	Hay	two 1-year leases	1405.5	$20.29/af/year
Tygh Creek		1-year donation	17.4	$ 0
Tygh Creek	Pasture	two 1-year leases	189	$10/af/year

Source: Data provided by Andrew Purkey, Director, Oregon Water Trust.

As shown, the price per acre-foot for purchase of water rights was several-fold the one-year lease rate. And the lease rate varies substantially across leases, illustrating the point that water is not sold in well-organized market with near-uniform prices.

Second, the Deschutes Basin Resources Conservancy has successfully partnered with the North Unit Irrigation District, the Bureau of Reclamation, and the Natural Resources Conservation Service in a Water Conservation Grant Program that replaces an open irrigation ditch with buried pipe. The pressurized pipe system provides water to approximately 445 acres. It is claimed that the project will save about 600 acre feet of water annually (by eliminating seepage in lateral canals). One half of the conserved water will be returned to instream flows. (Source: Deschutes Basin Resources Conservancy website: www. dbrc.org on 11/27/2000).

Third, the difficulties associated with water rights law have frustrated some additional attempts at water acquisition. According to Andrew Purkey, Director of the Oregon Water Trust, an attempt to obtain additional instream flow in Trout Creek was unsuccessful. The eight or nine landowners were assembled and agreed to share water contributions and the economic burden to improve stream flow. But the problems of water rights priority precluded implementation of the agreement.

8. Lessons from existing water markets and non-market transfers

The following are some lessons that the IEAB thinks can be drawn from the region's still quite limited experience with water markets and non-market water transfers.

a. Recognize that water acquisitions will have to conform to state water laws

The appropriation doctrine is deeply embedded in the water law of the Pacific Northwest states, and this is unlikely to change anytime soon. This means that water acquisitions for fish and wildlife purposes will have to conform to state laws – especially the laws on changes in place, timing, and nature of use.

Most of these rules evolved to protect the water rights of other irrigators. Given the economic importance and political power of Pacific Northwest irrigation interests, any viable water acquisition program must respect these concerns. Where significant third-party effects are likely, proposed transactions may have to include the affected parties, and may need to include mitigation provisions. If agreement on mitigation of third party effects is not possible, this may effectively block some proposed transactions.

Recognizing the dominant role of the states in water law and water allocation, it may still be possible to make changes in state water laws that would make water markets function more effectively while still protecting state prerogatives and the security of water rights. It is not now clear which changes would be most useful, but as the process of water acquisition proceeds and bottlenecks and ideas for change emerge, the Council should take the lead in promoting an open discussion of the alternatives.

b. Anticipate a range of water values

The cost of acquiring water will be highly case-specific. Most acquired water will come from irrigated agriculture because farmers currently hold most of the water rights. The cost of this water will depend on the crops being grown, the location, the irrigation technology being used, the reliability of the water supply, whether water rights are being purchased or leased, timing of the transfer within a year, conditions that must be met before the water is transferred, and the state of the agricultural economy at the time of the transaction. Other possible alternative uses (residential development, golf courses, industrial uses) can also affect the market price of water.

Because of this variability in water values, it is extremely important that a water acquisition program have access to local contacts, information and expertise. Currently, most of the experience with water acquisition resides in the state water trusts and other non-government organizations that have been brokering such deals. These organizations are probably best situated to find and execute the best deals on water to meet instream flow goals, and to avoid paying more than necessary for water.

c. Recognize hydropower and other instream flow effects as benefits or costs

Water acquired for fish and wildlife purposes will often pass through a series of downstream dams where it can generate hydropower. These effects may include changes in the amount, timing and reliability of hydropower generation. The effects may occur on both federal and non-federal power systems. These hydropower effects can be modeled using the power system models available to the Council, but for small acquisitions simple rule-of-thumb estimates of power system impacts may be adequate.

Such augmented flows may also affect recreation, resident fisheries and other endangered species, and water quality in downstream rivers. These economic effects (perhaps both positive and negative) should be recognized in considering proposed water acquisitions. Exactly what role these projected effects should play in the analysis of flow enhancement proposals is less clear, especially in the typical case where one agency would pay for the water, but these other instream benefits would accrue to another entity or perhaps to the general public. Where clearly definable hydropower economic benefits accrue to a private or public utility, it would seem to make sense for the utility and the affected consumers to participate in funding the water acquisition.

d. Be aware of hydrologic issues and effects

In most cases (depending on basin hydrology and state laws) the amount of water that can legitimately be marketed is the seller's historic consumptive use. Consumptive use can usually be estimated from information on historic cropping patterns, along with available information on how much water crops typically consume. In cases where the proposal's claimed augmentation exceeds the estimated consumptive use, special care must be taken to assure that the proposed water can actually be delivered at the time needed, and that possible third party effects are being realistically considered.

Water markets can encourage irrigators to switch among alternative water sources. These switches can be subtle – e.g., selling some storage rights, but relying more on groundwater in drought years. Project documentation should address these issues, and the likely effects on aquifers, third parties, and the fish and wildlife objective being pursued.

Keeping these cautions in mind, there may be potential for transfers involving "conservation," stored water and groundwater substitution. Transfers of stored water can result in "real" water savings from a basin perspective (i.e., more storage space to capture later runoff). Timing is the major issue in some areas, and water quality impacts from return flows can be an important consideration. An optimal water acquisition strategy for a region is likely to involve combinations of permanent and temporary fallow, conservation, and storage management.

e. Sometimes "zero" is the right price to pay for water rights

One lesson from the Oregon Water Trust is that there are situations in which some landowners will donate water to environmental purposes for a variety of reasons, such as altruism, potential tax savings, and avoiding abandonment. As any water acquisition program is likely to face a budget constraint, limited funds will clearly go farther if they are only spent on lands where there is a need to actually make payments in order to gain the desired water rights.

f. Prices may be lower (and cost-effectiveness higher) in headwater areas

Because the value of water is determined by alternative uses, water prices may be expected to decline the farther into headwater areas one goes. Often, the alternative economic uses of lands in headwater areas are more limited than downstream reaches in broader valleys (e.g., grazing rather than crops), which means that the price that must be paid for such rights in headwaters will be lower, as well. If, in addition, the biological effectiveness of increased instream flows is higher in headwater areas, the cost-effectiveness of water acquisition efforts may be substantially higher than in downstream areas.

g. Some forms of acquisition appear preferable to others

To the IEAB, it appears that the permanent purchase of water rights is the most preferred approach to acquiring water for enhanced instream flows. Next preferable would be dry-year option arrangements, where the acquiring party would have the right to call on the water under certain specified conditions. Third in the preference order would be leases, where the right to the water is acquired for, say, one year at a time, as available but perhaps not timed well to mesh with streamflow needs. Least preferable are "conservation" programs because of the track record of expense relative to expected flow augmentation that we have seen so far for such projects. This preference ranking takes into account existing knowledge of water acquisition programs, uncertainty regarding hydrological conditions and third-party effects, and the limitations of current state laws.

h. The lesson from the Teanaway River Instream Flow Restoration Project

What does this introductory look at water acquisition concepts and projects suggest about the stream flow enhancement project on the Teanaway River? In comparison to prices emerging in negotiated exchanges by the Oregon Water Trust, that project is unreasonably costly per acre-foot of water added to the stream. While prices have varied widely in Oregon (from zero to perhaps $250 for permanent purchases), the cost per acre-foot in the Teanaway exceeds a reasonable upper bound on water price. Because most of the irrigation water in the Teanaway is used for pasture, hay, and similar uses, there is no reason to expect water there to be substantially more valuable than water obtained at much lower price by the Oregon Water Trust.

9. Recommendations for cost-effective acquisition of water for fish and wildlife purposes

The Council is faced with the need to make decisions about flow augmentation and water acquisition projects. The following are IEAB recommendations on how to proceed.

a. Make use of existing expertise and existing markets in water acquisition

Since the early 1990s, several agencies and organizations have gained some experience in the acquisition of Pacific Northwest water for instream use. These include the Oregon and Washington water trusts, the Bureau of Reclamation, the Washington Department of Ecology, the Nature Conservancy, and the Environmental Defense Fund. Generally the non-governmental organizations play the role of broker, making the contacts, winning the trust of the participants, and putting deals together. When a deal is complete, the organizations turn the acquired instream water or water right over to be held in trust by the state. This body of acquired experience should be utilized in any expanded water acquisition program. It may be possible to design water acquisition programs in ways that let organizations such as the water trusts continue their broker role, perhaps with funding and some policy direction from the fish and wildlife program, and ultimately with direction from the Council subbasin planning process.

Note, however, that the issues related to water acquisition cut across state jurisdictions, geographic regions, various water user groups, a range of potentially affected third parties, and wider economic, cultural, and biological interests – a span of interests not now represented by any of the water trusts or other brokering agencies. Of course, the Council does represent this broad range of interests and may initially have to oversee the water acquisition programs to assure that the full range of interests are heard. Eventually, if water acquisition programs become a more routine part of the fish and wildlife program, the Council may want to delegate some of this oversight, perhaps to a committee charged with assuring that water acquisitions are indeed cost effective pieces of habitat restoration programs in both the basin-wide and subbasin planning processes. This would involve allocating funds to competing water acquisition projects in different basins or in different river reaches within a given basin.

b. Require careful justification and documentation of proposed acquisitions

Proposals to acquire water for instream flow augmentation should present documentation of (1) the amount, timing, quality and reliability of water to be acquired, including documentation that these water deliveries are realistic given the return flows, aquifer interactions and other hydrologic linkages in the basin, (2) documentation that the amount, timing, and reliability of water being acquired contributes to the biological goals expected from flow enhancement in this stream segment, (3) any expected third-party effects and proposals to minimize or mitigate these effects, and (4) estimates of the costs to acquire this water including an explanation of the basis of these cost estimates.

The Oregon Water Trust's requirements for water acquisition proposals are included as Appendix C to this report, and may provide some guidance for what the Council should require of flow augmentation proposals.

Preparation of such documentation may require assessment work by professionals such as hydrologists, irrigation engineers, economists and biologists. This information will be needed in order to judge both the biological effectiveness and the cost effectiveness of the proposals.

c. Embed water acquisition in the broader planning framework

Water acquisition is one among many means to improve fish and wildlife conditions. Proposals to acquire water should be compared to other alternatives. Habitat improvements, such as such as stream fencing, riparian vegetation enhancement, etc., should be compared to stream flow augmentation. Accomplishing this analysis requires substantial ecological assessment (such as in the Ecosystem Diagnosis and Treatment model). More narrowly, alternative means of augmenting streamflow (such as changes to structures and stream operation) should be considered as alternatives to water acquisition. The alternative ways of acquiring water rights – such as land retirement, improvements to diversion, conveyance and application infrastructure, water banks, contingent water markets and development of alternative water sources – should all be considered.

Some of these dimensions of cost-effectiveness should eventually be addressed as part of the basin planning process. On the project level, assuring the cost effectiveness of water acquisition compared to alternative ways of improving fish migration or habitat will have to be part of the fish and wildlife project approval process.

d. Foster market competitiveness through transparency

Competitive markets require transparent procedures. If additional water is desired in a basin, this should eventually be clearly stated in subbasin plans, along with the desired attributes of that water (timing, location and reliability). Such a public process is necessary to make sure that Council fish and wildlife projects don't buy water at one price without making sure there aren't some other potential sellers who, if they would enter the market, would help to bring the price down.

On the other hand, a degree of confidentiality may be requested or required before a seller will sell or lease water rights.

Another aspect of market transparency is familiarity of all parties with the processes involved. Since water acquisition for flow augmentation is a relatively new concept, it may be desirable to think in terms of pilot projects in a few basins, where the acquisition procedures can be tested, and the results (sale prices, consequences for flows and fish) can be assessed.

e. Weigh the advantages and disadvantages of leasing versus buying

Various forms of water acquisition and payment are possible, ranging from outright permanent purchase to various forms of annual payments for leases or options. Uncertainty on both sides of the market, as well as budget constraints, might suggest that leases are the way to start, rather than locking parties into long-term arrangements or outright transfer of rights in perpetuity. Of course this advice would have to be tempered by knowledge that leased water supplies are probably less reliable than water right purchases. Leased water may not be available in the years when flow augmentation is most needed.

If the present value of the stream of annual payments exceeds the purchase price of the water right, then purchase would be preferred to leases or options. Of course, this conclusion depends on the certainty of the long-term need for the specific water rights and may be influenced by inability to arrive at lease or option conditions satisfactory for both parties.

Opportunities to purchase water rights in a small basin, or to lease them, may only happen rarely. Flexibility to respond quickly to such opportunities may be key to successful instream flow augmentation.

f. Encourage development of contingent water markets

Water may not be needed for instream flow augmentation in all years. Contingent water markets can provide water when needed, so long as the required delivery frequency is quite low and the delivery trigger conditions are clearly specified. Contingent markets may minimize the effects on farming communities and basin hydrology. Successful use of contingent water markets may depend on improved water supply forecasts to use as delivery triggers.

g. Be willing to support infrastructure improvements

Seller market participation may depend on improved water management, measurement and control infrastructure, as well as clarifying property rights and resolving any uncertainty about third-party effects. The agencies interested in water acquisition need to be ready to encourage and support such infrastructure improvements.

h. Land value is an upper bound to the value of water for irrigation

An upper bound on the amount that should be paid to acquire augmentation water is the market value of the land appurtenant to the water. If the proposal involves irrigation infrastructure improvements that cost more than the value of the land served, it would be more cost effective to buy the land and water and retire the land. In some cases, these values may reflect potential alternative uses of the water and land that push their values far above their purely agricultural values. In such cases, if the particular water rights meet a critical environmental need that cannot be met through any other means, and if the acquisition still passes the test of cost effectiveness, high water acquisition costs may be justified.

i. Time the process to maximize avoided costs in irrigation

Irrigation farmers can alter their agricultural production decisions if the method of water acquisition gives them enough notice that they will have less water. This gives them more freedom to make changes in their operations to avoid production costs and reduce the amount that would have to be paid for the water rights. For example, before the planting season land may be fallowed, grazed, or planted with crops that have lower water requirements, or physical changes may be possible in irrigation technology. After the crops are in the ground, fewer choices are available. Any program to acquire water should maximize notice and timing flexibility.

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