Environmental Water Transactions: A Practitioner's Handbook

September 2013

Edited by Bruce Aylward

ECOSYSTEM ECONOMICS

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Citation:
Aylward, B. 2013, editor. Environmental Water Transactions: A Practitioner's Handbook. Bend, OR: Ecosystem Economics.

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In Memory of

Gail Louise Achterman

&

Robert (Bob) Frazee Main, Jr.

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ACKNOWLEDGEMENTS

We are very grateful for the funding provided by the Bonneville Power Administration and the Walton Family Foundation for the preparation of this handbook. Without the support of Chris Furey, Margaret Bowman and Morgan Snyder this project would never have seen the light of day. A huge debt of gratitude also goes out to Andrew Purkey of the National Fish and Wildlife Foundation and Todd Reeve of the Bonneville Environment Foundation whose support and encouragement over the last decade for this project and environmental water transactions generally has been invaluable.

PREFACE

In the Columbia Basin and much of the western U.S. a central problem in balancing water resource development and ecosystem needs is inadequate seasonal streamflow. In the winter, tributaries in headwater areas and on main stems are cut back as reservoirs fill. In the summer, diversions for irrigated agriculture dewater tributaries and main stem areas. In an increasing number of states – and particularly in the Pacific Northwest – ecosystem needs have been provided for largely through the approval of state instream water rights. These rights are typically junior in priority to senior agricultural rights. If existing property rights (i.e. the senior water rights) are to be respected then a promising approach to improving streamflow is the acquisition and transfer of senior agricultural rights to instream use. Over the last ten to fifteen years, the use of transactional approaches has appeared on the water management scene. These transactions are a viable method of achieving streamflow restoration in tributaries affected by irrigation withdrawals under the prior appropriation doctrine in the western U.S.

Since 2003, the Columbia Basin Water Transaction Program (CBWTP), administered by the National Fish and Wildlife Foundation with funding from the Bonneville Power Administration, has played an important role in the development of environmental water transactions in the Pacific Northwest. Given the CBWTP's role in leading regional capacity building efforts in this growing field, the Program first supported the development of a training manual back in 2007 as a first step in developing a professional training program, subsequently held on four occasions. In 2012 with support from the Walton Family Foundation, the Bonneville Environmental Foundation and Ecosystem Economics teamed up to provide capacity strengthening for environmental water transaction work in the Colorado River Basin. After a training workshop in Colorado with practitioners from the basin in 2013 this next version of the manual, now a "handbook" was prepared. In June 2013 a draft of the handbook was used for the inaugural graduate level course on water transactions held at Oregon State University, with the support of Mary Santelmann, the director of the Water Resources Graduate Program at OSU.

As with any area of professional endeavor, once the activity has spread wide and deep enough, there is a need for professional training. This handbook responds to this demand and has two primary motivations. The first objective is to shorten the period required for practitioners to come up to speed on the diverse range of subjects required in order to be a proficient project manager in this field. Second, is to provide those interacting with practitioners – whether policy-makers, funders, communities, academics or other professionals – with a better understanding of this new field. This handbook seeks to capture, codify and organize the experience and knowledge gained through the last ten years in this field by my co-authors, David Pilz, Ray Hartwell and Amy McCoy and myself.

As indicated, one of the difficulties posed by water transactions is that the work is often multi-disciplinary in nature. This poses a problem for an all-purpose handbook. To this end the handbook is presented in three parts.

Part I covers the science, law and policy that serves as critical background for understanding the problem and the context within which water transactions provide a useful tool in rebalancing western water use. Part II of the handbook provides a comprehensive exposition of environmental water transactions themselves, first supplying a conceptual approach to thinking about all the various transaction types and then defining and explaining the major types of transactions. The intent of Part II is to provide the reader with the perspective, tools, and experience to be able to understand the full range of transactional opportunities and their applicability across a range of situations. Part III follows the "transaction cycle," elaborating on the steps, mechanics, and tools that are deployed in developing, implementing, and monitoring an environmental water transaction.

Effort is made in the handbook to provide sufficient material for the aspiring practitioner to understand the basics but also to provide tips and strategies based on hard-won lessons. In addition, references, website links, databases and other resources are identified in each chapter and section so that the practitioner may delve deeper into the state of the art as their skills progress.

A final caveat is that ultimately water administration is a local matter with state law being interpreted by the relevant local agency – and sometimes courts. As a result, a certain level of generality is necessary in discussing how to undertake transactions when the target audience is working across the entire western U.S. It helps that these states in large part abide by the prior appropriation doctrine, but there are important variations between the water laws and regulations of each state. Effort is therefore made to point out such variation where relevant, however, ultimately the handbook is about a profession – one that shares many similar principles but is ultimately implemented in many jurisdictions. Thus, the handbook should not be taken as a comprehensive or authoritative statement about the relevant matters of water law, but rather as a formative effort to uncover, organize and present the common elements of the water transactions profession. As such all errors, omissions and misstatements remain the responsibility of the authors.

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September 2013

CHAPTER 1
INTRODUCTION TO WATER RESOURCES

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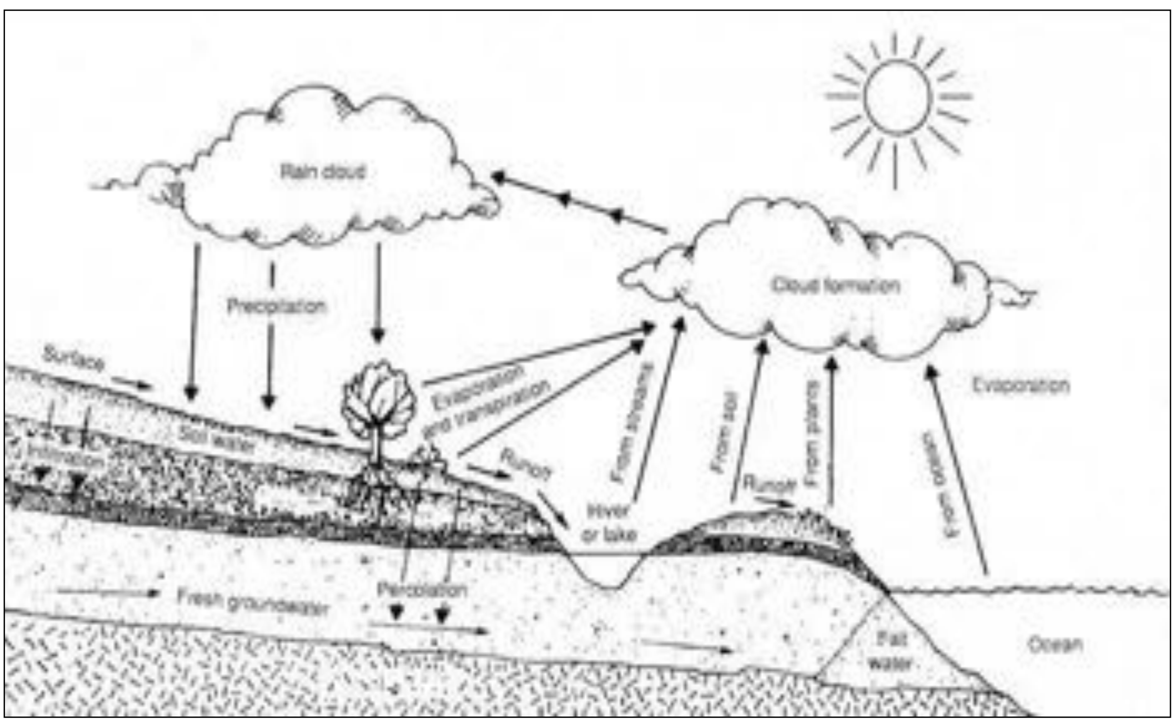
Introduction to Water Resources

A basic understanding of the water cycle and watershed-scale hydrology is essential to the environmental water transactions practitioner's ability to interact with water users, agencies, conservation groups and other stakeholders in the water resources domain. Following a brief introduction to the water cycle the concept of a water budget is introduced and applied to an example of out-of-stream diversions for agriculture, the "meat and potatoes" of water rights transactions. Later in the handbook we will return to this basic example to illustrate transactions and the complexity of administering the reallocation of water rights to eliminate or minimize downstream hydrological impacts.

1.1 The Water Cycle

The movement of water on the earth's surface and through the atmosphere is known as the hydrologic or water cycle. As illustrated in Figure 1.1, the atmosphere takes up water from the earth's surface as vapor through evaporation from the soil and from water bodies, interception and evaporation of precipitation that is intercepted by vegetation, and through transpiration from plants. Evapotranspiration is therefore the term used to describe the return of water from the surface to the atmosphere. The term consumptive use is likewise associated with the consumption of water by human uses and is effectively the same as evapotranspiration. The wind then moves water vapor from place to place until it condenses to form rain clouds. Water returns to the surface of the earth in the form of either liquid or solid precipitation.

Figure 1.1 The Water Cycle



Precipitation that is not intercepted by vegetation or does not infiltrate the soil is called surface runoff. Runoff flows downhill over the ground surface until it reaches a stream or other surface water body. Along with springs such run off forms the basis for streams and rivers.

The precipitation that does not run off percolates through the surface and is often called "infiltration." Such infiltration may serve to replenish soil moisture. Soil water rests in the pore spaces between particles of soil, and is immediately available to plants. The amount of water in the soil depends on the soil texture. The layer where soil water is present is the unsaturated zone located above the water table – water is transient, moving towards the water table or being taken up and respired by plants. The water table is the top of the groundwater saturated zone and indicates the level at which water can be extracted. When the water table falls, wells run dry and extracting water requires more power. The water table rises when infiltration is sufficient to push through to the water table and declines with seasonally dry weather, drought and reduced infiltration caused by compaction, sealing or pumping of groundwater.

Water percolating further downwards (by means of gravitational or capillary forces) enters underground geological water systems called aquifers. Aquifers are rock formations, in particular sandstone, chalk and limestone, that are sufficiently porous to contain water and through which water may percolate. This is known as aquifer (or groundwater) "recharge." Aquifers will usually have an outlet to surface waters or to the sea. The latter are regularly replenished through this aquifer "discharge." Freshwater in rivers and lakes then flows to the oceans, from which water evaporates again in the ever-repeating water cycle.

Aquifers may be confined or unconfined. Clays or other types of impermeable rocks or soil overlie confined aquifers. Water does not enter confined aquifers directly from the surface but through unconfined aquifer outcrops. Water levels in confined aquifers are not subject to seasonal fluctuations. Aquifers are unconfined when the rock formation that contains the aquifer is at the surface or is overlain by permeable soils. Water may enter the aquifer directly from the surface or after passage through the soil, and the water levels are subject to seasonal fluctuations. In a perched aquifer the water is stored above an impermeable layer and has no outlet; once full it spills water to the aquifer below. Fossil groundwater is held in aquifers located at great depth and that have little if any connection to groundwater recharge. Once extracted (or "mined") these groundwater reserves are difficult to replenish.

There are two types of freshwater resources: those in static storage and those in transit, i.e. those moving actively through the water cycle. Both are fully replenished during the hydrological cycle but at very different rates. The static storage includes freshwater whose complete renewal takes place over many years or decades. Intensive use of these resources unavoidably results in depleting stored waters and disturbing the centuries-old, natural equilibrium, restoration of which would require equally long time periods.

Freshwater resources, therefore, are both renewable and exhaustible resources. The hydraulic connection between ground and surface water further complicates this matter as the influence of recharge or withdrawal is felt, not just in terms of volume changes (for example in static storage), but also in terms of pressure within the hydraulic system. Just as additions (or not) to one end of a garden hose will affect the water emerging from the other end, recharge and withdrawal affect the rate and volume at which groundwater rejoins surface waters.

1.2 Water Budgets

Water and water management, particularly as it relates to ecosystems, involves physical, chemical, biological and ecological components. However, strictly speaking the use of transactions to acquire water for environmental flows is a physical matter. Water rights are typically written for volumes and rates of flow of water. The quality of the water is not specified. Obviously changes in volumes and rates of water have impacts on the other components of the system but in the first instance the water transaction is for a physical unit of water.

In order to be able to analyze potential water transactions in terms of their impacts on water users and ecosystems the processes underpinning the water cycle need to be converted into practical terms. Water budgets are commonly used in water resource management as a method for identifying and quantifying the flows and stocks of water in a given system (Healy et al. 2007). A water budget reflects the principal of conservation of mass. Draw a circle around any part of the water cycle and inflows must equal outflows, mass (or water) is neither created nor destroyed – even when humans engage in water management. The other principle that applies is that water obeys the laws of gravity; water flows downhill unless energy is applied to move it uphill.

With these principles in hand we can construct a simple example of a water budget before and after human diversion that helps to clarify how changes in water use will alter the water cycle – with consequent impacts on users and the groundwater and surface water systems. Again, the emphasis here is on diversion for agricultural use, although similar budgets can be derived for storage projects and municipal and other uses. This basic budget will then be used in Part II of the handbook to examine the hydrological impacts of different transactional approaches.

1.2.1 **The Watershed Budget**

Water budgets typically start with inflow to the system defined as precipitation (P). Precipitation will consist of rainfall and snow, as well as other intermediate forms. Precipitation may also come in the form of cloud moisture intercepted by vegetation or man-made screens (called "fog drip" or "horizontal precipitation"). Atmospheric conditions in a given place and season will place a demand on available water. Potential evapotranspiration (PE) refers to the amount of water that would be intercepted and evaporated from vegetation, soil and other surfaces as well as the amount of water that would be transpired by plants. PE is only "potential" in that at times water may not be actually available and, therefore, the potential demand is not met. For example, in the dry season soil moisture reserves (S) may be drawn down. Plants with shallow root systems may then not be able to obtain the water that they would otherwise consume. Actual evapotranspiration (ET) will therefore tend to be less than potential evapotranspiration. Evapotranspiration may come from the interception and evaporation of water by vegetation, from the evaporation of water retained on the ground surface and from the transpiration of soil moisture by vegetation.

An example of a water budget is provided in Table 1.1. The chart shows one year of measured and modeled water balance for corn and cassava cropping in West Java, Indonesia. The extremes of farming in a rainforest environment provide a vivid illustration of the annual cycle of a water budget. Note how the measured ET rarely exceeds the modeled PE (Penman open water evaporation), even when the rainfall input is significantly higher than PE (as in January). Also note how as the dry season takes hold from June onwards ET falls below PE and uses more and more water from storage. Also note how streamflow (Q) is reduced during this period. Where streamflow numbers are negative this represents simulated upward soil water movement. And, finally note how as rainfall picks up again in October and November ET stays relatively low and soil storage is recharged.

Table 1.1 Water Budget Example

Month	P	PE	ET	ΔS	Q
Nov (2nd half)	211	58	56	-20	175
Dec	394	127	121	-3	276
Jan	434	114	142	22	269
Feb	237	105	116	-14	134
Mar	441	122	136	33	272
Apr	299	106	108	-62	253
May	158	99	98	-17	77
Jun	72	95	89	-27	11
Jul	36	108	95	-63	4
Aug	2	130	90	-96	8
Sep	17	149	40	4	-27
Oct	220	130	83	153	-16
Nov (1st half)	168	54	55	97	16
Year Totals	2,688	1,398	1,228	8	1,452

Source: van Dijk (2002)

Once evapotranspiration is deducted from precipitation we are left with the balance of water that runs off to surface waters, and any net change during the period in soil moisture and water going to groundwater recharge, represented as a change in storage (ΔS). Soil infiltration rates will prescribe the rate at which precipitation reaching the ground percolates through to the water table. The simplest water budget equation is thus:

$$P = ET + \Delta S + Q$$

During a rainfall event, if the rate of fall of water exceeds the infiltration rate the excess water will move overland towards areas where it can infiltrate or towards places where it joins surface waters. It is important to keep in mind that streamflow will be the sum of base flow produced from groundwater discharge into surface waters from surface or sub-surface springs plus any runoff. During dry periods then streamflow is pretty much totally dependent on groundwater discharge (even if from discharge in the headwaters). Therefore any increases in ET from land use change will take away from the storage component, ultimately creating a deficit in the residual discharge to streams.

A few more specifics are useful before turning to a water budget for streams and water transactions. The relationship between a surface water body such as a stream and the water table will vary. A stream that lies above the water table may lose water to the water table. For streams this phenomenon is described as a “losing stream” or “losing reach.” Some streambeds may be “armored” which is to say they are impermeable and for all intents and purposes may lie above the water table but will not be losing streams. Alternatively a stream may be situated below the water table and therefore receive discharge from groundwater. Such a stream is called a “gaining reach.”

Second, aquifers may be considered as either underground rivers or underground storage reserves. Thus they have both a storage component and a flow component. Inflow to groundwater consists of water infiltrating the surface less water transpired by plant and any loss or discharge to surface waters. When an aquifer is in a fully charged equilibrium state groundwater recharge will be equal to discharge. When an aquifer is drawn down a portion of groundwater recharge will go to storage. The hydraulic pressure or "head" in an aquifer will however constantly push water out from the aquifer as springs, discharge to surface waters or subterranean outflow to the sea. Pumping and extraction of groundwater has two impacts on the normal function of recharge and discharge. First, pumping is likely to create a drawdown of aquifer storage in the vicinity of the extraction point. This is called a "cone of depression" and results in the lowering of the hydraulic head in the immediate vicinity. Pumping from new wells may therefore have an impact on static water levels in pre-existing wells depending on the amount of pumping and the conductivity of the aquifer. Second, continued pumping may interfere with the underground movement of water. In this fashion, pumping may actually intercept underground flow that was destined for discharge to surface waters. Further pumping close to stream channels that are not armored may lead to an increase in loss in a losing reach or a reduction in the gain in a gaining reach.

And finally, water storage and irrigation of lands will also alter the water balance. The purpose of irrigation is of course to make up soil moisture deficits during dry periods thereby raising transpiration and plant growth rates. Less efficient irrigation methods will also tend to increase interception by vegetation and the soil, hence causing evaporation rates to rise as well. Water seeping into the ground from reservoirs or water conveyance facilities like canals and ditches, as well as any irrigation water that is not used by crops but percolates through to groundwater will add to natural groundwater recharge. This may then lead to higher rates of groundwater discharge and even the transfer of surface water in one drainage to groundwater and discharge in another.

1.2.2 **Stream and Irrigation System Water Budgets**

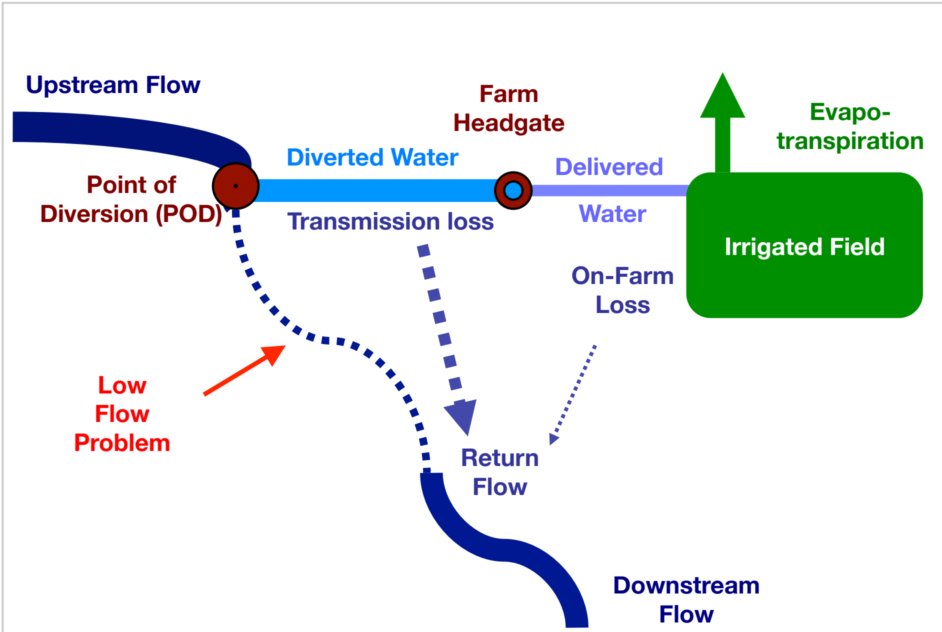
For the purposes of water transactions that involve irrigation water rights the key components of the water budget are:

- inflow of water in the stream (upstream of the point of diversion);
- the location of the point of diversion;
- the transmission loss or seepage, and evaporation from any conveyance facilities such as canals or ditches in delivering water to the farm (at the headgate);
- on-farm crop water use and evaporation beyond the head gate (evapotranspiration);
- on-farm loss through seepage from ditches and the application of water (by flood, sprinkler or other method); and
- location and rate of return flows from groundwater to the stream (sum of seepage from transmission loss and on-farm seepage not absorbed into deep or fossil groundwater).

These components are presented graphically in Figure 1.2.

The diversion of water for irrigation will alter local hydrology and the water budget significantly. The need for understanding these components is critical when developing and evaluating water transactions that will – in some fashion – move the stream back toward unregulated (or natural) flow. As we explore the social, economic and legal aspects of water use the importance of being able to predict the impact of changes to a given water use will become clearer. At present, it is sufficient to indicate that when a point of diversion, conveyance system or place of use is changed – amongst other possible changes – this will have consequences for the water budget and downstream hydrology and, therefore, downstream in- and out-of-stream flows and uses.

Figure 1.2. Stream and Irrigation Water Budget: Components



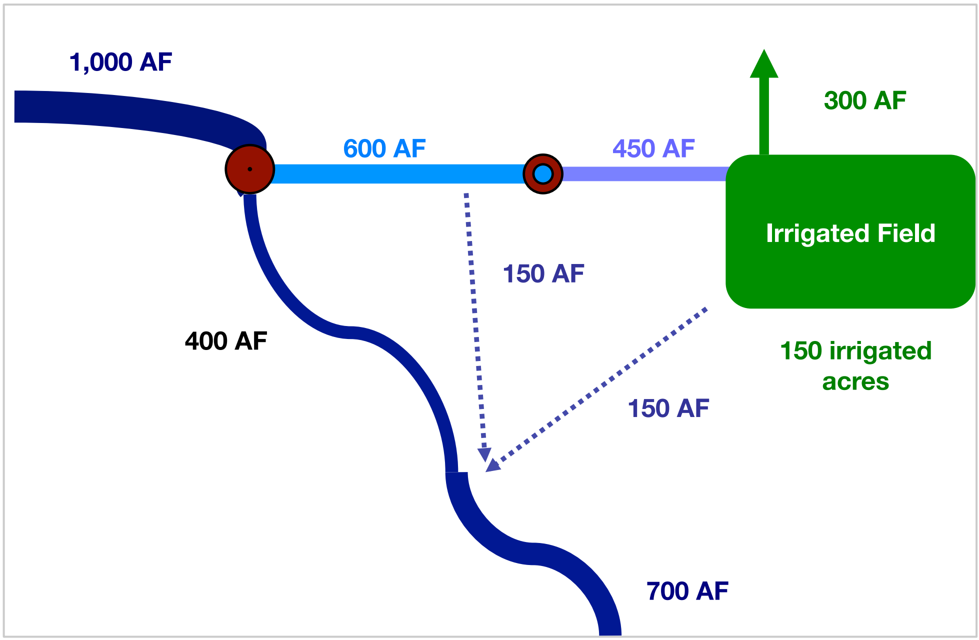
A worked numerical example of what the water budget might look like for a small stream when water is diverted for agricultural use is provided in Figure 1.3. Due to the time delay as any water flows downstream or is routed through the groundwater system a water budget is typically defined in terms of a volume of water over some time period. Water budgets are typically prepared on a daily, monthly or yearly basis depending on the need – though in the example in the figure the period used is an irrigation season. Volumes of water are of course merely the summation of flows over some time period, as explored further in the next section. The figure could therefore just as easily be presented in flow rates and, indeed, is presented this way in later chapters in order to simplify the numbers and concepts involved.

Reviewing Figure 1.3 and recalling the conservation of mass principle, it is clear that in this example the volume coming into the river system upstream from the point of diversion (POD) is equal to the volume of water leaving the system, that is the sum of evapotranspiration and surface water flows at the downstream end of the system. Further, as we move upstream through the system mass is conserved as well at each juncture. So the amount of water in the stream at the downstream end of the figure is equal to the sum of water in the low flow stretch of the stream plus the sum of the seepage to groundwater from loss in transmission or loss to on-farm water use, all of which comes back into the stream as return flow. If any water is lost from the basin due to deep percolation to fossil groundwater or other (typically unknown) destinations then this loss must also be accounted for in tracing the connection between seepage and return flow.

Looking at the farm itself, the water delivered to the farm will equal the evapotranspiration plus water lost as seepage from on-farm use and distribution. The definition of on-farm water use efficiency (portrayed here as 66%) is simply the portion of water delivered that goes to crop water use (evapotranspiration plus any water stored in the crop itself).

The water diverted from the stream must either go to water delivered at the farm headgate, to seepage during transmission or as evaporation from the conveyance facility. Although it is commonly assumed that large amounts of water evaporate from canals and ditches this is in fact typically only a minor source of water loss and is, therefore, left out of the figure. And finally, at the outset the amount of water diverted plus what is left instream at the POD will equal the original volume of streamflow coming into the POD.

Figure 1.3 Stream and Irrigation Water Budget: Numerical Example



1.3 Water Math

Water may be quantified in terms of its volume or its rate of flow. The former will be expressed in this handbook in terms of acre-feet (AF) although it may also be converted to other volume units. In the U.S. water may also be considered in terms of gallons (g), cubic feet (ft^3), and even miners-inches. Internationally, using the metric system the following units may be used: liters (l), cubic meters (m^3), and gigaliters (GL). Conversions for volume amounts are include in Box 1.1.

Box 1.1 Volume Conversions

1 acre-foot = 43,560 cubic feet = 325,850 gallons; 1 million gallons = 3.07 acre-feet
1 acre-foot of water covers 1 acre (43,560 square feet) to a depth of 1 foot
1 cubic meter = 1000 liters and 1 gigaliter = 1 million cubic meters
1 acre-foot =1234 cubic meters, so 100 gigaliters = 81,037 acre-feet

Rates of flow are defined as unit volume per unit time. In the U.S., irrigation water flow is often defined in terms of cubic feet per second (cfs or "second feet"). Pumping rates are often expressed in gallons per minute (gpm). Meanwhile municipal water rates are specified in gallons per day (gpd) or some multiple such as million gallons per day (mgd). When discussing average annual flows different units may be used such as acre-feet per year (AF/yr) or gigaliters per year. In a few places the miners inch is still used as a measure of flow. Internationally, rates are typically expressed in cubic meters per second (m^3). Box 1.2 provides common conversion factors between rate units.

Box 1.2 Rate Conversions

1 cubic foot per second = 448.4 gallons per minute = 40 miner's inches (OR, MT) or 50 miner's inches (ID)

1000 gallons per minute = 2.23 cubic feet per second

1 cubic foot per second = 28.32 liters per second = 0.02832 cubic meters per second

1 cubic meter per second = 35.3 cubic feet per second

a 1 cfs rate for one day = 1.9835 AF, so a 6 cfs rate for a 180 day irrigation season = 6 * 1.98 * 180 = 2,138.4 AF

1 million gallons per day is equivalent to 1,120 acre-feet per year

Again, any rate expressed in one unit can be converted into another rate. The most ubiquitous piece of water math the practitioner will encounter in the field is converting rate to volume and volume to rate. Typically this involves converting cubic feet per second as an instantaneous rate for flow or irrigation purposes into the amount of acre-feet that such a rate would produce over a calendar year or an irrigation season and vice versa. Calculating such figures in the field (when a calculator may not be in hand) is made easier by the fact that a 1 cfs rate over the course of a day yields approximately 2 AF (1.9835 AF to be precise as shown in Box 1.3). Therefore a 10 cfs rate over a 180 day irrigation season is just 20 (2 * 10) multiplied by 180 or 3,600 AF. Similarly if 2,000 AF is available for instream flow over the course of an irrigation season of 180 days the cfs would be 2,000 divided by 2 or 1,000 divided by 180, and since 180 is close to 200 the answer would be around 5 cfs. For when more precise calculations are required it is worth noting that most cell phones have a calculator feature for those who do not enjoy mental math.

Box 1.3 Rate to Volume Conversions

The exact amount of water that a rate of 1 cubic foot per second over one day yields in volume terms is calculated as follows:

$$\frac{1ft^3}{s} \times 1day = \frac{1ft^3}{s} \times \left(\frac{60s}{1m} \times \frac{60m}{1hr} \times \frac{24hr}{1day} \times 1day \right) = 86{,}400 ft^3$$

$$86{,}400 ft^3 \times \frac{1AF}{43560 ft^3} = 1.9835 AF$$

In conversions of this nature it is often advisable to employ both the figures and the units. A check that the conversion is correct can then be made by crossing out units that cancel each other in the numerator and denominator of the equation.

A final note on water math concerns the use of significant digits and rounding. Depending on the context the extra 0.0035 AF on a 1 cfs rate per day (using 1.9835 as opposed to 1.98) may or may not be relevant or important. In terms of significant digits it is worth noting that the "3" and the "5" in 1.9835 are the 4^{th} and 5^{th} significant digits. Given that most water meters and flow gauges have an accuracy of between 2 and 5% these digits are outside of the limits of accuracy of any gauge. Still, when undertaking water transactions within a legal regime where a number of instream water rights are summed to set the target for how much water is left in a stream, every extra amount would seem to help.

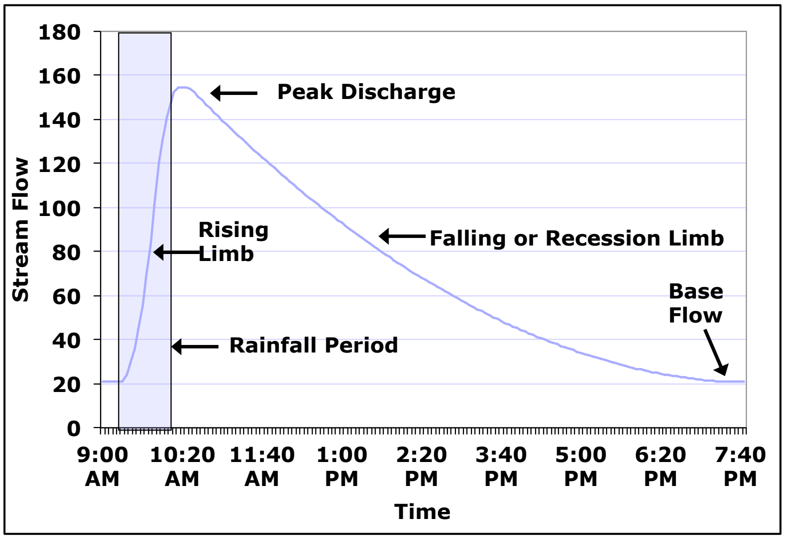
For example, if a storage water right of 10,000 AF is obtained and is to be released over a 90-day period during the peak of the summer, then the rate would be 56.1167 using 1.98 and 56.0277 using 1.9835. In this case using the more precise conversion factor reduces the protected amount of water. If on the other hand a natural flow irrigation right of 20 cfs that is good for 180 days is being purchased, using 1.98 suggests the right will produce 7,128 AF. If 1.9835 is used as the conversion fact then the amount obtained would be 7,140.6. Again, the more each dollar spent yields the more water is available and, from a reporting standpoint, the lower the cost per AF. Obviously an extra 12 AF is not much when compared to a base of 7,000 AF, but still it is equal to 4 million gallons of water – enough water to supply the indoor water needs of 160 Americans for a year.

Since the water transactions practitioner is measuring output in administrative terms of cfs and AF of water rights acquired, in the end it comes down to a question of how many digits beyond the decimal point are worth maintaining. The agency administering water rights in the given jurisdiction may or may not have a protocol in this regard. For example, they may specify what conversion rates to use in change applications. Generally going beyond 1 or 2 decimal points in acre-feet terms is not terribly productive. Similarly it is not typical to go beyond 2 or 3 decimal points on a rate figure. A further point is that rounding may need to be done with care. Rounding up on a rate or volume calculation could be regarded as enlargement of a water right. For example in the 10,000 AF storage right example above is used with the 1.98 conversion rate rounding up to two decimal places would yield 56.12 cfs. This would enlarge the water right over the 56.1167 calculation, for which 56.11 would be the non-enlarged rate. The ROUNDDOWN function in Microsoft Excel™ may be useful in avoiding such problems in calculating rates and volumes. More to the point, if the more accurate 1.9835 conversion factor were used the appropriate rate would actually be 56.02. While issues of significant digits and rounding are minutiae in the bigger picture of streamflow restoration, they are a reality that the practitioner will confront on every application. Understanding how these calculations work and choosing the state-approved factors and methods that yield the highest value in terms of water protected is one small part of the job.

1.4 The Hydrograph

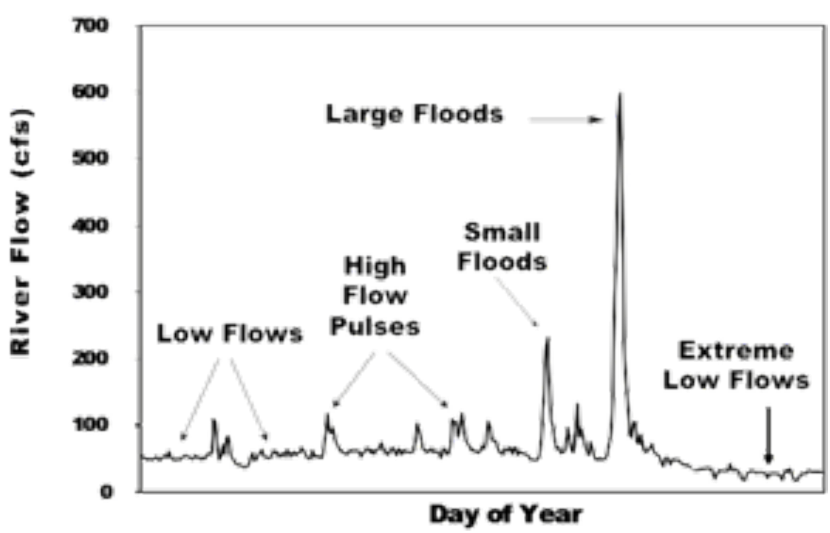
A hydrograph is merely a record of surface water discharge (i.e. flow) recorded over some time period at a particular point. Hydrographs are traditionally thought of as the measure of watershed's response to rainfall. Such a hydrograph might be recorded for a single storm event, for a season or for the year. The hydrograph for a storm event would typically begin at a low or base flow level rise to peak discharge and then recede as the precipitation drains from the watershed (Figure 1.4).

Figure 1.4 Storm Hydrograph



The hydrograph for a stream over the course of a year would vary with climate and geography of the watershed, but generally can be divided into a number of functional characteristics as shown in Figure 1.5. The wet season would consist of a number of peaks reflecting storm events. The first major storm event might have a lower peak as the water table and soil moisture are replenished after being drawn down during the dry season. Subsequent storm events would lead to periods of high flows. More extreme events would lead to small or large flood events. Such flood events are often characterized in terms of how frequently they occur. Thus a 1 in 15 year flood would be a lower magnitude event than one that occurs a 1 in 100 year event. With the onset of the dry season the hydrograph may gradually recede to a base flow level where the stream is essentially fed 100% from groundwater discharge along the water course.

Figure 1.5 Characteristics of a Stream Hydrograph

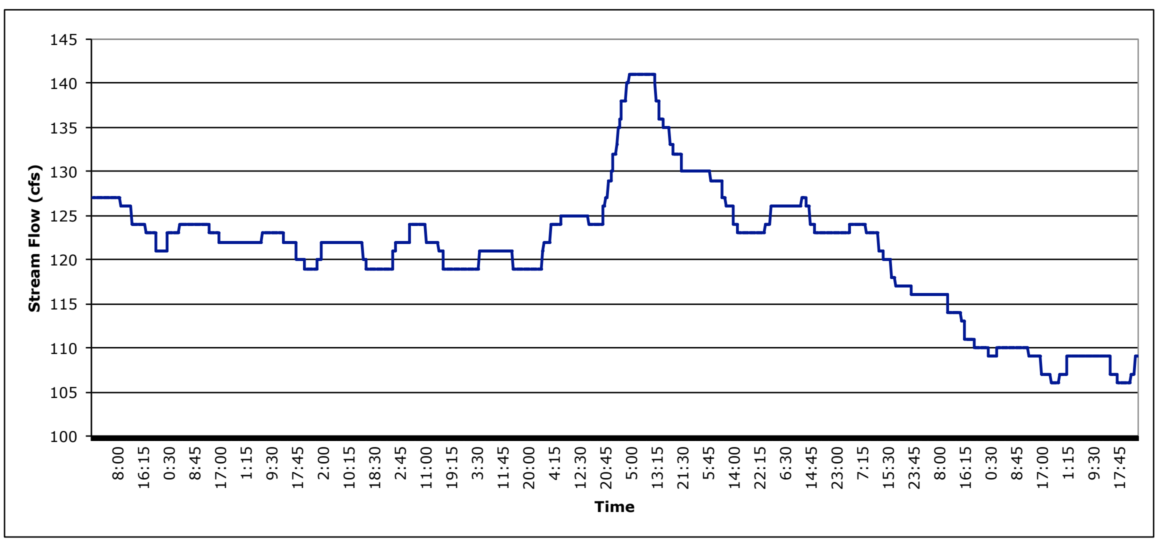


Source: Postel and Richter (2003)

In practice, the degree of hydrologic variation means that each hydrologic year will be unique. Just as with the allocation of water rights in the first place, planning for instream flow restoration then must build from a notion of water availability in the stream. The natural hydrograph as measured at a particular point on the stream satisfies this requirement. However, any useful hydrograph will be based on years of data and, thus, the statistics used to represent the natural variability in flow will greatly affect any estimate of water availability. The first most obvious statistics are the average (mean), the minimum and the maximum. However, given the potential for flows to be skewed in terms of their distribution the average for a period (say a day) may not be the best measure. For example, if you had only five years of data and one of those years had a 1-in-100-year flood, taking the average of flows for that day would not accurately represent the distribution of flows.

Typically, modern gages record flows over very short time intervals. It is often the practice then to use the average of these rates to obtain a mean daily flow rate for each day. Figure 1.6 provides an indication of how flows may vary within a day in a typical western mountain stream. With a time series of such daily flow rates the statistical distribution of these rates can be assessed. In any analysis it will be useful to define if you are after the probability, or likelihood, that a certain flow level will be met or whether you are just trying to figure out how much water is typically produced over some period. In the latter case, averages (or means) may be the appropriate measure. For example, for applications involving stored water it may be the average amount of water that is important not the probability of a certain level of inflow – given the stored water can be released when needed. For analysis of water availability in unregulated streams "exceedance" figures are often used. These simply represent the percent likelihood that a certain flow will be met or exceeded.

Figure 1.6 Intra-Daily Variation in the Summer on a Mountain Stream, Whychus Creek, Oregon



Notes: Data is for the period of August 1 to August 14, 2006

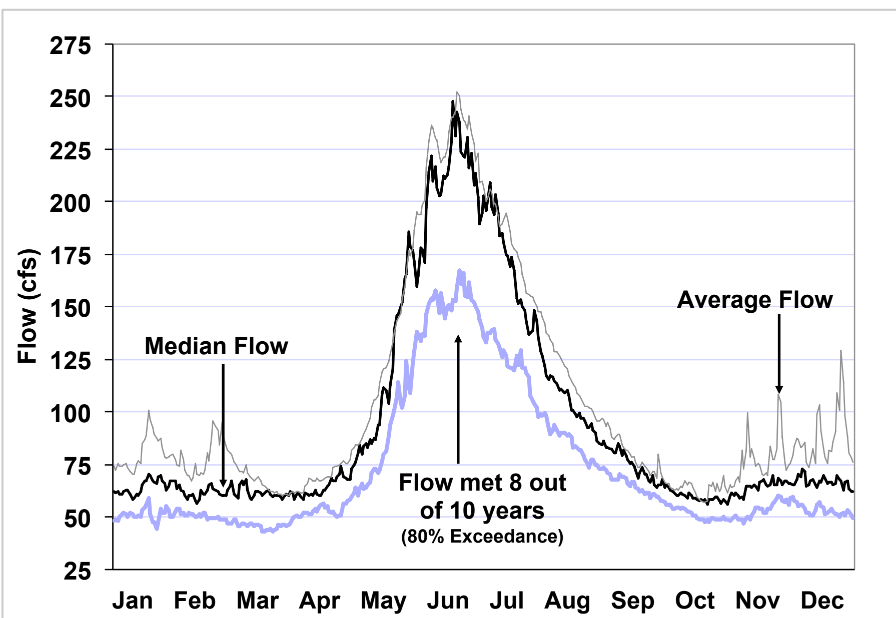
Source: Oregon Water Resources Department

For example, the median is the 50% exceedance flow, the flow that is exceeded 50% of the time. The median flow rate would be the flow figure that lies in the middle of the recorded values for the period of measurement, such as a day. So the median figure is that figure for which on half of all days the flow would be higher and on half the days the flow would be lower. Given the skewed nature of flow data described above, exceedances, such as the median are preferred over averages in assessment of water availability.

In evaluating streamflow reliability, exceedance figures are often used to determine if water is available for allocation to out-of-stream uses. For example, the Oregon Water Resources Department uses an 80% exceedance in its analysis of water availability (Cooper 2002). In this case if streamflow that occurs 80% of the time is already allocated to users then water is not deemed available for further permits to divert water. This is the same as saying that water is not available at least 20% of the time. Note that exceedances can be confused with percentiles; however, they are the opposite of percentiles. Such exceedances can easily be derived from time series data sets (but note that the 80% exceedance is the 20th percentile in Microsoft Excel^{TM}).

To illustrate these different measures Figure 1.7 provides the mean average, median and 80% exceedance levels for Whychus Creek in Central Oregon. From its glacial headwaters on the flanks of Broken Top and the Three Sisters in the Cascades Range, the creek flows 35 miles first through forest and then sagebrush steppe before joining the Deschutes River below the town of Terrebonne and just above Lake Billy Chinook. Whychus Creek flows are fed primarily by runoff from snow, glaciers, and rain, supplemented by groundwater discharge. Daily data for 1958 to 1987 from a gage on Forest Service land above all diversions is used in constructing this graph. This range of yearly data is recommended by the Oregon Water Resource as the most reflective of the last 100 years of conditions.

Figure 1.7 Different Statistical Measures of the Stream Hydrograph, Whychus Creek, Oregon



Source: Oregon Water Resources Department

The natural hydrograph of Whychus Creek reflects consistent glacial base flow augmented by runoff in late spring. Fall and winter base flow of from 50 to 70 cfs rise as snowmelt begins in April/May. Median flows of 200 cfs or more are observed as the creek enters its flood state in June. Rain on snow flood events can cause flood flows of over 1000 cfs. As the snowmelt recedes in July/August so does the creek, as there is little to no rainfall in the summer months. By September the creek runs low with a milky white color reflecting its glacial origins.

The Whychus Creek example in the figure above confirms that using the average flow measure will generally tend to suggest higher flows, reflecting the skewed nature of the distribution due to high flow days. This can most easily be seen in the fall and winter months when the majority of the precipitation occurs. During these months the average flows often peak out at almost double the median flows. Again, this illustrates the point made earlier about the streamflow pulses that occur during the wet season. As expected, the flow met 5 out of 10 years (the median) is higher than the flow met 8 out of 10 years, some times significantly so. The difference is on the order of 10 to 15 cfs during the fall and winter seasons. This difference is magnified to up to 60 cfs or more during the flood season. The extremely steady and reliable nature of the glacial met and groundwater input – and the lack of rainfall from August onwards is revealed by how close to each other the three measures run through October. With the onset of rainfall at the end of October the measures diverge once more. We will return to Whychus Creek in Chapter 3 where we will explore how diversions below this gage have affected streamflow further downstream.

1.5 Resources

1.5.1 Internet Links:

Oregon Surface Water Data: http://egov.oregon.gov/OWRD/SW/index.shtml - Surface_Water_Data

Bureau of Reclamation Hydromet Data: http://www.usbr.gov/pn/hydromet/

1.5.2 References and Further Reading:

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CHAPTER 2
WATER RESOURCES MANAGEMENT

Bruce Aylward

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Ecosystem Economics
PO Box 2062, Bend, OR 97709, USA
www.ecosystemx.com

Water Resources Management

People and ecosystems use freshwater for a wide variety of purposes. In order to better manage water resources an understanding of these uses, their nature and their impact on the water cycle is fundamental. The uses of water are characterized below in terms of their consumptive nature and the levels of demand seen globally as well as locally in the Pacific Northwest. Putting numbers to uses serves to illustrate the relative magnitude and importance of these uses. This is followed by a discussion of the challenges and nature of improved management, generally referred to as Integrated Water Resources Management. While water transactions practitioners are involved in a very specific and somewhat limited function of the overall management of water, the often controversial nature of moving water from traditional to instream uses often requires practitioners to have a broader context in which to place their work and actions.

2.1 Water Use

This section introduces the types of water uses and estimates current and future demands on water resources for both human and ecosystem purposes. The kinds of water resources described in the preceding chapter serve different uses in response to different needs and different demands placed on them by society. Many uses compete for available water resources both in terms of demands on water quantity and quality.

Water uses can be classified based on whether or not the water is consumed and where the water use occurs. For the first category, the term "consumptive" denotes uses that partially or totally "use up" water, through evapotranspiration, transformation, contamination or other processes. This categorization is limited in scope because water never disappears from the water cycle; the amount of water on the planet cannot be increased or decreased. Rather, consumptive uses return water to a vapor state and remove this water from the terrestrial part of the water cycle. Examples of consumptive uses include water for domestic and municipal needs, irrigation and industry. Consumptive uses are often only partially consumptive since only a portion of the water diverted from surface waters or withdrawn from groundwater will be consumed.

Uses of water are also "polluting" when they change the characteristics or lower the quality of water, rendering it unfit for other uses at the site or downstream. The extraction of water from a stream leaves a smaller volume and rate of flow in the stream. As the water travel downstream its temperature will be increasingly susceptible to warming (or cooling) depending on solar radiation and ambient air temperature. Similarly, the storage of water in a reservoir and subsequent release will alter temperature and the physical and chemical quality of water, depending on whether the release occurs from the top or the bottom of the reservoir. Water may also be removed from streams or the ground for industrial or power purposes and, upon its return to the system, its physical, chemical or biological quality may be significantly altered – often for the worse in terms of down-gradient uses (human and ecosystem).

Non-consumptive uses do not reduce the volume of water available to that stage of the water cycle. Non-consumptive uses include inland navigation, recreation and water sports, fisheries, hydropower production and ecosystem maintenance. Water used for hydropower is non-consumptively used, although producing electricity consumes the water's potential energy.

Water is also stored for future use. A central feature of water resource development is storing water to control when it is available for different uses. Storage may be consumptive or non-consumptive depending on how it is stored. The storage of water (as in reservoirs) for future diversion for a consumptive or non-consumptive use is in and of itself a consumptive use as stored water will typically increase evaporation. Water injected into groundwater is non-consumptive, whereas shallow reservoirs are highly consumptive.

In addition to the first classification, water usage is also classified by where it used. Water is used *in situ* either on land where it falls as precipitation (terrestrial) or instream where it falls, collects or flows. Moreover, water is abstracted, diverted, or withdrawn and moved to where it is needed. For example, irrigation requires diverting water from its natural course in rivers or underground to bring it to the fields; by contrast, inland navigation relies on water not being moved, as it requires reliable quantities of water in lakes or rivers. Floodplain agriculture is also an instream use because it takes advantage of natural flood cycles to "irrigate" crops.

Whether water is consumed is of primary importance, as it affects the amount and timing of water availability, as well as water quality. Where water is used is of secondary importance, but it is still useful to determine how surface waters are affected by the withdrawal or extraction of surface or groundwater. The complexity of water use for human and ecosystem purposes is shown in Table 2.1. Uses are separated by their consumptive nature (left-hand column) and the location of their end use. The table shows that water has many different uses, in many different locations and with varying degrees of consumption. Water in effect cascades through the water cycle as it is used and reused as it moves down gradient (pulled by gravity) back towards the sea. Not only is a portion of the water lost as water cascades through the system, but its quality is also affected as pollutants are added and subtracted. This multi-functional nature complicates water management and allocation.

Table 2.1 Classification of Human and Ecosystem Use of Water

	Location of Use			
Consumptive Nature of Use:	Terrestrial Uses	Instream Uses	Extractive Uses	Storage
Consumptive: Quantity and Quality	• Ecosystem Primary Production • Agriculture • Domestic		• Domestic • Industrial • Irrigation • Aquaculture	• Domestic • Industrial • Irrigation • Hydropower • Flood Control
Consumptive: Quality (only)	• Waste Discharge	• Aquaculture • Waste Discharge		• Aquaculture
Non-consumptive		• Capture Fisheries • Recreation • Ecosystems and Biodiversity • Barrage Run-of-River Hydropower	• Diversion Run-of-River Hydropower	• Aquifer Recharge • Recreation • Capture Fisheries

2.2 Human Consumptive Uses

A review of the different human uses of freshwater begins with the three major consumptive uses: domestic, industrial and agricultural.

2.2.1 Domestic Use

Domestic water use comprises drinking, washing, sanitary, culinary and other home uses, but also include outside uses such as the watering of lawns and gardens and washing vehicles.

These are, for the most part, extractive and consumptive uses of water. In rural areas households typically draw water directly from individual or communal wells. In urban areas water is typically supplied by municipal water systems. Municipal water comes from both surface and groundwater systems with water treatment varying from source to source as regulated by the Clean Drinking Water Act. In rural areas septic systems are typically used to dispose of in-house domestic water, returning the unused portion of water to the ground. In urban areas large sewer systems and wastewater treatment plants – also regulated by state and federal authorities – employ a variety of technologies to return water (of varying quality) to the ground or surface water systems.

2.2.2 Industrial Use

Industries use water for cooling, transportation and as a solvent; water also enters the composition of some finished products. Industrial processes produce heat, and water is the most efficient means to lower a machine's temperature. Industries and commercial establishments also require water for their air conditioning. In fact, cooling accounts for up to 70% of the water used in industry. Of the water that industries use, power generation plants use the most because of the massive amounts of water needed to cool assemblies.

The actual amount of water withdrawn and consumed will vary with the type of industrial use and the technology employed. Some uses, in particular cooling, consume large amounts of water. Other uses, in particular for cleaning purposes, consume little water but greatly degrade the quality of the water returned to the system; either as effluent to rivers or as recharge in ponds or through ground water injection. Similarly, water used in cooling may be returned to streams with significant consequences for stream temperature and aquatic biodiversity.

2.2.3 Water in Agriculture

Agriculture, including animal husbandry, is the largest human consumptive use of freshwater. Rain fed agriculture and permanent grazing are responsible for consuming 25,400 km^3/yr, according to one estimate (Falkenmark and Rockström 2004). This water produces about 60% of world food supply and supports a range of additional ecosystem services, particularly in grass and rangeland ecosystems where livestock is just one of many species taking advantage of the feed, water and landscape.

The other 40% of world food supply is produced by irrigated agriculture on 17% of the world's cultivated land. About 70% of abstracted freshwater is diverted for irrigation, and the figure reaches 90% in the dry tropics. Part of the water withdrawn for irrigation is used for crop production, and part is used to flush salts out of the soil to prevent a reduction in soil fertility over time. The total of global withdrawals for irrigation is 2,480 km^3/yr (see Table 2.2), although other sources suggest that the annual consumptive use of irrigation is 1,800 km^3. Of total irrigation withdrawals, 20% is estimated to come from groundwater pumping (UN/WWAP 2003). Irrigation thus is highly productive in terms of food produced per unit of land, but as presently practiced is inefficient and is by far the largest user of surface water.

Much of the dramatic increase in food production of recent decades requires high-yielding plant varieties (combined with fertilizers and pest control), and relies on irrigation to ensure an adequate and timely supply of water. World water withdrawals for irrigation have increased by over 60% since 1960 (UNDSD 1999), and irrigated areas are expected to expand, mainly in countries with an extremely rapid population growth (and, naturally with sufficient soil and water resources. These withdrawals for irrigation do not vary region to region as markedly as domestic and industrial use. The exception is Sub-Saharan Africa where withdrawals are less than one-third of the global average.

Irrigation is usually regarded as inefficient because much of the water diverted or pumped is not actually used by crops or livestock but instead ends up recharging groundwater. This arises due to seepage from unlined canals or leaky pipes and from evaporation. About 60% of irrigation water returns to river basins and to groundwater aquifers with its quality degraded by pesticide, fertilizer and salt run-off. Nevertheless, the return flow is not lost as it makes water available for other uses in the same watershed or downstream. With modern engineering and water technologies (sprinkling, drip, irrigation), a considerable amount of water can be saved. These methods will also increase crop productivity and decrease the volume of abstracted water.

2.2.4 **Extent of Withdrawals and Consumptive Uses**

In the U.S., comprehensive estimates of water use that build state, regional and national totals from on-the-ground measurements are not available. Instead, different watersheds and localities may have detailed information on some uses but not others. Meanwhile, the U.S. Geological Survey (USGS) pulls together data of varying degrees of reliability to examine water use at the basin and national scales. This information is also available at a state scale. Based on this information a number of efforts have been made to examine current water use and project future demand at a state and basin scale (Brown 2000; Houston et al. 2003). The USGS data and analyses thereof (from 1990 data) are reported below to provide a general understanding of the extent of current withdrawals, their use and the consumptive nature of each use. References to the Pacific Northwest refer to the states of Oregon, Washington, Idaho and Montana, and references to the Columbia refer to the portion of the basin in the U.S., including the coastal regions of Oregon and Washington. Figures are reported in gallons, including in “gpcd”, which refers to gallons per capita per day.

The World Health Organization (WHO) has not issued guidelines on the amount of domestic water necessary to promote good health. Nevertheless, there is a relationship between access to water and the degree of health concern. On this basis, WHO estimates that the amount of water for domestic use per person in rural areas must be a minimum of 5.2 gallons per day to fulfill basic needs with a total of 26.4 gallons per day to meet consumption and hygiene needs (Howard and Bartram 2003). Global per capita average withdrawals for domestic use is just less than 40 gallons per day (UN/WWAP 2003). According to the American Water Works Association per capita indoor water use in the U.S. is much higher at approximately 69 gallons per day. For all domestic and public uses, including outdoor irrigation of lawn and garden, the USGS estimates an average of 123 gpcd for the US. The figure is slightly higher for the Columbia at just over 140 gpcd.

Globally, 21% of water withdrawals from surface and groundwater are for industrial purposes – twice that of domestic uses (UN/WWAP 2003). Global average water withdrawal for industrial purposes is 90 gpcd. Industrialized countries have a much higher rate of withdrawals per capita than do countries in developing regions. USGS figures suggest an average of 147 gpcd for the U.S. as a whole and 216 gpcd for the Columbia.

Note that the preceding figures are amounts withdrawn from surface and groundwater not consumptive use figures. While consumptive uses are difficult to specify, the USGS calculates that the consumptive use portion of domestic and public uses is 21% and for industrial and commercial is 15%. The corresponding figures for the Columbia are 13% and 8%. This differs from a figure of 40% used by the National Research Council in its projections for future main stem Columbia River water needs (National Research Council 2004). On a more local note, the Oregon Water Resources Department regularly uses 40% as an indicative figure for consumptive use during the winter (when lawn irrigation is not occurring).

Using the USGS numbers suggests that the 10 million people in the Columbia Basin are withdrawing 360 gpcd for these municipal and industrial (M&I) uses. In consumptive terms this would be 36 gpcd, which would be a fairly small amount. Using the numbers gathered from cities in Oregon, a range of 100 to 250 gpcd for M&I water at a 40% consumptive use would suggest a consumptive use of from 40 gpcd to 125 gpcd. The lower range would be consistent with the USGS figures. Over the course of a year M&I consumptive use would be 14,600 to 45,600 gallons per capita (or 2,000 to 6,100 ft^3) – about $1/20^{th}$ to $1/8^{th}$ of an acre-foot per year.

In the western states and the Columbia Basin, agriculture is an important economic activity. The demand on water from irrigation and livestock uses is therefore comparatively high. Water withdrawals for this purpose in the Columbia are almost a quarter (23%) of total U.S. withdrawals at over 32 billion gallons per day. This is equivalent to withdrawals of 35.5 million acre-feet per year for the basin. Interestingly the Columbia has the lowest water use efficiency of any of the USGS basins. The consumptive use is calculated to be 39%, whereas the average for the U.S. is 60%. The annual total consumptive use for irrigation and livestock in the Columbia is thus 13.9 million acre-feet.

Estimates of the amount of water used to produce the meat rich diet prevalent in North America suggest a consumptive use of 56,500 ft^3 (1,600m^3/person/year) or about 1.3 acre-feet per year. Using a population of approximately 10 million for the basin suggests a consumptive water need of 13 million acre-feet per year. While this may appear to suggest that the Columbia Basin is in balance with regard to matching its water demand with its water use it is important to remember that the water use that underpins crop growth comes from both irrigation and rain-fed agriculture. As the analysis above focuses on withdrawals not total water use, as in evapotranspiration, it is perhaps safer to say that the Columbia is a net exporter of water from the basin due to the high use of irrigation water.

Nevertheless the overall consumptive use as against available water remains low. The USGS suggests that the freshwater supply for the Columbia (as defined here) is 276 billion gallons per day (bgd). (This is not total freshwater supply but the average renewable supply going to the sea, i.e. it excludes natural evapotranspiration and does not account for rain-fed agriculture.) Using the 1995 USGS data of 11.2 bgd of consumptive uses suggests that just 4% of the freshwater supply in the region is consumed by these human uses. This is a relatively low percentage and is more on par with basins from the eastern U.S. than the west – where basins are more typically in the 10 to 40% range.

A further point emerging from this analysis is that per capita consumptive use requirements for agricultural water will be from 10 to 26 times larger than M&I needs (1/8th to 1/20th of an acre-foot compared to 1.3 acre-feet. If M&I use is actually twice as efficient as agriculture as USGS suggests the extraction need for agriculture could rise to as much as 52 times that of M&I uses. Thus, M&I water needs in the Columbia are clearly small relative to those for agriculture. However, rapid in-migration to the Columbia Basin and the subsequent expansion of urban and suburban areas, as well as rural dwellings, means that the trend in M&I and rural domestic use is one of growth. Given the difficulty of obtaining additional surface rights and the increasing regulatory burden with regard to water treatment, M&I systems are increasingly turning to groundwater for their needs – as are rural subdivisions and homesteads. The impact of this demand on ground water and to a lesser extent surface water is an important trend in the Columbia Basin, particularly as it comes at the same time as efforts to acquire water rights for instream use are increasing. Reconciling these human and ecosystem demands on freshwater in the basin will be a significant challenge in the basin.

2.3 Human Non-Consumptive Uses

2.3.1 **Hydropower**

The use, directly or indirectly, of the potential energy in surface waters to create energy is called "hydropower." In the Columbia Basin the use of rivers for the generation of hydroelectric power is a major and highly economically rewarding use of water. Water is not consumed in the strict sense by hydropower facilities, since it may be used again once water returns to the system from the powerhouse power generation. However, as water is typically stored (or merely backed up) in reservoirs for this purpose and increase in evaporation may be associated with hydropower. More critically from an ecosystem point of few is the re-regulation of river flows and blockage of chemical and biological constituents that large dams and storage projects cause.

There are a number of different types of hydropower facilities and it is important to understand their difference in order to plan and implement water transactions. Hydropower facilities may first be divided into run-of-river or storage facilities. In a run-of-river system, the force of the river current applies the needed pressure; in a storage system, water is stored in dam-created reservoirs, which then release the water when the demand for electricity is high. Run-of-river projects depend on river flows and are affected by seasonal flows and hydrology. In contrast, storage facilities store water when electricity is less valuable (off-peak) and release water for power when it is needed most (peak).

Run-of-river facilities come in two types: diversion or barrage. A diversion run-of-river hydro project harnesses the natural gravity from the river flow to produce electricity. It does not require an impounding dam with a large reservoir. These projects have four major components: a diversion weir, a pond or other mechanism that removes sediment from diverted water, a high pressure tunnel through which the water travels, and a power plant.

Barrage run-of-river facilities do not divert water from the river. Rather they rely on a dam (called a barrage) to back water up to achieve a greater height from which to harness potential energy. These are not storage facilities, as, once filled, they are generally full and the incoming flow will not stop moving through, over, or around the facility.

Storage facilities consist of on- and off-river storage facilities and pumped storage. Off-stream storage may not block fish passage (if water is extracted rather than dammed and diverted) but will reduce flow levels. Pumped storage typically occurs when water is pumped up into a reservoir at off-peak periods to be realized during peak periods for power generation. Depending on inflow and storage capacity, storage reservoirs will store and release water on a daily, annual, or inter-annual basis. Irrigation requirements associated with hydropower dams can also play a major role in determining water use at such facilities. The history of multi-purpose dam projects is, however, that the hydropower operation ends up subsidizing the irrigation operation (World Commission on Dams 2000).

The Columbia River is a major source of hydropower. The Federal Columbia River Power System refers to the multipurpose facilities built, owned and operated by the federal government. The dams are operated by the U.S. Army Corps of Engineers (21) and the Bureau of Reclamation (10); and have a total installed generating capacity of 20,474 MW (Bonneville Power Administration 2007). In addition to the federal projects, a number of privately owned dams contribute additional hydropower to the regional grid. On an annual basis hydropower makes up just over 50% of the electric power supply to the four Pacific Northwest states (Northwest Power and Conservation Council 2005). Federally supplied power is marketed by Bonneville Power on a cost basis, which typically means lower electric power rates in the Pacific Northwest due to predominance of low-cost hydro in the generation mix. FCRPS power costs about $10/MWh to generate whereas new supply in the region is expected to be in the $70 to $80/MWh range. Grand Coulee dam underpins the FCRPS, producing 20 to 25 million MWh from an average water flow of 110,000 cfs at a cost of $1.35 per MWh (Ortolano and Cushing 1999). Grand Coulee has generated $15 billion in revenues (even at the cost-based rate) and each year saves the region around $500 million when compared to the cost of generation from natural gas (World Commission on Dams 2000).

2.3.2 **Navigation**

Waterways are also used for transportation, thereby avoiding the use of other power sources in transport. For hundreds of years humankind has been diverting water for canals, creating channels, dredging rivers and building locks and other structures to facilitate the use of waterways for transport. The use of the main stem Columbia and Snake Rivers as a means of transporting agricultural products to the sea remains the primary use of rivers in the basin for transportation. The existence of the dams on the Snake and downstream on the Columbia are a necessary precursor to this use of the river.

2.3.3 **Inland Fisheries and Recreation**

Inland fisheries consist of sport and recreational fisheries and aquaculture (fish-farming). Fishing provides food, employment, income and enjoyment. The catch from inland fisheries provides almost 12% of total fish consumed by humans and, in many countries freshwater fish make up the majority of total animal protein intake, particularly among the poor. Freshwater fish also provide essential vitamins and minerals. While the utilitarian benefits from fisheries in the Pacific Northwest are considerable, the status of “salmon” as icons of the region gives them a special significance. The role of creeks, streams and rivers as an integral part of the life cycle of anadromous fish is therefore seen as increasingly critical in terms of public policy.

Both the quantity and the quality of water must be maintained to sustain these inland fisheries. Flow, the physical and chemical quality of water, and the associated aquatic and riparian habitat are all of importance to a healthy fishery. The value of inland fisheries is invariably underestimated. Sport fisheries can have a very high economic value and are growing in importance as increasingly affluent retirees move to rural areas and dedicate themselves to outdoor pursuits in their waning years.

Despite the predominance of fish-centered ecosystem restoration as a driver for water transactions, rivers and lakes are also used for a number of non-fish related recreational purposes including boating, sailing, rafting, kayaking, and swimming. Because of the growing importance of recreation and tourism, the demands posed by recreational uses are given more and more importance globally in formulating water as well as environmental management policies. However, in the Columbia Basin healthy rivers are often still seen largely as a means to salmon survival and restoration.

2.4 Ecosystem Services and Biodiversity

Water is integral to the functioning of the earth's ecology; thus rivers, lakes and wetlands, and the aquatic and terrestrial ecosystems and biodiversity that depends on them, represent an important use of freshwater. By one global estimate less than 2.7% of the global annual throughput water goes to directly support the consumptive human uses identified above (Falkenmark and Rockström 2004). The number would rise to 10% if considered as a proportion of just ground and surface water throughput. This, as some 63% of the global precipitation input is consumed (evapotranspired) prior to reaching ground and surface waters (see Table 2.2). In other words, despite the extensive appropriation and use of ground and surface water, 90% of these waters continue to support ecosystem function. It is also worth noting that even though water may go first to support the function of these ecosystems, these ecosystems may in turn provide benefits to humans, or ecosystem services, as discussed further below. It is important though to note that the re-regulation of rivers for hydropower generation and transport is not incorporated into this analysis. Estimates suggest that some 60% of river systems are altered in some way by large dams (Vörösmarty, Lévêque, and Revenga 2005).

For water that is evapotranspired directly from vegetation and soil moisture (without ever joining surface or ground water) about 40% goes directly for human use in grazing and rain fed agriculture and the rest to support ecosystems (Falkenmark and Rockström 2004). All told about 70% of the global annual precipitation input goes to these ecosystem uses rather than to direct human use. Clearly, this ecosystem use is both consumptive and non-consumptive. In providing a range of goods and services for human use and simply in preserving their natural function and diversity, wetlands consume water through plant transpiration and evaporation of surface water. However, rivers that provide habitat and passage for fish that are harvested for protein and sport may be largely non-consumptive uses of water. It is estimated that 35% of the global annual throughput of freshwater goes to consumptive uses primarily for ecosystem use.

Table 2.2 Global Water Balance between Human and Ecosystem Uses

Component of Water Budget	Amount (km^3)	Percent
Precipitation Input	113,500	100%
Evapotranspiration	70,850	63%
For direct human use	25,400	22%
Ecosystem and indirect human use	39,760	35%
Unaccounted for	5,690	5%
Surface and Ground water	42,650	38%
For direct human use	3,100	3%
Ecosystem and indirect human use	39,550	35%

Source: Falkenmark and Rockström (2004)

Ecosystems require water to function, and these functions lead to not only water-related goods and services directly consumed by humans (such as those described above) but a series of goods and services that support economic activity and human welfare. Ecosystem services can be defined then to include the result of ecosystem function that directly or indirectly contributes to human welfare. This ecosystem function can be distinguished from the consequent socio-economic utility – the resulting ecosystem service. Addressing an ecosystem's function means addressing the full range of physical, chemical, biological and ecological function presented by a healthy ecosystem. By contrast, discussing an ecosystem service means discussing how ecosystem function contributes directly or indirectly to human welfare.

Freshwater ecosystem services are a subset of all these ecosystem services (see Figure 2.1). Freshwater ecosystem services may directly benefit humans, as when humans enjoy the benefit of cold, clean water to drink from springs or streams. Freshwater ecosystem services are also evident when freshwater ecosystem function ecological function indirectly results in human benefit, as when fish species harvested by humans have cold, clean water at their disposal for drinking, spawning, rearing, etc. And, finally, freshwater may merely support ecosystem function and biodiversity – for example providing cold, clean water that discharges into the ocean without any direct or indirect human use or that supports the survival of an aquatic species that is not used by humans. In this case, a purely utilitarian approach would not consider this function an ecosystem service unless humans place a value on the discharge or the species, irrespective of any existing or future plans to consume them. Such "existence values" may however be important elements of cultural or spiritual values placed on healthy, functioning ecosystems.

The Millennium Ecosystem Assessment (MA) provides a framework for classifying ecosystem services (see below). In this framework, freshwater is a "provisioning" service—the service freshwater provides to humans for domestic use, agriculture, power generation, and transportation. Freshwater and the hydrological cycle also sustain inland water ecosystems, including rivers, lakes, and wetlands. These ecosystems provide additional "cultural", "regulating", and "supporting" services that directly and indirectly contribute to human well being by supplying recreation, scenic value, and maintenance of fisheries. Freshwater plays an additional role in sustaining freshwater-dependent ecosystems such as wetlands, mangroves, inter-tidal zones, and estuaries, which provide another set of services to local communities and tourists alike.

The MA classification is useful insofar as it includes all services no matter the degree to which human intervention has occurred. This enables an approach that seeks to maximize the overall level of services as a societal goal. From an anthropocentric or utilitarian standpoint this is a sensible approach. The drawback of this classification is that it does not distinguish between the natural and human-made components of these services. It may thus be confusing to find hydropower as an ecosystem service, whereas hydropower is more often considered physical infrastructure that can adversely affect ecosystem function and biodiversity. However, this serves to highlight the larger challenge society faces in choosing the degree to which it wishes to emphasize the different services that are provided by water resources – and to what extent ecosystems and the water cycle are managed (or developed) to this end. Thus, with regard to freshwater the MA (and other international assessments) have concluded that the development of provisioning services through human intervention has in many cases gone too far, resulting in losses to human welfare through the degradation of the supporting, regulatory and cultural functions (World Commission on Dams 2000; Aylward, Bandyopadhyay, and Belausteguigotia 2005; Vörösmarty, Lévêque, and Revenga 2005). The task then is to recognize the tradeoffs between these functions under different development scenarios and attempt to better balance the full set of functions in the hopes of improving the overall provision of services and welfare.

Figure 2.1 Freshwater Ecosystem Services

<table>
<tr><td colspan="2">Provisioning Services
• Water (quantity and quality) for consumptive use (for drinking, domestic use, and agriculture and industrial use)
• Water for non-consumptive use (for generating power and transport/navigation)
• Aquatic organisms for food and medicines</td></tr>
<tr><td>Regulatory Services
• Maintenance of water quality (natural filtration and water treatment)
• Buffering of flood flows, erosion control through water/land interactions and flood control infrastructure</td><td>Cultural Services
• Recreation (river rafting, kayaking, hiking, and fishing as a sport)
• Tourism (river viewing)
• Existence values (personal satisfaction from free-flowing rivers)</td></tr>
<tr><td colspan="2">Supporting Services
• Role in nutrient cycling (role in maintenance of floodplain fertility), primary production
• Predator/prey relationships and ecosystem resilience</td></tr>
</table>

Source: Adapted from Aylward et al. (2005)

2.5 Ecosystems and Water Resources Management

Water management consists of allocation, distribution and conservation decisions for water resources. The discussion above suggests the need for clarity regarding the extent to which ecosystem protection (or management) and infrastructure investments in water resource development are complements or substitutes. Rather than suggesting that human needs be met only by naturally-occurring ecosystem services or only through the construction of infrastructure, it may be more constructive to focus on the benefits and costs of each approach in a given situation and choose the level of ecosystem protection and water resources development that optimizes human welfare, taking into account impacts to ecosystem health that may lie outside welfare considerations.

The difficulty in bettering human welfare in this fashion comes from attempting to understand and calculate the trade-offs for the many types of services a given ecosystem may provide. Thus, it may seem simple to say that irrigated agriculture creates substantial net benefits to society and the economy, and that therefore available water *should* be diverted for in growing crops as the principal provisioning ecosystem service. But a healthy, functioning stream or river provides many ecosystem functions that may also create value for human; therefore the trade-off between these ecosystem services and the level of human investment in water resource development is difficult to calculate in practice. Further, it is not so much a question of doing either one or the other – using all the water for agriculture or leaving all the water instream – but rather one of how much water to allocate to each use so as to produce the most value.

The management challenge faced in regions where little development of water resources has occurred is to balance the often low cost or free, naturally occurring ecosystem services with the potential to develop, and thereby alter, their provisioning. Where provisioning services have already been augmented through investment in infrastructure, the major challenge is recovering welfare-enhancing ecosystem services that water resource development has degraded without unnecessarily imperiling the supply benefits of development. The latter challenge is that facing conservation groups in the western states.

An illustration of the growing attention given to the services provided by healthy, functioning ecosystems is the increasing priority that ecosystem requirements, or "environmental flows," are receiving alongside traditional human consumptive and non-consumptive uses. Understanding ecosystem water requirements, and thus defining the "supply" needed by ecosystems, is a primary challenge of this approach. New approaches that are inclusive and multi-disciplinary are being developed to supplement earlier approaches that were based largely on minimum flows needed to sustain fish (and their habitat) and are described in Chapter 8.

2.6 Water Management Challenges and Water Productivity

Water will continue to grow scarce in areas that are already crowded and stressed and water scarcity will emerge in areas where it is now plentiful. Nevertheless, in absolute terms, there will be enough water, just not in the right amounts, at the right place and the right times. Like other natural resources, water only really becomes a "resource" if it is available to satisfy a need, at a time and place and at the quantity and quality that are needed. The main constraints on water availability are quantity, timing and quality. Moving water to where it is needed is often a matter of economics, engineering and socio-political concerns. In the past, water resources management focused on making water available, i.e. on water resources development. In the new era of water management, the focus is increasingly on maximizing water's productivity – rather than merely supply or efficiency – and acknowledging water's dual role in providing for human and ecosystem needs and, indeed, its multi-functionality (Molden and Falkenmark 2003).

Water managers face two principal challenges in managing water resources: (a) to accommodate additional water withdrawals from surface and ground water for human use while meeting the demand of ecosystems and (b) to find ways both to be more efficient with evapotranspiration and to increase the portion of evapotranspiration dedicated to crop production (to provide food for growing populations). Some areas, may respond to water problems by increasing surface and ground water supply through additional development. In most places, however, increasing supply by moving such water to when and where it is needed is costly. Managers need other tools, such as demand management, supply efficiency and water transfers, to find timely and cost-effective solutions.

Water managers have long focused on water resources management as purely a surface and ground water management problem, but the possibility of meeting future needs with changes in the use of evapotranspiration as well as surface and ground water have not been discussed at the policy level (Falkenmark and Rockström 2004). Just as with surface and ground water, the use of water can be made more "efficient" by moving precipitation from waste (pure evaporation) or ecosystem use to human use for food production. Of course such efficiency solutions must account for tradeoffs in terms of existing ecosystem uses of this water that might be supported by such "inefficient" uses.

The management of water resources is also subject to efforts to resolve other environmental and resource issues. A particularly salient example of the latter point comes from climate change. To mitigate climate change impacts, one could potentially store carbon in forests through conservation of existing forests, reforestation of degraded forests, or, simply, afforestation. However, forests have high rates of evapotranspiration. Planting forests for wood and carbon would increase the amount of the annual throughput of water used by forests. This would reduce the water available for food production. In some cases, it might even reduce the water supply by evaporating or transpiring water that otherwise would have contributed to groundwater or surface water. This example simply underscores the importance of taking an integrated look at how land and water are managed.

2.7 Integrated Water Resource Management

With the variety and scale of competing uses for water, the scope of water resources management is broad. The interrelation and intricacy of the water cycle, discussed above, and the desire to integrate social, economic and environmental requirements, make management all the more complex. These challenges can only be met through integrated management, typically called Integrated Water Resources Management (IWRM) or Integrated River Basin Management. The Global Water Partnership has defined Integrated Water Resources Management as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." Given the socioeconomic importance of land management it should be clear that this definition is not suggesting that water managers will drive land use and management. Rather the intent is that the interrelationships between land and other resources, and water be recognized and that planning and management for these resources be coordinated to the extent possible.

As far as freshwater is concerned the water cycle can be divided into three components: what happens from the ground up, what happens below the ground and what happens in surface waters. The management of these waters, their interrelationships, and their interrelations with land management can be grouped into three components, which form the basis of IWRM: watershed management, groundwater management, and surface water management.

To manage optimally consumptive and non-consumptive freshwater uses, water managers must integrate these three components into one management. Furthermore, taking IWRM in its broadest sense, managing the water cycle as a whole may also require adding climate management and coastal/ocean management.

The true sense of integration inherent in IWRM means more than simply setting the scope of the management problem. It also means ensuring that social, economic, environmental and technical dimensions are taken into account in water resource development and management. Moreover, IWRM will only succeed if it is a multi-disciplinary undertaking that uses all of the knowledge and experience available, including both scientific and traditional knowledge. IWRM must, thus, integrate across the scope of the management problem and the multiple social, economic, environmental and technical aspects of the affected resources.

IWRM also requires managing water resources at the appropriate unit. For watershed and surface water management, the watershed is the appropriate management unit. By contrast, the appropriate management unit for groundwater is the aquifer. Watersheds and aquifers do not always coincide, which makes it difficult to generalize about the appropriate management unit in practice.

Furthermore, management issues and responses may take place at different hydrologic levels, since watersheds lie within each other and are connected through upstream-downstream interactions. The issues that arise or the effects of management responses at one level in the water cycle may or may not lead to effects at others. For example, changes in land use in a headwaters area may affect flood flows immediately downstream with important consequences for landowners or recreationalists in the immediate area. However, further downstream in the basin the impacts are likely to be attenuated (reduced) as streams draining other headwater areas converge, each with their own distinct flood peak based on their watershed hydrology and the timing of precipitation (for example, as a storm moves across the basin). Understanding relationships between watershed function, groundwater recharge and discharge, as well as surface flow patterns across the extent of a watershed or basin is therefore important to integrated planning and management.

Finally, water management needs to be integrated at the temporal dimension. As explained earlier, some water moves through the water cycle on a human timescale — from weeks to years. Other water, particularly groundwater, has a time horizon that is much longer and may be measured in hundreds or thousands of years. Water management must therefore recognize that different components of the system react at different time scales – and understanding the timescale is important if water management is to succeed.

The fundamental goals of IWRM are harmonizing the institutional framework for water management and promoting the participation of water users. The need to confront the different problems related to water resources management in an integrated manner calls for the establishment of effective frameworks for the cooperation of all interested stakeholders in the processes of elaborating and implementing responsible and sustainable water policies and plans. Finally, IWRM has also an international aspect inasmuch as it requires cooperation and coordination among states that share the same water resources.

Successful IWRM hinges on many things, but it also depends upon a supporting policy and regulatory environment. The regulatory framework that underpins water resource management in the western states is explored in the next chapter.

2.8 Resources

2.8.1 Internet Links

International Water Resources Management

UNESCO World Water Assessment Program – www.unesco.org/water/wwap/

Millennium Ecosystem Assessment – www.maweb.org

International Hydropower Association – www.hydropower.org

International Committee on Irrigation and Drainage – www.icid.org

International Committee on Large Dams – www.icold-cigb.org

Water Resources Management in the United States

Bureau of Reclamation – www.usbr.gov

Natural Resource and Conservation Service (USDA) – www.nrcs.usda.gov

US Geological Survey – www.usgs.gov

US Army Corps of Engineers – www.usace.army.mil

US Environmental Protection Agency – www.epa.gov

Water Resources Management in the Columbia Basin

Bonneville Power Administration - www.bpa.gov

Northwest Power and Conservation Council – www.nwcouncil.org

2.8.2 References and Further Reading

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CHAPTER 3
WATER LAW AND WATER RIGHTS IN THE WEST

Bruce Aylward

Contents

Tables

Boxes

Ecosystem Economics
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www.ecosystemx.com

Water Law and Water Rights in the West

The allocation and management of water resources by society involves a number of choices. These choices respond to a number of key questions that emerge in managing water:

Institutional arrangements for managing resources: How does society organize itself to manage its natural resources?

Ownership and authority over water: Who owns water resources and what authority does government have to manage water?

The right to use water: If the state owns water or retains control over its allocation, how do public or private entities obtain state permission to use water? Which water uses require formal permission and which can simply be exercised? What types of water rights are there? What is the duration of a permission to use water? What other conditions are placed on the use of the water? Are there state fees and charges associated with the use of the water?

Priority of water use: How is water shared in times of shortage? Are there rules for prioritizing the allocation of water to different uses?

Water rights as property and transferability: Are water rights real property? What are the elements of a water use right? To what extent are these elements transferable and what oversight does government have in the transfer process?

In the sections that follow each one of these questions is addressed in terms of the origins of water law, typical approaches in the U.S. (in particular in the western states) and with respect to the water code in the four Pacific Northwest states.

3.1 Institutions for Water Resource Management

For those new to water law and management it is worth explaining that the government's institutional role in water management is expressed in a number of different ways. Federal and state constitutions provide the overarching legal framework but are often limited in what they proscribe about the management of specific resources like water. Allocation of water in the U.S. is left to the states and thus each state will have a section of its laws (or statutes or codes) dedicated to water (its water code). The legislature and the governor pass and sign laws and, ideally, these laws will reflect the policy regarding water that prevails in the balance between the executive and the legislative branches.

In the case of a natural resource such as water, the law is administered by executive agencies (government departments). In some cases these agencies are overseen or supported by citizen boards (or commissions). In order to effectively administer the water code these agencies and boards often require more detailed rules that deal with practical day-to-day issues of how to apply the law in practice. To this end the agencies will draft and approve administrative regulations that apply to water and the management of water rights. The final piece is of course the judicial system. The courts hear cases in which parties seek interpretations of, or engage in disputes over, statutory law, regulations, and their application. The results create case law, which provides additional reference point for agencies and water users.

The water transactions practitioner may need only to learn the administrative rules governing, for example, water leasing and instream transfers and will interact typically just with water rights staff at the respective state department. Still it is useful to understand the institutional structure that ideally makes the link between public policy and on-the-ground water transactions. Good policy does not necessarily lead to good laws, rules and water rights administration. Nor is it necessarily the case that policy is always ideal. While the Pacific Northwest provides a relatively supportive institutional environment for water transactions there is always room for improvement. Understanding how the system should work and then how it does work is often the first step in progress. Further, the field of environmental water transactions is a new area of endeavor. Therefore, every advance made in understanding and in implementation in this field has the potential of a demonstration effect in other jurisdictions.

3.2 Ownership and Authority over Water

Roman law included the concept of common waters (common to all and thus no one could own them), public water (belonging to public institutions) and private waters (associated with the land). The evolution and transmission of these traditions, particularly through centuries of development and application of European civil law, provides the historical underpinning to state or public control over water in most countries around the world. In particular, given the free-flowing and accessible nature of surface waters, most nations have chosen to treat water as a common resource and not to allocate private ownership rights for water, but rather to retain the authority to allocate the right to use water.

In the U.S., water is treated as a public resource to be managed for the common good (rather than owned by a private party). Private rights to the use of water may be established, but these are always incomplete and subject to the public's common need (Getches 1997). Treatment of water in the Pacific Northwest states follows this approach to the question of ownership and control (see Box 3.1). The states and the federal government share jurisdiction over water resources, with the federal government generally regulating water quality, and the states regulating quantity. For this reason, each state has developed its own body of law for the allocation and management of water. This makes generalizations difficult regarding the exact legal, regulatory and administrative rules that apply to water management and transactions. This handbook can provide only a first cut at the applicable rules. The references listed under Further Reading below are provided for those wishing to gain a more comprehensive understanding within a particular jurisdiction. Examples in the handbook are based on the author's experience and derive largely from Oregon and the Pacific Northwest.

The distinction between owning water and owning a right to use water may seem a matter of semantics. However, in negotiating water transactions it can also be useful to remind water users that they are just that: users not owners. Indeed the concept that the state retains ultimate control over the disposition of water and that the objective of the state's exercise of this control is the public good is a crucial element in underpinning both the case for, and the ability to, undertake transactions for environmental flows.

Box 3.1 Water Codes and Ownership of Water in the Pacific Northwest

In Oregon, the water code dates to the 1909 Water Appropriation Act in which the legislature declared that all "waters within the state" belong to the public (ORS 537.110). "Waters of the state" are defined in Oregon to mean "any surface or ground waters located within or without this state and over which this state has sole or concurrent jurisdiction" (ORS 536.007(12)).

The Constitution of Washington state asserts that the use of water of the state for irrigation, mining and manufacturing purposes shall be deemed a public use (Article XXI, Section 1). Under Washington's water code, passed in 1917, all "waters within the state" are declared to "belong to the public" and are held in trust for the people (RCW 90.03.010).

In Montana, the state constitution declares that all "surface, underground, flow and atmospheric waters within the state are the property of the state for the use of its people" (Article IX, Section 3 (3)).

In Idaho the water code declares that all waters "when flowing in their natural channels, including the waters of springs and lakes within the boundaries of the state are declared the property of the state." Control over these waters is given to the state, which is charged with equally "guarding" all interests involved (Title 42, Chapter 1).

It is also worth pointing out that there is some variation with regard to how different jurisdictions manage different types of water. Recall that to some extent it is possible for a water user to "use" water in its different forms, i.e. as precipitation, soil moisture, springs and water running across a property, as well as surface water and groundwater. Interestingly, Roman and Civil law both recognize rainfall and other waters associated with land (i.e. groundwater and minor waters) as private property. In some states, water that is on the surface of land from rain, snow or floods is called "diffused surface waters" and is the property of the landowner. In Texas, for example, this water is not subject to state authority, and Texas courts have affirmed that until diffused water enters a natural waterway it is the property of the landowner (Kaiser 2005). As shown in Box 3.1 only Montana's constitution explicitly recognizes precipitation as waters controlled by the state. Washington's water code refers to waters "within" the state, but appears to stick to regulating water as surface or ground water. The language in the water codes of Idaho and Oregon seem to exclude precipitation from state authority.

Leaving precipitation and water associated with the land apart from state authority is problematic for water management given the continuity of the water cycle. For example, a landowner that modifies vegetation and land on the property or directly appropriates and stores rainwater may alter the timing and availability of surface water downstream affecting downstream uses; however, these are left unregulated by the state if this water is the property of the landowner. For example, in Central Oregon, many landowners and ranchers suspect that removing juniper trees from their property will lower evapotranspiration and restore springs and creeks. While this may well be true, the difficulty comes when the water transactions practitioner is approached with an offer to help fund such projects in order to restore streamflow. As these uses are not regulated by the state there is no use permit that can be transferred to an instream use when the trees are cut and the creek begins to flow again. Instead, existing downstream users with permits would reap the rewards of such efforts.

In the U.S many states regulate groundwater separately from surface water, although some states have no groundwater rules at all (Getches 1997). Groundwater was considered private property under Roman Law. Civil law systems likewise recognize that water below a property belongs to the landowner, as do certain common law jurisdictions, including in the U.S. In 1904 the Texas Supreme Court adopted what has become known as the "rule of capture," which simply states that landowners may extract as much water as they want from below their property. *De facto* ownership is thus exercised by extraction, as given the lateral subsurface movement of groundwater through aquifers the concept of owning water beneath one's land has little practical import – compared to the size of a neighbor's pump (Kaiser 2005). In the Pacific Northwest all four states take an interest in regulating the use of groundwater, although they have taken different approaches, a topic of great importance in water transactions, and a topic to which we return at the end of Chapter 4.

3.3 The Right to Use Water

A key characteristic of any system for regulating water quantity and its use is whether and which sorts of uses require some form of government permission. Under Roman law the use of public waters (those that were navigable) required authorization from the state. Similarly, the right to use waters from streams adjacent to riparian lands required state authorization.

In the eastern U.S., increasing growth and development pressure on water resources led many states to adopt statutory permit systems by the middle of the last century (Getches 1997). These permit systems were in part necessary for evolving non-riparian uses, such as for municipal supply. Typical uses that are exempt from permitting include domestic uses, farm ponds and, in some cases, irrigation. Indiana, for example, does not require permits for riparian water uses limited to domestic, stock or agricultural water needs as long as withdrawals do not exceed 100,000 gallons per day.

All western states have permit systems established by statute except for Colorado, which adjudicates permits through special water courts in each water district. In most western states, the permit system typically requires filing, public notice and review, followed by issuance of the permit. The permit is not a "perfected" right (i.e. the user cannot begin relying on it) until he or she has demonstrated his or her intent to apply the water to a beneficial use. This requirement is satisfied by constructing the necessary infrastructure and applying the water to the beneficial use.

Water rights are typically classified by use, such as irrigation, municipal, industrial and so on. Each state will have its own set of permitted uses. Rather than enumerating the many types of water uses that require permits in each of the Pacific Northwest states it is more instructive to list the main types of use exempt from permitting, which are typically small uses of groundwater (see Table 3.1).

A number of general distinctions may be made beyond the type of use when it comes to water rights. A primary distinction is whether the source of the water is surface water or ground water. Surface water rights will require a point of diversion, whereas groundwater rights will have a point of appropriation. Surface water rights may include a right to divert the natural flow from a water body or they may involve the storing and subsequent use of water. Since storing water behind a dam alters the timing of available flow downstream a permit to store water is typically required. Subsequently the timing of release of stored water will once again alter the amount of flow in a water body. In order to ensure that this flow can be used by the appropriate water user a right to use released storage water is also necessary.

Table 3.1 Exempt Groundwater Uses in the Pacific Northwest

Oregon	Washington	Montana	Idaho
Domestic ≤ 15,000 g/day	Single or group domestic ≤ 5,000 g/day	Any use ≤ 35 g/m or 10 AF/yr	Domestic ≤ 13,000 g/day
Watering lawn ≤ ½ acre (or about 2 AF/yr)	Watering lawn ≤ ½ acre	Notice of department required 60 days following use	Watering lawn ≤ ½ acre (included in domestic use)
Industrial & commercial single use ≤ 5,000 g/day	Industrial ≤ 5,000 g/day		Domestic may include "any other" uses ≤ 2,500 g/day
Stock watering	Stock watering		

Source: Bastach (1998); Westesen and Bryan (1997); Pharris and McDonald (2000); Fereday et al. (2004)

For groundwater a similar situation applies with respect to efforts to intentionally recharge aquifers with the intent of later withdrawal. Aquifer recharge projects will first need a permit for the diversion of the source surface water and then a permit for storing this water in the ground. A further permit is required then in order to recapture this water through later withdrawal.

Another critical distinction is often made between the water right that serves as the primary source of water for the designated use and other water rights that may be employed when the primary source is not sufficient or available to meet the use. In other words a given use of water may be met through a number of water rights, one of which would be the primary right and the others designated as supplemental rights.

Irrigation rights in some states are deemed to be appurtenant to the land on which they are used. In other words the water "runs with the land" in terms of ownership. When the title to the land is transferred from a seller to a buyer the water rights are also transferred. This is a very powerful element in water law and creates a number of legal and administrative issues for conservation groups seeking to use water transactions to acquire water rights for temporary and permanent transfer to instream use.

While many water rights are assigned to individuals or businesses, some rights are held in common. For example, larger tracts of land developed as irrigation districts or companies may be watered through a single water right that includes permission to divert and apply water to many different and separately owned parcels of land. As an irrigation district exists to deliver water to its members the district, not the individual, is typically responsible for the diversion and transmission of the water to member properties. In the Pacific Northwest, water rights for irrigation districts reflect this in different ways. In Oregon, where water is appurtenant there is a natural tension in terms of the question of who owns the water right. While the water right is in the district's name, each landowner and their place of use is identified on the water right certificate. This has led to considerable confusion and a court case with regard to which entity, the district or the landowner, has the right to modify or change the certificate. Additional complications arise as supplemental storage rights are added into the equation. In some states, irrigation district water rights are not linked to specific lands, and it is up to the district to decide where the water is used in any given year. This is often the case when the source of district water is purely storage and may simplify water allocation and reallocation from an administrative standpoint. There may be advantages and disadvantages to developing transactions with district boards as opposed to individual landowners.

The duration of water rights in the U.S. is typically in perpetuity. Riparian rights are tied to riparian land and therefore not limited in duration by definition. In the western states, prior appropriation rights are typically created and allocated with no explicit consideration of their duration, thereby effectively not limiting their duration. Other countries have often chosen to extend licenses or rights for set amounts of time typically for a period between ten and forty years. In retrospect this has many advantages including that once society begins to change its mind about the purpose to which a resource is dedicated there is a guaranteed sunset date at which the resource may be reallocated by the state without charge. However, setting too short a duration will have an impact on the incentive to invest in developing productive uses of water. As the objective of extending water rights in the western states was to assist in development, the decision not to limit duration was a logical one at the time. It is of course possible to apply for the right to use water for a limited period of time. However, these are typically desirable only when the use is definitely circumscribed in time, such as for use as part of construction projects, quarries or other projects that require more water to complete, establish or build than will be required in later periods. If there is no additional cost (or no cost savings) to obtaining a permanent right (a temporary right) then there is little incentive even to apply for a temporary right.

As part of the permitting system, states may impose various conditions when they grant use permits, as well as levying fees and charges on the use. The government may impose conditions such as requiring a management plan and certain management practices, or specifying the amount of water permitted or the method of abstraction. Conditions placed on permits in Oregon consist of "advisories" that restate limitations on the use of water based on applicable laws and operational constraints (Bastach 1998). For example, in basins where surface and groundwater linkages may require future regulation of groundwater use, permittees are given permits conditioned by the possibility of future regulation or mitigation requirements. It is also now standard in Oregon for new permits to require all new groundwater permittees to meter and report their use.

In many countries a condition of water use is payment of fees assessed by the state. Leaving aside the direct costs associated with developing water systems and the actual delivery of water such water fees may be intended to:

- offset costs of administering water rights, including support to agency staff providing central or field services;
- offset costs of measurement, monitoring, research and planning; and/or
- secure watershed functions that support downstream water quantity or quality.

In the western states water users typically do not face any such fees. The administration and management of water by the state is provided through general funds from the state budget. The amount of funding for state administration and management therefore varies from state to state depending on the legislatures interest in appropriating funds for this purpose.

Water users seeking to change their water rights in some way are subject to fees but these are typically limited to at most the intent to recoup the extra administrative costs imposed on the agency by such changes. Washington and Oregon have reimbursement authority programs whereby certain applicants can receive expedited processing of applications and changes by covering the cost to the agency of subcontracting this work out to consultants. The agency vets these consultants and supervises their work. Such programs can be valuable where the agency is under-funded to provide basic services and process new applications, much less meet the growing (and more complex) demand for change applications.

3.4 Priority of Use and the Prior Appropriation Doctrine

Permitting the various uses of water enables the state to exercise its authority to control and manage the use of water as a public resource. However, the variability inherent to climate (over long periods) and weather (over short periods) suggests that obtaining a permit to use water is not the same as actually being able to access the water. The availability of water may be highly variable throughout the year, from one year to the next, and from a wet cycle of years through a drought cycle. Inherent in the allocation of permits to use water is then the question of whether and how the permit system regulates access to water, particularly in terms of shortage. How legal and regulatory systems provide for allocation of a variable resource is therefore of great importance to managing water resources (and avoiding conflict).

Around the world a number of ways of managing the priority with which different users may access water have developed. As summarized in Table 3.2 these approaches can be grouped according to whether the state explicitly prioritizes between uses and by whether cut-backs in times of shortage are shared or not (Aylward and Popp 2011). In the U.S. the riparian doctrine generally applies in the eastern states and the prior appropriation doctrine in the western states. It is worth noting that collective action in the form of centralized regulation is not always necessary to successfully manage water resources. For example, local authorities in a number of southern California basins have a long history of successful groundwater management, including conjunctive management (Blomquist 1992). Although much of the discussion of water transactions involves the use of the state water right system, it is equally useful to identify areas where mutually convenient arrangements between parties can resolve flow issues without resorting to state authority.

The riparian doctrine provides that landowners whose property abuts a water body may withdraw such water as is reasonable for their needs. In times of shortage all users are expected to proportionately cut back their water use. As time passes and demand for water rises, particularly new groundwater uses, the riparian system can be expected to have difficulty accommodating the multitude of uses. Given the hydraulic connection between groundwater and surface water, developing a new groundwater right is merely a way for non-riparian water users to obtain access to water. The riparian system may therefore be insufficient as a priority system in locations of water scarcity. Current problems with water resources management in the western states is the focus of this handbook, not future water resource management problems in the eastern states – however it suffices to say that the eastern states may one day also be in need of water transaction practitioners to aid in water reallocation.

In the U.S, many western states follow either the prior appropriation doctrine or a combination of the prior appropriation doctrine and the riparian rights doctrine. The prior appropriation doctrine originated from the customary practices of miners in the western states who resolved disputes over water based on who had first established a claim. When water codes were developed at the turn of the century this “first in time, first in right” approach was accepted as a logical way to spur the development of the west. The security of a claim based on a priority date was seen to provide the economic security on which investments in irrigation systems and other infrastructure could be based.

Table 3.2 Priority Systems for Allocating Water in Times of Shortage

	Allocation in Times of Shortage	
Prioritization Between Uses	Water Shared	Water Used According to Priority
None (state does not explicitly prioritize one use over another)	• Common property regimes based on community priorities (e.g. groundwater management in southern California) • Regulatory systems such as the riparian doctrine: right to use based on location but proportional cut-backs during shortage (e.g. eastern states) • Regulatory system in which government requires users to come to consensus on how to share water (not necessarily equally) (e.g. Japan)	• Unregulated open access: spatial priority – "first in line, first in right" • Regulatory system such as prior appropriation doctrine: temporal priority – "first in time, first in right" (e.g. western states)
State explicitly prioritizes types of uses	n/a	• Priority for Drinking water (e.g. Krygystan) • Priority for Domestic purposes (e.g. Indiana) • Priority for the Reserve (basic human and ecosystem needs (e.g. South Africa)

Source: Aylward and Popp (2011)

The prior appropriation doctrine is a powerful tool for regulating access to water. It carries the weight of an explicit regulatory approach to prioritization and also provides a very precise ordering of claims on water in a stream at any given time. Priority dates are established for each and every water right or permit and therefore there are no uses of water left outside the system creating uncertainty. (The exception of the exempt groundwater uses listed above will be discussed at the end of this chapter.) When water shortages occur, senior rights holders, i.e. those that appropriated water first, have the first priority for the available water, even if after their use no water remains for those who hold junior, inferior rights.

To accomplish this, senior users exercise a "call" for a specific amount of water for their use within the scope of their water right. Junior users must then turn off in the order of their priority dates (most recent shutting off first and so on), until the senior users call is satisfied at their point of diversion. The mechanism by which this is achieved will vary from place to place. In many parts of the western states there is a state-designated agent in charge of regulating water users. Called a watermaster in Oregon or a water commissioner in Montana, this person will, as necessary, effect the distribution of water to junior and senior users. With junior and senior users interspersed in no specific order along a creek or river this may be no small task. This is particularly true when instream water rights of varying priority dates are also included in the priority system. Alternatively, there may be no regulatory presence along a stream reach, and users undertake self-regulation based on long experience and the prospect of regulatory or legal action if the priority system is not observed.

3.5 Beneficial Use, Waste and Forfeiture

Unlike the riparian doctrine in which water rights are allocated based on location and reasonable use the prior appropriation doctrine – as a policy aimed at development of the west – was based on the concept of beneficial use. In the arid and semi-arid western states water was clearly in scarce supply, yet essential for crops and livestock. Thus, water policy and legislation developed based on the objective that water need to be used for the public good. In the late 19^{th} and early 20^{th} century the "public good" was consonant with the settlement of the west and the promotion of regional economic development, particularly the development of an agricultural economy. As a result water rights were to be allocated only upon proof of beneficial use and should such a cessation of this beneficial use occur the rights should be withdrawn and the water reallocated to new (and junior) beneficial uses.

Out of these objectives grew a bureaucratic system for administering water rights. New water users must apply to the respective agency for a permit to divert (or store, release, or pump) water for one of the uses designated as beneficial under the water code. The agency reviews the application according to its internal guidelines of technical adequacy and correctness and, if all goes well, grants a permit to develop the use. At that point the prospective water user may develop the necessary infrastructure to put the water to this beneficial use. Once the construction of the diversion and delivery system, building of storage dams, drilling of wells, etc. is complete the user begins to "prove" up on their beneficial use by actually using water for this purpose. Following some period (typically a year or more) of proving up on the use, a state employee or state-certified consultant will conduct an inspection to verify that the beneficial use is in accordance with the permit. After any changes that adjust the parameters of the permit to the actual beneficial the use proceeds to obtain a water right certificate. Only at that point can it be said that the water user has a water right. Typically it is further stated that the user has a water right subject to transfer, meaning in effect that the water right is transferable – a topic returned to later in this chapter.

In many places in the western states, claims on water pre-existed the passing of state water codes. The states therefore have developed "adjudication" processes whereby these "vested" water uses are validated and converted from claims to rights. Adjudications typically take place within a watershed or basin as a single process. The state will typically collect information about all the claims and verify actual beneficial use. The circuit court in the relevant county will then render its findings and issue a decree that specifies the parameters of each validated right. The state will then issue new water right certificates for these decreed rights. This process is ongoing in many basins throughout the western states. In basins that are not adjudicated it is not really possible to have a comprehensive water transactions program to restore streamflow due to the lack of security as to what the courts will find when the claims are evaluated. In other words claims are not rights and therefore are not subject to transfer, at least not in a predictable fashion. Any water transactions in such areas would need to be contractual in nature – as discussed further in Chapter 7 – rather than relying on state processes for changing water rights.

As mentioned above, in the western states water rights are typically appurtenant to land and thus when the land is sold, the water moves with the land to new ownership. There are a number of exceptions and ways around appurtenancy in each of the states. In the Pacific Northwest, water rights are not only appurtenant but the place of use is explicitly mapped out as part of the process of perfecting the water right. Any changes to this place of use – even a small shifting of the place of use – must be documented through a change in the water right. Otherwise, when the whole right is transferred the right may be cut back to the portion of the right exercised only on the area to which the right is mapped. In Oregon the only exceptions to this rule are on small properties of less than five acres. In Idaho, Montana and Washington large users, such as irrigation districts can define a large area as a place of use and have flexibility in any given year to apply water within these confines.

A further component of beneficial use is the concept of waste. Clearly if the policy objective is to maximize the benefits from development of water resources then occasions where a water user wastes water are to be discouraged. For example, Oregon's water code specifies a condition on beneficial use, i.e. that water is to be used "for beneficial purposes without waste" (ORS 536.310(1)). Regretfully "waste" is not defined in the statutes. Somewhat unfortunately, therefore, waste lies in the eye of the beholder. For an irrigation water user the transmission loss in a canal or ditch represents the "carry water" necessary to deliver water to the user's headgate. Further, the groundwater recharge occasioned by this seepage may represent the water that underpins a neighbor's users domestic well water use. However, such transmission loss may appear to be waste to the eager fly fisherman who sees creeks and streams as needlessly dewatered (Bastach 1998).

As there is no definition and hence no standard, waste is effectively not an operational concept of great value in water transactions. However, clearly where more water is diverted or appropriated than is necessary to satisfy the end use it can be said that there is the potential for conservation. Real opportunities for conservation will of course depend on the technical feasibility of actually saving the water as well as the associated social, economic and environmental costs and benefits of such an undertaking. This is discussed in detail in Chapter 6.

Finally, a failure to continue putting water to beneficial use also runs counter to stated objectives for water in the western states. The famous dictum "use it or lose it" applies to water rights under the prior appropriation doctrine. In the Pacific Northwest a period of non-use of five years makes the water right liable to forfeiture. In most western states there is also a provision for partial forfeiture. In other words, after five years of using water on only 10 out of 20 water-righted acres, the user is liable to forfeiting the right to irrigate the fallowed ten acres. Or if a user moves to more efficient irrigation and uses a lower rate and duty, then after five years of such practice the user may be liable to forfeit a portion of the rate and duty on the water right certificate. Amongst western states, Oregon has effectively eliminated partial forfeiture moving instead to a ready, willing and able test for forfeiture. Under these regulations, even if water users have not employed their full rate and duty, they may still transfer these rights as long as they appear ready, willing and able to divert the water. This considerably lessens the force of the "use it or lose it" rule under prior appropriation (Koehl 1998).

Of course, as with many aspects of water management, implementation is an important limitation to the utility of the notion of forfeiture. In many places, there is little to no active measurement, monitoring or enforcement of water use. Therefore, non-use is often only an issue for reaches in which water is extremely scarce and neighborly relations are not what they should be. Even where one neighbor is likely to turn in another due to bad blood the chances of this are diminished if the cancellation of a water right would likely mean that the water would stay instream and not be diverted for farming, for example. This, of course stems from the traditional agricultural perspective that any water going downstream to the mouth of a creek or stream is in fact "wasted" since it is not applied to wet up ground and grow food. With regard to environmental water transactions then, action to cancel unused water rights may be part of a comprehensive strategy to restore a reach – given that uncertainty over unused water rights and their potential for resuscitation may make it difficult to accurately plan and implement such a strategy.

3.6 Water Rights as Property and Transferability

A water right certificate gives its holder a perfected water right. A water right is made up of several elements or components. The discussion below draws on the context of Oregon and Idaho Water Law but with minor variation may be assumed to apply generally in prior appropriation states (Bastach 1998; Fereday et al. 2004). The elements of a water right are:

- holder: the name of the individual or entity that "holds" the water right;
- source: the body of water from which water is diverted or extracted;
- character or purpose of use: the type of beneficial use in accordance with state rules;
- point of diversion or appropriation: the geographical coordinates for where the water will be taken from surface water or groundwater;
- place of use: the geographical location in which the water will be used, for irrigation based on a water rights examiners" map;
- priority date: the day, month and/or year when the water right was first claimed or the application for the right received by the agency;
- quantity of water: typically expressed as a rate of flow (in cubic feet per second) and/or a volume or duty (in acre-feet);
- season of use: specifying the time period during the year when the water may be used; and
- conditions: any conditions required of the water right holder or restrictions on the right.

These elements define both the outer limits of allowable water use and the property interest owned by the water right holder. A water right gives an individual the right to use water in a specified way, but not actual ownership of the physical water. Nonetheless, a water right creates a property interest for the owner of a perfected water right.

A water right and its accompanying property interest may best be considered not as an open entitlement given to an individual by the state, but rather as a social contract. In exchange for putting the state's water to use for the benefit of the public, an individual is given a property interest in the right to use water. As with any contract, there are duties and rights on both sides of the exchange.

The state is obligated to allow a water right holder the use of water within the terms of their certificate. This includes the right to conditions as they existed at the time the right was perfected. The priority date ensures that no new (junior) users can diminish their water availability. In addition the place of use, character of use, and point of diversion elements prohibit senior users from changing their use in a way that could reduce the quantity of water available to junior users.

If the state breaches the contract by not making water available according to the terms of a perfected water right, the affected water right holder may seek damages for breach of contract, just compensation for a taking, or an injunction requiring the water be made available.

An individual is obligated to use their water in a way that benefits the public or face forfeiture as discussed above. If an individual breaches the contract by using water outside the terms of the certificate the user may face sanctions (or forfeiture) by the regulatory agency. Unfortunately, the task of monitoring water use is often a very large task left to a very small number of agency staff.

It is therefore relatively rare to see the state checking and enforcing that users are working within the terms of their rights. More often it is left up to other users – who if water is short will have such an incentive – to keep an eye on their neighbors water use and to complain to the state when things are amiss.

Once a water right is perfected it is "subject to transfer." While this is often thought of as referring to the sale of a water right to another user and the transfer of the right to a new beneficial use, "subject to transfer" has the broader meaning in that any of the fundamental elements of the right may now be changed. However, as described below, such a transfer is typically circumscribed by the provision that any such change shall not injure other water right holders.

Recall that a water right gives its holder the right to use water in a certain way, not absolute ownership of the physical water. The reason water is treated differently is because of its unique physical properties. Unlike with other types of real property, such as land, multiple users can and do rely on the same physical water to satisfy their rights.

As described in Chapter 1 an upstream user with a right to divert water for irrigation may consume only a portion of the water they divert. The rest of the water is lost in transmission or as run-off. The transmission loss and run-off rejoin the river further downstream as return flow where another water right holder relies on and uses it. The amount not consumptively used by the downstream user again rejoins the river as return flow where yet another user even farther downstream may rely on it, and so forth. Therefore, where hydraulic conditions allow reuse, the sum of the water diverted by water right holders can be greater than the amount of actual flow entering the river.

The contract between the state and the water user is for a specific beneficial use, described by the elements of the property right. While the user has the authority to sell the water right, the state retains the obligation to ensure that the changes made do not negatively affect other users ability to in effect have access to the same amount of water they had under the previous constellation of water rights and uses. The dendritic, network-like structure of diversions, seepage and consumptive use in a basin will be altered when one water right is picked up from the system and placed elsewhere. States therefore offer the opportunity to water right holders to market their rights to others, or to change them for their own purposes, but subject to an assessment that doing so will not injure other users. If the likelihood of injury is established then the dtate will limit the degree to which the full water right (the set of elements describing the right) can be transferred. This topic is examined in further detail in Chapter 7.

3.7 The Underpinnings of a Water Rights Market

The discussion of prior appropriation lays out the basics of how the doctrine functions and how it can lead to the trading of water rights. Economic theory suggests that where well-defined and enforceable property rights exist trade and markets will develop. Regardless of the initial allocation of water rights then, market forces left to their own guises are presumed to lead to an optimal and efficient allocation of water rights. As long as a prospective trade of rights exists that will make both the buyer and the seller better off this trade will occur.

In reality, all trade in goods and services in modern societies is backed by regulation, even if it is only the prospect of law and order and the exercise of police powers that enables a market to emerge in unregulated goods or services. In the case of water, the state creates the use rights and allows transfers. More specifically, the prior appropriation doctrine provides an implicit cap and trade framework that lends itself to trading. Under prior appropriation there are users who have secure allocations – senior users – and users that have interruptible supply depending on hydrological conditions – junior users. If a junior user or a prospective user of water has a beneficial use that is superior in terms of its financial returns to that of the senior user then the conditions for a mutually beneficial exchange of rights exists. If this is so, then the new or junior user may acquire the older priority date water and obtain a more reliable water supply. The senior user then reduces or retires their use of water, but obtains compensation for the rewards previously garnered from the water that has been transferred to the other user. In this manner both parties improve their financial situation through the trade of the permission to use water – resulting in a more financially efficient allocation of water.

The expectation that markets for water rights will emerge is of course subject to transaction costs – that is the costs of coordinating and undertaking such a trade. Where these transaction costs are high the potential gains from trade will be lessened and the incentive to engage in trade reduced. As already alluded to and as discussed further in later sections of this handbook there are many obstacles and restrictions on trading water rights that make the transaction costs a significant factor in the development of water markets (Garrick and Aylward 2012).

Beyond transaction costs, however, it is important to note that what the user is selling in physical terms – i.e. a rate and duty of water – may not be what the buyer will receive upon finalization of a transfer. The injury analysis may lead to a reduction in the rate and duty that can be beneficially used by the new user. Therefore, it is worth emphasizing that the oft-lamented lack of a "real" market in water suffers not just from high transaction costs but also the fact that what the seller gives up is not what the buyer receives. If a prospective buyer's use of water is twice as profitable as that of the existing use but the injury analysis of the new place of use causes the amount to be transferred to be halved then there will be no gains from trade. The prospective seller is better off retaining the right as the prospective buyer won't be able to make it worth the sellers while to engage in a trade. It is important to realize that this is not a problem, but rather just "how things are." Prior appropriation functions on the basis of right holders having the security to invest in their beneficial use and without the injury restriction on transfers this economic system would be undermined. The nature of water and its regulation, therefore serves as an implicit brake on trading and the development of active water markets.

The drawback of such a purely market approach is that disadvantaged social groups and the environment may not be able to effectively participate in such a market and would therefore not be able to meet their needs and would suffer as water moves to the activities with the highest market return. It is important to emphasize that from an economic standpoint the activities with the highest market return might not be those with the highest value to the economy as a whole: financially efficient outcomes may not be economically efficient. Thus in order for a market-based approach under prior appropriation to yield truly optimal outcomes further regulation or restrictions on the market may be necessary. We return to this topic in the case of ecosystems and environmental flows at the end of the next chapter.

3.8 Resources

3.8.1 Internet Links

Sites with Useful State Information:

Montana Water: Policy and Legislation – water.montana.edu/topics/policy/default.htm

State Water Codes:

Western States (Bureau of Land Management Site): Water Law Summaries – www.blm.gov/nstc/WaterLaws/

Oregon: Oregon Revised Statutes (ORS) – www.leg.state.or.us/ors/536.html

Washington: Revised Code of Washington (RCW) – apps.leg.wa.gov/RCW/default.aspx?cite=90.03

Idaho: Title 42 Irrigation and Drainage: Water Rights and Reclamation – www3.state.id.us/idstat/TOC/42001KTOC.html

Montana: Montana Code Annotated (MCA) – data.opi.state.mt.us/bills/mca_toc/index.htm

State Administrative Rules:

Oregon: Oregon Adminisrative Rules (OARs) – arcweb.sos.state.or.us/rules/OARS_600/OAR_690/690_tofc.html

Washington Administrative Code (WAC): Administration of Surface and Ground Water Codes (Chapter 508-12) – apps.leg.wa.gov/WAC/default.aspx?cite=508-12 and Department of Ecology (Title 173) – apps.leg.wa.gov/wac/default.aspx?cite=173

Administrative Rules of Montana: Deparment of Natural Resources and Conservation (Title 36) – arm.sos.state.mt.us/Title_36_Chapter_Table_of_Contents.htm

Idaho Administrative Code: Department of Water Resources – adm.idaho.gov/adminrules/rules/idapa37/37index.htm

State Water Agencies:

Oregon: Department of Water Resources – egov.oregon.gov/OWRD/

Washington: Washington Department of Ecology, Water Resources – www.ecy.wa.gov/programs/wr/wrhome.html

Idaho: Department of Water Resources – www.idwr.state.id.us/

Montana: Department of Natural Resources and Conservation, Water Rights Bureau – dnrc.mt.gov/wrd/water_rts/default.asp

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CHAPTER 4
WATER RESOURCES DEVELOPMENT, PRIOR APPROPRIATION AND ENVIRONMENTAL FLOWS

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Figures

Boxes

Ecosystem Economics
PO Box 2062, Bend, OR 97709, USA
www.ecosystemx.com

Water Resources Development, Prior Appropriation and Environmental Flows

In this chapter we review the context and driving forces that have led to low streamflows in the western states. After charting the history we move to the behavioral and hydrological mechanics of the environmental flow problem. Identifying the nature of the problem and its source also begins to provide us with the analytical tools required to chart the solution: i.e. a path towards evaluating the reliability of water rights and defining a water rights acquisition strategy. The worked example from Whychus Creek in the Deschutes Basin begun in Chapter 1 is continued as an illustration of over-allocation of surface water. Closing out the chapter is an acknowledgement that it is not just past allocations of surface water that need to be addressed, but also the potential future threat to ecosystems from groundwater development.

4.1 Water Resources Development and Ecosystems

The Lewis and Clark expeditions of 1804 to 1806 were the first overland crossings of the Pacific Northwest by non-indigenous explorers. Native Americans are thought to have inhabited the Pacific Northwest up to 15,000 years prior. After 1841 and prior to establishment of the transcontinental railroad in 1869, settlers migrated to the area via the Oregon Trail. In 1848 the Oregon Territory, an area largely consistent with the Columbia Basin, was organized by Congress following a number of years of diplomatic wrangling with the United Kingdom over the future of the area. A couple of decades later the areas we now know as Oregon (1859), Washington (1889), Montana (1889) and Idaho (1890) entered into statehood.

Prior to the onset of settlement of the Columbia Basin in the mid to late 1800s there was little modification of the water cycle by Native American tribes. The California Gold Rush of 1849 led to the eventual emergence of prior appropriation as the doctrine governing the establishment of water rights in the west. The concept of "first in time, first in right" was recognized by the federal government in the west in both the Homestead Act of 1862 and the Mining Law of 1872. The first claims to water (and later the first adjudicated rights) in the Columbia stem from this time period. Over the next century the hydrologic regime and associated inland freshwater ecosystems were modified in five principle ways by the land's new inhabitants:

1. Ecosystems were simplified through eradication of beavers and their dams, channelization and dredging of streams, draining of wetlands, and the removal of riparian vegetation – changes that reduced water storage, evapotranspiration and increased the "flashiness" of the hydrograph.
2. Damming and diversion of waters from creeks, streams and rivers; first as individual uses at prime locations and, subsequently, in places where gravity could feed large tracts of land – changes that reduced or dried up streamflow at specific points (and downstream) in mid-basin during summer irrigation periods, increased groundwater recharge rates from canal and ditch transmission loss and flood irrigation, and raised evapotranspiration rates (from natural vegetation to crops and pasture).
3. Damming and impoundment of waters in large reservoirs (in cases augmenting natural storage) for irrigation, hydropower and flood control – changes that reduced streamflow during winter months below the reservoirs as water was stored and then increased streamflow in the summer from the reservoir to the points of diversion, as well as increasing evaporation and groundwater recharge rates at the reservoir sites.

4. Damming and impoundment of waters behind large run-of river barrages for hydropower such as those on the main stem Columbia – changes that altered the daily and weekly hydrologic regime, effectively blocked downstream migration of anadromous fish, and increased evaporation and groundwater recharge rates.
5. Drilling wells and pumping groundwater for domestic use, municipal and industrial use and for irrigation – changes that reduced groundwater storage and affected groundwater discharge to streams, and that increased evapotranspiration rates.

The cumulative impact of all of these changes on the hydrograph and on freshwater ecosystems throughout the Columbia Basin have been extensive and far-reaching. The river icon for the Pacific Northwest – the salmon – is endangered or threatened in most of its territory, and it has not been unusual to see creeks and streams simply dry up due to diversions. As an example of this, the Deschutes River, a tributary of the Columbia in Oregon, has had its flow regulated down to 2% of its natural flow (of some 1,400 cfs) during the summer months near Bend due to massive diversions for irrigation. In the winter, storage for irrigation in the headwaters depletes streamflow in the upper Deschutes to a similar degree. As noted in Chapter 2 the Columbia Basin is not in danger of running out of water anytime soon – at least not in the main stem Columbia, but its highly altered hydrograph and tributary ecosystems have been "hammered" for quite some time.

The story in the Columbia Basin reflects that found across the western states. Restoring flow to these ecosystems and to support their iconic species will be a difficult task. It will also require cooperation across a range of different efforts, if these ecosystems are to find themselves back to anything resembling a healthy status. Simply restoring streamflow is not the answer, however, it is one of the constituent parts of the larger effort – and in some places is likely to be the critical factor. Certainly, there are many places where if you cannot demonstrate that streamflow can be restored it would make little sense to also invest in fish passage facilities, riparian restoration and land conservation. All of these other tasks come to naught if the creek is dry.

The nature of the challenge of streamflow restoration is one that lends itself to cooperative, voluntary approaches. Given a century and a half of prior appropriation and the entrenched nature of water rights, particularly for irrigation, simply reallocating water to environmental flows does not appear a viable option in socio-political terms. Water transactions provide a means to engender willing seller, willing buyer exchanges of water rights in a manner that can restore streamflow.

While this discussion sets the stage for the next chapter, the immediate need is to fully describe the problem of low streamflow, the solution to which water transactions practitioners devote the lion's share of their effort. In particular, what follows describes how prior appropriation and the history of water resource development has led to the over-allocation of creeks, streams and rivers.

4.2 Water Availability and Water Rights Allocation: A Historical Perspective

As described in Chapter 1, the water budget observes the law of conservation of mass. This law also applies when the diversion of water from streams by humans occurs. The water that is left instream will equal the water flowing into the diversion point less the amount diverted. In the frontier era new settlers had great expectations for developing the west. For them every drop of water they could divert from a river appeared to have a positive value. With certain exceptions, such as when a river was used to transport logs or cargo, water left in a river had little apparent value. The incentives driving the diversion of water from rivers were pervasive. Further, until such time as there was no more water to divert there was little to no point in being careful about the diversion or of being efficient with the diverted water. Any expenditure in this regard would have been compared against the value of leaving water instream, which as we have pointed out was extremely marginal if not zero.

However, settler communities (taking after the miners that preceded them) were smart enough to realize that if there was no order of priority as to who could take water and when, then in times of shortfall anarchy would rule and those on the upstream end of a river would be the only ones to divert water (before it ran out). In order to avoid such a "free-for-all" situation of open access to the water resource and provide downstream users with the possibility of obtaining water the "first in time, first in right rule" was adopted, first informally by communities and later in state water codes.

The difficulty of course was that as users made claims on the resource there was no one to make a claim on behalf of the stream or the ecosystem. Once water codes were in place further appropriation proceeded but environmental water was left off the list of beneficial uses. There was not only no one to make a claim on behalf of the ecosystem, but the ecosystem use itself held no legitimacy in law. Subject then only to the existing notion of water availability, water rights were handed out across the west, largely for consumptive uses. Further the information available at the turn of the century on the level of reliable flows was limited at best.

For example, in the Tumalo area of Central Oregon efforts to claim water and create private irrigation companies began in 1893 with the incorporation of the Three Sisters Irrigating Ditch Company (Winch 1985). In July of 1893 the company filed a Water Ditch Notice at the Crook County Courthouse announcing its intent to divert 250 cfs of "Turnello Creek," later renamed Tumalo Creek. Six years later a new corporation was set up as the Three Sisters Irrigation Company and claimed 500 cfs to irrigate 60,000 acres. Yet the first known measurement of Tumalo Creek did not happen until August 4, 1902 when the company's engineer estimated the flow at 208 cfs. Using this figure the engineer predicted a maximum flow of 3,476 cfs and June average of 1,200 cfs.

These figures turned out to be grossly mistaken as revealed by a gage operated from 1923 to 1987 by the Oregon Water Resources Department above the eventual diversion of what became the Tumalo Irrigation District. The median flow during this period for August 4 is 79 cfs with a minimum of 35 and a maximum of 165 cfs. The highest recorded mean daily flow during this period was 677 cfs during the pre-Christmas flood of 1964. Simply put this first measurement was way off the mark, as were the initial requests for flow rights. Tumalo Irrigation District currently provides irrigation water to 7,300 acres and is well known for its efforts to conserve water through investments in canal piping. It is worth emphasizing that the Carey Act of 1901 sought to reclaim and settle arid lands in the western states through private development of irrigation. Filing for large flow rates was one way for companies such as this Tumalo entity to acquire large acreages of previously public lands for free and resell them to prospective settlers.

So both water and land policy were driving forces behind the initial claims and later permit applications for water. Given the lack of reliable information about how much water was available there was a tendency to overreach and allocate water as desired. In this context, given the lack of any perceived value for flows left instream downstream from diversions there was little reason not to do so. After all, if a permit was issued and there was no water to fill it, then that would be the problem of the applicant. On the other hand if basins were closed to further appropriations based on some estimate of supply and this number turned out to be understated, then society would have lost out on the beneficial use of water and further development opportunities.

4.3 Water Availability and Over-Allocation

Based on the water budget and stream hydrographs it is clear that any stream or river has only so much water available during different times of the year and under different climatic conditions. The choice of how much water is deemed "available" is ultimately an arbitrary decision. Given the variable nature of supply, all the choice does is determine the likelihood that water will be available, not that it is always available. As documented above, many of the allocation decisions in western streams were taken prior to having anything resembling reliable information on which to base such a decision. Still, it is valuable to go back to water availability as a first step in designing a water transactions program or strategy. Logically, if data on how much water is typically available during the year is combined by the sum total of out-of-stream diversions then the remainder will be the instream flow.

There are two approaches to water availability. The first is essentially a water budgeting exercise that examines the available inflow as versus the sum total of consumptive uses. When conducted at large scales the return flows in a basin will appear in different places. Thus such a simple comparison gives a quick reading on whether water is available or not. If the annual consumptive use is 50% of the inflow then the outflow, or instream flow, will be 50% of the inflow. Depending on the metric employed it may be that further appropriations of water for consumptive use are warranted; water is available.

For example, in Oregon, water availability is determined for water availability basins (WABs) by the Oregon Water Resources Department. Inflows are evaluated using monthly figures for the 80% exceedance flows (Cooper 2002). The consumptive use portion of existing water rights and the established instream demands are then applied to this flow to determine if any additional water is available. This approach is sensible from a water budgeting standpoint and can provide useful indications of the degree to which water is allocated at the WAB scale. In practice WABs represent watersheds not basins and there are some 2,500 WABs in Oregon. WABs are typically defined at the "pour" point where tributaries join larger streams. As a result the WABs may not provide useful information about the availability of streamflow at key junctures and reaches in the system, specifically below large irrigation diversions and above points of return flow.

A more technical issue with such an approach relates to data aggregation. Even a monthly median figure can mask important temporal dimensions of low flow problems. Where streams and their habitat underpin important biological and ecological functions it can be the timing of streamflow availability that is important not the total amount of water available over some time period. In the extreme example, plenty of water may be available on a monthly time scale but if the reach dries up for five days during the month that may have drastic consequences for fish and other species.

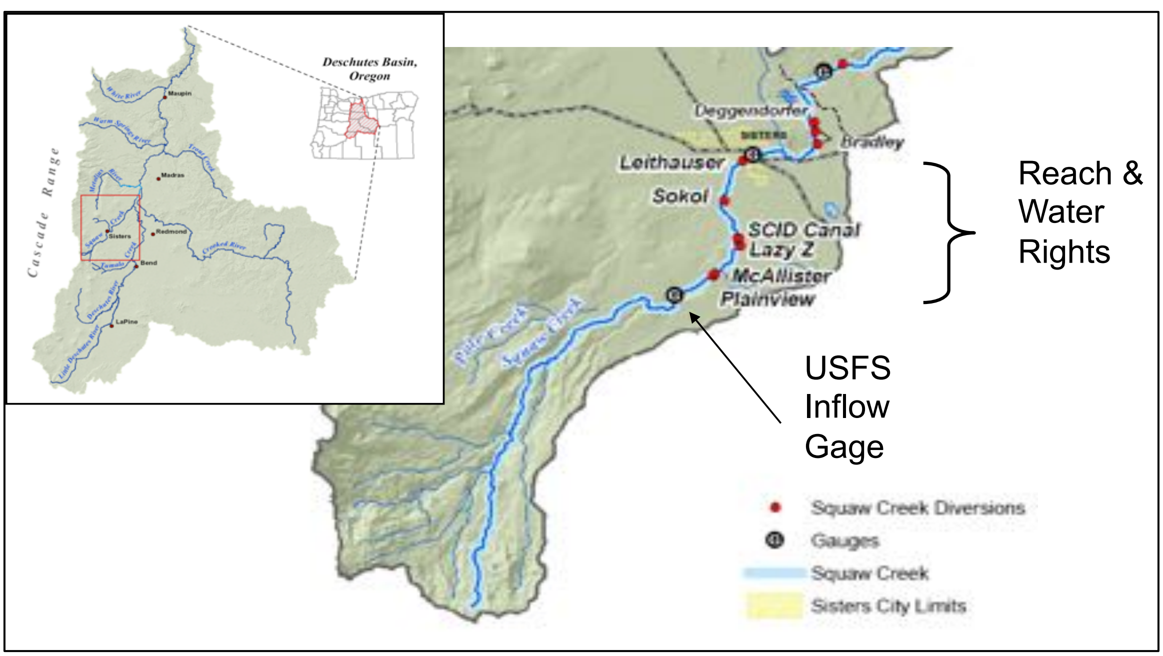
In designing effective water transactions it is important to ensure that water is not just available but that it is allocated to streamflow to meet environmental needs. The overlay of the daily (and/or hourly) hydrograph and existing water rights is a second and more direct analytical tool for the assessment of whether a stream is over-allocated. This tool can be used to assess where along the length of a critical reach shortfalls are likely and, in so doing, also serves to identify the direct drivers of this shortfall, that is the diversions and associated water rights that are both the problem and the potential solution. The analysis also provides value by providing the basis for water right pricing decisions by enabling a comparison of the reliability of rights with different priority dates.

Such an analysis of over-allocation – to distinguish it from the water availability analysis – can be done in different ways and with different levels of precision and reliability. Below, we explore a simple and straightforward approach that may be useful to the water transactions practitioner. In short we overlay the hydrograph of inflows into the creek with the sum of (diverted) water rights on the reach that stretches for a few miles below the gage and prior to the likely point of return flows. It is of course possible to examine water availability above and below each point of diversion as you proceed downstream. More sophisticated approaches that require the assistance of hydrologists and advanced software are available for this purpose and are described briefly following the example. However, here we seek only to provide an example of an analysis of over-allocation and examine what this means in terms of reliability of water rights for out-of-stream uses and instream uses.

4.4 Water Rights and Water Availability: An Example

The analysis considers the upper reach of Whychus Creek above the town of Sisters in the Deschutes Basin. The hydrograph for the reach was previously described in Chapter 1 (see Figure 1.7). The reach is defined at the upstream end by a U.S. Forest Service gage located some 25 miles from the creek's headwaters. A series of diversions stretch three miles downstream from the gage and above a second gage at the town of Sisters (see Figure 4.1). Below Sisters, springs and return flow gradually re-water the creek around the Camp Polk area. The upstream gage has continuous records since 1926, but the downstream gage was installed only in 2000 as a means to monitor streamflow in the reach through Sisters.

Figure 4.1 Whychus Creek: Gages and Diversions

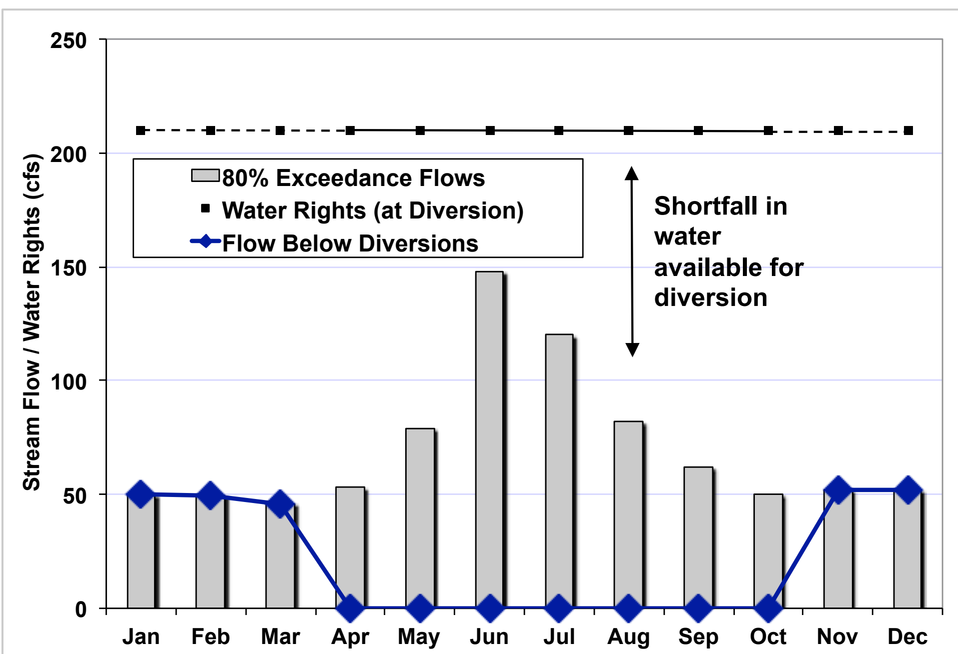


Source: Deschutes River Conservancy
Note: Whychus Creek was formerly called Squaw Creek

Flow alterations due to irrigation diversions have occurred since the late 1800s in the creek. Anecdotal historical observation suggests the stream is severely over allocated as the creek typically went dry during the late summer months. As a result this reach has been an important focus of early streamflow restoration efforts in Oregon, both the Oregon Water Trust (OWT) and the Deschutes River Conservancy (DRC) have prioritized this reach since the mid-1990s. Presently, Whychus Creek enjoys natural flows from its headwaters until around river mile 25, where a series of major irrigation diversions reduce flows significantly. Water transactions by OWT and the DRC now ensure that streamflow continues through this reach. This analysis, therefore, returns to the mid-1990s to demonstrate the methods that were used to evaluate over-allocation by OWT/DRC.

The 80% exceedance flow in the creek peaks in June at about 15 cfs. During the spring and late summer/fall months the reliable flow ranges between 50 and 80 cfs. Rights to divert water from this reach of Whychus Creek total just over 210 cfs. As shown in Figure 4.2 the overlay of these figures reveals a considerable shortfall during the entire irrigation season. Assuming irrigators exercise their rights on a consistent basis the reliable streamflow (in 8 out of 10 years) is also projected in the figure. The excess of out of stream demand relative to inflow suggests that the creek would be dewatered during the irrigation season. Of course, there is some variability in the actual use of water by irrigators across the season. However, in practice the irrigators have the right to use this water across the season and this reach can therefore be said to be "over-allocated" in legal terms.

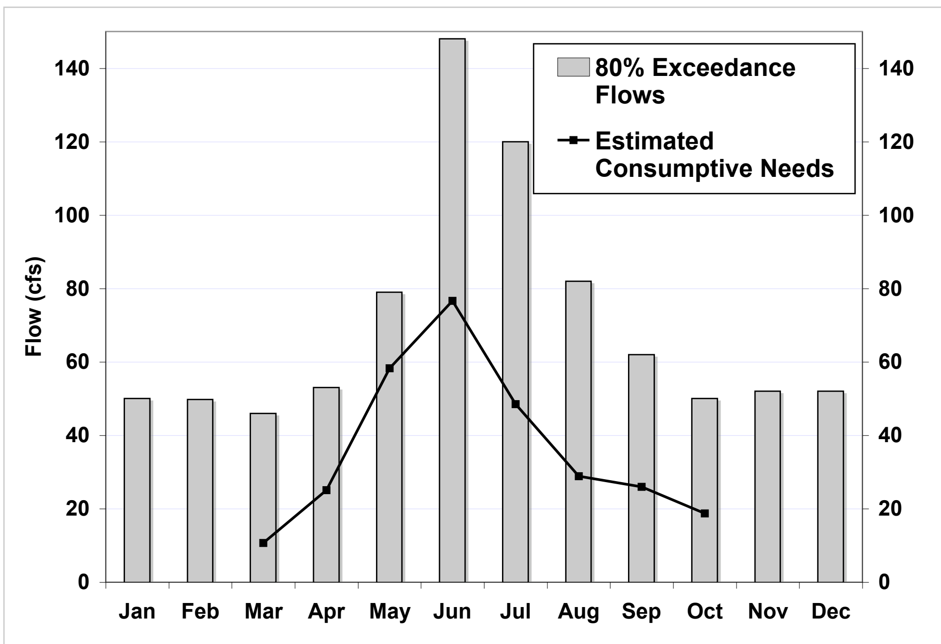
Figure 4.2 Monthly Inflow and Out-of-Stream Water Rights, Whychus Creek, Oregon (circa 1995)



Notes: The majority of the water rights in the creek do not specify a season (or a volume or duty). For this reason the representation of the water right is carried across the full year. The irrigation season in this part of Oregon is commonly held to be between April 1 and the end of October, therefore the line is solid during this time frame.

Would water be available in terms of inflow and consumptive use under these rights is a less critical question given that it appears that too many water rights have been allocated. At applicable diversion rates of approximately 1 cfs per 50 acres, the water rights represent beneficial use on about 10,500 acres. Using the USGS annual consumptive use figures and the distribution of this use by month based on diversion as provided by OWRD it is possible to calculate the irrigation consumptive use need as a monthly flow level. Using the water availability approach then it appears that existing uses under the surface water rights fall within the available inflows. Of course there are other consumptive uses, particularly from groundwater, in this area, as well as defined instream water rights (as we shall see later) so this does not imply that water would be determined to be available by OWRD in this reach. Rather it is to point out that from an environmental flow perspective it is much more accurate to assess projected environmental flows at or below major diversion points. In Chapter 7 we return again to Whychus Creek to consider how to use these tools to identify and target water rights acquisitions.

Figure 4.3 Inflow versus Surface Water Right Consumptive Use for Irrigation, Whychus Creek, Oregon (circa 1995)



4.5 The Groundwater Dilemma

As suggested above in the case of Whychus Creek, the exercise of groundwater rights may also have a bearing on water availability and the level or degree of allocation of a reach. Depending on the nature of the hydrologic connection the withdrawal of groundwater will have an impact on surface water availability at specific points on a reach or along its length. If there exists a point along a reach where the majority of groundwater discharge and return flow is present then this may be a useful juncture to include in water budget analysis, water availability modeling and/or analysis of the degree of over-allocation of water rights. As described above water availability modeling typically relies on the assumption that diverted amounts of water that are not consumptively used are available for use, but this will be the case only below the point of return flow. So while groundwater extraction may affect water availability along the length of a reach it will be a critical component of flows at the bottom of a reach, which in turn will determine inflows available in the next reach or the receiving stream downstream.

The right to pump groundwater is traditionally allocated in one of two ways. First are the exempt uses. As described in Chapter 3 most states exempt from permitting smaller household uses of groundwater that may include a not insubstantial quantity of water for outdoor irrigation around a house. Second, there is a formal permitting process that involves the proving up of a beneficial use and receipt of a certificate for larger, non-household uses. As with surface water rights, regulation of groundwater rights can occur if junior rights impinge on the ability of senior water right holders ability to pump water. Generally speaking however, water law in the west historically did not recognize the hydraulic connection between groundwater and surface water. Thus, groundwater applicants have been able to obtain permits and certificates to pump water that otherwise would have supported streamflow and the out of stream uses that rely on this flow.

As many parts of the west have become a magnet for migrant populations – whether of farmworkers, telecommuters, retirees or amenity migrants – the demand for additional water to satisfy domestic, industrial and commercial uses has increased rapidly. With surface waters often fully allocated and an increasing federal regulatory burden on the use of surface water for such uses (under the Clean Drinking Water Act) utilities, resorts, homeowners associations and homesteaders have turned to groundwater as their source. Whether through an exempt or permitted use the new right is obtained free of the need to purchase an existing water right – even though in most cases it may affect other existing users.

In this manner, population growth and increases in non-farm economic activity have increased the pressures on streamflow and existing water rights throughout the west. In other words, leaving groundwater effectively as an open access resource, free to all comers has increased the degree to which surface water are over-allocated. Therefore, in considering how to confront and resolve the over-allocation problem affecting streamflow it is critical to include groundwater. Otherwise it is possible that a successful program of water transactions will not actually restore streamflow as expected. Instead, even as acquired rights are transferred to environmental uses, increasing levels of groundwater withdrawals may diminish their reliability. Or alternatively, if extremely reliable senior rights are acquired for environmental purposes the groundwater withdrawals will exclusively effect remaining junior agricultural rights – with the possibility that the culprit for this will be seen to be the instream water rights. But first we must understand how states have dealt with the surface water over-allocation problem with respect to environmental needs.

4.6 Legal and Regulatory Framework for Environmental Water Transactions

The effects of over-allocation of streams and rivers across the west have accrued since the development of surface water. As the environment movement developed in the 1960s and 1970s it was slow to progress to water and more specifically rivers and aquatic ecosystems. Federal legislation tackled water quality problems beginning in the early 1970s and culminating in the passage of the Clean Water Act 1972 and subsequent amendments. But with water quantity management and water rights being largely a state matter it was not until the 1980s that states began to confront the legacy of prior appropriation. Below we review the legal and regulatory framework that has evolved to protect environmental flows and to enable the transfer of existing water rights to environmental uses.

4.6.1 Recognition of Environmental Flows as Beneficial Use

In particular, the major problem confronting states was that environmental flows were not classed as a beneficial use. Therefore unless a reach was closed to further appropriation prior to its over-allocation there was a great risk that the instream flow that would remain would be completely dependent on the efficiency of water use and the hydrogeological pattern (temporally and spatially) of return flows. As noted above, the calculations upon which water availability were based were prone to avoiding over-allocation of streams at points of diversion, but were oriented to ensure that the maximum consumptive use of available water resources was achieved.
The first part of the solution to this problem was to recognize that environmental flows are a beneficial use. The public uses of water include many different types of recreation and sport that rely on environmental flows. Further, the link between environmental flows and the quality of water required in these and other public uses is inescapable. Over the last two decades states have proceeded to add to their water code or create new laws that provide for instream water rights as beneficial use. Western states that currently recognize instream water rights include: Alaska, Arizona, Colorado, Idaho, Montana, Nebraska, Nevada, Oregon, Utah, Wyoming and Texas (Harder 2006). The manner in which instream water rights are provided for varies considerably as exemplified by the experience in Oregon and Idaho as covered in Box 4.1.

The legal recognition afforded to instream water rights and the designation of such rights in specific streams and rivers in these states was an important first step. However, it was not sufficient. With beneficial use, such rights had legitimacy but not priority. As with any other new water right these instream rights were given the date of priority associated with their application. The award of a 1980 or subsequent priority date means that the instream water right is typically junior to all older, pre-existing rights. In order to understand the significance of this it is necessary to consider how such rights function when streamflow is and is not over-allocated.

When streamflow is over-allocated the creation of a junior instream water right may mean very little in practice. Remember, our working definition of over-allocation is that in 8 out of 10 years all the streamflow is allocated to existing out of stream water rights. In other words, a new more junior right is likely to receive water only 2 out of every 10 years. Where significant over-allocation exists this situation would be even worse. When streamflow is not over-allocated and the instream right is the most junior, then the right is filled to the extent that water is available. But this would have occurred even absent the instream right. What the junior instream right does achieve is to protect that flow from being further appropriated to out of stream uses. In other words, any new use would be junior to the instream right and thus the junior right could be met prior to the exercise of any new out of stream right. The term “could” is used because in order for a water right to be met it must be “called” by the water right holder. Therefore if the water right holder – which in many states is the state water resources agency – does not call on the right the new junior out of stream right might receive the water to which the stream is otherwise entitled.

Box 4.1 Contrasting Instream Water Rights Legislation in the Pacific Northwest

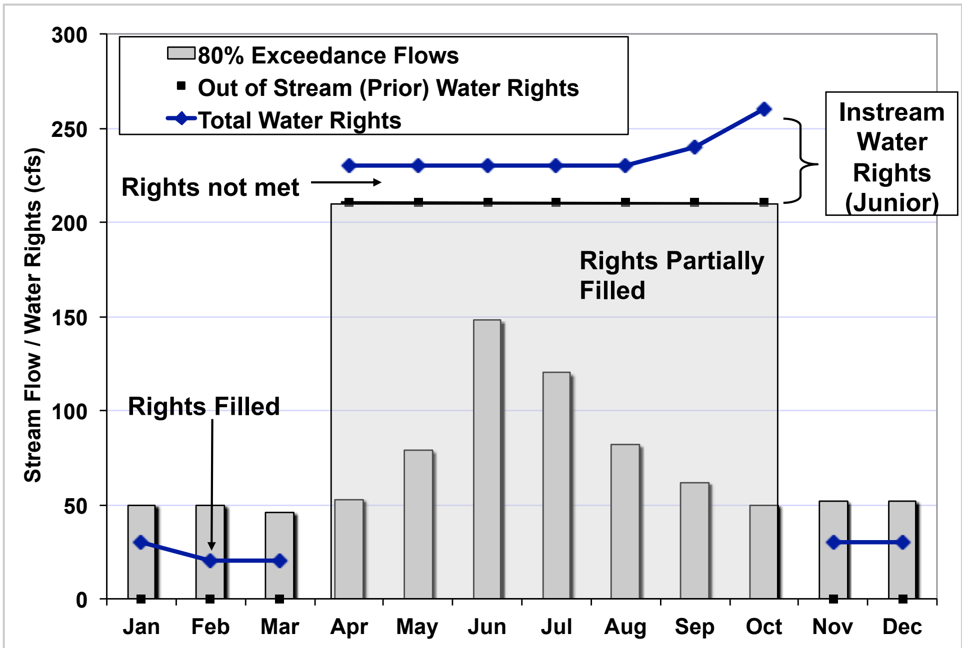
Oregon. The Oregon Instream Water Rights Act was passed in 1987 (and codified in ORS 537.332 to 537.360). The act recognizes public uses as beneficial uses and specifically identifies recreation, ecological values (including maintenance and enhancement of fish, wildlife and their habitat), pollution abatement, and navigation as public uses. The three agencies responsible for fish and wildlife, environmental quality, and parks and recreation are authorized to request instream water rights. These instream rights are to be held in trust by the Oregon Water Resources Department (OWRD) for the benefit of the people of the state and to maintain public uses. All instream water rights are certificated and once certificated have the same legal status as any other certificated right except that certain multipurpose storage and municipal uses may take precedence and the instream right is subject to emergency water shortage provisions. Instream rights applied for by state agencies bear the priority date associated with the application for the right. In approving rights applied for by agencies the Director of OWRD is the final authority as to what level of instream flow is necessary to protect the public use. "Instream flow" is specifically defined in the statute to refer to the minimum quantity of water necessary to support the public use. The 1987 Act explicitly provides for the temporary and permanent transfer of existing water rights to instream uses as well as authorizing the use of water saved by conservation measures to be dedicated to instream use.

Idaho. Despite a number of legislative actions to protect lake levels and instream flows that date back as far as 1925, instream use is not generally recognized as a valid beneficial use in Idaho. In 2000 the Idaho Supreme Court affirmed the requirement that water must be diverted in order to constitute a beneficial use. The Court acknowledged that exceptions to this rule include rights established under the 1978 "Minimum streamflow" statute and other specific legislative directives appropriating water for instream purpose. Under the 1978 statute, minimum instream flows are recognized as beneficial uses for fish and wildlife habitat, recreation, aesthetic beauty, water quality, etc. This statute allows the Idaho Water Resources Board (and only this Board) to apply to the Department of Water Resources for a minimum streamflow or lake level permit. Such permits are required to take the extraordinary step of being submitted to the Legislature for approval (or veto). As of 2007 the total of such rights numbers 296 covering just 1% of stream miles in Idaho. Other specific legislation has been passed by the legislature from time to time most notably modifications of the 1978 act in 2001 for a reach on the Lemhi River that included permission for the Idaho Water Supply Bank to engage in split season leases, and in 2007 for the Big Wood and the Little Wood Rivers including provisions for the donations of water right through the Bank. At present, water rights may only be leased temporarily to fill established but unmet minimum flow rights and only through the Bank, which was established in 1979 and is administered by the Board. As recently as 1992 the Idaho legislature rejected legislation to allow transfers to instream uses. A 2003 Water Conservation Statute effectively eliminates partial forfeiture and permits the transfer of saved water to other uses, but does not expressly authorize the transfer of such water to non-consumptive instream uses.

Source: Boyd (2003); Rassier (2007); Fereday, Meyer, and Creamer (2004); Amos et al. (2007); Bastach (1998)

The effect of creating a junior instream right can be shown by using the Whychus Creek example discussed previously. The upper reach of the creek has an instream water right of from 20 to 50 cfs throughout the year. The right has a priority date of 1990. As shown in Figure 4.4 this instream right must be layered on top of existing (prior) out of stream rights in portraying the total amount of water rights allocated in the creek. During the winter months the instream water right is filled 8 out of 10 years. Even if the water right was not satisfied there would be no way to augment flows given that there are no surface water right diversions during the winter. The exception would be winter stock runs but again those would be senior rights and therefore would prevail. So, in the winter, having the rights does not change streamflow. However, during the winter months the instream rights do protect the 1990 priority date instream rights against any new (and therefore subsequent) applications to withdraw water.

Figure 4.4 Impact of Adding Junior Instream Water Rights to an Over-Allocated Reach, Whychus Creek, Oregon (circa 1995)



Source: Oregon Water Resources Department

In the summer months, even the out-of-stream rights are only partially filled and therefore there is no flow to fill the instream rights. Creating these rights therefore does not change streamflow in the summer. Nor – given the existing over-allocation – does the instream right provide much protection against subsequent water right allocations. The exception would be where the out of stream water right holders engage in water efficiency improvements and thus pare back their actual demand from the limits of their water rights. In such case the existence of even a junior instream right may reduce the chance that such "saved" water might be allocated to new consumptive uses.

Simply put, legitimizing environmental flows as beneficial uses, therefore, does little to effect environmental flows. This is particularly true when this legal action is taken long after stream have been over-allocated to out of stream uses and the priority date afforded these instream rights is the date of their application. However, it can serve to recognize environmental flows as beneficial and protect flows from further appropriation.

4.6.2 Creation of Instream Rights through Water Transactions, Including Water Use Efficiency Projects

If instream water rights are to effectively protect environmental flows under prior appropriation it is essential that their priority date be of sufficient seniority that when called upon there is the likelihood that sufficient water will be available to meet the call. Given that water rights, including instream rights, have been allocated on the basis of their date of claim or allocation, and that the legislation creating instream water rights is of recent origin, the only way to effectively restore environmental flows is to convert or transfer existing water rights to instream use. This has generally been recognized and laws establishing instream uses as beneficial have accommodated, to some degree, this reality by providing for this conversion of existing rights. One of the key provisions of such laws has been the extent to which the conversion can take place without the loss of priority.

For example, the Oregon Instream Water Rights Act provides that the conversion of all or a portion of an existing right to instream use will retain the original date of priority. Such conversions may be effected by purchase or gift and may be undertaken on a temporary or permanent basis. For temporary conversions, the lease of the original right for a specified period occurs without risk to the original priority date and is considered as beneficial use for the purpose of forestalling the forfeiture provision. All conversions are subject to the same transfer requirements, including public notice and injury analysis, as other water rights transfers. As with all instream water rights, such "converted" rights are held by OWRD. In addition, the applicant may choose whether such converted rights fill an existing agency-applied-for right or whether the applicant wishes to create an instream right above and beyond such agency rights.

While not part of the original instream act, the Oregon legislature has also established a voluntary program that permits the sale or lease of the right to use water that is saved through water conservation measures (ORS 537.455 to 537.500). This Conserved Water Program allows those holding water rights subject to transfer to propose an allocation of conserved water based on measures undertaken no less than five years prior to submission of the application. Water so designated as conserved may be allocated to instream use or to a new consumptive use subject to the following provisos:

- any amount of water required to mitigate for injury to other water uses from the proposed uses of the allocation is first deducted from the proposed amount of conserved water;
- no less than 25% of the total amount of conserved water must go to instream use;
- the allocation to instream use must reflect at least the percentage of state or federal public funding received for the conservation measures and that is not subject to repayment; and
- unless otherwise requested by the applicant, the applicant shall receive no less than 25% of the conserved water.

The allocations to the applicant's new use of water and the instream use must each have a priority date equal to the original priority date or one minute later, at the request of the applicant. Further, allocations held by applicants may be reserved instream for future out-of-stream use without being subject to forfeiture.

Thus, key elements of legislation that underpin water transactions include the:

- ability to purchase and receive donations of existing water rights and water saved through water efficiency improvements for conversion to instream use;
- ability to lease and/or permanently transfer existing water rights or saved water to instream use;
- retention/status of priority date upon conversion to an instream right; and
- granting of beneficial use when water rights are leased instream.

Approaches to these elements that differ from the Oregon example in the other Pacific Northwest states are summarized in Chapter 7.

Providing the legislative framework for water transactions is an important step in enabling environmental flows through water transactions. As discussed in Chapter 3, the priority system under prior appropriation effectively functions as a cap and trade system. So by providing for well-defined and enforceable instream use rights and providing for the transferability of existing rights to instream rights the economist's ideal of a market-based approach to ecological restoration is created. No formal cap is required on surface water rights to enable such a market. Still, it is worth recalling the caution that if not properly regulated groundwater withdrawals may function as a form of leakage from such a cap and trade system and, thus, legislation ensuring that the hydraulic connection between surface water and groundwater is essential.

It is important to emphasize though that this legislative framework remains an enabling condition only. Such laws provide no guarantee that a single transaction will occur; only that they can in theory occur. Given that environmental flows are public uses and therefore in the economist's jargon are public goods, it can be expected that the benefits to any one individual of acquiring water rights for environmental flows are less than the costs of doing so. There is therefore little incentive for individuals and private groups to take advantage of such laws and the incipient market and engage in market transactions for this purpose. Rather economic theory suggests that collective action amongst members of society will be necessary – in this case to provide the investment necessary to overcome the costs of transacting in water rights and the costs of acquiring the rights. As we shall see this collective action has taken many different forms both in terms of organizations that have self-organized to undertake transactions and the private and public entities that have stepped forward to fund such transactions.

As discussed in Part II of the handbook this legal framework gives rise to a large number of transactional forms. Voluntary agreements between a water right holder and a party interested in streamflow restoration that do not avail themselves of the opportunity to create legal instream rights still occur. Indeed, these are often indicative of the level of transaction costs that taking the official, administrative route imposes on the parties to a transaction. However, it could be argued that pursuing a comprehensive flow restoration program in the absence of enabling legislation, e.g. relying purely on unofficial transactions such as diversion reduction agreements, would be a difficult proposition with long odds of success. Nevertheless, it is worth emphasizing that the phrase water transactions is taken here to refer to agreements that fall under the legislative framework, as well as those negotiated outside of it.

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CHAPTER 5
ENVIRONMENTAL WATER TRANSACTIONS: A CONCEPTUAL FRAMEWORK

Bruce Aylward

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Ecosystem Economics
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Environmental Water Transactions: A Conceptual Framework

Chapter 4 established the underlying root causes of low flows in western states that subscribe to the prior appropriation doctrine. The chapter also described the legal underpinnings for trading water between existing, traditional uses and environmental or instream uses. In this chapter we first define what constitutes an environmental water transaction. Then we proceed to briefly explain, describe and categorize the full set of transactional forms that have emerged to fill this niche within water markets and within the field of environmental flows and ecosystem restoration. The chapter concludes with a discussion of how the selection of specific types of water transactions is often shaped by the basin or watershed context.

Subsequent chapters in this part of the handbook then examine each of the major types of transactions along with illustrative examples.

5.1 Environmental Water Transactions

A simple definition of environmental water transactions that support environmental flows and contribute to the overall goal of ecosystem health and function is: "… environmental water transactions acquire water for the environment in willing seller-willing buyer settings" (Malloch 2005). A more detailed definition is formulated here as:

> *An environmental water transaction is any agreement (or set of related agreements) by which a water right holder, contractor, or user commits to a change in their water use and/or water right leading to legal or de facto protection of additional water in a waterway or water body to serve environmental purposes.*

This definition depends on a number of key elements including:

- the water right holder, contractor or user (i.e. the seller);
- the water right or water use;
- the buyer (or funder);
- the type of protection afforded the water;
- the set of agreements; and
- the additionality and purpose of the transaction.

Each of these elements is discussed below.

The Seller. The language used in the definition is intentionally broad so as to capture the full spectrum of potential sellers. The simplest case is a water right holder who uses water on their property. In this case the owner of the property right is the user. But in other cases the user may not be the same as the landowner, or may share interest in the water right with another entity such as an irrigation district.

The Water Right or Use. Similarly what is transacted may involve the water right, through a lease or a change in the water right, or it may simply involve a change or cessation in water use, without a concomitant change in the underlying right.

The Buyer. The buyer is not even specified in the definition as a buyer is not required for there to be a transaction. As discussed further below, the transaction may simply be an agreement between the seller and the relevant state agency for a change in the water right. Normally, however, there is a buyer who provides the economic incentive or payment that motivates the seller to alter their water right or change their water use. In most cases, the buyer is a local watershed entity, a state water trust, a state agency, or another state or local conservation buyer. Such buyers often obtain all or a portion of their funding from other entities that generate and deploy programmatic funding expressly for the purpose of restoring environmental flows. In which case the buyer is really an intermediary and the funder is the ultimate buyer of the environmental benefit provided by the transaction. Sometimes the funding chain is even longer. For example, the Columbia Basin Water Transaction Program is managed by the National Fish and Wildlife Foundation, which itself is an intermediary, funneling Bonneville Power Administration funds to qualified local entities in the Columbia Basin states for the purpose of environmental water transactions.

Type of Protection. "Legal" protection of the water refers to the lease or change of a water right through which the formal owner of the water right obtains permission of the relevant state agency to alter how the water right is used. The term *de facto* is used here to convey the sense of an arrangement between the seller and buyer that improves environmental flows without employing the state's administrative procedures to change a water right.

The Agreements. As noted in the definition there must be at least one agreement for there to be a *transaction*, but there will likely be more. Typically, these transactions involve three relevant agreements:

- an agreement between the seller and the buyer (the intermediary) regarding the terms of the overall transaction (referred to here as the "contract");
- an agreement between the water right holder and the intermediary to ask the state to change the water right (generically the "change application"); and
- an agreement between the intermediary and the organization funding the transaction (the "funding agreement").

Each of these agreements is explored at length in Chapter 10 of the handbook.

In any given transaction one or more of these three agreements may fall away, but one agreement will always be present. For example, in a direct donation to the state, the first and last agreements will not be present. In the case of a *de facto* transaction the first and last agreements are likely, but the change application is not required. Another way to look at this is to recognize that a transaction by definition requires two parties. If a water user takes a voluntary *de facto* action to increase streamflow there may be additional environmental benefit but there is no transaction.

Another element worth noting is that the definition does not presume that there is a purchase as such, nor does it assume there is an intermediary between the water user and the state administrative apparatus. As described earlier, state laws provide for donations. In many cases there will be an intermediary that actively solicits and processes the donation with the state agency. However, there will be occasions where a water user simply proceeds directly to a change application and works with the state agency to effect the change. This is still a transaction as it still involves an agreement with the state.

Of course there may be additional agreements as the number of parties to a transaction increase. In particular if there is more than one party that has an interest in the water right then they would typically need to be included in the transaction. For example, where irrigation districts or state and federal agencies have an interest in the water rights or manage water delivery their interests must be accounted for in the transaction. Often, this requires a fourth agreement. Also, some individual transactions may take place within a set of agreed upon general policy objectives, or specific rules and procedures as expressed in memoranda of understanding or agreement for water transactions programs. In this case, policy or program rules as set forth in related agreements may govern or place sideboards on the agreements for an individual transaction.

Additionality and Purpose. Generally speaking such transactions will be for the purpose of enhancing ecosystem health and function. The two components of this include not just the putting of water to the environmental use, but also the change in outcomes that result, i.e. the additional benefits that would not have come to pass were it not for the transaction. With respect to the environmental use this is often taken to be as an instream use. This is particularly the case in the Columbia Basin where such transactions began largely as a way to increase salmon habitat and provide greater salmon habitat. This necessarily, meant providing additional instream flows. However, in other contexts the objective of restoring the ecological health of a waterway or water body may imply that the water is not so much "left" instream as it is not diverted for out-of-stream uses but instead is left instream to improve water quality and provide water to riparian vegetation and wildlife. Ultimately, that water is consumed by the environmental use as it moves downstream. So such a transaction does not result in a non-consumptive use as with the traditional concept of an instream flow that is left to pass through a given river reach.

Strictly speaking, the intent of the seller in undertaking the transaction is irrelevant to the definition. In some cases, a water right user may enter into a transaction that increases instream flow as an incidental benefit. Or funding for the environmental benefit of a transaction may only be one of a number of reasons motivating the water right user to change their behavior. For example, piping of canals by irrigation district provides many different benefits, of which reducing water use may only be one.

Nor does the definition state that the water user must commit to the change voluntarily. In some cases, regulatory or administrative action will compel a water user to engage in a change in their water use or rights that increases instream flow. To say that is a willing seller transaction or that the seller's (or even the agency's) objective is environmental would be untrue, but it is a water transaction that improves ecosystem function nonetheless. A further proviso is that the transaction must meet the additionality test. A water rights transaction that offsets one use with the retirement of another water right, such as in groundwater mitigation programs, would need to provide some net environmental benefit to be labeled an environmental water rights transaction.

Despite these caveats, obviously the majority of transactions that occur will be voluntarily entered into by the seller and the objective of the buyer will generally be not just instream flow but ecosystem health and function.

5.2 The Environmental Water Transactions Toolbox

There are many approaches that could be used to classify and organize the many different types of water transactions. For example take a water lease and a forbearance agreement. These can be compared to each other. In the first case there is a one-year lease in which an irrigator temporarily leases their water right to a conservation buyer in return for payment and the conservation buyer legally protects the water right in an environmental use by means of application to the relevant state agency. In the second case a conservation buyer pays an irrigator not to divert and use their water right, leaving it to the stream and whatever other uses and water rights are on the system. These two transactions are similar in some respects and different in others. A few salient features on which they can be compared are as follows:

- water is freed up for environmental use (or "saved" in the original water use) by the irrigator idling some previously irrigated ground;
- neither transaction involves the buyer taking ownership (or a fee title interest) in the water right;
- with the lease the water saved from the original use is committed to environmental use through a legal process; with the forbearance agreement the water is not called to the point of diversion and is not legally protected from other diverters with rights in priority;
- the duration of the commitment in both cases is for one irrigation season; and
- the source of water in both cases is the natural flow of the river.

This example takes just five aspects of a transaction to identify the differences and similarities between these transactions. It is the differences that serve to identify that these are different types of transactions. In the case of the lease and forbearance agreement the principal difference is how the saved water is committed (or put) to environmental use. Each of these two approaches (the lease and the forbearance agreement) has its strengths and weaknesses (as seen in Chapter 7). Where there are varying strengths and weaknesses to different transactions there may be situations in which one or another of the alternative transactions may offer a higher probability of success and/or produce better results. In other words the attempt to identify different types of transactions serves the assumption that it is valuable for a practitioner to have the full range of alternative tools at their disposal and to then carefully consider which tool is best for the case at hand.

5.2.1 The Primary Axis: Pathway to Saving Water

In considering the many forms that environmental water transactions may take, a first cut at organizing them into categories relies on the distinction between whether the transaction affects consumptive use or whether it simply results in a rerouting of flows through the above and below ground hydrological system (for the benefit of instream flow). Even this is a simplification, as any change in how water is routed through a system and in particular the efficiency with which it is transported, distributed and applied will likely have some impact on evaporation. For example, enclosing an open ditch in a pipe has the primary effect of limiting the seepage of water into the ground. However, there will also be a secondary effect of reducing evaporation from the water surface in the ditch. For the purposes of the typology presented below – and based on practical experience to date – evaporation is typically considered to be either minor or secondary in nature for transactions that just reroute water through the system.

Thus, the classification of transactions employed here is based largely on the nature of their primary pathway for "saving" water as either (a) a reduction in consumptive use or (b) a change in water management. Water use efficiency projects are classed as water management projects given that they alter the flow of water through the system. Another way to phrase this is that these transactions affect the non-consumptive portion of the water use. It is important to note that this suggests that such transactions can only support non-consumptive instream flows and not any consumptive environmental uses. Otherwise, such transaction would "enlarge" the consumptive use under the water rights leading to injury (as discussed further in Chapter 7).

The use of the term "water conservation" will be avoided here given that it often conflates these two types of transactions. For example, the fallowing of land and leasing of water are sometimes included as conservation projects, alongside water efficiency projects. The many nuances of the term conservation lead only to confusion. It is important for the water transactions practitioner to understand the true basis for a transaction so as to understand what its impacts will be on the water budget and stream hydrograph and, therefore, the transaction's contributions to streamflow restoration. This is not to dispense with the use of the term "conservation." For precisely its generality the term can be useful in the field so as to avoid the perception that the water transactions practitioner seeks only to purchase water and dry up agricultural land.

As identified using the features suggested above, a long list of potential types of water transactions can be identified. In Box 5.1 the list is kept relatively simple just breaking out and grouping like sub-types under water management and consumptive use transactions. With regard to water management the transactions are grouped spatially in terms of whether they occur at or above the point of diversion (the "upstream management" transactions), at or between the point of diversion on the irrigation conveyance system (the "conveyance efficiency" transactions), or at the farm level (the "on-farm efficiency" transactions). Within each of these categories are placed the major types of transactions. As discussed in subsequent chapters there are further examples under each of these categories that demonstrate how these transactions vary in one way or another. In particular, there are many different ways to take land out of production in a manner that generates environmental flows.

Box 5.1 List of Water Transaction Types

1) Water Management
    a) Upstream Management
        i) Timing of Storage Releases, i.e. releasing storage during salmonid migration
        ii) Source Switch, i.e. using groundwater in place of natural flow
        iii) Point of Diversion Change, i.e. moving a diversion downstream
    b) Conveyance Efficiency
        i) Diversion Efficiency, i.e. modification of diversion structures
        ii) Deliver Efficiency, i.e. ditch controls, scheduling and distribution
        iii) Transmission Efficiency, i.e. piping and lining
    c) On-Farm Efficiency
2) Consumptive Use
    a) Reducing Crop Consumptive Use, i.e. switching to lower water use crops
    b) Taking Land out of Agricultural Production, i.e. fallowing or transferring water off land

5.2.2 Transactions and Ownership

Fee title (or "ownership") acquisition of water rights and related property is often considered to be part and parcel of participating in water markets and hence in environmental water transactions. Table 5.1 suggests, to the contrary, that most such transactions actually do not rely on the acquisition of fee title. Only certain methods for taking land out of agricultural production rely on "owning" the water right. Most, if not all the other approaches can be accomplished simply through arrangements with the owner of the land and/or the water. In other words, there are many ways to achieve environmental flow objectives short of acquiring property (and taking land out of production). This is not to say that the other approaches might not be accomplished alongside fee title acquisition, but rather to indicate that such acquisition is not necessary or required for these transactions.

Table 5.1 Environmental Water Transactions and Ownership

How is Water Saved or Freed Up?	Fee Title to Land and Water Acquired	Fee Title to Water RIght Acquired	Fee Title Not Aquired
Water Management			
Upstream Management			
Timing of Storage Releases			✔
Source Switch			✔
Point of Diversion Change			✔
Conveyance Efficiency			
Diversion Efficiency			✔
Delivery Efficiency			✔
Transmission Efficiency			✔
On-Farm Efficiency			✔
Consumptive Use			
Reducing Crop Consumptive Use			✔
Taking Land out of Agricultural Production	✔	✔	✔

5.2.3 Transactions and Commitment of Saved Water

As presaged above there are two main ways that water is committed or protected to an instream or environmental use. The first, most logical, approach is to change the water right to meet the new beneficial use. The second is simply to arrive at a contract between the buyer and seller for a change in water use, without altering the underlying water right. However, there is a third approach that may be called on in certain circumstances. In this case there is no agreement for a change in water user *per se* but there may be an agreement to fund a project by the seller that will in all likelihood result in environmental flow benefit. While such an arrangement provides little to no ability to guarantee additional flow from a transaction, it may be a precursor to such transactions. In some cases funding an initial infrastructure or technology project that improves water management can be an entrée into more sophisticated transactions down the road.

As shown in Table 5.2 the different types of transactions intersect differently with the three commitment approaches. For consumptive use transactions it is possible to use any of the three approaches, although it is typical to either change the water right or have a water user agreement with the seller.

The upstream management transactions typically require either a change in water right or a water user agreement. For a change in the timing of storage releases there needs to be an explicit agreement of one type or another. Often these may simply be a water user agreement as storage users are not usually compelled to use their storage at any particular time but can use the water at any point during their permitted season of use. However, the authorized purpose of use of the water from the reservoir may be limited and, in order, to protect the water from other users it may be necessary to change the purpose of use to instream or environmental use through a formal water rights change process.

Table 5.2 Environmental Water Transactions and the Commitment of Saved Water

How is Water Saved or Freed Up?	Change in Water Right*	Water User Agreement **	With no Agreement ***
Water Management			
Upstream Management			
Timing of Storage Releases	✔	✔	
Source Switch	✔	✔	
Point of Diversion Change	✔	✔	
Conveyance Efficiency			
Diversion Efficiency	CW	✔	✔
Delivery Efficiency	CW	✔	✔
Transmission Efficiency	CW	✔	✔
On-Farm Efficiency	CW	✔	✔
Consumptive Use			
Reducing Crop Consumptive Use	✔	✔	✔
Taking Land out of Agricultural Production	✔	✔	✔

Notes: Larger checks imply a more typical type of transaction than the smaller checks

"CW" refers to the possibility of legally protecting saved water as a water right, i.e. as in an allocation of conserved water under Oregon law

*A check here means the need to change an element of the existing water right to facilitate making saved water available to instream use

**A check here means that water can be made available ("protected") instream through a private contract to change water use without a change to the water right

***A check here means that if water right user is incentivized to change behavior, water can be made available instream without a change to the water right or an explicit contract regarding water use

For a source switch and point of diversion change a change in the water right will be necessary if the irrigation use does not already have legal permission to use, and to switch between, multiple sources or points of diversion. For example, state permission may need to be granted for the irrigator to switch from natural flow to a groundwater source. Alternatively, if the user already has access to multiple sources and points of diversion it may be possible to undertake such a transaction without further recourse to the state.

With regard to conveyance and on-farm efficiency transactions the approach taken will depend on the state legal context. In states such as Oregon and Washington, it is possible to save water through efficiency improvements and protect this water to an instream use. Depending on the circumstance this may be an important feature of a transaction. For example, if a downstream user previously had no access to the water that is saved, then protecting this water through the reach and past the user would be highly desirable to maximize the benefit of the transaction. However, in other cases and in other states, such a change in the underlying water right may not be desirable or feasible. In which case, a simple water user agreement that specifies the efficiency improvement and, if possible, the resulting flow improvement may be sufficient. In the extreme case, as noted above, it may be desirable just to fund a project but not have an explicit agreement regarding water use. For example, making improvements to a diversion structure may enable irrigators to divert less water from the stream and may facilitate further efficiencies down the ditch, but may not warrant a water user agreement *per se*.

5.2.4 Duration of Commitment

The duration of a commitment to provide environmental flows can be specified in terms of which part of the year and for how many years the commitment will be made. Depending on the situation, water for the environment may be short across the whole year or only during a specified period (a "split season" transaction). With regard to the latter examples, these can range from cases where dewatering limits upstream or downstream migration of salmonids for a matter of weeks, or where late season water availability and summer irrigation demand mean that streams are dewatered from June or July through the end of the irrigation season. In terms of duration across years any number of possibilities exist from short-term (typically one to five years), to long-term (five or more years), and to permanent dedications (in perpetuity). The potential variation here is considerable. Though not included in Table 5.3, interruptible contracts or dry year contacts may be used to commit water to environmental use only periodically over some defined time frame.

As shown in Table 5.3 there are some transactions that would be hard or unlikely to be arrived at for just part of a season. For example, infrastructure improvements that enhance efficiency will typically be "always" on and therefore not suited to split season use. Improvements that use technology, such as irrigation scheduling, have the advantage of being turned on or off and, therefore, can be used for split season transactions.

Table 5.3 Environmental Water Transactions and the Duration of the Commitment

How is Water Saved or Freed Up?	Split Season	Full Season	Short-Term	Long-Term	In Perpetuity
Water Management					
Upstream Management					
Timing of Storage Releases	✔	✔	✔	✔	
Source Switch	✔	✔	✔	✔	✔
Point of Diversion Change	✔	✔	✔	✔	✔
Conveyance Efficiency					
Diversion Efficiency		✔	✔	✔	CW
Delivery Efficiency	✔	✔	✔	✔	CW
Transmission Efficiency		✔	✔	✔	CW
On-Farm Efficiency		✔	✔	✔	CW
Consumptive Use					
Reducing Crop Consumptive Use	✔	✔	✔	✔	
Taking Land out of Agricultural Production	✔	✔	✔	✔	✔

Notes: "CW" means that this can be a permanent commitment if saved water can be certificated as conserved water for instream use.

In terms of the length of duration of a transaction, most can be used for short- or long-term purposes. The difference between transactions comes with regard to whether or not the water can be committed to environmental purposes in perpetuity. This will vary from state to state. Some states allow for permanent dedications of instream flow and others do not. With some transactions, such as storage releases and crop-switching to achieve reductions in crop consumptive use it will be difficult to structure a permanent transaction, given that ownership of the property and water use behavior can always change in the future. In the case of conservation and on-farm efficiency improvements, commitments in perpetuity are possible only if the state allows permanent dedications of water saved in this way (for example as an allocation of conserved water in Oregon).

5.2.5 Source of Water

Instream and environmental flow needs are typically met through surface water flows. Thus, the source of water for environmental water transaction is typically surface water, either natural (live or "native") flow or stored water. However, in some cases a transaction that involves a groundwater source can generate flow benefits. For example, a source switch from surface water to groundwater may generate environmental benefits for a time, even if the total water use remains the same. Similarly, on-farm efficiency improvements and reductions in consumptive use on farms using groundwater may also lead to streamflow benefits as the impact of pumping on streams that are connected to the groundwater source is lessened.

Table 5.4 Environmental Water Transactions and the Source of the Water

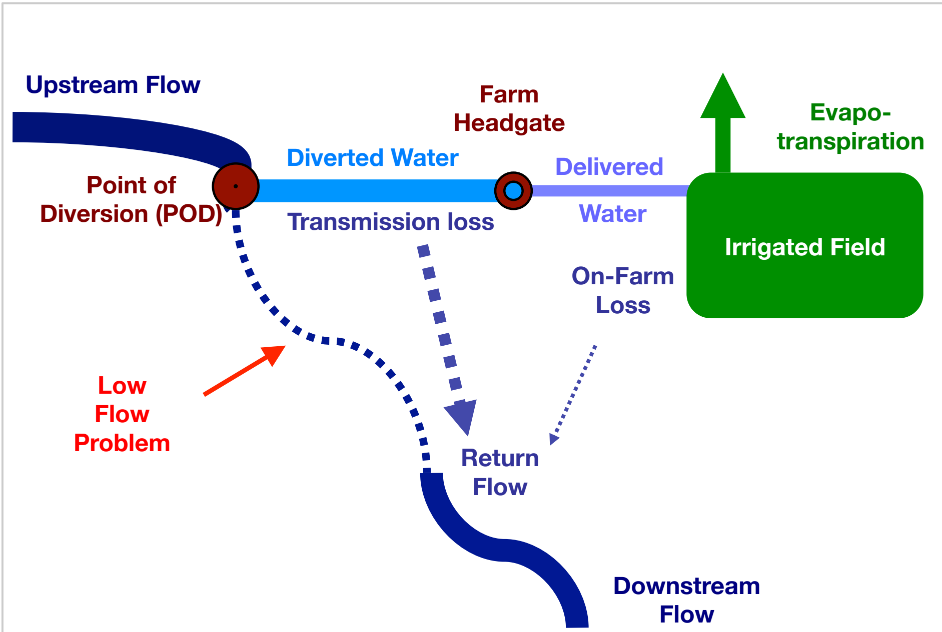
How is Water Saved or Freed Up?	SW: Natural Flow	SW: Storage	GW
Water Management			
Upstream Management			
Timing of Storage Releases		✔	
Source Switch	✔	✔	✔
Point of Diversion Change	✔	✔	
Conveyance Efficiency			
Diversion Efficiency	✔	✔	
Delivery Efficiency	✔	✔	
Transmission Efficiency	✔	✔	
On-Farm Efficiency	✔	✔	✔
Consumptive Use			
Reducing Crop Consumptive Use	✔	✔	✔
Taking Land out of Agricultural Production	✔	✔	✔

5.3 Using the Toolbox: The Before Transaction Water Budgets

In preparation for the next two chapters and their explanation of the full toolkit we develop here the "before" transaction (or baseline) scenario. This "before" transaction scenario is then altered for each transaction type so as to demonstrate how that transaction type changes the stream and irrigation water budgets

First we recall the idealized graphic of a stream and irrigation system from Chapter 1, which is repeated in Figure 5.1 below for ease of access. This figure provides an illustration of these two interdependent systems.

Figure 5.1 Simplified Stream and Irrigation System

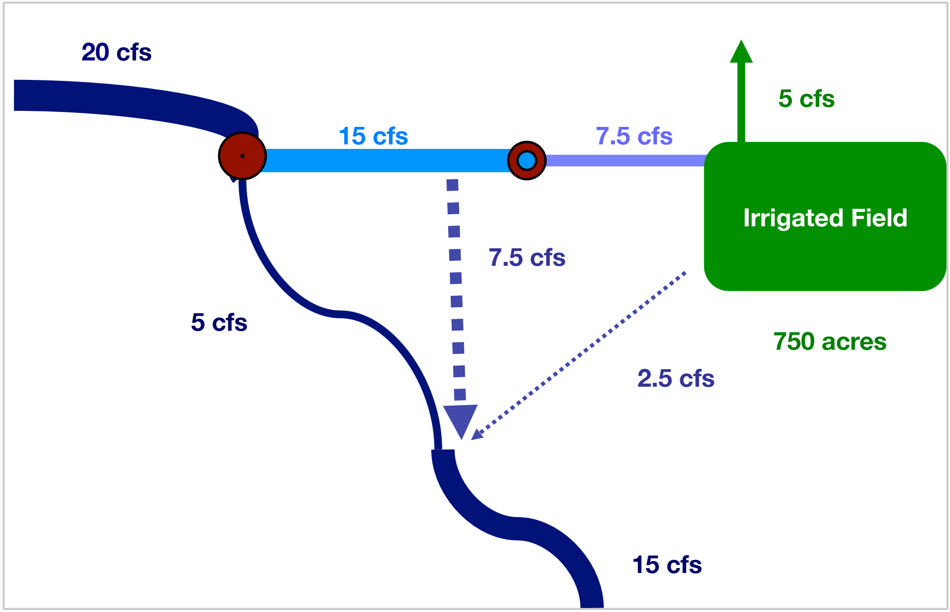


In order to prepare a numerical example for use as the "before" transaction scenario it is necessary to put forth a few parameters for the system. In order to construct the example the following conditions are assumed for late summer operation:

- the streamflows at 20 cubic feet per second (cfs) above the point of diversion;
- the ranch is 750 acres and has a water right at a rate of 50 acres per cfs, for a maximum rate of 15 cfs for the property;
- the ranch is able to divert its full water right, so the water diverted is 15 cfs;
- the flow in the ditch (15 cfs) is subject to a 50% ditch loss before reaching the ranch (or 7.5 cfs);
- the consumptive use at the peak of the irrigation season is 0.0067 cfs/acre and thus the consumptive use demand on the farm is 5 cfs;
- the irrigation application efficiency on the ranch is 67% (could be efficient flood irrigation or inefficient sprinkler irrigation), so the on-farm loss of water (as seepage and tailwater) is 2.5 cfs; and
- the total on-farm demand (use plus loss) is 7.5 cfs.

Figure 5.2 summarizes the budgets for the stream system and the irrigation system from upstream to downstream. Probably the most significant point of the example is that the ranch actually only consumptively uses 5 of the 15 cfs. But given the mechanics of the irrigation system, the stream is reduced from 20 to 5 cfs below the point of diversion. The 10 cfs of non-consumptive use by the ranch does return to the stream as it moves on downstream so this reduction in flow is not permanent. However, the loss of up to 75% of the flow will have impacts on water quality, fish, wildlife and vegetation in the reach. Of course this example is just that: an example. In some stream systems creeks, streams, and even rivers are completely dried up due to irrigation diversions. The next two chapters explore how different transaction types affect both systems and can be used to address this low flow problem.

Figure 5.2 Simplified Stream Reach Water Budget Example (in cfs)



Note: The lines in the figure are sized (weighted) in proportion to their respective flow (cfs) rate

5.4 Location, Location, Location: Context in Transaction Selection

Prior to examining environmental water transactions in detail it is important to point out that in a given stream system these transactions may be viewed as substitutes and/or complements. A water transaction program that aims to improve streamflows in a given reach will typically select a subset of the available transaction types as applicable to the situation. Within the reach, different transaction types may then complement each other, as each adds to the water made available to instream flows and environmental uses. However, with respect to a given landowner or irrigation delivery system these transactions may also be substitutes, as there may be a certain amount of flow or water that is desired, or only a certain amount of funds available to carry out transactions. In any event, the point is that the practitioner is often faced with a decision as to which approach to pursue, and when. The principal caveat to make at this point in this handbook is that context likely will rule in determining which transaction is most beneficial to pursue.

The type of system may direct the practitioner toward a solution. The obvious point about water management transactions is that they often do not lead to lasting benefit downstream. If water is routed down the stream instead of to the field, into the ground, and back into the stream, then obviously water management transactions benefit only that immediate reach. In some cases this may be a considerable distance. Or the distance may be short but sufficient to restore critical habitat for fish, for example. In which case, such approaches are recommended as they create the environmental benefit without greatly affecting the irrigation enterprise.

However, if the environmental objectives are to provide water to consumptive uses of vegetation and wildlife, or to provide flow to water bodies far downstream (as with desert terminal lakes or estuaries) then such spatially circumscribed approaches may not be sufficient. Rather there may need to be a reallocation of consumptive use in the system from irrigation to environmental purpose. In which case the consumptive use transaction types will need to be deployed.

Of course, just as irrigators use and return water over and over again down a stream system, so might environmental restoration be achieved by stringing together a series of water management transaction across a number of important reaches of a stream. Consideration of a variety of factors, including the total costs of restoration, will obviously be needed in formulating a transaction strategy. These issues are addressed in Part III of the handbook, where tools for assessing and evaluating transactions are provided. But, first we turn to a full accounting of the various transaction types and their uses in restoration of environmental flows.

5.5 References

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CHAPTER 6
ENVIRONMENTAL WATER TRANSACTIONS: WATER MANAGEMENT

Bruce Aylward

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Ecosystem Economics
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Environmental Water Transactions: Water Management

This chapter examines environmental water transactions that improve water management and water use efficiency, thereby freeing up water that was previously diverted for environmental flows. These transactions are as follows:

a) Upstream Management
    i) Timing of Storage Releases, i.e. releasing storage during salmonid migration
    ii) Source Switch, i.e. using groundwater in place of natural flow
    iii) Point of Diversion Change, i.e. moving a diversion downstream
b) Conveyance Efficiency
    i) Diversion Efficiency, i.e. modification of diversion structures
    ii) Deliver Efficiency, i.e. ditch controls, scheduling and distribution
    iii) Transmission Efficiency, i.e. piping and lining
c) On-Farm Efficiency

For each transactional form a description is provided as well as specifying the duration of the transaction, how the transaction affects the local water budget and the likely benefits, risks and costs of the transactional form are discussed.

6.1 Timing of Storage Releases

The re-regulation and storage of water by infrastructure, including on- and off-channel reservoirs and storage dams on farms, is undertaken for flood control, hydropower, transportation, municipal water supply and irrigation. Altering the management of such facilities is an important method for restoring instream flow and returning to a flow regime that more closely resembles the natural hydrograph. This approach is most often seen with large dams on major rivers. In such cases, a lack of flow is not so much the issue as the timing of the release of flow.

Indeed, transactions that merely alter the timing of release may be segregated from transactions where storage releases are acquired as part of water use efficiency projects or the fallowing of land. The latter projects involve working to cover the costs incurred of investing in water use efficiency technology or compensating water users for forgoing their use of water. Altering the timing of storage releases more typically involves compensating for the loss of productivity associated with regulating releases. The most common example of this is where providing for instream flows downstream from a hydropower project results in a change in power production with associated change in financial returns from power generation. Additional examples involve the release of flood flows from dams that were designed, at least in part, for flood control in the first place. While it is clear that dams and their impacts on river regulation are a major source of the loss of habitat and biodiversity in rivers, it is also the case that where a dam exists there may be opportunities to take advantage of the flexibility afforded by storage.

While the number of examples of dam releases to provide environmental flows is increasing; how many of these are transactions for instream flow is not clear. A number of organizations are working in the U.S. to promote this approach but so far many of the cases are in the eastern U.S. or are not really transactions. For example, The Nature Conservancy's Sustainable Waters program has formed a partnership with the U.S. Army Corps of Engineers to determine environmental flows requirements in major rivers that are regulated by Corps dams. The work entails a knowledge-based and advocacy approach more than a transactional approach. Other examples of similar efforts to gather stakeholders and try to obtain improved flow regimes have been undertaken in the context of efforts to meet or anticipate Endangered Species Act obligations, or as part of efforts to re-license dams under state or Federal Energy Regulatory Commission regulations. For example, Bonneville Power has engaged in flood releases downstream of dams on the Columbia for the purpose of supporting salmon habitat.

To the extent that these efforts involve specific agreements they may be considered as transactions. However, these may also simply be the case of voluntary actions by the owner or operator of the dam, based on improved understanding of their impacts and a simple interest in reducing their impact on fish and wildlife. Generally, little evidence of willing seller, willing buyer transactions is seen in this area. Given that many of such discussions do not result in agreement on additional releases or only succeed in achieving a single aspect of the desired environmental outcome (for example obtaining a flood release but failing to meet base flow requirements), the possibility remains that the type of market-oriented thinking underlying the transactional approach could be used to expand the implementation of storage releases of this kind.

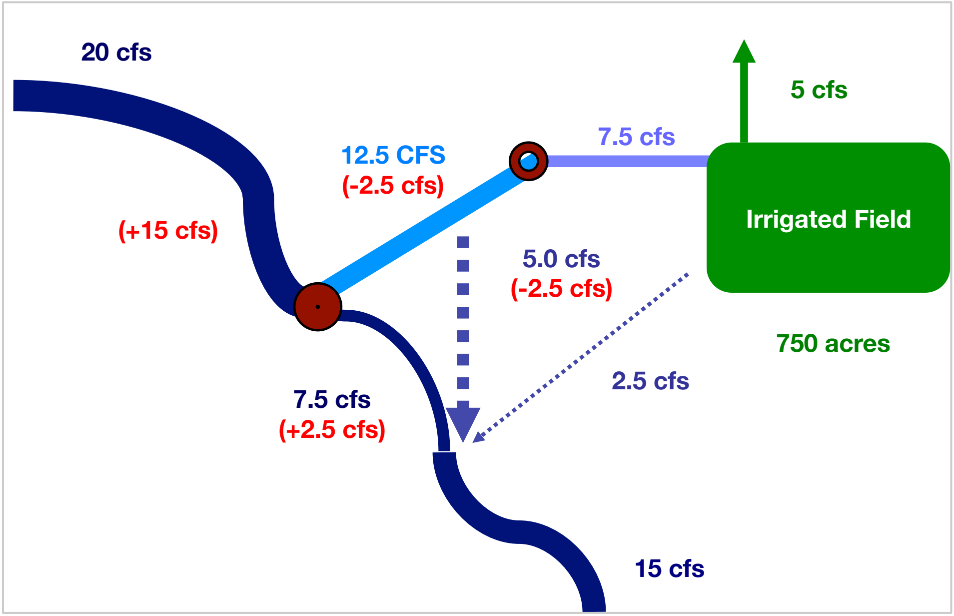
6.2 Point of Diversion Change

One of the more straightforward actions to improve streamflow is to move the point of diversion downstream along the original source stream. Typically such transactions are put into effect on a permanent basis as the water user must make a capital expenditure to effect the change and a permanent change to the point of diversion (POD) on the water right is made.

POD changes create two potential benefits: first the potential for called-upon water to remain instream for a greater distance downstream, and second the potential for a reduction in seepage loss during transmission of the water to its place of use (as shown in Figure 6.1). As noted in the figure with the POD change, the length of stream reach running at 20 cfs is lengthened down to the new point of diversion. Due to the new alignment of the canal to the headgate the amount of seepage from the canal is reduced (by 2.5 cfs). As a result of this reduction in seepage, less water (2.5 cfs) needs to be diverted from the stream at the point of diversion and flows from the new point of diversion down to the point of return flow are increased by 2.5 cfs. Note that there is no change in the water budget for the farm past the headgate so this transactional form has no impact on the farming operation. Also, note that downstream from the point of return flow there is no change in flow and therefore there is no injury to downstream users.

It is important to recognize that the two benefits of the POD change need to be evaluated and treated as independent parts which sum to the total benefit of the transaction. The instream benefit in the reach between the old and new POD does not require an instream right. When the water user calls on water this reach is re-watered due to the call on the out-of-stream right. Conversely, it is critical to understand that when the user is not calling on their right the reach may not be re-watered. For example, if there is an upstream junior water user that is not satisfied, then when the downstream senior water user turns off (or reduces his diversion) the junior user is perfectly entitled to turn on (or ramp up). In such a case the benefit of the POD change should be considered as an interruptible flow and, therefore, not secured.

Figure 6.1 Point of Diversion Switch



Even though no instream right is required, the POD change will require an application to the state to change the point of diversion on the water right. If the transaction also leads to savings in seepage and enables a reduced diversion, then an application to the state agency to create a new instream right for this savings may be useful, subject to state law (see the example in Box 6.1). The applicable reach would be that between the old point of diversion and the point where the return flow previously emerged. In the example in Figure 6.1 the seepage savings of 2.5 cfs is otherwise unprotected downstream of the old point of diversion. Such a change application will require an injury analysis. Potential complications here could occur if there were a junior right holder just downstream from the old diversion point who was previously relying on return flow from the now-eliminated portion of the canal. Whether or not such a change application would constitute injury might depend on the interpretation of injury in the relevant jurisdiction. Regardless of how this would be ruled, understanding that such a user would suffer harm from a reduction in actual access to water is important information that should be part of the transaction design process. Even if this might not constitute injury it may be useful to consider some form of compensation for the affected water user.

The costs of a POD change relate largely to the costs of decommissioning the old diversion structure, including a portion of the prior canal, and building a new diversion, as well as the canal connection required. This assumes that the POD change will continue to rely on gravity feed for the water system. Depending on the degree to which the water users will derive benefits from such a switch and the extent of the instream rights acquired and instream benefits, the prospective costs of a POD change to the environmental buyer will range between the full cost of the construction and some lesser amount agreeable to the water user. While there can be no set expectations as to the cost-effectiveness of POD changes, they are a logical first step to investigate in planning reach restoration. This, given that historical decisions on the location of PODs were taken in an era when being judicious in the choice of where water was diverted with respect to impacts on instream flow was not a consideration.

Box 6.1 Three Sisters Irrigation District Thompson Ditch Project

Collaboration between the Three Sisters Irrigation District, the Deschutes Soil and Water Conservation District, the Oregon Water Trust, the Natural Resources Conservation Services and the Deschutes River Conservancy led to a point of diversion (POD) change that relocated an irrigation diversion to a point further downstream and in so doing eliminated an irrigation ditch. Previously, the water rights were diverted above the low-water section of upper Whychus Creek and delivered by a roundabout route to land near the creek.

The original water rights were 1.04 cfs of senior and 1.08 cfs of junior rights. By changing the POD, transmission seepage was saved and the irrigation water now passes by the main irrigation district diversion point to an infiltration gallery at the new point of diversion. The project agreement called for a conserved water application to be undertaken whereby the delivery rate was lowered (from 1/50 to 1/80 cfs/acre) and the saved water dedicated instream. On October 4, 2005, the state approved new instream water right certificates of 0.28 cfs of senior (1885 + 1 minute priority date) and 0.33 cfs junior (1900 + 1 minute priority date) associated with the seepage savings. In addition to this instream water right, streamflow is increased when the irrigator is using water because irrigation water that was previously diverted is now delivered to the farm via the stream channel.

Source: Deschutes River Conservancy

For large irrigation districts making such POD changes can be a way of demonstrating their intent to do what they can to help instream flow restoration – while potentially shoring up the reliability of their water. For example in the early 1990s the Tumalo Irrigation District in Central Oregon moved the bulk of their water diversions to their Tumalo Feed diversion a number of miles downstream on Tumalo Creek. With their existing diversion damaged by flooding and their legal right to construct a new diversion in question, the district found it advantageous to make the switch, in the process eliminating large amounts of seepage and improving the reliability of their customers' water rights. In other words this project paid for itself, no transaction was necessary.

The direction of these beneficial POD changes is downstream. Moving a POD upstream would generally decrease instream flows and presents injury issues with regard to other out of stream users and, as such, is not helpful. If in fact an instream water right exists in the reach between the old diversion point downstream and the new point upstream and this water right is not met, then moving a POD upstream would likely deprive the junior instream right of water and constitute injury of that right. Scrutiny of any such upstream moves in PODs by conservation groups is therefore advised in order to protect existing instream flow levels.

6.3 Source Switch

Source switches refer to the change of a point of diversion from one source of water to another source. The alternate source can be groundwater, stored water, water from (typically) a larger stream or river, or water stored in the ground through aquifer recharge or injection. To a certain degree such source switches are similar to the simpler POD change discussed above in the types of benefits they offer and the injury issues that need to be considered, and thus a full exposition is not repeated here.

Two of the most frequent use of source switches are: groundwater exchanges in which irrigators temporarily switch from surface water to a groundwater source to assist in meeting streamflow during critical periods, and switching of one or two users on a small creek to a larger stream to which the creeks are tributary. While ideally suited to small creeks and streams these methods have also been used to substitute large amounts of flow in larger rivers. In particular large groundwater and surface water substitution programs have been implemented in the Deschutes Basin and the Umatilla Basin of Oregon.

In the case of groundwater substitution, or more properly groundwater "mitigation," the objective of such programs is the creation of new groundwater rights for urban or irrigation users, not environmental flows *per se*. However, to the extent that such efforts return flows to streams or rivers well above the point of impact or return flow from wells they can be said to restore streamflow.

The Umatilla Basin exchange project was funded by the Bureau of Reclamation, in partnership with local irrigation districts and the Confederated Tribes of the Umatilla Indian Reservation. The program allowed for the exchange of water sources between the Columbia River and the Umatilla River and various storage facilities. This permits the districts to draw water from the Columbia and leave water in the Umatilla (tributary to the Columbia). The project involved a major infrastructure project developing pumping facilities on the Columbia River and piping the water up to the Cold Springs Reservoir. The project is not gravity fed and therefore incurs recurrent costs from pumping water up to the reservoir.

A major difference in the economics between a gravity feed POD change and a source switch is the introduction of pumping costs. Clearly, many reaches could be restored if water were merely pumped uphill from a lower order stream where flows were plentiful or if the aquifer feeding such a lower order stream were tapped. The economic limitation on such projects is, of course, the increasing costs with distance of building a transmission system and the costs of pumping surface water up such a system or out of a well. A permanent source switch transaction effectively takes on these costs in perpetuity and, so, careful financial analysis and negotiation is required to arrive at an equitable financial structure for such a transaction.

6.4 Diversion Efficiency

Diversion efficiency refers to the efficiency with which water is diverted from the stream to feed the conveyance system. Many of the older, unimproved irrigation systems across the western states have push up dams or other crude installations that often dewater the entire stream, at least for some distance. Such structures are basically uncontrolled diversions. The control typically happens some way down the ditch or canal where excess water is returned, or dumped, back into the stream. Such diversions often go unmeasured and may exceed the formal diversion rate on those water rights.

Fixing such diversions by upgrading the infrastructure on the stream to divert only that amount necessary, and possibly also screening the diversion, may restore large amounts of water to shorter or longer reaches, depending on the situation. Such projects are not often considered as environmental water transactions *per se*. This, as the water they return to the stream may technically have been illegally diverted according to the letter of the law. Further, installation of improved structures does not guarantee any particular amount of the water right will be instream. Rather what the structure does is provide the possibility of actually managing the water that is diverted. As such, improving diversion efficiency may return flow below the diversion, but perhaps most importantly it represents a starting point (or a finishing point) for overall system efficiency improvements. Indeed, anecdotally it seems that diversions are either improved at the beginning of a transactional program in a reach or towards the tail end of such a program.

For example, the Three Sisters Irrigation District (TSID) replaced their existing and antiquated diversion structure on Whychus Creek in the Deschutes Basin only once the majority of the system down the ditch had been piped. To some extent the reason to put this improvement at the end of a series of improvements was to wait until there was enough streamflow protected downstream of the diversion to make it worthwhile to fix the problems created by the diversion. In comparison, on the North Fork of the Gunnison River in Colorado, Trout Unlimited and its partners have pursued diversion modification projects with local irrigation companies as the initial project. There are a number of reasons for this but probably the most critical is that such projects offer the opportunity to engage in a relatively uncontroversial and straightforward construction project as a way to begin building a partnership for flow restoration.

Relevant to both cases is that such projects can be quite expensive on sizable streams and diversion, i.e. in the 50 to 150 cfs or more range. Engineering and design will likely costs in the hundreds of thousands and the construction project can cost millions for mid-size installations on such creeks and streams. In the North Fork case this provides Trout Unlimited with the opportunity to demonstrate its ability to bring grant funds to the project. In the Whychus case it meant partners were unwilling to support the effort until it would be worthwhile. The difference between the Whychus and the North Fork being that Whychus is a smaller creek that was historically dewatered in the stretch where TSID has its main diversion, whereas the North Fork is a larger river that is not fully dewatered. The diversion on the North Fork thus interrupted fishing on a flowing river whereas the TSID diversion made a bad, dewatered situation worse.

From a streamflow perspective it is also worth noting that the TSID diversion takes water away from the creek and runs it overland, away from the creek to serve landowners, whereas in the North Fork, the diversions often parallel the river for quite some distance. In addition, as discussed earlier in this handbook, the flow of Whychus Creek is extremely over-allocated in and above the town of Sisters where the TSID diversion is located. In the case of the North Fork, large downstream senior water rights mean the river is delivering the bulk of the water downstream to diversion on the Gunnison River and on downstream. In other words there are water right and locational attributes that would favor large, uncontrolled diversions on the Gunnison, along with large returns to the river downstream of the diversions. On Whychus, by comparison, over-allocation meant that TSID could not over-divert on its water rights and the nature of the ditch meant that water that was diverted could not be returned to the stream. Thus, circumstances will likely dictate the historic efficiency of a diversion structure and may also determine when, in a phased transaction program, the modification of the diversion would be best situated.

6.5 Delivery Efficiency

A further opportunity to increase water use efficiency is to better mange the delivery of water down the ditch from the diversion. While primarily of value in large districts with many users this approach may also yield water savings on small conveyance shared between a few individual water users. Besides seepage from transmission loss and the application of water on the farm, seepage or return flow also occurs when water is unnecessarily stored in the system, when water is returned back to the river from ditches or laterals, or when water leaves the tail end of a conveyance system and is returned to the river (referred to as “tailwater”). This water is not delivered to the farm, and thus can be considered excess or waste. To the extent that delivery efficiency can be improved there is little to no need to divert this water in the first place. A lesser amount of water is needed at the point of diversion to meet water user needs. As described in more detail below under transmission efficiency each state provides varying opportunities to capture such savings and protect them instream through formal changes in water rights. Contracting directly to improve the system and leave this additional water instream is also an option, depending on how likely such an action is to produce flow at the desired time and location.

6.5.1 Scheduling and Distribution

Improving or just instituting a clear system of scheduling of water deliveries is one method for reducing the amount of water that needs to be diverted. The ability of a group of users to undertake such an improvement will vary. A small district or company with just a few users is probably the ideal situation (see Box 6.2). As the number of users increase or the size of farms decrease the difficulty and costs of administering a scheduling system increase. It is likely that where districts are free to divert their full water rights and face no opportunity cost (or penalty) for taking more than they really need, there will be a systemic underinvestment in scheduling. The only constraint will be the physical capability of the system to handle the full water right and any limitations placed on tailwater discharge (based on where this discharge occurs).

As indicated, accurately scheduling and delivering water through a large conveyance system with many users can be a major logistical task. Irrigation districts do not have the capability or resources to maintain the real-time data and operational software that would be required to do this with any precision. However, there are a number of investments that can be made that enable more efficient water management and distribution. First, is having realtime data about flows in the system. Second, is having the ability to quickly or remotely control flows in response to new information. Many districts are now investing in SCADA (Supervisory Control and Data Acquisition) systems and other technologies that provide this capability. Conservation programs have provided many grants to irrigation districts for these systems.

6.5.2 Infrastructure Upgrades

One reason for inefficiencies in water distribution is the lag time required to make changes. This is particularly true with long delivery systems – and such systems are often 20 to 50 miles long and in extreme cases can often be up to hundreds of miles long. Where districts rely mainly on storage for their water or use storage to increase or decrease flows as demand shifts the distance from source to farm is extended even further. Given flow rates this can mean a lag time measured in days between the decision to ramp up or ramp down storage releases or diversions. This means that when users at the end of a canal turn off unexpectedly (or if there is no explicit scheduling just turn off) unneeded tailwater may be generated for the lag period. Typically ditch riders will try to get other users to ramp up their use but whether this leads to efficient use of water is questionable.

Two infrastructure improvements that can help in this regard are system interconnections and re-regulating reservoirs. By interconnecting district systems that share parallel routes or adjacent geographical areas it may be possible to pool the excess water over a larger number of users. Building explicit re-regulating capacity into the canal system is useful as it reduces the lag time needed to adjust supply of water to changes in demand. Depending on the streamflow situation this capacity may be designed just for re-regulation during the irrigation system and, therefore, not actually increasing the amount of water that can be stored (which would further alter the stream hydrograph).

Box 6.2 Crook County Improvement District (CCID) Conservation Lease

In 2005 CCID and the Deschutes River Conservancy (DRC) partnered on a district-wide water study that evaluated transmission loss, tailwater and on-farm use. The study identified that while on-farm use was fairly efficient, large amounts of water (46%) were being lost to seepage and tailwater in the distribution system. The tailwater and miscellaneous distribution losses were largely due to lax management of water deliveries within the district. CCID water is delivered off the tail end of another, much large irrigation district, Central Oregon Irrigation District (COID), and in 2005 was contracting for an hour a day of COID ditch rider services to manage water in CCID.

In 2006 the DRC and CCID signed an agreement that provided an increasing incentive for CCID to reduce its diversions (in effect the water it ordered from COID). The first 500 AF of savings was priced at $10/AF, the second 500 AF at $15/AF and so on through a total of 2,000 AF. Water use was monitored throughout the year and at the end of the season total savings were calculated to just exceed 2,000 AF. CCID was paid the maximum value under the contract at $35,000, or $17.50/AF. The DRC had meanwhile processed a 1920 Act Sale of Surplus waters with Reclamation and local districts, as well a winter storage lease in the upper Deschutes River with the Oregon Water Resources Department. The reach is historically dewatered in the winter below the major project storage dams in the headwaters of the Cascades. The DRC worked with the state to shape the lease to maximize its ecological benefit, which resulted in the release of the full 2,000 acre-feet (36 cfs) in the month of December 2006.

The water savings were achieved through tightened water management practices within the district, recognizing that the district could ill afford to waste the opportunity to obtain the offered funds. Specifically, the district hired a ditch rider, improved communications between the 20 water users in the district and greatly reduce the amount of their diversion. Interestingly the district then employed the excess funds to continue studies of the feasibility of piping their main canals, which would reduce their diversion further.

Source: Fitzpatrick (2007)

6.5.3 **Water Pricing**

While not a transactional approach *per se* it is important to recognize in working closely with state agencies and irrigation districts that the manner in which water is priced (if at all) can have an important impact on the orderly delivery of water. In most western states the right to use water is given by the state for free, no annual fees are required to even maintain the right in good standing much less help shoulder the public burden of administering state water rights. Environmental groups often attempt to use legislative or regulatory opportunities to institute fees on irrigation and other water uses but this is a difficult proposition given the political influence of irrigation districts, farmers and ranchers.

Another point at which water pricing occurs is within irrigation districts or companies that levy assessments on their water users. Management of a delivery system, along with all the other tasks performed by an irrigation district, costs money. These costs are passed on to district members through annual assessments. Membership in a district is like belonging to a club, and with the privileges and benefits of participating in the club come the obligation to pay a share of the bill. These costs may include the past capital costs of creating and building the district, but they will definitely include the variable costs of running the district, the district operations and maintenance costs. There are different way that these costs are charged to district members, but generally users are assessed a fee that is fixed by the parameters of their share in the district and/or the acreage of their water rights. Such a system imposes no costs when users use more water than they need and provides no benefits when a user increases their water use efficiency. In some case districts have implemented either uniform or increasing block charges. Such systems are more progressive. Under a uniform charge system the user pays the same per unit fee for every unit (or block) of water used. In an increasing block charges system the per unit costs charged for additional units (beyond some base amount) are increased. The latter system is generally acknowledged as promoting careful use and conservation of water and is commonly used by municipal water providers across the western states.

Thus, in evaluating water use efficiency opportunities within irrigation districts it will be useful to first understand how water is priced. If increasing block charges are in effect farmers may already have invested in water saving technologies to a point where they have equalized the costs of such investments with the benefits from lower water charges. In addition in such a system it is likely that the delivery of water is carefully managed. Most likely water is provided only upon orders from the district member and is measured and reported to the user by the district. In this manner, water pricing can increase the efficiency of water delivery, as well as use.

6.6 Transmission Efficiency

Open, unlined water conveyance systems are likely to lose a significant amount of the water they transport to seepage. Figures of 50% loss or more are not uncommon for large irrigation district system in areas with relatively permeable geologies. Increasing the water use efficiency of a main conveyance system is usually undertaken through lining the bottom and/or sides of the canal or piping all or a portion of the conveyance system. A variety of lining materials and types of piping exist, each with their own efficiency, longevity and cost (Swihart and Haynes 2002). In terms of eliminating seepage loss over the long term (i.e. up to or beyond 100 years) piping with high density polyethylene or steel pipe would be preferred, though at the upper end of cost per mile.

Transmission efficiency projects may be considered across a range of scales. Small-scale projects may involve a single individual users or groups of users using the same point of diversion and having a short distance of shared main delivery ditch or canal. However, transmission projects are also frequently undertaken as part of infrastructure improvements and water conservation efforts in irrigation districts. These projects take place on the shared canals and ditches that deliver water to turnouts on water users' properties. The ditches and canals often lie on private or public land and have been established through easements on such properties. Although capital intensive, these projects can conserve large amounts of water, especially if existing conveyances are particularly inefficient.

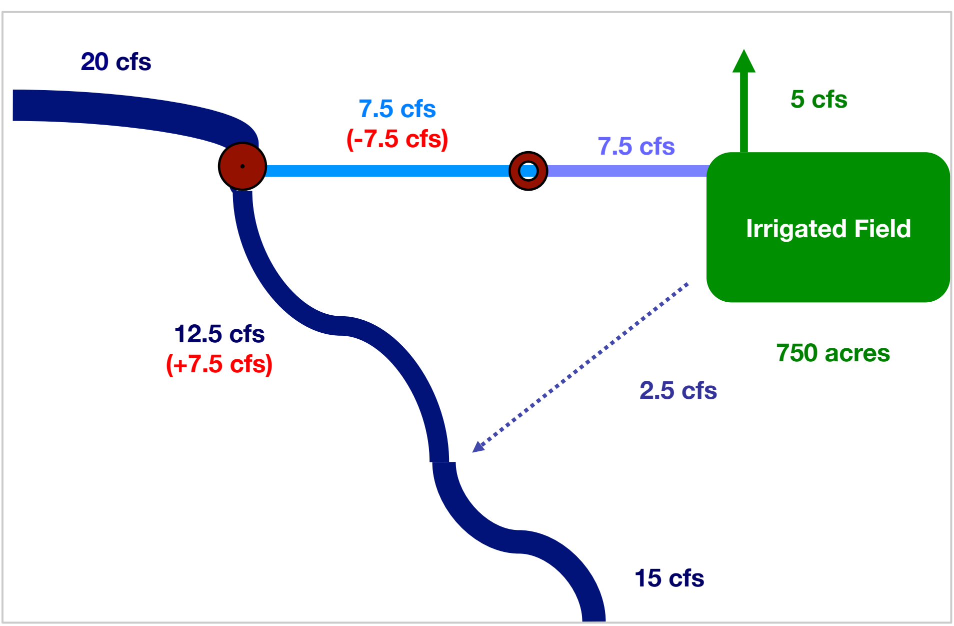
Depending on applicable state water rules the water saved through water use efficiency (or water conservation) projects may be protected instream on a temporary or permanent basis. In Oregon, the Conserved Water Program allows the creation of new instream (and out-of-stream) rights (Aylward 2008). As new rights the saved water is permanently converted to a new use and cannot revert back to the original right holder. This program does allow such rights to be held instream temporarily and, potentially, returned to a new agricultural use. To date, however, the program has largely been used to create new, permanent instream water rights. In Washington and Montana, conservation projects typically are of a duration that matches the length of time that water will be saved. In these states the transactions are thus temporary in nature.

The effect of a transmission efficiency project on the local water budget is shown in Figure 6.2. In the figure the point of return flow for transmission loss and on-farm seepage are considered as occurring at the same points in the downstream reach. This may or may not be the case depending on the distance of farms from the point of diversion and local hydrogeology. In the example portrayed the piping of the main canal eliminates the full 7.5 cfs of seepage, all of which is restored to the reach below the POD and above the point of return flow. This highlights that the mechanics of return flows in a given irrigated area can affect the dynamics of such projects. In particular, in cases where the water saved by such a project was formerly returning to the river as return flows and supplying another user, then assigning a new water right (with the same priority date) to the full conserved amount past the point of return flow can injure a junior water user. It may be debated whether, in the absence of a junior water user diverting downstream from the point of return flow, whether it is necessary to limit the protected reach. The difficulty is that if there an existing water users much further downstream that rely on the return flow and were one of these users to subsequently try and move their point of diversion upstream then the protected instream right would limit their ability to do so.

Perhaps for this reason, in Washington the protection of such saved water is always limited to the reach between the original diversion point and the next diversion point. Such a requirement errs in favor of protecting existing water users. Technically, the correct reach would be to the point of return flow. However, in many stream and river reaches confined to valleys there will be many points of diversion and return flow. Limiting the protected reach to the next point of diversion downstream simplifies the analysis required to determine the reach and ensures that such projects will not injure downstream users.

In addition, depending on the hydrological dynamics of the river reach in which the conserved water is to be protected, the instream water right associated with a conserved water project may be diminished to reflect natural groundwater recharge or evaporation loss in a losing reach. In either case, it is important to gain an understanding of the water budget in the affected reach at the planning stage so as to clearly anticipate the instream benefits of such efficiency projects.

Figure 6.2 Transmission Efficiency Project



6.6.1 District Projects

In practice, the manner in which such projects are designed and the type of partnership and cost- and benefit-sharing that are possible will depend on the type of rights held by the originating water user. For irrigation districts (or water users) that are water-short (i.e. that cannot reliably deliver their full water rights to patrons), conservation projects may be pursued with the aim of increasing the reliability of water supply as much as (or as well as) with the intent of restoring streamflow (Box 6.3). In this context, a portion of the water saved may go to new instream rights and the remainder is left out of any change application. By reducing the amount that it needs to divert the district will have in effect increased the reliability with which it can meet its patrons needs. Typically the division of the seepage savings between an instream right and firming up the districts water rights will be proportional to the cost-shares in the project.

In the case of districts (or users) with reliable, senior water rights there may be little interest in funding lining and piping projects to save water. Unless, of course an instream buyer for the water is interested in the project, or some other revenue stream or cost-savings will accrue to the district (Box 6.4). In the extreme case, districts may be relatively indifferent to infrastructure improvements, but if there is an instream buyer they may agree to allow the buyer to fund the entire project in return for obtaining rights to the saved water. Typically, there will be some savings in operations and maintenance or reduction in public safety risks associated with piping that will provide a residual benefit to the district and make such projects attractive. As the benefits accruing to the district increase, the more likelihood that they will be willing to bear a share of the costs of the project, while still allowing the full savings to be placed instream.

Box 6.3 Conservation Project in a Water-Short District: Tumalo Irrigation District Bend Feed Canal Piping Project (1999-2002)

In Central Oregon, the Tumalo Irrigation District (TID) holds water rights to Tumalo Creek and Crescent Lake, however historical supplies have not been sufficient to fully serve patrons. As a result, TID, assisted by the Deschutes River Conservancy, the Federal Government, and other conservation agencies has undertaken conservation projects to increase irrigation efficiency. The total cost of the Bend Feed Canal project was envisioned to be $4.5 million.

The conserved water application for the project received approval and a final order from the state in November of 2000. The state finalized the allocation of conserved water in April 2005, after the completion of the project. The final order on the conserved water application enabled a re-assignment of water rights.

From the 17.12 cfs of conserved water, an instream right was created for 5.82 cfs with a priority date one minute before the senior 9/30/1900 priority date rights to Tumalo Creek water. The district’s 11.3 cfs portion of the conserved water was assigned a 9/30/1900 priority date and is now part of the district’s certificate 74146 (the Tumalo Creek rights). This right also includes an additional 790 acres of irrigation previously served under certificate 76106 (the Crescent Lake rights). Certificate 76106 keeps its same priority date (December 8, 1961) and is now a junior instream right with a varying rate depending on the time of year. The project has greatly increased the reliability of the district patrons’ water supply and provides a 5.8 cfs senior instream right to Tumalo Creek. In addition, the piping of open canals in the City of Bend eliminates a potential liability within the urban area.

Source: Deschutes River Conservancy

Box 6.4 Piping in a District with Senior Rights: Swalley Irrigation District

In 2005, the Deschutes River Conservancy (DRC) began working with the Swalley Irrigation Conservancy to evaluate the cost and feasibility of piping the district's main canal and laterals for the purpose of instream flow restoration. From 2005 to 2007 the partnership led to the piping of three district laterals and an agreement to pipe the first 5.1 miles of the main canal. In selecting projects initial design and cost estimates for the entire system were developed (see below). Subsequent rises in pipe prices were incorporated as projects moved into the design phase.

District Conveyance Name	Length (feet)	Pipe Size (inches)	Loss (ac-ft)	Projected Piping Cost	Cost for Water ($/ac-ft)
A. Laterals Connecting above Main Canal & Hydropower Project					
Kotzman	*11,658*	*12*	*1,580*	*$ 145,268*	*$ 92*
NC-1	*3,203*	*8 to 6*	*800*	*$ 77,874*	*$ 97*
Rogers Sub	2,239	10 to 8	450	$ 67,100	$ 149
Riley Sub	6,731	12 to 10	710	$ 242,852	$ 342
Rogers	20,830	18 to 10	2,190	$ 1,026,175	$ 469
Riley	7,066	24 to 12	1,150	$ 580,608	$ 505
Subtotal	51,727		6,880	$ 2,139,877	$ 311
B. Main Canal (to 5.1 mi)	20,543	up to 63	7,640	$ 6,149,000	$ 805
C. Laterals Connecting below Main Canal & Hydropower Project					
Butte	5,459	10 to 8	480	$ 166,143	$ 346
Frakes	7,080	12 to 6	550	$ 222,799	$ 405
Mickelson	2,164	12	200	$ 84,650	$ 423
Deschutes	*7,560*	*12 to 10*	*530*	*$ 239,919*	*$ 453*
Elder	10,083	18 to 8	860	$ 487,690	$ 567
Subtotal	32,346		2,620	$ 1,201,201	$ 458
Grand Total	**104,616**		**17,140**	**$ 9,490,078**	**$ 554**

In the first year, while starting in on the work towards the main canal project the two entities signed agreements for the Kotzmann and Deschutes lateral projects. The DRC chose the Kotzmann as the most attractive project in terms of cost per unit of water protected instream and Swalley chose the Deschutes as its biggest operations and maintenance headache. The former lies within the City of Bend and the latter well outside the City and traversed County lands. Together the projects produced 5.88 cfs and 2,491 AF at a cost to the DRC of $458,000 or $180/AF. In the second year the Frakes lateral was also piped as delays in legal approvals set back the main canal project.

While the lateral projects were generally quite cost-effective relative to other opportunities to acquire water in the stretch of the Middle Deschutes between Bend and Lake Billy Chinook, the main canal offered the prospect of 20 or more cfs of savings in one project. Further it offered the opportunity to install a 1 MW hydropower turbine at the bottom end of the piped portion of the canal. The revenues from hydropower made this large project economical for both parties. During 2006 and 2007 engineering, legal, contractual and administrative work was completed that paves the way to install the project in the winter of 2007. At a maximum rate of 27 cfs instream and a total expected cost of over $12 million the project not only represents one of the largest instream conserved water projects seen to date in the Pacific Northwest but provides a vivid example of how such projects may be co-financed by the sale of instream rights, hydropower revenues and district O&M savings.

Source: Deschutes River Conservancy

In rapidly urbanizing areas, districts may be proactive in pursuing piping projects given the fragmentation and loss of irrigated area on ditches, as well as the increasing possibility of infrastructure conflicts and threats to public safety and welfare of open conveyances. A further opportunity in urban areas is to partner with developers. Typically, developers see benefits as ditches are piped and covered, leading to opportunities to reduce easement sizes and eliminate bridging costs. Also, as lands are converted to residential use, the volume of water to be delivered on a conveyance is lowered, and districts may place the burden of ensuring that other users on a ditch may continue to access their water on the developer that is leaving the ditch. Partnering with districts and developers can be a cost-effective way to undertake these efficiency projects.

As mentioned in Box 6.4 another opportunity to co-finance transmission efficiency projects exists where conveyance systems have hydropower potential. By attaching small hydropower facilities to the end of piped sections power may be generated by flow through the pipe. Depending on the the head generated, the flow rate, the length of the irrigation season and any increase in pipe size required (having more space in the pipe may reduce friction and increase power production potential) the installation of turbines and associated facilities can be quite profitable if the pipe is already in place. However, the ability to generate power does depend in the first place on the investment in pipe, so the savvy water transactions practitioner will insist that the hydropower projects should assist in financing the piping project in the first place. This in turn, lowers the effective cost of piping and lowers the cost of instream water obtained from such projects. Such transactions can be structured so that once any repayments for pipe are made the district still stands to make significant net revenue and has the incentive to participate in the project.

6.6.2 Water Efficiency and Storage Projects

Districts with storage water rights are yet another special case of water efficiency projects. In particular, when the saved water is water that otherwise would have come from a stored water source, then any new instream right issued at completion may also be a storage right. While this provides flexibility as to the timing and, in some cases, location of the new use, it also can have legal consequences depending on the status of a particular reservoir. Many large storage projects were developed using federal funds and may be authorized only for specific uses, such as irrigation. This means that in practice it may be difficult to apply for the required instream water right per the state statutory requirements.

These complications should be carefully considered when developing conserved water projects involving stored water. Close collaboration with state and federal agencies, any other users of the storage facility, and all other controlling authorities is important for success. On the other hand, the advantage of such efficiency projects is that it provides access to the flexibility of stored water uses without having any negative effect on its patrons or other storage holders. Another benefit of using stored water is that it may be released in the summer or the winter depending on the demand for water and the manner in which the reservoir is managed.

Most federal projects involve the use of stored water, and the water from these projects is typically authorized by Congress only for use in agriculture. This severely constrains the use of water saved by efficiency projects for instream uses. Even if a district is a willing seller and the instream buyer a willing investor in such a project the federal hurdle will be a major obstacle. In Oregon, a number of transactions by the Oregon Water Trust and the Deschutes River Conservancy have been able to move forward under the federal act of February 25, 1920 regarding the Sale of Surplus Waters Generally. Though the relevance of the act will depend on the specific context, the act’s provisions are described in Box 6.5. If the four conditions can be met then Reclamation may be willing to participate in such a transaction. The DRC project that employed this act was reviewed previously in Box 6.2.

Box 6.5 The Act of February 25, 1920 or *521. Sale of Surplus Waters Generally*

The Act reads, "The Secretary of the Interior in connection with the operations under the reclamation law is authorized to enter into contract to supply water from any project irrigation system for other purposes than irrigation, upon such conditions of delivery, use, and payment as he may deem proper," provided that the following four conditions are met:

1. That the approval of such contract by the water-user's association or associations shall have first been obtained.
2. That no such contract shall be entered into except upon showing that there is no other practicable supply for the purpose.
3. That no water shall be furnished for the uses aforesaid if the delivery of such water shall be detrimental to the water service for such irrigation project, nor to the rights from any prior appropriator.
4. That the moneys derived from such contracts shall be recovered into the reclamation fund and be placed to the credit of the project from which such water is supplied.

The alternative route to using federally authorized water for instream purpose is to obtain an Act of Congress to change the authority of the water to one of multiple purpose. This is a costly exercise. The only alternative solution would be outright acquisition of storage facilities from the federal government, a process that would require considerable upfront coordination and investment.

6.7 On-Farm Water Use Efficiency

Water use efficiency projects can also occur on the farm, broadening the potential water conservation options for individual water users and for irrigation districts. On-farm projects may include lining and piping of ditches and ponds past the head gate for the water users property. Such projects are akin to those described above and are not repeated here. The application of water to ground for the purposes of irrigation can be undertaken with different techniques each of which has its own application efficiency. This efficiency is defined by the amount of water that goes to plant growth as versus water that sits on the soil surface and evaporates or that seeps into the water table and percolates through to groundwater. Water use efficiency figures are thus the water that is the water transpired by the crop or stored in the crop. This crop water requirement divided by the total amount of water applied is the water use efficiency. Thus, in the example used in the irrigation system budget the delivery of 7.5 cfs to 750 acres with a crop water requirement of 1 cfs per 150 acres produces an efficiency of 66% (5 cfs / 7.5 cfs).

Improvements to application methods include conversion from surface (flood) to sprinkler irrigation systems, moving from sprinkler to micro (or drip) practices, improvements to existing sprinkler and surface irrigation systems, and providing adequate maintenance to sprinkler system hardware and pumps. Irrigation efficiencies using these different methods range from 35% for flood irrigation to 90% for drip irrigation as compiled for the Pacific Northwest (see Table 6.1).

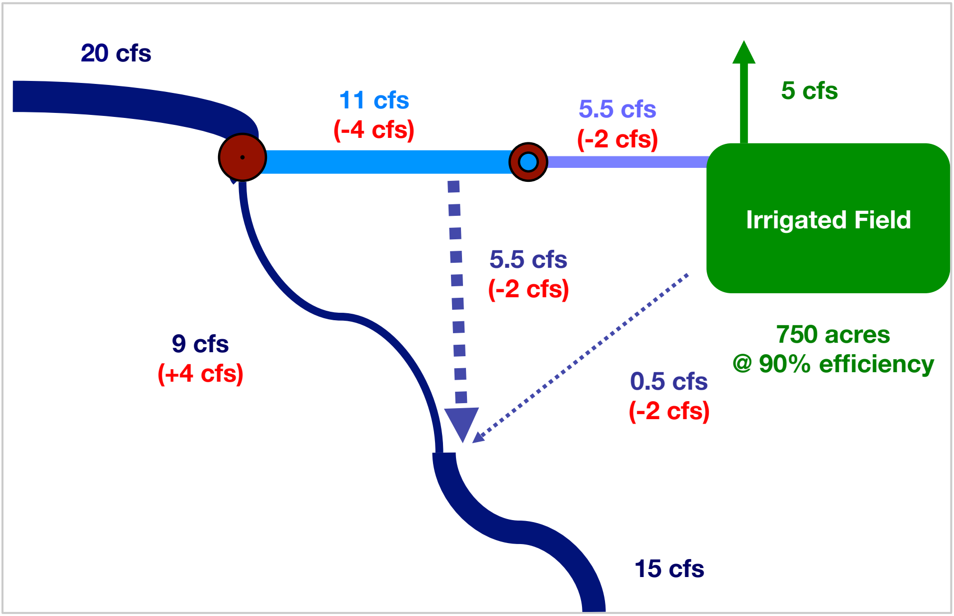
Table 6.1 Irrigation Efficiency by Irrigation System

Irrigation Method	Irrigation System	Ultimate Potential Efficiency (%)	Irrigation System Design Efficiency (%)	Overall Seasonal Irrigation Efficiency (%)	Typical Irrigation Efficiency (%)
Surface	Borders				
	Level or Basin	90	50-80	50-90	80
	Graded	80	50-60	45-60	60
	Furrow				
	Graded	75	50-60	50-60	60
	Corrugation	75	50-60	50-60	50
	Flood – controlled	60	40-50	30-50	40
	Flood – semi controlled	50	30-40	25-40	35
Sprinkler	Periodic move				
	Side-roll Wheel line	70	65-70	60-65	65
	Hand Move	70	65-70	50-65	65
	Solid Set	75	65-75	50-65	65
	Big Guns	60	60	50-60	60
	Continuous Move				
	Big Guns	60	60	50-60	60
	Center Pivot	85	85	75-85	80
Micro	Continuous Tape	90	85-90	80-85	85
	Point Source Emitters	90	85-90	80-85	85
	Mini Spray	85	85	80-85	85

Source: Newton and Perle (2006)

Using the generic irrigation water budget example it is possible to examine a switch from the baseline wheel line efficiency of 66% to a drip efficiency of 90% (Figure 6.3). Increasing efficiency reduces the diversion and thus the amount passed through the canals and ditches to the farm. In this example it is assumed that a small reduction in carry water alters the seepage from the main canal (i.e. transmission loss remains at 50% of diverted water). This may not be the case in practice. The complexities of how transmission loss varies with flow levels in a canal are significant and come into play with all transactions occurring downstream of the canal. For example, removing acres from production will also lower flows in a canal and thus affect seepage losses. It is rare that sufficient flow data at the needed points is available to interpolate losses and conduct statistical analysis to determine a flow/loss curve. Rather, field seepage studies or the use of temporary gaging structures are more practical approaches to understanding transmission losses in these contexts.

Figure 6.3 On-Farm Efficiency (Sprinkler to Drip)



Again, the duration of any protection for instream water will vary with state rules. One difference between on-farm efficiency projects versus transmission loss projects is their duration and ongoing costs. An investment in moving to sprinkler or drip will be a significant investment. If these systems have higher running costs then there is always the possibility that the water user will decide to retrench and return (for example) to flood irrigation. For transmission projects the ongoing maintenance costs of piping are extremely low and actually represent a net savings compared to maintaining open canals. Further, pipe is extremely long-lived. The equipment – aluminum pipe, sprinkler heads, pumps, dripline and tape – associated with mechanized and water efficient irrigation all requires either frequent maintenance or replacement. In addition, mechanized irrigation such as sprinklers may rely on pumping, whereas flood irrigation merely relies on gravity. Thus, the economics of on-farm water use efficiency are complex and water saving techniques cannot be assumed to be beneficial on net for the farmer – even if the water saved is sold to instream use. Also, the water user confronts many decision points at which the water-saving practices can be continued or discontinued.

It is also typical that funders are reluctant to fund capital improvements for landowners in their entirety. Thus, the landowner must derive some value from the changes in production practices. For large commercial farmers this is likely to be a dollar and cents issue. If saving water saves money than the farmer will be on board. For smaller farmers, including hobby farmers, there is typically a preference for convenience when it comes to watering small acreages. Pop-up sprinklers on a timer are popular when compared with spending time mucking about in fields managing flood systems. Still, a fundamental risk faced by all types of farmers is that of future energy costs associated with increased pumping costs. Given the prospect and uncertainty regarding future power rates it may be difficult to arrive at an equitable division of this risk in designing long-term or permanent transactions of this kind.

In designing on-farm projects it may also be advantageous to develop a comprehensive approach to the property and the water uses. Making such an overall assessment of water-saving opportunities and combining the various methods for achieving water use efficiency described above into a single project will ensure that the time invested in such projects yields the maximum benefit in terms of instream water. An example of a point of diversion, piping and on-farm efficiency project is provided in Box 6.6. Such projects do require substantial investment in understanding the water budget and changes wrought by the project so as to correctly prepare the change application to the state.

Box 6.6 Swalley Irrigation District and Deschutes River Ranch Project

In 2004, the Deschutes River Ranch, in cooperation with Swalley Irrigation District and the Deschutes River Conservancy, began developing a project for reducing water use on about 90 acres, which are largely used to provide pasture for an organic beef operation. A little over 30 acres were served by Swalley deliveries through the main canal and lateral system. The remaining water rights were direct river diversions (the ranch is adjacent to the Deschutes River) and some of the most senior rights on the reach. The project design involved the consolidation of all water rights at the direct river diversion, piping of all on-farm water and installation of a more efficient, pressurized irrigation system. Excavation costs for the pipe, the installation of 3-phase power by the local electricity cooperative and the sprinkler equipment formed the bulk of the costs of the project. During project design and construction the estimated costs were revised numerous times in an upward direction. The complexity of dealing with two different water rights and internal transfers on the Ranch lots (home sites) only added to the engineering and legal costs, as well as elapsed time in working with the state to understand and process the application.

In late 2007 the project was finally approved by the state. Project improvements allow for a reduction in duty for the Ranch's current water rights of both Swalley Irrigation District water and direct Deschutes River water rights to approximately 3 acre-feet per acre. The conserved water and point of diversion change for the Swalley water, provides an additional 1.5 cfs instream below Bend to the Ranch, of which 0.5 cfs is the Swalley water now diverted directly from the river at the new POD. Downstream of the Ranch up to 0.5 cfs of the saved direct diversion and Swalley water rights The DRC contributed $180,000 to the Ranch's cost for the project, which cost over $400,000.

Source: Deschutes River Conservancy and Oregon Water Resources Department

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CHAPTER 7
ENVIRONMENTAL WATER TRANSACTIONS: REDUCING CONSUMPTIVE USE

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Environmental Water Transactions: Reducing Consumptive Use

The human uses of water that lead to consumptive use are covered in Chapter 2. In the context of environmental water transactions the primary source of savings in consumptive use will be transactions that lead farmers or ranchers to fallow land, transfer water rights off the land permanently, reduce the water made available for crop growth or some variation on these. This chapter is devoted to understanding such transactions. First the types of transactions are described and then the hydrological, legal and administrative complexities of dedicating such water to instream use are detailed. The environmental, economic and socio-cultural issues associated with the potential impacts of these transactions on those who are not party to the transaction (i.e. "third parties") are then reviewed as they can pose a major stumbling block to successful water transactions of this type.

Given the number of potentially contentious issues that arise with these transactions it is important to ask why such transactions are even contemplated in the first place – particularly, when such a large range of opportunities to better manage water exists, as described in Chapter 6. In answering this question it is critical to recall that water management transactions only serve to reroute water through the system. Such transactions cause water that once was diverted across the landscape, seeped into the ground, and then returned to the stream as return flow to now be now routed downstream in the stream channel. While potentially hugely beneficial in some instances, these water management tools do not actually reduce consumptive use in a watershed, sub-basin or basin. Consequently, depending on the jurisdiction, the instream water can at most be protected only to the point of return flow and in some case only to the next diversion.

Depending on the flow restoration objective this simply may not be sufficient. Much can be gained from tighter and more efficient water management. However, in basins where cascading consumptive uses lead to the consumptive use of a larger percentage of available water, the ability to purchase consumptive use and protect it instream from the headwaters to the mouth may be invaluable. Simply put, achieving an increase in flow that can be sustained and protected from diversion through and on downstream is likely to require a consumptive use transaction.

A further issue is cost. It could be argued that water management improvements should have priority and be undertaken first. Then, and only then, if environmental flow needs are not met should the practitioner consider the fallowing of land or the permanent removal of water rights. But what if fallowing can be achieved at a fraction of the cost of such management improvements? More to the point, the last units of water gained from improvements will likely cost dramatically more than the first few unit obtained from fallowing. At the outset of a transaction program then, when the comparative costs of these approaches are not well known, it is hard to make an economic argument for pursuing only water management improvements. And, in the final analysis, cost-effective restoration plans are likely to include a mix of these two approaches.

Reductions in consumptive use involve cutting back either on the number of acres irrigated or the amount of water made available for plant growth. With regard to reducing acreage there are a large number of transactional possibilities. Generally however they can be described as to whether they result in environmental flows:

- temporarily (for a limited duration) or in perpetuity (permanent transfer);
- for the full irrigation season or only part of a season; and

- only when certain conditions exist, such as a drought (i.e. they are interruptible across years).

As with the water management approaches these transactions may involve a formal change in the water rights or they may simply represent an agreement on the part of the user not to take their water.

The next four sections take up the these transactions in the following order:

- reducing crop consumptive use;
- temporary reductions in irrigated acreage;
- permanent reductions in irrigated acreage; and
- water user agreements.

The discussion then turns to third party impacts and how to analyze and avoid injury to other existing water rights when undertaking water management or consumptive use transactions.

7.1 Reducing Crop Consumptive Use

Before committing to fallowing or permanently removing water from a property it may be worthwhile to investigate if crop consumptive use can be reduced. This approach is often one of the first ones suggested when environmental flow needs clearly require a reduction in consumptive use, and not just water management improvements. However, this approach has rarely, if ever, been successfully used to generate environmental flows. Nevertheless, it is important to review how this could in theory work. There are two variations on this approach. The first is to "under" irrigate the existing crop. The second is to switch to a lower water use crop.

7.1.1 **Deficit Irrigation**

The basic premise of deficit irrigation is that by reducing the amount of water provided to crops it may be possible to generate additional profit from the agricultural enterprise. This condition is met only if the loss in plant growth, decrease in final production, and decrease in gross revenue from the sale of the crop is less than the cost savings realized by using less water. Through careful examination of the agronomic variables involved and calculations of net farm income, studies have suggested that in the case of certain crops the cost of the loss in production can be offset by water savings.

An important component of the economic feasibility of this approach is the water economics involved. Reducing water use in efficient systems will likely save the water user in terms of their own costs of production – power savings, labor savings and perhaps savings in terms of reducing the need for other inputs. Clearly such savings will be small in proportion to total farm costs and, thus, the likelihood of adoption is low on farms that are not of a sufficient size and commercial scale. Only on such farms would the absolute amount of savings likely be sufficient to motivate behavioral change. In less efficient or antiquated systems, i.e. with leaky ditches and flood irrigation, the cost savings may be of little consequence. If the user is part of an irrigation district then the district may realize additional savings from not delivering as much water. However, there are few districts that structure their assessments in a manner that would financially benefit a water user from a small percentage reduction in their water use (as covered in Section 6.5.3).

Thus, there will be variability across situations as to whether just saving water will result in economic savings to the farm.

The economics would certainly improve if there were an opportunity for the farmer to effectively transfer or protect this saved water instream and receive a direct payment for this action. This would be on top of any cost savings realized from farm operations. The extent of this opportunity rests with the ability to change the water right. As this applies to both approaches to reducing crop consumptive use, this topic is taken up further below. Suffice it to say that this opportunity, though often proposed, has yet to be demonstrated.

In sum, in terms of economic feasibility, deficit irrigation suffers from three problems:

1. The approach only applies to a few select crops that have the desired agronomic characteristics in terms of their response to deficit irrigation.
2. The economic feasibility in part depends on cost savings, which may not be sufficient to motivate adoption, depending on the existing efficiency of the farm and its size or commercial nature.
3. Obtaining water transaction payments for water saved is unproven due to the difficult nature of carrying out a legal change on the water right so as to capture the water savings and protect them instream.

The unstated assumption with many of these types of conservation programs is to ignore the up-front investment and recurrent information and technology costs required to implement such a program. This approach will rely heavily on sophisticated agronomic and meteorological information. Most likely a state agency would require such detailed information before issuing a finding in favor of generating environmental flows from such a project. Precise measurement of water turned out to a field is no doubt feasible, particularly as part of academic studies. However, there may be concerns about precise measurement of say, 5% of consumptive use over the course of an entire irrigation season. While academic studies may feel comfortable citing these as significant figures, water managers often regard 5% as negligible given interannual variation in climate and hydrology, as well as the accuracy of measurement equipment.

As with crop switching, deficit irrigation might be more attractive as a temporary water use efficiency project, and deployed with the mechanisms described in Chapter 6 to protect saved water instream.

7.1.2 **Crop Switching**

Perhaps a more obvious and significant way to reduce crop consumptive use is simply to switch crops. This seems attractive given that the major use of water in the western states is for alfalfa, pasture and other hay crops. State engineers generally use alfalfa to place an upper bound on the potential crop consumptive use. So switching to lower water use crops seems of obvious benefit in terms of water savings. Amongst the crops often mentioned in this context are onions, grapes, leafy greens, barley and even tef (an Ethiopian grain). For example, if alfalfa hay has a consumptive use of three acre-feet per arce during the irrigation season, substituting a crop that uses only one to two acre-feet is obviously hugely beneficial in freeing up consumptive use water. Added to the excitement over this approach is the fact that many of these crops are higher in value than a hay crop. Creating economic benefits while reducing water use looks like a great win-win for agriculture and the environment.

However, the practical feasibility of this proposal rests on the idea that ranchers will want to, and be able to, become farmers. Aside from the technological, cultural and economic issues involved in such a transformation of irrigation there are those related to soils and weather. For example, in headwater streams pasture and ranching is the predominant activity. Growing crops in such locales might be feasible, but the fact that these are ranching not farming areas suggest there are important issues that would need to be resolved before any wide-scale adoption of lower water use crops. If the rationale for ranching over farming were purely economic then being able to convert a reduction in consumptive use into significant incentive payments through a transactions program would be straightforward. In all likelihood there are a number of reasons standing in the way of such a conversion, not just the economics. In addition, there is the legal, transfer issue as taken up next.

7.1.3 **Transfer Issues**

With both of the two crop water use reduction approaches outlined above the key that would unlock incentive payments and transactional opportunities is the ability to turn such an action into an instream flow right for environmental benefit. This implies the need to base the lease or transfer of a portion of the consumptive use of a water right on these actions. This can be quite difficult to achieve. Even in a state with progressive instream legislation like Oregon it is difficult, in effect, to take a slice off the top of the consumptive duty of the water right and put that to instream use. One reason for this is that water rights usually are not specified in terms of consumptive and non-consumptive portions. Thus, in Oregon an application under the Conserved Water Program could apply to reduce the duty (volume) of the water right. But this would just be lowering the total duty; it would not explicitly target the consumptive use.

A concern in approving an application to reduce the apparent consumptive use duty would be that the water right would be enlarged. The fear would be that once the duty on the water right is sliced in two and a portion of the consumptive use is transferred instream, the farmer (or the next owner) could well go back to the higher use crop or abandon deficit irrigation. If the full duty was reduced then the farmer would not have enough water then to be able to re-attain the full consumptive use. However, if the farmer invested in water use efficiency, shrinking the non-consumptive portion of the duty then the original consumptive use could be realized. However, if the portion of consumptive use that is transferred is already instream then this transaction would have enlarged the consumptive use, and likely injured other junior water users.

Split season leases (described later in this chapter) present the same danger of enlargement. However, a split season is conceptually and empirically simpler to mange given that the irrigation use is either on or off, and it is therefore easy to monitor for presence/absence of the diversion during the off period and to accumulate the water used during the on period (see Chapter 11 for more on monitoring split season transactions).

In conclusion, whereas deficit irrigation and crop switching probably bear further thought and experimentation with regard to methods for obtaining legal instream protection, for now they may be best regarded as potentials way for farmers to reduce their water use as part of diversion reduction agreements, as discussed later in this chapter.

7.2 Temporary Reductions in Irrigated Acreage

The following transactional approaches result in a temporary reduction in consumptive use, that is the water right user retains the authority to rescind the transaction at some future point and reapply the water to their land (or other originating use). In this sense, it can be said that the water user is "banking" their water; they are putting their water rights to another use but can reclaim them later. Typically this means fallowing land, but depending on the climate and agricultural practice some agricultural use of the land for pasture or rain fed farming may be feasible during at least some part of the year.

7.2.1 **Instream Leases**

Short-term temporary instream transfers, commonly referred to as instream leases, are one of the most commonly used beneficial use management tools. The water is protected from diversion and is a legally enforceable instream flow. Typically the instream right will carry the same priority date as the original right, although it may be diminished at the parties' convenience, if the state allows. Upon termination of the lease the instream use of the water right automatically reverts back to the original use area and requirements. State requirements that need to be met to obtain approval depend on the jurisdiction but may include:

- submission of evidence of the historical beneficial use of the water right;
- field verification of beneficial use and system delivery capacity by a state employee;
- a requirement that the point of diversion be screened to protect fish populations; and/or
- an injury analysis to ensure that the transfer does not negatively impact other water users.

Compliance with all of the above requirements would be a time consuming process. As described more fully below, documentation of beneficial use, injury analysis and full compliance with agency public notice periods imply that most transfers will take from 6 to 9 months if they are processed in a timely fashion and no delays or complications arise. For this reason some states have sought to lower the bar for short-term leases. For example, Oregon can process a lease application of up to five years in length in one month. This reflects the recognition that longer processing times would be prohibitive and that should a problem with a lease subsequently arise, the state can simply cancel the lease.

The benefits to irrigators of leasing their water include:

- at least limited validation of the parameters of the water right – less so in the case where injury analysis or historical use is not verified;
- maintenance of the water right in the form of a documented beneficial use – in the Pacific Northwest, leasing provides a means to meet a water right holder's need to beneficially use their water right once every five years giving water right holders an additional incentive to lease water they are not using;
- lease payments received by irrigators; and
- financial solvency for irrigation districts where lease payments help landowners to pay annual assessments.

The risks to irrigators are that submitting their water right for a lease will result in scrutiny and ultimately reduction of the water right. This cuts both ways. Leasing can be a useful step towards a permanent transfer of a water right – regardless of the nature of the transfer – as it will incur scrutiny. If the alternative for the irrigator is non-use, then obtaining a lease payment and qualifying for a future transfer may be advantageous.

On the other hand, water users that have not had their beneficial use actively managed or updated with the state may find that over the years their use has fallen outside of the parameters of the water right. For example, the amount of acres irrigated may have shrunk, a barn or other facility may have been built on top of a portion of the right, or the area irrigated may not be consistent with the certificated right. This can lead to the cancellation of all or a portion of the water right when inspected by the state. Clear disclosure of this possibility is advisable prior to entering into such a transaction. Oftentimes the water user will be agreeable as the costs of fully applying their water just to firm up the right may exceed any benefits gained. Where the official place of use is not fully irrigated, but additional acres on the property are, the water user is likely to be concerned when the state cancels the portion irrigated beyond the official use *and* the portion of the official place of use that has not been irrigated. In this case, when the user terminates the lease they will not be able to irrigate the same area previously watered.

The costs of leasing water from irrigators can generally be expected to be less than the comparable costs of permanently acquiring water. This, as the water user will benefit not just from the payment but also from the beneficial use and maintenance of the right. In addition, there is value for the irrigator in retaining the option to irrigate in the future. In states that have expedited processing times and requirements for short-term leases the added benefit to the water transactions practitioner is that the administrative costs of leasing may be lower than of permanent transfers.

While water leasing does not provide permanent instream water and thus is often considered as an inferior tool in comparison to permanent transfers it does have the following advantages as part of an environmental water transaction program:

- it represents a partnership-building opportunity with the irrigator (and the irrigation district) in which the water right is shared, rather than merely a trading relationship where the right is bought and sold;
- the option for the irrigator to reclaim the right for irrigation alleviates fears in the irrigation community that the water transactions practitioner will buy up and transfer all irrigation rights;
- it allows the water transactions practitioner to verify the utility of using the water right for an instream use (including verifying the reliability of its priority date) prior to committing large sums to a purchase of the right; and
- it provides financial flexibility to expand contract instream quantities of water depending on instream needs (i.e. reducing leasing during wet years) and the availability of funding.

In sum, leasing is often the first transaction entered into by new organizations engaged in environmental water transactions because the barriers to entry are low, leases are cost-effective and the flexibility to adaptively manage and grow leases are considerable when compared with permanent transfers. Simply put, leasing is an inexpensive and relatively uncomplicated way for the water transactions practitioner to build confidence and trust in a community that is new to the idea of environmental water transactions.

7.2.2 **Full vs. Partial Season Leases**

In a standard full-season instream lease, water users place their water instream for the entire irrigation season. The water user is the lessor. Lessors are unable to irrigate for the season, but they receive full beneficial use credit. It is important to note that once an irrigator has exercised their right during a given year, it cannot be leased instream that same season.

Within irrigation districts, approval of the district may be required and the district may be a second lessor on the lease. District patrons remain responsible for paying any district assessment for the water use, even if it is leased instream. It is also common for districts to require payment of the assessment prior to the season while the lease payment may not be forthcoming until administrative and financing arrangements are completed. It is important for the water transactions practitioner (in this case the lessee) to clearly lay out the timeline of the process from start to finish for the lessor. An example of a programmatic approach to leasing water rights with irrigation districts is provided in Box 7.2.

Split-season leasing provides an alternative to the traditional full-season lease that may be appropriate in some cases. In split-season leases, the water right, or a portion thereof, is leased instream for only part of the irrigation season, with irrigation permitted for the non-leased portion of the right. The season, duty, and rate of the water right are all split, and total water use cannot exceed the permitted use under any circumstances. So, while a water right holder can divide or split the lease in any way he desires, the portion of the water right that is used in irrigation is not available for instream lease and vice-versa.

Split-season leases allow streamflow restoration and farming to coexist, and may be appealing to landowners who only wish to farm for part of the season or in drought years they may wish to irrigate the best lands and not irrigated lesser quality croplands. An example is provided in Box 7.1. Measurement of water use is required in order to properly track the water under the lease. Split-season leasing is a form of enlargement of a water right, that is the use of a water right for two purposes in a given water year. Split-season leasing therefore generally requires legislation as it departs from principles in the water code. For example, in 2001 the Oregon legislature established the authority for split-season leases under ORS 537.348(3). Prior to this statutory change, the Oregon Water Resources Department (OWRD) was unwilling to allow this type of transaction because of concerns that it improperly allowed an irrigator a second beneficial use of his water in a season and could therefore constitute or lead to an enlargement of the water right. The new law resolved these concerns by requiring participating landowners to measure and report to OWRD the actual use of the water right for out-of-stream and instream purposes throughout the irrigation season. Moreover, the law requires that these uses cannot be concurrent.

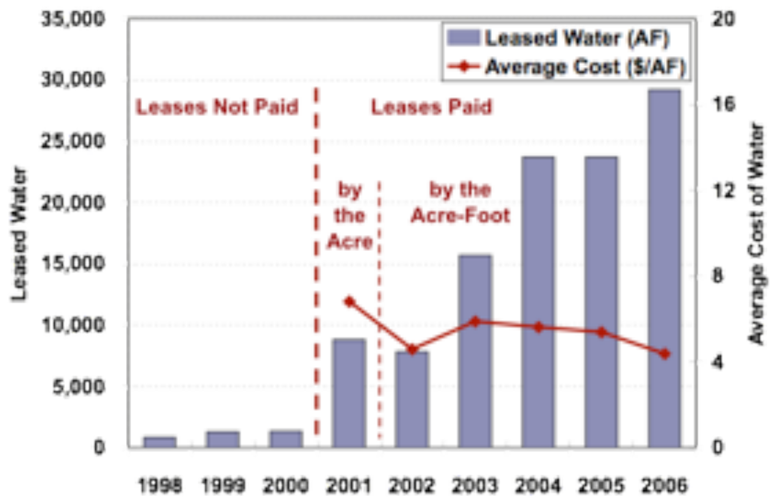
Box 7.1 Oregon Water Trust Split-Season Lease

Oregon Water Trust (OWT) pioneered the split-season lease in Oregon with a farmer along Evans Creek in the Rogue Basin. The farmer irrigates a grass hay crop with a diversion pump and wheel-line system. In exchange for payment by OWT, the farmer irrigates through June 30 and measures his water use for this period. On July 1, he removes his pump from the creek and stops irrigating for the remainder of the irrigation season. OWT then leases the late-summer portion of the farmer's water right to keep the water instream for streamflow to support fish. The payment is a negotiated price based on the farmer's estimated lost agricultural productivity from the elimination of the late-summer irrigation. OWT also provided the diversion flow meter to ensure that the total amount used by the farmer and protected instream does not exceed the total amount of acre-feet permitted by the water right. The first transaction occurred in 2002 and OWT entered into similar split-season lease agreements with the landowner in subsequent years.

Source: Oregon Water Trust

Box 7.2 Leasing in the Upper Deschutes Basin, Oregon

The Deschutes River Conservancy (DRC) has worked with irrigators to lease water rights for streamflow restoration in the upper Deschutes Basin since 1998. The program began with the DRC encouraging districts to take advantage of the state leasing program in order to maintain district water rights while contributing to instream flow. In 2001 the DRC worked with the North Unit Irrigation district, offering a lease payment of $40/acre for water protected in the middle Deschutes below the city of Bend. The response was immediate and significant as shown by the increase in water leased in the figure below. Unfortunately, North Unit customers could lease only 2 acre-feet per acre instream – the district relies heavily on storage from a federal facility authorized for irrigation purposes only. A number of other irrigation districts were in a position to lease 5 or more acre-feet per acre in the same reach. So, in 2002, the DRC offered a flat fee of $7 per acre-foot of protected water in the Deschutes River.



All of the irrigation districts in the upper Deschutes Basin subsequently entered into Memoranda of Understanding (MOUs) with the DRC that specifies the roles and responsibilities of each party in administering the program. Through the MOUs irrigation districts set any restrictions on acreage that may be leased and the time frame within which patrons may lease water.

Larger districts, such as the Central Oregon Irrigation District (COID), administer the program as one of many beneficial use management services offered to patrons. COID manages all contacts with participating landowners, fills in state leasing paperwork and bills the DRC at year-end based on the volume of water leased. Other districts (such as Swalley Irrigation District) have limited staff-time, so the DRC manages the leasing process, including contacts and paperwork, in coordination with the district.

The program has grown from modest beginnings to lease almost 30,000 acre-feet in 2006 at a total purchase cost of approximately $130,000. A large number of public entities holding rights donate these rights, which helps reduce the average cost of leased water to just under $5/AF. For example, the City of Redmond, which has acquired around 1,000 acres of water rights in COID is leasing those instream pending conversion to meet their upcoming groundwater needs for municipal purposes.

Source: Deschutes River Conservancy Leasing Program Report for Fiscal Year 2006

7.2.3 Time-limited Transfers

Although short-term instream leases are increasingly seen as a convenient, low-cost and flexible way to acquire instream flow, sometimes landowner and instream needs are better served by longer-term arrangements, including ones with timelines that are contingent on future conditions or events. In states that have an expedited short-term lease program this may imply the need to go through the state's full transfer process, if only to obtain a time-limited, or temporary transfer. Whereas short-term lease programs may limit what elements of a water right may be changed to the place and type of use, a time-limited transfer would allow the alteration of any of the elements of the water rights, including but not limited to the:

- place of use;
- type of use of a water right to store water;
- type of use from a primary right to a supplemental right;
- point of diversion or appropriation to facilitate a change in place of use;
- point of diversion in response to an emergency; or
- point of diversion from surface water to ground water appropriation.

So for example, a temporary source switch (as described in Chapter 6) might also involve a reduction in irrigated acreage. This would fall outside an expedited short-term lease approval process. A further use of a time-limited transfer is to provide for longer-term transactions, where expedited leasing may be limited to 5 years. In which, case more complex transactional structures may be used that allow for the insertion of contingencies that would unwind or continue the time-limited transfer at key future decision points for the landowner or the funding organization.

7.2.4 Dry Year Lease Options

In some cases streamflow may be a limiting factor in dry years but not in wet (or average) years. In this case, leasing water every year or paying top dollar to permanently acquire water may not make much sense from an instream perspective. From the irrigator's perspective farming can be difficult in a dry year. If widespread drought occurs the successful farmer may realize a higher price for their product in the marketplace. But given global integration of commodity and food markets localized drought is unlikely to greatly run up the price for farmers producing run-of-the-mill agricultural products like food crops, hay and beef. The farmer's attitude will also depend on how junior or senior is their water right. Seniors may not see any impact and thus have little incentive to participate only in dry years, whereas juniors or those that see curtailments during the peak summer months may see little point in reducing their acreage to cope with drought and would prefer to lease their water.

Although the concept of a dry season option is often discussed, examples are rare. Still the approach has much to recommend itself. The benefit of contracting to lease water only during dry years is that water is provided instream during times when flow is bound to be under more pressure than usual, while allowing irrigators to farm when water supplies are plentiful. Further even thought it is called a “dry” year option the definition of what constitutes a “dry” year is up to the parties to the agreement. Limiting the approach to dry years, such as 2 out of 10 or 20 years, probably stems from the likelihood that an irrigator would be reluctant to maintain an agricultural operation if irrigation water were only available 5 out of every 10 years. In particular, leaving the option to the instream buyer leads to considerable uncertainty for the irrigator.

A number of possibilities for expanding the remit beyond dry years would include pooling such leases and providing more control over the option to the irrigator. For example if water is required in average and dry years and these are generally 8 out of every 10 years, then pooling 4 irrigators into an option structure would mean that each irrigator need lease the water only 2 out of every 10 years. This would likely involve actually pre-scheduling the rotation amongst the irrigators as part of the contract. In this manner, irrigators would know that they are next in line to lease. Also, establishing an objective criterion as the basis for triggering the option to lease will eliminate some of the uncertainty and concern on the part of irrigators that the buyer may exercise the option in an unpredictable manner. The more such a criterion is transparent, available well in advance of the irrigation season (including in advance of critical dates for obtaining operating loans, contracting for labor and purchasing inputs) and determined by an independent third party the better. A final alternative is for the instream buyer to actually acquire the irrigation water right and lease it back to the irrigator on a wet year option basis, or some similar provisions.

7.3 Permanent Reductions in Irrigated Acreage

A permanent reduction in irrigated acreage provides the highest level of security that instream flow needs will be met in perpetuity. Conversely, this effectively means that the irrigated land is "dried up." Below we review the transactional approaches that accomplish this task. Many of the complications, controversies and obstacles that the water transactions practitioner will face, particularly in the irrigation community, stem from this type of transaction – and not from temporary reductions in irrigated acreage or water management approaches. These issues are fully described in the closing sections to this chapter.

7.3.1 **Instream Transfers**

Permanent reallocation of a consumptive use water right to instream use accomplished through a state change application (here called a transfer) and the creation of a new instream water right is the most long-lasting and efficacious way to provide a secure supply of additional water to meet downstream needs. The degree of reliability of the water right, i.e. its seniority, will be an important consideration in appraising the utility of a water right for transfer (see Box 7.3). Given the security associated with a transfer – as well as all the issues surrounding such transfers – the buyer can expect to pay a premium when compared with leasing and early stage "low-hanging fruit" water management alternatives. Typically, transfers are entered into only once these other approaches have been tried, tested, priced and evaluated for their ability to achieve flow objectives.

For the irrigator a transfer means permanently removing water from all or a part of the property. To the extent that the irrigation use is of value to the irrigator's livelihood and lifestyle, as well as of value to the community or region the opportunity costs of giving up the water right are considerable. Thus the incentive required to close such a transfer is likely to be significant as well. Further, there may be indirect impacts that will affect the seller, including how the resulting change in land use and property value affects the irrigator's property tax status and payments – or the irrigator's relationship with any lienholders (e.g. mortgage holders). In the unusual case where the irrigator is willing to donate the water rights, the tax implications –including tax benefits – also need to be investigated. Where such transfers involve water rights that are part of an irrigation district or a shared conveyance there are additional operational and financial concerns that will arise on the part of the district or other irrigators. Depending on the legalities and customary practice, the irrigator may need to make additional accommodations in this regard.

All these issues need to be considered and well handled if the water transactions practitioner and his/her organization hope to enter into subsequent transfers in this or other area. A number of these are touched on below, identifying how they affect the costs, risks and benefits of transfers.

Box 7.3 Water Right Purchases and Instream Transfers, Whychus Creek, Oregon

Whychus Creek has been a priority target for streamflow for the Oregon Water Trust (OWT) and the Deschutes River Conservancy (DRC) since the 1990s due in part to the prospect of reintroduction of anadromous fish. Historically the creek provided some 40% of anadromous habitat in the upper Deschutes above Lake Billy Chinook. In the mid-1990s, OWT negotiated a package of purchases of irrigation water rights from three landowners on the Smith-Barclay Ditch. With additional funding from the DRC and the Upper Deschutes Watershed Council, OWT acquired all 97.8 acres of water rights and the ditch for $111,000. By the end of 1999, 90.25 acres of 1885 water rights had been transferred to instream use with effective prices on the three transfers ranging from $1000 to $1,515/acre (T-7839, 7958, 8180). The water was transferred instream at a rate of 1/50 cfs/acre for a total of instream transfer of 1.81 cfs. No season was imposed on the instream right thus the water is effectively protected for the full irrigation season from April 1 to October 31 for a total potential instream volume of 769 acre-feet. The cost per acre-foot of instream water was $145/AF. These were the first senior instream water rights to be protected through the upper reach of Whychus Creek through the town of Sisters.

In 2000 the DRC purchased additional Whychus Creek water rights, this time from the Camp Polk property further downstream. Negotiated as part of a much larger transaction that saw the Deschutes Basin Land Trust acquire the Camp Polk property for the purpose of habitat restoration, this transaction returned 0.99 cfs of a mix of senior and junior water rights to the creek in the Camp Polk area. Since this water right was diverted below a section of spring recharge and return flows, the transfer does not make water available in the dewatered reach in upper Whychus Creek through Sisters. At $50,000 contribution to the overall land transaction the water cost was $1,010/acre of water rights and $149/AF of water instream.

Although each of these transactions legally protected significant amount of water and had the same approximate cost it is worth noting that the Smith-Barclay transactions has led to measurable instream water since 1999 whereas the impact of the Camp Polk transfers remain largely unclear due to the location and junior nature of the rights.

Since these initial acquisitions, the DRC engaged the local irrigation district in large scale piping projects and ran a significant leasing program returning much larger quantities of water to Whychus Creek. In 2009 the DRC completed another purchase, this time of 63 acres of non-district senior water rights for $6,800/acre. When transferred in stream in 2011 for 1.61 cfs the effective cost of this water came in at 890/AF. This represents a six-fold increase over the original acquisition but more closely reflects the market value of water in the area. Though more expensive, piping remains an attractive option for streamflow restoration in Whychus Creek due to the irrigation district's policy of not permitting district water rights to be purchased for instream transfer.

Source: Deschutes River Conservancy

Land Use, Zoning, Property Values, and Taxation

The value of water rights that run with the land is incorporated in the value of the property. To the extent that agricultural production depends on irrigation water, the removal of this water will affect the profits that can be earned from agricultural production. Irrigation water is one of a number of inputs – land, labor, fertilizer, and pesticides being the others – that result in agricultural produce. However, even in semi-arid or arid areas some form of residual production is likely to be associated with land, even if for extensive grazing. This represents the value of the land in rain fed agricultural production. Take for example a property of 250 irrigated acres with a price of $4,000 acre. If the rain-fed opportunities are good the property might be worth $1,000 per acre if the water were removed. In other words removing the water rights lowers the present value of future agricultural profits from the property by $3,000 acre or $750,000 in total. It stands to reason that the property owner would not part with the water rights on a permanent basis for less than $750,000. If on the other hand the land is not very fertile and receives little rainfall the land might be worth just $250 an acre without the water. In this case the water transactions practitioner might not expect to acquire the water for less than $937,500.

A fuller explanation of pricing and water rights appraisal comes later in this handbook, however, a number of points regarding the example above can be made. First, care needs to be taken if the landowner has an outstanding mortgage on the property or is using the property as collateral for other purposes. In the case above the original value of the land is $1 million. If there is a mortgage for $500,000 then the sale and removal of the water rights will reduce the property's remaining value below that of the mortgage balance. In such a case it would be advisable for the landowner to ensure that the mortgage is written down to be no more than the remaining value. In considering the incentives for a landowner to sell the water rights the water transactions practitioner should keep in mind that the rational landowner will care about their net profit on the transaction not just the amount (or price) paid by the buyer. Establishing what is owed on the property is therefore advisable.

Similar concerns apply to the tax consequences of the transaction. The sale of water rights may or may not lead to additional capital gains tax for the landowner. The amount of capital gains tax should also be deducted from the amount of the transaction in understanding the gains to the landowner. Conversely, where the landowner is willing to donate all or a portion of the water rights to public purposes (i.e. to a 501(c)3 non-profit organization) a tax deduction may be available (Hicks 2011).

In addition most properties will have some floor value just as raw land, regardless of their agricultural production potential. This value will vary along with the extent to which other future uses of the land may come into play. For example, irrigated land adjacent to a rapidly growing urban area will likely have a much higher value as raw land due to the prospects of future urban development. To the extent that land is zoned for agricultural use only, or for some range of other uses, this will impact on the extent to which the market value of the property will reflect its true economic potential in different uses. It is fair to say that where the probability of a change in zoning is nil this will greatly constrain the extent to which the economic potential of the property in other uses is exhibited in the market value. But, in the long run, land use prescriptions and laws change, as does the zoning of specific properties. Thus, there is likely to be some value ascribed to any property for acquiring the option to use it in another use down the road.

In making the decision to sell, the landowner will therefore need to consider applicable zoning designations and requirements. Zoning status may also determine property tax levels. In many states, tax assessment is skewed to favor rural farm and forest lands with the justification that such uses preserve rural character, open space and wildlife. Unfortunately, in the arid and semi-arid west the agricultural activity can only be maintained if the land is irrigated, thereby dramatically affecting aquatic function, habitat and fish and wildlife. Lower tax rates or arbitrarily low land values for lands classed as agricultural are employed to keep taxes on such lands low. While this does subsidize the rural ecosystem services valued by the public, it also in effect subsidizes irrigated agriculture. The landowner therefore needs to assess how selling and removing the water right will affect current zoning and property taxes.

In some cases the net effect may be to push the property into a class that can be taxed at a higher rate. In some jurisdiction the assessed value of farm properties for tax purposes is lower than the market value of the property. Removing water and curtailing or ending agricultural production on the property may then lead to a higher tax payment on the property. A related concern may be that removing water may provide the basis for a rezoning of the property. Where such a rezoning of the property could lead to commercial, industrial or residential development in a previously rural area the act of purchasing water rights may bring the water transactions practitioner into conflict with the local community and even local land trusts working to preserve the rural character of the area. Where possible the water transactions practitioner is advised to explore how the post-removal land use can be such as to reduce third party impacts and any consequent conflicts (as discussed further below under environmental issues). The change in character of use of the property therefore needs careful scrutiny as it may lead to additional costs (or benefits) for the landowner and will affect the future economic possibilities presented by the property – all of which will bear on the incentive and likelihood that the landowner will agree to the transaction. Water transactions practitioners may wish to consider adopting stated policies disclaiming responsibility for tax status changes precipitated by changes in irrigation status, so that it is clear that individual landowners are solely responsible for the tax status of their property (see Box 7.4).

Box 7.4 Property Tax Assessment Notice to Potential Lessors

The Deschutes River Conservancy (DRC) requires water leasing program participants to sign acknowledging that they have been informed that they are responsible for any tax status consequences of leases. Language from the notice is excerpted below:

"Instream leasing is a beneficial use that protects your water right from forfeiture and allows for compensation for this instream use, but please note that it does not automatically protect against loss of farm use special assessment. Exclusive Farm Use (EFU) zoned lands may still require at least minimal use with the intent to make a profit. It is the landowner's responsibility to know their tax assessment status and qualifying uses."

In addition to this disclaimer, the DRC provides program participants with information and resources on farm tax assessments.

Source: Deschutes River Conservancy

Removal and Instream Transfers of District Water Rights

The removal of water rights from an irrigation district pose a unique set of constraints, but for the water transactions practitioner may also represent a considerable opportunity. The first constraint is operational and arises when users are removed from a shared conveyance. When this sharing happens in the context of a legally created entity like an irrigation district (or other legal entity created for a similar purpose) the consequences are more severe than when the shared conveyance is for the convenience of water right holders who have no formal relationship or agreement. In the latter case the water right holder may well suffer no legal consequences from removing the water right. If the remaining water right holder does not have a large enough diversion right to supply water to their fields they are unlikely to have legal recourse against the departing water user. The issue may turn on how injury is defined under state water law. For example, in Oregon the state does not regulate for injury on a given delivery system but only between points of diversion. Thus, were remaining water users to suffer a shortage it would be up to them to resolve the issue, for example by improving the transmission efficiency of the conveyance.

In the case of an irrigation district the members have joined together for a mutual purpose and associated with this purpose are a set of rules that govern the district and specify the mutual roles and responsibilities of the district to its member and the members with respect to the district. Depending on the situation these rules may be legally enforceable. A particular aspect of a district's ability to affect the decision-making process of its members is the extent to which and the cause for which it can place a lien on members' properties. As the district is responsible for transmission and delivery of water it will need to take action when issues such as a shortfall of transmission water arise due to actions such as leasing and instream transfers. Leasing of water that leads to such shortfalls is amenable to adaptive management. If too much water on a conveyance is leased in one year the district may act to limit the re-occurrence of this problem – for example by placing a limit on leasing from that (or any) conveyance. Alternately, it could seek – together with the lessee – to cancel any offending lease.

Transfers, of course, are permanent and therefore present a more worrying problem for district management. The water transactions practitioner will therefore want to consider the potential operational impacts of any such transfers. Again, the utility of engaging in a leasing program prior to transfers is that by dint of trial and error there will be empirical evidence on the likelihood of a given transfer negatively affecting other patrons on the same conveyance. In the event that a serious shortage of water would be occasioned there is always an option to improve efficiency to reduce or eliminate the problem. The difficult issue is who should pay for this improvement. In isolated cases, experience suggests that the departing patron may need to contribute to this cost. For example, in urbanizing areas it is not atypical for the next to last water user on a ditch to foot the bill to pipe the ditch to the last user on the ditch when their development puts the final delivery at risk.

The second constraint on removal of a water right from an irrigation district is financial in nature. As member organizations providing a service to their members irrigation districts routinely assess their patrons for the services provided. The creation of a district invariably includes the ability not only to charge properties in the district for this purpose, but also the ability to lien the property for a failure to pay. Annual assessments are calculated in different ways but generally reflect some method for sharing the expected expenses of operating and managing the district across the membership. When a member files a transfer application with the state they are effectively noticing the membership of their intent to leave the club. The implication for the remaining members is that the departing member, other things equal, would prefer not to continuing paying for water delivery services when no water is to be delivered. Given that irrigation district expenses do not decrease with the departure of a member – and are typically increasing as costs rise – this implies that there is less of an assessment base across which to spread a fixed (or increasing) cost. It can therefore be said that the departing member is causing the per unit charges of remaining members to increase. Again, there are no hard and fast rules for the water transactions practitioner except that such a situation needs to be approached carefully. Negotiations with the district over how to best extract and transfer a water right instream are imperative.

One instrument that has proved useful is to work with the district to create a district "exit policy" that governs the transfer of a district water right off the district certificate. This typically includes not just how the transfer of the water right is carried out, but also the mechanism that secures the release of the departing member from being subject to the district's powers of assessment. While relevant state law will vary, the case of Grants Pass Irrigation District, in Medford, Oregon is instructive. In this district a number of district patrons took action to voluntarily cancel their share of the district water rights through the relevant state process. The district however insisted that these patrons were not exempt from paying assessments. Ultimately this led to the development of an "exit fee," which, once paid, enables the departing patron to be free and clear of any future assessment charges. The exit fee also includes any share of existing debt at the time of departure.

The benefit of an exit policy is that it formalizes the basis on which the water transactions practitioner may secure and remove water rights from the district. Such a policy may be beneficial for an irrigation district that is experiencing a reduction in demand for water from its patrons. The benefits of such a policy are the avoidance of a district "death spiral" wherein the price of water rights and the amount of district assessments recovered from patrons both fall precipitously due to a lack of demand for water and the inability to move such water to other uses. It can also prevent costly efforts to deal with "end runs" around the district by patrons seeking some economic alternative to applying the water for irrigation or continually leasing what is a surplus water right. Where the demand for water within an irrigation district is strong, the incentive for an irrigation district to participate in an exit policy and the removal of water rights will be weak. Where the exact level of demand for water in the district is unclear, the water transactions practitioner may be advised to develop a leasing program with the district first, so as to accumulate hard data on the potential for negotiating an exit policy. Box 7.5 reports on instream transfers developed under exit policies developed by irrigation districts in Central Oregon.

Box 7.5 Water Bank Transfers in the Deschutes

As part of a cooperative effort between irrigation, conservation and municipal interests in the upper Deschutes Basin, a local water bank pioneered cooperative efforts to transfer water rights out of irrigation districts in an orderly manner. Beginning in 2003 the Deschutes River Conservancy (DRC) began working with the Central Oregon Irrigation District (COID) on pilot instream transfer projects and the concept of an exit policy. By late 2005 COID and the Swalley Irrigation District (SID) had adopted exit fees and policies that permit a gradual and controlled reallocation of water rights away from district uses. In this case the use of instream transfers to back new groundwater rights for municipalities and other users was a critical motivational force.

By way of example, in 2006 the water bank moved approximately 190 acres of water from COID and SID to the DRC and the DRC Groundwater Mitigation Bank (for instream purposes and mitigation respectively) and to the City of Bend and Avion Water Company (as mitigation for new municipal groundwater rights). Transfers for these rights were filed in 2007. The districts received roughly $200,000 in exit fees in consideration for the removal of these rights from their districts. Exit fees varied from $1,000 to $2,000 an acre depending on assessment rates, formulas and existing debt levels.

Source: Deschutes River Conservancy and Aylward (2006)

An exit policy may help a district maintain financial solvency in the face of a drop in demand for the district's services and the assets it delivers. At the same time, irrigation districts are likely to be concerned that creation of such a window may lead either to the bidding up of prices by outside sources of demand – including instream transfers – or the exit of too many water rights. The latter of course is a worst-case scenario for a district and perhaps more clearly understood and feared than the death spiral scenario. It does however return to the operational issue discussed above. Consideration of how a program of improving district efficiency may be complementary to an exit policy and the removal of water rights is therefore advised.

7.3.2 Water Rights Cancellations and Diminishment

Perfected water rights may also be cancelled or diminished by request of the water user. In addition, as indicated earlier, a water right that has not been beneficially used may be subject to involuntary forfeiture. These actions, while only rarely likely to be part of a program of water acquisitions may be useful tools in particular circumstances. Their effect is either to remove a water user from the priority list (cancellation) or reorder the priority list (diminishment). Each of these possibilities is discussed below, with reference to their potential use in firming up instream flows.

Cancellations

A cancellation in effect promotes users with rights junior to the water user undertaking the cancellation. Removing a water user from the priority list reduces the cumulative out of stream demand. Thus, where streams are not horribly over-allocated there will be a point in the process of acquiring water where the next user to stop using their water will mean that the water is instream, regardless of whether it is cancelled or transferred. More typically, users are regulated off water as the irrigation season progresses. In this case canceling a water right will serve to push the date on which the stream is over-allocated back further into the season.

Thus, in a situation where instream flow cannot be explicitly protected as beneficial use a cancellation may be a reasonable, though third-best, alternative to legally protecting streamflow or engaging in water user agreements. A cancellation is in effect a permanent diversion reduction agreement. In states where instream rights are recognized and established as beneficial uses they will have junior status. If a stream is only on the cusp of being over-appropriated then a cancellation will in effect promote the instream right up the priority list and lead it to be filled more frequently. In Oregon, for example, instream transfers of senior rights are typically used to fill or “replace” the junior instream rights. In other words the new instream right does not add to the total amount of instream flow that the state regards as a valid beneficial use for instream purpose. Where a stream is not over-allocated, a cancellation will therefore achieve at least some level of instream protection. As a cancellation may be less demanding in terms of time and resources, and is less likely to be of concern to other, senior out-of-stream water users it may be an alternative in particular circumstances.

The argument for pursuing a transfer will likely relate to the relative seniority of the right. A water user giving up a senior right is likely to demand a higher level of compensation than one whose right is only available on an intermittent basis. Thus, it might not be feasible for the water transactions practitioner to pay the higher amount for a senior right and only fill a junior instream right. However, in cases where junior rights are being acquired – at presumably a lower cost – cancellation may be a reasonable alternative.

A final reason for undertaking cancellations is to “clean up” old, unused water rights in a system. In some cases, junior rights are effectively defunct, they are not used and all users – and even the local state agency – may know this, but no action to cancel the right has ever been taken. Given the possibility, however faint, that new landowners might resuscitate such rights, for example, it may be prudent to work to eliminate these rights. Again, where a junior instream right exists or where a stream is barely over-allocated, eliminating other junior users brings forward the year when out of stream demand is simply not enough or not of sufficient seniority to drain the stream.

Cancellation may be achieved at the request of the water user or by a petition of non-use by another party. While water transactions practitioners are not likely to be viewed favorably in a community if they are out canceling water users rights in some circumstances there may be call to work with the state regulatory agency or other entities to move such an initiative forward. When it comes to rights that are not effectively used by landowners an alternative to filing for an involuntary cancellation is to actually offer a small inducement to the water user to voluntarily cancel the right. The Deschutes River Conservancy has taken this approach on Whychus Creek, where there are quite a number of junior rights that are rarely used. The DRC offers a minimal incentive of $500 plus covering the direct costs of canceling the water right. In this effort the DRC works with local staff of the Water Resources Department who are interested in "cleaning" up water rights on the creek in preparation for reintroduction of anadromous fish.

Diminishment

Diminishment refers to a change in a water right that somehow "reduces" the originating right. In the case of water transactions the diminishment of an out-of-stream right can be used to restore streamflow. By diminishing one right, another right will indirectly be improved. If this right is an instream right or there are no other out-of-stream rights to take water now available to the diminishment then streamflow benefits. Diminishment can be used as a stand-alone tool or in combination with another action. For example, in the John Day Basin of eastern Oregon the Oregon Water Trust entered into a transaction with a rancher whereby he voluntarily shortened the season on his water right. By turning off early the rancher restored flow in an important anadromous tributary. (A video of this transaction produced by the Columbia Basin Water Transactions Program can be found online a thttp://cbwtp.org/jsp/cbwtp/stories/stories_media.jsp)

Also in the process of undertaking a transaction, the diminishment of one of the rights involved may be useful in facilitating the transaction. For example, if a water user is transferring a portion of their right they may wish to ensure that their remaining right is senior to the new instream right. The transfer would then ask for a priority date one minute later than the existing right for the new transferred right. Similarly, on a lease of water from fallowed land or from a water efficiency project, the water user or irrigation district may prefer to see their remaining rights met first. Diminishment of this nature lowers the reliability of the acquired instream right and, therefore, would demand a lower level of compensation to consummate the transaction. However, by assuring the seller that their remaining needs are met first such a step may enhance the prospects of reaching an agreement.

7.4 Water User Agreements

Apart from the formal statutory management approaches that involve processing change applications with the state, contractual arrangements between water users and an instream buyer can be used to directly reduce diversions and improve instream flow. The forms of such water user agreements include:

- Forbearance agreements in which a water user agrees to fallow land (the water user agreement counterpart to a lease);

- Diversion reduction agreements where a number of users or entire irrigation companies or districts agree to limit their diversion to a set amount; and
- Minimum flow agreements where the users that divert above a given reach agree to maintain flows in the reach at a set amount (by restricting their diversion as necessary).

Technically speaking, such agreements do not commit the water user to reduce their consumptive use. Thus, these approaches can be used to implement one of the water management transaction approaches described in Chapter 6. For example, on the Lemhi River in Idaho the state is providing payments to a landowner with the last diversion on a tributary of the Lemhi. The landowner is using the funds to improve his water use efficiency. He can therefore lower his diversion and re-water the reach just upstream from the Lemhi, therefore serving to reconnect the tributary to the Lemhi.

However, these agreements can also be used where a landowner plans on simply fallowing acres and reducing consumptive use. Or they may be used where a combination of water use efficiency improvements, fallowing and deficit irrigation are all employed – as they best suit the users involved in the transaction. The advantages of these agreements are several. First, such arrangements can increase efficiency, as each water user on a diversion chooses the least-cost method of achieving their share of the diversion reduction. Perhaps the most attractive element of this approach to both parties is the ability to avoid the risk and transaction costs associated with the state change process. From the water transactions practitioner's perspective a key advantage is that all that needs to be negotiated is the price of the transaction, the practitioner does not need to be involved in (or know) the projects and decisions that irrigators make to meet the diversion target.

Water user agreements are often employed as a reconnect strategy (such as in the Idaho case above) with a single irrigator. In this case the transaction costs are low. However, in a situation where all water users on a reach (or at a diversion point above a key reach) can agree to cooperate and coordinate their diversions, a contract could be used to alter traditional water use arrangements to meet a diversion reduction target. This is an example of a diversion reduction agreement.
A drawback of diversion reduction agreements is that the resulting instream flow will vary with hydrologic conditions. The minimum flow agreement may therefore be preferable as the irrigators agree to leave an agreed upon amount of flow in the stream (see Box 7.6). This puts the hydrologic risk on the irrigators, but provides more security to the instream buyer – and thus likely increases the value of the transaction.

While water user agreements have merit, they require careful consideration because water will not be protected from diversion by right holders who are not party to the agreement, there is the risk of shirking (on the part of irrigators), and beneficial use may not be maintained in all cases. The first two issues suggest that the monitoring and enforcement costs may be higher than with a change application. In the Lostine case cited in the box below, the Oregon Water Resources Department has required extra funds each year in order to monitor and enforce the project. The third issue suggests that irrigators may be at risk unless they carefully manage the process and their beneficial use. As long as these issues are addressed, diversion reduction agreements can be an effective tool, allowing for straightforward temporary reallocation of water use to instream purpose.

Box 7.6 Lostine River Minimum Flow Agreement

In 2005, Oregon Water Trust (OWT) began working with ranchers and farmers to maintain instream flow in the Lostine River near Enterprise, Oregon. Under agreements with six ditch companies, OWT entered a contract to compensate landowners for meeting the goal of 15 cfs in the river through the town of Lostine from August 1 through September 30. The agreement allowed for irrigation for much of the season, restored flows that allowed adult Chinook salmon to swim up to their spawning grounds high in the Wallowa Mountains unimpeded, and compensated local irrigators for the use of the water. The irrigators were presented the "2005 Award of Merit" by the Oregon Chapter of the American Fisheries Society for their efforts in enhancing salmon habitat and improving streamflow.

Due to the success of the project, the contract was refined and renewed in subsequent years. In 2007, the flow target was raised to 20 cfs and the contract period shortened to August 22 through September 30 to best meet the needs of the irrigators and fish. The project demonstrates the promise of multilateral operational contracts as an alternative to official leasing in managing water diversions.

Source: Oregon Water Trust

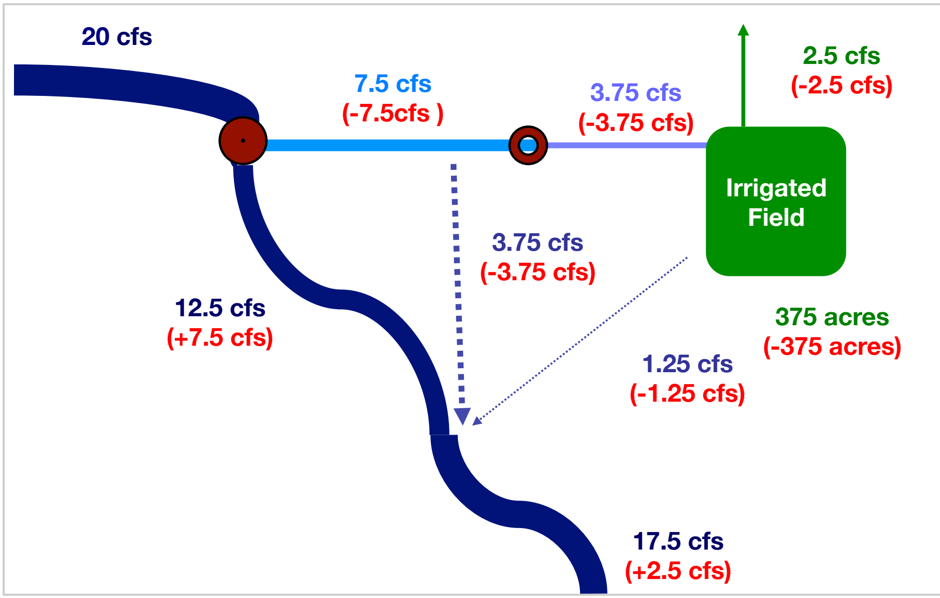
7.5 Hydrological Impacts and Administrative Issues

Employing the transactions described above will lead to a reduction in consumptive use. Depending on the situation this change in consumptive use may also be associated with a reduction in groundwater recharge, whether on the farm or as part of the water delivery system. In the extreme case where all the water rights on a diversion are given up, the groundwater recharge associated with the water use may be completely eliminated. With regard to such actions there are two questions that require analysis. The first is how much water can be protected instream (including where and when precisely). The second is how can potential impacts of this action on other water users be avoided, reduced or negated. These questions have both a hydrological and a legal answer. It is useful to first understand the hydrology involved and then proceed to the legal analysis. This, as the laws of physics are the same in every jurisdiction, whereas the laws of humankind vary from one locale to the next. Then the consequences of the different legal regimes in terms of hydrological, environmental and economic impacts can be contrasted.

7.5.1 **Hydrological Analysis**

Figure 7.1 charts out the changes in flows that would occur if the consumptive use on the farm in our example were cut in half. The reduction in acreage reduces the consumptive use. The decrease in consumptive demand reduces the amount of water required to be delivered given the application efficiency. Similarly, then, the reduction in water required at the head gate may reduce the amount of water that needs to be diverted. In the figure it is assumed that all these changes are proportional to the change in demand, whereas in actuality they will depend on the specifics of the delivery system. In the example, halving the acres irrigated leads to a 2.5 cfs reduction in consumptive use but a 7.5 cfs reduction in diverted water. Other things equal this would increase streamflow from the point of diversion down to the point of return flow by 7.5 cfs. It is important to note, however, that below the point in return flow the added amount of flow is only equal to the change in consumptive use (2.5 cfs).

Figure 7.1 Reducing Consumptive Use on Irrigated Land



It is therefore possible to use this simplified example to generalize that the action of reducing consumptive use provides additional flows in two reaches. In the first reach, from point of diversion to point of return flow, the gain is equal to the reduction in groundwater recharge plus the change in consumptive use. Downstream from the point of return flow the additional flow is equal to the consumptive use. These are often referred to as the primary and secondary reaches on an instream lease or transfer. As these are truly additional waters made available by reducing consumptive use these amounts reflect the water that is available for protection instream – without affecting other users.

7.5.2 **Legal Analysis: Protectable Instream Water Rights**

How the law treats these additional flows and the establishment of new instream water rights varies with the jurisdiction (Boyd 2003). With respect to the creation of instream water rights there are a number of principal elements in the water code that determine how much water can be protected. These elements are the reaches that are recognized as valid reaches for instream protection, the type of water that can be protected (consumptive use or total diversion), and whether the amount protected is based on the amount on the water right or the amount historically used. The amount on the water right is referred to as the "paper right." A final element is whether water right changes may be made permanently or only on a temporary (leased) basis.

Table 7.1 provides a summary of how the different jurisdictions in three of the Pacific Northwest states treat the protection of instream flow according to these elements. In Montana, for example, the amount historically diverted is protected to the prior point of diversion and from there only the consumptive use portion is protected. In Oregon and Washington, the full amount of the diversion on the certificate can be protected through to a defined point of return flow (Boyd 2003). From there only the consumptive use can be protected. The difference is that in Washington the amount considered for transfer begins with the amount historically diverted for beneficial use, while in Oregon it begins with the paper right. It is important to note that these elements are used to determine the starting point for instream rights and remain subject to the analysis of injury as discussed below.

Table 7.1 Leased or Transferred Water that can be Legally Protected Instream in Pacific Northwest Jurisdictions

Type of Water	Consumptive Use Only		Total Diversion	
Reach	Historic Use	Paper Right	Historic Use	Paper Right
Reach 0: to the POD		n/a	Washington* Montana**	Oregon*
Primary Reach: POD to point of return flow	Montana**	n/a	Washington*	Oregon*
Secondary Reach: Below point of return flow	Washington* Montana**	Oregon*	In hydrologic terms only the consumptive use is available	

Notes: *Denotes can be protected under both a permanent transfer and a lease. **Denotes can be protected only on a temporary basis (i.e. permanent transfers not allowed).

Sources: Boyd (2003) and Montana: MCA 85-2-408 (7);

7.5.3 Legal Analysis: Injury to Junior Users

In changing an existing water right and creating a new instream water right, there is the potential to affect other users that rely on the return flow derived from the groundwater recharge associated with the original out-of-stream use. In water law terminology it is important that changes to one water right do not "injure" junior users. Protection of senior users is implicit, as their call on water would supersede that of a junior instream water right. Generally speaking the intent of injury analysis is to ensure that after a change is made junior water users still have access to the same amount of water (with the same amount of reliability) as before the change. In the simplified example used above in Figure 7.1 this is fairly straightforward. Previously diverted water may be protected down to the point of return flow and from there the consumptive use can be protected.

That this approach protects against injury is easily demonstrated in this simplified case. For example, if there were an intervening junior user with a 10 cfs water right directly below the point of diversion then the junior user would be able to divert 5 cfs prior to the change in irrigated acres (see Figure 7.2). According to the hydrological analysis the change frees up 7.5 cfs of flow below the point of diversion, of which 2.5 cfs is the change in consumptive use. If the water were not protected at all below the point of diversion then the junior irrigator would fill their right at 10 cfs leaving 2.5 cfs instream down to the point of return flow. However, under a lease or transfer in Oregon or Washington the water transactions practitioner would protect that additional 7.5 cfs through to the point of return flow. As the protected water is additional and the total flow in the stream is 12.5 cfs the junior user still has access to their 5 cfs of diversion (see Figure 7.3). More importantly, whereas originally the junior user dried up the stream below their point of diversion, with the instream flow right there is now 7.5 cfs in this reach. Were this transaction to occur in Montana only the consumptive use portion of the fallowed land would be protected instream. This would amount to just 2.5 cfs. The junior user would no doubt divert the other 5 cfs.

Figure 7.2 Irrigation with Downstream Junior User

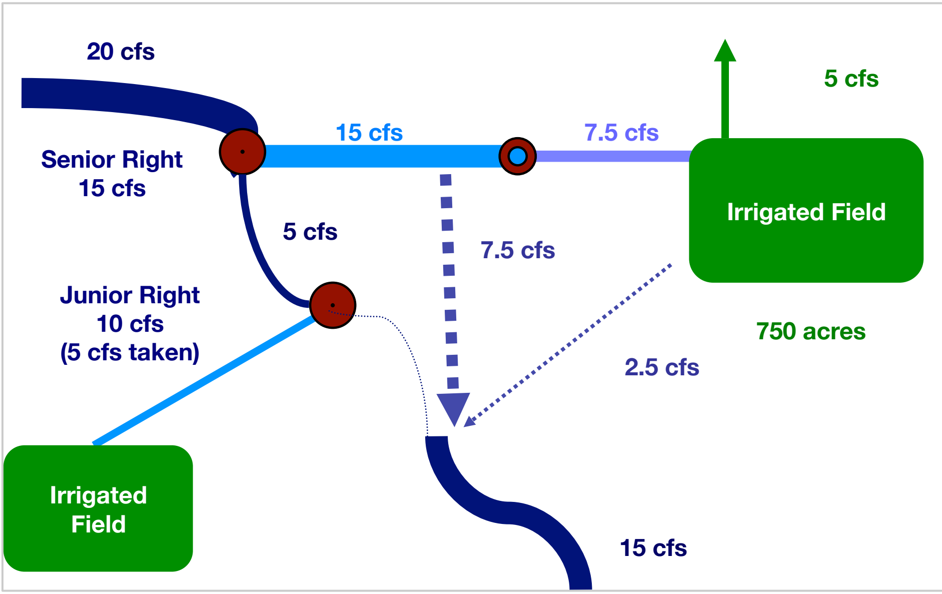
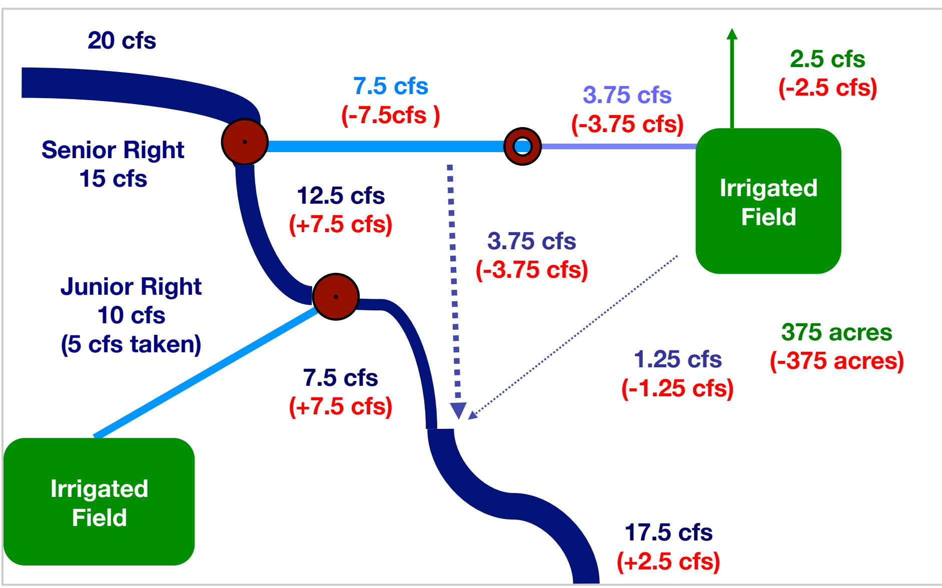


Figure 7.3 Protecting the Junior User from Injury by an Instream Right



The simplified example portrayed above provides a vivid indication why in over-allocated streams it can be valuable to have a water code that follow the laws of physics and allows the protection of the maximum gains produced by a transaction. However there are a number of factors that can make real-life examples much more complex to assess in terms of how much water can be protected without causing injury or harm. In particular these include the spatial and temporal pattern by which groundwater recharge does or does not return to the stream as return flow, including:

- groundwater recharge may not return to the downstream reach instead going to deep groundwater storage – in which case there is an argument that the full diverted right is additional and protectable, not just the consumptive use;
- groundwater recharge may return to another source stream (in effect irrigation creates an inter-basin transfer of water) – in which case users relying on the return flow may be harmed by the change, but the water code may rule that they had not right to such water and are not injured, and the full diverted right is additional and protectable;
- return flows may occur immediately downstream from the point of diversion – in which case the primary reach does not exist and only consumptive use may be protected from the point of diversion;
- return flows may occur in a diffuse pattern along the stream – in which case the protectable flow may be reduced throughout the reach (for example by 5% per mile);
- return flows may be thought to occur but there may be no data or information on where and how they return – in which case in order to avoid injury only consumptive use may be protected; or
- return flows may occur with a time lag such that they arrive during the winter (not the irrigation season) – in which case there is an argument that the full diverted right should be protected through the point of return flow as the junior irrigation user did not have access to this return flow beforehand.

Further complications arise if the reach downstream from the point of diversion is a losing reach, in which case further reductions in the amount of water that can be protected in both primary and secondary reaches may be necessary. Another issue is how far downstream can or should an instream water right be protected, even if only the consumptive use. In theory, the consumptive use gain is additional through to receiving streams and downstream reaches all the way to the ocean. However, even in states with progressive instream water codes like Oregon rules may limit how far downstream such rights can be protected.

These complications suggest why some states have chosen not to protect recharge/return flow quantities past the point of diversion. Where uncertainty exists over the possibility of injury to junior rights a precautionary approach would argue for simply avoiding the problem by limiting water protected downstream of the point of diversion to the consumptive use quantity. Unfortunately this comes at the potential expense of the full benefits of investments to acquire instream rights. Ultimately, this creates a disincentive to engage in water transactions – or at the very least can greatly increase the cost of reaching streamflow targets.

7.5.4 **Historic Use vs. Paper Rights**

A final issue for consideration is how the Oregon paper rights system compares with the historic use system employed in states such as Washington. The simple answer is that the Oregon system favors the senior right holder and the water transactions practitioner, at the potential expense of the junior user. The actual impact of transferring a paper right to instream use on other users will depend on how much water was previously diverted and used under the water right being transferred. Given the lack of measurement on many irrigation diversions it is not possible to generalize as to what portion are likely to be diverting more or less than the amount on their water right. Past history of lax monitoring and enforcement would suggest that there will be cases where transferring a water right to instream use would actually free up physical water for junior users due to prior use in excess of the water right by seniors.

That said, the trend over the last 30 years to move to labor-saving, water-efficient technologies like sprinkle irrigation would suggest that many water users are now diverting less than the right they were originally granted (when they were using flood irrigation). In an effort to protect irrigators from future conditions, including higher energy prices, many states have acted to ensure that irrigators do not risk partial forfeiture of their water rights. Thus, for example, Oregon and Idaho have both passed statutes that recognize that the decision to undertake conservation does not constitute abandonment of the remaining portion of their water right – and they can, at any time, return to their full diversion right (Fereday, Meyer, and Creamer 2004; Koehl 1998).

However, in hydrologic terms, the diversion of less than the face value of a water right does mean that the remaining water is available to junior users. In economic terms the long-term availability of this water may also influence investment decisions by water users. Therefore, when a water user in Oregon transfers the full paper right to instream use it is not surprising that this is of concern to junior users. Contrast this with Washington, where the water user must document their historic diversion and beneficial use under the right and this is the amount of water available to transfer. In the paper rights case, the transfer may cause real economic harm. In the historic use case, the junior user may feel more secure but the senior user may be tempted to increase their use prior to entering into a lease or transfer so as to maximize the value of the transaction. In which case economic harm is also engendered, as well as the needless waste of water.

Neither system therefore is perfect. From an economic perspective a system where partial forfeiture was applied after a period of years would be optimal – removing the possibility of harm and the inducement to try and cheat the system. However, in an effort to protect irrigators, legislators have created a two-edged sword. The water transactions practitioner needs to understand the consequences of working within these two systems. Working to the paper right or encouraging users to exaggerate their use may help to increase the water put to instream use in the short term. However, the long-term tradeoff in terms of social opposition and ultimately legal costs need to be weighed carefully.

7.6 Third Party Impacts of Reductions in Consumptive Use

The direct impacts of reducing consumptive use on irrigators, instream flows and junior users are complex and contentious. It is however, possible, for the water transactions practitioner to analyze the hydrology, law and economics involved and chart a reasonable approach and course of action. Even so there remain a host of issues affecting third parties that may arise from these transactions. While some of them will be positive benefits of a transaction many of them will be taken – at times rationally so and times not – as negatives when it comes to the incentives for landowners and communities to participate in, and approve of, instream water transactions.

7.6.1 Environmental Impacts and Issues

The impact on land of removing irrigation water can be quite substantial, particularly where irrigation has been longstanding. The opportunity for invasive or noxious weeds to find a home on dried up properties (whether temporarily so or not) is considerable. The spread of weeds can lead to negative impacts on neighboring lands as well as on scenic values in a community. In many areas of the west, weed problems are endemic and have existed well before the onset of water transactions. Still, a program of water transactions in a community can quickly become a scapegoat if the issue is not addressed.

The water transactions practitioner is well advised to have at least an internal (if not external) policy regarding weed management, if for no other reason than to avoid legal responsibility for weed problems. Leases that are processed through the Deschutes River Conservancy in Oregon require weed management during the term of the lease. In particular, the DRC requires landowners to sign a form acknowledging the following policy concerning weeds and instream leases:

> *The DRC expects participants in the Leasing Program will continue to exercise agricultural best management practices on lands enrolled in the Program, particularly with respect to the control of noxious and/or nuisance weeds. Failure to control weeds on leased acres may result in exclusion from Program compensation.*

In addition to this acknowledgment, the DRC provides lessors with information and resources on weed management.

Another environmental issue that is often cited as a problematic consequence of the removal of water rights is the loss of open space and rural resource values. This, as the removal of water and the siting of subdivisions and commercial activities are often thought to be intricately linked. In some jurisdictions, only when water is removed can zoning and land use change so as to allow the development of land. The water transactions practitioner will need to anticipate such problems and be cognizant of how land and water policy interact. Although it is often thought that water issues can be used to limit growth and land development the reality is that land policy has more often been the driver of water use. As a case in point the development of the west has meant that the need to develop land for agriculture has come at the expense of water in streams and rivers. To now expect that water policy should drive land use is not only a false reading of history but to place unrealistic expectations on the water community. Water transactions practitioners will need to exercise diplomacy in this regard with land trusts and environmental groups and be able to explain how land use drives water use, and how solid land use policy can provide a platform for sensible water policy.

A final environmental concern relates to how the reduction of consumptive use or irrigated acres may affect the local water table. Lower levels of localized groundwater recharge may affect trees and other vegetation that have come to rely on this byproduct of irrigation. Perhaps more critically, domestic wells may also rely on recharge to maintain their supply. Although there is little that can be done legally to restrict leases or transfers on this basis – there is no way to compel a surface water right user to continue to divert water in order to maintain vegetation or groundwater levels – there remains the concern of what impact this might have on a community. Efforts to mitigate for such impacts – as with any other detrimental impact – may be considered by the water transactions practitioner on a case-by-case basis, depending on the risk they pose to continued water transactions.

7.6.2 **Economic Impacts and Issues**

The reduction of irrigated acreage and agricultural production is often thought to have a number of potentially significant and adverse economic impacts. These are particularly feared in the case of permanent transfers of water to instream use. A number of these are discussed below.

There is a fear of duress sales and rural de-capitalization; the idea being that the removal and sale of water from land liquidates the capital of the agricultural community and can leave sellers bereft of income producing opportunities. This can then lead to sellers remorse. While studies have found that those selling water rights have dipped into and spent the financial capital so acquired, it is hard to say that this is necessarily a negative thing. A rational approach to lifetime savings suggests that during their working lives people put money away for their retirement. Whether this capital is in the form of financial assets or physical assets like land and water it is then drawn down in later years. It is also the case that subsequent buyers of the property can of course acquire water rights from other sellers, transfer them on to the property and engage in irrigated production. It does appear that this concern is therefore simply one of the potential negative consequences of reallocating water rights to instream use and not having them available for out-of-stream uses.

In economic terms, the key issue is whether the aggregate stock of capital is conserved. If so then future income opportunities for society as a whole have not been diminished. The question then comes down to the economics of instream uses and whether they are indeed of higher value to the economy than the out-of-stream uses they replace. While the answer will vary from location to location there are sufficient indications of the economic utility of restoring and protecting instream flows to merit further investment in water transactions (Wilson and Carpenter 1999).

Another related concern is the fear that the removal of water from land will lead to a lack of availability of water in the future for agriculture. Some think that agriculture is going through a temporary period of poor profitability and that in the future this will change and agriculture will become very profitable. Another variation on this is that transferring water to instream use leads to food insecurity, particularly in a future where energy and transportation costs are so high that food must be grown locally. Another is that instream transfers mean that water will not be available for municipal use or will be so expensive that communities will not be able to afford it. In either case, the water market is judged imperfect, as once permanently transferred to instream use, water rights may not be re-allocated for out-of-stream use. The latter argument is of course valid. But then species extinction is forever and therefore the need to secure a level of instream flow that provides resilience for species and other aspects of streams and rivers valued by humans is not a temporary one. It can also be argued that as instream rights are held by the state that should the situation be so desperate with regard to human survival that states would likely rethink the level of protection afforded to instream flows. In other words, fear of what might happen in the far distant future should not stop the water transactions practitioner from engaging in the reallocation of water that makes economic sense in the here and now.

7.6.3 **Social and Cultural Issues**

The water transactions practitioner will hear many arguments against putting water to instream use. The trick is to understand which concerns reflect tradition and are effectively philosophical objections and which represent socio-economic issues of material consequence. This is not to say that cultural opposition to instream use and views that instream use constitutes “waste” of water or that agriculture has an inherent entitlement to water should be ignored. But rather to identify which require a change in awareness and attitude and which concerns may yield to some form of mitigation or action. Arguably, these require different approaches. The former can be dealt with in transaction program design and the latter requires outreach, communication and education.

The fear that instream transfers will harm remaining out-of-stream water users is an interesting case. As explained above the concern is not groundless with much depending on the legalities of transfers in the jurisdiction. In some cases, the water transactions practitioner may wish to mitigate for potential harm, even where no injury would occur by strict application of statute and rule. However, even in cases where the administrative determination of no-injury is clear, the fear may continue. In such cases, efforts may be needed to explain and communicate the basis for this finding so that it is well understood by the irrigation community.

Indeed, the general public is assaulted daily with media that proclaims a global water crisis. Careful, localized assessment and planning are needed to determine where the long-term balance of supply and demand for water lies in a basin. This local picture must then be continually emphasized so that local behavior can adapt to the reality of local conditions and local needs for actions, instead of falling victim to Chicken Little-esque global pronouncements.

7.7 Summary

The advantage of undertaking the reallocation of water to instream uses through the transactional approach laid out above is that it respects existing rights, uses and interests. While a complex endeavor it is possible to arrive at transactions that provide for both the concerns and future of the water user and those that share a delivery system, such as in an irrigation district. There is much to be said for such a willing seller, willing buyer approach; particularly when the alternative would be compulsory acquisition perhaps without prospect of compensation. The other advantage of the transactional approach is that it relies on the logical extension of existing regulatory and administrative systems for changing water rights. While the complexities of any particular case may be substantial, the principles outlined in this chapter are clear. What remains is to assess – both generally and in specific cases – what level of detail and assurances are cost-effective. Water transactions practitioners have much work to do with their regulators and with irrigators to improve, adapt and formalize existing approaches in this fast-moving field.

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CHAPTER 8
DEVELOPING ENVIRONMENTAL WATER TRANSACTIONS

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Developing Environmental Water Transactions

This chapter covers the initial phases of developing a transactions program through to finding funders, sellers and undertaking due diligence on transactions. Subsequent chapters delve more deeply into specific phases of the transaction "project cycle."

8.1 Transactions Program

When we talk about environmental water transaction "practitioners" who are these people? And where do they work? We start with the last question first.

8.1.1 **Who Does Environmental Water Transactions?**

The idea of using water transactions and water markets to acquire flow for environmental purposes is an elegant but relatively obvious response to water scarcity. As such the idea was in circulation well before there were organizations to undertake such transaction, or the capacity to do so. In 1992 Zach Willey, an economist at the Environmental Defense Fund and a leading proponent of market approaches to environmental issues, even published an article in the *Harvard Journal of Law and Public Policy* with the title "Behind Schedule and Over Budget: The Case of Water, Markets, and the Environment." Expectations have been high for this approach but it has been slow to develop.

Enabling instream flow legislation in the western states began as early as 1971 in Washington and 1973 in Colorado. Oregon's Instream Water Rights Act of 1987, and subsequent modifications, provided probably the most complete set of authorities for environmental water transactions.

Early activity in this field came through federal agencies, with the U.S. Bureau of Reclamation (Reclamation) and U.S. Fish and Wildlife Service (USFWS) engaging in transactions related to project reauthorizations and endangered species concerns (Landry 1998). For example, the USFWS partnered with The Nature Conservancy in 1990 to purchase water rights for the benefit of the Stillwater Wildlife Refuge in Nevada, and Reclamation began leasing large quantities of water in 1994 under the Central Valley Project Improvement Act.

In the non-profit sector, Oregon has been a pioneer in this field, as is the Pacific Northwest generally. Created in 1993, the Oregon Water Trust was one of the first non-profit organizations in the U.S. to explicitly target water rights acquisitions for the purposes of instream flow restoration. In the next decade a number of non-profit water trusts with an express focus on environmental water transactions were formed including:

- Great Basin Land and Water (Nevada) formed in 1996;
- the Washington Water Trust formed in 1998;
- the Montana Water Trust formed in 2001;
- the Colorado Water Trust formed in 2001; and
- the Klamath Basin Rangeland Trust (Oregon) formed in 2002.

Also, the Deschutes River Conservancy (of which Zach Willey was a founding member) was created in 1996, although it did not actively engage in water transactions until 2001. The early history and motivations of the water trust "movement" is well documented in King (2004).

Other, larger national non-profit organizations such as The Trust for Public Land, Environmental Defense Fund, Ducks Unlimited, The Nature Conservancy, and Trout Unlimited were also involved early on in specific environmental water transactions (King 2004; Landry 1998). In recent years, other such organizations have engaged in water transaction program development in particular locales, e.g. World Wildlife Fund (the Rio Grande), Audubon (the Rio Grande), and American Rivers (in California).

In the last decade, the drive to create statewide water trusts that focus almost exclusively on environmental water transactions has receded somewhat. Two of the original state water trusts were merged into other, larger organizations. The Oregon Water Trust merged with Oregon Trout to become The Freshwater Trust, which engages in the full suite of restoration actions not just transactions. The Montana Water Trust was folded into the Clark Fork Coalition, a "place-based" watershed organization that works exclusively on the Clark Fork above Missoula, Montana. In each case the former water trusts essentially became flow restoration programs within larger organizations. During this same period the Deschutes River Conservancy took the opposite approach, choosing to focus its efforts exclusively on environmental water transactions and developing explicit partnerships with local watershed councils and land trusts to achieve non-flow restoration outcomes.

During the last decade a number of other state or local organizations have created transaction programs:

- Idaho Department of Water Resources;
- Walla Walla Watershed Management Partnership (Washington);
- the Trans Pecos Water and Land Trust (Texas);
- the Arizona Land and Water Trust;
- ProNatura Noroeste and the Sonoran Institute (Baja, Mexico);
- Resource Renewal Institute (California);
- Friends of the Teton River (Idaho); and
- National Fish and Wildlife Foundation's Walker Basin Restoration Program (Nevada).

Trout Unlimited is particularly notable for having greatly expanded its Western Water Project to engage in conservation projects and water transactions across a number of western states (including Colorado, Idaho, Montana, Utah, Washington, and Wyoming).

As this transactional approach gains credence, other countries are looking into ways to promote this approach: In Australia the federal government has an active program to acquire water for environmental purposes in the Murray-Darling Basin, as do a number of its states such as Victoria. Britain is moving forward with water marketing and Spain is examining the potential for water banking. Already mentioned above, since 2005 the government of Mexico has partnered with a Mexican environmental non-profit ProNatura, as well as the Sonoran Institute and Environmental Defense Fund in the creation of a Colorado River Delta Water Trust to acquire water rights in the Mexicali Valley for use in floodplain revegetation projects. Under a new modification of the treaty governing the Colorado River, Minute 319, this program is set to grow significantly between 2013 and 2017.

In sum, a wide range of types of organizations are currently engaged in water transactions either exclusively or as part of a larger environmental mission including:

- Federal agencies like USFWS;
- State agencies like Idaho Department of Water Resources;
- Non-profit statewide water trusts like Washington Water Trust;
- Local place-based non-profits like the Deschutes River Conservancy;
- National non-profit organizations with multi-state programs like Trout Unlimited;
- National non-profit organizations with specific state or local transactions programs like American Rivers;
- National foundations implementing specific basin transactions programs like National Fish and Wildlife Foundation; and
- Mixed state and local land and water trusts with water transactions programs like the Arizona Land and Water Trust.

8.1.2 The Environmental Water Transaction Practitioner

So who works at these organizations? These organizations are staffed by a wide range of individuals with multidisciplinary work experience and backgrounds. In the early years of the water trust movement, staff was often made up of young attorneys and/or recent graduates in environmental sciences or related fields. Smaller organizations with fewer staff still tend to have attorneys on staff, but as time passes and as some organizations have grown, staff with specialized experience in economics, hydrology, GIS, and engineering have come on board. The early trend to hire fresh-faced recent graduates has also reversed a bit with a number of organizations experimenting with hiring from within local communities and finding staff with prior work experience in state agencies or with local water districts, and even on occasion hiring seasoned ranchers themselves. The trend away from a reliance on attorneys also represent to some degree the move away from a water trust and water rights focus to a broader focus on water transactions generally, which include the need for project management skills related to the types of water management transactions covered in Chapter 6 of this handbook.

8.1.3 Practitioner's Niche: Collaboration with the Water Resources Community

The environmental water transaction practitioner has a very specialized niche amongst the larger set of environmental professionals. But the practitioner is also a part of the broader water community and, thus, is often in a position to serves as bridge between the environmental and water user communities. In terms of outlook, policy and funding, the practitioner is typically still rooted in the environmental (or conservation) community. Coordination with lobbyists, legislators, agency staff and environmental foundations is critical to moving the policy reform agenda forward as well as in developing funding streams for transactions (as described further below).

However, transactions are ultimately compromises, and the engagement of a practitioner with the irrigation community must be a collaborative one centered on building trust. As a result the practitioner is not well-placed to advocate, agitate or litigate against ideas, policies and initiatives broadly speaking with respect to water projects, policies and transfers put forward by other groups and individuals. The practitioner is uniquely well informed to comment on the potential impacts of these given the practitioners practical understanding of hydrology, water rights, streams and irrigation systems. The practitioner must therefore walk a delicate line with respect to advocacy and engagement within the environmental and water communities. Some practitioners are more active in advocacy and some simply ignore it. In small organizations the choice between spending time on changing the rules of the game or simply working within the rules to achieve transactions is a difficult one. Policy reform is time consuming and can take a long time to bear fruit. However, attempting to undertake water transactions in an unfavorable policy and regulatory environment can be equally frustrating. Ultimately, each organization must make up its own mind regarding the balance between these two activities and their relative payoffs and risks.

It is worth mentioning that the early mindset – that progress could only be made by way of formal water right changes, and, hence, that it was essential to work to ensure a favorable policy and regulatory environment – was a bit misleading. To some extent this was a feature of the early water trusts being staffed with attorneys. As the saying goes, "If all you have is a hammer, everything looks like a nail." Experience now suggests that water user agreements and other "work-arounds" to formal water right changes may be alternative entry points for practitioners. Indeed, experience suggests that thoughtful analysis and creative problem solving with water users can lead to novel solutions and that efforts to make do with the laws and regulations on the books should be the first priority. Once efforts have been made and obstacles clearly identified and understood there can be clarity and perhaps even support for a policy reform agenda.

At the state and local level the practitioner must be integrated into the water community. This implies the need to develop relationships with a different set of stakeholders ending with farmers and ranchers themselves. In this context the practitioner may be viewed as the "radical" element, even if within the environmental community the practitioner is seen as a "conservative" (with tongue in cheek, water transaction practitioners have been accused of being "right wing environmentalists").

How practitioners deal with this challenge is important. For those coming into a given community from the outside there are two approaches. One is to try to avoid being the "other" by affecting the behavior and look of the relevant community. The second approach is to accept the role of "change agent" and be clear about who the practitioner is and what he/she represents and is trying to achieve. Each approach has its pros and cons, and indeed there can be hybrid approaches.

For those hired as a practitioner from within the water user community, the look and feel is likely already there and so the issue becomes how the practitioner addresses the possible complaint that they have "sold out" to environmental interests. As with the outsider, the "inside" practitioner will need to find their own best way forward. The only practical advice to offer is that ultimately what matters is the trust that the practitioner builds with individuals and the community. This trust cannot be based merely on appearances given that the changes the practitioner seeks are serious ones that will have impacts for the community. Thus, what matters is honesty, integrity, and competence. Without these the practitioner is unlikely to be around long or engage in many transactions.

8.2 Developing a Transactions Strategy and Plan

In this section we examine how an organization or program that wants to engage in water transactions gets started. Obviously one option is just to get going: hiring staff and sending them out to find sellers. However, at this point in this handbook it should be pretty clearly that water transactions and flow restoration is a fairly complex business and, therefore, that sending practitioners out without a strategy or a plan is a bad idea. In what follows then, we examine some generally useful steps in getting to the point that you can be sent out the door to find willing sellers and develop water transactions.

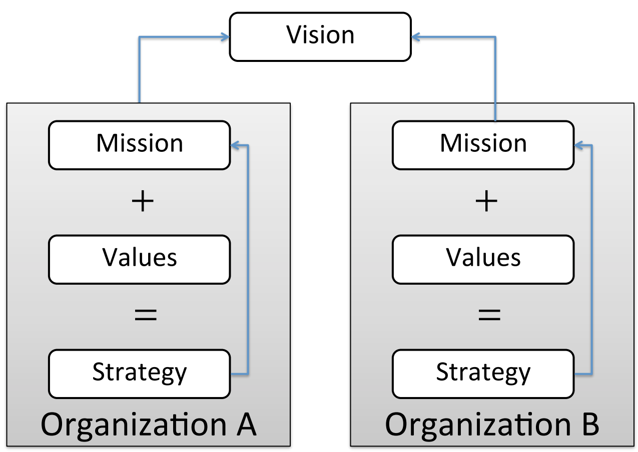
8.2.1 Strategic Planning

Strategic planning typically involves the formulation of the following:

1. Vision: the organization's view on what the future should look like.
2. Mission: what the organization will do to help achieve the vision.
3. Values: the values and principles of the organization, which will determine what it will pursue and how it will go about its activities.
4. Strategy: the roadmap for what the organization seeks to achieve and how it will do so.

The idea behind strategic planning is to formulate a logical framework that is internally consistent and that shows how an organization's implementation of its strategy will lead towards the realization of the vision. However, often the vision is a high level, complex vision that the organization can aspire to achieve, but cannot accomplish on its own. If that is the case, finding other organizations with a shared vision, but different strategies for working towards that vision can then help propel the groups towards the shared vision (as shown in Figure 8.1).

Figure 8.1 Two Organizations, A Shared Vision and Strategic Planning



With respect then to a vision for restoration of freshwater ecosystems in the western states, individual organizations may have a comprehensive vision for the restoration and protection of a watershed or basin, but few will have a mission that covers all the strategies necessary to realize the vision. A watershed or basin group may have an ambitious mission statement that conveys the higher order objective of the organization or transactions program, i.e. "protect and restore the Bear Creek Watershed" or "improve water quantity and quality in the Bear Creek Watershed." Such an organization may have an environmental water transactions program as one tool, or strategy, for achieving the mission nested within a broader organization.

Alternatively, a water trust might have a vision of "our rivers are restored to ecological health" and a mission of "working to restore flow to our rivers." This is a more circumscribed mission that provides one element of the action necessary to realize the vision. In any event the point remains the same at the higher level: it is great to have an expansive vision but unless the organization has a matching level of capacity, the effort will necessarily be shared between organizations that have different missions but a shared strategy.

The caveat here is that regardless of the exact focus of the organization, when two organizations have the same or overlapping missions they will likely have the same or overlapping strategies. Consider a large irrigation district within which two municipalities are located. Each municipality needs to provide for its patrons by acquiring water within the irrigation district. This immediately conjures up a competitive situation and the possibility of water wars and water prices spiraling ever higher. Or it suggests the possibility of a partnership between the municipalities for mutual benefit.

The same situation exists for organizations engaged in environmental water transactions. Consider the potential for geographical overlap in missions of the various organizations cited above that work on water transactions. Just as with the municipalities it will be important for any such overlaps in missions to be worked out between organizations, so as not to be actively competing. Unfortunately, given a crowded field, ample financing, and the difficulty of the work this can be harder to do than might be imagined.

8.2.2 **A Logical Approach**

Turning to what constitutes a water transactions strategy, the first step is to acknowledge a subtle but obvious point that flow (and water) is typically the means to an end, not the end in and of itself. What this means is that before defining the desired flow-related outcomes and working back to transactions it is important to first define the desired ecological outcomes and then work back to the role of flow in attaining these outcomes. Depending on the situation this may be a discussion within a watershed group (one with a broad set of strategies) or it may be a discussion between a water trust and its partner organizations (that specialize in strategies that complement the water transactions piece). Once the larger restoration logic is specified the water transactions portion can be filled in. Of course, in some cases the practitioner or their organization comes to a situation where the immediate objective is already clearly defined. For example, settlement by stakeholders of contentious issues may result in a clear directive such as "restore 6 cfs in the middle reach of Bear Creek." Or the state fish and wildlife agency may have clearly set forth an instream flow target or right that needs to be filled. Absent such clear direction the practitioner must strategize at both levels.

Beyond the goal setting discussed in the prior section the practitioner will benefit from at least some level of work on a strategy. The generally accepted approach is to develop what is called a "logical framework." A logical framework is simply a way of laying out how a set of resources and actions lead to a set of outcomes, outcomes that in turn fulfill the organization's mission. Such a framework can take many physical forms, from a simple sketch on a white-board, a detailed input-output model in a spreadsheet, or a formal strategy document prepared by staff and vetted by the organization's management and board.

In formulating such a strategy it is efficient to turn it around and proceed from objectives to resources and actions (i.e. from right to left), even though in implementation it will proceed from left to right, from inputs to outputs.

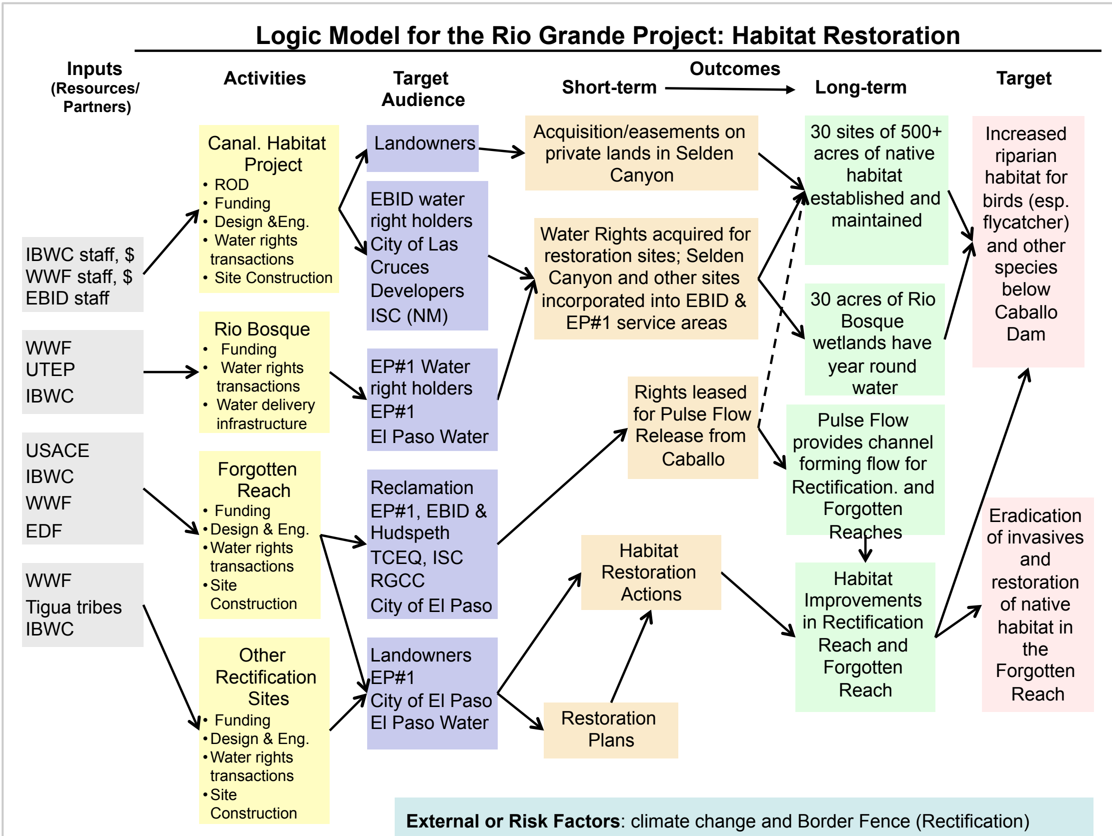
The approach suggested here is one of many and loosely follows the approach recommended by the National Fish and Wildlife Foundation to its grant recipients. Such a logic model approach links the following items together in a framework that builds from the target of the work backwards to outcomes, target audiences, activities and resources and partners. In the process it makes the links between resources, collaboration and activities and the ultimate target of the work explicit. The logic model employed by NFWF uses the following components to arrive at a graphical portrayal of the restoration strategy:

- targets for ecological restoration, including streamflow restoration;
- long-term physical outcomes desired, quantified where possible;
- short- and medium-term outcomes desired, which can be formulated as the behavioral changes desired;
- target audience, i.e. the groups that will need to change their land and water management;
- activities, i.e. the sets of tasks that the partners in this effort must undertake; and
- resources and partners necessary to engage in these activities.

In addition to these components it is useful to list the external or risk factors that are beyond the control of the organization, but that could potentially affect the ability of the organization to reach the planned outcomes.

Such a logic model approach can be used to show that the higher-level ecological restoration target is the product of effort to address a set of factors that limit restoration in the target area. The example presented in Figure 8.2 shows how water acquisition fits into the larger scheme of riparian habitat restoration for bird species in the Rio Grande, downstream from Elephant Butte in New Mexico. Alternatively, the target in such a logic model can simply be the long-term quantity of flow restored in a given creek. In which case the logic path will purely extend back to those audiences, activities and inputs necessary to achieve the tasks that are the domain of the environmental water transactions practitioner.

Figure 8.2 A Logic Model for Habitat Restoration, including Water Acquisition



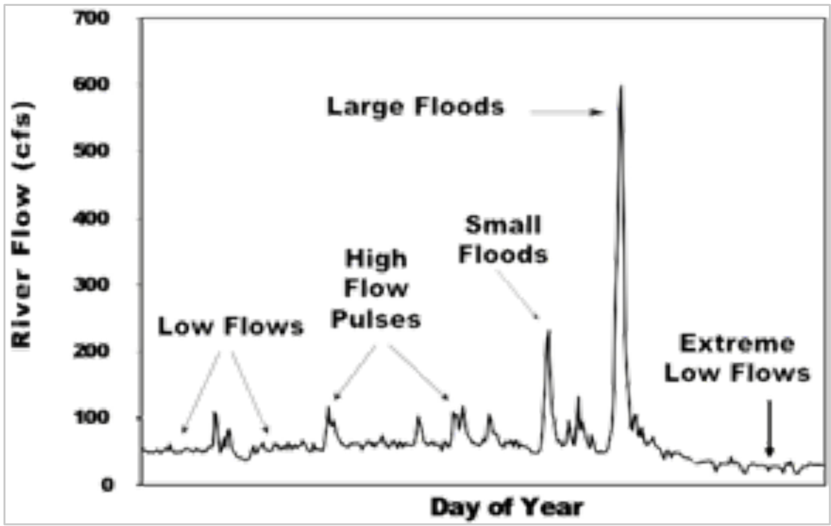
Source: Aylward (2009)

8.2.3 Defining Flow Objectives

As useful as it is to have a conceptual framework such as the logic model discussed above, transactions are ultimately about numbers: cfs, acre-feet and dollars amongst others. Therefore, you, the practitioner, may want to quantify desired transaction outcomes and use those to direct efforts under the transaction program.

An important and difficult element of developing a transactions strategy and plan is defining the needed environmental flows. Environmental flows are described as "the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems" (Brisbane Declaration, 2007, Appendix 1). The notion in the western states of "instream flows" relies on the idea of a minimum baseflow needed to sustain minimum fish passage and habitat. The term "environmental flows" stretches this notion in two directions. First, it sets the environment, or ecosystem health and function, as the objective not merely the minimum flow needed for a single species. Therefore, the concept – as shown in Figure 8.3 – is to take a dewatered stream and rebuild the hydrograph. The idea is that these hydrological features, such as large and small floods, pulse flows, etc. are just as much a part of the hydrograph as late summer base flow and that they have a role to play in restoration of ecosystem function. Second, the term environmental flows goes beyond instream flows to emphasize the environment's need for water. This means more than simply non-consumptive needs for physical streamflow and includes water to meet physical, chemical, biological and, ultimately, ecological needs of functioning ecosystems. This will include, for example, the consumptive use of water in restoring floodplain vegetation as well as the hydraulic energy from a flood flow necessary to maintain geomorphological processes such as sediment transport.

Figure 8.3 Characteristics of a Stream Hydrograph and Environmental Flows



Source: Postel and Richter (2003)

While the concept of environmental flows is a significant advance in our understanding of the environment and underpinned by scientific investigation, the question is how does it enter into the life of an environmental water transactions practitioner in the western states? While it is easy to say that freshwater systems are essential to human livelihoods and quality of life, it is much harder to be definite about the quantity of instream flow or water needed to meet "intermediate" objectives such as the needs of fish, water quality or riparian habitat. Quantifying environmental flows in support of freshwater biodiversity is an evolving field of study and practice, and includes more than 200 methodologies ranging from widely implemented physical habitat models to more recently developed "presumptive flow standards" based on natural or historic flow variability (Tharme 2003; Richter et al. 2001). But it is extremely unlikely that the practitioner will find that such a study exists for a rural watershed in the western states. At best, the state fish and wildlife agency will have set minimum base flows for resident fish species. In some states such base flows determine the beneficial uses prescribed in (junior) instream water rights, such as those established in Oregon by the Department of Fish and Wildlife.

Unfortunately, one of the first questions an irrigator is likely to ask you is "how much water do you need." Retreating to a general statement about environmental flows and the need for better science will not impress or comfort irrigators. Conversely, simply throwing out a (low) figure for needed late summer baseflow may be selling the concept of environmental flows short. Ultimately you need to decide how to present your desired outcomes to irrigators and the community. Since it is fair to say that there really is no one perfect amount that is needed in any reach there is some leeway here. A practical recommendation is to choose some interim flow target that is not too far from the status quo and that can be expected to provide some level of additional environmental benefit. Then see how it goes and modify the figure from there. In other words an adaptive management approach is best and, indeed, necessary given that your organization may not have generally agreed upon flow targets in hand when starting up a transactions program. Where ecologically-based targets do exist and have been put forward by other organizations or processes those targets are an excellent place to start.

A final point is that organizations that specialize in transactions are unlikely to have the requisite experience to determine scientifically what the needed flow level might be. Instead all they can do is be smart about picking (or not) a target and communicating the target and progress toward the target to relevant audiences. Typically, flows are so far from what might be necessary that worrying unduly over the target amount is putting the "perfect before the good." The practitioner's job is to undertake transactions. If and when you are successful and making headway it may then be wise to make sure an informed discussion and the needed science is undertaken to set or refine flow objectives and targets.

8.2.4 Identifying Water Rights of Interest and Selecting Transaction Types

With one or more defined reaches and flow targets (or at least objectives) established the practitioner then must identify which water rights are relevant and what transactions might be undertaken to acquire water for these environmental needs. There is no formula for this task given the variation in possible circumstances. However, some general guidance can be offered to the practitioner in this regard:

Know the Hydrograph: The first step is to develop an understanding of the hydrograph in the relevant reach, both the natural (or unregulated) flow that is available to the reach as well as how flows are affected by diversions in the reach. Depending on the stream/reach, gage data may or may not be available to develop a representative characterization of the hydrograph above diversions and down through the reach. This information is valuable and you are well advised to analyze the data to understanding the behavior of the hydrograph across the year and from dry years to average/typical years to wet years.

Ultimately, restoring water to streams is a matter of probabilities given meteorological and hydrological variability. If gage data is not available you may want to conduct a synoptic campaign, i.e. measure flows at different points in the reach at times of the year that seem relevant to the flow objectives. Alternatively, interviews of key informants can be used to elicit streamflow characteristics. These may be long-term residents or local subject matter experts and/or agency staff.

Study the Water Rights: There is no substitute for reading and compiling the water rights that affect streamflow in the target reach. The practitioner will need to read decrees, permits, certificates and available reports to determine how prior appropriation should work in the reach.

Know the Water Use: Obtaining data on actual water use can be difficult, but it is a key step in the process. An important caveat is that oftentimes water is not used in accordance with a strict interpretation of the water rights. Understanding historic practice of water diversion and use will be important, as even if it does not strictly follow the letter of the law, any changes made by an environmental water transaction will alter this pattern of use and you need to be aware of not just how water rights will change but how actual water use will be affected.

Experience the Irrigation System: It will be advantageous if the practitioner knows what happens to irrigation water once it is diverted. In particular, if you are to take advantage of the opportunity presented by the water management transactions explored in Chapter 6 a working knowledge of the conveyance system and on-farm use of water is essential. Oftentimes the best approach is to arrange a tour with your local water managers to see the system and follow up from there with reports and further interviews and site visits as useful.

Understand the Reliability of Water Rights: In order to know who to approach for water to fill a need at a given place and time it is essential that you understand the reliability of the water rights on the stream. There are varying degrees to this type of analysis. It can be more or less quantitative and statistical. On the simple end, it may be that it is generally known in the water community that you need, say, a 1905 water right to have water instream past July 15. On the other end, there are a variety of probabilistic analyses of reliability that can be developed by the practitioner or partner organizations.

If you are handy with spreadsheets, you might develop a simple supply and demand model that allocates available flows to water rights in priority. More complex surface water distribution models (such as MODSIM developed by the Bureau of Reclamation) can be developed if water right and historic diversion information is available and you have access to the needed technical expertise. The U.S. Geological Survey, your local agency hydrologist, and consulting hydrologists are all good people to get to know.

Study the Hydrogeology: Water use does not stop at the farm. What happens to the water that is not lost to consumptive use can be just as important for transaction design, particularly for understanding the tradeoffs between different types of water management and consumptive use transactions.

Brainstorm, Brainstorm, Brainstorm: With all of the information collected and analyzed it is important to spend time brainstorming on all the various creative ways that transactions with various types of water rights and landowners might meet your flow objectives. Depending on how far along you are in your relationship with prospective landowners it is also a good idea to throw out ideas to them and get them working on the problem too. You can only reproduce a portion of their understanding of the system – though you might well know the numbers and probabilities in a more formal way – and, ultimately, they must be the judge of whether transactional ideas make sense or not.

8.3 Finding Money

8.3.1 Sources of Funds

A non-profit (or state agency for that matter) that wants to do water transactions needs two basic types of funding: acquisition funding to pay for water transactions themselves, and funding for everything else. In a cruel twist of fate, it is often much easier to find acquisition dollars than it is to find money to pay to keep the lights on and pay employees – a classic case of cart before horse that almost every such organization deals with on a daily basis. However, as the water transaction movement continues to grow and gain momentum, funders are showing an expanded interest in funding water transactions and, more importantly, an expanded willingness to support the necessary work and related costs it takes to put projects on the ground.

Funding sources for water transactions can generally be broken into four categories, government (both state and federal), private foundations, mitigation or mitigation-like, and private/corporate. The lines between these four funding categories are often blurred but a brief discussion of some of the important distinguishing characteristics of each follows.

Government Funders. Sources of government funders span the entire spectrum of government itself from local to state to federal. Government funding for water transactions also varies greatly in terms of purpose and scope. While some agencies fund water acquisitions, others, like the Natural Resources Conservation Service (NRCS) are limited to funding water conservation projects like irrigation and/or diversion infrastructure upgrades. Others, like Reclamation fund a blend of water management planning, project feasibility studies, and water transactions.

One of the most prominent examples of government funding of water transactions is the federal Bonneville Power Administration's (BPA) funding of the Columbia Basin Water Transactions Program in the Northwest (covering parts of Oregon, Washington, Idaho, and Montana). Under an Endangered Species Act requirement stemming from the impact of BPA's operation of Columbia River hydropower facilities on listed fish species, BPA finances a vast world of restoration activities including a robust water transaction program. State agencies can also play a major role in funding water transactions in some western states. For example, Washington's Department of Ecology is a major funder of water transactions targeted at ESA-listed fish recovery in the state of Washington.

Private Foundations. Not-for-profit regional, local, and national foundations are playing an expanding role in funding water transactions. Depending on the foundation, some fund both acquisitions and transactions costs, while others provide more restrictive funding. The Walton Family Foundation, for example, is making a major investment in expanding water transactions as a viable tool to help address severe water scarcity in the Colorado River Basin from the headwaters to the delta in Mexico. Like Walton's focus on the Colorado, foundation funding is often mission-driven, meaning that funding is often restricted to a certain area or type of project. Numerous regional foundations for example, will fund water acquisitions only in a limited geography that is important to the particular foundation.

Mitigation and Mitigation-Like Funding Sources. To some, the term mitigation carries the negative connotation of papering over past bad deeds with present good deeds. In this context however, the term is used more generally to denote a broad array of funding sources that arise from some kind of impact on rivers and/or riverine ecosystems that provide a basis or motivation for funding water transactions. Mitigation funding is also not necessarily always a funding source in and of itself. For example, BPA's funding of water transactions in the Pacific Northwest is directly tied to an ongoing mitigation requirement arising from the Endangered Species Act. Another prominent example of mitigation funding is groundwater mitigation programs. Rapidly urbanizing areas with scarce water resources have given birth to some creative water transaction programs that require developers seeking water to offset their future impact by acquiring water for dedication instream in hydrologically connected surface/groundwater systems.

Finally, a new species of mitigation-like funding sources is also expanding. Among these, the Bonneville Environmental Foundation's (BEF) Water Restoration Certificate (WRC) program is a prime example. WRCs are marketed to individuals, but mostly to corporations that are looking for ways to be stewards of one of their primary production inputs: water. For example, a large brewery that depends on water to make delicious beer might purchase WRCs from BEF, which uses that money fund water transactions in and around the brewery's headquarters. While the water transactions are not specifically tied to any one impact and are therefore not technically mitigating anything, these funding sources are motivated by the idea of promoting the health of a natural resource on which their livelihood depends.

Private/Corporate Funding. The final broad category of funding sources is private and corporate donations. Private funding can be as simple as membership of a non-profit and regular donations to a cause they believe in and as large as a major corporation funding transactions either through a program like BEF's WRC program mentioned above, or simply donating to an organization that undertakes or funds transactions. Altria, a large U.S. corporation with major vineyard operations in the Pacific Northwest, for example, is working with the National Fish and Wildlife Foundation to help fund water transactions in Washington.

8.3.2 Tapping other Project Benefits and Non-Traditional Funding Sources

In addition to seeking more traditional grant and/or mitigation funds for water transaction programs, practitioners should always be on the lookout for creative ways to capitalize on the benefits of water transactions that may be less obvious or common. Most water transactions are implemented to improve ecosystem health. The primary motivation for transactions then, and what many funders are willing to pay for, is often increasing river habitat, providing water to a wetland, or providing some other environmental benefit. The key to thinking creatively about funding water transactions outside of philanthropic purpose is to think about what potential benefits the transaction could have to other water users or to the local community or to any other entity with some kind of stake in the watershed. Some examples are illustrative.

Large-scale water conservation projects like piping long, leaky conveyances, can provide major instream benefits that a number of traditional public-purpose funders, like government and private funders, might line up to fund. However, these projects can also be incredibly expensive and can exceed the capacity of relevant traditional funding sources. What other benefits can these large piping projects have? From the water users' perspective, the benefits can be numerous. Piping canals can result in the delivery of pressurized water to users who, before the project, had to rely on gravity and plastic tarps to get water to every corner of their field. Some users will be willing to contribute to a project to have this benefit.

In some systems, piping large canals can also open the door to new renewable sources of energy production. Water flowing long distances in pipes has tremendous energy generating potential and putting a hydropower facility somewhere on a large piped irrigation system can not only provide benefits today, but can generate a revenue stream long into the future. The potential to generate revenue in the future also opens up the world of private finance for water transactions. Banks are often willing to lend money to fund a project with significant energy producing potential.

Another example of a fast-developing non-traditional funding source is the development and sale of ecosystem credits generated by water transactions. For example, Oregon has one of the nation's most advanced water quality trading programs specifically related to water temperature. In much of the Pacific Northwest, water temperature is regulated as a pollutant under the Clean Water Act. Entities such as municipalities that discharge clean but warm water into rivers, have an obligation to provide some form of cooling to the system to offset their impact. Oregon has developed a system that allows these regulated entities to offset their impact by planting riparian shade to help cool stream reaches. The amount of cooling is calculated in terms of kilocalories of sun effectively "blocked" by new riparian vegetation and each of these kilocalories can be sold as a credit. In the coming years, the hope is that a similar tool will be implemented to account for and market the cooling effects on watersheds that water transactions can have. Once in place, such a system will provide a new funding source for implementing water transactions.

The sky is the limit when it comes to creative ways to capitalize on all of the benefits water transactions provide. The key is to look at the entire watershed and all of the people and entities with some stake in the watershed, especially downstream of the transaction, and think through any and all potential benefits the transaction might provide. Then it is just a matter of determining if any of those benefits might be valuable and whether someone else might be willing to pay!

8.3.3 **Creating a Financing Package**

Few water transactions are funded by only one source. In fact, most transactions, especially large, complex projects, require a mix of funders and types of funding. When planning a transaction in the early phases, it is vital to begin to piece together a variety of options to pursue for funding. Start with any partners that you know are interested in particular project or watershed, and partners that have provided funding in the past. These relationships almost always provide the first and foundational funding. From there, be creative. As mentioned above, think about how you might tap non-traditional funding sources and get value from project benefits other than obvious environmental benefits. For projects with the potential to generate revenue such as projects that might include hydropower, bank or other financing may also be an option.

Cost share, bringing other funding sources into a project, is also a vital strategy. For example, you may have ready access to funding to pay for water acquisitions but not for infrastructure like pipes and sprinklers. In these cases, engaging funders and partners who do have access to funding for these project pieces, such as NRCS, will be vital to project success. In many cases, it may also be appropriate to discuss with the landowner(s) and/or an irrigation district (if one is involved) about their willingness to provide some form of contribution to the project, whether through labor, materials, or cash funding.

When designing a project, especially a large and/or complex project, the best funding strategy is often a diverse and creative mix of traditional grant funding (foundation, government, etc), landowner and other cost share, and leveraging project benefits other than water instream for maximum value.

8.4 Finding Willing Sellers

While it is a great advantage for the practitioner to have a strategy, a plan, and money, these are by no means a guarantee of success in environmental water transactions. It is not uncommon for practitioners in new programs to take considerable time, even years, to successfully locate a willing seller. Research has shown that people holding an asset that is not frequently traded and, therefore, for which there is no market and/or the market value is uncertain will focus on the risk of loss and not the potential gains from the sale when asked to sell the asset. This "endowment effect" implies that it will be difficult to persuade such asset holders to part with property of this nature. Water rights clearly fit this definition of a long held asset that is rarely if ever traded in a market. By implication the practitioner's job is largely one of overcoming this fear of loss – and persuading the water right holder to focus on the potential gains of the transaction. A practical implication is also that the practitioner may need to pay a premium to persuade a water right holder to sign on the dotted line.

This section attempts to walk through the issues involved in finding the elusive "willing seller."

8.4.1 **The Change Agent and the Adopter: Diffusion of Innovations**

As stated earlier the practitioner is a change agent, someone who brings an innovation to a community. Based on early work in the Midwest on the adoption of new agricultural practices

Everett Rogers developed a field of study entitled the “Diffusion of Innovations” (Rogers 2003). According to Rogers, diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. The change agent is of course a primary, but by no means the only, such channel. Rogers suggests that each potential adopter (i.e. water right holder) must work through their own innovation-decision that follows a 5-step process (adapted here to environmental water transactions):

1. **Knowledge**: the potential willing seller becomes aware of environmental water transactions and has some idea of how they work (which may be more or less accurate depending on where they obtain their information).
2. **Persuasion**: the seller forms a favorable or unfavorable attitude towards environmental water transactions.
3. **Decision:** the seller pursues further information and contacts that lead to the choice to adopt or reject a transaction.
4. **Implementation:** the seller negotiates a landowner agreement with the practitioner, changes their water right or water use, and receives compensation.
5. **Confirmation:** the seller evaluates whether the decision to enter into the transaction was a good one (and shares this view with others thereby looping back into the knowledge phase for other potential sellers).

Rogers’ book is filled with a long series of such categorizations and observations that provide a valuable clearinghouse of experience with the diffusion process. The point here is that while environmental water transactions are a relatively new approach to water management they are still just one of many innovations. The general insight provided by years of research into how the process of diffusion works is therefore invaluable to the practitioner and is recommended here. Below this work is supplemented by our characterization of the experience and learning so far from the field of environmental water transactions.

8.4.2 Strategies for Finding Willing Sellers

If you were blindfolded and dropped into Any Watershed U.S.A and told to start doing water transactions with farmers and ranchers, how would you do it? How would you find willing sellers in what can be a hugely controversial endeavor? Though there is no one formula to answer this question, there are some general principles that, applied in whatever way fits the specific community, economic, and environmental context the best, will provide a good chance of success. The key to finding willing sellers in even the most difficult situations is to be strategic.

First, narrow the field of potential sellers through rigorous prioritization. Next, capitalize on opportunity where it occurs and where opportunity doesn’t immediately arise, look for and then exploit positive deviations—a potential partner, for example who indicates a willingness to manage water differently than their neighbors or their great-grandparents. Finally, use the power of demonstration and diffusion to grow the pool of potential partners by showcasing successes, no matter how small. Each of these three basic strategies is discussed in more detail below.

Prioritization. Depending on the specific target basin or river reach, the world of potential water right sellers can range from thousands of water right owners to a single person. If the target stream or reach has more than one water right holder, prioritization is a key first step. Prioritization begins with the selection of an attribute or attributes to use to differentiate between classes of sellers.

Some of the desired transactional attributes are obvious, such as water right priority and/or location in the watershed as discussed earlier in this chapter. Examples of other, personal attributes that are less obvious but possibly more important include: age (time to retirement, time until the next generational turnover of a ranch, recent college graduate), owner type (hobby farmer vs. fifth generation farmer, 2nd home owner vs. subsistence farming family, etc.), education level, past participation in Farm Bill conservation programs like CREP and EQIP (federal government-financed riparian fencing and irrigation equipment upgrade programs, respectively).

With a prioritization scheme in place based on one or a combination of relevant attributes, the next step is to identify a class of possible sellers with whom you have the best possible chance of success and figure out how to tailor and deliver a message to those individuals that will resonate (the outreach process is discussed in detail below in the next section).

Opportunism: Capitalizing on Positive Deviations. In the search for willing sellers, a positive deviation is any water right holder who indicates some greater willingness than their neighbors to pursue a water transaction. Sometimes these people may approach you. Other times, it may be a person who has been involved with a local Soil and Water Conservation District for many years and is referred to you by a district employee. Spotting positive deviations that can result in transaction opportunities is an important instinct to develop. The key to developing this instinct is spending time in a community, meeting and learning about key "influencers" in the community (can be anyone, from county leadership, to an influential long time rancher, to a soil and water conservation district board member, etc.), and above all, being observant and knowing what to look for.

At the end of the day, securing the first willing seller is often attributable to a healthy dose of luck. While this may not sound very strategic, being ready to capitalize on this luck is a key strategic element. In the early phases of developing a water transaction program, taking advantage of any and all opportunities that present themselves is vital. Your first transaction opportunity may necessarily involve ignoring your carefully developed prioritization. In many instances, it is worth securing a deal with a junior or less important water right to simply get the ball rolling and get a transaction on the ground. Getting one or several "low hanging fruit" on the ground is the key to beginning to build a transaction program.

Going with the Flow: Diffusion of Innovations and the Rate of Adoption. As a group, ranchers and farmers are about as far from technophiles as possible. Rather than wait in line on release day to be the first to get their hands on a new technology, innovation diffuses through ranching and farming communities slowly. Ideas seep from one field to the next as neighbors spend time observing each other, asking questions, and letting change sink in. This holds true whether you are talking about a new tractor or about the impact to a farm from an instream lease. In the early years of transaction activity in a basin or watershed, something as radical as instream leasing, split season water use, or a sprinkler irrigation upgrade can take time to reach even a modest level of acceptance.

The first person in a basin to do a water deal might be branded as "crazy." But when their lights stay on and even better, they buy a new tractor with the proceeds from the deal and that lets them more effectively harvest the next year's crop that label slowly peels off. When the young son of a third generation farm family takes over the family place and in the first year signs up for a multi-year split season lease, the old timers will chock it up to youthful inexperience. But when the proceeds from the lease give the young farmer the capital he needs to put a down payment on some additional hay ground, double his herd size, and cut his late season irrigation costs, those same old timers may start to look a bit closer, or even ask some probing questions.

There will always be people in a basin that will never come around to the idea of changing the way water is used. But by growing a transaction program one small success at a time, the innovative idea that water is a valuable asset that can be monetized in ways people may never have thought of before, will start to catch on.

8.4.3 **Outreach to Potential Sellers**

The heart of a water transaction practitioner's job is outreach. Defined broadly, outreach means educating landowners about your work, soliciting potential partners and sellers, and also educating other members of the community and community groups to garner their support for water transactions (or at least head off opposition). Outreach strategies are variable and always work best when closely tailored to the relevant audience. For instance, you may employ a different outreach strategy in a quickly urbanizing, formerly rural landscape, than you would in a community of multi-generational farm families.

This section will discuss only some of the many possible types of outreach that can be more narrowly tailored to specific situations including: word of mouth, direct and unsolicited contact, indirect contact, community event participation/sponsorship, and one-on-one outreach to specific landowners.

Word of Mouth. The best advertisement for water transaction work comes from satisfied customers. Much of the outreach that has the most impact does not come from water transaction practitioners themselves. Neighbor to neighbor conversations are a highly effective way to spread positive messages about water transactions. Even though word of mouth outreach is not carried out by practitioners, that doesn't mean you don't play a role in encouraging and catalyzing it. For example, if you have an established relationship with one water right holder, try to learn about that person's relationships – their neighbors, perhaps their family members, and their friends. If they are happy with the outcome of a water transaction, ask them to spread the word in their circle of influence.

Direct, Unsolicited Contact. Compared to word of mouth, the most effective outreach strategy, direct, unsolicited contact is probably the least effective. Examples of direct, unsolicited contact include blanket mailings to all water right holders on a stream, or cold-calling a specific set of landowners. Utilize direct, unsolicited contact with great care. In early phases of transaction program development, this type of outreach can cause more problems than it solves. It can raise suspicions and generate opposition. However, in a maturing program in an area with some level of acceptance of water transaction, direct unsolicited contact can be effective both to solicit sellers and also just to raise awareness of water transaction work. Another advantage of direct unsolicited contact is the ease with which it can reach a large audience. Few other strategies can reach as many people with as little effort. In addition, several specific transaction types especially rely on direct, sometimes unsolicited contact. Reverse auctions and river wide instream lease and/or mitigation banks are examples of projects that may take advantage of this type of outreach.

Indirect Contact. Indirect contact is the intentional use of someone other than yourself to reach out to a potential seller. It is distinct from word of mouth in that indirect contact often relies on local partners such as soil and water conservation district employees, NRCS staff, or other partner organizations rather than a landowner. However, it can have some of the same benefits as word of mouth outreach. Especially for a statewide water transaction organization that does not have field offices everywhere they work, utilizing local partners for outreach is a strategic way to leverage existing relationships and trust. A landowner is more likely to be open to an idea from a member of their community or a partner they have worked with in the past, than to someone who comes in from out of town. Using indirect contact as a viable outreach strategy requires significant investment in educating local partners about water transaction benefits and programs.

Community Event Participation/Sponsorship. In 2012, The Freshwater Trust donated $3,500 to help the small town of John Day purchase new lights for its high school football field. Other organizations have been known to buy sheep and cows from local 4H kids at the county fair. These are examples of outreach that do not involve directly soliciting willing sellers, but instead raise an organization's profile and build trust in an important community with important demographics. One of the most damaging images water right holders can have of a transaction organization is that they don't care about anything other than stripping water off of land. Making a commitment to restore streamflow in a watershed can be as much about making a commitment to the people in that watershed as it is to the environment. Trust is the most valuable commodity in the pursuit of willing transaction partners and community participation is one of the best ways to build trust.

One-on-One Outreach to Landowners. Many water transaction practitioners who have been in the business for a long time measure the effort required to secure a deal in the number of cups of coffee at a water right holder's kitchen table. Of all of the outreach strategies discussed in this section, one-on-one face time with landowners is the most important. These meetings are vital to developing trust with landowners. Sometimes the conversation will move quickly to water, while other times it can take several meetings before water comes up at all. Learning to read the pace of a conversation is important; rushing into prices and discussions about transaction options can work for some landowners, but as a general rule, listen more than you talk. Ranchers and farmers usually love to talk about their operations, their history, their theories on the best strain of alfalfa. One of the most useful skills a water transactions practitioner can have is the ability to listen and the instinct to know when is an appropriate time to broach the subject of a water transaction.

8.4.4 **Designing the Transaction**

Once a willing partner/seller is identified, the timing is ripe to begin to craft a water transaction. While the primary focus of outreach is to raise interest in a water transaction, another key task during the outreach phase, especially in one-on-one meetings with landowners, is to begin to build a range of transaction options based on the landowner's preferences, style, and particular business/operation. This section describes the general framework of a water transaction. While later chapters will discuss transaction implementation elements such as contract drafting and state water right change applications, this section is focused on basic transaction design: the who, what, when, where and why of developing a water transaction for environmental benefit.

The "who" of a water transaction involves identifying not just the willing seller and/or project partner, but also other necessary parties to the transaction. Examples of other parties who might need to be involve are irrigation districts or, if stored water is involved, the owner of the storage facility such as the Bureau of Reclamation. Another important question to answer about who is relevant for a given transaction, is to identify the buyer. In the case of most environmental water transactions, the buyer will be a funder of one type or another (government, foundation, etc., discussed above) and it is vital to match funders with transaction opportunities that meet their particular needs. Finally, some project types, especially projects with large infrastructure components like canal piping, may have some bank financing involved as well and identifying these partners in the transaction design phase is vital.

"What" a water transaction entails is one or more water rights or some part of one or many water rights. When designing a transaction, the next step after figuring out all of the relevant parties is making a basic determination of the water right(s) involved. Though water right due diligence is explained in detail in the next section, at the early transaction design phase, it is sufficient to outline basic details of the right or rights involved like the quantity (rate, duty, acres) the season of use, and any unique characteristics of the right. Water rights are the raw material of most every transaction, even if the transaction does not officially change the water right and therefore the "what" of a water transaction is of utmost importance.

Timing is one of the most delicate aspects of any water transaction and practitioners should devote significant focus to the "when" of transaction design. It is never too early to think about how a transaction will unfold in time and begin to identify major potential deliverables such as submitting necessary water right change applications. Timing is always front and center on sellers' minds and beginning to lay out a basic, realistic, timeline for the transaction is a vital step.

Transactions unfold in time and also in space. "Where" the transaction is implemented is another important piece of early transaction design. Water transactions can be spatially complex, involving protection of water through a particular stream reach, or the movement of points of diversion from a tributary to the main stem of a river system. Mapping out a transaction, using GIS when possible, is the best way for all the parties to see what a transaction will look like instream. This step is often of particular interest to funders who like to have a geographic reference point for project investments.

The final basic element of early transaction design is the "why." Water right holders enter into transactions for numerous reasons, but the environmental water restoration movement is, at its core, an incentive and market-based approach. The "why" of a water transaction therefore is focused on the particular set of incentives that drive a transaction. For most transactions, this means sketching out the price and payment structure. If a final price has not been agreed to, this step can include mapping out how to arrive at a final price, either through an official appraisal or some less formal price negotiation.

8.5 Finding Good Water: Due Diligence

Given an identified transaction and seller, due diligence is the process of defining and validating the different elements of the deal. This will typically go beyond mere due diligence on the water rights as the practitioner is often engaged in something novel, and must take prudent steps to make sure that the transaction will work out well for all involved including the funder, the seller, other water users, and the community as a whole. Typically the practitioner would only be concerned with buyer's remorse. But in this case, the practitioner (effectively as an intermediary making a deal happen) must be concerned with buyer (funder) remorse, seller (landowner) remorse, as well as remorse on the part of other water users on the conveyance system, the river and, finally, the community.

So below we discuss due diligence with respect to water rights, related assets, water right changes and water delivery, third party (non-water) impacts, and the community.

8.5.1 Water Rights Due Diligence

Due diligence in the water right context is a structured, replicable approach to assessing the validity and eventual transferability of water rights. Water right certificates memorialize a water right as it was "proven up" at the time of issuance. For many old water rights, that means the information on a certificate could be more than one hundred years old. Many things can change from when a water right was certificated to today. For example, it is not uncommon for roads to be built over land that had a water right on it many moons ago. Landowners will often develop their property too, building new barns and garages where their water rights used to exist.

For this and other reasons discussed below, practitioners should never take a water right certificate at face value. It is a rare water right that, on the ground today, reflects the same conditions as the date it was certificated. A thorough water right review includes analyzing site visits and photographs, determining a water use history for the relevant right, comparing old and current maps and creating new maps, examining existing and historic water infrastructure and examining the chain of title for the underlying land and also the water rights themselves. Some steps besides detailed scrutiny of the water rights on the property that the practitioner will want to undertake as part of their due diligence are listed below.

Site Visits and Photos. The first and most obvious due diligence task is a site visit. Often more than one site visit is required to truly understand the lay of the land and to get a strong impression of the site and the fit of the paper water rights to conditions on the ground. Before, during, and after these site visits, it is also useful to compare any available current and historic aerial photos of the site to your impressions from walking the ground.

The key conclusions to draw from visiting the land and studying photographic evidence are the general "fit" of the paper water rights to the reality of the property, the presence of any new or new looking structures including roads and other rights of way, and, most importantly, an impression of how water moves on and off of the site. Since the issue of return flows from the irrigated land will be vital later in the transaction process, try to get a sense on the ground of the presence, absence, and/or location of possible return flows from an irrigated field back to the source stream.

Water Use History. Depending on state law, the amount of water available for transfer may be limited to historical use or it may be limited to maximum potential consumptive use, or transfers may begin with a presumption that the full paper right can be transferred instream. It is therefore vital to first know your state's particular law, and then use the due diligence process as a chance to gather and analyze any and all information you can find on historical water use. Pertinent information to gather includes crop records (what was grown, how much), site specific evapotranspiration rates for different crops, diversion records, pumping records, electricity bills, and detailed descriptions of past and present operations by the landowner. All or some combination of this type of evidence will help determine a precise history of water use for the relevant water rights. In turn, this can be compared to the paper water right to help you determine how much water may be transferable.

Mapping and Water Infrastructure. Several different maps are useful in the due diligence process. Historical maps like original water right decree maps, the maps that accompanied an original permit application, or maps from previous transfers involving the same water right. Comparing any and all available maps is a useful way to track any changes that were made to the water right over time. Practitioners with the capability should also create a new map using GPS, current aerial photos, and GIS. This new map can be compared with the historic maps to help confidently locate the correct acres under irrigation.

Analyzing the existing water infrastructure is also a key step. Examine and photograph the diversion works including the headgate, fish screen (if present) and other key features. Walk the length of the ditch (if there is one) and note any major concerns such as visible leakage. Finally, closely examine the landowner's take out from the ditch, or their pump system in the case of a piped irrigation works. For pumps, make note of the type of pump, the horsepower, the number and size of sprinkler nozzles (if any). All of this information is useful in quantifying the water right and current levels of use.

Title Work on Land and Water Rights. For long term and permanent water transactions, it is worth the time and effort to pay a title company to do a title search on the relevant property. Title searches help discover any red flags and encumbrances that could derail a transaction late in the process. A search of county records for any recorded water right sales can also help to ensure that the relevant water rights have not been sold to someone other than the landowner. Though it seems like this would be obvious to a landowner, it is not uncommon for real estate agents to represent that a property is irrigated when in fact the water rights have been reserved by the seller or sold to someone else.

8.5.2 Due Diligence on Related Assets

In addition to conducting due diligence on the water rights themselves, it is also important to carefully analyze any assets related to the water rights such as the irrigation infrastructure. For some water rights, this could be a very limited review. For example, if the landowner is the only water user on a short ditch or the landowner simply has a pump in the creek, this analysis will not be difficult. However, if the water user is part of a large shared ditch or diversion system with significant infrastructure, the analysis can be more complex.

8.5.3 Due Diligence on Water Right Changes and Water Delivery

Another form of due diligence that is vital to quantifying the transferability of a water right is to thoroughly vet potential water right changes with both state agency staff and any relevant on-the-ground water managers that may be involved such as an irrigation district manager. Consulting with the local watermaster or other state agency field staff about planned water right change applications is not only a major time saver later in the process, but it can be a vital due diligence step before committing to a transaction as well. Local agency staff will have insight about water use and protectability of water instream that are not obvious to the water user or practitioner. Other water managers such as district staff will also be helpful in this process.

The essential question to answer with this phase of due diligence is whether the proposed water right change at the heart of the potential transaction is realistic and workable. To determine, in other words, the quantity of water instream that will likely result from the proposed project and also how or how far that water can be protected downstream once an instream right is created. As discussed later, the state agency change process can be fraught with challenges and hurdles. Work done up front to thoroughly analyze every angle of the transaction will more than pay for itself in later transaction stages.

8.5.4 Due Diligence on Transaction Contingencies with Third Parties

A final important water right due diligence step is to analyze and prepare for the contingency of potential third party impacts.

Subsequent Land Use – Weeds, Dust, etc. Carefully talk through the landowner's plans for land stewardship after the transaction is complete. Especially if the transaction could result in drying up formerly irrigated land, it should be the transaction practitioner's responsibility to help the landowner develop a stewardship plan to cut down on invasive weeds and dust problems that might be long term management headaches not only for the landowner, but for their neighbors.

Water use – Conveyance Authorities (i.e. Irrigation Districts and Companies). On shared irrigation systems, instream leases and transfers can impact non-participating third parties by reducing the overall diversion. Before committing to a transaction, make sure that these impacts are well understood and, more importantly, agreed to by necessary parties.

Terms of any Change in the Water Rights. In consulting with state agency partners on potential transactions, one of the key lines of questioning should be what conditions, if any, they might require on the proposed water right change in order to approve it. Conditions can include diversion upgrades, inclusion of measurement devices, installation of fish screens, and/or conditions on how the water can be protected once instream. For example, the state agency is likely to propose reductions in the amount protected instream to account for channel reaches with significant amounts of natural loss. Knowing these conditions before hand is vital to finalizing and negotiating a water transaction.

Other Complications. Thorough due diligence is about trying to think through all possible contingencies. In addition to land stewardship concerns, conveyance impacts, and possible water right change conditions, it is important to look for any other possible conditions related to the specific context of the transaction. These could be specific issues with a neighbor, or if the right is located near a tribal reservation, particular complications involving tribal water rights. Removing water from a property may also affect the tax deferment status of a property zoned for agricultural use. These are just three out of a world of possible complications. The point is to think carefully through every transaction. It may be impossible to cover every contingency, but that doesn't means you shouldn't try!

8.5.5 **Community Due Diligence**

In addition to water right due diligence, community due diligence is a way to buffer against unforeseen consequences of a transaction. There is no set format for how to conduct community due diligence. The primary concerns this analysis seeks to address are the potential for protests of proposed transactions, the potential for public backlash that could affect the transaction organization's long term prospects in a watershed, and the effect the transaction might have, positive or negative, on prospects for future transactions.

8.6 Moving Forward: the Transaction Cycle

With money, a willing seller, an identified transaction and due diligence in hand, the practitioner is ready to move forward with the transaction. Further steps in the transaction cycle are provided below in Box 8.1, along with an indication of the chapter in which the topic is pursued.

Box 8.1 Additional Steps in the Transaction Cycle

1) Transaction: Decision-Making
    a) Process of deciding whether to proceed with the transaction to include:
        i) Appraisal or Valuation of Water Rights (Chapter 9)
        ii) Evaluation and Necessary Board Approvals for Transaction (as per the organization)
2) Transaction: Contracting with Seller (Chapter 10)
    a) Negotiation of terms with seller to include:
        i) Legal agreements with seller
        ii) Legal agreements with third parties
        iii) Escrow, closing and recording/conveyance
3) Transaction Contracting with Buyer (Chapter 10)
    a) Negotiation of terms with buyer to include:
        i) Obtaining approvals for funding from agencies and non-profits
            (1) Funding agreements
        ii) Marketing water rights to buyers (for out-of-stream uses)
            (1) Legal agreements with buyer
4) Changes to Water Rights (Chapter 10)
    a) State and Federal approvals for changes to water rights (as necessary)
5) Conveyance, Operations and Compliance Monitoring
    a) Necessary operational arrangements for the diversion/non-diversion of water and delivery/protection through to end use/end of protected reach (as per the project)
    b) Compliance Monitoring (Chapter 11)
6) Effectiveness Monitoring (Chapter 11)
    a) At transactional, reach or programmatic level, assessment of effectiveness of transaction and conveyance in achieving transactional goals

8.7 Resources

8.7.1 Internet Links

Water Transaction Programs:

The Columbia Basin Water Transactions Program and links to Qualified Local Entities http://www.cbwtp.org

Bonneville Power Environment, Fish and Wildlife Program: http://www.efw.bpa.gov

Walker Basin Restoration Program: www.nfwf.org/walkerbasin/

Minute 319: www.ibwc.state.gov/Files/Minutes/Minute_319.pdf

Water Transaction Funding Programs:

BEF Water Restoration Certificates: www.b-e-f.org/our-solutions/water/water-restoration-certificates/why-wrcs

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CHAPTER 9
WATER RIGHT APPRAISALS FOR ENVIRONMENTAL WATER TRANSACTIONS

Ray Hartwell

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Figures

Boxes

Ecosystem Economics
PO Box 2062, Bend, OR 97709, USA
www.ecosystemx.com

Water Right Appraisals for Environmental Water Transactions

This chapter covers appraisals of water rights in the context of water transactions, addressing key issues for the water transactions practitioner. The discussion is focused on central issues of concern to the practitioner who will not personally undertake appraisals but may commission them in the course of work or encounter appraisals commissioned by others. The chapter begins with a description of what appraisals are, when they are needed, and what they typically entail. Specific valuation methods used in appraisals are then presented, coupled with key considerations pertaining to the use of appraised values in development and execution of transactions.

9.1 Water Right Appraisals

Appraisal is the practice of formally estimating the market value of real property. In the appraisal of water rights, the right to appropriate water is the real property interest that is being valued. It is important to emphasize that appraisal is a formalized process for assessing the market value of property. This appraised value is not necessarily the amount that will be negotiated between the buyer and the seller for the exchange of the water rights. Also, the appraisal produces an estimate of value that can be used to decide whether or not to purchase the water rights. The appraised value does not, in and of itself, say anything about whether the purchase will be "worth it" to the buyer.

Formal Standards. Appraisal adheres to formal standards that establish who can perform appraisals and how they are to be conducted. A credentialed appraiser generally conducts an appraisal, whereas economic valuation can be undertaken by anyone with requisite knowledge of economics and the local water market. Credentialing of appraisers varies by jurisdiction, but most states regulate who can perform appraisals used for official purposes. Formal standards for completing appraisals provide guidance on the structure and methods used in appraisals. Economic valuation, by contrast, can incorporate a broader suite of techniques in arriving at estimates of value.

Market Value. Appraisals provide estimates of market value and do not consider other values. Guidelines for conducting appraisals specify that market value determines the value of the property in the appraisal. Market value is an appropriate measure of value in the context of most real property transactions (including water transactions). However, this implies that the non-market value of water for streamflow or other environmental use is not considered in appraisal.

Appraisals are required to estimate the value of the property in its highest and best use. This implies that a water right's value in an appraisal will equal its value in whatever permissible use has the greatest market value, notwithstanding its current use. Importantly, consideration of highest and best use is limited to market values and therefore will typically not include environmental uses, no matter how high their economic value. Economic valuation, in contrast to appraisal, does consider non-market values.

Understanding precisely what appraisals are and how they arrive at estimates of value can inform a practitioner's choice of formal appraisal or broader economic valuation of a water right. In some circumstances, appraisals are required (potentially alongside other valuation information) – these cases are discussed below.

9.2 When are Appraisals Needed and How are they Used

Though appraisals and less formal valuations can produce identical estimated values for water rights, appraisals are explicitly required in some circumstances. This section addresses when appraisals are needed and how they are used.

9.2.1 Need for Appraisal

The valuation information provided in an appraisal is broadly useful in developing and structuring transactions of water rights, but the strict *need* for appraisals generally stems from requirements associated with transaction funding sources. Three specific funding-related needs for appraisals are to:

- meet requirements for expenditure of public funds;
- establish defensible values of rights for tax uses; and
- access financing.

Public Funds. Federal and state funding for water right acquisition figures prominently in supporting many water transactions programs, and appraisals may be required to justify sales prices for these purchases. Appraisal requirements will vary with funding source and practitioners should always check with the managing agency to confirm specifics. Notably, there are separate appraisal guidelines for federal acquisitions; these are codified in the "Yellow Book," or *Uniform Appraisal Standards for Federal Land Acquisitions,* discussed below (USAFLA 2000). In practice, the differences between different appraisal standards are not great, but it is critical to understand specific requirements to ensure that the appraisal will be acceptable for its intended use.

Tax Values. Appraisal is also often required to substantiate values claimed for tax deductions related to donation of water rights or conservation easements. Specific requirements vary by jurisdiction and the practitioner should check with the appropriate taxing authority for details. There is some question about whether organizations receiving donated rights have obligations to ensure that values used by donors in calculating tax deductions or credits are appropriate; in practice, many organizations use disclaimer language advising donors of internal revenue service requirements but stop short of further involvement (see Nichols et al. 2001, p. 48 for more information).

Financing. As with residential mortgages, banks and other financial organizations often require appraisal to establish the value of properties being financed. Although debt financing is not common in conservation purchases of water rights, appraisal of the rights would be needed to access this funding from most conventional sources. Also, in the case of the prospective sale of water rights from a property, a bank or other creditor may require an appraisal to ensure that the seller (and then the creditor) is not stranding the land value in the mortgage by selling the water rights at a discount to their market value.

9.2.2 Uses of Appraisals

Water right appraisals can be used in several ways to support transactions. First, appraisals can obviously be used to meet the needs described above related to procedural requirements of various funding sources. However, the valuation and market information in the appraisal report also can deliver other benefits.

By their vary nature, water right appraisals provide a wealth of information on the local market for water rights and the different bases for water value. In most cases, the appraisal will address the sales prices of recent comparable water right transactions, the production value of water in agricultural use, and perhaps even the cost of developing water supplies. All of that information is critical in informing an appropriate acquisition price for the environmental buyer.

The market research contained in an appraisal provides value even if a formal appraisal is not needed for other reasons. Conducting research through an appraisal ensures that estimates of value will follow a strict methodology and be broadly consistent with those made by other appraisers. Appraisals can confirm or call into question less formal economic valuation and market research, and can thereby increase confidence as water transactions are negotiated.

Appraisals, by virtue of the their prominent and standardized role in many real estate transactions, can justify prices paid for water rights. Even in cases where flexibly funding sources do not require appraisal prior to conservation purchases, organizations may wish to have potential acquisitions appraised as a way to demonstrate additional due diligence.

Notwithstanding these valuable uses of water right appraisals, practitioners should use caution in relying on appraisals as a single source for information on what they should pay for a water right for several reasons. First, as mentioned above, appraisals identify the market value of a water right, but have little bearing on the environmental value of the right. In cases where a right provides a unique source of ecologically critical water, it might make sense to pay more than the market value to acquire the right if necessary to secure the transaction. Second, market value of a water right does not provide any information on what it costs to dedicate water to restoration purposes, and so it should not be relied on alone in determining whether to pursue a deal.

9.2.3 Appraisal Standards

As mentioned above, appraisals are conducted to various standards depending on their intended use. The two main standards for the conduct of appraisals are the *Uniform Standard of Professional Appraisal Practice* (USPAP) and the *Uniform Appraisal Standards for Federal Land Acquisitions* (UASFLA or "Yellow Book").

USPAP. The USPAP is the standard governing real estate appraisal in the United States. The guidelines outline the format and methodological requirements for appraisals. Most appraisals will follow USPAP, though practitioners should always confirm the requirements related to using appraisals for different purposes.

Yellow Book. The Yellow Book standards govern appraisals used when federal funds are expended. This separate set of standards exist to ensure uniformity of practice by the various agencies acquiring property on behalf of the federal government. Such standards are particularly relevant in cases where the United States exercises eminent domain to "take" private property. In such cases the government is required to provide just compensation, which is defined to be the fair market value at the time of appropriation or what "a willing buyer would pay in cash to a willing seller" (USAFLA 2000: 29).

In addition, certain government purchasing practices also have implications for appraisal methods. For example, the federal government typically pays the cost of a lease in a single initial payment rather than a stream of monthly payments, and the conversion of cash flows to accommodate this approach is addressed in the Yellow Book (USAFL 2000: 99). Yellow Book standards are consistent with USPAP, but use the latter standard's "jurisdictional exception rule" to ensure consistency with overriding federal law. Yellow Book standards themselves can be modified in certain circumstances. Therefore, as with all appraisals, it is important to confirm specific standards and requirements with the agency or entity that requires the appraisal.

Project Appraisals. The Yellow Book also has specific guidance on "Project Appraisals", which have particular relevance to acquisition of water rights for environmental restoration purposes. A project appraisal is a single report that provides valuation estimates for multiple properties or a class of property. These appraisals are appropriate when the multiple properties being appraised are similar in terms of geography, improvements, highest and best used, appropriate valuation method, and data used in valuation (USAFLA 2000: 103). For federally-funded water transactions programs where multiple similar water rights will be acquired, a project appraisal is probably appropriate.

As previously mentioned, the differences between different appraisal standards are often not large, but it is important to understand the standards governing the appraisal needed in each specific case and ensure that the appraisal is performed accordingly.

9.3 Appraisal Issues for Water Rights

Appraisals and the associated standards pertain to real estate generally, including land, improvements on land such as buildings, and additional partial interests such as water rights. Because right to use water generally are associated with the land where the water is used, rights are regarded as a partial interest in a piece of real estate (Herzog 2006).

As with other partial interests, water right values are often assessed using a "before and after" analysis where the value of the property is estimated both including and excluding the water right. The two valuation estimates are compared and the difference in value is the value of the water right. This analytical approach is also used to value encumbrances on land, such as conservation or other easements that restrict use and lower value. Notably, the valuation approaches used to estimate the values of the property with and without rights are the same as those used in other appraisals (discussed below).

Although land appraisal can be the basis for deriving water value, in areas where there are transactions in water rights, it may be possible to directly establish the market value of the right from examining these transactions.

Appraisals always include definition of the "neighborhood" in which the property is located. The neighborhood informs whether a comparable transaction is in the same market, and therefore whether information on the value of that transaction is relevant to the appraisal. In the case of water rights, definition of the neighborhood is not defined purely by the geographic proximity of the place of use. Instead, the basin or hydrological system (such as an irrigation district or confined subreach of a stream) is used as the relevant market in which to value the rights. It is therefore important to consider delivery infrastructure and the ability to transfer rights between uses and locations when defining the neighborhood for appraisal purposes. This process sometimes produces counterintuitive result – in areas where no infrastructure or institutional ability exists to allow transfers of water rights, a municipality adjacent to a water-righted farm may be in a different neighborhood for purposes of appraisal. This is particularly the case when legal barriers prevent water transfers, as is often the case with moving water over state lines or between basins. Conversely, a distant purchaser may be appropriately included in an appraisal's neighborhood if water can be transferred to that location.

Finally, water right appraisals are uncommon. Many appraisers are unfamiliar with water rights, water law, and hydrology, and may be challenged to perform an accurate valuation without support. It is therefore common for appraisers to team with other water professionals to ensure a full understanding of the rights being valued, their legal status, historical use, and reliability. Practitioners may need to assemble a team to support the appraiser in accurately valuing water rights.

9.4 Appraisal Content and Concepts

Appraisals include standard formal content defined in the USPAP or Yellow Book and will all have common elements. This section introduces the key content elements of an appraisal and highlights implications for valuing water rights. Note that the order and structure of these sections may vary in individual appraisals, but in many cases they are consistent across practitioners, property types, and regions. An appraisal will also be described either as "summary format" or "self-contained." Summary appraisals are theoretically condensed relative to self-contained reports, but in practice the length and contents of the two formats are often similar.

9.4.1 Title Page and Letter of Transmittal

The title page and letter of transmittal will introduce the appraisal. The letter provides basic information including a description of the property/water rights being appraised and confirmation of the effective date of the appraisal. It will summarize any hypothetical conditions or extraordinary assumptions that may qualify the value estimate, and will state the estimated value of the appraised property. The appraiser will sign the transmittal letter.

9.4.2 Appraiser's Certification

The appraiser's certification is a formal statement describing the methods and context in which the appraisal was conducted, and certifying compliance with professional standards. It is similar in some ways to an auditor's opinion letter accompanying a financial audit. The certification confirms that the appraisal contains true and correct information. The certification will also address standard requirements to preserve objectivity and avoid conflicts of interest, including confirmation that the appraiser does not have a financial interest in the property appraised and is not receiving fees that are contingent on a specific appraisal result. The standards used to conduct the appraisal will be described – this is typically a simple statement that the appraisal followed USPAP or the Yellow Book. The certification will also describe any assistance the appraiser received, typically disclosing the role of any consultants involved in the process. In the case of water right appraisals, this typically will include any engineers, hydrologists, lawyers, or other professionals who provided information that informed the appraisal. The certification will also include the estimated value of the appraised property.

9.4.3 Summary of Salient Facts and Conclusions

The key facts and conclusions of the appraisal are presented in the summary. This will typically summarize the results of sub-analyses included later in the appraisal, including presentation of:

- identification of the property that is appraised;
- the highest and best use of the property identified in the appraisal;
- description of improvements to the property;

- the value of the property using each approach to valuation used in the appraisal;
- the final value estimate of the appraisal; and
- hypothetical conditions or extraordinary assumptions incorporated in the appraisal.

9.4.4 **Assumptions**

Appraisals invariably include assumptions in their analyses of property values. In many cases, these are routine and relatively uncontroversial – for example, a water right might be appraised under the assumption that the long-term hydrological conditions are stable. Appraisals can also incorporate more aggressive assumptions that entail a significant risk of being incorrect. For example, the analysis might assume that a water right could be transferred to municipal users through state regulatory processes even absent precedent or government assurances confirming that assumption. In this case, if the assumption proved incorrect, the appraised value of the right would also likely change. Assumptions of this nature are formally termed "hypothetical conditions" or "extraordinary assumptions" of the appraisal. Conducting an appraisal under aggressive assumptions is permissible in most cases, but the assumptions must be clearly stated; as such, hypothetical conditions and extraordinary assumptions incorporated in the appraisal will be cited in the letter of transmittal and appraiser's certification.

The ability to include assumptions in appraisals is helpful in the case of water rights where transferability, adjudication, consumptive use, and other relevant determinants of value may be unknown. An appraisal can proceed using assumptions as long as they are disclosed. The use of assumptions can also effectively reduce the scope of the appraisal, thereby potentially reducing costs.

9.4.5 **Scope**

An appraisal will be conducted within a certain scope that defines the extent of the investigation undertaken by the appraiser in estimating value. The scope will typically describe the geographic and temporal extent of any search for comparable transactions, for example. It can also define the amount of due diligence conducted to confirm data used in valuation. In this way the scope may imply the use of assumptions – for example, when the scope does not include in-depth investigation into whether a water right is subject to forfeiture for non-use, it implies that the appraisal is using the assumption that the right is not subject to forfeiture. Depending on the appraisal requirements of a specific transaction, it might make sense to limit the scope in areas where there is ample information and require additional research of the appraiser where there is relevant uncertainty. A scope might also exclude one or more approaches to value if they are not relevant. For example, the cost approach to value is not typically relevant to water rights in the context of over-appropriation (as explained further below). The appraiser will describe the appraisal's scope in his report.

9.4.6 **Purpose**

Appraisals will also include a section describing the purpose for which they were conducted. The purpose will typically be to estimate market value of the property as of a specific date. The intended user and use of the appraisal report will also be described (though typically in vague terms).

For purposes of appraisal, the Yellow Book defines market value as:

> *Market value is the amount in cash, or on terms reasonably equivalent to cash, for which in all probability the property would have sold on the effective date of the appraisal, after a reasonable exposure time on the open competitive market, from a willing and reasonably knowledgeable seller to a willing and reasonably knowledgeable buyer, with neither acting under any compulsion to buy or sell, giving due consideration to all available economic uses of the property at the time of the appraisal. (USAFLA 2000:13)*

This definition of market value will in turn inform the appraisal's valuation analysis. For example, price information on sales executed under duress might be excluded from analysis because they do not conform to the definition of market value.

9.4.7 **Property Description**

The appraisal will also include a detailed description of the property being valued. This description will appear both at the summary level and also in an in-depth section of the appraisal. In a standard real estate appraisal, the description will include the legal description of the parcels being valued, photographs, descriptions of any buildings, infrastructure, or other improvements, and physical conditions of the site (e.g. forests, soil conditions, etc.). In the case of water rights, the relevant description may be more limited, but it is important to understand whether the property being appraised is limited to the rights or includes conveyances, sprinklers, pumps, or other infrastructure.

Along with description of the specific property being appraised, the report will also include a description of the neighborhood. This section will describe the local geography, population and economic trends, roads and relevant infrastructure, and other information relevant to the value of the property. While the neighborhood concept is intuitive for residential real estate appraisals, it becomes more subjective for rural properties and can be difficult to specify for water rights. As mentioned above, given the use of the neighborhood concept to define the relevant market for the property being appraised, for water rights it is best defined by the basin or relevant water management area. This definition of relevant market determines which other transactions may be considered comparable sales, and therefore directly influences the valuation analysis.

9.4.8 **Appraisal Problems**

The appraisal will also include a section describing any problems or difficulties encountered by the appraiser. With appraisal of water rights, a lack of information on comparable sales of water rights in the market is a frequent problem. Appraisal problems are described in the body of the report and are also highlighted at the summary level if significant.

9.5 Valuation: The Core of Appraisal

The estimation of value is at the core of appraisal. This section describes the formal approach to valuation used in appraisals, highlighting key considerations for the appraisal of water rights. Valuation in appraisal involves two steps. First, the "highest and best use" of the property being appraised is determined. Second, the value of the property in this highest and best use is estimated using one or more of three methods: (1) comparable sales, (2) income, and (3) cost.

9.5.1 Determining Highest and Best Use

Determining the highest and best use of property being appraised is the first step in valuation analysis. Crucially, the highest and best use of the property may differ from its current use. Rules around using the highest and best use are designed to prevent the undervaluing of property. For water rights, this can comes into play when rights used in agriculture are more valuable when transferred to municipal, industrial, or other development use. In this case, agriculture is not the highest and best use of the rights and their value will be based on the price of purchase for transfer to other use.

The highest and best use property must be (i) legally permissible, (ii) physically possible, (iii) financially feasible, and (iv) maximally productive. While these criteria are relatively straightforward, there are some considerations for water right appraisals that bear emphasis. Requirements that the highest and best use be legally permissible and physically possible often impact appraisals of water rights.

Legally Permissible. Both water law and institutional constraints can limit the transfer of rights to many uses. For example, water often cannot legally be transferred across state lines, and most irrigation districts limit or prohibit sales of rights outside of the district boundary. This means that, for example, sales of water rights from a southern New Mexico irrigation district to municipal use across the state line in El Paso, Texas, cannot be the highest and best use of the right because it is illegal. Similar, spreading a water right's volume over more acres than are permitted cannot be the highest and best use even if it is relatively profitable.

Physically Possible. A legal use of water may not be physically possible because limits to conveyance infrastructure or transferability. For example, it might be physically impossible to transfer a water right between two tributaries, even within the same basin. In this case, the use in the other tributary cannot be the highest and best use, even if it more profitable than other uses.

The highest and best use of a water right also refers to market value alone. As a result, it will typically reflect the use of the water right in agriculture (whether in production or sale) or in sale to municipalities/developers in areas where that is feasible in the market. The requirement that highest and best use be a market value means that environmental, social, or other non-market values will not be considered. This, however, does not imply that the water is not of value (or even most valuable) in those uses, but rather that they are not market values. These non-market values can be included in economic valuation.

9.5.2 Comparable Sales

The comparable sales approach to valuation is perhaps the most common of the three techniques considered in appraisal valuation. In this method, the appraiser assembles a list of recent sales of similar pieces of property, called comparable sales, and analytically infers the market value of the property being appraised from these similar transactions. By using prices from market sales to establish value, the approach is less reliant on determination of the right's highest and best use to arrive at value. Market prices may reflect sales for any purpose, and so drawing distinctions between agricultural and development uses is less central to the method.

In an ideal situation, numerous recent transactions of very similar properties will provide a strong basis for estimating the appraised property's market value. With respect to water rights however, the comparable sales approach can be difficult to implement because there are often few similar transactions that can offer a basis for comparison. In fact, difficulty finding appropriate comparative sales also is common in appraisal of farm and ranch properties. In both of these cases, a small volume of trade coupled with variation among properties can challenge the appraiser to assemble a group of comparison sales that reflects the likely value of the appraised property. If there are few or no past sales of comparable water rights, appraisers will often look to comparable sales of land with the goal of understanding the difference in value between parcels with and without water rights – this difference is the value of the water rights.

Transactions used in the list of comparable sales must (obviously) be similar to the property being appraised. For water rights, this means that values are presented for the same unit, class, and grade of water rights. Specifically:

- sales data should use common units of quantity; for example, comparing sales of acre-feet with sales of acres of water rights would be inappropriate;
- water rights used in comparison should have the same priority date or be of similar reliability;
- the quality of water should be similar; and
- related costs should be similar; for example, rights that require payment of an irrigation district assessment should not be directly compared with those that can be diverted at no cost.

In addition to these water-specific criteria, general guidelines for comparable sales require that:

- sales be from the same market or neighborhood; as described above, with water rights this can be more a reflection of the water management area than actual place of use;
- differences in soil quality, property improvements, and physical site characteristics be considered with land sales; and
- sales be recent; inclusion of transactions from further back in time may be warranted if the market has been otherwise stable, but this generally requires justification.

In most cases, even the best list of comparable sales will include properties that are not perfect comparisons in all aspects with the one being appraised. For example, the appraiser may be faced with the problem of appraising:

- an 1870 priority date based on data on the sale of an 1899 priority date;
- a 100 acre water right based on the sale of a 2 acre water right;
- a water right in one watershed based on the sale of a water right in another watershed;
- a surface water right based on the sale of groundwater rights; or
- a supplemental right based on the sale of a primary right.

Additional analysis must then be performed to arrive at a realistic estimate of value. This analysis is typically performed using either hedonic analysis or an adjustments grid.

Hedonic Analysis. Hedonic analysis is a method to estimate the contribution of different components to a piece of property that is composed of multiple different attributes. In appraisal of farm properties, the value of a property might include contributions from several attributes: the acreage of land, soil quality, buildings, water rights, and proximity to urban areas. Hedonic analysis uses price variation between properties that differ in these attributes to estimate values for the attributes themselves. In a simple case, comparing the value of properties with and without water rights produces an estimate for the value of those rights, assuming the properties are otherwise similar. The technique can also be used to compare water rights themselves and arrive at estimates of the contribution of priority date, duty, or other factors to the value of the right.

In economics, the statistical technique of multiple regression is used to carry out hedonic analysis. Providing there is sufficient data available from comparative sales, this can be a powerful and objective way to estimate value in appraisals. In most cases, however, the comparable sales list does not include enough data to allow for regression, and adjustment grids or other techniques must be used. An example of hedonic analysis is provided in Box 9.1.

Box 9.1 Hedonic Analysis of Groundwater Right Sales in the Lower Rio Grande.

Demouche, Landfair, and Ward (2010) conducted a hedonic analysis of groundwater right prices based on 24 transactions in New Mexico's Lower Rio Grande executed between 1980 and 2007. After analyzing several potential regression specifications, they developed a model that explains roughly 45% of the variation in observed prices based on the following five variables: (i) urban demand, measured as the total water consumption by the City of Las Cruces; (ii) priority year of the water right; (iii) farm income, expressed as gross cash receipts from sales of farm commodities in Dona Ana and Sierra Counties; (iv) acre-feet sold (captures economies of scale) and; (v) reservoir level, measuring the availability of surface water.

Of these variables, only farm income and acre-feet sold are statistically significant predictors at conventional levels. The impact of farm income is significant, with a $1 million increase in regional farm income associated with an $11.42 increase in the price per acre-foot. A slight discount accrues to the buyer as the volume of water right purchased increases; for each additional acre-foot included in a transaction, the average unit price decreases by $1.21. As expected, an inferior priority date is associated with a lower sales price, though the impact of $12.83 per year of later priority is not statistically significant.

This example highlights several considerations in implementation of hedonic approaches to comparable sales (Hartwell and Bardwell 2012). First, despite a database of 24 sales, the model did not produce statistically significant results for all variables, and factors hypothesized to be major drivers of value were not found to strongly impact results (e.g. priority date). Second, because the technique is based in statistics, any parameter included in the model must be expressed as data. So, for example, the strength of the farm economy is captured using the farm income variable and Las Cruces' consumption is a proxy for urban demand. For some properties, establishing variables can be difficult – consider for example the challenge of quantifying variation in soil quality or scenic views. In sum, hedonic analysis can produce powerful results, but these results are dependent on large quantities of data that will rarely be available.

Adjustments Grids. Manual adjustment of comparable sales through an "adjustment grid" is the most common approach to addressing the issue of imperfect comparisons in the sales comparison approach to appraisal. Under this approach, the observed prices of comparable sales are systematically adjusted to reflect variation in the property being sold, approximating an "apples to apples" comparison as demanded by the comparable sales approach. This approach is often presented in a matrix or grid that articulates the differences between sales transactions and specifies the resulting adjustment to the sales price for comparison purposes. Figure 9.1 below provides an example.

Figure 9.1 Appraisal Adjustments Grid

Factors	Subject (Property Being Appraised)	Comparison Sale 1	Comparison Sale 2
Sale Price	N/A	$1,700,000	$275,000
Sale Conditions	Per Market Value Definition	Arms Length	Motivated Seller
Adjustment 1		$0	+ $25,000
Adjusted Price 1		$1,700,000	$300,000
Improvements	Irrigation ditches and roads	Similar plus house and barn	Similar
Adjustment 2		-$100,000	$0
Adjusted Price 2		$1,600,000	$300,000
Applied Water per Acre	4.0 acre-feet	3.75 acre-feet	2.0 acre-feet
Adjustment 3		equal	inferior
Priority Date	1924	Pre-1914	Pre-1914
Adjustment 4		superior	superior
Adjustments 3+4		-$100,000	$0
Final Adjusted Price		$1,600,000	$300,000
Acres		1,000	200
Adjusted Price per Acre		$1,600	$1,500

Source: Adapted from Herzog (2006: 3-5)

The sample adjustments grid above presents a simplified example of typical adjustments made in the course of implementing the comparative sales approach to appraisal. Initial sales prices are quantitatively adjusted based on conditions of sale, differences in the property, and discrepancies between associated water rights. The price of Sale 2 is adjusted upward to compensate for the seller's motivation, which is judged to have resulted in a low actual sales price. Similarly, Sale 1's price is adjusted downward to remove the assumed impact of a house and barn, which are improvements absent in the property being appraised. Finally, factors related to water rights are considered. For Sale 1, the duty is roughly equivalent to the subject property, but the water right has superior priority date, so the price is adjusted downward to render it more comparable to the junior priority date of the parcel being appraised. Sale 2's water also has a senior priority date, but this advantage is offset by a lower duty, and no adjustment is made. Finally, all prices are normalized on a per acre basis to facilitate comparison.

As is illustrated above, adjustments entail first assessing relevant differences between comparable transactions. Due to the nature of properties being appraised, this is typically done in qualitative or directional terms. For example, the location of one sale might be described as "inferior," "superior," or "vastly superior" to another. The appraiser then must judge the quantitative dollar impact on property value of this qualitative difference in the property based on market knowledge. This is the most subjective aspect of the analysis.

The adjustments grid approach provides a formal method or framework in which the appraiser makes professional judgments about the value of different attributes of property. While statistical hedonic analysis or inference from directly comparable sales rely only on empirical data to inform valuation estimates, the adjustment grid approach uses pricing data as a point of departure from which the appraiser estimates the final value. There are tradeoffs inherent in this approach. On the one hand, departure from the foundation of observed market data introduces some risk of subjectivity in the analysis, regardless of the appraiser's intentions. At the same time, slavish devotion to data is a liability in cases where comparable sales do not fully reflect the property being appraised (warranting the adjustments). For the practitioner, understanding this tradeoff is important to assessing an appraisal. This is not to say that skepticism is warranted when adjustments grids are used – often they are the best technique given the available information – but simply to highlight that the appraiser's market knowledge and individual judgment is being applied through the grid.

9.5.3 **Income and Productivity Approaches**

The income approach estimates the value of property based on the income that property can generate in production. Under this approach, the stream of income produced by the property in its highest and best use is converted into an estimate of present value. Major inputs into this calculation include:

- identification of the property's highest and best use;
- calculation of the income produced by the property in that use; and
- identification of the relevant time horizon and discount rate for use in deriving a present value from the income stream.

The property's highest and best use is drawn from that section of the appraisal, and is integral to this approach because it determines the stream of income used to calculate the property's value. For example, if a water right's highest and best use is the production of forage, then the net income attributable to the water right in that use should be used in the calculation. This can be challenging, because analysis is required to understand what portion of the value of forage produced is related to the water right. Typically this is calculated by taking the forage income and subtracting from it all production costs. These will include variable inputs (e.g. labor, fuel, and fertilizer) as well as appropriate charges for other assets, or fixed costs (e.g. machinery and land) deployed in generating the forage.

Note that analysis of net income is much more straightforward if there is a lease/rental market for the water right that provides a single figure for lease income for water rights. However, this figure is only relevant to the value calculation if it reflects the right's highest and best use. Many irrigation districts have an annual lease market for surplus water allocations that allows farmers to purchase additional water. Often this water is offered at low prices designed simply to cover irrigation district assessment costs. Theses leases are usually not the highest value use of water, and so lease rates are not that useful in the income approach to valuation. The current use of a water right in economically marginal ways is not a suitable basis for an estimate of the appraised market value of the right, which is based instead on its highest and best use.

Once the net income is defined a stream of such income must be projected out into future years to represent the highest and best use over time. As there are many goods and services involved in the net income calculation and the prices of these goods and services may vary over time such projections are subject to assumptions made by the analyst. Often the simplest approach is to assume that net income does not change over time, or that market prices simply escalate with inflation. It is worth noting that even such an approach represents and implicit assumption, in this case that prices will not change or will change in lockstep fashion and at a constant rate of inflation.

Once an income stream is defined a discount rate must be chosen in order to account for the time value of money (or cost of capital). The choice of this rate, which is the inverse of an interest or capitalization rate, poses challenges for the income approach to valuation for two reasons. First, there is not an agreed upon single rate that should be used. Second, even small differences in rate produce large differences in estimated value. For example, an income stream of $10,000 over 30 years equates to a value of $173,000 at a 4% discount rate, while the same stream will be valued at $224,000 using a 2% rate. In theory, the cost of capital in the highest and best use should determine the choice of rate. For example, farm interest rates should be used if agricultural production is the highest and best use, but municipal costs of borrowing might be more relevant if the right will be leased to cities. Even with this guidance, the choice of rate will involve some judgment. Because variations in interest rates between borrowers (as a function of their creditworthiness) and over time can materially impact the calculation of value, practitioners are advised to understand the choice of rates and consider how that choice shapes the final estimate of value.

A final consideration is that the choice of length of the income stream, or time horizon, is related to the choice of discount rate. The nature of discounting is that the value of net income in each successive year declines. At some point continuing to include additional years of production and accruing present values of future income streams becomes a trivial exercise. Thus, the higher the discount rate the fewer the number of years that need to be included in the analysis. For example, a 10% discount rate usually suggests the need to accrue values over a 40-year time horizon. The present value of a future income stream after 40 years at 10% discounting is minimal at 2% of the original future value. However, at a 4% discount rate this percentage of original value at 40 years would be 21% and thus cutting off the time horizon at 40 years would be truncating the income stream and under-estimating the present value of the property.

In practice, the challenges described above mean that the income approach to value is rarely central to an appraisal for the purchase or sale of water rights, particularly if comparable sales data is available. The appraiser will typically have more confidence in comparable sales because they represent observed data points of how actors in the water right market value weigh and assess all the considerations that go into an income calculation. Therefore, the income approach is more of value as a secondary figure for use in comparison with estimates of value obtained from the comparable sales approach. If a conservative valuation estimate under the income approach is greater than expected based on comparable sales, additional explanation of the variance is appropriate.

Conversely, for the purpose of appraisal of lease or time-limited water right transaction the income approach may be preferred as it may be a better representation of the highest and best use of the water right in the short term. For this purpose, values emerging from a comparable sales approach using data for the purchase and sale of a water right would need to be converted into annual or short-term estimated of value. This requires a capitalization rate that allows the derivation of an annual value from a present value, and, thus, raises questions about whether this is appropriate and what rate to use (as discussed above).

9.5.4 **Cost**

The cost approach to value is the third method used in appraisal. Under this approach, value is estimated based on the cost of production of the property – for example, a house could be valued based on the cost of purchasing land and building a comparable house.

The cost approach is generally disfavored relative to the other approaches, as it is hard to confirm the accuracy of resulting estimates. For water rights, the approach would calculate value based on the cost of developing a water right on a piece of land, for example by appropriating surface water or drilling a well and perfecting the right. Of course, most areas where appraisals of water rights would be performed are closed to additional appropriate of water – if that were not the case there would be no reason to purchase water rights, and no demand for the appraisal in the first place. In these instances the cost approach to valuation would not be relevant to water right appraisal. Exceptions include situations where new sources of water could be developed through aquifer recharge, desalination, or other engineered techniques, however the high cost of these water sources are generally not translatable into appraisal values because they do not reflect market values. Very high engineering estimates of what it would cost to produce water using some technological approach are suspect as they are not tethered at all to the preferences of participants in the water market and, thus, there can be no assurance that any water user would be willing to pay such a price for water.

9.5.5 **Reconciliation**

Value estimates may be derived using any of the three approaches to value, so long as the approaches are appropriate. While it is common that one or more approaches will be disqualified, there are still many cases where multiple estimates of value are calculated. Because these estimates are rarely in perfect agreement, they must be reconciled to arrive at a final valuation. This typically involved a series of judgments based on the appraiser's knowledge of the market, the strengths and weaknesses of different approaches, and other factors that can reconcile differences in estimated value. The reconciliation in an appraisal should describe how the differences in intermediate findings from the valuation approaches employed were translated into a single estimate in the final opinion of value.

9.6 Issues and Considerations in Using Appraisals

This section condenses information from the discussion above into a list of key considerations for practitioners when obtaining or considering appraisals of water rights.

9.6.1 **Need for an Appraisal**

Consider the need for an appraisal when deciding whether and how to proceed with any contracting. Specifically:

Confirm whether an appraisal is actually needed for your purposes: Do you require an appraisal, or information on the value of a property? Will economic valuation or more general market research suffice? Be sure not to underestimate your own experience with water rights and the local water market.

Consider how your needs match with likely available data: Are you looking for an appraisal for a temporary or permanent transaction? If you need an appraisal of a potential purchase and there are likely to be no or few comparable sales then the appraisal will likely be complex, unreliable and ultimately frustrating.

Check with funders or partners to identify the requirements of the appraisal: What specific requirements exist? Should it be performed to "Yellow Book" or some other standard? Is the use of assumptions or secondary sources acceptable? Recall that the purpose of Yellow Book standards is to protect property holders from the government, not to stimulate an active water market. Practitioners will therefore need to weigh the potential benefit of taking on more rigorous or bureaucratic standards against the additional costs in terms of complexity, time and money.

Consider the likelihood of success: Is there a pool of qualified water right appraisers to which you will have access? Water right appraisals are much less common than real estate appraisal, and there may not be a local appraiser with the understanding of water needed to conduct an appraisal. This poses a dilemma between hiring someone with local knowledge of the real estate market (which has bearing on the value of water) and using a water appraisal expert who may be unfamiliar with local conditions. Experience suggests that it is unwise to assume that local real estate appraisers, no matter how good they are at valuing rural or developed land, can provide useful or cost-effective estimates of the value of water rights. However, under-funding a non-local water rights appraiser is likely to result in unsatisfactory work.

Consider individual versus project appraisals: For an ongoing effort, is a program appraisal appropriate? If so, it could be more cost-effective than conducting appraisal after appraisal as rights come up for purchase.

9.6.2 Soliciting and Contracting an Appraisal

Once it is determined that an appraisal is necessary, a contract with a qualified appraiser will need to be executed. Selecting an appraiser can be done informally or through a competitive Request for Proposals process. As the person contracting for the appraisal, you can shape the scope of the work and select an appraiser to meet your purposes. At a minimum the scope should be adequate to meet formal requirements of the appraisal. However, there are other considerations:

Consider whether there are particular areas where more or less market research is appropriate: If the market for agricultural rights is well known, the appraisal scope might incorporate defensible assumptions while concentrating primary research in other areas such as the municipal market.

Consider how to manage costs within your budget: Appraisals can range widely in cost depending on scope – one source mentions a range of $4,000 to $40,000 (Nichols et al. 2011: 48). Tailoring the scope of the appraisal can help meet needs while also being efficient with the available budget.

Consider how to manage information during the process: When do you reveal the property to be appraised and what information do you disclose? Typically, appraisals are part of a confidential negotiation process so the RFP will only generally identify the property. It will be to your advantage to reveal specifics about the property only once you are in contract negotiations and these should be confidential discussions between you and the appraiser.

Consider the water right expertise when evaluating appraisers: If the likely comparable sales data will include water rights of various priority dates it is essential that you choose an appraiser who has demonstrated experience in assessing the reliability of water rights of different priorities. In some cases, it might be necessary to assemble a team of professionals to perform the appraisal, perhaps combining a qualified real estate appraiser with a water rights expert.

Check references: If you are unfamiliar with candidate appraisers make sure to check their references, but also ask key informants about the reputation of the applicants. Whether appraisers typically represent buyers or sellers may be useful in shaping your expectations.

9.6.3 Assessing an Appraisal

Although appraisals follow formal standards and specified approaches, professional judgment plays a significant role in arriving at valuation estimates. Practitioners should consider the following when assessing the opinion of value in an appraisal:

Consider the objectivity of the appraisal: Appraisal standards expressly prohibit certain conflicts of interest and require objectivity, however critical consideration of an appraisal's objectivity is still important. Who paid for the appraisal and what was their interest in the value estimate? Sellers typically favor higher values, and buyers prefer lower prices. Myriad judgments and assumptions help shape the valuation in any appraisal, and well-intentioned appraisers may be swayed by their client. Practitioners should always ascertain whether they are considering a "buyer's appraisal" or a "seller's appraisal" when assessing estimates of value.

Check the facts: Practitioners should always read the entire appraisal and assess any facts. Is the property described properly? Is the appraiser overlooking any relevant market or transaction information? Are conclusions about highest and best use reasonable? Are regulatory considerations included? Given the novelty of water right appraisal in some areas, appraisers may be operating in unfamiliar territory and it is important to be sure that information is accurate and relevant facts are not overlooked.

Assess assumptions: The assumptions used in an appraisal can have a large impact on estimates of value, and it is critical to understand their role in the analysis. Are hydrological and administrative assumptions appropriate and accurate? Are any identified hypothetical conditions or extraordinary assumptions being used? If they change, what will happen to value?

Follow the logic: It is also important to examine the logic underlying the estimation of value. Is the argument internally consistent? Are direct comparisons made on an "apples to apples" basis, and if not, are reasonable adjustments made? Are there reasonable arguments that would significantly change the analysis? Have important factors been overlooked?

Judge the judgment: An appraiser's judgment is central to any appraisal. Practitioners should consider judgments made and assess them for reasonableness. While ideally the appraiser's opinion of value would be based primarily in fact, subjective determinations of value are also common. These judgments should be examined in light of available data – do they reflect rigorous statistical analysis or might they run counter to the data?

Comment, comment, comment: The practitioner should ensure that the contract allows for review and comment on the appraisal. Good appraisers will be very busy and will welcome the extra pair of eyes. Bear in mind that ultimately it is the appraiser's opinion that matters, but if you feel there are elements of an appraisal that are poorly developed or analyzed you should make this clear to the appraiser.

Estimated value for the same property can be expected to vary between appraisers, and this variation is not usually a sign of malfeasance. In valuing water rights, where few transactions and poor information is the rule, judgment and assumptions play a more significant role and variation among appraisals is expect to be greater. Assessing an appraisal requires balance between appropriate critical thought and respect for the professional judgment of the appraiser. In the frequent case of a potential conservation buyer assessing a seller-funded appraisal, good stewardship of restoration dollars requires engagement with a critical eye. The guidance above is designed to help identify initial questions about an appraisal.

The key consideration is whether any questions about an appraisal impact the value estimates in a significant way. The practitioner may be able to recreate the appraisal analysis informally using different assumptions and judgments to roughly gauge whether they materially influence results. If differences are significant or the impact is unknown, discussion with the seller (or whoever hired the appraiser) is appropriate – the may invite you to talk directly with the appraiser. Depending on the tenure of that conversation, you could engage a different appraiser to conduce a review appraisal – basically a formal review of the initial appraisal. Alternatively, you could hire an appraiser to conduct a separate appraisal of the same property for comparison purposes. Given the expense and potential contention around review and second appraisals, informal conversation should be a starting point in addressing difference of opinion on appraisal matters.

9.7 Conclusions

In thinking about whether or not to undertake an appraisal and how to use the results of an appraisal a number of important points should be remembered. First, remember what an appraisal *is not*:

The value of the water to the seller: Landowners will vary in crop choice, agricultural practices, and a number of other economic and social variables. As a result, the appraised price for water may be higher or lower than the actual returns experienced by the landowner.

The price at which the practitioner will buy water: In theory, the practitioner and the seller might agree to abide by the results of a co-funded appraisal. However, this is rarely observed. Rather the appraisal often is used to document fair market value as a matter of meeting applicable agency regulations or funder requirements. The actual negotiation to arrive at a price acceptable to both parties then ensues. Typically, for environmental water transactions the practitioner will need to offer a premium of some amount in order to close the transaction. The exception might be with large, ongoing programs where the practitioner can adopt a “take-it-or-leave-it” approach to acquisitions.

The economic value of water: Appraisal is not the same as economic valuation. Appraisal merely returns an estimate of the market value in its highest and best use, it does not purport to provide the economic value of water.

The market-clearing price: The environmental water buyer represents a new source of demand in a water market. The use of past comparable sales data will by definition reflect earlier market conditions (without demand from the environmental buyer), and therefore will not provide an estimate of the market-clearing price going forward.

What it will cost the practitioner to obtain instream flows: For this the actual sale price is needed plus your transaction costs. To calculate the per unit cost of water it will also be necessary to deduct the water that you will lose through the change application process.

Also it is important to note that in Yellow Book appraisals the appraiser is not to take prior purchases by government programs as comparable sales. The basic intuition here is that the appraiser’s opinion should not be swayed by the actual price at which prior program transactions are concluded. This requirement serves a useful purpose, that of preventing a government program from ratcheting up or down the fair market value of property through strategic market behavior. However, in the context of environmental water acquisitions this requirement may pose a problem. As noted above an additional source of demand for water will, all else equal, imply that the price of water will rise. However, if the appraisal process cannot over time internalize these price increases then government programs ability to acquire water rights may be constrained.

So what is appraisal? For the purchase and sale of water rights, an appraisal is a formalized approach to estimating the opportunity cost to the landowner of selling their water right. In other words, the landowner is presumed to be a rational, self-serving (egoistic) actor who should not sell their water right to the environmental water transactions practitioner at a price less than they would obtain if they sold the water back into the traditional market, typically the agricultural market. This approach typically relies on comparable sales data. The reliability of the opinion of value rests on the extent of the sales data and its comparability, i.e. the number of differences between the water right that is being appraised and the water rights that make up the sales data. Ultimately, an appraisal yields a point value or a range for the opinion of value. If conducted in accordance with relevant federal standards, the appraised value is an estimate of the fair market value of the water. As such the appraised value may fulfill agency and/or funder requirements, as well as serve as a useful point of departure for the negotiation of a water rights acquisition.

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CHAPTER 10
AGREEMENTS FOR IMPLEMENTATION OF ENVIRONMENTAL WATER TRANSACTIONS

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Contents

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Agreements for Implementation of Environmental Water Transactions

As introduced in Chapter 5, environmental water transactions will involve at least one and often three separate agreements. These agreements, or contracts, serve to link funding to environmental flows by coordinating actions between funders, the buyer (the intermediary), the water right holder, and the state.

In a nutshell, contracts are about setting expectations. Contracts form the set of deadlines and deliverables that guide agreement implementation from start to finish. Though they can carry significant legal weight, the process of negotiating and executing a variety of contract types does not require either a law degree or a background in rocket science. After all, though it is not advisable, a legally binding contract can be written on a napkin. Though legal review of contracts from an attorney representing your organization's best interests is a necessary evil, that fact should not prevent non-attorneys from being deeply involved in the process of creating the agreements that drive water transactions.

Contracts memorialize agreements between transaction practitioners and landowners, between funders and practitioners and between state agencies and landowners and their agents. A common misconception is that you need to know a special language – full of "shalls" and "wheretofors" – in order to draft a contract. Quite the opposite is true. The best contracts are written in plain, descriptive English that anyone can read and understand. The most common contractual disputes are disagreements over the meaning of a single sentence, or even word—all the more reason to draft clear, concise contract language from the beginning.

Well-crafted contracts are a vital piece in every water transaction for numerous reasons. First, they establish a playbook, or script, that all parties acknowledge will guide key steps in the transaction. Second, they establish timelines and specific deliverables for both parties; whether producing documents, or making payments, these action items are the heart of implementing an agreement. Finally, contracts establish a clear framework for what happens if something goes wrong. They lay out provisions for solving disputes between the parties and for handling unexpected or unlikely contingencies. Taken together, these and other aspects of contracts formalize the set of expectations that all parties can count on.

This chapter will provide a broad overview of important elements of contracts pertinent to water transactions including agreements between landowners/water right holders and third parties, agreements between funders and transaction proponents to fund a water transaction, and agreements between landowners and state agencies to change water rights.

10.1 Agreements

Three types of Agreements constitute a water transaction.

Agreement between landowner/water right holder and any third parties:
Of all the contracts water transaction practitioners will be involved with, landowner agreements are at once the most difficult and interesting type of agreement. This is where the many cups of coffee at a rancher's kitchen table, sipped while dreaming up a water transaction, come to life. Simply put, landowner agreements define how the transaction will be implemented. The basic elements of a landowner agreement include how the landowner will participate in the transaction (from simply signing a change application, to shutting down their irrigation on an agreed-upon

date and everything in between), when and how payment will be made to the landowner, how/when access to the landowner's property will be handled for monitoring or other needs, and a host of other technical elements such as liability and default provisions.

Agreement between funder and practitioner to fund the transaction:
With the exception of rare donations, most water transactions cannot happen without funding. The second type of contract discussed below is funding agreements. These agreements form a different, but no less fundamental set of expectations from landowner agreements. Instead of detailing how a transaction will be implemented, these agreements form the basis for the relationship between the practitioner's organization and the water transaction funder. Depending on the type of funder (i.e. private foundation, public agency, litigation settlement funds, etc.) water transaction funding agreements will outline a different set of expectations. The key elements of funding agreements include process requirements for funding disbursement (invoicing), periodic and final reporting requirements, match funding requirements, monitoring and enforcement expectations and sometimes agreements about the allocation of marketable credits for mitigation or some other purpose.

Agreement between water right holder and state to change the water right:
Often the most frustrating of the three, the final agreement type that makes up a water transaction is the agreement by a state and a water right holder to make and then carry out/enforce a change to a water right. The most common examples of these agreements are instream lease and transfer agreements, though there are numerous other potential water right changes. State change agreements are different from landowner and funder agreements which are traditional contracts. State change agreements can take the form of a contract between the state and the applicant (landowner), but instead of negotiation, they involve a significant amount of administrative process. In other words, the parties don't sit down and hammer out terms the way you might in a landowner agreement. Instead, states have set requirements that applicants must comply with, both administrative requirements (what information is required to submit an application) and legal requirements (i.e. no injury to other water rights) in order to successfully change their water rights. Though the process can be frustrating, one of the more satisfying moments for the practitioner is receiving a signed final order and/or certificate establishing the right to call on water for environmental flows.

10.2 Landowner (Seller) Contracts

Landowner contracts define how a water transaction will be implemented, formalize important aspects of the relationship between the non-profit buyer and the landowner, and set milestones and deadlines that must be met to complete a transaction. The purpose of putting all of these things down on paper and signing on the dotted line is to form a mutual understanding of how the transaction will work. Mutual understanding in turn, builds trust between parties and creates clear expectations – expectations of what happens if everything goes right, and also expectations of what happens if something goes wrong.

This chapter goes into detail about key elements and aspects of landowner contracts including the different types of agreements and their uses, contracting timelines from drafting to closing, specific contract tools and mechanisms. The chapter concludes with a list of tips to help practitioners avoid common mistakes.

10.2.1 Parties to a Landowner Contract

People and entities signing a contract are called "parties" to the contract. Throughout the contract, when referring to the contract's signatories, contract drafters will use this term. For example:

> *Water Trust and Landowner (collectively referred to in this Agreement as the "Parties") desire to enter into an instream lease agreement.*

Most commonly, the parties to a landowner contract for an environmental water transaction will be a non-profit organization that specializes in water transactions and a named landowner or landowners. However this is not always the case. When beginning the contracting process, be sure to ask the landowner whether the landowners hold the subject land and water rights in their own names or if the land is held in the name of another entity. Common entities include family trusts and limited liability corporations. If the land/water rights are held by an entity then the contracting parties will be the transaction proponent and that entity instead of the named landowners.

Often, a third party in addition to the landowner and transaction proponent will also need to be involved in a landowner contract. This situation occurs if a party other than the landowner has some legal interest in the subject land and/or water rights. Some common examples include irrigation districts, mortgage holders (usually banks), and land lessors. Depending on state law, land and water rights can be owned by an individual but subject to the authority of a quasi-public entity such as an irrigation district. In these cases, the owners of the water rights may not have carte blanche to make changes to their water rights without irrigation district approval. In such cases, irrigation districts are necessary third parties to a landowner contract.

Mortgage holders are another common third party. When a bank provides a loan to a landowner to purchase a piece of property, they retain an ownership interest in the property until the landowner pays off the entire loan. If a bank owns such an interest in the land and water rights, they may require the landowner to seek their permission before making substantive changes to property such as a long term or permanent change in the water rights. In these cases, the landowner will need to seek agreement from their banker/mortgage holder to make the changes contemplated in the landowner contract.

A final example of a necessary third party to a landowner contract occurs if the landowner interested in entering into a water transaction is leasing the subject land and water rights from another landowner. Unless expressly excluded, irrigated land leases include the right to manage the water rights as the lessee sees fit, including entering into instream leases that do not extend past the term of the land lease. The owner of the land, or lessor in these cases, is often a necessary third party to a landowner agreement involving water rights appurtenant to the leased land.

Beyond irrigation districts, banks, and lessors, there may be other necessary third parties to a landowner contract. The key to determining whether and who a necessary party may be is to discuss with the landowner whether any one or any entity other than themselves (including family members) has any interest in the land and water rights at issue in the transaction.

10.2.2 Contractual Elements

The law does not prescribe a particular format for contracts. They can and do take many forms from a credit card receipt (yes, every time you sign a credit card receipt, you are signing an agreement with the credit card company to pay them back) to complicated, hundred-page tomes. However, most formal written contracts share important structural elements, arranged as follows:

Title. Landowner contracts should include a descriptive title that says what the agreement does in as few words as possible. For example, titles such as "Water Use Agreement," or "Instream Lease Agreement," are commonly used for landowner contracts. While the title does not carry any legal weight, it will help orient anyone who picks up the document to what the agreement does.

Introductory Clause. The introductory clause, included right below the title, summarizes some key information about the contract: the type of agreement (usually just a restatement of the title) the date of the agreement, and the parties to the agreement. The introductory clause will often contain other information such as the parties' addresses and other explanatory information; if one of more parties is not an individual some kind of entity, for instance, the introductory clause will explain the types of entities involved. For example:

> *This Instream Lease Agreement is dated January 1, 2014, by John Q. Waterholder ("Waterholder") and the Best Water Trust ("Water Trust") a non-profit corporation in the state of Oregon.*

Recitals. Before getting into the meat of the contract terms, the recitals section follows directly after the introductory clause and broadly describes the context of the agreement, the purpose of the agreement, and, if the agreement is part of a broader transaction (for example an access agreement that is an add-on to an instream lease agreement), a description of how the contract fits into the broader picture. At the end of the recitals section, the reader should have a basic idea of what the contract is meant to accomplish.

In water transactions, recitals will often identify the land that is subject to the agreement, outline the type of water right change or water management change the agreement contemplates, and broadly portray other pertinent information. While useful, recitals are not a required part of any contract. For simple agreements, recitals can be left out.

Legally speaking, recitals carry significantly less weight than the body of the contract and a court interpreting a contract will not generally rely on the recitals to decipher the parties' contractual intentions. Recitals are however, a very useful mechanism for introducing, in plain, easily understood language, what the contract is meant to do.

Recital of Consideration. If you have read any contracts, you have no doubt encountered a recital such as the following:

> *NOW, THEREFORE, in consideration of the premises and the mutual covenants set forth herein and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties hereto covenant and agree as follows.*

Don't be intimidated by this bit of legal mumbo jumbo. Even though it is common practice to include such a recital, they are not necessary. The concept of consideration is most first-year law students' worst nightmare—an arcane contractual requirement that is frustratingly difficult to master.

For the non-lawyer water transaction practitioner, suffice it to know that a valid contract requires three things: an offer, an acceptance, and consideration. Consideration, simply put, refers to the thing or things being exchanged or given up by one or both parties pursuant to the terms of the contract. In most water transactions the consideration will be all or some portion of water rights from the landowner in exchange for money or some other incentive from the water transaction proponent. Now, forget you ever heard the term and let your lawyer worry about the technicalities of offer, acceptance, and consideration!

Definitions. Like recitals, definitions are not a requirement of contracting. As a general rule, for simple, short agreements, definitions can usually be left out. However, for long or technically complicated agreements, definitions may be useful to avoid confusion between the parties and/or any third parties trying to understand the agreement, about what particular words mean.

Definitions can be part of the recitals section or can stand alone in their own section. Use definitions sparingly. Don't define common terms unless they are being used in a novel way. Terms like "conserved water," and "injury," which may have legal definitions different than their plain meanings are good candidates for definition.

Contract Terms. The next and most important section of every contract, truly the only 100% required section of any agreement, are the contract terms. When you think of a contract, this is what you picture: a set of numbered (usually) paragraphs, often with brief headings for each paragraph succinctly stating what the paragraph is about. This is where long hours of negotiation are turned into action.

Contract terms set out what each party is committing to do. For example: the landowner is committing to apply to permanently transfer her water rights to instream use; the transaction proponent is committing to act as an agent in the transfer and to pay the landowner a specified amount of money upon specified deliverables in a specified way; the landowner agrees to allow the transaction proponent to access the property for monitoring and installing of gauges, etc. The sky is the limit in this section of a contract. No formal formatting or order is required. The only requirements are an eye for detail and a commitment to brevity and clarity.

General Clauses/Contract "Boilerplate." After the contract terms are laid out, most contracts will contain a set of boilerplate language – language that gets used and reused, often verbatim, in every contract. Every attorney will have their own particular set of general clauses, many of which can be very important from a legal risk, liability, and dispute resolution standpoint. Because of the technical nature of this section of a contract, the details are best left to the parties' lawyers.

However, a basic understanding of what may be included as boilerplate will help transaction practitioners wade through this section in a contract they are asked to review. These clauses apportion liability between the parties. For example, if someone is injured while on the relevant property for monitoring, is the landowner liable for medical expenses? Another common concept is indemnification. Indemnification clauses state whether either party is willing to defend the other party in court if something goes wrong. A common example would be a water transaction non-profit agreeing to cover a landowner's costs related to defending against a lawsuit arising out of a negligent action taken by one of the non-profit's employees while doing work pursuant to the relevant contract.

Another important section usually included in the general clauses is a set of warranties (legally enforceable statements of fact by each of the parties). Common examples include warranties by the landowner that they have the authority to enter into the contract and make changes to the water rights and warranties that the water rights at issue are valid, non-cancelled, and non-forfeited/abandoned.

Finally, general clauses will include provisions about how to handle default (one party not performing as promised), how to settle disputes that may arise under the contract, how (if allowed at all) the contract is to be modified, what happens if the landowner sells the land, and the effective date and term of the agreement. This is not an exhaustive list and many contracts will include more or less than the provisions than listed above. Even though these provisions may sound dry and overly legal, they are vital to include in anything but the most simple contract and should be carefully vetted between water transaction practitioners and their attorneys.

***Signature Page*.** This one is pretty self-explanatory. The signature page can simply be two blanks for each party to sign and date, or it can be many pages with many blanks for all of the various parties to sign. Some types of contracts, such as anything that will be recorded in official county records, may require more than just simple signatures. In these cases, the signature page may require space for a notary public to witness the signatures of the parties and provide their stamp.

Exhibits. The last section of most contracts is a set of exhibits that help to illustrate certain aspects of a contract. Exhibits are so called because they do fit neatly into the body of a contract. Common exhibits include legal descriptions, property maps, pictures, copies of water right certificates or permits and other illustrative documents. Exhibits will often be referenced in the body of the contract. For example:

> *Landowner owns certain real property located in Grant County, Oregon (Hereafter called the "Property" and further described in attached Exhibit A).*

Like many of the contractual elements described above, exhibits are not a requirement of every contract. However, they are extremely useful for providing detail and context and helping to flesh out aspects of an agreement that cannot be easily captured in text.

10.2.3 **Types of Landowner Contracts and their Uses**

Water transaction practitioners need a variety of tools in their belt to meet the variety of landowner needs and situations that occur in the complex world of water rights and environmental water needs. The next section covers several types of landowner agreements and their uses. The list is by no means exclusive. Creativity is one of the keys to success in water transactions. However, the starting point for even the most creative water transactions is often a simple landowner agreement template. This section will cover leases, purchases, option agreements, water use agreements, and third party agreements as these are the most frequently encountered contract types.

Lease Agreement. The most basic landowner agreements, often building blocks for longer and more involved transactions, are short-term leases. Depending on state law, leases can last for up to five years before requiring renewal. Also depending on state law, leases can usually be renewed for one to five-year terms indefinitely, meaning that multiple five year leases may be stacked one after the other to make up a longer term lease.

The basic contract terms of a landowner agreement for a water right lease will include the length of the lease, the timing of applying for state agency approval of the lease, an estimated timeline for approval by the state agency of the lease, and payment terms. One important feature to keep in mind for all landowner agreement types, but especially for leases, is that payment for the lease can either be based on the paper water right amount or the amount of the water eventually approved by the relevant state agency for instream use. Choosing between the two options will depend on several factors including the desires of the relevant funder (many funders will strictly require payment only for what is approved instream), the specific state agency approval process for the relevant application (whether, for example, the relevant state agency will protect any water past downstream headgates), and landowner or practitioner needs (factors that come up during a negotiation may mitigate in favor of one direction or the other).

Purchase and Sale (Water). The second most basic type of water transaction is a permanent purchase/sale of water and/or water rights. Permanent water transactions require significantly more in-depth landowner agreements than limited term leases because the stakes are higher for both the landowner and the purchaser. Permanent purchases can also take numerous forms including the purchase of land and water together, the severing of water rights from the land and purchase of the water rights alone, and, where allowed, the purchase of water resulting from a water-conserving action that frees up formerly consumed water for sale. Each of these agreement types and some specific requirements are discussed in the following sections.

Land and Water (Whole Farm). Spend any time in the water transaction business and, depending on where you work, it quickly becomes apparent that the world of people willing to sell water permanently off of their land can be very small. However, the sale of land and water rights together can be more common and therefore can be an alternative, albeit more expensive, avenue for acquiring water rights. A common land/water purchase strategy is for the purchasing organization to buy the land and water, make a permanent change (be it instream transfer, some other water use change, or even a conservation easement restricting water use) and then resell the land.

All permanent (called fee title, or simply, fee) purchases are very involved from the landowner agreement perspective. Land purchases will require the transfer of title to the land through one of several kinds of deeds including a warranty deed, quitclaim deed, or bargain and sale deed. Most permanent purchase agreements, but especially land purchases, will be handled by a title/escrow company that is experienced in closing transactions in the relevant jurisdiction. Upon closing, these transactions will be recorded in the county records where the transaction takes place. Recording of permanent transactions is a legally significant action that provides notice to others that real property has changed hands and records the details of the transaction and the new owners in the local records.

When purchasing land and water together, excellent and detailed due diligence is of vital importance to ascertain the nature of the water rights attached to the land at issue. Real estate agents are often not well trained in water law and regulation and as a result practitioners should not take real estate listings at face value in terms of the number of irrigated acres and/or amount of water rights appurtenant to the land listed for sale.

Purchasing/Selling Water Rights Only. From a water transaction perspective, the purchase of water rights alone is a cleaner and simpler transaction than a land/water purchase. However, water purchases often require extra steps compared to land/water purchases because some action, usually a state agency process, must be taken to sever water rights from the land so that they can be transferred instream or to another property. Landowner agreements for the purchase of water rights will therefore need to detail not just the purchase terms, but terms that line out how all necessary state application processes will proceed, who will pursue the necessary approvals (the landowner? the transaction practitioner as the landowner's agent? a third party?), and what contingencies need to be in place if the process does not go as planned. As with lease agreements, it is important to be clear about what is being purchased, whether it is paper water rights, consumptive/historic use water, or some other arrangement. The agreement reached on this term will often guide the choice of form for the transfer of title to the water rights.

Warranty vs Quitclaim Deeds. The two most common ways to transfer title to water rights are through a warranty or a quitclaim deed. A warranty deed spells out exactly what is being transferred. For water rights, that means that a warranty deed will specify the exact amount of water at issue (usually the amount of water that the relevant state agency will approve for transfer instream) and will provide the purchaser with recourse if the warranted amount of water is not, in fact, available for transfer. In warranty deeds, the bulk of the risk is borne by the seller who has made specific warranties to the buyer.

On the other hand, quitclaim deeds put the bulk of the risk on the buyer and for this reason, can be simpler and sometimes cheaper to negotiate and close. Unlike a warranty deed that promises a specific amount of water, quitclaim deeds are a legal mechanism for the seller to say "I am not sure exactly how much water I have, but whatever it is, I am selling it to you." While that may sound a little open-ended, quitclaim deeds can be appropriate in situations where experience and/or due diligence are enough to give the buyer confidence that they can accurately quantify the water they will get instream from the relevant land. Most often, this means that the practitioner has completed other water transactions of a similar type in the same context and agency approval process, and has a strong handle on how much water will be transferable at the end of the transaction.

Because they lack specificity and do not require as detailed agreements as warranty deeds, in the right setting, quitclaim deeds are the most efficient means for purchasing water rights. However, if the transaction at issue is the first of its kind, or the first in a certain basin, or has some other uncertainty factor, and the purchaser (or funder) is not willing to any significant risk, warranty deeds can be a better, though more complicated and sometimes more expensive, title transfer vehicle.

Conservation Project/Conserved Water. The strict legal definition of conserved water will vary by state but simply put, conserved water is the increment of water saved by some increase in water use efficiency. The subtle contours of what legally counts as conserved water are discussed in Part II of this handbook. However, for our purposes here, it is important to just keep in mind that determining the amount of conserved water that is available for transfer instream (or to another use, for that matter) is a complicated technical question with legal and hydrological considerations. Landowner agreements dealing with conservation projects and conserved water therefore, need to be detailed enough to capture these technicalities.

As discussed in Chapter 6, a common example of a project that results in conserved water transferred instream is the piping or lining of a leaky, earthen irrigation ditch. Landowner agreements for conservation projects/conserved water take two basic forms: contracts to purchase the conserved water that has resulted from an already-completed project or a project that has already begun; and contracts to pursue a conservation project and transfer the resulting conserved water instream.

Contracts to purchase conserved water from completed projects are straightforward. In these situations, the amount of water available for purchase should be clear and the parties need only negotiate and close a purchase/sale of that amount of water. Agreements to pursue conservation projects can be vastly more complicated. Conservation projects can vary from a small piping or flood to sprinkler irrigation switch, to a multi-party, fifty-mile long canal piping with hydroelectric facilities and a mix of public and private financing. Landowner agreements for these projects therefore vary just as greatly.

The most important factors that will go into an agreement to undertake a water conservation project are: clear terms that specify who pays for which part of the project (is the landowner contributing labor? cash? nothing?); whether the project proponent is paying for both the capital piece of the project (pipes, sprinklers, etc.) and the resulting conserved water or just one or the other? Because these agreements can be so complicated, knowing the relevant jurisdiction's legal and hydrological requirements for conserved water and water conservation projects is of vital importance to a successful landowner agreement.

Option Agreements. Option agreements are a useful tool for practitioners to understand because they are a way to help deal with uncertainty. In the context of water transactions, option agreements are contracts negotiated between a prospective seller and a prospective buyer that, for a price, gives one or the other the right to exercise their "option" to buy or sell water or land in the future. Buyer options give the buyer the right, for some agreed-upon amount of time and for a negotiated price (the option price), to purchase the asset in question for an agreed unit cost (the purchase price). Seller options are the opposite: the seller has the right for a specified time period and for a specified option price, to sell the asset to the buyer for a negotiated purchase price. Options can grant exclusivity as well, meaning that for the option's term, only a buyer who is a party to the option agreement can purchase the relevant asset.

Buyer options can be a powerful tool for water transaction practitioners because they have the power to lock up a water right or piece of land for a set amount of time for less than it would cost to buy the land or water outright. This time can be used to search for cheaper water, for more water to determine whether a set goal can be reached, or to search for funding for the eventual purchase transaction. The most important terms of option agreements are the option's term (how long it will last), it's cost (often negotiated as some percentage of the eventual purchase price), the purchase price, exclusivity, and whether the option price will be counted toward the purchase price if the buyer exercises the option. Finally, options can either include terms whereby the option self-executes upon some future condition such as the ability of the practitioner to secure funding, or terms that give the buyer the right to exercise the option at their sole discretion.

Third Party Agreements. Another common type of agreement in the water transaction setting is a third-party agreement. No single type of third party agreement dominates water transactions but several are worth mentioning including irrigation district assessment agreements, and agreements involving the release and management of stored water.

Members of irrigation districts pay yearly assessments to the district for ongoing maintenance, operation, and delivery costs. Assessments are often based on the number of acres of irrigated land they own that is serviced by the relevant district. These assessments keep irrigation districts functioning and any acre that is removed from the district, for example by transferring a water right instream, can reduce the district's bottom line.

Therefore, before transferring a water right out of a district, many districts will require their patrons to agree to pay an exit fee or to continue to pay an assessment to help keep the district's finances whole. Such requirements are especially important in districts where transfers out of the district are becoming more common due to active water markets. These district assessment requirements are handled in a third party agreement as part of a water transaction involving a district patron's water rights. Such agreements will stipulate the conditions upon which the district will allow the water transaction to take place including any payments or fees to the district from the patron or the water transaction practitioner.

Depending on state law, ownership of irrigation district water rights is an important issue to keep in mind. In Oregon for example, when the water right at issue is in the name of the irrigation district, the district, as well as the patron who owns the land to which the right is appurtenant, has a property interest in the water right. In this setting, a water transaction requires an agreement with the relevant landowner and a third party contract with the irrigation district.

Another example of a third party contract arises in the context of federal water storage reservoirs. When the U.S. Bureau of Reclamation (Reclamation) builds a reservoir, they own the water and have contracts with irrigators to release the water for irrigation use. Though not allowed on every Reclamation facility, some reservoirs allow for the purchase and use of Reclamation water for instream purposes. Water transactions in these settings, like in the irrigation district case, usually require multiple agreements: a primary landowner agreement to lease or purchase the landowner's Reclamation water, a third-party agreement between the purchaser and the Reclamation to supplant the original agreement between Reclamation and the landowner, and sometimes even another third party agreement with a local fisheries manager to determine when and how to ask Reclamation to release the water instream. The details of these transactions will vary and will depend on local Reclamation policies and state law.

Water User Agreements. This final category of landowner agreements is expansive and open ended. Water user agreements can include anything a water transaction practitioner can dream up if it does not include an outright lease or transfer of water rights. Examples include forbearance agreements, minimum flow agreements, season of use diminishments and other transaction types for which no state's law provides an adequate regulatory and/or enforcement mechanism. In these transactions, the landowner agreement is of utmost importance.

Unlike transactions that conclude with a state-recognized instream lease or permanent instream water right, water user agreements must stand on their own. The only enforcement mechanisms are those built into the landowner agreement itself. Water transaction practitioners and landowners pursuing water user agreements need to work closely together to craft realistic agreements with clear requirements of both parties. Clarity in these agreements is vital to ensure a positive ongoing relationship between the parties as the transaction is implemented and also to give funders the confidence that their investment is sound.

10.2.4 **Contracting Timelines**

Contracting is a process that begins long before any ink touches the signature page of a final agreement and can last many years after the date an agreement is signed. This section provides a general outline of the phases of contracting beginning with the basic question of when to begin drafting a contract through closing and implementation of finalized agreements.

In the life cycle of the average water transaction, contracting comes somewhere towards the middle of the timeline. The seeds of a contract are first planted when the parties begin to talk about the basic terms of the transaction. Long before putting pen to paper, most water transaction practitioners and landowners will negotiate through a variety of scenarios: water transaction types, prices, etc. before arriving at one that fits both parties needs best. Before both parties are substantially aligned on these broad terms of the agreement, talking about formal contracting can be a distraction. In fact, the more terms the parties can agree to in principal before beginning contracting, the easier the contract drafting process.

Formal contract drafting should begin when negotiations reach a point where the parties agree on the general outline of the deal (type, price, etc.). Many water transactions are completed without the help of any attorneys. However, before beginning formal contracting, always advise the landowner and any other parties that their interests will be best served by consulting with an attorney. Water transactions practitioners should not give landowners legal advice about contract terms. It is fine to explain what a certain term means, but stop short of talking landowners through the legal implications of, for example, an indemnification or warranty clause.

The arc of contracting begins with initial drafting, progresses to review of a final draft and signature, and concludes with closing and implementation. Each phase is discussed briefly below.

Initial Drafting. This phase of contracting is the process of parties trading proposals and draft agreements, making edits, and getting the agreement into its final shape. Once the parties are at the go-point of formalizing an agreement, they can begin to trade drafts of the contract. Unique agreement types may need to be drafted from scratch, while common agreement types such as instream lease agreements are well suited to using a template. Most water transaction non-profits will have a library of agreement templates for the most common transaction types they encounter and contract drafting may be as simple as inserting new dates and landowner names.

Final Draft and Signature. Once the parties agree on all the contract terms, the parties should review the final contract. Though this sounds almost too obvious to state, small typos can make big differences: a decimal point in the wrong place on the purchase price for example, or a wrong date for the end of the relevant instream lease.

Once the parties have a final, clean copy free of typos, the agreement should be signed. Signing a contract is also referred to as "executing" the agreement. As mentioned above, some agreements simply require the signature of the parties, however some agreements, such as agreements that will be recorded in county records, may require notarized signatures.

Closing. Complex agreements and agreements that involve the transfer of title, should go through a process called "closing." This term refers to the use of a neutral, non-party to the agreement, usually a title or escrow company, to receive and disburse funds, facilitate the transfer of title, and, most importantly record the transaction in the relevant county records. Going through a formal closing is time consuming and adds transaction costs. However, doing so also adds increases transparency, and provides an additional layer of confidence for the parties and any funders of the transaction.

The term "closing" is also used generally to refer to making a final payment or otherwise finalizing key deliverables under the agreement. For simple agreements such as a lease, closing may not need to be handled by a neutral party. In these cases, payment will usually take place upon receipt by the parties of a final agency order or some other official approval by the relevant state agency.

10.2.5 **Contractual Tools and Mechanisms**

This section discusses some common and helpful contractual tools and mechanisms for water transaction practitioners.

Recording. The process of recording transactions is a legal mechanism intended to provide notice to any and all parties who do and/or might in the future want to know the details of a transaction. The most obvious example of a party who might care in the future about the outcome of a transaction is a person who purchases a piece of property from a landowner who entered into a water transaction. By officially recording an instream transfer, all subsequent purchasers of the relevant land from which the water right was transferred will be on notice that the land no longer has an appurtenant water right.

The most common transaction type to record is a transfer of title to land and/or water rights through some form of deed. However, other agreement types can be recorded too depending on local and state requirements. In addition to recording proof of a transfer of title, recording can also be used to put new or changed water rights or other specific transaction documents such as an access easement into county records so they become part of the record that will come up when someone investigates the relevant property.

There is no bright line rule about when to record a transaction and when not to. Two transaction factors are instructive though: time and money. If the term of the transaction is long-term (ten years or more) or permanent, recording is highly advisable because it is possible or even likely that the land may change hands during the term of the agreement. If the transaction is very expensive, recording is also a good idea, even if the term is relatively short, because recordation is a sort of insurance policy in the event that the land is unexpectedly transferred during the term of the agreement.

Recording is completed by county records offices. These offices often have very strict requirements for what they will record and even more strict requirements on the format of recordable documents. It is often best to consult directly with the relevant county records office before preparing documents for recording because the requirements can vary across a state and any given attorney likely doesn't know all the different variations. County clerks as the recording agents are called, can also sometimes be uncomfortable recording water transactions because 99% of their work involves land transactions. Don't give up if you encounter push back from a county clerk about recording a water right transaction. Instead, work with the relevant office to find an acceptable form for recording.

Escrow. Escrow is a term that describes both a neutral agent who facilitates money changing hands in a transaction, and a type of account where money can be held waiting for performance of an agreement term by one party or the other. Escrow is a valuable tool for facilitating landowner payments. Escrow accounts provide a way to demonstrate to a landowner or other party that money is in hand and ready to be disbursed pending some action on their part. The parties provide the escrow agent with a copy of the agreement and the escrow agent acts as a neutral party to determine when contract terms are met and when disbursement of funds from the escrow account is triggered. Escrow is most useful in complex transaction and transactions where large amounts of money will change hands.

Repurchase Agreements. Repurchase agreements allow a buyer to purchase an asset from a seller with the agreement that the seller will, at some later date, purchase the asset, or some part of the asset, back, usually at a higher price than the original sale price. Repurchase agreements essentially function like loans where the buyer is loaning the seller money with property as collateral and repayment at a later date and a higher price (not unlike an interest charge).

Right of First Refusal. Negotiating a right of first refusal for a given asset gives the owner of the right the chance to be the first person to whom the asset is offered for sale. Though not as ironclad and detailed as an option agreement, rights of first refusal are mechanisms that can help transaction practitioners put down a marker without making a major purchase or other commitment.

Rights of first refusal can be useful in a variety of situations. For example, they are useful in active markets where sellers are being hesitant to participate, but indicate that they may be willing to participate at some point in the future. In this case, a right of first refusal would be an agreement that a given seller would first offer their water right for sale to the other party to the agreement (the water transaction practitioner) before offering it for sale on the market generally. Rights of first refusal might also be useful in a situation where an older landowner indicates that they are not ready to sell their water rights today, but will be willing to sell as they get closer to retirement.

Exclusivity. Exclusivity is a contractual tool that can be negotiated as part of an option agreement, a right of first refusal, or in a stand-alone agreement. Exclusivity agreements are meant to lock potential sellers into negotiating only with the potential buyer who is party to the exclusivity agreement.

Reserving other benefits. Water transactions can have multiple benefits including providing additional habitat for aquatic species, decreasing water temperature, and more generally improving water quality. When drafting a landowner agreement, it can be a good exercise to think through which of these benefits are relevant to the transaction at hand. If one or another benefit of a water transaction might be valuable beyond the immediate transaction, for example if the temperature benefit might be valuable to a downstream municipality trying the meet their temperature obligation under the Clean Water Act, consider inserting a contract term that reserves the right to pursue compensation for that benefit at a later date. Reserving other benefits can be a tool to make sure that if opportunities arise in the future to take advantage of a previously overlooked benefit of a transaction, the opportunity will not be excluded.

Contingencies. Contingencies are contractual trigger mechanisms. In other words, one party's performance of a specific contract term may be made "contingent upon" some other event that may or may not occur. A common contingency in the non-profit water transaction world is a funding contingency: "This water right agreement is expressly made contingent upon Water Trust receiving final funding approval for the transaction." As long as funding is received, the transaction proceeds. But if funding is not available, no further performance from the landowner is triggered. Contingencies are useful tools to set deliverables/mileposts for executing an agreement—providing the parties with performance requirements at specific deal points to trigger continuation, or signal a pause or stop, in agreement implementation.

Indemnification. Indemnification, is an important, if very technical, contractual tool. To indemnify means to secure another party from the legal consequences of their actions. Offers of indemnification are often specific to one or several actions rather than blanket guarantees. For example, a buyer in the water right context might offer to indemnify the landowner from any legal consequences arising out of the buyer's access to the property for streamflow monitoring purposes. Another example is a buyer's offer to indemnify a landowner against any third party lawsuits for claimed legal injury caused by a water transaction— defending them against a neighbor for instance, who sues the landowner for injuring their water rights.

Because indemnification clauses can have such major legal consequences for both parties, they should be carefully reviewed by both parties' lawyers, and possibly both parties insurance agents as well.

Contract Amendments. Once a contract is signed and performance of the agreement begins, the parties to the agreement are legally bound to the actions outlined therein. Unless, of course, they mutually agree to amend, or change the contract. When drafting a landowner agreement, it is important to include a clause that states whether amendments will be allowed and, if so, how they will be handled. A common amendment clause will allow amendments to the agreement upon the "signed, written consent of all parties to the agreement."

In general, contract amendments should be limited to relatively small changes to specific clauses of an agreement rather than a wholesale replacement of major sections. Amendments are not uncommon and the need to change parts of agreements can arise for a variety of reasons. For example, if the parties find they need more time to complete some piece of the state agency process, they may decide to amend the agreement to make sure neither party defaults due to unanticipated, changed conditions. If major changes become necessary, the parties may consider drafting a new superseding agreement rather than trying to amend large sections of an existing agreement.

10.2.6 **Tips and Strategies**

Some tips and strategies to keep in mind when working on landowner contracts include the following:

Plan landowner agreements with great care: Contract terms that take ten seconds to draft, may take ten years to complete. When drafting landowner agreements, it is vital to think through every important contract term, not only in terms of how to word it on paper, but in how to execute it in reality. This point is hard to stress enough. Contracts are actionable documents, meaning that the terms they contain need to be capable of implementation on the timescale, and for the agreed upon price, intended in the agreement. Think and plan carefully before you write a contract.

Manage expectations: Recall that contracts are about setting expectations. Never forget this fact when drafting landowner agreements. What ends up in a final agreement forms the basis for all of the parties' expectations for how the transaction will be implemented. The key to managing expectations is to be realistic. The best way to be realistic is to make conservative estimates about the time it will take to complete contract milestones. If your state's water agency usually takes 90 days to approve a lease, give yourself 120 days in the contract if at all possible. Contracts should anticipate that if something can go wrong, or take longer than expected, it will. But if the parties recognize this up front and bake this fact into their expectations, everything should go smoothly.

Set the tone: You may have a vision in your mind of a contract negotiation from a TV show or movie, where the parties pound the table, yell, and threaten to walk out of the room and blow up the agreement. Put those images out of your head. Water transactions are based on mutual trust and respect between the parties. Contract negotiations to implement these transactions should have a similar tone. Think of contract drafting as the business transaction that it is rather than some form of competition and maintain that tone of mutual respect throughout the drafting process. Even when disagreements do arise, which is not uncommon, maintain an even head and focus on realistic solutions rather than bargaining positions.

Take the extra time to proof read agreements once, twice, three times. . . then do it again: Every word and number in a contract is of potential legal and practical significance. Typos in contracts can have unintended consequences. Carefully proof read agreements as many times (and ideally, with as many fresh sets of eyes as are willing and available) as possible to make sure final agreements are clean and devoid of mistakes.

Consult attorneys, especially for complex agreements, and encourage other parties to do the same: One of the main purposes of this chapter is to take some of the mystery out of the contracting process. Contract drafting does not require a law degree and should be part of the job skills of the water transaction practitioner. However, every practitioner and every water transaction non-profit nonetheless owes it to themselves and their supporters to consult attorneys at some point in the contracting process to check for legal red flags and potential risks. This is especially true for complex, important, or expensive transactions. And finally, the same holds true for every party to an agreement. At the very least, practitioners should recommend to every landowner that they consult their own attorney before signing a contract.

Be clear, keep it simple, and don't resort to jargon or Olde English: Henceforth, whitneseth all who read this: contracts do not have to read like a Shakespeare play to be effective. Leave the "wherefores" and "whomsoevers" in the past and write contracts in plain English. Equally important as writing in plain English, is to avoid water transaction jargon that, while it may be part of your daily vocabulary, could look like Swahili to another party reading the agreement for the first time. Even something as simple as the term "water transaction" can mystify the uninitiated. Keep this in mind when drafting a contract. When in doubt, ask yourself whether a middle-schooler could understand the agreement. If the answer is "yes," congratulations, you have drafted a really good landowner agreement.

10.3 Funding (Buyer) Agreements

If landowner agreements are the engines that move water transactions forward, funders are the fuel. Water transactions do not happen in a vacuum; that is, a variety of interests combine to incentivize and facilitate not just the transactions themselves, but the framework in which the transactions occur. Perhaps the single most important pieces of this framework are the funders. Much like working with landowners, water transaction funders have their own set of expectations about their role in transactions. These expectations run the gamut from expecting very little involvement, to close and intense collaboration with funding recipients. Wherever a funder/recipient relationship falls on that spectrum, funder agreements play a vital role in guiding the parties' behavior.

10.3.1 The Purpose of Funder Agreements

Various entities fund water transaction work, from private foundations and companies, to state and federal agencies. Each entity has one or more reasons for funding this work, but the particular motivations of funders are vital to keep in mind when working with funder agreements. Pure altruism can be a motivation for funding water transactions. More often, funders have specific goals in mind such as meeting a regulatory requirement or recovering an aquatic species. Funder agreements therefore, are a mechanism for putting those goals into practice by setting expectations for how a funding recipient can use funds.

10.3.2 Types of Funding Agreements

This section discusses the basic set of funder and funding agreement types including foundation funding, state/federal funding, mitigation funding, and private sector funding. It should come as no surprise to learn that government funders usually have the most stringent and complex requirements, and small foundation funders tend to have more simple agreements.

Foundation Funding Agreements. The term "foundation" covers a broad range of entities; from family foundations awarding small grants to organizations in their local geography to large, billion-dollar national foundations that award millions of dollars across broad geographies every year. Foundation funding agreements reflect this variety. In general, small foundations and small, single-year grant awards (in the range of $10-$100K) will come with fewer strings attached than large and/or multi year commitments from national or regional foundations.

Small foundations are often interested in a specific geography or subject area. Their primary interest in awarding funding for water transactions may involve restoring a single watershed that is of particular interest to their board or to a family member who guides the foundation. Or they may be focused on proving up a specific tool such as instream leasing. In these cases, funding is likely to be disbursed all at once with few restrictions on specifically what it can be used for beyond a geography or project type.

On the other hand, large foundations may have a more programmatic approach. For example, the Walton Family Foundation invests significantly in water transactions/policy/conservation in both the Colorado and Mississippi River basins. The National Fish and Wildlife Foundation runs a regional funding program for water transactions in the Columbia River Basin. These types of funding programs are more methodical and often have more specific goals and outcomes in mind than smaller foundations. They will often invest in organizations over a period of many years in order to reach these outcomes. The funding agreements are predictably more complex with multi-year monitoring and reporting requirements, more strict financial record keeping requirements, and tighter restrictions on the use of funds.

State/Federal Funding Agreements. State and federal agencies contribute significant funding to water transactions specifically and watershed restoration more generally across the west. Because agencies are accountable to the legislature and the public, funding agreements with government entities can be orders of magnitude more complex than agreements with private foundations. These agreements are generally more restrictive of when and how funding disbursement is handled, they usually have more substantial reporting requirements, and may have more restrictive requirements about organizational governance.

Mitigation Funding Agreements. Though details vary widely, mitigation funding is generally intended to create benefits in one location to offset, or mitigate for, negative impacts in a different or adjacent location. Mitigation therefore often involves very specific types of actions in specifically limited geographies. Mitigation funding is the most targeted type of funding discussed in this chapter. Funding agreements in the mitigation setting can be the most restrictive of any funding agreement type in terms of what actions qualify for funding. An example is illustrative.

Ground water mitigation programs are growing in popularity and applicability throughout the western states. Usually occurring in rapidly urbanizing areas where ground and surface water resources are closely connected, common groundwater mitigation schemes requires new developments seeking groundwater for residential use to purchase surface water and dedicate it instream to mitigate the impact of new groundwater use. A central entity will often serve as a clearinghouse to create mitigation credits by purchasing water right for transfer instream with funds provided by groundwater developers. Funding agreements in these settings are likely to be tightly focused on specific geographies and transaction types that qualify for mitigation. They are also likely to have more tight controls on costs and monitoring than many other funding types.

Private Sector Funding. The least common funding type and probably the most variable, is private sector funding. More and more businesses are making efforts to reduce the environmental impact of their operations in a variety of ways. For many water dependent businesses, such as soft drink makers and large-scale farming operations (corporate vineyards, for example), investing in river restoration and water transactions in particular, is an obvious way to make a positive impact on a resource their business practices depend on.

The most notable elements likely to be part of private sector funding agreements are terms that guarantee the funder credit and or public relations benefits from the transaction. Many private sector funders are, after all, funding restoration in the hopes that it will raise awareness of their actions and/or demonstrate a commitment to caring for the resources they use.

Recently, some non-profits, most notably the Bonneville Environmental Foundation (BEF), have sought to catalyze private sector funding for water transactions. BEF created a "Water Restoration Certificate" program where the private sector can purchase parcels of water (sold in 1000 gallon units). In term, BEF uses the money from these sales to fund transactions. In these cases, the water transaction practitioners come to an agreement with BEF, rather than directly with the private sector funders.

10.3.3 **Typical Elements of a Funder Agreement**

This section discusses a number of elements that are unique to funder agreements. In addition to controlling how and for what purposes funds can be used, typical funder agreements may also include process requirements for funding disbursement (invoicing), periodic and final reporting requirements, match funding requirements, monitoring and enforcement expectation. In some cases, funders may be providing money for water transactions to generate mitigation or some other type of ecosystem service "credit." In those cases, funder agreements will also include detailed contract terms about credit generation/quantification, credit registry, credit ownership, and ongoing maintenance and enforcement of credit-generating projects.

No two funders have the same set of expectations of their funding recipients and therefore funder agreements are highly variable. Funder agreements can be as simple as one page that states broad expectations such as "Use the grant amount to support instream flow restoration in the John Day Basin." And they can also entail many pages of technical requirements that must be followed to unlock funds. The amount of detail and complexity is often proportional to the level of funding commitment in terms of the amount of funding, the length of the funding promise, the intricacy of the funder's needs or some combination of those three factors.

Restrictions on Use of Funds. In the water transaction context, there are essentially two primary uses for funding: programmatic (also called "transaction") costs, and project or acquisition costs. Programmatic costs cover salary, travel, rent, legal costs, and essentially all of the expenses necessary to allow you to negotiate and implement water transactions. Project or acquisition costs are the dollars that change hands, usually from you to a landowner, to finalize a water transaction. Some funders prefer funding one type of cost over the other, and truly unrestricted funding is rare. Most non-profits have an easier time funding project and acquisition costs and have to work hard for every dollar of programmatic costs. However, because water transactions are particularly heavy on programmatic costs— it can take a lot of staff time and travel for instance, to secure an acquisition—it is vital to make sure you seek the right balance in funding agreements between programmatic and acquisition costs.

Funding Disbursement. Terms controlling the release of funds in funding agreements will vary from one lump-sump payment up front, to detailed invoicing requirements. Many government contracts require work to be performed before an invoice can be submitted. In contrast, many foundations are willing to provide a lump sum payment upon executing the funding agreement. Carefully review this section of a funding agreement to make sure that delayed funding disbursement or any other disbursement arrangement will work in the particular context of the relevant transaction.

Reporting Requirements. Funders' reporting requirements are among the most important terms to note when reviewing a funder agreement. While some funders only require a general, year-end or grant-cycle-end report, other will require detailed periodic (such as quarterly) and/or final reports.

Match Requirements. One of the most important concepts to understand in funding agreements is that of match funding. Most funders like to fund projects and organizations that have other funding partners. Many funders require it. The term "match" refers to how much money a project or organization needs to have secured from other sources to qualify for funding for a different source. Federal and state agreements likely have the most strict match requirements, often requiring one dollar of match for every dollar of funding requested. The term match need not refer only to money. Many grants allow what is called "in-kind" match to qualify for some, or all, of the match requirement. In-kind match is essentially any non-monetary contribution to a project such as the provision of materials, and/or labor (time) to a project. Funders are generally explicit in their materials about any match requirements. Before applying for funding, make sure you thoroughly understand the matching requirements and whether your organization does or will be able to meet those requirements.

Monitoring and/or Enforcement Expectations. Depending on the project and the funder, funding agreements may require significant levels of pre- and post-transaction monitoring to ensure that their investment bore fruit. Once again, government funders, with their enhanced levels of public accountability, likely have the strictest monitoring and deal enforcement requirements of the various funder categories.

10.3.4 **Funding Agreement Life Cycle**

Unlike landowner agreements, funder agreements do not have a relatively standard rhythm. Funding water transactions is mostly an opportunistic pursuit and opportunities can arise any time. However, as relationships between practitioners and funders grow, some recurring funding opportunities can become predictable, especially with government agencies and larger, well-organized foundations. Where that is the case, the timing of funding and landowner agreements need to be carefully coordinated so that practitioners can have money in hand at the exact time they need it to correspond with their obligation under a landowner agreement or other requirement.

Synching up funding and landowner agreements is one of the trickiest parts of water transaction work. Knowing your funders' specific requirements and being able to bake those into landowner agreements is the key to successfully navigating this high wire. Though funders' requirements will vary greatly, the following is an example of a relatively complex funding cycle.

The Columbia Basin Water Transactions Program (CBWTP) provides both programmatic and acquisition funding to qualified local entities in the basin for environmental water transactions. Acquisition funding decisions are made on a rolling basis, with three project solicitations each fiscal year. In order to qualify for review by CBWTP, a project must have a draft landowner agreement or a signed letter of intent from a landowner. At that point, the acquisitions will be reviewed and scored. If the deal meets CBWTP requirements, the landowner agreement must be signed and then sent to the Northwest Power and Conservation Council for final approval of funding.

At that point, any necessary state application process, if they have not already, can be put in motion. CBWTP will not release funds until a final order is received from a state agency, or proof of enforcement (in the case of purely contractual deals) is submitted. Even at this point, there is a 45-day waiting period between submitting an invoice and receiving funds. It is easy to see the many places in this funding cycle where a practitioner could go astray of either the funder's or a landowner's expectations. While not all funding agreements are this complex, the CBWTP serves as a perfect example of why practitioners need to know their funders' agreement cycles in great detail.

10.3.5 **Tips and Strategies for Funding Agreements**

Before tackling the final section of this chapter, this section provides a brief discussion of some strategies for executing successful funding agreements.

Get to know your funders and their requirements: The goal of any funding relationship should be longevity. The most successful projects stem from long-term relationships and funding commitments between funders and project proponents. Therefore, it is impossible to put too much importance on spending the time it takes to get to know all potential funders and, more importantly, once you develop a relationship, to get to know that funder's requirements. Like landowners, you want to make sure you meet funders' expectations to a "T" and that requires you to go the extra mile to understand exactly what is being asked of you in every funding agreement.

Take reporting requirements seriously: At the end of a long project or a long year, the last thing you might want to do is sit down at the computer and type a long report. However, from the funder's perspective, reports are essentially all they have to demonstrate the success or lack thereof of their investment. Take reporting requirements seriously and know them before you begin a funding agreement.

Educate funders about the programmatic costs of doing water transactions. Compared to many restoration actions that funders may be more familiar with, water transactions can look very expensive from a programmatic investment standpoint. As a practitioner, it is vital therefore, to explain to potential funders that water transactions require intense amounts of face time with landowner (i.e. lots of travel), and that transactions take time to move through contracting and state agency processes (i.e. lots of staff time). Once they learn what goes into a successful water transaction, most funders are willing to provide the necessary programmatic support for these projects.

Be creative but honest with matching: Providing match under a funding agreement can be more art than science and it is useful to thoroughly explore your options. A few things not to forget are: any dollar on one grant that does not match a dollar on another grant is wasted match; private and state dollars are often the most valuable match as they can leverage large federal grants; draw the circle that constitutes match as widely as you can consistent with funder guidelines (including both monetary and in-kind sources); and don't forget to use large dollar acquisition funding to leverage the necessary programmatic expenditures.

Be timely: Many tips can sound too obvious, especially when written down. But the number one issue funders have with funding recipients is timeliness. Be timely in every aspect of a funding relationship: be responsive to your funder's requests for reports and updates; respond to funder data requests and any other requests a funder makes as quickly as possible. Especially when it comes to government funders, timely execution of a funding agreement is vital to being in a position to be funded by the same source multiple times.

Map out your responsibilities and check in periodically: Finally, when you first receive the good news that you have been funded, take the time to carefully re-read the funding agreement and map out important timelines and deliverables. Don't just put the agreement on a shelf and go spend the funder's money. Make sure you calendar important dates and deadlines. Do this work as though your next paycheck depends on it. It is very possible that it does!

10.4 Water Rights Change (State) Applications

The final section in this chapter discusses water right change applications. Once a landowner agreement and funding are in place, the most common next step is to pursue some form of state administrative, or more rarely, judicial process to make a temporary or permanent water right change. Obviously, no two states have the same, or even similar, application procedures for water right changes so this section is meant to provide general information, some specific examples, and a base of knowledge for further work.

Like the federal government, state governments are broken into three branches keeping each other checked and balanced. The courts, or the judiciary, interpret laws made by the legislature (the particular form and make up of which varies by state) and the executive, or the governor, enforces the laws. State agencies, such as water resources departments, or state engineer's offices, are part of the executive branch, charged with putting laws into action. In carrying out laws passed by the legislature, state agencies write rules and regulations (called administrative code) and develop internal policies and procedures. Major application requirements are usually outlined in laws, but the step-by-step processes for administering water right changes are usually codified in administrative rules and policies.

One notable and major exception to the above is Colorado, where permanent water right changes go through specialized water courts instead of an administrative process. In addition to a court proceeding, some temporary instream flow transactions in Colorado go through administrative approval by an agency called the Colorado Water Conservation Board.

The next section will cover typical elements of state change applications, including specific sections and exhibits often required.

10.4.1 The Change Application

State water right change applications essentially boil down to a simple requirement: provide enough information for the relevant agency, usually in consultation with field-based staff such as a watermaster, to determine if the change can be effected without injury to other water rights. The crux of most, if not all, water right changes is the presence/absence and/or ability to mitigate for or condition the change to avoid injury. Injury is discussed in detail in Chapter 7 of this handbook.

Besides field observations and monitoring, the basic information necessary to make an injury determination includes: details of the relevant water right(s) or piece(s) of water rights (including ownership, rate and duty, place of use location, point of diversion location), and proof that all or at least some part of the relevant water right is valid, non-forfeited, non-canceled, and not abandoned.

The following list of general requirements will apply in many, but not all, of all the western states. While they are loosely based on Oregon's requirements, they also do not fully represent Oregon's administrative requirements. Nonetheless, they form the basic set.

Subject Water Right Description. The first and most obvious requirement of a water right change application is a description of the water right for which a change is sought. Where the entirety of a water right owned by only one person is involved, this can be a simple task. However, when the water right involved in a transaction is large, when there are many water rights involved in a transaction, or only part of a water right with multiple owners is involved, describing the specific water right at issue can be more complicated.

Proof of Ownership. Before processing a change application, most states will require some form of proof that the person signing the application actually owns the water right. This can be as simple as providing a signature attesting to that fact. However if the property recently changed hands, or the subject water right is actually being leased, proof of ownership may involve submitting evidence of title transfer or a copy of the relevant lease.

Descriptions of Place of Use and Point of Diversion. Water right change applications will require detailed descriptions, using public land survey coordinates and survey information, of both the place(s) of use of the relevant water rights (POU) and the point(s) of diversion (POD). Especially where only a part of a water right is involved, or a water right has multiple owners, carefully describing, by quarter-quarter, the exact acreage involved in the contemplated change is important. In addition to describing, usually in relation to a surveyed corner, the location of a POD, an application may also require a detailed description of the diversion and irrigation works.

Proposed Change. The final narrative requirement of a state change application is usually a description of the type of change sought. Obviously this varies by transaction, but for most instream leases and transfers, two simultaneous changes are being requested: a change in the place of use (the land to which the right is appurtenant) and a change in the type of use (from out-of-stream use such as irrigation, to instream use).

Map. In addition to a narrative description of the POU, POD, and proposed change, most application processes will also require a map showing the relevant context. Depending on whether the change is temporary or permanent/long term, the map may need to be drafted by an appropriately certified water rights examiner or a surveyor.

Proof of Water Right Validity. Some applications will require an attachment to the application that proves the validity, and/or the extent of the validity of the right. In some cases, a signed, notarized affidavit stating that the water is not forfeited or abandoned may suffice. However, if there is any question, it is advisable to include other evidence such as dated aerial photos, crop receipts, irrigation pump electricity records, etc.

Notice to Local Government. Some states require that water right change applicants notify relevant local planning authorities such as counties or cities, or tribes, before making any change to water rights located within or near that local government's jurisdiction.

Third Party Permission. Particularly in the case of irrigation district water rights, state applications will likely require proof that any relevant third parties (see description of third party agreements above in this chapter) have given permission to the applicant to make the requested change.

10.4.2 **Types of Change Applications**

State change application processes vary by type of change sought. In general, the longer and more complicated a change request, the more stringent the application requirements. This section briefly details some of the hallmarks of different change processes. Here again, the details are loosely based on Oregon regulations, but the broad details are applicable across other jurisdictions as well. Of course, not all jurisdictions will have the same ability to change a water right to instream use (as in Oregon).

Full Season Instream Lease. Instream lease applications are the simplest state change processes in the water transaction hierarchy. But that doesn't necessarily mean they are simple. Because these changes are short term and temporary, the stakes are lower than permanent water right changes. Instream lease applications generally have less stringent mapping requirements, and call only for the basic information outlined above: water right descriptions, POU and POD descriptions, proof of ownership, and usually a simple statement that the water right is valid.

Split Season Instream Lease. Split season instream leases require additional information above and beyond what is required of full season instream leases. Split season leases apportion some amount of the total duty of a water right between to out-of-stream period and the remainder of the duty to an instream period. Split season lease applications then, require a description of how the right is to be "split" and a proposal for how the applicant and/or the water transaction practitioner propose to measure water use to make sure that the split use of the right does not result in enlargement.

Transfer. Because they are permanent, instream transfer application processing is a whole order of magnitude more difficult than instream leasing. Though the specific information called for in transfer applications may not differ greatly from leasing, the degree of scrutiny applied to each piece of information necessitates a great deal more due diligence before submitting an application. For example, many transfer rules will require a specific for (or forms) of proof of water right validity including an affidavit and some supporting documentation. Transfer maps are also likely to have a requirement that they be prepared by a surveyor or certified water rights examiner. In Oregon, notice of transfer applications must, at the applicant's cost, be published in a local newspaper for three weeks before the application can begin to be processed.

Conserved Water. Only Oregon has a specific change authority related to conserved water, but other states allow similar changes using their leasing, transfer or water banking authorities. However, dedicating just a portion of the water right to instream use is different than just fallowing or drying up acres through a lease or transfer. Depending on the complexity of the project, conserved water applications (or their counterparts) can be far and away the most complicated applications to draft and review. First, these applications must provide all the relevant water right information required by a transfer. Next, they require an in depth description and supporting documentation of the conservation measures implemented or planned. This step is vital so the state agency can substantiate the amount of water actually being conserved and then proposed transferred instream.

Conserved water projects can have a particularly burdensome injury review process. The primary question for the state agency is what water that was conserved, was formerly return flows that are legally owned by downstream water right holders. Answering this question can put a great deal of pressure on applicants to provide the right kind and amount of evidence supporting their proposed change. As if that is not enough, once the amount of conserved water has been corroborated, the agency will then go through an instream transfer process just as complicated as a standalone transfer.

Downstream POD Change. Downstream POD changes are a species of water right transfer. In these cases, as in all transfers, the main question the state agency will wrestle with is whether the change can be completed without injury to other water rights. For downstream POD changes, a map of the existing and new POD locations should be prepared by a surveyor/certified water rights examiner.

Surface Water to Groundwater Exchange. Surface to ground water substitutions can take two basic forms. The first is where a surface water right is transferred instream in exchange for the development of a new ground water right from an aquifer that is not connected to the surface source. The second form, essentially a change in the point of diversion, is a switch from a surface water POD to a ground water POD that is connected to the surface water source.

The first case, where the ground and surface water sources are not connected, involves two applications: a new ground water right application and an instream transfer application. The primary factor the state will consider is whether the applicant has proven that the groundwater source is not connected to the surface water source where the right is being transferred Instream. Satisfying this condition may require in depth hydrologic analysis.

In the second case, where the ground and surface water sources are connected, the change will likely only be allowed if it can be implemented in a way such that the source stream is not impacted in a different way using a ground water POD that it was when the surface water POD was in place. This might involve reducing the right to account for transmission losses from the previous ditch if it was long and unlined or some other condition to prevent injury to other users of the source stream. Either way, these applications will require careful mapping and hydrologic analysis.

10.4.3 **Water Right Change Application Timing**

Like funding agreements, water right change application timing must be carefully worked into the overall timing of water transactions generally and landowner agreements specifically. Of all of the stages of a water transaction, state change application procedures are the most likely sources of delay. Not only are state agencies under staffed and under funded, but public processes involving water rights can, and often do, receive scrutiny and sometimes official protests from third parties who think they might be affected by the change. This section will walk through the steps that an instream transfer proceeds through in Oregon. Though not specifically representative of anywhere but Oregon, this thorough process is largely similar to steps required by other western states.

Submitting an application to change a water right subjects that right to scrutiny it might otherwise avoid. For example, without requesting a change, the landowner may never be called to prove the validity of their water right unless a neighbor submits a formal complaint about their water use. A formal map may not ever be needed outside of the application process and sometimes mapping can uncover uncomfortable realities like the fact that a road now sits where state records show irrigated land should be.

Because exposing a water right to this scrutiny can carry some risks for the landowner and also for the transaction, it is best to wait until as late in the process as possible and/or practical to formally submit the change application. At the very least, the landowner needs to be committed (via a signed landowner agreement, ideally) to pursuing the change and needs to know what the contingencies are should something unexpected come up or should something go wrong. In addition, funding should also ideally be in hand, or at least secured before beginning the state process. Many state processes cannot be undone. Having a change finalized and no money secured to compensate the landowner for the change could be severely damaging the landowner relationship and to the transaction proponent's credibility.

There may be some exceptions to the rule to wait as long as possible before submitting state applications, but waiting until as many contingencies are settled as possible is advisable in any situation.

A basic instream water right transfer process follows a basic timeline:

- pre-application prep and meetings with the state agency field and processing staff;
- final application drafting and submission;
- public notice/opportunity for protest;
- if necessary, response to public comments/protests;
- review and negotiation on proposed orders and conditions; and
- issuance of a final order.

Each of these steps is discussed briefly below.

Pre-application Preparation. It is always advisable to do as much legwork as possible before beginning to draft a state agency application. This includes simple steps such as gathering relevant documents but also includes more complex and important steps like meeting with field staff (watermasters, engineers, etc) to describe the proposed change and get their off-the-cuff take on any possible problems or issues. The more prepared you are before drafting the application, the more time can be saved on negotiations and clarifications after the application is submitted.

Final Application Drafting and Submission. Carefully read all application requirements and make sure all i's are dotted and t's crossed. Many applications will come with a checklist that allows applicants to ensure they have all the necessary documentation before submitting an application. Failure to submit a complete application can result in serious process delays so take extra time when drafting the final application to ensure all necessary pieces are in place. An extra day spent finalizing an application can save weeks later in the process.

Public Notice/Opportunity for Protest. Public notice can either be the responsibility of the applicant or the state agency or a combination, but in most cases, there will be a mandatory mechanism (such as newspaper) and a mandatory waiting period to receive public comment and/or protest. Handling comments and protests are dealt with separately in the next section.

Proposed Orders. Before issuing a final order, the state agency may provide a draft or proposed order to the applicant in order to preview what the final order will look like and begin a discussion about any variations between the applicant's proposed change and the agency's decision. Careful review of proposed orders is a vital step in the process. Not only are significant typos sometimes caught (misrepresented acreages for example), but sometime serious policy disagreements may arise at this point.

Most state agencies that issue a proposed order do so to initiate some amount of negotiation or at least discussion before making an order final. It is therefore always worth having a discussion with the agency about any disagreements you have with a proposed order, whether they are technical or legal. It is not uncommon to find some middle ground that the agency can live with and that makes the project more successful.

Final Order Issuance. Once you give the agency the green light, they will issue a final order. Final orders themselves may not be the last step in a project. For example, for permanent instream water rights, the transaction may not be final until the agency issues a new instream water right certificate which does not always occur at the same time as final order issuance.

For other change types, like conserved water applications or POD changes, final orders will give a timeline by which physical/infrastructure work such as building a new diversion must be finalized. Once finalized, these will also likely need to be "proven up" and a claim of beneficial use submitted before the project can truly be finalized. However, the issuance of a final order is often a significant funding deliverable and represents a beginning of the end of the transaction.

Handling Third Party Protests. Though this topic itself could take up a book, this section discusses third party protests and provides some basic strategies for addressing them when they arise. Protests fall into two basic categories: serious challenges based on either technical legal or hydrological principles, and frivolous challenges based on philosophical problems with instream flow protection.

State agencies vary in how much they will countenance frivolous protests. These protests are usually easy to spot and are often dismissed by the agency out of hand with a simple acknowledgement and a statement that the protest did not state any valid reasons for denying an application. Serious protests are different and can trigger everything from a mediated settlement, to a multi-year court-like legal proceeding called an administrative hearing, to a process that goes all the way into a state's appeals courts.

State agencies first line of defense is to try to broker a mediated compromise between the protestant and the applicant. The advantages to this are obvious: it can avoid a prolonged, possibly reputation-damaging and public battle (one former practitioner whose name shall remain secret, ended up being the subject of a political cartoon in a local newspaper during the heat of a prolonged protest of an Instream transfer). However, there can be valid reasons to press your case over protest. Either way, protests are situations where consulting an attorney is beneficial. An attorney can help navigate the potential minefield and help you determine what various process options may be.

The best way to handle protests is to avoid them completely by building broad support for projects where possible. However, protests may be unavoidable and in those cases, the wisest choice will depend entirely on the technical merits of the project and the project's context—both legally and socially. At the end of the day the choice often comes down to whether the proponent and the applicant care more about getting a project done quickly, or proving an important legal or technical theory. If getting the project on the ground is the priority, a negotiated solution can usually be found. If precedent is the objective, steel yourself for a possibly long and painful process.

10.4.4 **Tips and Strategies for State Application Processes**

Navigating the state agency change application process can be one of the most frustrating parts of the water transaction project cycle. However, with some work and some patience, and some dedication to building a solid working relationship, the agency change process can be made more efficient for everyone. The following section provides some tips for taking some of the pain out of the process.

Build a relationship with your relevant state agencies: Perhaps no single tip is more important that getting to know your state agency. Get to know both field staff and office-based processing staff so that your communications with them while application processes are ongoing can be substantive and meaningful. It can also be useful to establish a friendly relationship at the top of the agency organization chart with a director or someone else at the executive leadership level. These high level relationships are most important when things go wrong or you disagree with an agency decision. The decision-makers at the agency may be able to exercise some discretion and flexibility where office and field staff cannot.

Consult technical experts whenever possible: For complex and/or permanent water right changes, it can pay off to hire technical experts to help prepare maps and other relevant application exhibits/attachments. Having an engineer's or a hydrologist's stamp on a proposed project will give agency reviewers more confidence in the proposal and can help head off questions that may come up about hydrology or other technical aspects of a project.

Manage the application process and landowner relationship carefully to avoid risks: Remember that submitting an application to a state agency to process a change application can expose the relevant water right to serious scrutiny. It is vital therefore to talk through these risks with the landowner so they are prepared for any unexpected challenges that may arise.

Don't be shy about engaging with the agency before and during the process: Requesting a pre application conference with either or both field and office-based agency staff to brief them on an application you plan to submit and hear their initial feedback is an extremely useful tactic if the agency staff have the time. They can help spot possible pitfalls before you submit the application and provide you with a head start addressing possible weaknesses in the application prior to submittal. Pre application work also primes agency staff to look for your application and be ready to jump right into review without having to first familiarize themselves with something they have never encountered.

Once the application is submitted, stay in close contact with all relevant personnel and ask for updates as the application progresses. If it feels like you are pestering the agency, then you are probably doing just the right amount of communicating with them!

10.5 Resources

10.5.1 Internet Links

Funding Programs:

Columbia Basin Water Transactions Program: www.cbwtp.org

Bonneville Environmental Foundation Water Restoration Certificate Program: http://www.b-e-f.org/our-solutions/water/water-restoration-certificates/why-wrcs/

United States Bureau of Reclamation WaterSMART Grants: http://www.usbr.gov/WaterSMART/grants.html

Oregon Watershed Enhancement Board: http://www.oregon.gov/OWEB/GRANTS/pages/index.aspx

Walton Family Foundation Freshwater Conservation Initiative: http://waltonfamilyfoundation.org/environment/freshwater-conservation

State Agency Application Examples:

Oregon Water Resources Department Transfer of Water Right Forms: http://www.oregon.gov/owrd/pages/pubs/forms.aspx#transfers

Washington Department of Ecology Application to Enter a Water Right into the Trust Water Right Program: https://fortress.wa.gov/ecy/publications/SummaryPages/ECY07054.html

Colorado Water Conservation Board Instream Flow Rules: http://cwcb.state.co.us/legal/Pages/Rules.aspx

10.5.2 References

General references for contract drafting:

Espenschied, L. E. 2010. *Contract Drafting: Powerful Prose in Transactional Practice*. Chicago: American Bar Association.

CHAPTER 11
MONITORING AND ACCOUNTING FOR ENVIRONMENTAL WATER TRANSACTIONS

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Ecosystem Economics
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Monitoring and Accounting for Environmental Water Transactions

This chapter discusses the rationale, methods and framework for monitoring water transactions from contractual, hydrological, ecological, and biological perspectives. While there are undoubtedly thousands of techniques, protocols, and theories of monitoring, this chapter presents a sequential step-by-step framework for tracking the impacts and outcomes of water transactions on stream function. The steps of the framework are based on a cascading series of threshold hypotheses, where streamflow must be augmented by a defined percentage in order to produce measureable hydrologic, ecological, or biological changes.

This framework was initially developed with a focus on flow restoration and salmon recovery for the Columbia Basin Water Transactions Program (CBWTP). However the framework is broadly applicable in a wide variety of stream systems where low flow conditions can be addressed through water transactions, including snowmelt dominated streams, groundwater dependent streams, and regulated irrigation and storage systems.

The chapter begins with a discussion of the rationale and need for monitoring and then offers a brief overview of monitoring methodologies that can be used to account for the impacts of flow transactions. Several examples of the application of the framework are given as a way to ground some of the theory in applied scenarios.

11.1 Monitoring and Accounting

As discussed throughout earlier chapters in this handbook, many local and national organizations are devoting time to quantifying flow needs, developing transaction programs, and successfully negotiating transactions with water right holders. These transactions lead to reduced diversions and the protection of water for instream and environmental purposes. Yet, limited effort is devoted to assessing and tracking outcomes from flow transactions. This imbalance between implementation and assessment of effectiveness arises from multiple factors, including the high costs of long-term monitoring and limited project budgets. As a result, critical knowledge gaps remain around the relationships between transactions, flow restoration, ecological responses, and biological communities.

These knowledge gaps are receiving significant attention in the Columbia River Basin. Throughout the basin, the magnitude and scale of efforts to revive salmon runs are considered to be unprecedented in U.S. history (Barnas & Katz, 2010). Between 2001 and 2003, nearly $400 million federal dollars per year were directed towards rehabilitating the Columbia River Basin (Rumps et al 2007). However, comparatively little is known about the effectiveness of these endeavors, both as individual projects and cumulatively. Several significant large-scale monitoring efforts have been developed to bridge these knowledge gaps, including the Columbia Habitat Monitoring Program (CHaMP), the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), Northwest Power and Conservation Council's Columbia River Basin Monitoring, Evaluation, Research and Report Plan (MERR), and the Integrated Status & Effectiveness Monitoring Program (ISEMP), among many others. Website links for these programs are provided in the resources section later in this chapter. Each of these efforts has based its monitoring plans on three general categories of monitoring actions (NPCC 2010):

Compliance and Implementation Monitoring. These monitoring activities track the extent to which the steps of a plan have been carried out, or the degree to which established laws, rules, or requirements have been met.

Status and Trend Monitoring. These efforts characterize existing conditions that serve as a baseline and documents changes in conditions, stressors, or responses over time as compared to baseline conditions. Status and trend monitoring does not necessarily determine the causes of observed results.

Effectiveness Monitoring. There are two types of effectiveness monitoring. Project scale effectiveness monitoring measures environmental parameters to determine if activities were effective in creating a desired change in habitat conditions. Action effectiveness monitoring endeavors to establish "cause and effect" relationships between biological population dynamics, habitat conditions, and management actions.

From the perspectives of water transactions, knowledge gaps remain around documenting direct relationships between flow alteration and targeted biota. Recent research supports this challenge in showing that community and process-based physical and biological indicators do not respond to changes in the flow regime in predictable ways and are therefore difficult to track and monitor (Poff and Zimmerman 2010).

With these cause and effect challenges acknowledged, the monitoring framework presented in this chapter focuses primarily on the first two categories of monitoring: compliance and implementation monitoring as well as status and trend monitoring. While effectiveness monitoring is an essential component of any restoration program, the targeted focus of water transactions as a restoration tool makes it difficult and resource intensive to trace ecological and biological changes that result specifically from augmented flows. Therefore, the framework is built around ensuring contractual compliance and tracking hydrologic and ecological changes over time as a result of increased flows.

11.2 Need for Transaction Monitoring and Accounting

Monitoring can provide information for multiple purposes, including ensuring compliance, tracking progress towards programmatic objectives, informing strategic decisions and planning, and assessing ecological changes that may result from restoration actions. The need for cost-effective, efficient, and targeted stream monitoring programs is apparent in restoration programs from the federal to the local level. These needs are driven by demands from communities, funders, and managers for more scientifically informed and transparent restoration decisions, as well as consistent feedback on stream conditions and responses (Gordon et al 2004).

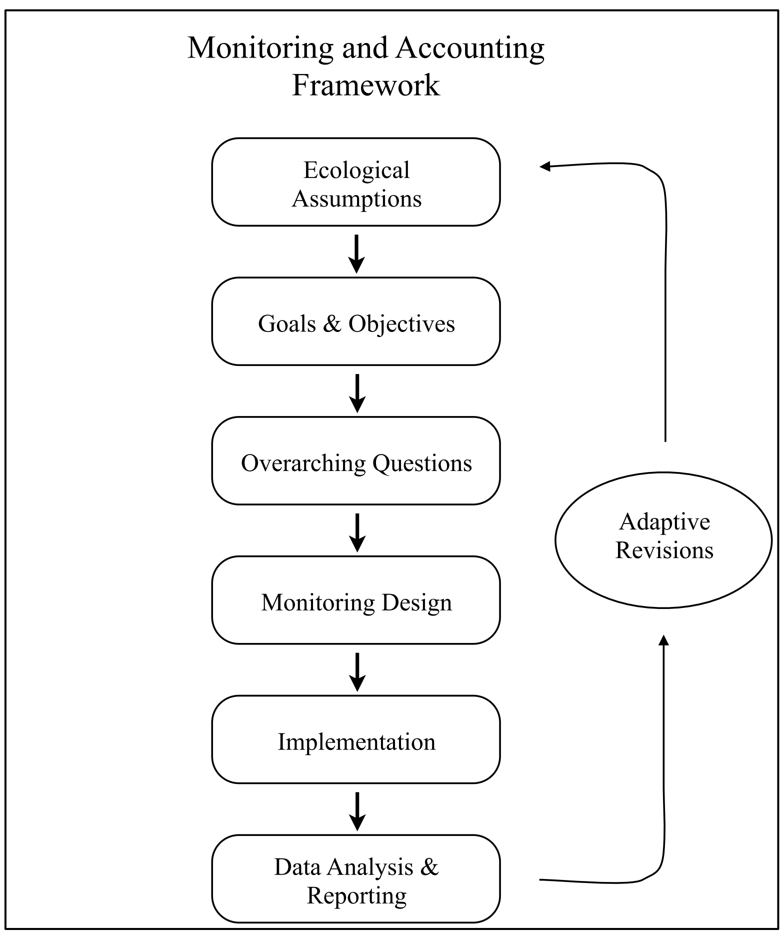
11.2.1 **Foundational Logic Path**

While ecological monitoring is a broad and expansive field, there remains a need for a targeted framework for monitoring and accounting for environmental water transactions. Federally-funded programs such as the Walker Basin Restoration Program, federal imperatives such as the International Boundary and Water Commission Minute 319, and privately funded flows initiatives such as Bonneville Environmental Foundation's Water Restoration Certificates each require focused, systematic, and long-term monitoring and accounting strategies that can provide consistent and quantifiable information on the impact of streamflow restoration. This information can aid restoration practitioners, transaction specialists, stakeholders, managers, and funders in several key ways by:

- providing accountability to funders and agencies for the ongoing investments in flow restoration;
- delivering feedback to local stakeholders that participate in flow (and other) restoration activities and providing assurance to the public that a scientific and accountable process is in place to maximize and measure the outcome of restoration investment and participation;
- documenting positive results that could reinforce current restoration efforts and seed future collaborative restoration activities with landowners, agencies, organizations, and stakeholders; and
- generating critical data to facilitate an adaptive and scientific restoration process that will inform natural resource managers and water transaction activities.

The design for this monitoring framework focuses on streamflow restoration efforts and is based upon a specific and cascading logic path that forms the basis for a measured approach to evaluating programmatic and ecological outcomes (Figure 11.1). The headings in the remainder of this section follow each step of the logic path.

Figure 11.1 Effectiveness Monitoring Logic Path



Source: This figure is adapted from and informed by Hillman and O'Neal (2009)

11.2.2 Ecological Assumptions

The foundation of the framework is premised upon two key ecological assumptions that strengthen the development of water transactions as a tool for aquatic habitat restoration.

1. Transacted water can be measured and accounted for within a specified stream reach and/or shallow groundwater aquifer.
2. Flow is a limiting factor for streams to support biologically important habitat composition and targeted species. For example, maintaining fish species listed under the Endangered Species Act, sustaining functional riparian habitat, and supporting important migratory bird species.

11.2.3 Goals & Objectives

The goal of a monitoring and accounting framework is to create and implement a methodology that uses well-defined measures of progress to track the effectiveness of flow restoration as a tool that contributes to improved aquatic habitat conditions for targeted biota.

A number of objectives provide guidance to the design and implementation of a monitoring and accounting framework that:

- produce structured and meaningful guidance to water transaction practitioners and partner organizations on programmatic and ecological monitoring requirements to track the outcomes of water transactions;
- work within known programmatic capacity and budget constraints;
- utilize existing monitoring data to demonstrate seasonal, yearly, and multiyear impacts of flow restoration in targeted streams and sub-basins;
- comply with funding and programmatic reporting requirements; and
- integrate monitoring data with ongoing and scaled-up habitat and biological monitoring and research efforts.

11.2.4 Overarching Questions

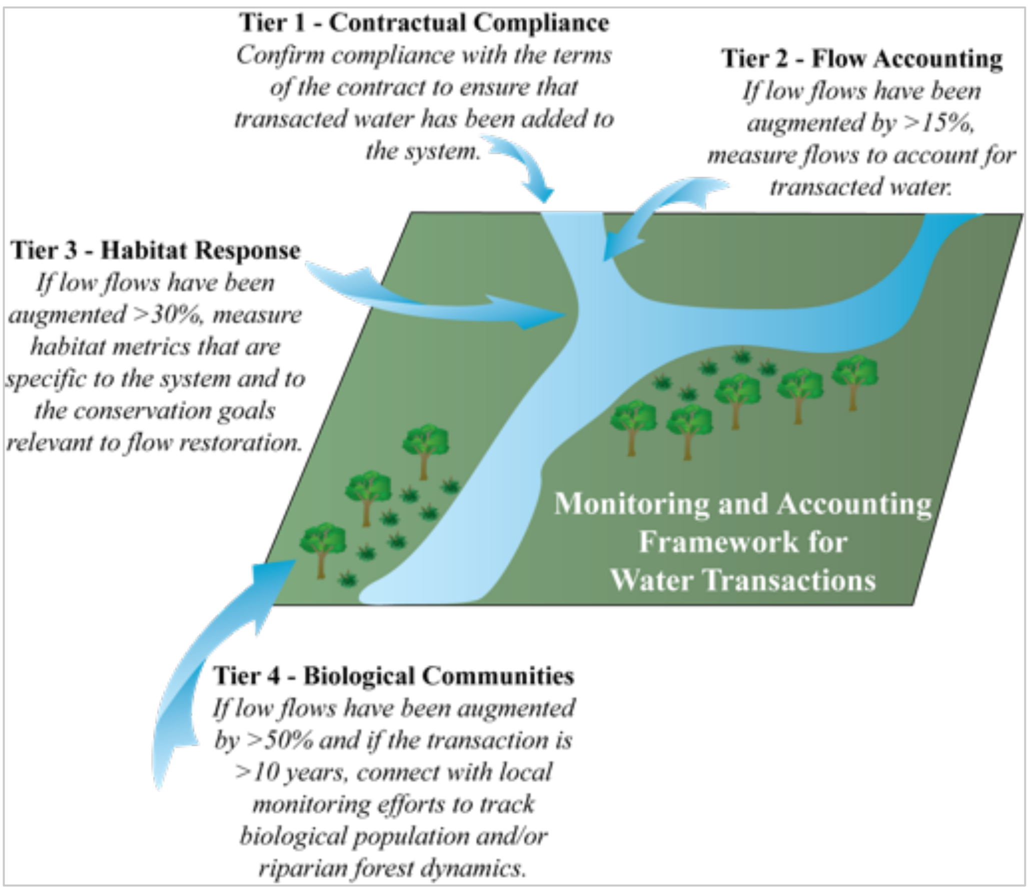
An accounting and monitoring framework for transactions ideally addresses four questions about the progressive and anticipated levels of impacts that may result from restoring flow to streams:

1. Project Compliance: Are the terms of the contractual agreement for each transaction satisfied?
2. Flow Accounting: Can the flow added to the stream through a single water transaction be accounted for immediately downstream of the point of diversion (POD) and along a specified length of the protected reach during the seasonal time frame defined by the transactional agreement?
3. Habitat Responses: What changes in flow-related habitat characteristics can be tracked and identified in protected stream reaches?
4. Biological Communities: What changes in the biological community can be detected as a result of streamflow restoration?

11.2.5 Monitoring and Accounting Framework Design

Building on these questions, a monitoring framework can be based upon four cascading tiers as described below and illustrated in Figure 11.2. Ideally, this framework can be applied to programs that are just beginning, as well as programs that are mature and have numerous transactions and restored streams. For nascent programs that are just getting underway, forecasting for monitoring needs in advance can help direct strategic planning for transaction placement and funding. For more mature programs, data generated from the monitoring framework can assist in tracking impacts from a reach to a regional scale, as well as provide important feedback to funders and strategic plans. In addition, this framework can be applied to programs working to restore shallow groundwater aquifers. While measuring the degree of change in shallow aquifers can be more challenging, the overall concept of threshold still applies. For example, an estimated 30% change in shallow aquifer levels is assumed in order to affect changes in riparian habitat robustness. As a result, Figure 11.2 can be used a starting point for determining a framework for shallow aquifer systems.

Figure 11.2 Four-tiered Water Transactions Monitoring and Accounting Framework



The four monitoring tiers are:

Tier 1 – Contractual Compliance. Compliance actions within Tier 1 ensure that the legal terms of each transaction are met. If possible, all transactions within a program are included within Tier 1 in order to fulfill annual reporting requirements as defined by the transaction type (e.g., lease, purchase, split-season). In some cases, flow monitoring may be mandated by transaction structure, at which point the transaction automatically moves into Tier 2. This step is the foundation of the framework, as there needs to be a high level of confidence that the transacted water was added to the system before any hydrological measurements can be made.

Tier 2 – Flow Accounting. This tier is premised upon two necessary conditions:

1. Tier 1 has ensured contractual compliance and there is a high degree of confidence that the water has been successfully added to the system, and
2. The transacted water is of sufficient volume to be detectable above the level of uncertainty and any potential losses from transpiration, evaporation, and/or groundwater recharge.

For the purposes of this framework, a threshold range of 15% flow augmentation during periods of low flow (or during the specified period of ecological significance) is suggested. The percentage of augmented flows a transaction contributes to a stream can be calculated by comparing the volume of transacted water to the median daily low flows for the relevant period. The period of ecological significance is a unique time period for each stream reach and refers to the time frame during which streamflow is a limiting factor for targeted biological populations and ecological goals. This period is typically defined through expert knowledge of stream conditions and habitat needs for the targeted biological populations and ecological goals. This tier is designed to track and account for the flow instream from the POD and/or throughout along the specified length of the protected reach before, during, and after the period of ecological significance.

Tier 3 – Habitat Response. This tier is intended to track changes in flow-related habitat characteristics by accounting for aquatic habitat metrics along a specified section of the protected reach during the period of ecological significance. The tier is therefore premised upon the condition that a sufficient amount of flow has been added to the system as to have an impact on habitat characteristics such as riffles, bankfull, and wetted width. For the purposes of this framework, the suggested threshold for Tier 3 is 30% augmented flows for low flow conditions and/or the period of ecological significance. Due to the site-specific characteristics of each stream and/or shallow aquifer, this framework does not prescribe a specific monitoring methodology for this tier. Rather, to minimize the resource expenses of monitoring at this level, projects that fall within this tier would ideally develop a monitoring strategy in collaboration with ongoing monitoring and evaluation efforts and experts in order to leverage existing data and scientific investment.

Tier 4 – Biological Communities. This tier is designed to integrate transaction and flow-specific habitat metrics gathered in Tiers 1, 2, and 3 with broader monitoring efforts to place flow transactions within the context of biological population recovery efforts. This tier is premised upon an assumption that a sufficient amount of habitat change must occur in order to influence broader scale population dynamics. Therefore, only the most intensive and long-term transaction projects would necessarily fall within Tier 4. In addition, monitoring efforts within Tier 4 are intended to nest within larger research and monitoring efforts that focus on aquatic species or riparian-specialized population dynamics.

The tiers are differentiated by the following factors:

Level of Investment. The contractual compliance tier requires the least amount of monitoring effort, while the biological communities tier requires the highest level of expertise, time, coordination, and resource investment.

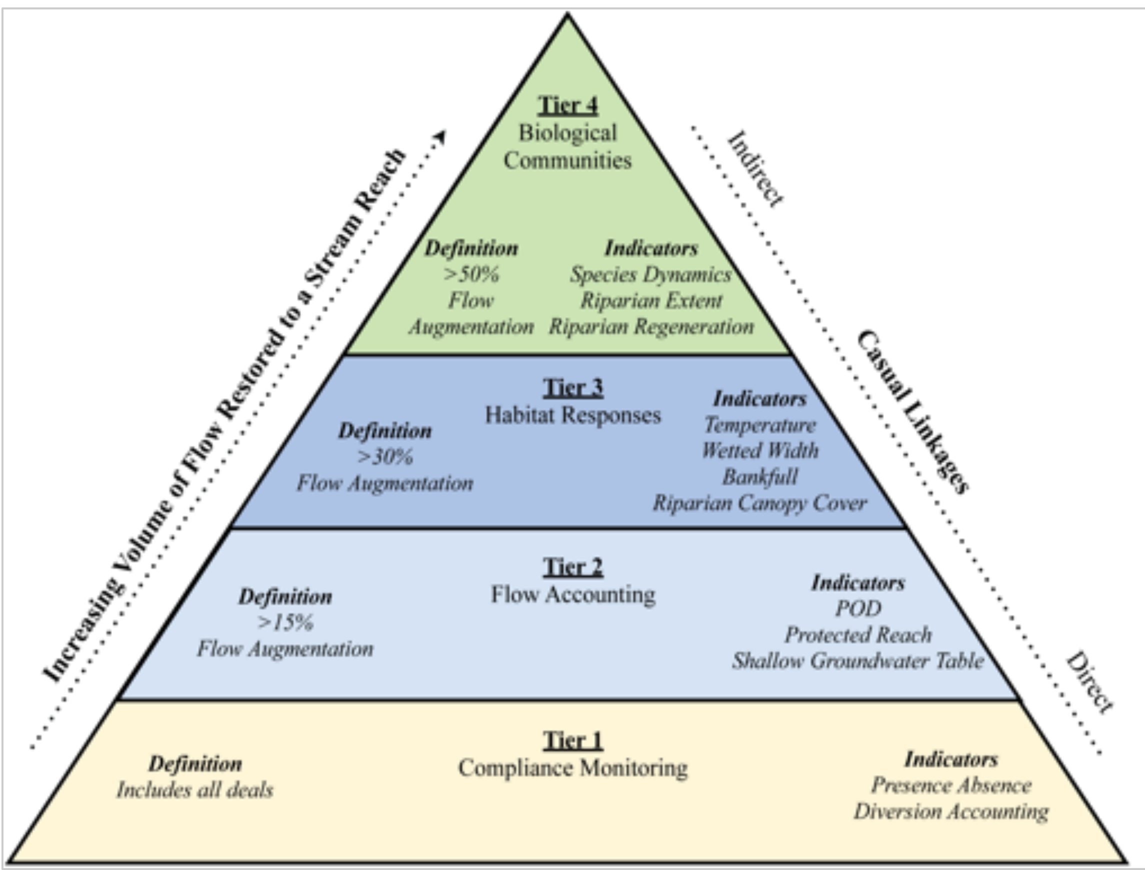
Scale of Focus. The contractual compliance and flow accounting tiers are focused on individual (or cumulative) transactions, while the habitat responses and biological communities tiers are focused on stream reaches that include multiple transactions.

Selection Criteria. Transactions and stream reaches are sorted into tiers according to well-defined selection criteria. All transactions will require monitoring under the contractual compliance tier, with progressively fewer transactions and stream reaches falling into the subsequent tiers.

Hydrologic Dynamics. Monitoring indicators are selected to produce data that correspond to variable rates of change in aquatic responses to flow alteration. Sampling for these indicators will occur at a frequency that reflects the expected rate of change. For example, multiple data points will be gathered over the course of each season to reflect short-term changes in flow and/or water levels in shallow groundwater aquifers.

Within the design of the framework, monitoring requirements include those activities specified for the assigned tier as well as for the preceding tiers. For example, a transaction that is placed in Tier 1 would only need to fulfill Tier 1 requirements. However, a transaction that is placed within Tier 3 would also include monitoring activities under Tier 2 and Tier 1.

Figure 11.3 Monitoring Tieramid



This monitoring and accounting framework provides overall guidance on a monitoring structure to characterize the effectiveness of flow transactions as a restoration tool. The idea is to tailor the framework to identify a preferred suite of monitoring procedures and protocols that may be implemented within the purview of the individual organizations' or programs' abilities and needs. An example how this would be implemented is provide in Figure 11.3.

11.2.6 Reporting Requirements

Requirements for the frequency and duration of monitoring for each transaction type are specific to the agencies and/or organizations funding and implementing the transactions. As an example to provide some guidance for monitoring frequency and details, reporting requirements for the CBWTP are listed in Table 11.1. Transactions are monitored at the tier level into which they are assigned for the duration of time listed for the qualified tier. Once the time requirement is fulfilled, the transaction will be placed into a pool from which at least 20 per year will be randomly selected for monitoring. If selected, monitoring requirements will be consistent with the original tier in which the transaction was assigned.

Table 11.1 Frequency of Monitoring on CBWTP Transactions

Transaction Type	Required Monitoring Duration
Source Switch	Annually for first 5 years After first 5 years, monitor randomly at least once every 10 years for life of project
Leases	
Short-term	Annual monitoring
Long-term	Once a year for 10 years After first decade, monitor randomly at least once every 10 years for life of project
Purchase and Transfer	Once a year for 10 years After first decade, monitor randomly at least once every 10 years for life of project
Minimum Flow Agreement	Annual monitoring

11.3 Tier 1 – Contractual Compliance

11.3.1 Intent

The goal of the contractual compliance tier is to ensure that the legal terms of each transaction are met through clear and standardized reporting requirements for each transaction. The focus of monitoring under this tier is limited to the original place of use and/or diversion to confirm the change in water use specified within the contract. Some transactions may require an additional level of monitoring instream to demonstrate that the water has been added to the stream; these automatically qualify for Tier 2 monitoring.

It is worth noting that compliance monitoring focuses specifically on the proper execution of the contract. This tier does not focus on, nor rely upon, the degree to which the environmental flow goals were achieved. Hydrological, ecological, and biological responses to flows are tracked and reported in subsequent tiers of this framework.

11.3.2 Tier Description

Monitoring under Tier 1 establishes the foundation for each of the subsequent three tiers and therefore applies to all transactions completed under a transactions program. Compliance monitoring focuses on the unique terms of each transaction type and structure. Specific compliance requirements for each type of transaction fall into two categories:

1. Presence/Absence Monitoring. This protocol focuses on water that has been transferred from an out-of-stream consumptive use to an instream flow-related use.
2. Diversion Monitoring. Diversion observation and/or gaging methods are required to verify continued, but partial, water use.

In the CBWTP protocols, each transaction is given a compliance status following the completion of the compliance monitoring requirements. The compliance status categories are defined as:

- Green: compliance was achieved, and there were no obstacles or issues;
- Yellow: compliance was not entirely met, and an explanation is required to explain the obstacle, issue, or reason why compliance might vary or seem to have varied;
- Red: compliance was not met to CBWTP standards, monitoring has not occurred, or there are significant issues with monitoring and follow-up is required; and
- Purple: no compliance monitoring was completed.

This system, or something similar, may be useful for other transaction programs as it offers a relatively straightforward way to track the degree to which contractual requirements were met over the course of a season, and it produces data that may be useful in adaptively refining the development, strategy, and implementation of transactions in the future.

11.3.3 Presence/Absence Compliance Monitoring

These monitoring procedures verify the presence or absence of the water that is leased or sold. This approach is only applicable in absolutes—when water on appurtenant acres is forgone, a diversion is completely closed, and ditches, sprinklers, etc. are no longer used and/or wet. These procedures are based upon visual observation of the land, headgate, ditch, sprinkler, etc. through personal observation, photo documentation, LANDSAT/aerial photos, and/or communication and photo documentation with the landowner or other local individual/entity.

Photo point monitoring can be incorporated into Presence/Absence compliance monitoring. Photos used to document presence or absence of use should capture either the ground, in context with surroundings, or the diversion in context with the river to note the absences of flow. At the diversion or instream, two photos should be taken: one looking upstream and the other looking downstream. The time, date, picture number, stream location, GPS coordinates, and any other relevant information should be recorded. Establishing a digital database or library at the beginning of the transaction is a useful technique for organizing and archiving photos for each transaction, as photos can quickly multiply into unwieldy collections.

Often, the organization that implemented the transaction is responsible for determining the degree to which compliance with the contract was achieved. This determination is based upon the information gathered via field visits, satellite/aerial imagery, photo documentation, and/or conversations with the landowners. Compliance monitoring data are occasionally necessary for third-party review of transaction implementation, as is the case with CBWTP and Bonneville

Environmental Foundation transactions. In these cases, a third party may ensure compliance directly via the methods described above, or by reviewing the documents and reporting forms produced by the organization that implemented the transaction(s).

11.3.4 **Diversion Monitoring**

Compliance monitoring for diversions focuses on transactions where only a portion of the full amount of water in a ditch or diversion is moved instream. Compliance monitoring demonstrates that the reduction in the volume of water in the diversion is equal to the amount of water specified in the contract. This category of monitoring typically occurs for each diversion that is physically connected to the protected reach and included in the transaction. These monitoring actions focus exclusively on the diversion and ensuring compliance with the transacted amount of water. Any monitoring completed within the stream or at the POD falls under Tier 2.

There are three generally accepted and commonly used methods for measuring flow within a diversion: a flow meter or staff gage in the diversion, an open channel measurement device, and use of a headgate (automated or standard) with verification of action (calibration that shows a correlation between the amount of change in a headgate and the amount of water that passes through the headgate). Depending on the context of the transaction(s) and the resources available within the organization, any of these three measurement methods can be used multiple times annually to ensure compliance.

11.3.5 **Reporting Options**

Reporting requirements will vary dependent on transaction type and required monitoring. Often, compliance monitoring is required by the entity funding the transaction in order to confirm that the water purchased according to the terms of the contract and applied to the stated environmental purpose. For this reason, it may be necessary to perform some level of compliance monitoring for every transaction, even if the frequency and method of that monitoring varies by transaction. For example, for a transaction where a diversion to a field is closed and those flows remain in the stream, it may only be necessary to confirm that the diversion was closed by taking before and after photos of when the diversion was on and irrigating a green field, and when the diversion was turned off and the field went fallow. In instances where a portion of the water in a diversion is leased, frequent measurements may be useful in showing that a reduced volume of water is diverted for the entire term of the transaction contract.

Suggested monitoring and reporting forms that can be tailored to the individual needs of each organization are presented in the resources section at the end of this chapter.

11.4 Tier 2 – Flow Monitoring

11.4.1 **Intent**

The goal of the flow accounting tier is to determine the degree to which transacted water can be accounted for at the POD and along a specified length of the protected reach. The objective is to track changes in discharge during the period of ecological significance, as defined by the purpose of the transaction in addressing the key limiting factor of flow for identified and targeted species. In addition, some contracts will require flow monitoring at the POD, which would be covered under Tier 1.

Flow monitoring enables transaction practitioners to track and confirm the quantity and timing of environmental flow restoration. It is therefore important to highlight two conditions for data gathered under Tier 2:

1. For the purposes of this framework, it is assumed that transacted water can most reliably be detected when historic median daily low flows for the period of ecological significance are augmented in excess of 15%. This percentage has been approximated based on the USGS standard of potential error for flow gages (Rantz 1982).
2. This framework is based on an assumption that the full volume of transacted water will not be detectable throughout the protected reach over the course of the monitoring season due to climatic variables, hydrologic conditions, downstream uses, and/or water management factors. Instead, the framework assumes that monitoring data can be used to characterize the ways in which transacted flows have (or have not) affected stream conditions.

11.4.2 **Monitoring Methodologies**

Stream flow monitoring is the hydrologic foundation of the flow transaction. Streamflow, or discharge, is the volume of water moving past a designated stream cross-section over a fixed period of time. Discharge is most typically represented in cubic feet per second (cfs). Flow monitoring tracks the degree to which changes in discharge can be accounted for along a specified length of the protected reach as a result of a water transaction.

Site Selection. To accurately gauge and track a flow transaction, at least two locations are monitored:

- the point of diversion (POD); and
- the end (or a point within) of the protected reach.

The POD is typically monitored for compliance and defines the upstream boundary of the protected reach in which flow is augmented. Monitoring directly downstream of the POD enables tracking and accounting for flow transaction(s). The downstream boundary of the protected reach is theoretically an important location to monitor for a flow transaction, as this point helps to quantify the changes, and in some cases benefits, provided by the transaction. However, in some cases the protected reach may be too long to reasonably monitor, or the downstream boundary may be difficult to access. In these cases, selecting a consistent point downstream of the POD and within the protected reach can suffice to account for transacted flows.

While monitoring at the POD and approximately at the end of the protected reach are the minimum number of sites suggested for monitoring under Tier 2, additional sampling locations within the protected reach can assist in further characterizing the reach and accounting for flow dynamics.

Discharge measurements should be taken at site locations where hydraulic conditions are as uniform and straight as possible and are free of obstacles that may alter or influence stream velocity. In addition, staff gaging sites during low flow periods should be selected with a downstream stage control. Staff gaging locations should be marked with stakes, flagging, and/or GPS coordinates from a surveyed benchmark.

Temporal Period. Flow transaction monitoring under Tier 2 is relevant to the period during which a water right holder may otherwise use their water right for beneficial use, or the period of ecological significance defined by the transaction. At minimum and if feasibly possible, flow measurements are recommended during three periods: immediately prior to the initiation of the flow transaction (to characterize pre-transaction conditions), during the flow transaction (to characterize the change affected by the transaction), and following the end of the transaction (to characterize the return to baseline conditions). This monitoring frequency helps characterize the response of the system to the flow transaction, which directly relates to an understanding of the hydrological, ecological, and possibly biological responses of the system to augmented flows.

Sampling Procedures. Discharge measurements will be taken at established channel cross-section locations immediately upstream and downstream of the POD and at the end of the protected reach. Monitoring data upstream and downstream of the POD and at the end of the protected reach may be collected via one of the following options:

- USGS stream gage (preferred method if gage is located in close proximity to the POD or within the protected reach);
- continuously recording stage recorders and staff gages; and
- manual field measurements with a flow meter deemed most appropriate for the stream characteristics, including velocities and cross-sectional depths.

The frequency of discharge measurements varies by transaction type, as described below. However, these requirements do not apply if a continuously recording device is used and a rating curve can be developed from the data points.

Split-season transactions that are implemented for a single irrigation season should be monitored during the season specified by the transaction. Over the course of the monitoring season, discharge measurements are required during the specified time period of the flow transaction. These measurements characterize changes in the hydrograph that result from the transaction.

For transactions that span multiple periods of use over the course of a single year, monitoring activities should take place during the defined period of ecological significance. Over the course of the monitoring season, discharge measurements are required during the specified time period of the flow transaction. These measurements characterize changes in the hydrograph that result from the transaction.

11.4.3 **Flow Monitoring Equipment**

Due to the essential role that flow monitoring plays in both contractual compliance, as well as understanding how augmented flows contributed to restored stream conditions, selecting appropriate flow monitoring equipment is important. Equipment selection varies depending on both the hydrologic conditions and available resources in the potential transaction location. Therefore, while no specific flow monitoring equipment is absolutely recommended, the following short description of available equipment will hopefully assist the practitioner selecting the most appropriate course of action. A thorough review of flow meters and monitoring protocols is offered in the National Fish and Wildlife Foundation Draft CIG Field Monitoring Protocols, developed by Holmes et al. (2011). The information below on flow meters below is adapted from this document.

Flow Current Meters. Making a decision about an optimal flow meter depends in part on five considerations: flow monitoring needs, budget availability, stream velocities, stream characteristics, and cross-sectional depths. Four common current meters are listed below that would reliably produce data needed for monitoring flow transactions:

1. Marsh-McBirney Flo Mate 2000.
2. Price-AA Meter Model 6200 (designed by USGS).
3. Price Pygmy Current Meter (similar, but smaller than the Price-AA).
4. Son Tek Flow Tracker ADV (for low flow conditions).

Continuous Stage Recorders. These flow devices collect time series water depth (stage) data for a specified period of time. Their strength is in capturing streamflow variability over periods of time (daily, weekly, and seasonally), as well as recording points of maximum and minimum flows. These gages are particularly useful for minimum flow agreements, where a certain flow triggers the beginning of a transaction.

There are a variety of continuous stage recorders available:

- Solinst Levelogger Gold Model 3001;
- Geo Scientific Ltd AquaRod;
- TruTrack Ltd - WT-HR Water Height Data Logger; and
- Global Water Instrumentation Inc. WL 16 Data Logger.

In addition to the list suggested here, USGS has approved a variety of types of flow meters and methods that are unique to the wide range of streamflow conditions throughout the country (Olsen and Norris 2007).

11.4.4 **Monitoring Protocols**

Stream discharge is measured as the volume of water that passes through an identified stream cross-section per a specified unit of time, typically expressed as cubic feet per second (Rantz 1982). While this monitoring framework does not offer a specific streamflow monitoring methodology, USGS-approved protocols and methods as described in (Rantz 1982, Olsen and Norris 2007) are suggested as the recommended and preferred flow monitoring methodologies.

Several general suggestions that are adapted from Holmes (2011) are offered below to give some indication of options for taking discharge measurements. In addition, consulting USGS flow measurement reference guides is advised to ensure accurate measurements and a comprehensive understanding of procedures.

Manual Flow Measurements. When taking manual flow measurements, the surveyed cross-section should optimally be divided up into sub-sections, with no greater than 10% of the volume of water being gauged per any one sub-section. At each of these identified sub-sections, velocity measurements are averaged over a 40-second period per sub-section.

Standard Portable Flow Meters. If the stream cross-section depths are less than approximately 0.8 m (2.5 ft), the sixth-tenths-depth (0.6) point velocity-area measurements typically would be used. This method measures stream velocity at 60% of the stream depth at one point (for 40 seconds) using a USGS top setting wading rod at each sub-section within the stream cross-section. A description of this method can be found in USGS flow monitoring publications such as Rantz (1982) and Olsen and Norris (2007).

If the streams vertical cross-section depths are greater than approximately 0.8 m (2.5 ft.), a two-point method would be recommended, which requires velocity measurements at 20% and 80%

stream profile depths then averaging the two for mean velocity. Holmes (2011) is recommended as a reference for this method.

When taking discharge measurements, it is suggested that data always be recorded in field notebooks and/or in handheld computer equipment such as computer laptops or personal digital assistant (PDA) using the standardized USGS data sheets. Information typically recorded includes:

- site name;
- date /time;
- field technician;
- flow current meter (serial number);
- stream condition;
- weather conditions;
- gauge heights (before measurement and after measurements); and
- edge of water for measurement.

This data is then easily accessed and reference for analysis and reporting.

11.4.5 **Flow Reporting**

Monitoring data gathered under Tier 2 can be aggregated and reported on for multiple purposes:

Flow Accounting. At the most basic level, monitoring under Tier 2 provides data to confirm that transacted flows have been added to the stream. If low flow conditions in the stream have been augmented by more than 15% (as calculated from the median daily low flow data) and transacted flows cannot be detected, then several scenarios should be considered. As one possibility, the protected stream reach may be a losing reach, in which case flows may need to be augmented by more than 15% in order to be detected. Data gathered under Tier 2 can help understand these stream dynamics and therefore assist in adapting a flow restoration strategy for the stream.

Flow Assurance. As a second possible scenario, if flows cannot be detected through measurement and monitoring, it may be possible that flows are being diverted downstream of the POD. If this occurs, the transacting organization may need to call on the water via the local water master, irrigation district, water agency, or directly with the downstream user. While the action taken to call on water may be triggered by monitoring under Tier 2, it is important to note that this framework and the monitoring protocols suggested herein are not intended to provide statistically robust data that can be used to enforce water rights. If that level of data accuracy is required, a more intense and rigorous monitoring program is recommended.

Flow Targets. For stream reaches that have established flow targets, the amount of transacted water that is tracked under Tier 2 can be compared to the relevant target to determine the degree to which a flow target has been met by an individual transaction and/or by cumulative transacted flows. This may assist an organization in crafting flow restoration plans or in setting flow targets (either officially or voluntarily) if none exist.

Stream Characterization. If transacted flows can be detected via discharge measurements taken at multiple sites along the protected reach and at various points throughout the period of ecological significance, then it is possible to generally characterize the impact of transacted flows on stream velocity and dynamics. This information is a requisite building block for observing physical habitat changes that result from increased flows, which over time may include biological communities such as fish, birds, or riparian forests.

Suggested monitoring and reporting forms for flow accounting that can be tailored to the individual needs of each organization are provided in the resources section at the end of this chapter.

11.5 Tier 3 – Habitat Monitoring

11.5.1 **Intent**

This tier tracks changes in flow-related limiting factors by accounting for aquatic habitat metrics along a specified section of the protected reach during the period of ecological significance. The habitat metrics are defined by the objective of the transaction in addressing key limiting factors that are unique to the location and purpose of the transaction. Given the variation of stream reaches, habitat conditions, and restoration goals across transactions programs and projects, it is recommended that a monitoring and accounting strategy be developed for each transaction placed within this tier. Ideally, this tier could be designed in collaboration with other entitles that have ongoing monitoring and evaluation efforts in the reach. This helps to leverage existing data and scientific investment.

Tier 3 is based on the assumption that flow is a limiting factor in streams with active water transactions. Thus, the goal of Tier 3 is to track changes to identified aquatic habitat limiting factors that may result from flow augmentation throughout the length of the protected reach. Aquatic habitat changes are most usefully tracked during the period of ecological significance and can be calculated as a percent change towards improving the limiting factors or improving conditions relative to an overall restoration goal.

11.5.2 **Description**

Aquatic habitat indicators are intended to measure and quantify flow-related aquatic habitat characteristics that may change in response to flow transactions along a protected stream reach. Potential indicators of aquatic changes may include: water depth, wetted width, velocity, and temperature. Indicators of riparian habitat change may include: survivor rates for new plantings, increase in canopy cover, increase in species diversity for dominant trees, or increase in canopy height.

Metrics for aquatic indicators include changes in the standard deviation of flow velocity, as well as percent change to the depth, wetted width, and velocity over the course of the monitoring season and from year to year. Metrics for riparian habitat indicators may include percentage change over time or density of species within a select area. The percent change calculations are useful in evaluating the degree to which the needle has moved towards improving the limiting factors of flow and passage and other limiting conditions explicitly described for individual basins.

As a general rule, three conditions can be referenced to guide the identification and selection of Tier 3 monitoring efforts:

1. If the transacted flows are equal to or greater than 50% of median daily low flows for the period of ecological significance during the prior decade and the term of the transaction is greater than or equal to 10 years.
2. If transacted flows provide the water to meet an established flow target and the term of the transaction is equal to or greater than 10 years.
3. The stream reach includes monitoring efforts by partner agencies and has been identified as a priority stream reach for monitoring in management and agency documents.

Under Tier 3, total transacted flow is calculated for the entire protected reach and may include either a single transaction or cumulative transacted flows for that reach. Note that in many cases, flow data is limited and a full decade of data is not available. Under those conditions, a best estimate of average flows during the low flow season will suffice to determine the approximate percentage increase in flows that will result from both individual and cumulative transactions. If data are not sufficient to develop median daily low flow, the project will remain in Tier 2.

Given that Tier 3 monitoring efforts are highly specialized and unique to the stream that is the focus of the monitoring effort, an individualized monitoring plan is suggested for each project. This monitoring plan can i) provide a summary of transactions per stream reach, ii) can outline the conservation outcomes, biophysical habitat description, fish status and utilization, habitat summary and flow targets and goals of each river or creek, and iii) list potential monitoring partnerships that can assist in reaching the monitoring goals. These plans may include the following elements:

- implemented transactions;
- ongoing monitoring efforts in the region that provide partnership opportunities;
- goals of transaction implementation, including the limiting factors to be addressed; and
- estimates of the potential impact of water transactions on identified limiting factors.

11.5.3 **Potential Habitat Metrics**

Given the wide variety of monitoring plans that can be developed for Tier 3, a general overview of protocols and habitat metrics are offered as a starting point for crafting a Tier 3 effort. In addition, Tier 3 monitoring is intended primarily as a status and trends effort to compare changes over time to baseline conditions.

Metrics of aquatic habitat changes following streamflow augmentation are based principally on wetted area, water depth, and velocity changes. Additional metrics may include changes in the standard deviation of flow velocity, as well as percent changes to the following parameters calculated from habitat survey data (Holmes (2011) offers expanded information and details on monitoring protocols and procedures for these habitat parameters):

- cross sectional area;
- wetted width;
- width to depth ratios;
- mean/maximum/minimum pool depth;
- mean/maximum/minimum riffle crest depth; and
- water temperature.

Stream habitat data is typically collected using protocols from monitoring programs established by federal and state agencies. Holmes (2011) suggests the following reference list: federal protocols and methods include those established by the U.S. Forest Service's Aquatic and Riparian Effectiveness Monitoring Program (AREMP 2005) and the U.S. Environmental Protection Agency's Environmental Monitoring Assessment Program (Kaufmann and Robison 1998). Relevant state protocols and methods include the California Department of Fish and Game's Surface Water Ambient Monitoring Program bioassessment protocols (Ode 2007) and the Oregon Department of Fish and Wildlife's Aquatic Inventories Project (Moore et al. 2006).

11.5.4 **Habitat Monitoring Reporting**

Tier 3 monitoring forms and reporting procedures are inherently site specific and tailored to the monitoring plans that are developed for each Tier 3 effort. Therefore, this framework recommends partnering with other organizations and agencies that are monitoring for habitat conditions and implementing the protocols specified above as a way to incorporate flow improvements into larger context monitoring endeavors.

11.6 Tier 4 – Biological Population Monitoring

11.6.1 **Intent**

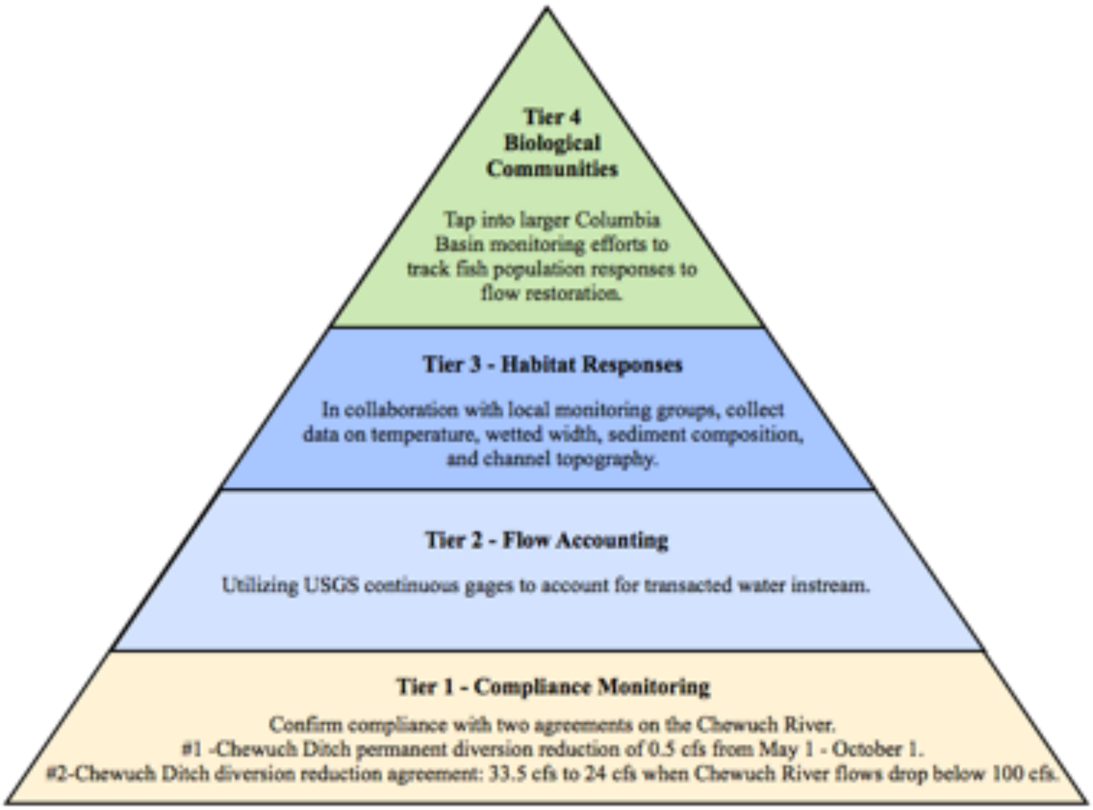
The biological populations tier relates transaction and flow-specific monitoring data gathered in Tiers 1, 2, and 3 with broader monitoring efforts in priority regions throughout the region of focus. Two primary objectives guide this tier.

1. Biological Monitoring Integration: The monitoring framework is designed primarily to track the contributions of water transactions to improvements in flow, which is a limiting factor to endangered species, biologically important populations, and riparian habitat. The goal of this tier is to coordinate with biological monitoring efforts in order to correlate, to the greatest extent possible, changes in flow-related aquatic habitat metrics with changes in biological metrics. Monitoring under this tier is ideally carried out in close collaboration with organizational partners and agencies collecting biological monitoring data.
2. Region-wide Integration: In a concerted effort to coordinate and connect with broader basin-wide biological monitoring efforts, Tier 4 is designed to integrate with larger academic, agency, or organizational efforts to collect and analyze systematic habitat status and trends information that can be used to assess basin-wide habitat conditions.

11.6.2 **Description**

Due to the project-specific nature of this Tier, each monitoring plan for biological populations will be unique. The monitoring Tieramid presented in Figure 11.3 above offers a general step-by-step approach to identifying the context and potential opportunities for a four-tiered monitoring effort. Figure 12.4 offers an example of such a monitoring plan for the Methow Basin in eastern Washington.

Figure 11.4 Tieramid Monitoring Plan: Chewuch River, Methow Basin, Washington



11.7 Tips and Insights

Designing an accounting and monitoring program can be a daunting task from a scientific, programmatic, budgetary, or personnel perspective. However, distilling monitoring needs down to four essential questions may help pave a path to a straightforward, step-by-step, and manageable monitoring effort. The framework presented in this chapter will hopefully seed a thought-process for considering and responding to these questions.

Who will benefit from monitoring data? Considering a monitoring program from the perspective of who needs data, rather than what the full range of hydrological, ecological, or biological questions could be asked, may help point to the type of monitoring activities that are needed. For example, if an organization has funded a transaction and needs to verify that the water they purchased is in fact instream, then compliance monitoring may be the highest priority for a monitoring program. Alternatively, if broad ecological goal is driving the transaction(s), then integrating with larger scale riparian, fish, or avian population monitoring efforts may be critical.

What partnerships can assist in gathering monitoring data? Monitoring activities are known to be resource intensive in terms of personnel and budget. Identifying monitoring partners at the beginning of a transaction program and working to include transactions as an essential component of achieving conservation outcomes may help ease the monitoring burden for the transacting organization. In addition, partnership organizations may have well-established databases and/or data synthesis protocols that could house and integrate transaction specific monitoring data.

Can monitoring be included in transaction budgets? Given the resource intensity of monitoring, it may help to talk with funders upfront about including monitoring in the full budget for implementing a transaction. Monitoring undoubtedly helps to expand an understanding of the contribution of transactions to overall ecological goals and may be considered a very legitimate transaction cost to flow restoration.

What is the overall story that needs to be told? Transactions play an important role in not only achieving ecological goals, but also in moving the needle toward voluntary and collaborative restoration efforts. Considering this story in the design of a monitoring program may assist in finding unexpected partners and guiding the nature, extent, and intensity of monitoring efforts.

11.8 Resources

11.8.1 Links

Information on Monitoring Programs:

Columbia Habitat Monitoring Program (CHaMP) is available at: www.champmonitoring.org

Pacific Northwest Aquatic Monitoring Partnership (PNAMP) is available at: www.pnamp.org

Monitoring, Evaluation, Research, and Reporting (MERR) plan is available at: www.nwcouncil.org/fw/merr/home

Integrated Status & Effectiveness Monitoring Program (ISEMP) program is available at: www.isemp.org

11.8.2 References

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11.8.3 Compliance Monitoring Form

Compliance Monitoring Summary Information
This information may be used by the organization implementing the transactions to confirm compliance with each transaction contract. In addition, this information may be submitted to the funding entity and/or to a third-party verifier to demonstrate that compliance monitoring activities were completed and the level of compliance has been determined.

Summary Information

a) Transaction Identifier (Name, Number, etc):
b) Transaction Description:
c) Transaction Type:
d) Timeframe for Instream Use:
e) Transacted Volume of Water:

Summary of Compliance Monitoring Activities	
Presence/Absence Monitoring	
Method(s)	
Number of measurements	
Number of on-farm locations monitored	
Description/Number of photos (if applicable)	
Diversion Monitoring	
Method(s)	
Number of Measurements	
Compliance Conclusions	
Compliance Status (Green, Yellow, Red, Purple – or the equivalent)	
Comments	

Attachments: These may include any supporting/explanatory documentation:

1. Sample flow measurement records
2. Site Maps
3. Photos
4. Other

11.8.4 Flow Monitoring Form

Flow Monitoring Summary Information
This information may be used by the organization implementing the transactions to confirm that transacted flows are detectable within the protected reach, as well as signal a possible need to call on water, enforce a senior water right, measure progress towards a flow target, or establish baseline data for measuring habitat metrics.

Summary Information

a) Transaction Identifier (Name, Number, etc):
b) Transaction Description:
c) Transaction Type:
d) Timeframe for Instream Use:
e) Transacted Volume of Water:
f) Diversion Location Name (Gage #/Name):
g) Latitude of Monitoring Location:
h) Longitude of Monitoring Location:

Summary of Flow Monitoring Activities	
Flow Monitoring Specifics	
Flow Monitoring Method	
Flow Equipment	
Number of measurements over the course of the season	
Number of sampling locations	
Compliance Conclusions (if flow monitoring is required as part of the contract)	
Compliance Status (Green, Yellow, Red, Purple – or the equivalent)	
Comments	

Attachments: These may include any supporting/explanatory documentation:

1. Sample flow measurement records
2. Site Maps of Monitoring Locations
3. Hydrograph for Protected Reach during the Transaction Timeframe
4. Photos
5. Other