Economic Feasibility, Cost and Issues Related to Acquiring Water Right Options to Secure Drought Water Supplies for Lahontan Valley Wetlands

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1.0 INTRODUCTION

Over the last century, the size of the Lahontan Valley wetlands in western Nevada have been significantly reduced as the historical inflows of water were reallocated for agricultural and urban development and to avoid jeopardizing the endangered cui-ui at Pyramid Lake. Congress recognized the importance of maintaining the Lahontan Valley wetlands with the passage of the Fallon Paiute-Shoshone and Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990. The Settlement Act mandated the Secretary of the Interior to sustain a long-term average of 25,000 acres of wetland habitat in the Lahontan Valley wetlands (LVW) designated as four areas in the Stillwater-Carson Lake region: the Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake and Pasture, and Fallon Paiute-Shoshone Indian Reservation wetlands.

The U.S. Department of Interior, Fish and Wildlife Service (USFWS) plans to acquire existing water rights in the Truckee-Carson River basin in order to meet this 25,000 acre wetland objective (in conjunction with the water management actions of other organizations). Federal and Nevada Division of Wildlife (NDOW) wetland managers have determined that it takes five acre feet (AF) of water per acre per year to sustain one acre of Lahontan Valley wetland. Therefore, the total annual average volume of water required for delivery to the wetlands is estimated to range from 122,000 AF to 126,000 AF depending on management patterns, timing and other conditions. An annual supply of 125,000 AF of water per year to the Lahontan Valley wetlands is used as the target amount in the USFWS Draft Environmental Impact Statement.

The current supply to the Lahontan Valley wetlands consists largely of drainage (return flow) from irrigated agriculture and occasional storage reservoir spillage. In addition, approximately 13,000 AF of Newlands Project water rights have been purchased for the LVW through voluntary market transactions. The Newlands Project, constructed by the U.S. Bureau of Reclamation, is the largest source of water in the area with project releases now limited to approximately 320,000 AF of water per year. Most of the water rights in the Newlands project are owned by and used in irrigated agricultural operations to produce alfalfa and other hay (over 80 percent of the irrigated acreage).

A plan proposed to achieve the USFWS LVW objective is to acquire a base of 75,000 AF of water through voluntary fee (permanent) purchases of Newlands Project water rights plus other permanent supplies. Assuming current water deliveries to the LVW plus the proposed purchase acquisition program and other supplies (e.g. ground water and Naval Air Station sources), based on the hydrologic record there will still be a shortage or gap of approximately 18,400 AF more than half of the time between LVW water deliveries and the 125,000 AF supply objective. Outright fee purchases of water rights needed on a intermittent or temporary basis may impose unwanted costs on the economies of local communities relying on irrigated agriculture and may

not be the least expensive solution. Therefore, temporary, rather than permanent, purchases of supplemental water have been proposed by the USFWS and others to fill this supply gap.

Water supply option contracts (WSOC), also referred to as interruptable or drought-contingent supply contracts, are an alternative to the fee acquisition of Newlands Project water rights to secure supplemental water, on a temporary basis as needed during drought, for the LVW. For the purposes of this study, a WSOC is defined as a formal long-term agreement between a water right owner, assumed to be a Newlands Project farmer, and a wetlands water supplier, e.g. The Nature Conservancy or USFWS, to temporarily transfer water during occasional critical drought periods from agriculture to wetland use. The potential benefits of option contracts include drought (gap filling) supply security for the wetlands, mitigation of some of the socioeconomic impacts that the permanent purchase and transfer of water rights from agriculture would have on producers and the community, improved management of existing water resources, and a reduction in cost of the LVW water right acquisition program. Whether these benefits will be realized depends on the economic, hydrologic, water management and institutional situations. The focus of this study, prepared for The Nature Conservancy, is on the economic feasibility and issues related to implementing water supply option contracts to provide the LVW with supplemental or temporary water as needed, assuming proposed management strategies and conditions.

Specifically, this report: 1) addresses economic, hydrologic and legal issues and information required to analyze and establish water right option contracts; 2) develops estimates of the variables required to evaluate option contract feasibility; 3) conducts an evaluation of the economic feasibility and financial requirements of option contracts under proposed conditions and water delivery strategies; 4) explores the economic benefits/costs of option contracts under alternative management and market condition scenarios; and 5) suggests possible modifications in existing water management proposals and institutions that could reduce program impacts and improve the cost-effectiveness of the overall water right acquisition program.

2.0 WSO CONCEPT, EVALUATION EQUATION AND CONTRACT PROVISIONS

2.1 WSOC Concept and Potential Benefits

Water supply option contracts (WSOC) are defined here as a formal agreement or contract between a water right owner, assumed to be a Newlands Project farmer, and another water user (for example, The Nature Conservancy or USFWS) to transfer water temporarily from agriculture to the Lahontan Valley wetlands during occasional critical drought periods or as needed. Through such a contract, a drought or temporary seasonal water supply is secured to sustain the wetlands as mandated by law, while the farmer retains ownership and access to the water supply during normal supply situations. In financial exchange market terminology, the holder of the option contract (The Nature Conservancy) has the right to lease water temporarily at a specified price, termed the exercise price, from the seller of the option (a water right owner). The seller of the option is then guaranteeing future delivery of water under specified conditions and price; that is, a payment is made to the farmer in exchange and as compensation

for the temporary transfer of water to the wetlands. Depending on hydrologic and other conditions, the option may be exercised one or more seasons (within an agreed upon limit) over the life of the contract. The circumstance or trigger that determines when an option will be exercised, such as a prolonged period of drought or specified shortage, is critical in ascertaining the value of an option, and should be clearly defined for the mutual understanding and benefit of both parties, precluding arbitrary exercise of the option.

Rather than having the water permanently withdrawn from agricultural use, as would be the case under a strictly fee purchase water right acquisition program, with option contracts ownership of the water right remains with the farmer and agricultural use of the water continues in most, but not all years. As listed earlier, potential benefits of option contracts include drought supply security for the wetlands, mitigation of some of the socioeconomic impacts that the permanent purchase and transfer of water rights from agriculture would have on producers and the community, improved management of existing water resources, and a reduction in cost of the Lahontan Valley wetland water right acquisition program.

Distinguishing WSOC from Short-term Lease Programs

Spot leasing water from farmers on a short-term or seasonal basis has also been proposed as a method to acquire supplemental water for the wetlands. Leasing and option contracts have similarities and are both methods that can be used to obtain water on a temporary basis. However, spot leases and option contracts differ in what they provide in terms of long-term supply security, cost assurance and exercise or transfer conditions. In many regions of the semi-arid southwestern U.S., surpluses of water are available for rental or lease from water right owners on a temporary seasonal basis. As long as a sufficient quantity of water is made available for leasing, when the water is needed and at a reasonable price, reliance upon leasing may be a viable alternative for acquiring water on a temporary basis. However, when water supplies are uncertain and supply security is critical (e.g. urban use or critical wildlife habitat), reliance on seasonal water leases can be risky and/or expensive. There is no assurance that sufficient water will be available for lease during times when water is needed or how much that water will cost. In fact, the periods when there are shortages and supplemental water is needed to supply the wetlands coincides with the periods when other users are also short of water and less likely to lease their water. On the other hand, water option contracts are designed to guarantee long-term (20-30 year) water supply security when the water is needed and at a set price to fairly compensate farmers. The economic benefits of either option contracts or leasing depend in large part on the relative cost of purchasing a water right in relation to the exercise or lease cost, and on the frequency of need to exercise the option or lease. As with any temporary use or rental program, a point is eventually reached as the water is used more frequently that it is more cost-effective to purchase, rather than rent water for temporary use.

2.2 Determining WSOC Net Benefit or Cost

The net benefit or cost of water supply option contracts is derived by comparing the costs of an option with the costs of the supply alternative (both in present value terms). If option contract costs are less than the alternative, in this case the permanent purchase of a Newlands Project water right, the present value option benefit (PVOB) will be positive, representing the economic

benefit of an option contract. If option contract costs are greater than the alternative, the PVOB will be negative, implying that an option contract is the more expensive alternative. Following convention in benefit-cost analysis, the evaluation is in real terms (inflation adjusted), so that costs, revenues and the discount rate are commensurate. The generalized equation and terms used to estimate net WSOC benefits or costs are shown and described below.

This evaluation of water supply option contract feasibility is based on research and analysis methods developed by Ari M. Michelsen and Robert A. Young that are described in more detail in "Optioning Agricultural Water Rights for Urban Water Supplies During Drought," American Journal of Agricultural Economics, American Agricultural Economics Association, (75) November 1993.

Generalized Equation for WSOC Economic Evaluation

$$PVOB = \sum_{t=o}^{T}\left[(K_{t=o} \cdot r + M)_t - (E \cdot P)_t\right]d_t + \left[K_{t=o} - K_{t=o}(1+\alpha)^T\right]d_T$$

where:

PVOB	=	present value of option benefit (+ benefit; - cost)
K	=	water right purchase (capital) cost
t	=	time in years from contract start (t=0) to termination date (t=T)
$K_{t=0} \cdot r$	=	annual interest/opportunity cost of water right purchase
M	=	annual operation and maintenance costs of water right ownership (term can also include: externalities; third party impacts; and purchase benefits in non-exercise periods)
E	=	exercise cost of option (payment to farmer for actual water transfer)
P	=	annual probability of option exercise ($0 < P < 1$)
K_T	=	water right cost at end of contract period; $[K_{t=o} \cdot (1+\alpha)^T]$ where α is the annual rate of water right cost appreciation/depreciation
r	=	real interest rate
d_t	=	discount factor for present value, $1/(1+r)^t$

Cost of Water Supply Alternative

The alternative to an option contract to secure drought water supplies for the wetlands is assumed to be the fee purchase of Newlands Project water rights. The cost of a water right purchase in present value (today's) terms is the sum of the following two types of costs (expressed within the first parenthesis on the right hand-side of the equation): 1) the capital investment cost to acquire the water right (opportunity or bond interest costs plus principal) plus 2) the annual operation and maintenance cost associated with the water right.

The capital cost to purchase a water right today must be spent from existing funds or borrowed. The amount of real income that could have been earned with the money used to purchase a water right is the opportunity cost of the purchase[1]. The purchase or capital cost (K) of the water right is composed of two terms, the opportunity or interest costs of investment ($K_t \cdot r$) and principal/ownership cost (K_t) where $K_{t=0}$ is the water right purchase cost at the start of the contract. This approach provides an explicit means to account for water right price appreciation and to separate the opportunity cost from the principal cost of the water right to allow for direct comparison with option contracts. (At the end of the option contract, the farmer retains ownership of the water right). Annual operations and/or maintenance costs (denoted M) are also incurred with water supply ownership. Note that if water rights are purchased and rented back to farmers during non-exercise years, M could be of opposite sign reflecting an annual income in excess of annual outlay. M can also be used to represent other costs or benefits, such as externalities or third party impacts (when quantified). Each of the variables is discounted by the appropriate interest factor d_t and summed to obtain the present value cost of a water right purchase.

Water Supply Option Contract Costs

The expected present value cost of a water option contract is the sum of the costs to exercise the option (take the water) multiplied by the expected number of times of option exercise plus any cost appreciation/depreciation of the value of the water right, plus any payments to the seller to hold the option (option price), each discounted to present value.

The cost of exercising the water option contract (E) during drought (transferring the water for wetland use) is based on the foregone economic benefits of the seller, that is, the price at which farmers are willing to release water supplies, and is paid only when the option is exercised. Agricultural enterprise and water valuation models can be used to estimate foregone economic benefits to the farmer. Actual exercise payments need to be negotiated based on both party's perceptions of transfer losses and benefits. The probability of exercising the option is (P), the annualized probability of needing the water for wetland supply over the contract term.

By holding an option contract instead of purchasing a water right, the holder does not capture (or avoid) the value of any water right price appreciation. The appreciation cost ($K_{t=0} - K_{t=0} \bullet (1 + \alpha)^T$) is the real change in water right price over the contract period, which, if negative, is an opportunity cost of holding the contract.

The option value (PVOB) is the maximum economic benefit of an option contract; in other words, it is the maximum price a purchaser would be willing to pay for the option. Some of the option value will be paid to the agricultural water right owner as incentive to enter into an option contract. This payment is termed the option price, the value of which needs to be negotiated between the buyer and seller. The option price may be paid either annually or as a lump sum. The remaining value is the net benefit to the holder of a water option contract.

[1] With public funds, the opportunity cost is the public debt avoided.

The equation for calculating the comparative economic benefits (or costs) of WSOC to the water supply alternative, in this case the fee purchase of water rights, can be summarized as:

PVOB = [WR Purchase Cost] - [Expected Exercise Cost] - [WR Price Appreciation]

In other words, the PVOB is the present value benefit (when positive) of WSOC costs compared to the cost of the water supply alternative, the permanent acquisition of a Newlands Project water right. Payments made to a farmer to hold the option, if any, must be subtracted from the PVOB. The terms on the right hand side of the equation account for the economic costs associated with the purchase of a water right (including purchase, operation and maintenance costs) compared to the economic costs of using a WSOC (frequency of need, timing and exercise compensation payment amount and opportunity cost of not purchasing the water right now) to provide water to the LVW on a temporary basis.

2.3 Option Contract Conditions and Provisions

The basic conditions required to establish water supply option contracts are summarized below and addressed further in the following chapter on the development of WSOC evaluation information. The basic conditions to establish a WSOC are: 1) The water supply must be reliable enough to provide sufficient water for wetland use in drought years and plentiful enough in average years to supply agricultural use; 2) Water (property) rights must be definable and transferrable; 3) Agricultural operations must be capable of being temporarily suspended; 4) Both buyer and seller must have realistic knowledge of water use values and alternative water supply costs; 5) The probability and severity of drought (the expected frequency of exercising the option) must be able to be estimated within acceptable limits of risk for both parties; and 6) Total option contract costs, including the transaction costs of negotiation, approval for the temporary transfer of water, and delivery of water to the wetlands must be less than the cost of the water supply alternative(s) (the fee purchase of the water right and all transaction and transfer costs).

Option Contract Terms and Provisions

Contract terms and provisions identify and protect the rights of both parties. Selected terms and provisions more unique to water option or interruptable supply contracts are identified below. Specific terms and provisions will need to be developed, refined and negotiated as part of the process of implementing a water supply option contract program.

Exercise Trigger -- The trigger or criteria for option exercise must be specified for the mutual understanding and benefit of both parties. Exercise criteria could be specified in terms of hydrologic or management conditions such as a minimum wetland supply delivery level or project yield, projected seasonal runoff or project yield amounts on a specified date, or based on the size or water level(s) of the wetlands.

Exercise Price -- The exercise price is the cost to exercise the option per period (year). In theory, this will be the value of the water transferred by the option - the agricultural production value. In practice, the exercise price can be negotiated between the purchaser and farmer or set at a standard amount.

Advance Notification -- Advance notification that the option will be exercised is important to the seller and can reduce purchaser costs. A farmer can avoid routine variable production costs, such as fertilizer, reseeding or establishment costs with prior notification, reducing the cost of exercising the option. The amount of advance notification can be negotiable, but a suggested period would be in the range of three to twelve months to allow both parties time for determination of need and supply adjustments. Provisions should be included in the event of late notification of option exercise and adjustments should be specified for any inconvenience and costs incurred in the event of late notification.

Option Water Quantity and Quality -- The option water quantity, quality, place and time of delivery should be specified in the contract. The quantity to be transferred can be a fixed amount (e.g. 300 acre feet) or flexible if specifying water rights related to a number of variable yield irrigation shares or water righted acres of irrigated land. In the case of variable yields the minimum acceptable delivery quantity should be specified.

The contract should also contain provisions to address: adjustments in payment amounts over the life of the contract (escalator clauses); unforseen changes in underlying contract conditions (renegotiation clauses); and conditions or allowances for the sale of the right prior to contract termination. For more detail regarding water supply option requirements and contract provisions refer to "Optioning Agricultural Water Rights for Urban Water Supplies During Drought," American Journal of Agricultural Economics, American Agricultural Economics Association, (75) November 1993.

3.0 DEVELOPMENT OF WSOC EVALUATION INFORMATION AND ASSUMPTIONS

This chapter presents the assumptions and development of the hydrologic requirements, proposed water management strategies and institutions, water right purchase costs, exercise payment or temporary transfer cost, and other information used for the evaluation of water supply option contract feasibility and financial requirements. The discussion has been organized into the following categories.

Hydrologic Information and LVW Water Management Assumptions

- LVW water management strategies (as proposed in the USFWS, Draft EIS)
- wetlands water deliveries and supply sources
- frequency (probability) and size of wetlands supply shortages
- water rights/number of acres needed to supply LVW shortages

Water Right Purchase Cost and Yield Assumptions

- water right purchase costs
  - prices and appreciation
  - operation and maintenance costs
- water transfer assumptions

Option Exercise Cost (payment to farmers for the temporary transfer of water)
- basis of exercise cost (maintain farmers welfare)
- farm production costs and returns
  - farm enterprise budget
  - typical yields and crop prices
- estimated option exercise payment

Other Economic Variables
- discount (interest) rate
- transaction costs
- option payments

3.1 Hydrologic Information and LVW Water Management Assumptions

This section reviews the proposed water supply objectives and management strategies and describes the hydrologic and institutional conditions and assumptions used in the evaluation of water supply option feasibility.

The mandated objective of the USFWS is to sustain a long-term average of 25,000 acres of Lahontan Valley wetlands. Federal and Nevada Division of Wildlife wetland managers have determined that it takes five acre feet per acre per year to sustain one acre of Lahontan Valley wetland. The total annual average volume of water required for delivery to the wetlands is estimated to range from 122,000 AF to 126,000 AF depending on management patterns, timing and other conditions. A long-term average of 125,000 AF of water per year to the Lahontan Valley wetlands is used as the supply target in the USFWS Draft Environmental Impact Statement (DEIS).

A combination of permanent or fee purchases of Newlands Project water rights and temporary water right purchase programs is proposed to meet the supply target. Currently, the primary sources of water delivered to the wetlands are Newlands Project irrigation return flows, storage spills and fee purchases of water rights for wetlands use (proposed to form the core of the wetlands water supply). The water management strategy proposed in Alternative 5 of the DEIS is to achieve the 125,000 AF wetlands water supply target by acquiring a base of 75,000 AF of water through voluntary fee (permanent) purchases of Newlands Project water rights and their transfer at a reduced rate of 2.99 AF per acre, and then acquire additional supplies from irrigation return flow, ground water, the fee purchase of water rights outside the Newlands Project, municipal effluent, water conservation at the Fallon Naval Air Station, and through temporary purchases of water (e.g. leases or option contracts) to make up any difference or shortage from the supply target.

Lahontan Valley wetlands water deliveries and the frequency and magnitude of wetlands annual water shortages were estimated by David Yardas, Environmental Defense Fund, based on the water acquisition and management strategies proposed in DEIS Alternative 5. For additional detail refer to David Yardas' August 10, 1994 memorandum summarizing the Below Lahontan Reservoir hydrologic model assumptions and results included in this report as Appendix A.

The Below Lahontan Reservoir model uses a 92 year historical record (1901-1992) of Truckee-Carson River basin hydrologic conditions and proposed water management strategies to simulate year-to-year water supplies, project yields, diversions, return flows, and quantity of water required to maintain long-term deliveries to the wetlands of 125,000 acre feet of water per year. Less than full yields (100 percent water supplies) for all project water rights were considered in setting the annual target for the wetlands. Water right yields of less than 100 percent and transfers at a reduced duty of 2.99 AF per acre are both incorporated in determining the supply that must be acquired on a temporary basis to meet the target for the wetlands.

Results from the hydrologic model indicate that based on existing regulations and proposed management strategies, additional water supplies of 5,000 AF or more, beyond the 75,000 AF of purchased water rights at reduced transfer rates plus all other supplies, will be required on average 14 out of 20 years or more than 67 percent of the time. The largest target-supply gaps of 18,400 AF, reflecting more severe drought conditions, occur only somewhat less frequently, and would require temporary purchases in slightly more than one out of every two years on average, or more than 50 percent of the time. The estimated frequency, quantity of water and number of water righted acres required to fill the LVW target-supply gap with temporary acquisitions are summarized in Table 1.

For perspective, the number of water righted acres reported in the fifth column of Table 1 is based on the total water gap (fourth column) with the transfer of full Newlands Project water right duties of 3.5 AF/acre. This assumes that the full duty of a water right can be transferred to the wetlands as described by The Nature Conservancy and Environmental Defense Fund in their December 11, 1993 Concept Paper on a Second Settlement (attached as Appendix B). It is also assumed that temporary water transfers of two years or more does not constitute abandonment of the water right.

Based on the Alternative 5 water management strategies and hydrologic model results, additional water required on a temporary basis is needed with a frequency of one in every two years (1:2) or with an expected probability of use of 0.5 in any given year. This frequency of use is assumed for the base case analyses of WSOC feasibility. This corresponds to a total temporary purchase or dry-up of a minimum of 5,257 Newlands Project water righted acres for each year of temporary use, assuming full duty transfers at 3.5 AF per acre and 100 percent supplies or water right yields.

If less than the full duty of each water right can be transferred (currently only 2.99 AF of a Newlands Project water right is transferred) the number of water rights/acres required to be purchased or withdrawn from production to fill the supply gap will increase, and thus the impact on agricultural production will be greater. The number of water rights required will also increase with less than 100 percent water right yields. The sixth column shows the average reduction from both reduced transfer rates and water right yields. The last column in Table 1 provides an estimate of the minimum number of acres of water righted land, adjusted for lower transfer rates and reduced yields, needed to fill the wetlands supply gap.

In analyzing this information it becomes apparent that with the current management strategy the frequency and size of temporary acquisitions necessary to fill the wetlands delivery gap is inverse of the conditions generally conducive to temporary purchases. Other water management and acquisition strategies discussed later in this paper may reduce the frequency and quantity of water that is needed on a temporary basis.

Table 1 - Temporary Acquisition Frequency, Quantity of Water and Number of Newlands Project Water Righted Acres Needed to Fill the Gap Between the LVW Supply Target and Projected Deliveries

Number of Years Required Out of 92 Year Total Record	Percent of Hydrologic Record	Frequency of Gap/Need for Temporary Water Supply	Quantity of Water Required (minimum gap in AF)	Irrigated Acres (min req full duty & yield)	Water Right Reduction (% full)	Minimum # of Irrigated Acres Required (adj. for duty & yield)
48	52.2	1:2 10 in 20 yrs	>= 18,400	5,257	.85	6,185
52	56.5	1.13:2 11 in 20 yrs	>= 11,500	3,286	.75 -.85 (avg .80)	4,107
59	64.1	1.28:2 13 in 20 yrs	>= 9,100	2,600	.74 - .85 (avg .81)	3,210
62	67.4	1.35:2 14 in 20 yrs	>= 5,000	1,429	.70 - .75 (avg .73)	1,958

Source: Compiled from the Below Lahontan Reservoir hydrologic model results for the USFWS, DEIS Alternative 5: Leases and Dry Year Options, prepared by David Yardas, EDF, August 10, 1994.

3.2Water Right Transfer and Purchase Cost Assumptions

The fee purchase of Newlands Project water rights has been identified as the most likely alternative to using water supply option contracts (or leases) to secure water to meet temporary wetland shortages. The cost of the supply alternative, purchasing Newlands Project water rights, is an important factor in evaluating the economic feasibility and financial requirements of water supply option contracts.

Newlands Project Water Right Prices

Estimation of the purchase cost of a Newlands Project water right is based on an evaluation of available market data and market conditions in the project area. Within the last few years (1990-93), Newlands Project water rights only (exclusive of land) have been selling for $1,100 to $1,200 per water righted acre, or about $315 to $350 per acre foot assuming 3.5 AF per acre. During the same period of time, sales prices of Newlands Project water rights along with land that has little or no potential for subdivision have been reported in the $1,500 to $1,900 range per water righted acre. This implies a price for land of a few to several hundred dollars per acre, or if there is no market for the land, it is a premium paid to acquire the water right.

A review of fifteen individual sales of Newlands Project water rights along with land (excluding land with subdivision potential) during the period from 1990 to 1994 was conducted. Based on this examination, the average sale price was approximately $2,000 per water righted acre including land. This is consistent with more recent sales (1994) to the USFWS of Newlands Project water rights (purchased for wetlands use) along with land (not priced for subdivision development) reported to be around $2,000 per acre.

There have also been reports of even higher prices for sales of land and water rights when the land can be, or is expected to be, subdivided for development. However, these sales are not comparable or relevant for this analysis because these prices are for developable subdivided land and the amount of land that can be subdivided and profitably developed in the area is relatively limited. When the land has little potential for development, the value of land alone (without water) and the opportunity for resale of land alone will probably be quite small.

The opportunity for resale of land is likely to continue to be low or even decrease as more water rights are sold along with land and the market supply of land alone increases. Under these market conditions, sellers will probably require, as some are now doing, the purchase of both the land and water rights, with little likelihood of purchaser resale of the land. Unless water rights can be purchased separately or the land can be resold, the relevant cost to acquire Newlands Project water rights is the price paid to acquire the water rights acres along with land. A Newlands Project water right acquisition cost of $2,000 per water righted acre (including land) is therefore used as the base case for this analysis. Other scenarios, including different water right purchase costs are also evaluated.

Water Right Transfer Rates

The actual or per unit cost of water depends on the transfer rate of the water right. The amount of Newlands Project water rights currently being transferred for wetlands use is 2.99 AF per water righted acre, regardless of the water duty for the land. Although it is recognized that there are a number of grave issues about the legality and transferability of Newlands Project water rights, for the purposes of this analysis, they are assumed to have been settled as described by The Nature Conservancy and Environmental Defense Fund in their December 11, 1993 Concept Paper on a Second Settlement (Appendix B). Therefore, this analysis assumes that Newlands Project water rights can be transferred to the wetlands at a full headgate duty of 3.5 AF per acre (bottom land) or 4.5 AF per acre (bench land). For simplicity, only the bottom land duty of 3.5 AF per acre is used in the analysis. Assuming the base case purchase price of $2,000 per Newlands Project water right and a transfer rate of 3.5 AF per acre (water right unit), the price per acre foot is $571.

It is important to note that this assumption about the water right transfer rate will not significantly affect this evaluation of option contract feasibility. The reason for this is that the transfer rate applies equally to both the quantity of water (cost per AF) from the *temporary* source (Newlands Project water) and the quantity of water (cost per acre foot) that would be obtained from the permanent purchase of the same water right. It should also be noted that the cost above assumes transfer and delivery of the full duty of the water right. This is often not the

case in drought conditions where delivery quantities (yields) are reduced and therefore the number of water rights required to obtain the same quantity of water will be greater and the cost per unit of water received will be higher. This situation, which affects both the purchase and option/lease of water rights, is a result of the proposed water management strategy for supplying water, existing water right institutions and storage or carryover constraints. No carryover storage is presently authorized. However, if allowed, carryover storage could be used to mitigate reduced water right yields in dry years.

Water Right Price Appreciation

Water right price appreciation is also a component in the evaluation of the potential economic benefits and costs of water supply option contracts. Price appreciation is an opportunity cost incurred by not purchasing a water right at this time. Although nominal prices of Newlands Project water rights appear to have appreciated over the last several years, this is a very short period to base a forecast. For example, over the last 30 years, water right prices in other markets have observed both increases and decreases, but the trend has tended towards price appreciation (e.g. see Saliba 1993 and Person and Michelsen 1994). Because of this uncertainty and difficulties in forecasting prices with any degree of accuracy or consensus, a real water right price appreciation rate of two percent per year is assumed for the base case analysis. Other rates of water right price appreciation are also evaluated.

Operation and Maintenance Costs

The purchase of a water right usually involves a recurring expense - operation and maintenance costs. Over the last eight years there has been relatively little change in Newlands Project water right operation and maintenance assessment costs. Based on a transfer rate of 3.5 AF per acre for bottom land, the purchaser of a water right will incur an operation and maintenance cost of approximately $7.00 per acre foot per year.

3.3 Estimation of Option Exercise Payment

Option Exercise Cost

A key concept in the analysis of option contracts is the cost of exercising the option. The option exercise cost is the payment made to a farmer as compensation for temporarily transferring water from agricultural production to the wetlands. This payment is designed to maintain at least the same level of net income to a farmer as he/she would have had without exercise of the option. In the case of option exercise (and spot lease), a farmer's production decisions are in a very short-run context and requires compensation not only for the foregone return to water (net profit for the farm acreage temporarily withdrawn from production), but also for any fixed production costs that are incurred because of the temporary transfer of water. These additional costs include the opportunity costs of management, taxes, depreciation on equipment, and fixed investments, e.g land and water. The exercise cost is accordingly larger than the annualized long-run value of water by the amount of fixed costs included in the offer.

Calculation of the estimated exercise cost or payment is based on representative farm production costs and reported crop yields and prices. The estimated exercise payment is the sum of profit (net revenue) plus the fixed production costs per acre of irrigated land. The primary source of

information for the crop production costs is "Alfalfa Production Costs for the Fallon, Nevada Area" by Gene Wheeler and Gordon Myer, University of Nevada, 1990, attached as Appendix C (this information is in the process of being updated but was unavailable at the time of this study). Farmers that were interviewed in the process of this study had the opportunity to review this budget and expressed general concurrence with the figures, at the same time indicating that some costs may vary for their particular operation. Minor modifications were made in the budget to reflect changes in market conditions, and to include management and other opportunity costs of production. The individual cost items were then categorized as either fixed or variable costs as shown in Table 2.

Establishment rotation periods vary, but were typically reported to be from six to eight or more years in the Newlands Project area. Alfalfa establishment costs of $184.32 per acre were amortized over a six year period (consistent with Wheeler and Myer) and included as a fixed cost of production in Table 2. Although established aflalfa is fairly resilient, partial or full re-establishment of a field could be required if irrigation water was unavailable, either due to drought or temporary transfer of the water to another use. If re-establishment becomes necessary because of option exercise (or lease) transfer, this cost should be included in the exercise payment. However, over an entire farm it is common to have fields in different stages of rotation, possibly enabling farmers to avoid additional re-establishment costs by transferring water under a WSOC from fields that are near the end of, or between, establishment rotation. For this evaluation, it is assumed that the need for re-establishment of an existing field can be avoided, and therefore no additional cost beyond the normal amortized establishment cost is included[2]. Impacts of temporary transfers on established fields could also be mitigated if farmers were permitted to split water duties across water righted fields, thereby minimizing costs and maximizing water use and farm returns.

The University of Nevada alfalfa crop enterprise budget is used as the basis for farm production costs and compensation payments but, it should be noted that total costs and some individual budget items seem relatively high when compared to other alfalfa enterprise budgets (e.g. flood irrigated alfalfa production in northern Colorado; DARE IR:92-1). Fallon alfalfa production costs are also close-to or exceed corn production costs for the Fallon area as reported by Isidoro-Mills and Myer (1988). In that study, the guideline "typical" enterprise budget figures indicate negative net returns for corn production - silage, grain and earlage. These differences are important to note because higher fixed costs of production can result in higher estimated compensation payments, especially during drought or periods with low yields or prices, making temporary options or leases based on these figures less desirable and the permanent purchase of water rights an economically better alternative. Alternatively, compensation payments adjusted for operations with lower than these average fixed costs and with lower returns from less productive land (lower yields) are more conducive to short-term water transfers and would result in lower economic costs and impacts.

[2] In his analysis of socioeconomic impacts, Sunding (1994) assumes that total unamortized re-establishment costs of $180/acre will be compensated, along with highly variable net profits, for a spot lease. With a spot lease, however, a farmer is not contractually obligated to interrupt production and can always avoid re-establishment costs. On the other hand, Sunding also assumes that all other fixed production costs need not be compensated for a spot lease.

Table 2 - Fallon Area Alfalfa Hay Enterprise Production Costs Per Acre

Category and Type of Production Cost	Appendix C Costs	Production Cost Per Acre
Fixed Costs		
Management (7% costs)	---	$28.80
Interest on Capital	$38.96	$38.96
Overhead	($9.37)[1]	$10.00
Real estate taxes	$4.06	$4.06
Land and water ownership ($2,000)	$66.00[2]	$80.00
Crop establishment (amortized over 6 years)	$35.80	$35.80
Machinery taxes & insurance	$7.44	$7.44
Machinery depreciation (.20 total)	$44.59[3]	$8.92
Water right O&M assessment	($20.88)[1]	$23.90
Fixed Cost Subtotal	$196.85	$237.88
Variable Costs		
Operating Costs	$123.77	$123.77
Machinery depreciation (.80 total)	---	$35.67
Labor	$42.84	$42.84
Variable Cost Subtotal	$196.86[4]	$202.28
Total Fixed and Variable Production Cost per Acre	$393.71	$440.16

Sources and notes: Gene Wheeler and Gordon Myer, "Alfalfa Production Costs for the Fallon, Nevada Area," Fact Sheet 90-36, Nevada Cooperative Extension, University of Nevada, Reno, Nevada, 1990. Production costs were adjusted to include management and other opportunity costs of production. [1] Included as a variable cost in UNR budget. [3] Cost of land only. [3] Total depreciation. [4] Includes water right O&M and overhead costs shown above. Values in nominal dollars.

Alfalfa farm enterprise gross and net revenues for various yield and crop price assumptions are shown in Table 3. Gross revenues (yield times price) are based on published data in the Nevada Agricultural Statistics; U.S.D.A. Soil Conservation Service, University of Nevada, Cooperative Extension Service data; and producer interviews (reported values indicated in the notes for Table 3). Net revenue or profit per acre is equal to gross revenue minus the fixed and variable production costs from Table 2, based on adjusted UNR enterprise budgets. Note that for a number of reported crop yield and price conditions producer net revenues are estimated to be negative. These revenues are based on alfalfa hay; revenues for other hay are lower (about $20 per ton).

Table 3 - Fallon Area Alfalfa Farm Enterprise Estimated Gross and Net Revenues for Various Yield and Price Scenarios[a]

Price and Yield Scenario	Yield (b)	Price (c)	Gross Revenue per acre	Net Revenue (profit) per acre
Average Price Scenario				
high yield	7.0	$90.00	$630.00	$190
avg yield 1	6.0	$90.00	$540.00	$100
avg yield 2	5.0	$90.00	$450.00	$10
low yield	4.0	$90.00	$360.00	($80)
High Price Scenario				
high yield	7.0	$110.00	$770.00	$330
avg yield 1	6.0	$110.00	$660.00	$220
avg yield 2	5.0	$110.00	$550.00	$110
low yield	4.0	$110.00	$440.00	$0
Low Price Scenario				
high yield	7.0	$80.00	$560.00	$120
avg yield 1	6.0	$80.00	$480.00	$40
avg yield 2	5.0	$80.00	$400.00	($40)
low yield	4.0	$80.00	$320.00	($120)

Notes:

a) Net revenues are calculated from gross revenues based on reported yields and prices minus alfalfa farm enterprise production costs for the Fallon area.

b) Nevada Agricultural Statistics 1991-92. Yield of alfalfa hay (approximately 80% of total hay production) in Churchill county was 4.6 tons per acre in 1990 and 3.5 tons per acre in 1991 (both drought years). Yield of all other hay in Churchill Co. was 2.25 and 2.29 tons per acre in 1990 and 1991 respectively. Average yield reported by individual producers on "good land" during normal water years ranged from 5 to 7 tons per acre with some producers reporting as much as 10 tons per acre on select land with optimal management. Yields during drought are typically lower with producer and other reports ranging from 20% to 50% lower on acreage remaining in production.

c) There is a wide variation in reported crop prices received depending on the quality of hay, market and time of year. Nevada Agricultural Statistics 1991-92 monthly alfalfa hay prices (state average; county prices are not reported) over the five year period from 1988-1991 ranged from $78 per ton to $110 per ton. Statewide annual average (unweighted) alfalfa hay prices over this period ranged from $91 per ton to $104 per ton. Producers in the project area reported prices from $70 to $110 per ton with typical prices in the $80 to $100 per ton range. Prices received for other hay were significantly less (approximately $20 per ton lower). Values unadjusted for inflation.

If production is interrupted under a WSOC, the farmer will both forgo net profits and continue to incur fixed costs in the short-run, while avoiding variable costs. In order to maintain a farmer's economic well being, exercise payments should therefore equal net profits plus fixed costs. Estimated exercise costs or compensation payments for a range of crop yield and market price conditions are shown in Table 4. In the event that profit is negative (a producer loss), the exercise payment is set equal to fixed costs and is not reduced by the estimated loss. Individual production costs, yields and returns are site-specific, and, therefore, payments to maintain the same level of well being would actually vary from farm to farm. Varying exercise payments based on individual farm costs and actual productivity would result in a more efficient economic solution (see Sunding, 1994), however in practice, documenting individual farm production costs, yields and returns is usually quite difficult because of the lack of, and variation in, record keeping. Because of these complexities and the accompanying difficulty in negotiating individual compensation payments, a single representative or average exercise payment is assumed for the evaluation. It is important to note that the assumption and use of exercise payments based on average costs and returns probably overstates the economic impact from temporary transfers of water. Farms that are economically marginal with below average yields or profits that desire to remain in business are more likely to enter into this type of program because it would actually offer better returns than their normal operations.

Table 4 - Estimated Compensation Payments for Option Exercise That Would Maintain or Improve the Net Welfare of Alfalfa Producers in the Short-run (season payment per acre of irrigated land for various crop yields and prices)

	Estimated Exercise Cost/Compensation Payment Per Acre (equal to net profit plus fixed cost)		
Crop Yield tons per acre	Price received per ton of alfalfa		
	$80	$90	$110
4.0	$238	$238	$238
5.0	$238	$248	$348
6.0	$278	$338 [1]	$458
7.0	$358	$428	$568

Note: Compensation payments are the sum of estimated net revenue (profit) plus fixed production costs. When net revenue is zero or less because of low yields, crop prices or both, compensation payments are not reduced for losses but instead are set at a minimum equal to fixed costs. [1] Base case scenario for WSOC evaluation.

Reported crop yields have been lower than average during drought periods (e.g. 4.6 and 3.5 tons per acre in Churchill County in 1990 and 1991 respectively) and hay from other producing markets have moderated increases in price during periods of reduced local production with the net effect being reduced revenues and profits. As noted above, exercise payments could be

adjusted to reflect these changes in yields and varying market conditions, however for simplicity and to be conservative, an average exercise payment of $338 per water right is used as the base case for this evaluation. This value assumes an average alfalfa crop yield of 6.0 tons per acre sold at a price of $90 per ton.

Applying the same full duty water right transfer rate of 3.5 AF per acre, this payment translates into an exercise cost of $97 per acre foot of water. Again, using an average production yield and market price is a conservative approach that works in favor of the farmer when yields, prices, or both are lower than average or when the water to be transferred is used in marginal production.

Although the crop production costs and water values are estimated from reported production statistics, the values are high in comparison with other estimates of the short-run value of water in alfalfa production, leading to higher estimated exercise payments and a reduction in temporary water transfer benefits compared to permanent water right purchases. Lower transfer rates would result in even higher costs per acre foot of water.

3.4 Discount Rate, Transaction Cost and Option Payment Assumptions

Discount Rate

Present value water supply option contract benefits and costs are calculated using a real, inflation free, discount rate of 6.0 percent per year. With current market conditions, this corresponds to a nominal discount rate (including inflation) of around 9-10 percent. Because the economic feasibility and present value of financial costs are sensitive to the discount rate selected, evaluations are also conducted using alternative discount rates.

Contract Length

A contract length of 20 years is used for the evaluation. Option contract holders (purchasers) may prefer longer contracts for long-term supply security and to increase amortization of option contract transaction costs.

Transaction Costs

Transaction costs would be incurred both in purchasing and optioning water rights. Once established, WSOC transaction costs are assumed to be equal to water right purchase transaction costs. Transaction costs are not explicitly incorporated into this evaluation, however, when transaction costs are estimated they should be included as part of the costs in both purchasing a water right and entering into an option contract.

Option Payment

The option payment provides additional incentive for the water right owner to enter into a water supply option contract. This payment may vary depending on the established exercise payment, expected frequency of exercise and quantity of water rights under contract. No option payments are assumed to be made for this evaluation. Option payments, if any, must be deducted from the estimated benefit value (PVOB) of a water supply option contract.

4.0 EVALUATION OF WATER SUPPLY OPTION CONTRACT FEASIBILITY

This chapter describes the calculation and interpretation of results of the economic evaluation of water supply option feasibility under the base case conditions and assumptions. Next, several alternative scenarios varying hydrologic, water management and market conditions are evaluated in terms of their impacts on supply option feasibility, use and benefits. The last section of this chapter presents estimates of annual and contract period total financial requirements to secure temporary water through supply options (which also relates to spot leases) and provides a comparison to the financial cost of purchasing Newlands Project water rights.

4.1 Summary of Base Case Conditions and Assumptions

The base case conditions and assumptions can be summarized as follows:

Hydrologic and Institutional Conditions

- Supply target for the Lahontan Valley wetlands is 125,000 acre feet per year.
- Water management strategy proposed to meet LVW supply target involves the:
  - fee or permanent purchase of 75,000 AF Newlands Project water rights for transfer at a reduced rate of 2.99 AF/acre.
  - temporary acquisition of additional water rights to make-up gaps from supply target.
- Below Lahontan Reservoir model results with this management strategy indicate that:
  - additional temporary supplies of 5,000 AF are needed in 2 out of every 3 years.
  - frequency of more severe drought requiring 18,400 AF is 1:2 years or 0.5 per year.
  - to fill the 1:2 year temporary gap requires the interruption of a minimum of 5,257 irrigated acres.
- Institutional conditions and assumptions:
  - transfer of temporary water assumed at full headgate duty of 3.5 AF/acre (lesser rates would apply equally to both permanent and temporary purchases).
  - no storage or carryover allowed (requires target to be met each year).
  - temporary transfers of two consecutive years does not imply abandonment.
  - water right duties can be split to improve farm and wetlands water use efficiency or to mitigate the cost of re-establishing alfalfa.

Water Right Purchase Cost Conditions

- Purchase cost of Newlands Project water right assumed to be $571 per AF.
- Purchase price assumes both land and water purchased, no resale of land.
- Water right price appreciation of 2% per year.
- Water right operation & maintenance cost of $7 per AF/year.

Option Exercise Cost

- Designed to maintain farmer well being (keep at least as well off as without transfer).
- Based on reported farm enterprise costs, yields and prices.
- Equal to sum of expected net revenue plus fixed production costs.
- Payment amount based on costs and returns of average producer, normal conditions.
- Extraordinary re-establishment costs are avoided.
- Assuming average conditions, payment of $338 per time of option exercise (transfer).
- Base case exercise cost (payment to farmer) is $97 per acre foot.

Other Assumptions

- A real (inflation free) discount rate of six percent.
- Transaction cost estimates for both fee and temporary purchases are excluded.
- No option payment is made; such payment may be needed as an incentive to enter a WSOC and would need to be deducted from the total option benefit (PVOB).
- An option contract term of 20 years is assumed.

4.2 Calculation and Interpretation of Supply Option Evaluation Results

The value of water supply options is derived by comparing the costs of an option with the costs of the supply alternative, the fee purchase of Newlands Project water rights. Economic feasibility of using water supply options is calculated with the present value of option benefits (PVOB) equation described in Section 2.3 and shown again below. The variable values, equation definitions and terms used to calculate the base case supply option benefits are summarized in Table 5.

$$PVOB = \sum_{t=0}^{T} [(K_{t=0} \cdot r + M)_t - (E \cdot P)_t] d_t + [K_{t=0} - K_{t=0}(1+\alpha)^T] d_T$$

Table 5 - Option Equation Terms, Definitions, and Base Case Variable Values

Equation Term	Definition	Base Case Value
PVOB	Present Value of Option Benefit	Option Benefit (+) or Cost (-)
t	time in years from contract start (t=0) to termination date (t=T)	20 years
$K_{t=0}$	water right purchase cost per AF (at beginning of contract, t=0)	$571 AF
r	real interest rate % per year (range in interest rate)	6.0 % (4.0 % - 8.0%)
M	annual operation and maintenance costs of water right ownership	$7.0 per AF
E	exercise cost of option (payment to farmer for transfer)	$97 per AF
P	annual probability of option exercise (0<P<1)	0.5 per year probability (1:2)
d_t	discount factor for present value $1/(1 + r)^t$	n.a.
α	water right price appreciation (percent per year)	2.0 % (0.0 % - 4.0 %)
$(K_{t=0} \cdot (1 + \alpha)^T)$	water right price at end of contract	$848 AF

A positive PVOB represents the economic benefit or savings of using a supply option contract to acquire temporary water compared to the fee purchase of a water right. A negative PVOB value indicates that a fee purchase is more cost-effective. Under the base case conditions shown in Table 5 and the currently proposed water management strategy, the present value option benefit (PVOB) is -$170 per acre foot. Under these conditions, the preferred economic solution would be to purchase water rights rather than option water to meet projected shortages in wetland supplies.

Table 6 shows the base case option value and illustrates its sensitivity to two key parameters, the discount rate and the water right price appreciation rate. Perhaps counter to intuition, water option values increase with increasing discount (interest) rates. With a higher discount rate, the opportunity cost of purchasing a water right increases while future option exercise costs and water right appreciation are more heavily discounted. On the other hand, as water right prices appreciate or rise, option values decline. This occurs because the opportunity cost of entering into an option increases as water right prices increase more rapidly. In other words, if fee purchase prices are rising rapidly, it is better to invest or buy water rights now rather than pay a higher (real) price later. Over the range of interest and appreciation rates shown, estimated option contract values remain negative with some exceptions (e.g. +$41 per acre foot benefit at 8% interest and zero price appreciation). Under these hydrologic, market and management conditions it would be more cost-effective to permanently purchase and transfer water rights from agriculture for temporary wetlands use. The obvious implication of this for current water users is that instead of having temporary transfers of water to wetlands, the water right would be fee purchased and permanently withdrawn from agricultural use. Socioeconomic impacts of permanent purchases (beyond the scope of this report) could be greater than the comparative cost of supply options, and if so, would provide justification for using supply option contracts to temporarily transfer agricultural water for LVW use.

Table 6 -- Water Option Supply Present Value Benefits
Alternative Price Appreciation and Discount Rates
Option Exercised 10 Times Over 20 Years

Water Right Price Appreciation Percent per Year	Option Supply PV Benefits Per Acre Foot Discount Rate Percent 4.0	6.0	8.0
0.0	-254	-83	41
1.0	-311	-122	14
2.0	-380	-170	-18
3.0	-464	-227	-58
4.0	-564	-295	-105

Water Supply Option Equation Parameter Values		Value per Acre Assuming Transfer	3.5 AF/acre
Exercise Payment	$97.00 AF		$339.50
Exercise Probability	0.500 per year		n.a.
Water Right Price	$571.00 AF		$ 1,999
O&M Assessment	$7.00 AF		$24.50
Contract Length	20 years		n.a.

4.3 Water Management Strategies and the Frequency of Water Transfers

The frequency that gaps must be filled in the water supply for the LVW is a major factor in determining the feasibility of option contracts or the feasibility of any other type of temporary supply program (e.g. spot leases). The benefits of temporary supply programs derive, in large part, from the lower cost of the less frequent use or transfer of water. As temporary purchases or rentals of water become more frequent, the cost of rental approaches and then exceeds the cost of purchasing the water. The frequency of the need for additional temporary Lahontan Valley wetlands water supplies is dictated by water management strategies and institutional regulations as well as hydrologic conditions. Figure 1 shows a 30 year sample from the 92 year hydrologic record illustrating the high frequency of "temporary" water demands for the wetlands under current institutions and the management strategy proposed by DEIS Alternative 5. The wider bottom line on the figure (shortage) shows the frequency and amount of "temporary" water that must be leased at reduced water right duties and yields in order to satisfy the wetlands target supply gap shown by the hatched area or shortage at the top of the graph. The dashed lines running across the bottom represent the shortage quantity of water needed in 14 out of 20 years (lower line) and 10 out of 20 years (upper line).

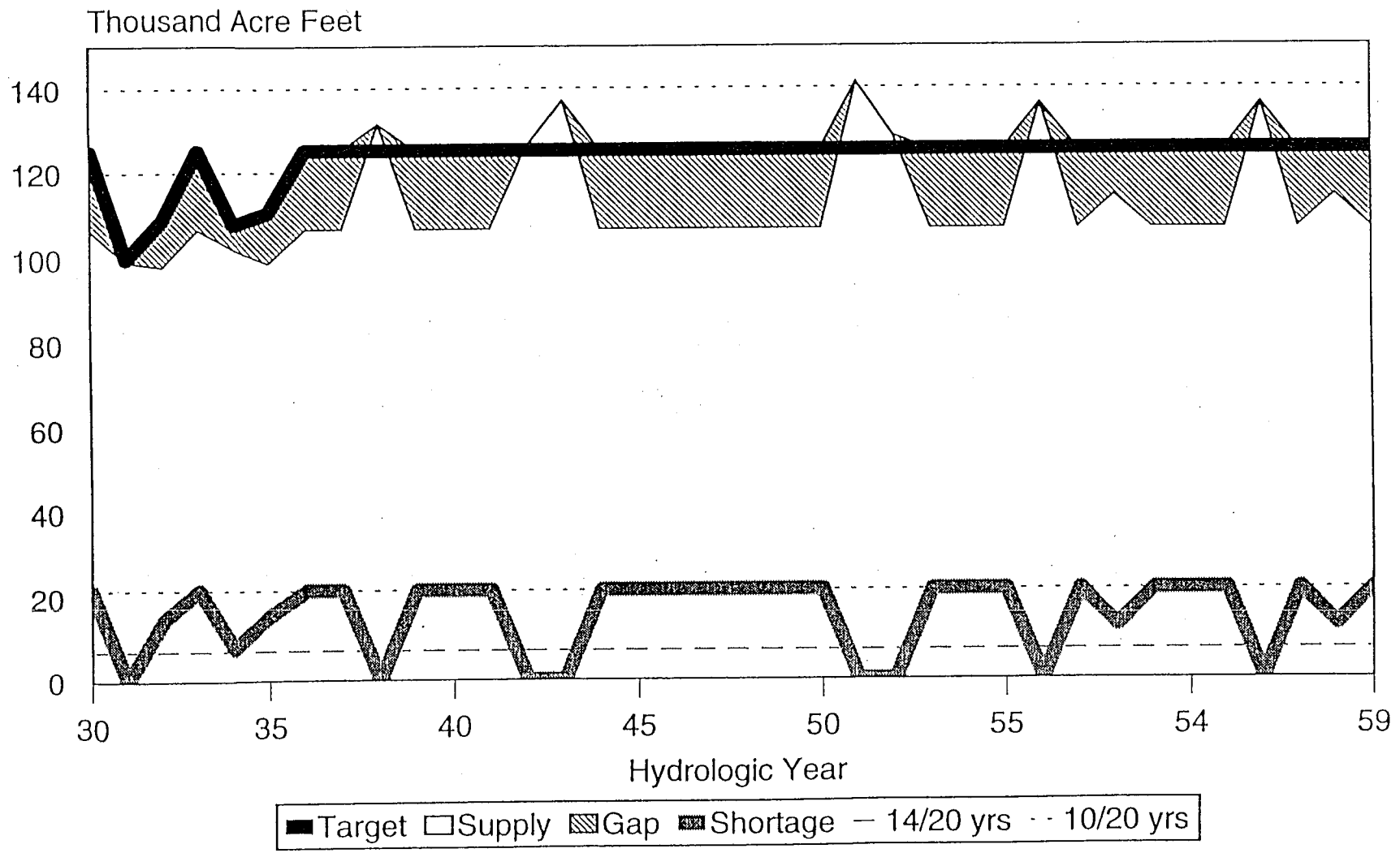
Management or institutional alternatives that could reduce the frequency of wetlands shortages would improve the feasibility of temporary water supply programs. For example, Table 7 shows estimated supply option present value benefits for the same base conditions as Table 6, except the frequency of the need for additional water is assumed to be five, instead of ten, years in 20, or a probability of exercise of 0.25 per year. In this case, the PVOB is +$109 per AF of water. To put this dollar amount of benefits into perspective, if 10,000 AF of water is acquired through option contracts and transferred at full duty, about half of the projected wetlands temporary water shortages of 18,400 AF, the present value savings for a 20 year contract compared to permanently purchasing water rights is estimated to be $1,090,000.

As one more example of the impact of a reduction in frequency, Table 8 shows PVOB values with an annual probability of exercise of 0.20 per year, or five times over 20 years. Under these conditions the present value option benefit is $164 per AF over the alternative of the fee purchase of water rights. In this case the present value savings (benefit of a 20 year contract) compared to permanently purchasing 10,000 AF and transferring at full duty is estimated to be $1,640,000.

4.4 Alternative Water Right Price and Exercise Payment Scenarios

The base case set of evaluations consider only one water right price and one level of exercise payment. Higher initial water right prices represent greater initial purchase or opportunity costs resulting in increased water option benefits. The impact of different water right price scenarios, ranging from $400 per AF to $1,000 per AF in $200 increments, on the value of option benefits are shown in Table 9. These benefit values were calculated assuming an annual probability of exercise of 0.25, transferring water in five out of 20 years, with the other base case conditions held constant. Positive benefit values with these water right prices and discount rates range from $17 per AF to $512 per AF.

LVW Water Supply Target, Deliveries, Shortages, and Temporary Water Required: DEIS Alternative 5



Data Source: DEIS Alternative 5, Below Lahontan Reservoir Model, August 10, 1994; 30 year sample from 92 year record.

Table 7 -- Water Option Supply Present Value Benefits
Alternative Price Appreciation and Discount Rates
Option Exercised 5 Times Over 20 Years

Water Right Price Appreciation Percent per Year	Option Supply PV Benefits Per Acre Foot Discount Rate Percent 4.0	6.0	8.0
0.0	76	195	279
1.0	19	156	252
2.0	-51	109	220
3.0	-134	52	180
4.0	-234	-17	133

Water Supply Option Equation Parameter Values		Value per Acre Assuming Transfer	3.5 AF/acre
Exercise Payment	$97.00 AF		$339.50
Exercise Probability	0.250 per year		n.a.
Water Right Price	$571.00 AF		$ 1,999
O&M Assessment	$7.00 AF		$24.50
Contract Length	20 years		n.a.

Table 8 -- Water Option Supply Present Value Benefits
Alternative Price Appreciation and Discount Rates
Option Exercised 4 Times Over 20 Years

Water Right Price Appreciation Percent per Year	Option Supply PV Benefits Per Acre Foot Discount Rate Percent 4.0	6.0	8.0
0.0	142	251	327
1.0	85	212	300
2.0	15	164	267
3.0	-68	107	228
4.0	-169	39	181

Water Supply Option Equation Parameter Values		Value per Acre Assuming Transfer	3.5 AF/acre
Exercise Payment	$97.00 AF		$339.50
Exercise Probability	0.200 per year		n.a.
Water Right Price	$571.00 AF		$ 1,999
O&M Assessment	$7.00 AF		$24.50
Contract Length	20 years		n.a.

The cost for exercising an option may be different than the value estimated based on reported average production fixed costs and returns. As noted earlier, the production value approach using locally reported data results in a relatively high value of water ($97 per AF, or about $338 per 3.5 AF water righted acre) compared to irrigated alfalfa hay production water values reported by researchers in other regions (e.g. $13-$52 long-run/short-run average values per acre foot in northeast Colorado). Marginal or incremental water values and the value of water on less productive land with lower crop yields and poorer quality hay will be even lower (this is described in more detail by Sunding 1994, in his evaluation of socioeconomic impacts).

During some of the recent water shortages, farmers in California have been willing to sell and transfer their water for a single season to a water bank for payments of $50 to $70 per AF. This indicates that water may be made available for option or spot lease for less than $97 per AF. Table 10 shows present value option benefits for different exercise or agricultural payment levels ranging from $50 per AF to $120 per AF. Again, these benefit values assume an annual probability of exercise of 0.25, with the other base case conditions held constant. Supply option benefits at a six percent discount rate range from $43 per AF with exercise payments of $120 per AF, to a benefit of $243 per AF with exercise payments of $50 per AF. Compensation payments could be lower if adjusted for reduced crop yields or prices. As shown in Table 4, compensation payments that would keep farmers at or even above the same economic level of welfare with a temporary water transfer are estimated to be around $238 per acre or $68 per AF with lower yields or crop prices (payments equal to fixed costs). With an exercise payment of $70 per AF ($240 per 3.5 AF water righted acre), the present value benefit of having 20 year options on 10,000 AF at full duties is estimated to be $1,860,000 compared to the permanent fee purchase for this quantity of water.

Table 9 -- Water Option Present Value Benefits
Alternative Water Right Purchase Prices
Option Exercised 5 Times Over 20 Years

Water Right Purchase Cost Dollars Per AF	Option Contract PV Benefits Per Acre Foot Discount Rate Percent 4.0	6.0	8.0
400	-106	17	103
600	-41	124	239
800	23	231	376
1000	87	339	512

Water Supply Option Equation Parameter Values		Value per Acre Assuming Transfer 3.5 AF/acre
Exercise Payment	$97.00 AF	$339.50
Exercise Probability	0.250 per year	n.a.
WR Price Appreciation	2.0 % per year	n.a.
O&M Assessment	$7.00 AF	$24.50
Contract Length	20 years	n.a.

Table 10 -- Water Option Contract Present Value Cost
Alternative Exercise Payment and Discount Rate
Option Exercised 5 Times Over 20 Years

Exercise Payment $ per AF	Option PV Benefits Per Acre Foot Discount Rate Percent 4.0	6.0	8.0
50.0	109	243	335
70.0	41	186	286
85.0	-10	143	249
97.0	-51	109	220
110.0	-95	71	188
120.0	-129	43	163

Water Supply Option Equation Parameter Values			Value per Acre Assuming Transfer 3.5 AF/acre
Water Right Appreciation	2.0		n.a.
Exercise Probability	0.250	per year	n.a.
Water Right Price	$571.00	AF	$ 1,999
O&M Assessment	$7.00	AF	$24.50
Contract Length	20	years	n.a.

4.5 WSOC Financial and Estimated Annual Cash Flow Requirements

The financial and annual cash flow requirements of using water option contracts to supply the wetlands with additional water during temporary shortages are shown in Table 11. These costs are based on the following conditions: feasible annual option exercise probability of 0.25 (one in four years or five times over a 20 year contract); the base case exercise cost of $338 per water right acre; 6.0 percent discount rate; water right purchase cost of $571 per AF; and water right operation and maintenance cost of $7.00 per AF. The supply shortage evaluated in each option year is 10,000 AF of water, assuming full duty transfers of 3.5 AF per acre. At this transfer rate, 2,857 water righted acres would be subject to a WSOC. Lower transfer rates would proportionately increase the number of irrigated acres and cost to satisfy the shortage. For example, with a transfer rate of 2.99 AF per water right, a total of 3,344 irrigated acres would need to be withdrawn from production.

With an equal probability of supply option exercise in any given year over a 20 year contract (a 25 percent chance in every year), the total annual nominal exercise cost is $241,429, with an expected present value total cost of $2,769,167. This figure is exclusive of price appreciation opportunity costs, if any, and option payments. The total option contract present value cost can be compared to the alternative present value cost of purchasing water rights, totalling $5,714,567 (purchase price plus discounted annual O&M costs). The difference of $2,945,400 is the present value benefit (exclusive of price appreciation opportunity costs) of the water supply option contract.

Table 11 - WSOC Financial Requirements: Estimated Annual Cash Flow and Total Present Value of Payments to Acquire 10,000 AF

* Estimated Quantity of Water to Meet Wetlands Gap: 10,000 acre feet
* Estimated WR Land Assuming Transfer of 3.50 /ac 2,857 acres
2.99 /ac 3,344 acres
2.50 /ac 4,000 acres

Contract Year	Equal Prob. of Exercise Each Year of Contract: Nominal $ Cost	Equal Prob. of Exercise Each Year of Contract: Present Value $	Specific Time of Exercise: Early in Contract: Nominal $ Cost	Specific Time of Exercise: Early in Contract: Present Value $	Specific Time of Exercise: Late in Contract: Nominal $ Cost	Specific Time of Exercise: Late in Contract: Present Value $
1	241,429	227,763	965,714	911,051	0	0
2	241,429	214,871	965,714	859,482	0	0
3	241,429	202,708	965,714	810,832	0	0
4	241,429	191,234	965,714	764,936	0	0
5	241,429	180,409	965,714	721,638	0	0
6	241,429	170,198	0	0	0	0
7	241,429	160,564	0	0	0	0
8	241,429	151,475	0	0	0	0
9	241,429	142,901	0	0	0	0
10	241,429	134,812	0	0	0	0
11	241,429	127,182	0	0	0	0
12	241,429	119,983	0	0	0	0
13	241,429	113,191	0	0	0	0
14	241,429	106,784	0	0	0	0
15	241,429	100,740	0	0	0	0
16	241,429	95,037	0	0	965,714	380,150
17	241,429	89,658	0	0	965,714	358,632
18	241,429	84,583	0	0	965,714	338,332
19	241,429	79,795	0	0	965,714	319,181
20	241,429	75,279	0	0	965,714	301,114
Total**	4,828,571	2,769,167	4,828,571	4,067,940	4,828,571	1,697,409
Compared to the PV Purchase Cost $		5,714,567 ***		5,714,567		5,714,567
WSOC PV Cash Benefit		2,945,400		1,646,627		4,017,158

Estimated Parameter Values

Exercise payment	$338.00 per acre per year
Probability	0.25 equal probability per year
Discount rate	0.06 per year
Quantity of Water per acre	3.5 AF
Water Right Purchase Price	2,000 per acre
Water Right O&M Cost	$24.50 per acre

* water requirement and transfer amount
** excluding opportunity costs.
*** ownership plus O&M costs

Water shortages, unlike equal probability distributions, may occur in any combination, for example, the first, middle or last five years of the option contract. The cash flow requirements and total financial cost will vary accordingly. If the shortages occur during the middle of the contract period, the total present value cost will be the same as the equal probability example. If the shortages occur and the contracts are all exercised in the first five years, the total annual nominal or cash cost will be $965,714 (this is the nominal cost any year all 10,000 AF of contracts are exercised), and the total present value cost would be $4,067,940. This is still less (by $1,646,627) than the cost of purchasing water rights to satisfy this shortage. If the water supply shortages occur during the last five years of twenty year option contracts, the total present value cost would be $1,697,409, a savings of $4,017,158 over purchasing water rights.

5.0 CONCLUSIONS

Water supply option contracts are an economically feasible supply alternative to purchasing water rights with less frequent shortages than the proposed water management strategy. For example, the present value benefit of using option contracts to acquire temporary supplies is $109 per AF when water is supplied five years over a 20 year period (0.25 per year probability or 1:4), holding all other base case conditions constant. Under these conditions, if 10,000 AF of full duty water is supplied through options rather than through the permanent fee purchase of water rights, the total present value savings is estimated to be $1,090,000 over the life of the contract, excluding option payments, if any. These figures assume an exercise payment of $97 per AF per year water is optioned, based on an average farm enterprise budget and yield. As noted previously, this estimated value or price for temporary water is much higher than what has been reported in other regions for alfalfa production and is fifty to one hundred percent higher than the price actually paid to farmers by recent water banks in California. With an exercise payment of $50 per AF and shortage frequency of 1:4 years, holding all other conditions constant, the present value of option benefits is estimated to be $243 per AF, almost two and a half times greater. Although the assumption of a single exercise cost based on average farm cost and production data simplifies exercise payment calculations and farmer contract negotiations, payments based on farm averages are economically inefficient and overstate the actual value and socioeconomic impact of temporary water transfers.

Option benefits are sensitive to the fee purchase price of the water right assumed at the beginning of the WSOC period. The benefits presented above assume a water right fee purchase price of $571 per AF or $2,000 per water right acre, based on current market conditions in the project area. Option benefits would increase if actual water right prices are higher. With a water right fee purchase price of $800 per AF, assuming an exercise price of $97 per AF and shortage frequency of 1:4 years, holding all other conditions constant, the present value option benefit is estimated to be $231 per AF, again almost two and a half times greater. On the other hand, option benefits decrease with higher rates in the appreciation of fee purchase prices.

The evaluation for the potential of implementing water supply option contracts to satisfy Lahontan Valley wetlands shortages indicates that they are not cost-effective under the proposed water management strategies and institutional conditions. The poor cost-effectiveness of supply options can be attributed, in large part, to the high frequency of water shortages. The frequent shortages are a characteristic of the proposed acquisition program, water management strategies and institutional regulations. The proposed water acquisition program involves the fee purchase of 75,000 AF at a reduced transfer rate of 2.99 AF per acre, other permanent sources and return flows as a base supply, with the balance of the 125,000 AF supply objective consisting of temporary water purchases. With this management strategy, shortages of 5,000 AF or more would be expected, on average, two out of every three years. Shortages of 18,400 AF would be expected to occur half of the time. This frequency of use is difficult to characterize as temporary and drives the economic solution to the permanent purchase of water rights to satisfy shortages; i.e. buying is less expensive than renting water.

These results also apply to spot leases of water assuming that water available to be spot leased has the same short-run value. That is, payment accepted for a spot lease should compensate a farmer for both forgone net profits and for continuing fixed costs. The economic benefits of spot leases will be greater, given the same water management strategy and frequency of interruption, only if spot lease prices were lower, as would be the case where water offerred by farmers for spot lease is considered as surplus for that season (the production value of the water is below the spot price). However, in contrast to WSOC, with spot leasing there is no guarantee of supply availability from year-to-year and, during shortages less water is likely to be available for spot leases. In both cases, the cost-effectiveness of temporary purchases would be even lower with less than transfer of full water right duties or in years with lower than full water yield.

Alternative acquisition programs and management strategies could reduce the frequency of shortages and mitigate socioeconomic impacts. One method would be to increase the base supply with the fee purchase of water rights to reduce the frequency and quantity of temporary water required. For example, the base supply could be increased by transferring fee purchased water rights for the same acreage at a full headgate duty of 3.5 AF per acre. This solution would be less expensive than purchasing temporary supplies under the current management strategy. Annual shortages and the frequency of temporary water purchases may also be able to be reduced if mechanisms existed that would allow storage to carryover water when supplies are plentiful. But the advantages of carryover are qualified by the risk of spill and evaporation and seepage losses during storage.

Program costs and acquisition impacts could be further reduced if water is temporarily transferred during periods of high water right yields. Transfers during these periods would be less likely to interrupt firm supplies for other users and, with higher water right yields, the marginal value to farmers and effective water acquisition price is lower. High yield transfers would be most effective when the water could be banked or carried over for use during shortages. Carryover storage could also mitigate socioeconomic impacts if water could be temporarily transferred from less productive farms in years when it was not needed for wetlands supply. Such carryover water might then be delivered to fill a gap in the supply to the wetlands in a succeeding year instead of interrupting water supplies to more productive farms (e.g. see Sunding 1994).

A portfolio strategy to acquire supplemental water for wetlands shortages may also offer potential benefits. This strategy involves the acquisition of a portfolio of temporary water supplies whose source would probably vary more than the total amount of water required. Essentially, the interruption of production could be rotated over many farms to derive a targeted wetland supply. The total amount of the supply might be governed by a constant or set revenue base, with carryover storage rather than additional WSOC or spot leases being used to address shortage years. A portfolio of short-term leases or contracts could also serve as an interim base supply before a base supply of fee purchases is completed. Potential benefits of this strategy include the ability for wetlands managers and farmers to schedule transfers, reduce short-run farm costs (e.g. avoid re-establishment costs), and transfer and capture of water during higher than average yields to minimize supply costs and delivery interruptions. The critical factor is still

the frequency of temporary transfers. The total cost of temporary transfers (portfolio sum of the transfer cost or payment multiplied by the number of times transferred) must be less than the cost of permanently purchasing water rights to satisfy shortages. The portfolio approach would also spread and even-out program cost and cash flow payments.

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M E M O R A N D U M

To: Gary Shellhorn

From: David Yardas, EDF

Date: August 10, 1994

Re: **DEIS Alternative 5**

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This memo summarizes my current understanding of DEIS Alternative 5 based on our numerous discussions over the past several weeks. Please let me know ASAP if you have any questions, or if anything else needs attention.

Baseline The starting point for this analysis is DEIS Alternative E1, the 20,000 AF No Action baseline. (This includes all supporting assumptions, such as continued use of the 1901-92 period of record for estimates of BLR-model simulated averages, probabilities, and comparisons across cases.)

Core Acquisitions The Newlands Project fee-purchase core is set at 75,000 AF of active or eligible rights transferred to (and/or exercised for) the primary Lahontan Valley wetlands at 2.99 AF/acre.[1]

Navy Water Approximately 5,500 AF of active or eligible headgate delivery entitlements at NAS-Fallon are assumed to be conserved and transferred to the wetlands through conversion of 1,760 acres from alfalfa hay to irrigated pasture in the Smart District (half each to Stillwater and Carson Lake) and 440 acres from alfalfa hay to wheatgrass in the Factory District (all to Stillwater).[2]

Upstream Acquisitions Approximately 12,100 AF of upstream consumptive use entitlements are assumed to be acquired, banked in or wheeled through Lahontan Reservoir, and then released/delivered to the primary wetlands.[3] (See the

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[1] Sub-district totals are down-scaled proportionately from those assumed in DEIS Alternative E2.

[2] Potential conservation increments are based on data presented in the Navy's April, 1994 Review Environmental Assessment for greenbelt-area management at NAS-Fallon. To accomplish a demand-neutral transfer of conserved Navy water, the BLR model's LANDBASE and HGDLVR variables were modified in amounts sufficient to offset the quantities of water so conserved and transferred. However, the co-management of these supplies that may be required by section 206(c)(3) of P.L. 101-618 has yet to be addressed.

[3] This represents approximately 75% of the decreed net consumptive use total in Segment 7, though upper-segment transfers (e.g., seasonal wheeling of water released from Mud Lake storage) could also be assumed to be included. Also, while associated increases in terminal wetland inflows are now included in BLR model results (via the model's NATURAL input array), I cannot at present do the same in terms of Lahontan Reservoir banking. Thus, associated increases in storage or hydrogeneration will have to be handled qualitatively

attached sheet labeled FTCH for details.) Below-Lahontan losses (estimated at 68% net) are subtracted from the total actually delivered to the primary wetlands each year, as are reductions in yield indexed to annual variations in Carson River supplies. On average, approximately 6,200 AF of the acquired upstream supplies are delivered to the wetlands every year, ranging from 8,200 AF in average and above-average years to as little as 800 AF in the driest (1977) simulation year.[4]

Pumped Groundwater It is assumed that groundwater can and will be pumped in and around the wetlands in amounts sufficient to yield, together with acquired upstream supplies, a "composite" annual total of 15,000 AF. (Here, as above, the attached sheet labeled FTCH provides details.) The resulting average of 8,800 AF/year of pumped groundwater ranges from as little as 6,800 AF to as much as 14,300 AF annually.[5]

Effluent Some 600 AF of treated effluent is assumed to be delivered to Stillwater each year at the rate of 50 AF/month.

Leases/Options Leases, dry-year options, and other forms of recurring but intermittent acquisitions (from willing sellers) of active or eligible Newlands Project water rights are assumed to be implemented in conjunction with each of the above sources to yield a long-term average estimated supply to the primary wetlands of 125,000 AF/year. (See the attached sheet labeled SUMWIN5 for details.) Note that Project-wide shortages are assumed to be "shared" on a pro-rata basis when determining annual inflow targets (see the column labled "LVW Target"). Shortages as well as consumptive-use transfer limitations are also taken into account when determining the amount of supplemental acquisitions needed (i.e., the difference between the columns labeled "Gap" and "Lease")--though as a practical matter, no such acquisitions are undertaken if the identified Gap is less than 2,500 AF in any year.

I have not yet incorporated the above lease/option estimates into the BLR model framework, so neither associated return-flow impacts nor changes in shortages or spills have yet to be fully considered. Nevertheless, based on the above, a preliminary average of 13,200 AF of supplemental leases and options presents a reasonable estimate of anticipated long-term needs. Associated annual totals will vary from 21,600 AF in approximately 52 percent of all years to zero in approximately 33 percent of all years. Details are provided in the right-hand columns of the sheet labeled SUMWIN5.

(as mitigation?) or through similar "off line" approximations.

[4] These and other composite supplies are assumed to be delivered within the irrigation season window based on reported monthly Carson Division averages from 1989. They are apportioned approximately 60% to Stillwater and 40% to Carson Lake.

[5] This 15,000-AF "composite" supply could also serve as a proxy for (a) other sources of potential supply, such as co-managed Canvasback inflows or appropriate reliance on Project regulating reservoirs, and/or (b) reduced needs or application intensities relative to the 125,000 AF otherwise assumed for primary wetlands.

File FTCH 05-Aug-94
Carson River @ Ft Churchill and Segment 7 Transfers

6,450 acres @ 2.5 AF/ac = 16,125 AF
75% 12,094 <-------
67% 10,750
50% 8,063

Total composite supply: 15,000

	Sorted	Ann	Annual/ Average	Capped @ 1.0	Upstrm 12,094 68%	Pumped GrWtr
1	804.6	427.8	1.49	1.00	8,224	6,776
2	798.9	373.2	1.30	1.00	8,224	6,776
3	662.2	289.8	1.01	1.00	8,224	6,776
4	617.3	558.6	1.94	1.00	8,224	6,776
5	611.9	271.4	0.94	0.94	7,757	7,243
6	586.6	611.9	2.13	1.00	8,224	6,776
7	579.9	798.9	2.78	1.00	8,224	6,776
8	570.5	228.2	0.79	0.79	6,523	8,477
9	561.0	570.5	1.98	1.00	8,224	6,776
10	558.6	370.5	1.29	1.00	8,224	6,776
11	551.8	662.2	2.30	1.00	8,224	6,776
12	549.7	174.0	0.60	0.60	4,973	10,027
13	537.5	160.9	0.56	0.56	4,599	10,401
14	533.3	617.3	2.15	1.00	8,224	6,776
15	483.0	297.4	1.03	1.00	8,224	6,776
16	467.1	549.7	1.91	1.00	8,224	6,776
17	459.8	467.1	1.62	1.00	8,224	6,776
18	448.7	223.0	0.78	0.78	6,374	8,626
19	431.6	255.9	0.89	0.89	7,314	7,686
20	427.8	145.4	0.51	0.51	4,156	10,844
21	423.4	296.2	1.03	1.00	8,224	6,776
22	403.3	459.8	1.60	1.00	8,224	6,776
23	403.0	329.1	1.14	1.00	8,224	6,776
24	382.3	91.2	0.32	0.32	2,607	12,393
25	373.2	266.8	0.93	0.93	7,626	7,374
26	370.5	114.2	0.40	0.40	3,264	11,736
27	354.1	340.6	1.18	1.00	8,224	6,776
28	341.0	169.7	0.59	0.59	4,850	10,150
29	340.6	91.5	0.32	0.32	2,616	12,384
30	338.4	148.9	0.52	0.52	4,256	10,744
31	329.1	65.0	0.23	0.23	1,858	13,142
32	322.4	307.1	1.07	1.00	8,224	6,776
33	321.3	121.6	0.42	0.42	3,476	11,524
34	309.9	76.3	0.27	0.27	2,181	12,819
35	307.1	210.1	0.73	0.73	6,006	8,994
36	297.4	274.7	0.95	0.95	7,852	7,148
37	296.2	262.0	0.91	0.91	7,489	7,511
38	295.1	579.9	2.02	1.00	8,224	6,776
39	289.8	139.5	0.48	0.48	3,987	11,013
40	279.0	279.0	0.97	0.97	7,975	7,025
41	276.1	243.9	0.85	0.85	6,971	8,029
42	274.7	403.0	1.40	1.00	8,224	6,776
43	271.4	403.3	1.40	1.00	8,224	6,776
44	266.8	169.3	0.59	0.59	4,839	10,161
45	262.0	309.9	1.08	1.00	8,224	6,776
46	261.9	261.9	0.91	0.91	7,486	7,514
47	259.6	164.6	0.57	0.57	4,705	10,295
48	255.9	151.5	0.53	0.53	4,330	10,670
49	244.2	167.4	0.58	0.58	4,785	10,215
50	243.9	259.6	0.90	0.90	7,420	7,580

51	240.4	423.4	1.47	1.00	8,224	6,776
52	235.4	586.6	2.04	1.00	8,224	6,776
53	228.2	240.4	0.84	0.84	6,871	8,129
54	223.5	176.6	0.61	0.61	5,048	9,952
55	223.0	114.4	0.40	0.40	3,270	11,730
56	217.6	533.3	1.85	1.00	8,224	6,776
57	210.1	223.5	0.78	0.78	6,388	8,612
58	197.5	341.0	1.19	1.00	8,224	6,776
59	187.6	108.4	0.38	0.38	3,098	11,902
60	176.6	59.5	0.21	0.21	1,701	13,299
61	174.0	44.4	0.15	0.15	1,269	13,731
62	171.0	217.6	0.76	0.76	6,220	8,780
63	169.7	338.4	1.18	1.00	8,224	6,776
64	169.3	136.2	0.47	0.47	3,893	11,107
65	167.4	382.3	1.33	1.00	8,224	6,776
66	166.4	171.0	0.59	0.59	4,888	10,112
67	164.6	448.7	1.56	1.00	8,224	6,776
68	162.3	162.3	0.56	0.56	4,639	10,361
69	160.9	561.0	1.95	1.00	8,224	6,776
70	151.5	322.4	1.12	1.00	8,224	6,776
71	148.9	295.1	1.03	1.00	8,224	6,776
72	145.4	187.6	0.65	0.65	5,362	9,638
73	139.5	276.1	0.96	0.96	7,892	7,108
74	136.2	354.1	1.23	1.00	8,224	6,776
75	121.6	321.3	1.12	1.00	8,224	6,776
76	121.2	80.6	0.28	0.28	2,304	12,696
77	114.4	26.3	0.09	0.09	752	14,248
78	114.2	244.2	0.85	0.85	6,980	8,020
79	110.9	235.4	0.82	0.82	6,728	8,272
80	108.4	431.6	1.50	1.00	8,224	6,776
81	91.5	121.2	0.42	0.42	3,464	11,536
82	91.2	551.8	1.92	1.00	8,224	6,776
83	80.6	804.6	2.80	1.00	8,224	6,776
84	76.3	483.0	1.68	1.00	8,224	6,776
85	73.0	197.5	0.69	0.69	5,645	9,355
86	71.5	537.5	1.87	1.00	8,224	6,776
87	65.0	110.9	0.39	0.39	3,169	11,831
88	59.5	43.2	0.15	0.15	1,236	13,764
89	54.2	166.4	0.58	0.58	4,755	10,245
90	44.4	71.5	0.25	0.25	2,045	12,955
91	43.2	73.0	0.25	0.25	2,086	12,914
92	26.3	54.2	0.19	0.19	1,550	13,450
Avg	287.7	287.7	1.00	0.75	6,198	8,802
Max	804.6	804.6	2.80	1.00	8,224	14,248
Min	26.3	26.3	0.09	0.09	752	6,776

File SUMWIN5 09-Aug-94

YEAR	Project Supply	LVW Target	E5 Supply	E5 Gap	E5 Total	E5 Lease	Sorted Yr	Sorted E5 Lease
1	100.0%	125.0	122.8	0.0	122.8	0.0	87	21.6
2	100.0%	125.0	122.8	0.0	122.8	0.0	85	21.6
3	100.0%	125.0	106.6	18.4	125.0	21.6	81	21.6
4	100.0%	125.0	137.1	0.0	137.1	0.0	79	21.6
5	100.0%	125.0	106.7	18.4	125.0	21.5	76	21.6
6	100.0%	125.0	140.2	0.0	140.2	0.0	73	21.6
7	100.0%	125.0	157.1	0.0	157.1	0.0	72	21.6
8	100.0%	125.0	106.6	18.4	125.0	21.6	71	21.6
9	100.0%	125.0	136.0	0.0	136.0	0.0	68	21.6
10	100.0%	125.0	125.5	0.0	125.5	0.0	66	21.6
11	100.0%	125.0	148.8	0.0	148.8	0.0	64	21.6
12	100.0%	125.0	106.6	18.4	125.0	21.6	63	21.6
13	100.0%	125.0	106.6	18.4	125.0	21.6	60	21.6
14	100.0%	125.0	140.2	0.0	140.2	0.0	59	21.6
15	100.0%	125.0	113.2	11.8	125.0	13.8	57	21.6
16	100.0%	125.0	148.5	0.0	148.5	0.0	55	21.6
17	100.0%	125.0	136.0	0.0	136.0	0.0	54	21.6
18	100.0%	125.0	106.6	18.4	125.0	21.6	53	21.6
19	100.0%	125.0	106.6	18.4	125.0	21.6	50	21.6
20	100.0%	125.0	106.6	18.4	125.0	21.6	49	21.6
21	100.0%	125.0	106.6	18.4	125.0	21.6	48	21.6
22	100.0%	125.0	122.8	0.0	122.8	0.0	47	21.6
23	100.0%	125.0	114.6	10.4	125.0	12.2	46	21.6
24	100.0%	125.0	106.6	18.4	125.0	21.6	45	21.6
25	100.0%	125.0	106.6	18.4	125.0	21.6	44	21.6
26	100.0%	125.0	106.6	18.4	125.0	21.6	41	21.6
27	100.0%	125.0	106.6	18.4	125.0	21.6	40	21.6
28	100.0%	125.0	106.6	18.4	125.0	21.6	39	21.6
29	100.0%	125.0	106.6	18.4	125.0	21.6	37	21.6
30	100.0%	125.0	106.6	18.4	125.0	21.6	36	21.6
31	79.9%	99.8	99.2	0.0	99.2	0.0	33	21.6
32	87.1%	108.8	98.0	10.8	108.8	14.6	30	21.6
33	100.0%	125.0	106.6	18.4	125.0	21.6	29	21.6
34	86.2%	107.7	102.1	5.6	107.7	7.6	28	21.6
35	88.4%	110.5	98.8	11.7	110.5	15.5	27	21.6
36	100.0%	125.0	106.6	18.4	125.0	21.6	26	21.6
37	100.0%	125.0	106.6	18.4	125.0	21.6	25	21.6
38	100.0%	125.0	131.3	0.0	131.3	0.0	24	21.6
39	100.0%	125.0	106.6	18.4	125.0	21.6	21	21.6
40	100.0%	125.0	106.6	18.4	125.0	21.6	20	21.6
41	100.0%	125.0	106.6	18.4	125.0	21.6	19	21.6
42	100.0%	125.0	125.7	0.0	125.7	0.0	18	21.6
43	100.0%	125.0	136.8	0.0	136.8	0.0	13	21.6
44	100.0%	125.0	106.6	18.4	125.0	21.6	12	21.6
45	100.0%	125.0	106.6	18.4	125.0	21.6	8	21.6
46	100.0%	125.0	106.6	18.4	125.0	21.6	3	21.6
47	100.0%	125.0	106.6	18.4	125.0	21.6	5	21.5
48	100.0%	125.0	106.6	18.4	125.0	21.6	90	21.4
49	100.0%	125.0	106.6	18.4	125.0	21.6	89	16.8
50	100.0%	125.0	106.6	18.4	125.0	21.6	35	15.5
51	100.0%	125.0	141.2	0.0	141.2	0.0	62	15.2
52	100.0%	125.0	128.4	0.0	128.4	0.0	32	14.6
53	100.0%	125.0	106.6	18.4	125.0	21.6	78	14.1
54	100.0%	125.0	106.6	18.4	125.0	21.6	15	13.8
55	100.0%	125.0	106.6	18.4	125.0	21.6	75	12.8
56	100.0%	125.0	136.0	0.0	136.0	0.0	65	12.8
57	100.0%	125.0	106.6	18.4	125.0	21.6	58	12.7
58	100.0%	125.0	114.2	10.8	125.0	12.7	23	12.2

59	100.0%	125.0	106.6	18.4	125.0	21.6	88	11.8
60	100.0%	125.0	106.6	18.4	125.0	21.6	61	8.3
61	88.0%	110.1	103.8	6.2	110.1	8.3	34	7.6
62	88.3%	110.3	98.9	11.5	110.3	15.2	77	7.1
63	100.0%	125.0	106.6	18.4	125.0	21.6	92	0.0
64	100.0%	125.0	106.6	18.4	125.0	21.6	91	0.0
65	100.0%	125.0	114.1	10.9	125.0	12.8	86	0.0
66	100.0%	125.0	106.6	18.4	125.0	21.6	84	0.0
67	100.0%	125.0	122.7	0.0	122.7	0.0	83	0.0
68	100.0%	125.0	106.6	18.4	125.0	21.6	82	0.0
69	100.0%	125.0	122.8	0.0	122.8	0.0	80	0.0
70	100.0%	125.0	125.8	0.0	125.8	0.0	74	0.0
71	100.0%	125.0	106.6	18.4	125.0	21.6	70	0.0
72	100.0%	125.0	106.6	18.4	125.0	21.6	69	0.0
73	100.0%	125.0	106.6	18.4	125.0	21.6	67	0.0
74	100.0%	125.0	122.8	0.0	122.8	0.0	56	0.0
75	100.0%	125.0	114.1	10.9	125.0	12.8	52	0.0
76	100.0%	125.0	106.6	18.4	125.0	21.6	51	0.0
77	83.3%	104.1	99.1	5.0	104.1	7.1	43	0.0
78	86.4%	108.1	97.6	10.4	108.1	14.1	42	0.0
79	100.0%	125.0	106.6	18.4	125.0	21.6	38	0.0
80	100.0%	125.0	122.8	0.0	122.8	0.0	31	0.0
81	100.0%	125.0	106.6	18.4	125.0	21.6	22	0.0
82	100.0%	125.0	135.7	0.0	135.7	0.0	17	0.0
83	100.0%	125.0	161.6	0.0	161.6	0.0	16	0.0
84	100.0%	125.0	168.7	0.0	168.7	0.0	14	0.0
85	100.0%	125.0	106.6	18.4	125.0	21.6	11	0.0
86	100.0%	125.0	143.3	0.0	143.3	0.0	10	0.0
87	100.0%	125.0	106.6	18.4	125.0	21.6	9	0.0
88	89.6%	112.0	102.9	9.1	112.0	11.8	7	0.0
89	90.3%	112.9	99.9	13.0	112.9	16.8	6	0.0
90	99.9%	124.9	106.6	18.3	124.9	21.4	4	0.0
91	46.5%	58.1	72.7	0.0	72.7	0.0	2	0.0
92	38.5%	48.1	57.1	0.0	57.1	0.0	1	0.0
Avg	97.3%	121.6	113.9	11.1	125.0	13.2		13.2

NOTES ----------

E5 = ENAQ + 75 KAF @ 2.99 + 5 KAF Navy + 15 KAF upstrm/gw

Project Supply percentage based on E1 (No Action) conditions

Target = 125 KAF * Project Supply percentage

Supply = LVW total inflow prior to leasing

Gap = Target - Supply (or zero if Target - Supply < 2.5 KAF)

Lease = option or lease amount = Gap / Project Supply percentage * 3.50/2.99 (i.e., the amount that would have to be acquired to fill the calculated "Gap" taking full account of shortages and transfer rate differentials)

Total = Supply + Lease. Note: does not account for changes in LVW seepage, returns, or spills associated with lease/option transfers.

EDF 09-Aug-94 (BLR model version 3.31)

ALTERNATE LEASE/OPTION SCENARIOS

LVW Target	E5a Supply	E5a Gap	E5a Total	E5a Lease
115.0	122.8	0.0	122.8	0.0
115.0	122.8	0.0	122.8	0.0
115.0	106.6	8.4	115.0	9.9
115.0	137.1	0.0	137.1	0.0
115.0	106.7	8.3	115.0	9.8
115.0	140.2	0.0	140.2	0.0
115.0	157.1	0.0	157.1	0.0
115.0	106.6	8.4	115.0	9.9
115.0	136.0	0.0	136.0	0.0
115.0	125.5	0.0	125.5	0.0
115.0	148.8	0.0	148.8	0.0
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	140.2	0.0	140.2	0.0
115.0	113.2	0.0	113.2	0.0
115.0	148.5	0.0	148.5	0.0
115.0	136.0	0.0	136.0	0.0
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	122.8	0.0	122.8	0.0
115.0	114.6	0.0	114.6	0.0
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
91.8	99.2	0.0	99.2	0.0
100.1	98.0	0.0	98.0	0.0
115.0	106.6	8.4	115.0	9.9
99.1	102.1	0.0	102.1	0.0
101.6	98.8	2.9	101.6	3.8
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	131.3	0.0	131.3	0.0
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	125.7	0.0	125.7	0.0
115.0	136.8	0.0	136.8	0.0
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	141.2	0.0	141.2	0.0
115.0	128.4	0.0	128.4	0.0
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	106.6	8.4	115.0	9.9
115.0	136.0	0.0	136.0	0.0
115.0	106.6	8.4	115.0	9.9
115.0	114.2	0.0	114.2	0.0
115.0	106.6	8.4	115.0	9.9

LVW Target	E60 Supply	E60 Gap	E60 Total	E60 Lease
125.0	113.3	11.7	125.0	13.7
125.0	113.3	11.8	125.0	13.8
125.0	97.0	28.0	125.0	32.8
125.0	127.6	0.0	127.6	0.0
125.0	97.0	28.0	125.0	32.8
125.0	130.7	0.0	130.7	0.0
125.0	147.6	0.0	147.6	0.0
125.0	97.0	28.0	125.0	32.8
125.0	126.4	0.0	126.4	0.0
125.0	113.7	11.3	125.0	13.3
125.0	139.3	0.0	139.3	0.0
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	130.7	0.0	130.7	0.0
125.0	99.9	25.1	125.0	29.4
125.0	138.9	0.0	138.9	0.0
125.0	124.3	0.0	124.3	0.0
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	113.2	11.8	125.0	13.8
125.0	104.9	20.1	125.0	23.5
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
99.8	89.0	10.8	99.8	15.8
108.8	88.9	20.0	108.8	26.9
125.0	97.0	28.0	125.0	32.8
107.7	91.5	16.2	107.7	22.0
110.5	89.9	20.6	110.5	27.3
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	121.8	3.3	125.0	3.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	115.7	9.3	125.0	10.9
125.0	126.4	0.0	126.4	0.0
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	131.7	0.0	131.7	0.0
125.0	114.1	10.9	125.0	12.7
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	97.0	28.0	125.0	32.8
125.0	126.5	0.0	126.5	0.0
125.0	97.0	28.0	125.0	32.8
125.0	104.5	20.5	125.0	24.0
125.0	97.0	28.0	125.0	32.8

115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
101.3	103.8	0.0	103.8	0.0	110.1	92.9	17.2	110.1	22.8
101.5	98.9	2.7	101.5	3.5	110.3	89.8	20.5	110.3	27.2
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	114.1	0.0	114.1	0.0	125.0	103.7	21.3	125.0	25.0
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	122.7	0.0	122.7	0.0	125.0	113.1	11.9	125.0	13.9
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	122.8	0.0	122.8	0.0	125.0	113.2	11.8	125.0	13.8
115.0	125.8	0.0	125.8	0.0	125.0	114.6	10.4	125.0	12.2
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	122.8	0.0	122.8	0.0	125.0	113.1	11.9	125.0	13.9
115.0	114.1	0.0	114.1	0.0	125.0	104.5	20.5	125.0	24.0
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
95.8	99.1	0.0	99.1	0.0	104.1	89.1	15.0	104.1	21.1
99.4	97.6	0.0	97.6	0.0	108.1	88.6	19.5	108.1	26.4
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	122.8	0.0	122.8	0.0	125.0	113.2	11.8	125.0	13.8
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	135.7	0.0	135.7	0.0	125.0	125.9	0.0	125.9	0.0
115.0	161.6	0.0	161.6	0.0	125.0	151.5	0.0	151.5	0.0
115.0	168.7	0.0	168.7	0.0	125.0	158.7	0.0	158.7	0.0
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
115.0	143.3	0.0	143.3	0.0	125.0	132.2	0.0	132.2	0.0
115.0	106.6	8.4	115.0	9.9	125.0	97.0	28.0	125.0	32.8
103.0	102.9	0.0	102.9	0.0	112.0	92.8	19.2	112.0	25.1
103.9	99.9	3.9	103.9	5.1	112.9	90.8	22.1	112.9	28.7
114.9	106.6	8.3	114.9	9.7	124.9	97.0	27.9	124.9	32.7
53.5	72.7	0.0	72.7	0.0	58.1	64.9	0.0	64.9	0.0
44.3	57.1	0.0	57.1	0.0	48.1	51.8	0.0	51.8	0.0
111.9	113.9	4.5	118.4	5.3	121.6	104.2	19.1	123.3	22.7

E5a = E5 but with LVW target reduced to 115 KAF (normal year)
E60 = E5 but with "core" (fee) acquisitions reduced to 60 KAF

APPENDIX B

Concepts for a Second Generation Truckee-Carson Settlement

The Nature Conservancy and Environmental Defense Fund

Testimony of Graham Chisholm before the U.S. Senate Energy and Natural Resource Committee on Water and Power, Reno, Nevada, December 11, 1993

CONCEPTS FOR A SECOND GENERATION TRUCKEE-CARSON SETTLEMENT

December 11, 1993

INTRODUCTION

The Fallon Paiute-Shoshone and Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990 (1990 Settlement Act) enabled some remarkable settlements of long-standing water conflicts, but only established a framework for addressing a number of other major issues that it purposely left unresolved. This paper, a collaboration of The Nature Conservancy and the Environmental Defense Fund, seeks to consistently and comprehensively offer a host of concepts for a second generation settlement of those issues, without representing that we originated many of them.

Our perception of the major issues left unresolved by the 1990 Settlement Act and a statement of principles for a second generation settlement prefaces this catalog of concepts. We have assumed that as long as the lower Truckee and Carson rivers are not simply and completely de-coupled, we must embrace them as a whole and must rigorously avoid tunnel visions which trade one interest off against another.

MAJOR UNRESOLVED ISSUES

What constitutes a valid Newlands Project water right, what amounts can be lawfully delivered to farm headgates or transferred away from them, and who owns or benefits from any savings in the delivery of water to farm headgates or in its application below headgates?

What should be the acreage base, storage targets, system and on-farm efficiencies, unused deliveries and other premises for the Operating Criteria and Procedures (OCAP) for the Newlands Project?

How much water is needed for the Lahontan Valley Wetlands given these premises?

What are the consequences of these premises for the acquisition of Newlands Project water rights to recover the cui-ui and to supply Truckee Meadows municipal demands?

How much water is needed to recoup unlawful Newlands Project diversions from the Truckee River and to recover the cui-ui? What delta access and fish passage improvements are needed to recover the cui-ui?

How can cui-ui recovery be integrated with the restoration of the Pyramid Lake/Lower Truckee River ecosystem encompassing the riparian forest and potentially the Lahontan cutthroat trout?

What are the implications of recoupment and cui-ui recovery to the water rights acquisitions for the Lahontan Valley Wetlands?

Can the water needed for the Wetlands, for Pyramid Lake, and the Truckee Meadows be acquired consistently with the evolving water needs and shifting agricultural base of the Fallon and Fernley communities?

How can the domestic water supply systems in the Lahontan Valley and the Fernley area be modernized and made more reliable?

What accommodations still need to be made in the management of water on Fallon tribal lands?

To what extent should Newlands Project water rights be leased for municipal use in the Truckee Meadows or for the Wetlands?

How else can Newlands Project water be rotated among the principal demands and how should leasing and other interruptible water supplies be funded?

To what extent can the lower Truckee and Carson river basins be operationally if not physically decoupled?

SETTLEMENT PRINCIPLES

The fundamental, initial allocations of water supplies between the lower Truckee and Carson River basins should be defined in a way that minimizes uncertainties and contentious variables.

Basic water supply allocations should then be integrated and rotated using market incentives, water banking and consensual adjustments whenever possible to live within a comprehensive budget that addresses all water demand sectors in both basins.

The importation of water from outside the basins should only be pursued as a last resort, and in no instance where it would shift environmental and socio-economic costs to another basin.

The dependence of the Lahontan Valley on Truckee River diversions should be reduced, its reliance on Carson River supplies increased, and the lower Truckee and Carson river basins operationally if not physically de-coupled to the greatest extent possible.

SETTLEMENT CONCEPTS

Newlands Project Releases and Lahontan Reservoir Storage Targets Under the OCAP

The annual releases from Lahontan Reservoir and the Truckee Canal would be scaled back and governed by a fixed, annual limit that would be easily verified and independent of many of the controversies about the premises for the current OCAP (like the project's acreage base, bench-bottomland classifications, historic deliveries relative to maximum headgate entitlements, and distribution system efficiencies). As with current operations, this fixed release could be overridden by reservoir spills in very wet years and could be shorted in very dry ones.

Lahontan Reservoir storage targets would be reduced and modified in correspondence with the scale-back of annual project releases -- before any consideration of water rights purchases for the Wetlands or Pyramid Lake or of reciprocating water uses.

Such OCAP reform would lessen the dependence of the Newlands Project on Truckee River diversions and would increase the amount of unappropriated water in the Truckee River that accrues to the water rights that would be granted to the Pyramid Lake Tribe once its agreement with the State of Nevada is carried out.

The OCAP litigation would be dismissed.

Individual Project Water Rights

The project's maximum acreage base would be reduced and the scale-back in total project releases would be facilitated by the purchase of inactive water rights at a substantial discount. If these rights are retired from the project's acreage base, the loss of operation and maintenance (O&M) revenue could be replaced by adjustments in the ownership/priority of hydropower resources at Lahontan Dam. Some across-the-board increase in O&M assessments could also be necessary.

An alternative would be to re-structure individual project water rights into "shares" or "units" at farm headgates, along the lines of the more contemporary Colorado-Big Thompson federal reclamation project. Such project shares would not be strictly based on the individual parcels specified in the original water right applications or contracts, but would be readily transferable from parcel to parcel and to different types of water use, and could be "bankable" or carried over in storage from year-to-year subject to available storage space. The original, maximum water duty at the farm headgate could be split or re-allocated upon review by the Truckee-Carson Irrigation District (TCID) for beneficial water use and feasibility of delivery.

Such flexibility in water duties for project shares would enable the marketing of project water supplies that were saved by switching to less consumptive crops or by improving on-farm efficiencies. Shareholders could also reduce and shift some of their burden to pay O&M assessments by becoming more efficient and parceling out their project shares.

Project water rights could be re-structured along these lines under the so-called Alpine Decree if all owners agreed to seek the Nevada State Engineer's approval to severe their project water rights from their current parcels and duties, to pool them, and to transfer them to the project as a whole. Initial project shares could then simply be defined as the total fixed release or project supply for either the Truckee or Carson Division as determined under the reformed OCAP discussed above, less distribution system losses as is much the case with the Colorado-Big Thompson Project, divided by the total, pre-existing water righted acres in either Division, regardless of whether those acres had been actively irrigated or otherwise contested.

In either case, the litigation over bench-bottom land classifications, over the transfer of inactive water rights, and over the abandonment, forfeiture, and lack of perfection of such rights would be dismissed. If project water rights are re-structured into shares, there would be no need to adjust the project's O&M base.

Wetlands Drainwater Rights

The "drainwater" rights for the Wetlands would be simultaneously re-structured (also by seeking the approval of the Nevada State Engineer to change the nature of these water rights pursuant to the

Alpine Decree). The existing drainwater rights for the Stillwater National Wildlife Management Area, jointly held by the U.S. Fish and Wildlife Service (FWS) and the Nevada Department of Wildlife (NDOW), and for the Carson Lake Pasture, held by TCID, do not imply any right to order the delivery of project water or to maintain any level of tailwater, return or drain water flows, or spills into the Wetlands. These Wetlands water rights are essentially at the mercy of all upstream transfers of project water rights, of improvements in the efficiency of the distribution system or in project operations, and of improvements in on-farm efficiencies.

To protect a base of inflows to the Wetlands, while enabling a freer marketing of project shares, the drainwater rights for the Wetlands would be re-structured to provide for a much greater maintenance of all inflows associated with the reformed OCAP discussed above. The only exceptions to the maintenance of such inflows under these re-structured drainwater rights might be the measures discussed below to recoup past illegal diversions from the Truckee River or improvements in the efficiency of the initial on-farm application of project water. The pump-back or re-use of tail or drain water from initial farm applications would not be excepted.

Security of O&M Revenue

The FWS is bound to make O&M payments on all project water rights purchased for the Stillwater Refuge under the long-term agreement with TCID, subject to the retirement of inactive water rights or the re-structuring of all project water rights. TCID would enter a similar agreement with the NDOW or would rely on mandatory payments in lieu of taxes on water rights transferred to Carson Lake, and would also enter such an agreement with the FWS for any project rights transferred to Pyramid Lake. Given their sovereignty, a similar agreement would be negotiated with the Fallon Tribes.

Some or all of these O&M payments on water rights acquired for the Stillwater Refuge, Carson Lake, or Pyramid Lake could be made out of the Fish and Wildlife Fund which collects the payments in excess of the O&M costs at Stampede Reservoir to be made by Sierra Pacific for the use of such federal storage space under the Truckee River Operating Agreement, and such "appropriate" payments for federal storage space could be set with these revenue needs in mind.

TCID would not protest water rights transfers to the Wetlands or Pyramid Lake based on the security of O&M payments.

Purchase of Truckee Division Water Rights for Pyramid Lake

The dependence of the Newlands Project on Truckee River diversions would be further decreased by targeting a large block of irrigation water rights in the Truckee Division for purchase.

These purchased Truckee Division water rights either would be transferred directly to Pyramid Lake, or the associated reduction in Truckee River diversions would be banked in upper Truckee reservoirs as convertible storage credits for cui-ui spawning flows, for improvement of Truckee River instream flows, Pyramid Lake levels, or water quality, or for urban drought supply. The purchased Truckee Division water rights could also simply not be exercised. The cost of purchase would be shared among federal and non-federal interests according to such benefits.

Operational Decoupling of the Truckee and Carson River Basins

These two basins would be operationally decoupled by combining the purchase of a large block of Truckee Division water rights with the further modification of Lahontan Reservoir storage targets to put the Truckee Canal on a kind of stand-by or on-demand operation, and with the further reduction of deliveries in the Carson Division, as explained below. This modification of storage targets and reduction in project deliveries would go significantly beyond the reformed OCAP discussed above.

Except for critically dry years, such modification of the storage targets for Lahontan Reservoir would effectively curtail diversions from the Truckee River to Lahontan Reservoir during cui-ui staging and spawning months (January through June), but would allow for late season diversions when needed to meet allowable Carson Division demands or end-of-year carryover objectives.

This further reduction in Carson Division deliveries would be mostly achieved through the storing (banking) Truckee River diversions in upper Truckee reservoirs, rather than Lahontan Reservoir, for later delivery on demand to farmers, municipalities, or federal agencies in the Carson Division and through the off-project lease of a set amount of private headgate entitlements to supply municipal demands in the Truckee Meadows and to improve water quality and instream flows in the Truckee River. In some years an increase in the risk of project-wide shortages could also be necessary.

Substantial savings in Truckee Canal losses and in evaporation from Lahontan Reservoir should be realized.

Reciprocating Water Use Between Pyramid Lake and the Wetlands

Water savings at the Fallon Naval Air Station could be transferred to the Wetlands, subject to an agreement to interrupt those deliveries and to decrease associated Truckee River diversions whenever required by pre-specified rules for restoring the Pyramid Lake/Lower Truckee River ecosystem, although such reciprocating water use might be put into effect only in the interim before interstate apportionments are developed and deplete the Truckee River pursuant to the 1990 Settlement Act. A similar but long term agreement could be entered under which a block of project water rights would be transferred to the Wetlands at maximum headgate entitlements but then interrupted when the associated reduction in Truckee River diversions would better serve the restoration of the Pyramid Lake/Lower Truckee River ecosystem.

Such a reciprocating water use agreement could also be based on project shares that were transferred to the Wetlands rather than the difference between reduced and maximum headgate entitlement transfers. The operational decoupling of the Truckee and Carson rivers by substantially modifying Lahontan Reservoir storage targets to go significantly beyond the reformed OCAP first discussed above and to put the Truckee Canal on stand-by, however, could result in much the same kind of reciprocation between water rights transferred to the Wetlands and the Pyramid Lake ecosystem without such agreements.

Upstream Leasing of Private Headgate Entitlements

Along with any block of space in upper Truckee reservoirs allocated for credit storage of the reduced Truckee River diversions associated with individual water rights purchased in the Truckee Division to

benefit Pyramid Lake, another block would be allocated for the credit storage of the Truckee River share of headgate delivery entitlements still within the Carson Division (which could still be delivered on demand from upper Truckee reservoirs), for the credit storage of the Truckee River share of headgate entitlements leased off the project, and for the credit storage of the reduced Truckee River diversions associated with the operational savings accruing from the second and more substantial modification of the storage targets for Lahontan Reservoir. The amount and mix of these storage credits would be limited by the size, availability, and allocation of this block of upper Truckee storage space.

The return flows from Carson Division headgate entitlements leased off-project, distribution systems losses below Lahontan Reservoir, and all Carson River contributions to any headgate entitlements so leased would be banked at Lahontan Reservoir for delivery to the Wetlands, which would also help offset hydropower losses at Lahontan Dam due to upstream leasing.

Appropriate payments for the upstream storage of Carson Division headgate entitlements leased off the project would be negotiated, along with the recoupment surcharges on headgate entitlements discussed below, O&M payments to TCID, and any additional payments to mitigate hydropower losses at Lahontan Dam.

Recoupment

A percentage of the storage credits for the Truckee River share of headgate entitlements still within the Carson Division and for the off-project lease of the Truckee River share of such entitlements would be automatically converted only to fishery credits for the benefit of Pyramid Lake until the past unlawful diversions from the Truckee were recouped. The balance of the reductions in Truckee River diversions from effectively operating the Truckee Canal on stand-by (including those based on the reduction in Truckee Canal losses or in Lahontan Reservoir evaporation) would be banked in upper Truckee reservoirs as credits that were convertible between Pyramid Lake, municipal users in the Truckee Meadows, and Newlands Project releases for irrigation and the Wetlands. But all such storage credits would be converted only to fishery credits for Pyramid Lake until the past unlawful diversions from the Truckee River were recouped.

Any reduction in Truckee River diversions from operational savings that were not banked in upper Truckee Reservoirs would contribute to recoupment by accruing to the water rights to be granted to the Pyramid Lake Tribe for the direct maintenance of Truckee River instream flows and Pyramid Lake levels. Any increase in average project-wide shortages due the modification of Lahontan Reservoir storage targets to put the Truckee Canal on stand-by would be recognized as a consequence of recoupment.

Past unlawful diversions could also be recouped through improvements in distribution system efficiencies below Lahontan Dam that enabled reductions in project releases from Lahontan Reservoir and the Truckee Canal below those fixed by the reformed OCAP first discussed above, and through savings realized by surcharging the tail blocks of headgate deliveries. Off project leases would be surcharged based on the original, maximum headgate entitlement.

While individual headgate entitlements would be financially surcharged and a percentage of any such entitlements that were banked in upper Truckee River reservoirs would be automatically converted to fishery credits until recoupment was complete, these individually owned project water rights would not

be substantially discounted across-the-board to provide recoupment. All recoupment claims would be dropped.

Post-recoupment

After recoupment, the storage credits in upper Truckee reservoirs based on the reduced Truckee River diversions after operational decoupling, but not attributable to headgate entitlements still within the Carson Division or to leasing of private headgate entitlements off-project, would be leased by the U.S. Bureau of Reclamation to supplement supplies for the Truckee Meadows, Pyramid Lake, the Wetlands, and other Newlands Project water users.

Other post-recoupment savings--e.g., distribution efficiencies which enable a reduction of the project releases fixed under reformed OCAP and on-farm efficiencies encouraged by surcharges on the tail blocks of headgate deliveries or on maximum headgate entitlements leased off-project--would be banked at Lahontan Reservoir and managed by the Lahontan Valley Restoration Trust, discussed below.

Restoration of the Lower Truckee River

All of the preceding operational reforms, water rights purchases, and agreements would be paralleled by the aggressive restoration of lower Truckee River riparian and instream habitats, and none would be delayed pending the exact quantification of the very substantial benefits of such restoration.

The flow regimes for restoring this riparian ecosystem would be evaluated and integrated with those needed for cui-ui recovery. The management of convertible storage credits in upper Truckee reservoirs would then be based on these integrated instream flow regimes. The feasibility of also integrating instream flows for recovery of the Lahontan cutthroat trout would be assessed.

Fish passage over the Truckee River delta at low Pyramid Lake levels, over Marble Bluff Dam, over Numana Dam, and over Derby Dam would be reviewed and improved.

Water Rights for Lahontan Valley Wetlands

The Wetlands would be sustained through a combination of:

► assured minimum annual and seasonal inflows of good quality water that varied from wet to dry years based on the re-structured drainwater rights and on the in-fee purchase of active water rights or project shares for direct deliveries in the Carson Division or on the purchase of active water rights or storage supplies on the upper Carson River, and

► leased or interruptible supplies from within the Lahontan Valley, as well as reciprocating inter-basin water uses with Pyramid Lake and the Truckee Meadows.

A cap on in-fee purchases in the Carson Division and the rate at which such purchases occurred would be negotiated considering the socio-economic implications of such purchases for the Lahontan Valley and of all other water supplies that can be secured for the Wetlands including leased and reciprocating

water supplies and the in-fee purchase of active water rights or storage supplies on the Carson River above Lahontan Reservoir.

Because the in-fee purchases in the Carson Division would be capped, the assured deliveries based on such purchases would be insulated from some shortages in project-wide supplies. In dry years, such insulation would apply to lower assured minimum inflows.

The in-fee purchase of Newlands Project water rights for the Wetlands would be directed to the periphery of the water project using locally developed criteria aimed at retiring the least productive lands, increasing the efficiency of the irrigation project, and improving drainwater quality. This rating system could be applied in the marketplace through a kind of reverse auction.

The development of the land permanently retired from irrigation by such peripheral water rights purchases and left in private ownership would be addressed by local planning and zoning. Such private lands fallowed on the periphery of the project could be exchanged for public lands elsewhere that could be developed into locally preferred land uses.

A land exchange bank could also complement water rights purchases in core areas where continued agricultural production was locally preferred. Farmers could then trade into these lands and transfer other project water rights back onto them.

Lahontan Valley Restoration Trust

The leased or interruptible intra-basin water supplies for the Wetlands would be managed by a locally based Restoration Trust whose tool chest would include the acquisition and exercise of short and long-term leases, and drought year options; intra-basin water banking at Lahontan Reservoir; and in-fee acquisitions in excess of the cap.

The Trust would be guided by a set of water delivery and quality schedules which considered all sources of supply and varied from wet to dry years.

The Trust could be annually funded from a variety of sources, including:

► a portion of the payments for federal storage space allocated in the upper Truckee reservoirs for the credit storage of headgate entitlements leased off the project,

► surcharges on the tail blocks of private headgate entitlements both within the Newlands Project or leased off-project at least until past illegal Truckee River diversions are recouped (the surcharge on private water delivery entitlements could be matched by annual federal appropriations to the Trust that were equivalent to recoupment surcharges on direct deliveries to the Wetlands),

► a portion of the post-recoupment revenues from the leasing of federally controlled storage credits in upper Truckee reservoirs (these credits would include those based on reduced Truckee Canal losses and Lahontan Reservoir evaporation from operational decoupling),

► surcharges on all project diversions from the Truckee River,

► some recapture of any increased hydropower revenues from the adjustment of the ownership/priority

of hydropower resources at Lahontan Dam or from other federal facilities on the upper Truckee,

► surcharges on existing upstream hydropower production.

The Trust could also be modestly endowed through private fundraising.

Conservation of Lands Retired from Irrigation

The demonstration projects by the Navy and the Soil Conservation Service (SCS) would be broadened, but completed on schedule. The recommended techniques would be funded and applied by the SCS in cooperation with private parties and the Nevada Division of State Lands to all undeveloped Newlands Project lands that had been permanently retired from irrigation by water rights transfers. The re-structuring of project shares discussed above would enable the marketplace allocation and rotation of direct deliveries at fractions of the original maximum, headgate entitlements for transitional irrigation to help establish native ground cover on retired lands.

Ultimately, the Lahontan Valley Restoration Trust could be funded to be responsible for the conservation of all farmland retired to serve the Wetlands or off-project water demands.

Water Management for Fallon Tribal Lands

Water deliveries to Fallon tribal lands in compliance with the limit set by the 1990 Settlement Act would be insulated to some degree from shortages in project wide supplies. Because this cap is already in place, it would not be necessary to retire inactive water rights on the reservation through discounted purchase. But any re-structuring of the tribal water rights into project shares would be based on this cap.

Tribal members would also be authorized to lease headgate entitlements off the project or to bank them at Lahontan Reservoir to the same extent as all other Carson Division farmers.

The TJ Drain would be closed or modified in accordance with the 1990 Settlement Act, but the outflows from any modified drain would be disposed of concurrently with the drain modifications and not in subsequent phases. Prime farmland outside the reservation that was retired by water right transfers for the Wetlands or Pyramid Lake would be offered at no cost to Fallon tribal members who wished to transfer active water rights or project shares served by the TJ Drain onto such land and to put it back into agricultural production.

The purchase of water rights for wetlands on Fallon tribal lands would be undertaken by the FWS commensurately with the water purchase and management program for all other Lahontan Valley Wetlands.

The Fallon Tribes would be invited to assume TCID's operation and maintenance responsibilities within the reservation.

Domestic Water Supplies for Fernley and Fallon Areas/Re-design of Delivery Systems

The federal study of domestic water supply systems for the Fernley and Fallon areas would begin immediately and would not be driven solely by the impacts of water rights purchases for the Wetlands or Pyramid Lake.

Federal funding for the purchase of Newlands Project or other water rights for these domestic systems and for their construction would be tied to full settlement of both inter-basin and intra-basin water allocation issues, and to the demands placed on such systems by the Fallon Naval Air Station or by the construction and operation of a new federal prison.

The design and construction of the water delivery system for the three primary wetland units (the Stillwater Refuge, the Fallon tribal wetlands and Carson Lake) would accommodate both base and variable water supplies, allow the rotation of water among these three wetland units, and be integrated with a water management agreement with the Canvasback Club.

The routing of some wetlands deliveries through the lower Carson River would be investigated in combination with opportunities for restoring riparian habitat and flood control along this channel, and for recharging the "basalt aquifer" pumped by the Navy, the City of Fallon, and the Fallon Tribes.

In conjunction with the design and construction of these domestic and wetlands water supply systems, the whole irrigation distribution system would be reviewed and perhaps be re-configured to best serve the core agricultural areas that will remain in production.

Wetlands Boundary Adjustments/Interim and Permanent Management of Carson Lake

A systematic inventory, classification, and representativeness analysis of all wetlands in the Lahontan Valley would be completed prior to adjusting the boundaries of the Stillwater National Wildlife Refuge in 1997. Where habitat functions can be assured, wetlands sites in addition to the three primary units would be considered for restoration and protection.

Until Nevada is indemnified against Superfund liability or Carson Lake is added to the Stillwater Refuge in a boundary adjustment, these wetlands would be managed under an amendment to the 1948 Tri-Party Agreement.

Nevada would continue to purchase water rights for these wetlands and would manage these water rights cooperatively with the FWS.

When Nevada is indemnified against Superfund liability, an O&M agreement is reached with TCID for project water rights transferred to Carson Lake, "appropriate" payments for the use of Stampede Reservoir by Sierra Pacific or an equivalent source of revenue is available to defray the O&M assessments on such transferred water rights, and a water management plan for this marsh is developed, Nevada would take ownership subject to the reverter clauses required by the 1990 Settlement Act and accept permanent responsibility for Carson Lake.

University of Nevada Cooperative Extension

Alfalfa Production Costs for the Fallon, Nevada Area

Gene Wheeler, Area Extension Specialist
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Data were gathered from a panel of local alfalfa producers in February 1990. Data represent the typical costs and returns associated with 320 acres of alfalfa using flood irrigation.

Table 1 provides a summary of the per acre cost of alfalfa and income estimates. Since income and cost data represent a typical situation and will vary from farm to farm, space is provided so information can be changed to meet specific situations. The table is divided into variable and fixed costs. Variable costs are those that can be varied with the level of production. They include fuel, repair, custom/material, and labor costs. Fixed costs are those that must be paid even if no production occurs. "Land cost," an opportunity cost of keeping capital invested in land, is a fixed cost. It is assumed that the land has a market value of $2,200 per acre and the landowner receives a three percent return.

Table 2 lists the breakdown of costs by cultural practices. The columns under "hours/acre" represent hours of machine and labor time required to perform the operation on one acre. The columns under "power unit costs" represent costs per acre for the power unit. For example, for the baling operation the "power unit" costs would be for the 130 HP tractor, while the "implement costs" would be for the baler. The column "custom/material" lists the cost of special materials (e.g., chemicals) and/or custom costs.

Table 3 provides a breakdown of costs by cultural practices for the establishment of an alfalfa stand.

Table 4 lists machinery costs, estimated hours of annual use, hours of life, and percent of purchase cost that total repairs are estimated to be over the life of the item. These values will vary significantly from one farm to another and should be adjusted for specific situations.

The columns "power unit costs" and "implement costs" in Tables 2 and 3 are broken down into fixed, fuel, and repair costs.

The following formulas are used to calculate these costs. Note that values from the cost formulas are on an hourly basis and must be multiplied by hours per acre to determine costs per acre.

Fixed Cost Columns

1. Depreciation
   (purchase cost - salvage value) ÷ hours of life = cost/hour
   NOTE: Salvage value is estimated at 10% of purchase cost.

2. Interest
   $\frac{(\text{Purchase cost} + \text{salvage value})}{2} \times 12\% \div \text{annual hours of use}$
   = cost/hour

3. Taxes

$\frac{\text{(purchase cost)}}{2} \times 35\% \times 2.5\% \div$ annual hours of use = cost/hour

4. Insurance

$\frac{\text{(purchase cost)}}{2} \times .6\% \div$ annual hours of use = cost per hour

5. Housing

$\frac{\text{(purchase cost)}}{2} \times 1\% \div$ annual hours of use = cost per hour

Fuel Cost Column

$\frac{\text{(drawbar horse power x .65)}}{11.2} \times$ price per gallon x 1.15 = cost/hour

Diesel price per gallon = $1.00

Repair Columns

(purchase cost times % of purchase cost total repairs are for the life of item) divided by total hours of life = cost per hour.

TABLE 1. SUMMARY OF ALFALFA PRODUCTION COSTS AND INCOME ESTIMATES BASED ON 320 ACRES.

GUIDELINE VALUES	($/AC.)
1. INCOME	
6.5 TONS AT $90.00/TON	$585.00
2. VARIABLE COSTS	
1. HARROW	.79
2. IRRIGATION 8X	20.88
3. SWATH 4X	19.74
4. BALE 4X	75.76
5. HAUL & STACK 4X	20.65
6. RAKE	1.83
7. LABOR	42.84
8. RODENT CONTROL	2.00
9. DITCH MAINTENANCE	3.00
10. GENERAL OVERHEAD (5% OF VARIABLE COSTS)	9.37
11. TOTAL VARIABLE COSTS	$196.87
3. FIXED COSTS	
12. INTEREST ON CAPITAL	38.96
13. DEPRECIATION	44.59
14. TAXES ON LAND	4.06
15. INS., TAXES, STORAGE ON MACHINERY	7.44
16. AMMORTIZED EST. COST (12% FOR 6 YEARS)	35.80
17. LAND COST	66.00
18. TOTAL FIXED	$196.86
19. TOTAL COSTS	$393.73
20. RETURN OVER VARIALBE COST	$388.13
21. RETURN OVER TOTAL COSTS	$191.27

LE 2: ALFALFA HAY PRODUCTION COSTS ON A PER ACRE BASIS BASED ON 320 ACRES

TH	OPERATION	DESCRIPTION	MATERIAL DESCRIPTION	HRS./ACRE MACHINE	HRS./ACRE LABOR	POWER UNIT COSTS FIXED	POWER UNIT COSTS FUEL	POWER UNIT COSTS REPAIR	IMPLEMENT COST FIXED	IMPLEMENT COST REPAIR	CUSTOM/ MATERIAL	LABOR COST	TOTAL COST
CH	HARROW	75 HP TRACTOR CHAIN HARROW		0.10	0.12	0.51	.50	0.25	0.20	0.04		1.02	2.[illegible]
.I	RRIGATE	FLOOD	5.25 INCHES		0.25						2.61	2.13	4.74
	IRRIGATE	FLOOD	5.25 INCHES		0.25						2.61	2.13	4.74
E	SWATH	16 FT. SP SWATHER		0.20	0.22	5.59	1.33	3.60				1.87	12.40
E	BALE	130 HP TRACTOR 3 WIRE BALER	2.2 TONS/AC. WIRE $32.50 FOR 15 TN	0.25	0.27	3.34	3.25	1.83	5.13	3.50	14.30	2.30	33.45
:	HAUL & STACK	BALE WAGON		0.18	0.20	7.75	1.58	3.60				1.70	14.62
:	IRRIGATE	FLOOD	5.25 INCHES		0.25						2.61	2.13	4.74
	IRRIGATE	FLOOD	5.25 INCHES		0.25						2.61	2.13	4.74
	SWATH	16 FT. SP SWATHER		0.20	0.22	5.59	1.33	3.60				1.87	12.40
	BALE	130 HP TRACTOR 3 WIRE BALER	1.8 TONS/AC. WIRE $32.50 FOR 15 TN	0.25	0.27	3.34	3.25	1.83	5.13	3.50	11.70	2.30	30.85
	HAUL & STACK	BALE WAGON		0.18	0.20	7.75	1.56	3.60				1.70	14.62
	RRIGATE	FLOOD	5.25 INCHES		0.25						2.61	2.13	4.74
	.RRIGATE	FLOOD	5.25 INCHES		0.25						2.61	2.13	4.74
T	SWATH	16 FT. SP SWATHER		0.20	0.22	5.59	1.33	3.60				1.87	12.40
T	BALE	130 HP TRACTOR 3 WIRE BALER	1.5 TONS/AC. WIRE $32.50 FOR 15 TN	0.25	0.27	3.34	3.25	1.83	5.13	3.50	9.75	2.30	28.90
T	HAUL & STACK	BALE WAGON		0.18	0.20	7.75	1.58	3.60				1.70	14.62
T	IRRIGATE	FLOOD	5.25 INCHES		0.25						2.61	2.13	4.74
	IRRIGATE	FLOOD	5.25 INCHES		0.25						2.61	2.13	4.74
	SWATH	16 FT. SP SWATHER		0.20	0.22	5.59	1.33	3.60				1.87	12.40
R	RAKE	75 HP TRACTOR 2 SIDE DELIVERY RAKE		0.14	0.16	0.72	0.70	0.35	2.28	0.78		1.36	6.19
R	BALE	130 HP TRACTOR 3 WIRE BALER	1 TON/AC. WIRE $32.50 FOR 15 TN	0.25	0.27	3.34	3.25	1.83	5.13	3.50	6.50	2.30	25.85
R	HAUL & STACK	BALE WAGON		0.18	0.20	7.75	1.56	3.60				1.70	14.62
[redacted]						67.98	25.80	35.90	23.01	14.82	63.13	42.64	273.49

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3: ALFALFA HAY ESTABLISHMENT COSTS

OPERATION	DESCRIPTION	MATERIAL DESCRIPTION	HRS./ACRE MACHINE	HRS./ACRE LABOR	POWER UNIT COSTS FIXED	POWER UNIT COSTS FUEL	POWER UNIT COSTS REPAIR	IMPLEMENT COST FIXED	IMPLEMENT COST REPAIR	CUSTOM/ MATERIAL	LABOR COST	TOTAL COST
RIP	130 HP TRACTOR 7 BOTTOM RIPPER		0.33	0.35	4.41	2.88	2.15.	5.77	1.19		2.98	19.35
DISC	130 HP TRACTOR 12 FT. OFFSET		0.17	0.19	2.27	1.47	1.11	3.33	0.82		1.62	10.61
FLOAT	130 HP TRACTOR 12 FT. SCRAPPER		0.05	0.07	0.67	0.43	0.33	0.30	0.07		0.60	2.40
LAZER	CUSTOM $50.00/AC.									50.00		50.00
BORDER	75 HP TRACTOR BORDER DISC		0.05	0.07	0.26	0.25	0.13	0.15	0.04		0.60	1.42
IRRIGATE	5 INCHES			0.25						2.61	2.13	4.74
FERTILIZE	75 HP TRACTOR BROADCAST	100 LBS. OF 12-15-15 WITH SULFUR AT $15/AC	0.17	0.19	0.67	0.84	0.43	2.79	1.19	15.00	1.62	22.74
PLANT	75 HP TRACTOR 12 FT. DRILL	22 LBS. OF SEED AT $55.00/AC.	0.33	0.35	1.70	1.65	0.83	5.13	1.08	55.00	2.98	68.33
IRRIGATE	5 INCHES			0.25						2.61	2.13	4.74
COSTS					10.18	7.52	4.95	17.47	4.38	125.22	14.62	184.32

LE 4. MACHINERY INFORMATION.

IPMENT	PURCHASE COST	HOURS OF ANNUAL USE	HOURS OF LIFE	% REPAIRS AS PORTION OF PURCHASE COST
IRE BALER	$35,000	350	2,500	1.0
FT. OFFSET DISC	10,000	50	2,500	1.2
HANK RIPPER	4,500	50	2,500	1.0
HP TRACTOR	65,000	600	12,000	1.2
HP TRACTOR	25,000	600	12,000	1.2
FT. SWATHER	45,000	300	2,500	1.0
IDE DELIVERY RAKES	14,000	100	150	1.0
8 NH HAROBED	80,000	250	4,000	1.0
ADCAST	7,000	50	2,500	1.2
IN HARROW	1,000	50	2,500	1.0
FT. SCRAPPER	3,000	50	2,500	1.0
DER DISC	1,500	50	2,500	1.0