IRRIGATION WATER SALVAGE ISSUES IN THE GRAND VALLEY OF COLORADO

A Supplement to: An Analysis of Water Salvage Issues in Colorado

Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

Adopted and Approved for Transmittal to the Colorado General Assembly on January 22, 1992

I. Introduction:

The Water Conservation Act of 1991, HB 91-1154, contained a provision directing the Colorado Water Conservation Board (Board) to "conduct an analysis of water salvage which may result from federal programs, including salinity control ...." Section 37-60-106.5, C.R.S. During discussions of that analysis the Board recognized that the General Assembly's interest in water salvage arose, at least in part, from a complex water supply situation in the Grand Valley reach of the Colorado River near Grand Junction, Colorado. Representative Foster's bill, HB 91-1110, sought to address one aspect of this situation - "saved" water resulting from improved irrigation efficiency. The Board directed that this situation be examined specifically, separate and apart from a more comprehensive, or "global" analysis of water salvage and conservation on a statewide basis. This report addresses the Grand Valley issues.

II. Overview of Grand Valley Water Issues

Several very senior water rights diverting from the Colorado River several miles above its confluence with the Gunnison River near Grand Junction effectively "control" water use in the basin. Collectively these rights are known as the "Cameo Call". There are no significant diversions in Colorado downstream of these rights. Due to the seniority of these rights the users in the Grand Valley normally receive a full supply of water, sufficient for all their needs. The Cameo Call consists of water rights decreed for a total of 2,374 cfs with priority dates between 1882 and 1918, however due to size limits in various structures a maximum of 2,260 cfs can be diverted at any one time. A list of these rights and a map showing the location of major features in the Grand Valley is attached as Table 1 and Figure 1.

Except for a 400 cfs hydropower right and 270 cfs used for pumping irrigation water at Orchard Mesa the remainder (1,700 cfs) of these rights are used for irrigation. Rights of 1,730 cfs are diverted at a common point, the Grand Valley Diversion Dam, and delivered in an extensive interconnected system of canals, known as the Grand Valley Project, built with federal reclamation assistance. The remaining 640 cfs, including the most senior 520 cfs, is diverted by the Grand Valley Irrigation Company (GVIC) at a separate diversion dam, 8 miles downstream, near the town of Palisade. GVIC is a privately built and operated system with approximately 3,000 shareholders. The Orchard Mesa "Check" allows delivery of a portion of the Grand Valley Project diversions into the GVIC system.

The bedrock and soils of the Grand Valley are of marine origin and contain high amounts of salt. When irrigated these salts leach out of the soil and bedrock, creating saline return flows to the Colorado, making the Grand Valley a large contributor of salt to the river. In the early 1970s the seven Colorado River Basin states and the United States recognized that salinity of the Colorado River was a major water quality problem. In

response to this, the Congress passed the Colorado River Basin Salinity Control Act (1974) and the states formed the Seven Basin States Salinity Control Forum. The purpose of the Act and the Forum was to reduce the amount of salt entering the river from irrigation and other uses and thereby improve the water quality. One of the initial salinity projects authorized by the Act was the Grand Valley Unit which is currently being implemented.

The salinity program aims to reduce salt loading by reducing saline return flows through improved irrigation systems. These improvements are capable of reducing consumptive use and also irrigation diversions while historical irrigated acreage remains constant and crop yields improve. Improvements consist of canal and lateral lining or piping and on-farm practices which will reduce irrigation diversion requirements. A by-product of these improved systems is "salvaged" and "saved" water. These two terms are defined as follows:

"salvaged" water: the difference between historical consumptive use and consumptive use occurring in a more efficient system.

"saved" water: the amount of water no longer needed for diversion at the headgate because of system modernization.

Within the last decade, several species of fish native to the Colorado River Basin have been listed as endangered under the Endangered Species Act by the U.S. Fish and Wildlife Service (FWS). Two of these, the Colorado Squawfish and Razorback Sucker, are found between Cameo and the Colorado Utah stateline. Recovery efforts for the endangered fish species have focused on preserving a segment of this habitat, "the 15-Mile Reach", found between the GVIC diversion dam near Palisade, Colorado and the Gunnison River confluence. The recovery program goal is to provide sufficient instream flows through this reach to meet the habitat needs of the endangered fish. The FWS has determined that present flow levels in the reach are not adequate and is leading an effort to find new sources of water to augment existing flows.

III. The Federal Salinity Control Program

The Federal Salinity Control program was developed as a cooperative effort of state and federal agencies to manage salt concentrations in the Colorado River, which were of concern because of delivery obligations to Mexico, and also because high salinity levels could interfere with beneficial uses of water in the basin states. The program was established by the Salinity Control Act of 1974 and 1984 amendments, 43 U.S.C. Sections 1571-1599. The primary federal salinity activities with regard to irrigation are improved delivery systems installed by the U.S. Bureau of Reclamation (USBR) and improved on-farm irrigation systems installed by the Soil Conservation Service (SCS). Participation in either of these programs is entirely voluntary. In general USBR is lining large canals and ditches, while SCS is helping farmers to better manage and deliver water on-farm with sprinkler systems and piped or lined laterals. Both programs aim at reducing salt load into

the Colorado River by reducing the deep percolation which causes highly saline return flows in areas like the Grand Valley. The program is also active in the Uncompahgre Valley of the Gunnison Basin, and the McElmo Creek area near Cortez, Colorado.

USBR salinity improvements are federally funded in recognition that the Mexican delivery is a nationwide, rather than a basin specific, obligation and because of the vast land holdings of the U.S. in the basin. A 25% repayment on USBR salinity project construction costs is made to the federal treasury from the Lower Colorado and the Upper Colorado River Basin Funds. Local project participants pay no share of USBR project costs. While they ar quired to sign contracts obligating themselves to maintain and operate the newly improv systems, USBR fully reimburses participants for any additional maintenance expens s caused by those new systems. The SCS program requires both cost sharing by individual project participants and repayment from the same Basin Funds used to repay the USBR. Ultimately, the SCS on-farm measures are paid for in the following proportion: 30% by individual participants, 21% from the Basin Funds, and 49% by the U.S. There is no requirement tying participation in the USBR program with participation in the SCS program. Therefore, a farmer could benefit from an improved ditch without committing to expend any funds or making any on-farm changes.

Construction of salinity control features in the Grand Valley has been underway since 1980 when a 6.8 mile segment of the Government Highline Canal near Mack, Colorado was concrete lined as a demonstration project, Grand Valley Unit Stage I. Using salinity data and design information gained in Stage I a comprehensive program to remove 139,500 tons per year of salt from the Colorado River was proposed as Grand Valley Unit Stage II. Portions of Stage II are currently being constructed, other portions are being designed, and some have been deferred or eliminated as new cost estimates indicate they are no longer cost effective. As currently configured Stage II will remove approximately 108,000 tons per year of salt load from the Colorado River when fully implemented. As of early 1990 Stage I had already reduced salt load by 21,900 tons per year and the completed portion of Stage II reduced the load by another 26,000 tons per year.

Segments of the GVIC system involving approximately 217 miles of earthen laterals to be replaced with gravity pressure pipe were included in the Stage II plan. The improved GVIC segments were estimated to reduce saline seepage return flows to the Colorado River by 6,500 AF per year. This volume of seepage reduction was at the core of efforts to enact HB 91-11 with several GVIC water users strenuously promoting their right to retain and sell any o this water not needed for diversion as "saved" water. As of July, 1991 this seepage reduction will not occur, since GVIC shareholders voted not to participate in the Salinity Program, and this particular increment of "saved water" will not materialize.

The federal Salinity Act creates no claim to any saved or salvaged water produced through the program. The fate of this water, if any, is specifically left for allocation under state law. The Salinity Control Act states that "in implementing the units ... the Secretary shall comply with procedural and substantive state water laws," 43 USC Section 1592(b)(4),

(1984 Amendment). Reinforcing the Salinity Program's general deference to state water law is detailed language in various contracts and documents pertaining to the Grand Valley Unit wherein the United States disclaimed any right to the salvaged or saved water, leaving the allocation of any such water to be decided under state law. "Nothing in this contract shall be construed to alter, amend, modify, or conflict with the right of the Association to make use of all water adjudicated for use within the Gravity Division in a manner consistent with the laws and constitution of the State of Colorado; provided, however, that any water saved by the rehabilitation and operation of project facilities may be applied only to those lands within the Gravity Division which are classified as irrigable...in a manner which shall not result in any material increase of salinity inflow to the Colorado River." Grand Valley Water Users Association-USBR Contract for Rehabilitation, Operation, and Maintenance of Distribution Facilities, April 10, 1986. "The Districts have agreed not to use this saved water [an estimated 1,760 AF per year from reduced seepage] in a manner which would materially increase the salinity contribution to the Colorado River. Beyond that requirement, the (sic) Reclamation and the salinity program defer to Colorado State water law to determine the destiny of the salvaged water." Price-Stub Ditch Improvements, Draft Environmental Assessment, June 1990, page 16.

Participants in the program agree not to use the improved systems or saved water in any way that would cause additional salt loading to the river. This agreement effectively prevents participants from using "saved water" to add new irrigated acres under an improved ditch system. Colorado water law similarly would prevent use of an existing decreed right on new irrigated acres as an expanded use.

Environmental impacts caused by improved irrigation systems must be mitigated to some degree. The USBR is required to provide replacement of wetland and wildlife habitat to offset the losses to these values caused by the improved conveyances it is constructing. Participants in the SCS program are encouraged to participate in a voluntary program to replace wetland and wildlife habitat lost as a result of the program.

IV. Availability of Salvage or Saved Water in the Grand Valley

The Bureau and the SCS have been analyzing salt loading and water use in the Grand Valley since the early 1970's. Hydrosalinity models analyze water use and salt movement by measuring and projecting water flows and salt concentrations at various gages in the Grand Valley. The model is based on a mass balance approach that tracks all water and salt inflows into the valley, accounts for water use in the valley, and checks against known outflows. The Bureau and SCS then formulate and design project features to reduce saline return flows in the most effective manner by targeting those areas that produce the highest salt load. These plans have been developed in phases, and refined based on experience and data gained from earlier phases. Table 2 summarizes the current components of Stage II of the Grand Valley Salinity Control Unit.

The abatement of saline return flows is accomplished by reducing irrigation system conveyance losses and on-farm losses. While the salinity control program is aimed at reducing the seepage that causes return flows, it also reduces the "non-productive" or "incidental" consumptive use that occurs during irrigation. The incidental consumptive use of water involves permanent, but unintentional, loss of water from the basin by evaporation from exposed water surfaces and evapotranspiration by noncrop vegetation. These incidental losses are reduced by combining ditches, replacing open ditches with pipe, eliminating standing water, drying up water logged soils, and reducing wetland acreage. Based on climate data for the Grand Valley it is estimated that every mile of 2-foot wide lateral placed in pipe reduces evaporation losses by 1 AF per year. Every acre of wetland lost will yield approximately 2 AF per year of reduced incidental consumptive use. Data in the 1986 Grand Valley Stage II verification memorandum indicate that at full build-out Stage II would line or pipe 325 miles of canals or laterals and reduce wetland acreage by 300 acres. This scale of project would reduce historical incidental depletions and thereby produce 950 AF per year or less of "salvaged water" from the Grand Valley. With a construction cost of $37 million (excluding all overhead and design costs) this salvaged water would have an annual cost of approximately $3,700 per AF.

The original Stage II program proposed by the Bureau was expected to reduce total seepage losses by 42,900 AF per year, 6,500 AF of which were from the GVIC system. Nearly all this seepage historically returned to the Colorado River system within the Grand Valley. As more is learned about salinity in the Grand Valley, as construction costs increase, and as the voluntary participants opt in and out of the program, it is unlikely that all increments will remain cost effective and some will be deleted from the final implementation plan. Recent estimates indicate that the combined salinity program of USBR and SCS in the Grand Valley will reduce irrigation seepage by approximately 70,000 AF per year. As of December 1990, the USBR/SCS program in the Grand Valley had reduced irrigation seepage by approximately 27,000 AF per year. It is important to understand that these seepage reduction estimates are made for the purpose of determining salt loading, not quantifying water availability. As the hydrosalinity model data are revised, these seepage estimates may also change.

The majority of the irrigation water potentially made available through improved efficiencies was not previously lost through consumption, but returned to the Colorado River below the confluence with the Gunnison. While these return flows are not lost to the river system, they historically have not been of benefit to users in Colorado because of the proximity of the Utah state line, the adequate supply of water that exists in the Colorado River below the Gunnison River, and lack of demand below Grand Junction. Those return flows support instream uses in the Colorado River between Grand Junction and Utah. Current demands for Colorado River water, and shortfalls in supply are in the headwaters areas, and the water that eventually becomes return flow has already been called past those demands. This water called past upstream headgates does provide significant instream values between the headwaters of the Colorado and the Cameo diversions.

V. Grand Valley Project

The Grand Valley Project was built by the Bureau between 1912 and 1917 and is operated by the Grand Valley Water Users Association (GVWUA), Orchard Mesa Irrigation District (OMID), Palisade Irrigation District (PID), and the Mesa County Irrigation District (MCID). USBR retains a key role in the functioning of this project. As a federal entity USBR has its own responsibilities under the Endangered Species Act, which it is currently addressing by participation in the endangered fish recovery program. USBR has looked at ways that the Grand Valley project and other projects it is involved in can lessen impacts on critical habitat and be operated to augment flows in the "15-Mile Reach". Draft Report, July, 1990: Study of Alternative Water Supplies for Endangered Fishes in the "15-Mile Reach" of the Colorado River.

During operations studies of the Grand Valley Project, the USBR has identified several feasible measures which can reduce irrigation headgate diversions without impairing crop deliveries. USBR believes it would be possible to structurally improve the Government Highline Canal by installation of automated level control gates ("checks") so that administrative spills from the system could be reduced. Currently the canal must be kept full of water throughout its 55 mile length to provide a sufficient volume and height of water to all delivery points. When irrigation demands are less than anticipated, canal water is spilled or "wasted" back to the river. At certain times this spilled water has been called past upstream juniors. It is also not available to the reach of critical habitat between the canal headgate and the waste discharge point. USBR estimates that some 60,000 AF is spilled annually and preliminary indications are that 60% of these spills could be avoided with improved facilities and management techniques. On this basis USBR estimates 36,000 AF per year of saved water potential from operational changes in the Government Highline System. These estimates are based on a very preliminary analysis of operational changes in the system and water users do not necessarily agree with these estimates.

VI. Disposition of "Salvage" Water Produced in the Grand Valley

Water salvaged (no longer consumed) or saved (no longer diverted), if any proves to be physically available, could be allocated to various water users pursuant to the following scenarios, depending on how legal and policy issues are resolved.

Under existing state law and the Salinity Control Act there is no barrier to the original appropriator using saved or salvaged water to make up current shortfalls in their own supply, provided no additional irrigated acres are added. Despite the seniority of the Cameo call there are indications that shortfalls do exist during peak irrigation periods in the Grand Valley. This occurs despite the fact that the full decreed amount is being diverted, because that rate is not large enough to provide for all the deliveries that may be required at a particular moment. Better scheduling and rotating demands may alleviate this situation. Current information indicates that a major portion of the water previously lost to seepage may continue to be diverted to meet short term peak irrigation demands, unless ditch systems become able to better schedule and meet demands.

A second scenario for use of water available through better irrigation efficiency assumes that diversions in the Grand Valley will be reduced in some proportion to the reduced conveyance and on-farm loss. That would effectively reduce the size of the Cameo call, leaving more water available for other users to divert under existing or future appropriations. Currently the Cameo call is satisfied in part by releases from Green Mountain Reservoir and a reduction in the size of the call would allow other uses of this stored water. The reduction in Grand Valley diversions could be voluntary, recognizing that less water is needed to accomplish the same purposes, or administratively enforced by the State Engineer.

A third scenario assumes that an entitlement to the saved and/or salvaged water currently exists or is legislatively created as an attribute of the original water right. Such an entitlement conceivably could be assigned to the original appropriator or to the entity that invests in conservation measures and produces the saved water. Once a property right is assigned the saved water could be transferred or temporarily leased to any use in or out of the basin. There are two current demands which might be expected to acquire rights to this water: the U.S. Endangered Fishes Recovery Program seeking water for the "15-Mile Reach" at Grand Junction, and junior water rights upstream of the Grand Valley. A transferable salvage right might also be of interest to a revived oil shale industry located upstream of Grand Junction or to the CWCB as the basis for a senior instream flow right on the Colorado River.

A fourth scenario assumes that any return flows from the Grand Valley should remain in the reach of the Colorado River below Grand Junction. This requirement could arise from junior downstream conditional water rights claiming reliance on those return flows for a water supply. Any future CWCB instream flow right for endangered fish or other purposes would also be a downstream junior, possibly relying on Grand Valley return flows. The Colorado River and the Upper Colorado River Basin Compacts apportion the amount of Colorado River water each of the basin states can use. As a result, some water must flow out of the state of Colorado to satisfy apportionments made to downstream states. These apportionments are not unlike a downstream water right capable of calling water from upstream users. Upstream rights junior to the Compacts may argue that they relied on the availability of Grand Valley return flows to help meet downstream apportionments and that they should not be placed at risk of having their own diversions curtailed in the future for compact purposes by a change of historical return flows.

VII. Legal and Policy Issues

The same range of policy and legal issues presented in the more comprehensive Analysis of Water Salvage Issues in Colorado generally apply in the particular case of the Grand Valley.

A. Legal Issues

The main legal issues surrounding salvage and saved water in the Grand Valley involve the entitlement to claim historical diversion levels, and thus return flows, as an attribute of the original appropriation. Current law appears to fix the priority date for a plan to use return flows to the date such an intent is formed and manifested, not the date of the original appropriation. Water Supply and Storage Co. v. Curtis, 733 P.2d 680 (Colo. 1987). The availability of the "no injury" rule to upstream juniors who have not made physical use of return flows, but wish to assert reliance on those return flows will be at issue if a right to reuse or transfer saved water is recognized. The issue of reliance on return flows will be further complicated by uncertainties over how Colorado River Compact apportionments will be met and the role of return flows in meeting those apportionments.

B. Policy Issues

The prospect of finding some increment of "new" water in an over-appropriated basin raises water supply allocation policy questions, particularly where the status of that water within the priority system is unclear. If the priority system does not provide a basis for allocating this water, the courts or the General Assembly may have to allocate it on policy grounds.

The Endangered Species Act requires federal resource and permitting agencies to do everything in their power to avoid jeopardizing endangered native Colorado River fish. Those powers include review and approval of non-federal water development projects. Potential solutions to the habitat needs of endangered fish may depend upon a consensus within the water user community. Until the habitat needs are protected all future Colorado River depletions, and to some extent current depletions, are at risk, regardless of where the end use of those depletions occurs.

There are also important environmental and economic policy questions, involving protection of wetlands and fair recognition of federal taxpayer investment in local water supply projects. The environmental price for saved water may be high. In the Grand Valley the main beneficiaries of irrigation losses are wetlands and ditch and field tree borders. The seepage from the Government Highline Canal, for instance, supports a vegetated corridor through otherwise barren range and cropland, used extensively by wildlife and for local recreation. The Salinity Program will be mitigating some portion of its environmental impacts, but if a broad incentive for further irrigation efficiency is created, there may be no mechanism to prevent environmental damage from private conservation efforts. On the other hand, if municipal demands are forced to look elsewhere for water, the environmental consequences may be worse than the loss of phyreatophytes or artificial wetlands.

Some believe that since the U.S. has funded the bulk of the efficiency improvements which produce salvaged or saved water, its claims to control that water are superior to that of the original appropriators. The Salinity Act requires that the Grand Valley Unit be

designed and operated in compliance with state water law. If state law is changed or found to currently allow claims to salvaged or saved water, the federal government may make equitable or legal arguments that this water should accrue to the U.S.

Another policy raised by salvage in the Grand Valley relates to interstate compacts and whether the extent of an eventual compact call is too speculative to be factored into present day water allocation decisions. A related compact issue is the difficult question of how to use the Board's instream flow authority near statelines in a manner that will preserve important Colorado environments along the State's borders while not impairing the State's ability to fully consume compact entitlements.

VIII. Findings

Based on the foregoing analysis and the discussion undertaken by the Board with respect to broad questions of water salvage and saving, the following findings can be made:

a) Based on present knowledge of salinity control activities in the Grand Valley some unquantified amount of salvage/saved water may be available.

b) To quantify the amount that is now or may become available in the future would require detailed engineering and operation studies of the Grand Valley Project and the Grand Valley Irrigation Company.

c) Salvage/saved water from the Grand Valley Irrigation Company system is not likely to become available because GVIC shareholders voted not to participate in the salinity control program.

d) If the availability of salvage/saved water is established, the legal and policy issues affecting water management described in the report can be addressed.

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Table 1

Water Rights Comprising the Cameo Call

Operating Entity	Structures	Irr. Acres	Decreed Rights	
			Amount (cfs)	Priority Date
G.V.I.C.	Grand Valley Canal	4,230		
	Mesa County Ditch	1,090	520.81	1882
	Grand Valley Highline Canal	7,240	119.47	1914
	Kiefer Extension Ditch	5,970		
	Grand Valley Mainline Canal	7,760		
	Independent Ranchmen's Ditch	2,310		
		28,600		
P.I.D.	Price Ditch	3,710	80.	1889
			23.5	1918
O.M.I.D.	Orchard Mesa Canal No. 1	7,390	10.2	1898
	Orchard Mesa Canal No. 2		450	1907
	Orchard Mesa Power Canal		400 *	1908
M.C.I.D.	Stub Ditch	900	40	1903
G.V.W.U.A.	Government Highline Canal	25,900	730	1908
TOTAL		66,500	2,373.98	

G.V.I.C. = Grand Valley Irrigation Company

P.I.D. = Palisade Irrigation District

O.M.I.D. = Orchard Mesa Irrigation District

M.C.I.D. = Mesa County Irrigation District

G.V.W.U.A. = Grand Valley Water Users Association

* P.S.C.C. = Public Service Company of Colorado, operates the power plant at the end of the Orchard Mesa Power Canal, using the 400 cfs right.

All structures except for G.V.I.C. divert at the Grand Valley Diversion Dam, 0.25 miles above the confluence with Plateau Creek.

The G.V.I.C. Dam is approximately 8 miles downstream, near Palisade, Colorado.

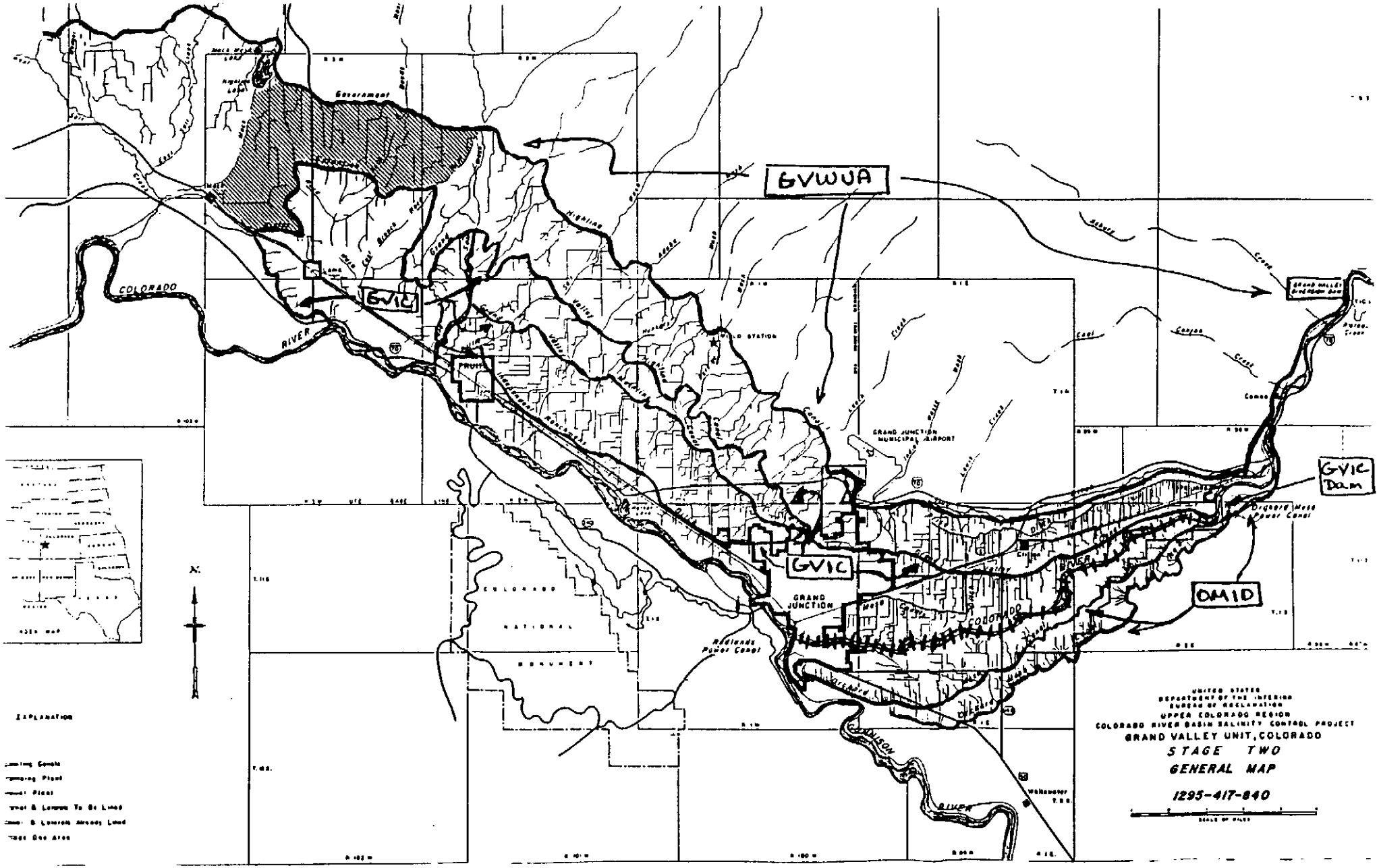
GVWUA
GVIC
GVIC
GVIC Dam
OMID
COLORADO
RIVER
GRAND JUNCTION
GRAND JUNCTION MUNICIPAL AIRPORT
Government
Highline
Redlands Power Canal
Orchard Mesa Power Canal
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
UPPER COLORADO REGION
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
GRAND VALLEY UNIT, COLORADO
STAGE TWO
GENERAL MAP
1295-417-840

Table 2
Incremental cost-effectiveness analysis
Stage Two plan of development
(Verification Memorandum) 1/

Lateral and canal increments	Costs: Total investment ($1,000) 2/	Costs: Annual OM&R ($1,000) 3/	Total annual ($1,000)	Tons removed	Cost effectiveness: Increment ($/ton)	Cost effectiveness: Cumulative ($/ton)
Price Ditch laterals	10,278	7	625	15,800	40	40
Stub Ditch laterals	1,452	1	88	1,500	59	41
East end portion, Government Highline Canal laterals	6,844	-4	408	6,400	64	47
West end portion, Government Highline Canal laterals	21,556	-12	1,285	20,000	64	55
East end portion, Government Highline Canal	24,280	128	1,589	24,300	65	59
** Grand Valley Canal laterals 4/	9,326	6	567	7,200	79	61
Middle portion, Government Highline Canal laterals	32,848	-18	1,958	23,300	84	66
** Kiefer Extension laterals	5,655	3	343	3,400	101	67
West end portion, Government Highline Canal	9,509	50	622	5,600	111	70
** Grand Valley Highline Canal laterals	10,977	7	667	5,600	119	72
** Grand Valley Mainline Canal laterals	16,249	10	988	5,700	173	77
** Middle portion, Government Highline Canal	41,012	218	2,686	15,300	176	88
** Orchard Mesa Canal No. 1 laterals	9,439	6	574	3,100	185	90
** Independent Ranchmen's Ditch laterals	3,456	2	210	1,100	191	91
** Orchard Mesa Canal No. 2 laterals	3,829	2	233	1,200	194	92
Total	206,730	407	12,841	139,500		

1/ Based on January 1985 preconstruction-level data at 5 5/8 percent for a 50-year time period.

2/ Includes prorated share of wildlife, Irrigation Management Services, moss and debris removal structures, and interest during construction.

3/ Represents increase or savings in operation, maintenance, and replacement expenses as compared with the present system.

4/ Includes the Mesa County Ditch laterals.

** Increment is deferred or not currently proposed for construction

AN ANALYSIS OF WATER SALVAGE ISSUES IN COLORADO

Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

Adopted and Approved for Transmittal to the
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Table of Contents

I. Introduction

A provision of the Water Conservation Act of 1991, HB 91-1154, directed the Colorado Water Conservation Board (the "Board" or "CWCB") to "conduct an analysis of water salvage which may result from federal programs, including salinity control, and report its findings to the General Assembly by January 1, 1992." Section 37-60-106.5, C.R.S. This report presents the analysis conducted by the Board and the findings are hereby transmitted in fulfillment of the initial obligation to report to the General Assembly. Since HB 91-1154 did not contain specific instructions concerning the scope of the analysis, this report assumes the General Assembly was interested in a broad overview. CWCB anticipates that the General Assembly may seek additional follow up information after reviewing this report and would welcome an opportunity to work further on the complex issues raised by efforts to salvage irrigation water and more generally improve the efficiency of water use in Colorado.

Staff initially focused the analysis on recent proposals (HB 91-1110, SB 86-126; see Appendix A.) brought before the General Assembly to modify or clarify the law regarding irrigation efficiency improvements. Those proposals sought to recognize or create a transferable water right based on reduced irrigation water use. It was believed that such a right would provide an incentive for existing users to improve the efficiency of their systems. Comparing between the bills highlighted a key problem in irrigation efficiency improvement proposals, namely whether a credit to the original appropriator should be based on reductions in historical consumptive use, or the larger volume of water represented by changes in diversion rates.

Following initial discussions, the Board decided to expand the scope of the analysis to include a variety of activities being considered that might better conserve and manage the quality and quantity of surface and groundwater water available for current and future use statewide in Colorado. If specific rights to salvaged or saved water are to be recognized or created a balancing of complex factors must be undertaken. Accordingly, this analysis considers water salvage within the context of better use of scarce water resources and presents the interrelated technical, legal, and environmental issues that must be weighed.

The Board understood that an underlying reason for the General Assembly's request was a concern with the water development issues arising on the Colorado River near Grand Junction which HB 91-1110 sought in part to address. The Board recognized that competing demands for Colorado River water and the current activities of the Federal Salinity Control Program in the Grand Valley had created a situation requiring closer examination. Thus a second report has been prepared, addressing salvage potentials and water supply options in the Grand Valley. That supplemental report presents water salvage issues in a more concrete setting, and may lead to discussions of a negotiated solution to that particular situation.

The analysis herein, focuses on water use efficiency improvements and disposition of the water which may result from such activities. The terminology, both legal and technical, and the processes used to improve irrigation efficiency in particular, and other uses more generally, are described. Federal programs which may produce salvage water, as well as other stimuli to more efficient use are presented. The current legal framework surrounding water use and efficiency changes is reviewed. The resource impacts of changing water use efficiency are then described in general terms. Finally this analysis sets out what the Board believes to be the major policy questions and issues to be resolved through the legislative process.

II. Description and Definition of Water Salvage

Water salvage generally connotes a scheme where irrigation water use is reduced by using more efficient delivery and application methods. Salvage measures usually involve recovery, transfer, and use elsewhere of the water made available by the reduced irrigation use. Recent salvage bills provided that the original irrigator would retain the legal rights, including the priority date, for some portion of the recovered water, and allowed sale of it as an incentive to make the improvements to his delivery system.

Much of the debate over water salvage indicates that imprecise use of terminology creates needless confusion and often obscures the real policy considerations. A better evaluation of the role of salvage will be fostered by the use of consistent language and an understanding of irrigation water use. An irrigation water budget which identifies and quantifies water in the various stages as it passes through the hydrologic cycle is a useful tool to illustrate the terminology and physical processes related to irrigation water use.

A. Irrigation Water Budget

Examples of water use from a typical unimproved and improved irrigation system are shown in Appendix B. Water in its various locations can be quantified and tracked on a daily, weekly, monthly, or annual basis. A tabular quantification of the annual water budgets for the illustrated systems is shown in the accompanying table. A water budget becomes more complex if done on a short term basis because water moves through different parts of the system at different rates. Generally, water is stored in the soil and groundwater systems while stream diversions are taking place, and then returns to the stream from ground storage much later in the season. In a very large system diversions can occur several days prior to farm deliveries due to of the transit time required to move water through the canal and ditch system. With sufficient information about the ditch, soil, and groundwater systems these storage and time lag effects can be accurately computed. On an annual basis they tend to average out and can be ignored, unless precise timing of competing needs is important.

A review of the water budget indicates that after the initial headgate diversion losses of water from the delivery system begin to occur. These losses reduce the amount of water arriving at, and available for use by, the irrigated crop. Losses decrease the overall irrigation efficiency, measured as the ratio of crop use to headgate diversions. When losses occur between the headgate and the farm they are called conveyance or transit losses. After turnout to a particular farm field losses are referred to as field or on-farm losses.

Some of these losses are consumptive, meaning the water is permanently lost from the system and can not be recovered elsewhere in the basin. When water is consumed it is no longer available for other uses and the water supply is depleted or reduced by the actual consumptive use. Consumptive losses include: evaporation from water surfaces in ditches, ponds, and puddles on the farm, seepage which percolates into geologic zones not

hydraulically connected to the surface stream, and transpiration by non-agricultural vegetation along ditches and on the perimeter of cropped areas. These types of losses will be called "incidental" or "nonproductive" consumptive use in this analysis because they are unintended results which produce no economic gain for the irrigator. While these losses are not intentional, neither are they completely avoidable under practical irrigation techniques. Since part of this consumption of water occurs during the necessary process of moving water from the stream to the point of use, it probably can not be considered a non-beneficial use. The user receives benefit from these losses because they allow for a practical method of delivering his crop water needs.

A second category of losses illustrated in the water budget results in return flows, water returning to the stream from which it was diverted. These losses include deep percolation from ditches and fields into tributary aquifers, necessary or accidental water spills from the distribution system, and tailwater or unused irrigation water which runs off of the irrigated acreage. Since these losses can frequently be observed and can be as high as 50% of the amount diverted they are cited as indicating the waste and inefficiency of irrigated agriculture. However, by definition this water returns to the stream and is available for use by downstream appropriators, thus the pejorative term "waste" should not be automatically applied. To decide if water is "wasted" the observer must determine whether any other use (decreed or not) is deprived of water due to the losses resulting from the irrigator's actions, and whether or not those losses are reasonable and necessary. Often return flows help meet the late season water supply needs of other users. In the South Platte basin return flows get re-diverted as they move downstream and used some three times before reaching Julesburg.

The remainder of the water diverted for irrigation is available for consumptive use by the crop. This use involves root uptake of soil water delivered to the crop's root zone, and subsequent evapo-transpiration by the plant and incorporation into the plant tissues. This consumptive use is the ultimate beneficial use for which the diversion was made and represents the bulk of the depletions caused by irrigation.

When certain irrigation techniques are employed more water is delivered to the root zone than can be used by the plant or stored in the soil. Deep percolation occurs whenever gravity moves water from soil that is too wet, to a level below which a crop's roots can no longer reach it. This water continues moving downward until it reaches the water table, signifying the presence of an aquifer. Once in an aquifer (either seasonal or permanent) deep percolation water normally begins moving toward the stream from which it was diverted, unless an intervening geologic barrier creates an isolated basin of non-tributary water. In regions where the soil and/or the irrigation water supply contains salts some deep percolation is necessary to maintain a salt balance in the soil. Extra water is intentionally applied to the field to leach out salts deposited in the soil from previous irrigations. Leaching carries the salt below the root zone where it will not hinder plant growth. Much of this saline deep percolation water eventually drains back to the surface water system as return flow.

As illustrated by the water budget, an irrigation diversion results in depletions or consumptive uses and return flows. Depletions can be further divided into intentional, productive consumptive use and incidental, non-productive consumptive use. Return flows may be direct (over the land surface) or more typically by underground flow following deep percolation.

B. Definitions:

As the water budget demonstrates there can be a variety of water supply changes that occur when irrigation efficiency is improved. It is important to be precise when discussing a particular increment of the water involved. Terms must be consistent with accepted legal and technical understandings. For that reason a glossary of legal and technical terms used in describing water salvage and conservation is provided as Appendix C. The key technical terms have already been discussed in the water budget description. These include conveyance loss, depletion, deep percolation, evapo-transpiration, root zone, soil moisture, and return flow. Legal terms will be discussed in Section IV below.

The terms "salvaged", "conserved", and "saved" water have been given specific definitions in legislation brought before the General Assembly. These are:

saved water - "the amount of water which has been available to a direct flow water right in priority, and which an applicant claims will no longer be needed for diversion at the applicant's headgate because of modernization ...." HB 91-1110 (House Committee on Agriculture, Livestock, and Natural Resources Report January 31, 1991.)

salvaged water - "water which is part of an appropriated water supply that would be lost to users of the water source as a result of evaporation, transpiration, seepage, or otherwise and which is conserved or otherwise made available to beneficial use.... The difference between historical consumptive use and post-salvage consumptive use shall determine the quantity of salvaged water." SB 84-161 (as introduced)

conserved water - "the quantative difference between the historic consumptive use of the right and [the] lesser consumptive use ... no amount of water shall be included which historically constituted waste, after taking into account and giving effect to the then prevailing and accepted methods and norms for the agricultural water use." SB 85-95 (as introduced); SB 86-126 (as introduced)

Consistent with those definitions of "salvaged" water and "conserved" water and for the sake of clarity, we will only use the term "salvage" to describe reductions in historical consumptive use, signifying the retrieval of water previously lost to the system through

evaporation, evapotranspiration, or deep percolation to non-tributary aquifers. Likewise, the term "saved water" will be used to describe the larger increment of water produced by changes to historical diversion rates made possible with efficiency improvements.

C. Methods of Improving Irrigation Efficiency

An accepted measure of overall irrigation efficiency is the ratio of crop consumptive use to gross headgate diversions. This efficiency can be improved by either reducing diversions or increasing crop consumptive use (or by a combination of both). Generally, the expanded use doctrine limits adding new consumptive uses to a decreed Colorado water right. In some circumstances, such as when an irrigator who historically has never had enough water to satisfy his crop needs becomes able to get more water to his existing acreage, increased consumptive use is allowed. Efficiency changes considered herein will focus on the more common means of increasing irrigation efficiency - reducing losses thereby reducing the diversion side of the efficiency ratio.

Often, an increase in efficiency is endorsed as a reduction in "waste" without an attempt to define the term "waste". As already shown, non-consumptive losses generate return flows which are used by others and such water is not necessarily wasted. While frequently an increase in irrigation efficiency is promoted as conserving water supplies and in the public interest, such generalities fail to recognize the intricate movement of water within an irrigated region. Further, it is tempting to classify conveyance losses as non-beneficial uses of water, but, in fact, such water actually serves the necessary and beneficial purpose of moving the remaining water to its place of need. It is only when the method of conveyance is <u>not</u> "reasonable and appropriate under reasonably efficient practices" that these losses should be characterized as "non-beneficial." Section 37-92-193(4), C.R.S.

What "reasonably efficient practices" means is central to statements about the efficiency and waste involved in irrigation water use. A common understanding is that beneficial use is a flexible concept which tolerates whatever degree of "inefficiency" is present in the prevailing irrigation methods of an area. Courts will likely be reluctant to require innovations with private investment that force any advance beyond those prevailing methods. Likewise, the State Engineer can probably not require state-of-the-art irrigation systems in an effort to reduce irrigation water diversions. However, the legislature, as the best arbiter of public perceptions and desires, may be in better position to balance policy questions and decide to move water users towards more efficient practices. It can do so by providing incentives (funding or creating a marketable right as proposed in the salvage bills) or by regulating (i.e., by declaring which "reasonably efficient practices" are necessary or otherwise tightening the definition of beneficial use). Similar approaches have already been applied to municipal users, i.e., financial and technical assistance on the one hand and mandatory plumbing code revisions containing maximum fixture demands on the other.

Absent regulation, current conditions give some incentives for irrigators to make improvements to their systems. Some of the reasons cited by irrigators who have made

efficiency improvements include the labor savings which result from modern delivery and application systems, lower chemical (fertilizer and pesticide) and water costs when application rates are reduced, fear of liability resulting from open and/or leaky ditches, concern with local groundwater quality, increase available water supply to improve crop yields, and availability of financial assistance through existing federal and state programs.

Specific practices employed to reduce irrigation diversions generally effect both non-productive consumptive use and the return flow component of the irrigation water budget. Certain measures can have a larger impact on reducing incidental consumptive use than others. Ditch evaporation can be reduced by combining parallel ditches and replacing ditches with closed conduits, such as pipes. Reservoir operations can be modified to reduce evaporation. Field evaporation can be reduced by delivery methods that get water into the crop root zone faster than traditional flood irrigation methods, thereby reducing the amount of water exposed to the atmosphere. Phreatophyte consumptive use can be reduced or eliminated by clearing and cutting, or ditch lining which limits seepage into non-cropped areas and eliminates seasonally high water tables. Irrigation management, which involves the closer timing of irrigation deliveries to soil moisture content and crop needs, is also capable of reducing field evaporation and phreatophyte growth.

Non-consumptive losses are usually reduced by ditch lining and on-farm practices which reduce seepage and thereby deep percolation. Reuse of tail water from pump back pits will reduce diversions and return flows. Generally any method capable of reducing consumptive losses will also impact deep percolation and return flows to some extent.

The water budgets displayed in Appendix B represent the before and after conditions for two areas in Utah where irrigation improvements are proposed under the federal salinity control program. The improvements will mainly consist of replacing flood irrigation practices with sprinkler systems. Some minor ditch lining will also be provided. These areas historically have experienced short supplies due to junior water rights. Here, consumptive use (but not irrigated acres) will actually increase after the improvements are installed. The examples demonstrate the relative magnitude of the changes in non-productive consumptive use and return flows before and after a salinity project. Case III presents a calculated irrigation budget for each area with crop consumptive use held constant. The Case III budgets represent the situation that would occur if an area already had a sufficient or full water supply based on senior rights and did not experience shortfalls to existing irrigated acreage.

Comparison of the figures reveals that non-productive consumptive use by phreatophytes and evaporation can be reduced by as little as 1% up to 6% after a system is improved. Deep percolation and tailwater that return to the stream can be reduced, allowing reductions in diversions of up to 25%. Irrigation efficiencies are improved from below 40% to above 50%. In case II for the Uintah area, the amount of water deemed "conserved" or "salvaged" under the definitions previously set forth is only 420 af/year, or a half percent of

pre-improvement diversions. In that same case the amount of "saved water", measured as the difference in diversions, is 6,310 af/year, representing 8% of pre-improvement diversions. The amount of "saved water" actually available for new uses or transfer would depend on the legal status of the 12,000 af of reduced return flows in that particular setting. The difference between 420 af and 6,310 af (or 2,005 af and 18,190 af in Case III) highlights the distinction between salvaged and saved water.

While other improvement projects using a different mix of strategies will have different results, the order of magnitude and relative quantities in the example indicate an important distinction between "salvaged water" and "saved water". Generally, opportunities to reduce consumptive use are limited and do not appear capable of adding large quantities of new supplies to a watershed. Since the volumes of salvaged water are relatively small, a proposed transferable salvage water right may not create the economic incentive envisioned. The salvage water in the examples would come at a high price, ($300-600 per year per af), and may not provide a viable supply of new water. However, in the examples saved water appears to be available at an annual cost of $35 to $125 per af.

D. Municipal and Industrial Water Use Efficiency

Discussion of efficiency improvements and water salvage generally target irrigation use simply because agriculture makes 90% of the water diversions in Colorado. However, it would be misleading to imply that municipal and industrial users do not also have opportunities to improve their use efficiency. While some of the legal and economic issues may be different for these users, the General Assembly may not want to overlook salvage potentials available to non-agricultural users.

Municipalities are generally allowed to expand their use of decreed water rights in the sense that they need not divert the full decreed amount immediately to claim it. The "great and growing cities" doctrine allows a city to secure more water than it currently can use so that it may meet anticipated future needs. By conserving water cities are able to stretch out the time period over which they "grow into" their decreed rights, and forestall additional facility construction and water rights acquisitions. When cities establish effective conservation programs they are not inclined to transfer the saved increment to new uses. Rather they retain any savings for their own future customers, a form of expanded use which is allowed under Colorado law.

An additional reason municipalities do not need salvage rights is because a significant portion of their water supplies are considered fully consumable. Supplies which come from transmountain imports are considered developed water which is outside of the priority system. Converted irrigation rights have already been reduced to historical consumptive use during the change of water rights adjudication and can thus be used to extinction. With these sources of water there is no real distinction between diversion rights and historical consumptive use.

Industrial users divert and consume a small percent of the water used in Colorado. By modernizing equipment and production methods these users could reduce their consumption and/or diversion rates. Generally, they do so as a business decision spurred by several market factors. Typical industrial uses are junior to agricultural rights and must purchase existing rights to create firm supplies. To keep water purchase costs low, processes are designed with conservation in mind. Additionally, industrial and municipal return flows are subject to stringent permitting requirements under the Clean Water Act. To reduce investment in expensive waste water treatment facilities, production processes are designed and updated to minimize the amount of waste water produced. Still in a particular situation the same arguments advanced in favor of an irrigation salvage or saved water right could apply to older industrial plants.

III. Federal Programs Resulting in Salvage

HB 91-1154 directed that this analysis be limited to "water salvage which may result from federal programs, including salinity control." This limitation probably reflects the fact that irrigation efficiency improvements are already being installed in the Colorado River basin by the Federal Salinity Control Program. Participants in the salinity program were uncertain as to the effect these improvements would have on their water rights. HB 91-1110 was an attempt to clarify the status of their water rights after salinity improvements are made, and to grant participants a state recognized right to claim and transfer water no longer necessary for diversion as a result of the salinity program.

Another reason for limiting the salvage analysis to that resulting from federal programs may have been a belief that a saved water right could thereby be limited to the Western Slope. The major U.S. Bureau of Reclamation (USBR) projects, including the Colorado-Big Thompson and Fry-Ark, make their diversions on the West Slope. During debate on HB 91-1110 it became clear that the bill would be more acceptable if it did not apply statewide. The Arkansas and South Platte River basins were presented as extremely over-appropriated areas with extensive reliance on return flows. By excluding these basins, but avoiding the appearance of special legislation, the bill's chances were presumed to be improved.

Federal programs do have significant potential for generating saved or salvaged water as described below. The extent of those programs is very broad however, potentially reaching all corners of the State.

A. Federal Salinity Program

The Federal Salinity Control program was developed as a cooperative effort of state and federal agencies to manage high salt concentrations in the Colorado River. Salinity was a concern because of delivery obligations to Mexico, and also because it could interfere with beneficial uses of water in the basin states, particularly in California and Arizona. The program was established by the Salinity Control Act of 1974 and amended in 1984. 43 U.S.C. Sections 1571-1599. The primary federal salinity activities with regards to irrigation are construction of improved delivery systems by the USBR, and improved on-farm irrigation systems designed and partially funded by the Soil Conservation Service (SCS). Participation in either of these programs is entirely voluntary. In general USBR is lining large canals and replacing leaky main ditches. SCS is helping farmers to better manage and deliver water once it arrives on-farm with sprinkler systems and lined farm laterals. Both activities are designed to reduce salt load into the Colorado River by reducing the deep percolation which causes highly saline return flows in certain geographic areas. In Colorado those areas include the Grand Valley on the Colorado River, the Uncompahgre Valley in the lower Gunnison Basin, and the McElmo Creek area near Cortez, Colorado. The salinity control program also has procedures for addressing municipal and industrial salt discharges through state water quality regulation.

USBR salinity improvements are federally funded in recognition that the delivery of water to Mexico is a nationwide obligation and because the federal government owns a major portion of the saline land in the basin. A 25-30% repayment on USBR salinity project costs is made to the federal treasury from two basin funds which receive a surcharge from federally generated power revenues. Local project participants make no direct payment for the construction of USBR salinity improvements. While they are required to sign contracts obligating themselves to maintain and operate the newly improved systems, USBR fully reimburses participants for any additional maintenance expenses attributable to those new systems. The SCS program requires both cost sharing by each individual participant and repayment from the same electric surcharge fund used to repay the USBR. The final cost share breakdown for SCS on-farm measures is: 30% by local participants, 21% by power revenues and 49% by the U.S. There is no requirement tying participation in the USBR program to participation in the SCS program. A farmer can be in the salinity program without committing to expend any funds or making any on-farm changes.

Importantly, the salinity program makes no claim to any saved or salvaged water produced through the program. The fate of any produced water is left for allocation under state law. Specifically, "in implementing the units ... the Secretary shall comply with procedural and substantive state water laws." 43 U.S.C. Section 1592(b)(4), (1984 Amendment).

Finally, as federal agencies USBR and SCS have statutory duties to mitigate, to varying degrees, the environmental impacts caused by improved irrigation systems. These impacts are explained in Section V.D, below.

B. Other Federal Programs

Despite an apparent belief that "federal programs" would limit salvage proposals to the West Slope there are in fact a number of ways in which federal programs could result in water salvage or savings throughout the state.

1. Clean Water Act

The Clean Water Act (CWA) led to creation of an extensive system of water quality standards for the nation's surface waters. 33 U.S.C. 1313. These standards are designed to preserve and improve the chemical, biological, and physical quality of water for the benefit of all water users. Water quality programs in Colorado are administered by the Colorado Department of Health (CDOH) with the approval and assistance of the U.S. Environmental Protection Agency (EPA). The primary enforcement mechanism is the National Pollution Discharge Elimination System (NPDES) permit which all municipal and industrial water users must obtain. Waste water from a discrete or "point source" must be treated to acceptable levels before discharge into a receiving surface waterway. Although agricultural water use does result in discharges to surface water (return flows) these do not occur at discrete points and control of these "nonpoint" discharges was specifically left out

of the NPDES system. A less stringent nonpoint control program (CWA, Section 319) was established based on land management practices, in lieu of discharge permits and waste treatment technologies. Agriculture is a significant, but not the only contributor to nonpoint pollution. Others include mining, urban storm runoff, construction, and logging. There is some pressure to amend the CWA to provide additional regulatory control over agricultural return flows.

The nonpoint source program in Colorado is explained in two documents prepared by CDOH: "Colorado Nonpoint Assessment Report", November, 1989; and "Nonpoint Source Management Program", October, 1990. The Assessment Report identified specific stream segments impacted by nonpoint pollution from agricultural activities. Throughout the State over 500 stream miles were considered severely impacted, and over 2,000 miles experienced some impact. The main pollutants were sediment, salinity, and nutrients (nitrates and phosphorous), with some small critical segments effected by toxics (selenium, herbicides, and pesticides). It is important to note that irrigated agriculture alone is not responsible for this entire impact, since the agricultural category also included dryland crop production, grazing, and feed lot operations.

To control agricultural pollution the Management Program proposes a multi-agency approach with a combination of demonstration projects and educational programs. Demonstration projects will be targeted at priority watersheds having the worst pollution to illustrate effective control strategies. These strategies involve use of Best Management Practices (BMP's) defined as: "the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water/stream quality goals". Program, pg. 42. BMP's for irrigated areas may be structural such as: canal repair and lining, land leveling, sprinkler installation, and tailwater recovery; or non-structural such as: better scheduling of irrigation water, fertilizer budgets, and improved cropping and tillage methods.

Obviously, the nonpoint source control efforts are very similar to the federal salinity program since both seek to keep pollutants from agricultural lands out of the surface and groundwater systems. Like the salinity program, the improvements being undertaken are designed to reduce return flows and can yield saved and/or salvaged water. The nonpoint program already has BMP demonstration projects underway in the San Luis and Arkansas basins. Funds and technical assistance have been provided by EPA and USDA. In addition certain water user entities such as the Central and the Northern Colorado Water Conservancy Districts have begun their own studies to identify nonpoint problems and potential solutions within their service areas. There has been no suggestion that existing water law or the lack of an express right to claim any salvaged water produced through installation of BMP's has hindered the nonpoint program.

The regulation and protection of wetlands by the federal government arises out of Section 404 of the CWA. While wetlands protection does not generally result in saved or salvaged water, certain mitigation measures conceivably could require conversion of

historical irrigation water rights to wetland replacement purposes. More typically wetlands preservation has posed an obstacle to improving irrigation efficiency, since wetlands created by irrigation losses are jeopardized by reductions in those losses.

2. U.S. Army Corps of Engineers (Corps)

The Corps has dual roles, acting as an environmental regulator and also as a project developer and operator. Major facilities operated by the Corps include John Martin and Trinidad Reservoirs in the Arkansas basin and Chatfield, Bear Creek and Cherry Creek Reservoirs in the South Platte basin. Re-allocation of flood control capacity at federal reservoirs could result in new ways of managing irrigation water and possibly produce saved or salvaged water. Revised operating procedures at these facilities could reduce evaporation losses or in other ways lead to water salvage. Under its Section 404 permit responsibilities the Corps could require improved irrigation efficiencies as mitigation for wetland impacts of new irrigation development (similar to the conservation measures Denver was required to adopt during Two Forks permitting). The typical new irrigation development involves supplemental water for existing senior, but inadequate, water rights. Mandated conservation could result in salvage or savings of water available under those existing rights.

3. U.S. Bureau of Reclamation (USBR)

The USBR also is a project operator and developer outside of its role in the salinity program. It has programs to improve irrigation efficiency even where salinity is not a problem. While the federal subsidies are smaller, programs such as Rehabilitation and Betterment Loans are attractive to users of federally developed water and can result in water savings or salvage. USBR also has a statutorily mandated duty to require development of water conservation plans under the Reclamation Reform Act of 1982. While USBR is requiring such plans from all users taking water from their projects, they do not yet require implementation of those plans. Still, the plans themselves may lead users to take steps which result in water salvage, and in the future may become the basis for mandatory efficiency improvement efforts. As a project operator USBR is subject to the same environmental laws that all water users face, and has been required to modify project operations (eg. the Newlands Project in Nevada) to mitigate environmental impacts. Modification could result in water salvage which might be claimed by either USBR or local water users, depending on who held the project water rights or paid for the project modifications.

The USBR is also involved in efforts to extend the useful life of non-tributary aquifers, such as the Ogallala in eastern Colorado, by enabling well irrigators to become more efficient. The USBR's Closed Basin Project adjacent to the Rio Grande could be viewed as a federal salvage project already being implemented. This project salvages groundwater, in part produced by irrigation seepage, by pumping it out of the Closed Basin and into the Rio Grande, thereby making it available for water users according to their existing priorities and the Rio Grande Compact.

4. U.S. Department of Agriculture (USDA)

Like USBR the USDA currently has a variety of irrigation management programs not necessarily related to nonpoint pollution or salinity. These programs provide a mix of financial and technical assistance designed to encourage improved water efficiency and better protect impacted environmental values. Surplus crop and soil bank programs can lead to the temporary or permanent retirement of marginally productive lands which may result in saved or salvaged water based on historical practices. The potential for water salvage under these agriculture programs exists statewide.

5. Federal Energy Regulatory Commission (FERC)

Under the Federal Power Act of 1920 FERC licenses are required to generate hydroelectric power at most facilities in the U.S. These licenses must be periodically reviewed and renewed. During the licensing process FERC is required to consider a variety of environmental and hydrologic impacts caused by storage and diversion of water for hydropower and to impose license terms that protect these values. Such license terms could modify historical hydropower diversions leading to claims of saved water.

IV. Legal Standards Implicated by Water Salvage

Implicit in saved water proposals based on changes in historical diversions (such as seen in HB 91-1110), as opposed to reductions in consumptive use, is the claim that historical diversions are the property (or should be) of the diverter. The basic notion of Colorado water law is that a water right is the "right to use in accordance with its priority a certain portion of the waters of the state by reason of the appropriation of the same." Section 37-92-103(12) C.R.S. An appropriation is "the application of a specified portion of the waters of the state to a beneficial use". Section 37-92-103(3) C.R.S. Beneficial use is "the use of that amount of water reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the appropriation is lawfully made...." Section 37-92-103(4), C.R.S. (all emphasis added). Beneficial use, not a decreed diversion rate, has always been deemed the full measure and extent of any water right. Green v. Chaffee Ditch Co., 150 Colo. 91, 371 P.2d 775 (1962). Indeed, "to view a water right as a fixed tangible amount of water is to misunderstand the doctrine of prior appropriation." Navajo Development Corp. v. Sanderson, 655 P.2d 1374 (Colo. 1982).

The law of water rights has always recognized the extreme hydrologic importance of return flows to other water users. This recognition resulted in the "no injury" doctrine, which prevents a senior water right holder from making changes to his water right that would reduce the availability of water to others on the stream. Changes to the historical depletion caused by the senior's original decreed use are not allowed to interfere with other rights. The "no injury" rule is often expressed as the maxim that a junior water right holder is entitled to preservation of stream conditions as they existed on the date he made his appropriation. Return flows often provide the water supply for junior appropriators and the law has always protected their reliance on that source of supply.

When a change of water right is made, often the simplest and easiest way to prevent injury is to limit the volume of the change to the historical consumptive use that occurred under the right. This assures that only water previously lost from the system and upon which no one else could rely is moved. However, there appears to be no precise requirement that only the historical consumptive use can be changed. The legal limits on the ability to change a water right are prescribed by the amount beneficially used and by the "no injury" rule.

The water remaining after making beneficial use of a diversion becomes return flow if it can reach the stream and waste if it cannot. Return flows do not belong to the appropriator, but rather are a portion of the waters of the state, available for proper appropriation by the original appropriator or by others. Water Supply and Storage Co. v. Curtis, 733 P.2d 680 (Colo. 1987). The fact that no one will be injured by the original appropriator's reuse of return flows is not a sufficient basis upon which to claim a right to those return flows. Id. Rather, all the requisite elements of an appropriation must be met; i.e., concurrent intent to appropriate and overt acts to demonstrate that intent. Since return flows are available for use by present vested rights and to supply new appropriations, one

may not preempt "the development potential of water absent a demonstrated intent to put that water to beneficial use." Id, at 684. Thus, under current law the priority date for a plan to reuse return flows should be based on development of that plan, not the date of the original appropriation.

A concern presented by attempts to salvage water through the reduction of non-productive consumptive use, is the fact that this will be done in large part by either removing phreatophytic vegetation or depriving it of a water supply. A line of cases cited by those urging caution in creating a right to salvaged water holds that developed water can not be produced by the eradication of phreatophytes. SECWCD v. Shelton Farms, Inc., 187 Colo. 181, 529 P.2d 1321 (1974). Developed water is "new" water not previously part of the river system and is not administered within the priority system, i.e. it is not subject to curtailment by call. Id. Additional cases following Shelton Farms have held that elimination of non-phreatophytic vegetation also does not produce developed water. Giffen v. State, 690 P.2d 1244 (Colo. 1984). Nor may one dry up a marshy area, thereby allegedly reducing natural consumptive use and claim a right to the saved water outside of the priority system. R.J.A., Inc. v. Water Users Association, District 6, 690 P.2d 823 (Colo. 1984). After Shelton Farms the General Assembly also decided that a plan for augmentation could not "include the salvage of tributary waters by the eradication of phreatophytes." Section 37-92-103(9), C.R.S. However, the General Assembly has allowed gravel pit operators to take an augmentation credit for the "historic natural depletion ... caused by the preexisting natural vegetative cover ... permanently replaced" in the process of mining and exposing the water table to the atmosphere. Section 37-92-305(12)(a), C.R.S. This statute indicates that in some instances limited salvage is already allowed in Colorado. It should be noted that the above language allowing credit for preexisting vegetative cover in sand and gravel augmentation plans is being challenged in Central Colorado Water Conservancy District v. Danielson, Case No. 89CW170, Water Division No. 1.

Salvage and saved water proposals submitted to the General Assembly do not involve claims for developed water, rather the saved or salvaged water would continue to be administered within the priority system. Both salvaged and saved water transfers also would be subject to the no injury rule, a further recognition that this water was and remains part of the tributary water system. Thus Shelton, Giffen, and RJA do not directly apply to irrigation efficiency improvement projects. However, the Court in those cases did express concern for the environmental damage that may result if incentives are given for removing vegetation and drying up wetlands. Section 37-92-103(9), which prohibits "eradication" may be a obstacle to salvage plans because almost every transfer of water rights involves a plan for augmentation as the means of preventing injury to other rights. Often phreatophytes need not be directly, or "actively" eradicated (i.e. cut down and removed) to reduce consumptive use, rather water can be prevented from reaching their root zones by reducing the seepage which supplies their water needs. The result, death and loss of this type of vegetation, has been referred to as "passive" eradication. When phreatophyte loss follows seepage reductions, it is unsettled whether the courts will find that the legislature intended to prevent so called passive eradication and require water users to continue to provide a

water supply to this vegetation. It should be observed that phreatophyte protection and other resource trade offs require balances which the General Assembly is ideally suited to adjust. In the Shelton Farms line of cases the court has urged the General Assembly, in the strongest language, to develop policies and mechanisms to accomplish better water management after weighing the competing resource use issues.

Senator Glass introduced bills in 1984, 1985, and 1986 which would have created a right to sell, transfer, or reuse salvaged water (defined as any reduction in historical consumptive use) resulting from efficiency improvements under the original priority date. SB 84-161, SB 85-95, SB 86-126; see appendix A. Senator Glass explained that such a right might already exist with respect to a Colorado water right, but, due to uncertainty, water users were reluctant to become more efficient, or at least had less incentive to do so. The right to change a portion of the historical consumptive use of a water right while continuing the full level of activity under which that consumptive use previously occurred apparently has never been judicially approved. Such a plan might seem like an improper expansion of use, and yet the stream would be unaffected because actual depletion before and after the efficiency improvement would remain the same.

In 1991 a different approach to encouraging improved efficiencies was introduced by Representative Foster, HB 91-1110. That bill would have allowed the sale, transfer, or reuse of "saved water" defined as the reduction in historical diversion rates resulting from system modernization, which would otherwise be lost to appropriators in Colorado. A saved water right would retain the same priority date as the original appropriation. Any use or change of this saved water could only occur if it caused no injury to any downstream users. This proposal would appear to overturn the holding in Water Supply Co., supra that a reuse right only receives an appropriation date fixed by the formulation of the intent and "first step" to reuse the water.

During attempts to move HB 91-1110 out of the Senate Agriculture, Livestock, and Natural Resources Committee, an amendment limiting saved water to the Colorado River basin was considered. There was substantial support for the concept in Western Colorado and return flow reliance there is not as great as on the Front Range. Such an attempt to limit the statewide applicability of a salvage or saved water right may raise issues of special legislation and equal protection under the law. However, there may be valid reasons based on hydrology, compact provisions, and resource demands to target specific watersheds. Another potential constitutional problem arises from assigning a priority date which predates the actual intent to make an appropriation for reuse purposes. This may be inconsistent with the declaration that "The water of every natural stream, not heretofore appropriated ... [is] the property of the public, ... subject to appropriation .... The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied." Colo Const. Art XVI, Sections 5 and 6.

A final legal concept which needs to be considered is the authority of the State Engineer Office (SEO) to administer water rights, prevent waste, and determine that water rights have

been abandoned. The State Engineer is given broad powers to enforce priorities to water by curtailing diversions by junior rights when supplies are short. Section 37-92-502(2)(a), C.R.S. However, under the "futile call" doctrine he may not curtail a junior diversion, unless he is reasonably certain the water will actually benefit the calling senior right. Id. Under this doctrine the SEO refuses to curtail a junior right for the benefit of a wasteful water diversion. The SEO is also directed to investigate and remove abandoned water rights from the priority system. Section 37-92-402, C.R.S.

These powers and duties can draw the SEO into any irrigation efficiency program, even if there is no attempt to change the use of the water. Under current law, if efficiency improvements are made by a water right holder, the SEO may reduce the size of any call made by that right to the extent water is not needed for beneficial use. If actual diversion rates remain reduced for a sufficiently long time the SEO could, or may be forced to, find that a portion of the decreed water right of the improved system has been abandoned. However, such a determination, while it might reduce a portion of the diversion right, could not impair the irrigator's ability to continue to beneficially use the quantity of water actually used and needed for the perfected historical purposes of the original appropriation.

V. Resource Impacts of Water Salvage

When the efficiency of water used for any purpose is improved there are resulting changes to stream flows, depletions, and return flows. Changes potentially effect both the quantity and timing of water in the stream system. When a water right is transferred similar changes occur, but the "no-injury" rule has a counter balancing tendency to preserve stream conditions, at least to the extent other appropriators can demonstrate reliance on those conditions. Changes in the stream system result in a variety of related environmental impacts.

A. Water Supply Impacts

In an efficiency improvement project some combination of incidental consumptive uses and return flows will change in response to the typical mix of activities. The following discussion considers those changes separately to illustrate discrete impacts.

When incidental consumptive use is reduced by efficiency improvements depletions are reduced resulting in a gain, or accretion to the net available water supply in the basin. How that increased supply gets used depends on the hydrology of the particular basin, the location in the basin where the efficiency improves, demands for water, the distribution of water rights in the basin, and interpretations of water law. The increased supply might be picked up by the original diverter to meet new or existing needs, by other appropriators above or below the location of the improvements, or may flow downstream if there is no current demand for this new increment of water. While it is not possible to identify in absolute terms the final fate of a particular accretion to the basin supply, it is clear that any reduction in depletions by one user leaves more water in the stream for other users.

When an efficiency improvement reduces return flows the effect on the stream system, is even less clear. Return flows can be reduced as a result of increased consumptive use (if allowed) or lower water diversions made possible by reduction of conveyance and on-farm losses. If consumptive uses (either productive or incidental) are not reduced there will be no change in depletions and no gain to the basin water supply. In a basin which already has sufficient water to meet all potential depletions at any location there would be no impact on available supplies from reducing return flows. However, there can be significant impacts on the available water supply as a result of changing diversion rates and patterns in a basin where demand outstrips supply.

If a senior irrigator who historically has called out junior users to make its diversions becomes able to meet its needs with less water, then upstream juniors who previously had to bypass water to meet the senior's call will experience an increase in their available supply. If those juniors divert this water upstream depletions may be increased, causing a corresponding decrease in the available water supply downstream of those juniors. If other downstream users have sufficiently senior rights, they may continue to call the saved water past upstream users. Note that the no injury rule only applies when a water right is

changed, and that merely diverting less water to carry out the same historical decreed purpose is not considered a change of water right.

The holder of junior rights sees improved efficiency as a way to reduce losses so that more water can be consumed under the historical diversions available to him. This increases depletions (and reduces return flows) below the area. So long as this increased use is consistent with the original decreed water rights, there is no change of rights and no opportunity to apply the "no injury" rule. If the improver is not able to increase consumptive use it will then divert less water, consume the same amount, and return less water to the stream. In that case, and assuming upstream users already have an adequate supply, the reduced diversions will result in an increased supply below the headgate and a decreased late season supply in reaches below where return flows historically entered the stream.

B. Water Quality Impacts

There are two types of water quality impacts that result from efficiency changes: changes in the assimilative capacity of the stream and changes in the pollutant load entering the stream.

Irrigation return flows may pick up sediment, dissolved minerals, or agricultural chemicals as they travel across the field and through the soil. Return flows could then add pollutants to the watercourse. The size of the pollutant load depends on farming methods, soil types, underlying geology, and distance from the stream, but in general, any reduction in return flows will result in a lower pollutant load entering the stream.

The assimilative capacity of the stream measures its ability to absorb a given pollutant load without adversely impacting water quality. This process is more complex than simple dilution, because it depends on more than just the volume of stream flow (i.e., temperature, biological activity, chemical composition, etc.). However, in general terms, the ability of a stream to assimilate wastes does improve when the volume of stream flow increases. This tension between water quality and water quantity is already recognized in a number of ways, and may eventually limit diversion and use of surface water in Colorado. The precise effect of irrigation efficiency changes on the assimilative capacity of a stream will depend on downstream uses, types of pollution discharges entering lower reaches from other sources, timing of other discharges (i.e., seasonal irrigation return flows, intermittent industrial discharges, or year round municipal waste discharges), and the quantity of flows in the stream. For instance, the loss of return flows may reduce late fall and winter flows in smaller streams, making them less able to assimilate the discharges from municipal users.

C. Groundwater Impacts

Groundwater can be a renewable or a finite resource depending on whether overlying geology allows recharge of the aquifer.

Rechargeable aquifers are usually hydraulically connected, or tributary, to the surface water system. Colorado water law recognizes this physical connection and tributary groundwater is allocated and administered on the same basis as surface water. These tributary aquifers are recharged in many areas by irrigation water that infiltrates into the soil and deep percolates down to the aquifers. The water table then rises and groundwater flows to surface streams that intercept the aquifer. Reduced irrigation losses produce less deep percolation and less recharge. Declining recharge rates reduce the rise in the localized groundwater mounds and the regional water table, with potential impacts on well pumping levels and return flows. Pumpers are willing to reduce their well diversions to save on energy consumption and cost of agricultural chemicals (lower water application rates allow reduced applications of fertilizer). When tributary well pumpers become more efficient they have little absolute impact on the annual water table, because reduced pumping offsets any loss of recharge. However, when surface irrigators become more efficient they can decrease the supply of water available to the tributary aquifers, impacting well users who have come to rely on those return flows.

Non-tributary aquifers are geologically isolated from significant surface recharge. The incentive to improve the efficiency of uses of non-tributary aquifers, such as the Ogallala, is to conserve a vanishing resource. Significant efforts are now under way to reduce well pumping by using water more efficiently and thereby extend the life of this finite supply. The allocation and conservation of non-tributary groundwater is beyond the scope of this analysis, but may merit further attention and consideration if the General Assembly is going to create incentives to encourage improved irrigation efficiency.

D. Environmental Impacts

When stream flows and groundwater levels are changed, water dependent environmental values are impacted, some being degraded and others enhanced as a result of efficiency improvements.

As explained above, the water supply impacts of efficiency changes depend on basin characteristics and the relative priority of the improved right. Clearly, when consumptive use is decreased additional water is available in the basin. Depending on current and future needs in the basin this water may get consumed by others or may remain in the stream to improve aquatic and riparian values. Where return flows are decreased the effect is less clear. If those return flows are reduced by reducing diversion volumes it might be concluded that stream flows are improved. Actually, the lower diversion rate may only make it possible for some other upstream user to now divert and consume more water, in fact decreasing stream flows. If no upstream use of the reduced diversions occurs, instream flow will be increased between the headgate and the point(s) where return flows historically entered the stream. Below that point annual flows should be similar to historical levels, but the monthly pattern would vary, returning to a more natural flow distribution. In Colorado the pre-irrigation flow distribution often saw peak flows in spring and dry streams in the

summer and fall. Irrigation return flows have changed intermittent streams to perennial streams with a year-round water supply; improved efficiencies may reverse this trend.

Another environmental resource impacted by irrigation efficiency changes is wetlands. Losses from irrigation systems can augment the water supply for natural wetlands and often result in creation of new wetlands entirely dependent on irrigation for their water supply. Water that would otherwise return to the surface stream is consumed by wetland vegetation, creating a stream depletion. Incidental consumptive use within an irrigation system is often reduced with a corresponding loss of wetland acreage. Indeed, the Federal Salinity Control Program has been required to mitigate this type of wetlands loss caused by its projects.

There are also socio-economic impacts associated with improved irrigation efficiencies. The vegetation along ditches, which relies on conveyance losses for a water supply, has in some areas become a major community amenity. Ditch lining eliminates this vegetation, and replacing ditches with pipe eliminates both the vegetation and the artificial waterway. In urban areas ditches serve as aesthetic and recreational surrogates for a natural watercourse. On the other hand, transfer of increments of salvaged or saved water is presented as an alternative to the total conversion of agricultural water rights to municipal uses. Thus, rural communities may be spared the economic and environmental impacts associated with large scale total dry-up of irrigated acres.

VI. Policy Issues

A number of policy issues must be addressed and resolved before salvaged or saved water can be fully incorporated into the water rights system in Colorado.

A. Role of the State

Should Colorado take an active role in promoting and encouraging better water use efficiency? It has always been state policy that water should be used wisely and beneficially, and that waste is not tolerated. However, the state has primarily relied on private efforts in a free market to accomplish this goal. Water users have resisted suggestions that the state develop a comprehensive water management plan. Rather, the creation of a specifically defined and transferable property right to the use of water, has permitted economic forces to move water to its highest valued use. Is this a sufficient role for the future? Public perceptions about waste, inefficiency, and conservation may demand a more proactive approach. The equitable apportionment doctrine which invites federal judicial scrutiny of wise resource use, as well as Colorado's current efforts to maintain compact entitlements, may dictate a stronger state role.

If the state decides salvaged or saved water should be a component of a strategy to better use its water supply it must then determine what types of efficiency measures should be promoted. Salvage water, defined as changes in historical consumptive use, is least likely to interfere with return flows relied on by others, but also has limited potential to add significant supplies of water. Saved water, defined as changes in historical diversions can yield larger volumes of water for new uses, but will require close analysis of return flow patterns. Litigation over that analysis and the extent of the "no injury" rule can be expected. Requiring review of salvage or saved water applications by the State Engineer may simplify the fact finding process, and give other water users some protection without the expense of objecting in water court.

If the state wants to take a more active role in promoting efficiency it can do so using either a "carrot or stick" approach, with incentives or regulations. Examples of actions which might encourage more efficient operations are: removing current market barriers and reducing transaction costs, funding programs designed to improve efficiency, and creating new entitlements to water made available through conservation measures. Examples of actions which could force more efficient water use include: more specific and tighter definition of beneficial use, giving the State Engineer increased authority and resources to curtail wasteful or inefficient practices, and regulation of agricultural return flows as a nonpoint pollution source.

B. Resource Tradeoffs

Should wetlands, albeit artificial, be impaired to provide new water supplies? Does water consumed by vegetation along ditches and farm fields provide a valuable aesthetic and

habitat resource to the local community or is that water more valuable elsewhere? Do the improvements to water quality that will result from reduced return flows offset the likely loss of wetlands? Is preservation of artificial, irrigation-induced wetlands to be preferred over efficiency changes that result in improved streamflows and benefits to riparian habitat? Can salvage reduce the pressure to completely dry-up irrigated acreage as a source of municipal water? How can efficiency efforts by groundwater consumers and pumpers' reliance on surface irrigation losses be recognized and protected consistent with the state policy to encourage conjunctive use of tributary groundwater and surface supplies?

C. Legal Questions

Does strict enforcement of the "no injury" rule, as currently applied, prevent creative and more efficient use of our water supplies by focusing too narrowly on maintenance of the status quo, and do plans for augmentation provide adequate relief to rigid application of the "no injury" rule?

Does or should a water right include the right to transfer changes in historical diversions to new uses while retaining the original priority date, subject only to the "no injury" rule? Would such an entitlement reward previously wasteful or inefficient practices and give credence to the disputed maxim "use it or lose it"? Would retention of the original priority date for saved water be speculative in that it allows a priority date that predates actual formation of the intent to appropriate?

Do upstream junior water right holders have any reliance claims to saved water? Such claim would be based on their expectations, formed at the time of their appropriation, that inefficient, but senior downstream practices would someday be improved, thereby reducing the senior calls on their rights. Is such an expectation reasonable and justified, and is it protected by the "no injury" rule? Even if there was no such express expectation on the junior's part at the time of appropriation, does the prior appropriation system fairly imply a gradual attrition of senior rights through abandonment which eventually leads to a better water supply for juniors?

How should stateline delivery obligations created by compact or court decree be accounted for when evaluating a saved water proposal? Upstream juniors, potentially subject to a compact call, may assert that return flows which currently flow out of state benefit them and allow additional upstream depletions. Do we know enough about how and when a compact call will be administered in each basin to allow a senior the right to transfer return flows?

Does an adequate rationale exist for creating different salvage entitlements in various regions of the state? Each basin can be considered unique in terms of hydrology, water development, local economies, and compact obligations. The prior appropriation system, however, has always included the right to take water from any basin for use anywhere else in the state. Can or should a salvaged or saved water entitlement be limited to certain activities, such as "that resulting from federal programs"?

VII. Conclusion

The Board's analysis of water salvage reveals that opportunities to "maximize the beneficial use of Colorado's water resources" exist through improving water use efficiency, particularly agricultural water use. However, after accounting for the return flow dynamic the quantity of water supply made available for new uses through efficiency improvements may not be as large as some would suggest. Implementation of salvage opportunities will result in additional social, economic, and environmental gains and losses. Difficult policy questions and resource tradeoffs must be evaluated and balanced before any approach to water salvage or savings is adopted by the General Assembly.

The following points provide a framework for that evaluation.

A. Varying degrees of water conservation may be recognized.

1. Reduction in historical productive, beneficial consumptive use.

2. Reduction in any historical consumptive use.

3. Reduction in historical diversion volumes, where the differential amount would not be physically available to other users.

4. Reduction in historical diversion volumes, but subject to "no injury rule".

B. Various possible entitlements to salvaged or saved water can be recognized or created.

1. Water historically consumed and no longer needed belongs to the original user and can be used for new purposes or transferred since no injury will result when only consumptive use is transferred.

2. Water historically diverted, but no longer needed belongs to the original appropriator for transfer under the original appropriation date, but subject to the no injury rule.

3. Salvaged or saved water produced by efficiency improvements retains its original priority and belongs to the party causing the improvements to be made. A water user might be forced to allow someone else to improve his system and claim the salvage, provided historical consumptive use is not impaired in any way.

4. Water no longer needed for a decreed beneficial use belongs to the stream system and is available to existing and future appropriators for use under their own priorities.

C. Various roles for State of Colorado

1. Maintain status quo and make no changes to existing law.

    a. Let State Engineer move water users toward more efficient practices with his current authority and jurisdiction.

    b. Let those who want to improve efficiency proceed with only the current incentives to stimulate such activity.

    c. Let judiciary resolve entitlement to saved or salvaged water in a proper case with specific facts.

2. Clarify current entitlement to saved or salvaged water by legislative declaration with specific statutory changes to make that intent clear.

3. Support and encourage increased water conservation through enhanced efficiency.

    a. Clarify or change law in ways that create additional incentives.

    b. Provide additional state programs with technical and financial aid.

    c. Incorporate saved water into a comprehensive strategy to meet future water quantity and quality goals.

    d. Minimize transaction and litigation costs by allowing review and approval by State Engineer, leading to rebuttable presumptions.

4. Create a specific entitlement, if no present entitlement exists, to saved or salvaged water as an incentive to those who otherwise might not become more efficient. It may matter less who gets the entitlement, than that the right be clearly assigned. The market place will then determine where the saved water goes.

5. State could take a portion of saved water, and use for instream purposes and to offset potential injuries to others on stream system.

6. Regulate and mandate that water use efficiencies must meet specific minimum requirements. Authorize the State Engineer to vigorously eliminate wasteful or inefficient practices. Consider allowing private enforcement actions by those who can show a use for water currently denied to them by an inefficient water use.

Appendix A.

Salvage and Saved Water Bills Previously Considered by the General Assembly

LDO NO. 84 0075/1 Fifty-fourth General Assembly SENATE BILL NO. 161

STATE OF COLORADO

BY SENATORS Glass, Beatty, Hefley, MacManus, Peterson, Stewart, and Baca;
also REPRESENTATIVES Herzog, Campbell, Hume, Davoren, and Reeves.

AGRICULTURE, NATURAL RESOURCES & ENERGY

A BILL FOR AN ACT

CONCERNING SALVAGED WATER.

w/

Bill Summary

(Note: This summary applies to this bill as introduced and does not necessarily reflect any amendments which may be subsequently adopted.)

Permits the affirmation of salvaged water subject to vested water rights and subject to the same laws and procedures as apply to appropriation under the priority system. Declares that the acquisition and application of salvaged water is a beneficial use of water when affirmed as being from an original appropriation.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. Article 82 of title 37, Colorado Revised Statutes, as amended, is amended BY THE ADDITION OF A NEW SECTION to read:

37-82-107. Affirmation of a water right to salvaged water. (1) As used in this section, "salvaged water" means water which is part of an appropriated water supply that would be lost to users of the water source as a result of evaporation, transpiration, seepage, or otherwise and which is conserved or otherwise made available for beneficial use. The

difference between historical consumptive use and postsalvage consumptive use shall determine the quantity of salvaged water.

(2) To ~~encourage the conservation and~~ maximize the beneficial use of all the waters of this state, ~~the acquisition and application of salvaged water in this state is declared to be a beneficial use of water from an original appropriation when affirmed as being salvaged from an original appropriation as provided in this section.~~

(3) (a) Any person who desires an affirmation of a water right or a conditional water right, a change of water right, or an approval of a plan for augmentation to salvaged water shall file an appropriate application therefor with the body having jurisdiction over the original appropriation from which the salvaged water is derived and comply with the requirements of this section in addition to any other requirements, terms, and conditions provided or authorized by law pertaining to such application.

(b) The acquisition and application of salvaged water shall not be valid until an application for affirmation therefor is filed and approved by the state engineer, the ground water commission, or the water judge, as the case may be. Before affirming the acquisition and application of salvaged water as being from the original appropriation and the original appropriator's right to the salvaged water, such body processing the application must first find that the

proposed plan to salvage water will not injure vested water rights by depriving other appropriators of quantities of water to which they are entitled.

(4) In determining the quantity of water salvaged, the applicant must submit evidence to prove the claim to the satisfaction of the body processing the application. The date of priority of any affirmation of salvaged water shall be the appropriation and adjudication date of the original appropriation from which it is derived, regardless of the date of filing.

(5) All awards affirming the acquisition and application of salvaged water from a water source shall be subject to reconsideration by the awarding body in the same manner set forth in section 37-92-304 (6). Notice of all awards under this section shall be sent to the state engineer.

(6) All salvaged water shall be administered within the priority system and, as otherwise allowed by law, may be used, sold, or transferred by the appropriator of the original water right without restriction on place of use. Salvaged water shall also be available for reuse as provided in section 37-82-106.

(7) The state engineer shall maintain separate records regarding claims and affirmations of salvaged water rights and shall submit reports to the general assembly thereon and on the implementation of this section, including, but not limited to, data concerning the number of claims and affirmations and

their location, selected comments from affected government agencies and objectors, and recommendations relating to the affirmation of salvaged water. Such reports shall be submitted by December 31, 1984, and June 30, 1985.

SECTION 2. 37-82-104, Colorado Revised Statutes, is amended to read:

37-82-104. Not to impair vested rights. Nothing in sections 37-82-103 to 37-82-105 OR SECTION 37-82-107 shall be construed to amend or repeal section 37-82-102; or impair, diminish, or destroy any valid appropriation of water for any beneficial use which has been made or decreed in accordance with law; or modify, amend, or affect any decree of court or the statutes limiting the time wherein appropriators must appear for determination of priorities of right for diversions from natural streams or the decisions of the courts construing the statutes.

SECTION 3. 37-82-106, Colorado Revised Statutes, as amended, is amended to read:

37-82-106. Right to reuse of imported water. (1) Whenever an appropriator has lawfully INTRODUCED SALVAGED WATER INTO A STREAM SYSTEM OR HAS introduced foreign water into a stream system from an unconnected stream system, such appropriator may make a succession of uses of such water by exchange or otherwise to the extent that its volume can be distinguished from the volume of the streams into which it is introduced. Nothing in this section shall be construed to

impair or diminish any water right which has become vested.

(2) To the extent that there exists a right to make a succession of uses of foreign, nontributary, SALVAGED, or other developed water, such right is personal to the developer or his successors, lessees, contractees, or assigns. Such water, when released from the dominion of the user, becomes a part of the natural surface stream where released, subject to water rights on such stream in the order of their priority, but nothing in this subsection (2) shall affect the rights of the developer or his successors or assigns with respect to such foreign, nontributary, SALVAGED, or developed water, nor shall dominion over such water be lost to the owner or user thereof by reason of use of a natural water course in the process of carrying such water to the place of its use or successive use.

SECTION 4. Effective date. This act shall take effect July 1, 1984.

SECTION 5. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

LDO NO. 85 0619/1 Fifty-fifth General Assembly SENATE BILL NO. 95

STATE OF COLORADO

AGRICULTURE, NATURAL RESOURCES & ENERGY

BY SENATORS Glass, Lee, Fenlon, and Peterson;
also REPRESENTATIVES Herzog, Hume, and Underwood.

A BILL FOR AN ACT

CONCERNING WATER RIGHTS FOR CONSERVED AGRICULTURAL WATER.

Bill Summary

(Note: This summary applies to this bill as introduced and does not necessarily reflect any amendments which may be subsequently adopted.)

Provides that, when the owner of an absolute agricultural water right uses conservation methods to reduce the historic consumptive use of the water right, he may use, sell, lease, exchange, or make available for augmentation or substitute supply the amount of water which he conserves. Further provides, however, that no injury can occur to the owners of water rights or persons entitled to use water under a water right. Requires that a change of water right decree must be obtained before the use of the conserved water is changed. Provides that conserved water does not include water which was wasted historically. Calculates the measure of conserved water as the difference between the historic consumptive use and the reduced consumptive use of the agricultural water right. Contains a savings proviso which recognizes that articles of incorporation, bylaws, or contractual arrangements of a ditch or reservoir company may prevent transfer or change of water out of the ditch or reservoir.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. Article 82 of title 37, Colorado Revised Statutes, as amended, is amended BY THE ADDITION OF A NEW SECTION to read:

Capital letters indicate new material to be added to existing statute.

37-82-107. Conserved agricultural water. The owner of an absolute agricultural water right who employs methods to use water from that water right more efficiently than it was utilized prior to the effective date of this section shall be entitled to utilize, sell, lease, exchange, or make available for augmentation or substitute supply, for any beneficial use, that amount of conserved water which is the quantitative difference between the historic consumptive use of the right and his lesser consumptive use, so long as a change of water right decree is obtained pursuant to law before any change in use of the conserved water is made. The change of water right decree shall insure that such change will not injuriously affect the owner of, or persons entitled to use, water under a vested water right or a decreed conditional water right. In calculating the measure of conserved water for purposes of the change of water right decree, no amount of water shall be included which historically constituted waste, after taking into account and giving effect to the then prevailing and accepted methods and norms for the agricultural water use. This section shall not be construed to allow the use, sale, lease, exchange, or use for augmentation or substitute supply of any water of a ditch or reservoir company in derogation of the articles of incorporation, bylaws, or contractual arrangements of the ditch or reservoir company.

SECTION 2. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary

LDO NO. 86 0286/1 STATE OF COLORADO SENATE BILL NO. 126

AGRICULTURE, NATURAL RESOURCES & ENERGY

BY SENATOR: Glass;
also REPRESENTATIVES Scherer and Allison.

A BILL FOR AN ACT

CONCERNING WATER RIGHTS FOR CONSERVED AGRICULTURAL WATER.

Bill Summary

(Note: This summary applies to this bill as introduced and does not necessarily reflect any amendments which may be subsequently adopted.)

Provides that, when the owner of an absolute agricultural water right uses conservation methods to reduce the historic consumptive use of the water right, he may use, sell, lease, exchange, or make available for augmentation or substitute supply the amount of water which he conserves. Further provides, however, that no injury can occur to the owners of water rights or persons entitled to use water under a water right. Requires that a change of water right decree must be obtained before the use of the conserved water is changed. Provides that conserved water does not include water which was wasted historically. Calculates the measure of conserved water as the difference between the historic consumptive use and the reduced consumptive use of the agricultural water right. Contains a savings proviso which recognizes that articles of incorporation, bylaws, or contractual arrangements of a ditch or reservoir company may prevent transfer or change of water out of the ditch or reservoir.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. Article 82 of title 37, Colorado Revised Statutes, as amended, is amended BY THE ADDITION OF A NEW SECTION to read:

37-82-107. Conserved agricultural water. The owner of

Capital letters indicate new material to be added to existing statute.

an absolute agricultural water right who employs methods to use water from that water right more efficiently than it was utilized prior to the effective date of this section shall be entitled to utilize, sell, lease, exchange, or make available for augmentation or substitute supply, for any beneficial use, that amount of conserved water which is the quantitative difference between the historic consumptive use of the right and his lesser consumptive use, so long as a change of water right decree is obtained pursuant to law before any change in use of the conserved water is made. The change of water right decree shall insure that such change will not injuriously affect the owner of, or persons entitled to use, water under a vested water right or a decreed conditional water right. In calculating the measure of conserved water for purposes of the change of water right decree, no amount of water shall be included which historically constituted waste, after taking into account and giving effect to the then prevailing and accepted methods and norms for the agricultural water use. This section shall not be construed to allow the use, sale, lease, exchange, or use for augmentation or substitute supply of any water of a ditch or reservoir company in derogation of the articles of incorporation, bylaws, or contractual arrangements of the ditch or reservoir company.

SECTION 2. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

First Regular Session

Fifty-eighth General Assembly

LLS NO. 91 0295/1 HOUSE BILL 91- 1110

STATE OF COLORADO

BY R

A BILL FOR AN ACT

CONCERNING WATER WHICH IS SAVED.

Bill Summary

(Note: This summary applies to this bill as introduced and does not necessarily reflect any amendments which may be subsequently adopted.)

Provides for the adjudication of conservation water rights for the owners of direct flow water rights who meet certain requirements and can show that a certain amount of water will be saved by virtue of any modernization, improvement, or change in an applicant's method of operation. Specifies the procedures to be followed by applicants for such adjudications. Specifies that an applicant's original water right will be reduced by the amount of water saved due to the modernization, improvement, or change in operation of the applicant and that such an applicant will be granted a conservation decree for the amount of water saved.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. Part 3 of article 92 of title 37, Colorado Revised Statutes, 1990 Repl. Vol., is amended BY THE ADDITION OF A NEW SECTION to read:

37-92-301.5. Conservation water right - application - adjudication. (1) AS USED IN THIS SECTION, "SAVED WATER"

Capital letters indicate new material to be added to existing statute.
Dashes through the words indicate deletions from existing statute.

MEANS THE AMOUNT OF WATER WHICH AN APPLICANT CLAIMS WILL NO LONGER BE NEEDED FOR DIVERSION AT THE APPLICANT'S HEADGATE BECAUSE OF MODERNIZATION, IMPROVEMENT, OR CHANGE IN THE APPLICANT'S METHOD OF OPERATION.

(2) AN OWNER OF A DIRECT FLOW WATER RIGHT WHICH HAS BEEN USED FOR AT LEAST SEVEN OF THE LAST TEN YEARS AS LISTED IN THE LATEST QUADRENNIAL TABULATION MAY APPLY TO THE WATER CLERK FOR ADJUDICATION OF A CONSERVATION WATER RIGHT AS SPECIFIED IN THIS SECTION. THE PROCEDURE FOR ADJUDICATION OF A CONSERVATION WATER RIGHT SHALL BE THE SAME AS THAT FOR THE ADJUDICATION OF OTHER WATER RIGHTS UNDER THIS ARTICLE UNLESS SUCH OTHER PROCEDURES WOULD BE IMPRACTICABLE OR IN DIRECT CONFLICT WITH ANY SPECIFIC PROVISIONS OF THIS SECTION. AN APPLICATION FOR A CONSERVATION WATER RIGHT SHALL AT A MINIMUM SET FORTH THE LOCATION, AMOUNT, AND USE OF ANY DECREED WATER RIGHT WHICH FORMS THE BASIS OF THE APPLICATION FOR A CONSERVATION WATER RIGHT. SUCH APPLICATION SHALL ALSO INCLUDE ANY MODERNIZATION, IMPROVEMENT, OR CHANGE TO BE MADE IN THE APPLICANT'S METHOD OF OPERATION AND THE AMOUNT OF SAVED WATER WHICH WILL RESULT FROM ANY SUCH MEASURE. AT THE OPTION OF THE APPLICANT, AN ADJUDICATION OF A CHANGE IN A POINT OF DIVERSION OF A WATER RIGHT MAY BE COMBINED WITH THE ADJUDICATION OF A CONSERVATION WATER RIGHT PURSUANT TO THIS SECTION. THE WATER CLERK SHALL INCLUDE ANY APPLICATION FILED UNDER THIS SECTION IN THE MONTHLY RESUME OF APPLICATIONS FILED IN THE DIVISION AND MADE AVAILABLE TO THE PUBLIC PURSUANT TO SECTION 37-92-302

(3).

(3) IF THE REFEREE OR WATER JUDGE IS SATISFIED THAT AN APPLICANT WILL UNDERTAKE THE MODERNIZATION, IMPROVEMENT, OR CHANGE IN THE APPLICANT'S METHOD OF OPERATION AND THAT ANY SUCH CHANGES CAN OCCUR WITHOUT INJURY TO DOWNSTREAM USERS, THE COURT SHALL ENTER A DECREE ADJUDICATING SUCH A CONSERVATION WATER RIGHT. SUCH A RIGHT SHALL REDUCE THE ORIGINAL WATER RIGHT OWNED BY THE APPLICANT BY THE TOTAL AMOUNT OF WATER SAVED, AND THE ORIGINAL DECREE SHALL BE AMENDED ACCORDINGLY. A CONSERVATION WATER RIGHT SHALL ENTITLE THE APPLICANT TO THE AMOUNT OF SAVED WATER IN THE FORM OF A CONDITIONAL WATER RIGHT WITH THE SAME PRIORITY AS THE APPLICANT'S ORIGINAL WATER RIGHT.

(4) IN CONSIDERING EVIDENCE ON AN APPLICATION FOR A CONSERVATION WATER RIGHT, THE COURT SHALL ACCEPT AS CONCLUSIVE EVIDENCE THE AMOUNT OF WATER LISTED IN THE QUADRENNIAL TABULATION AS THE AMOUNT OF WATER ADJUDICATED TO THE APPLICANT FOR THE WATER RIGHT FORMING THE BASIS OF THE APPLICATION FOR A CONSERVATION WATER RIGHT PURSUANT TO THE PROVISIONS OF THIS SECTION.

SECTION 2. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

Appendix B

Irrigation Water Budget

Figures 1-6

Tables 1-2

Uintah Basin Unit Expansion - Flow Diagram

CASE I

Future Without Project
March 1991
Annual Flow in AC-FT
20,800 Irrigated Acres

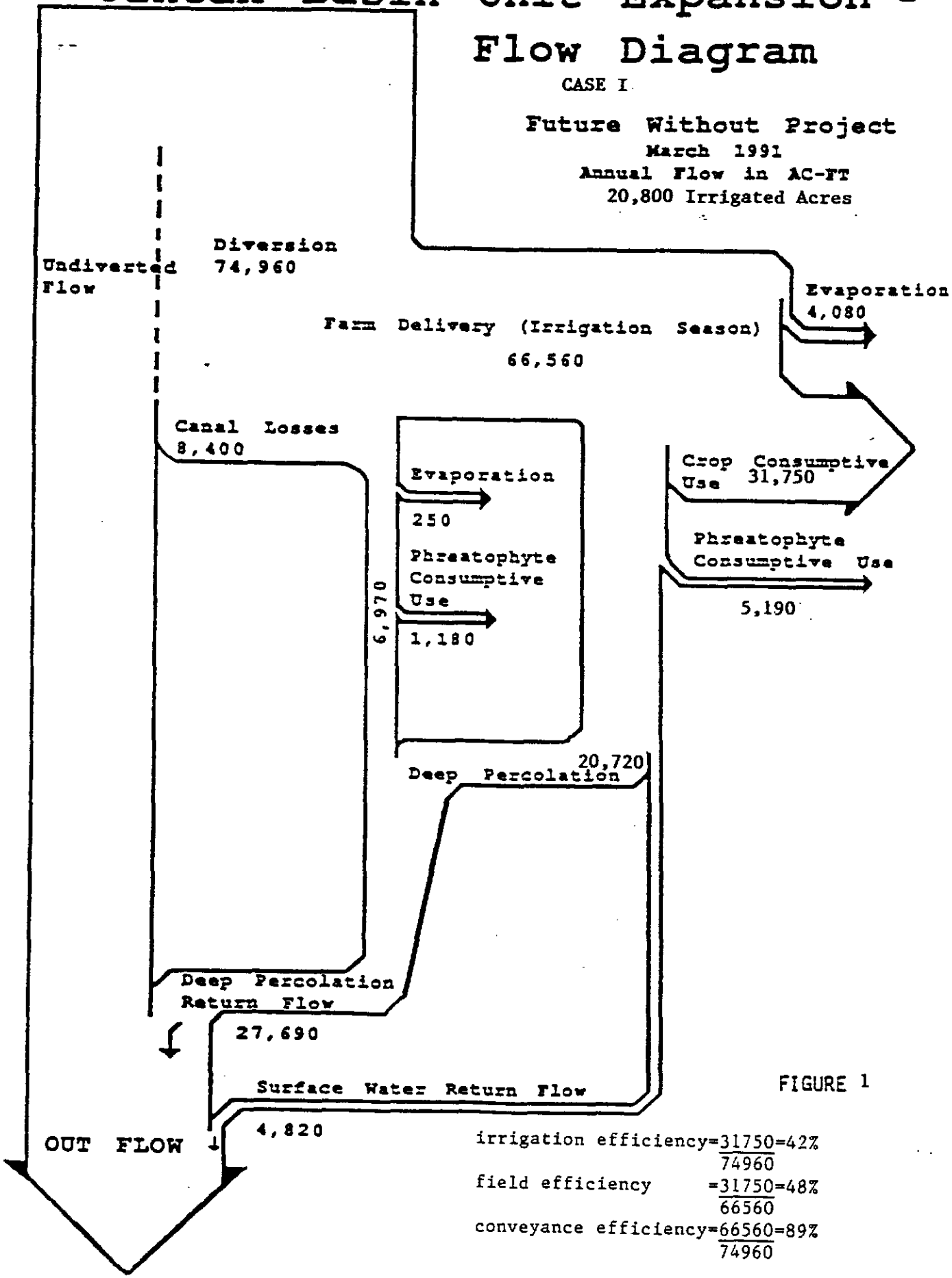


FIGURE 1

irrigation efficiency = $\frac{31750}{74960}$ = 42%

field efficiency = $\frac{31750}{66560}$ = 48%

conveyance efficiency = $\frac{66560}{74960}$ = 89%

Uintah Basin Unit Expansion - Flow Diagram

CASE II

Future With Project
March 1991
Annual Flow in AC-FT

20,800 Irrigated Acres

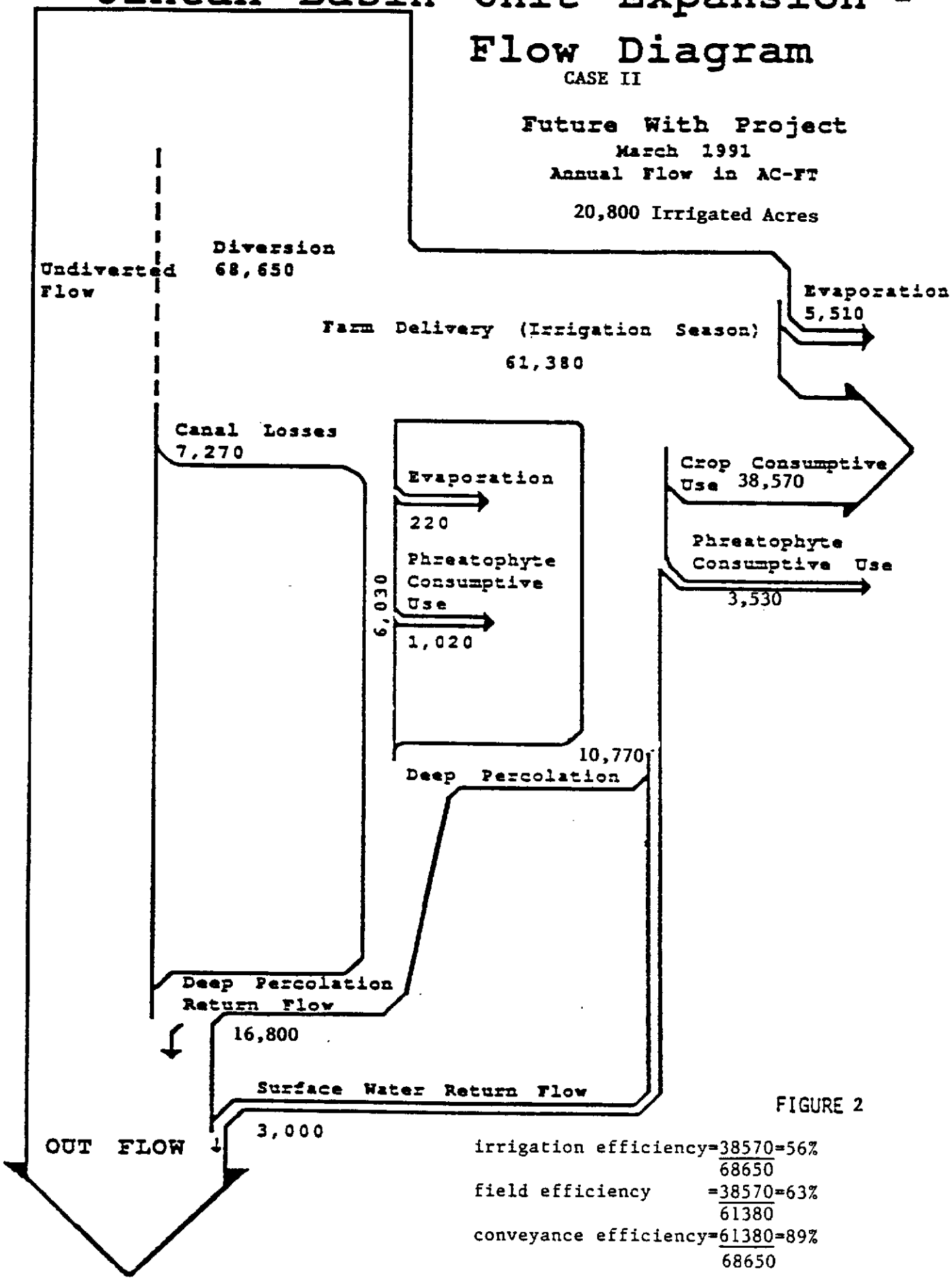


FIGURE 2

irrigation efficiency = $\frac{38570}{68650}$ = 56%

field efficiency = $\frac{38570}{61380}$ = 63%

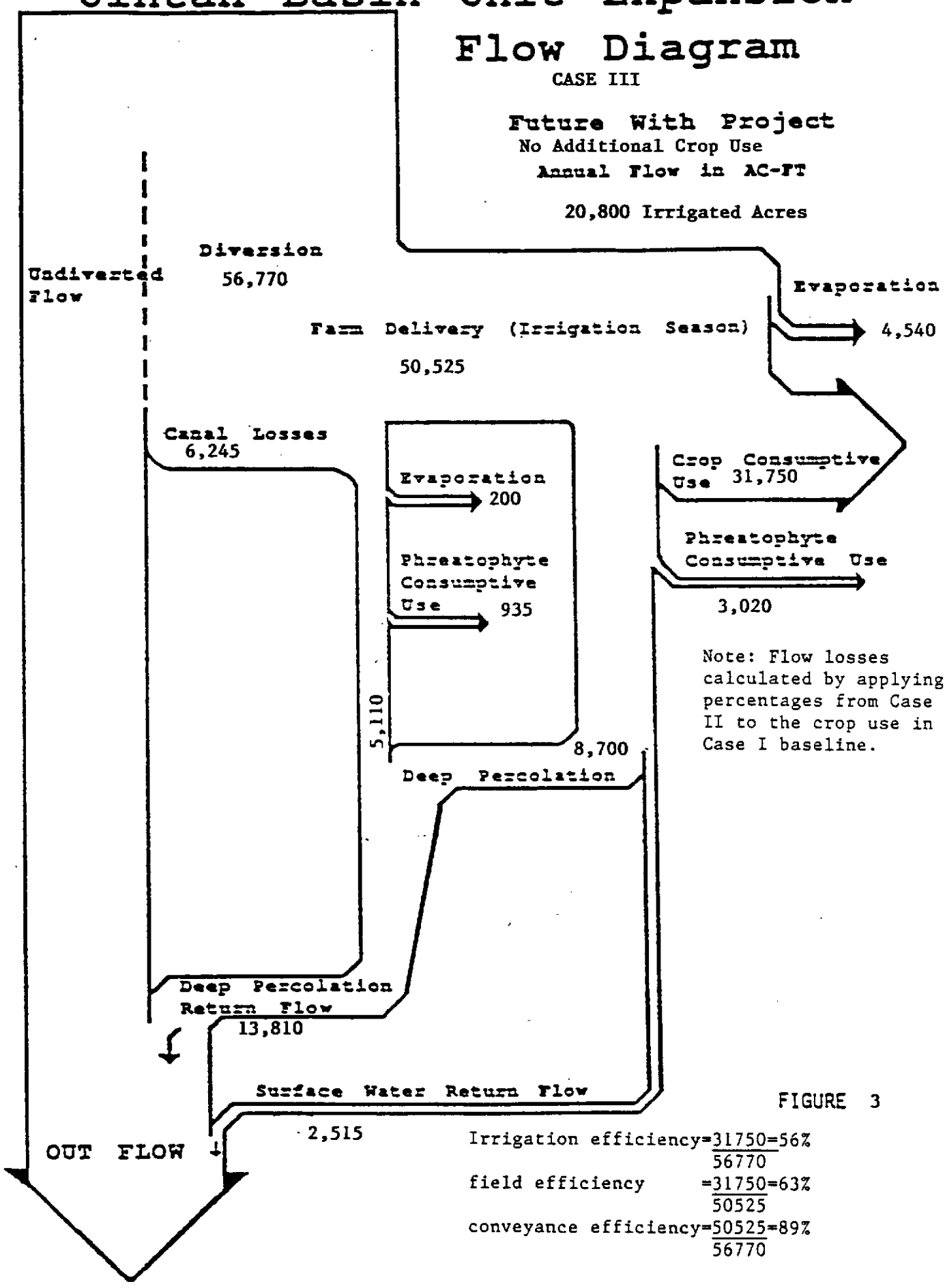
conveyance efficiency = $\frac{61380}{68650}$ = 89%

Uintah Basin Unit Expansion - Flow Diagram

CASE III

Future With Project
No Additional Crop Use
Annual Flow in AC-FT

20,800 Irrigated Acres



Note: Flow losses calculated by applying percentages from Case II to the crop use in Case I baseline.

FIGURE 3

Irrigation efficiency = $\frac{31750}{56770}$ = 56%

field efficiency = $\frac{31750}{50525}$ = 63%

conveyance efficiency = $\frac{50525}{56770}$ = 89%

PRICE-SAN RAFAEL RIVERS UNIT

Flow Diagram

CASE I

Future Without Project

Annual Flow in AC-FT

45,280 Irrigated Acres

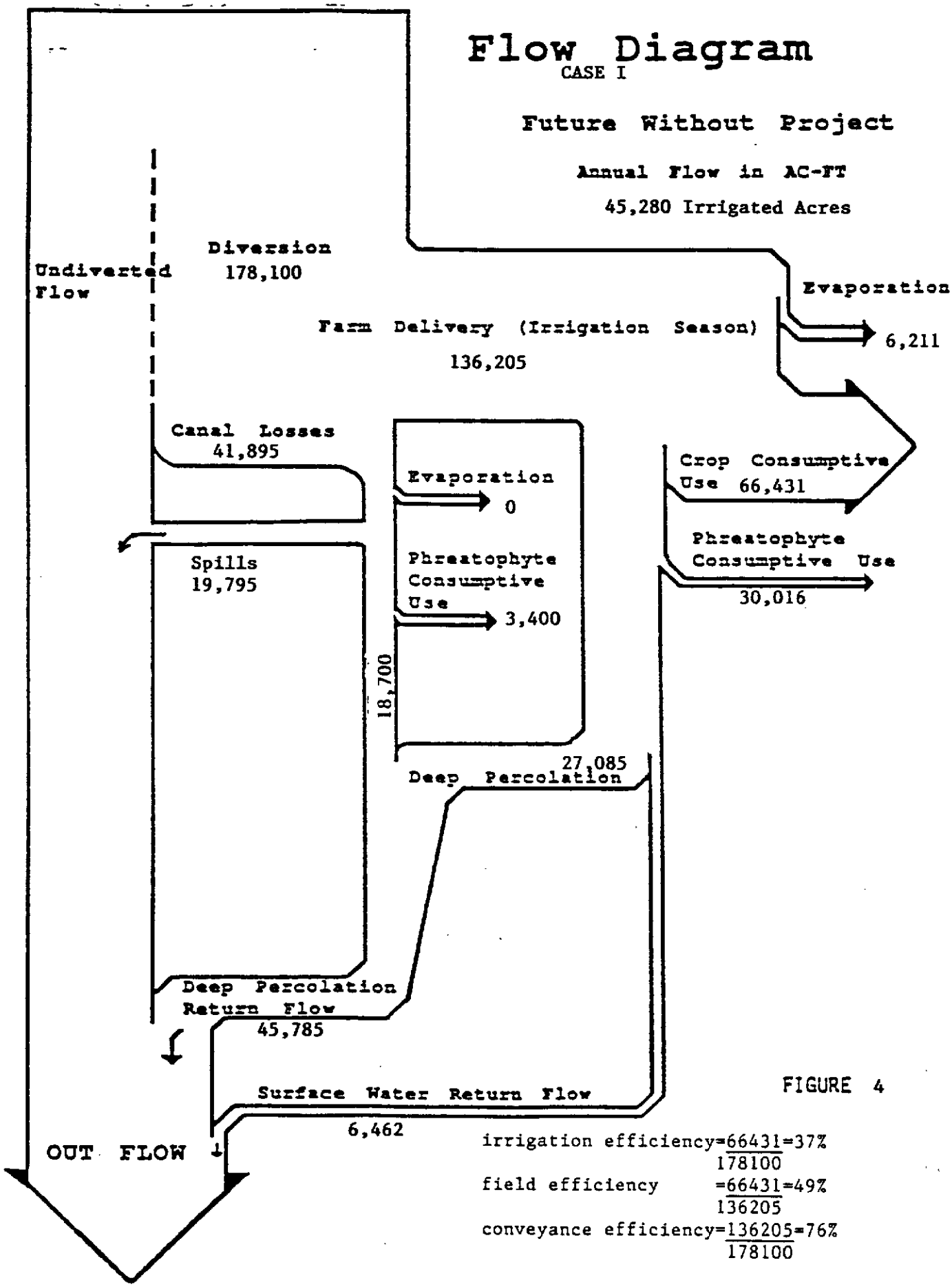


FIGURE 4

irrigation efficiency = $\frac{66431}{178100}$ = 37%

field efficiency = $\frac{66431}{136205}$ = 49%

conveyance efficiency = $\frac{136205}{178100}$ = 76%

PRICE-SAN RAFAEL RIVERS UNIT

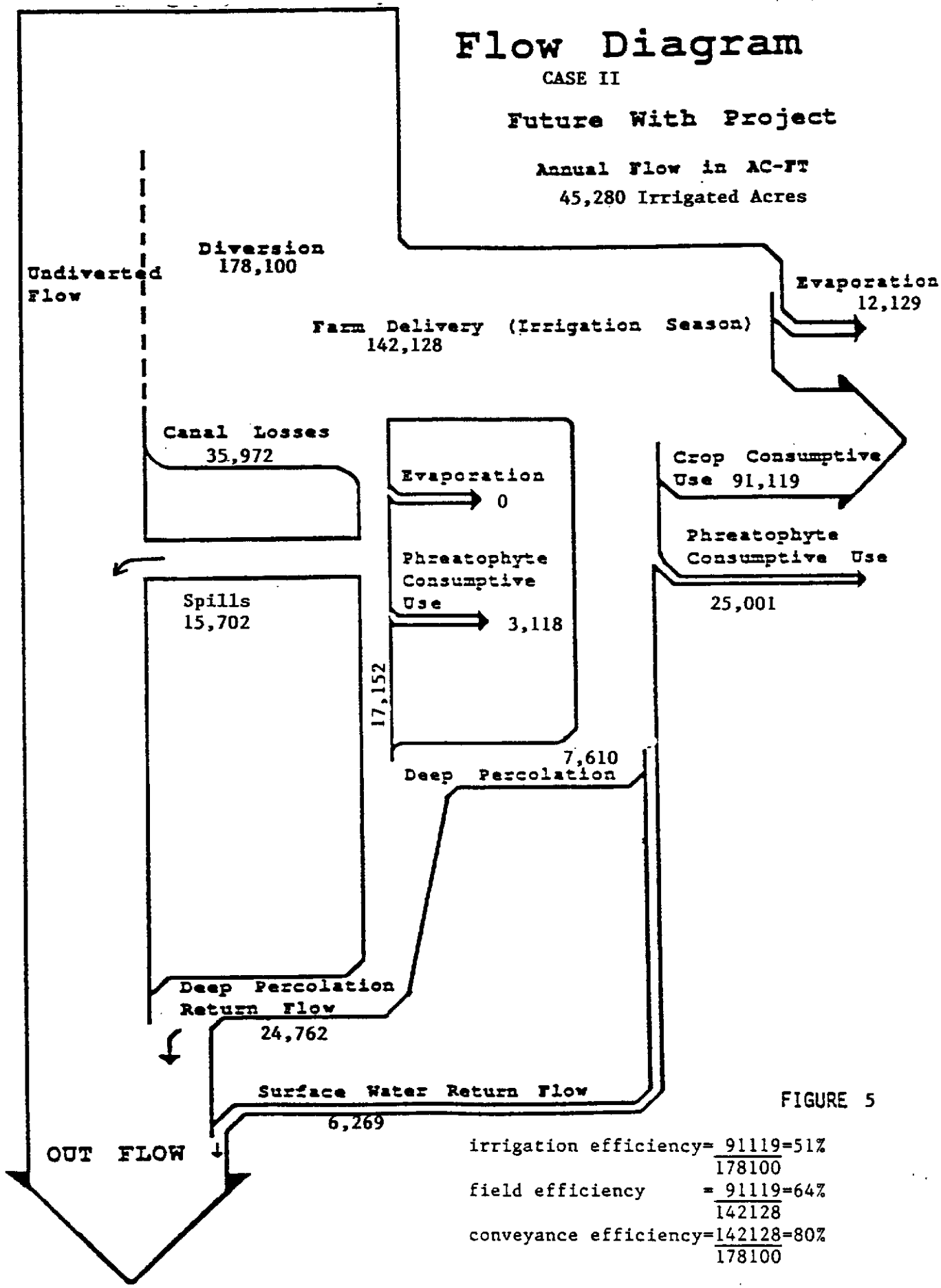


FIGURE 5

irrigation efficiency= $\frac{91119}{178100}$=51%

field efficiency = $\frac{91119}{142128}$=64%

conveyance efficiency=$\frac{142128}{178100}$=80%

PRICE-SAN RAFAEL RIVERS UNIT

Flow Diagram

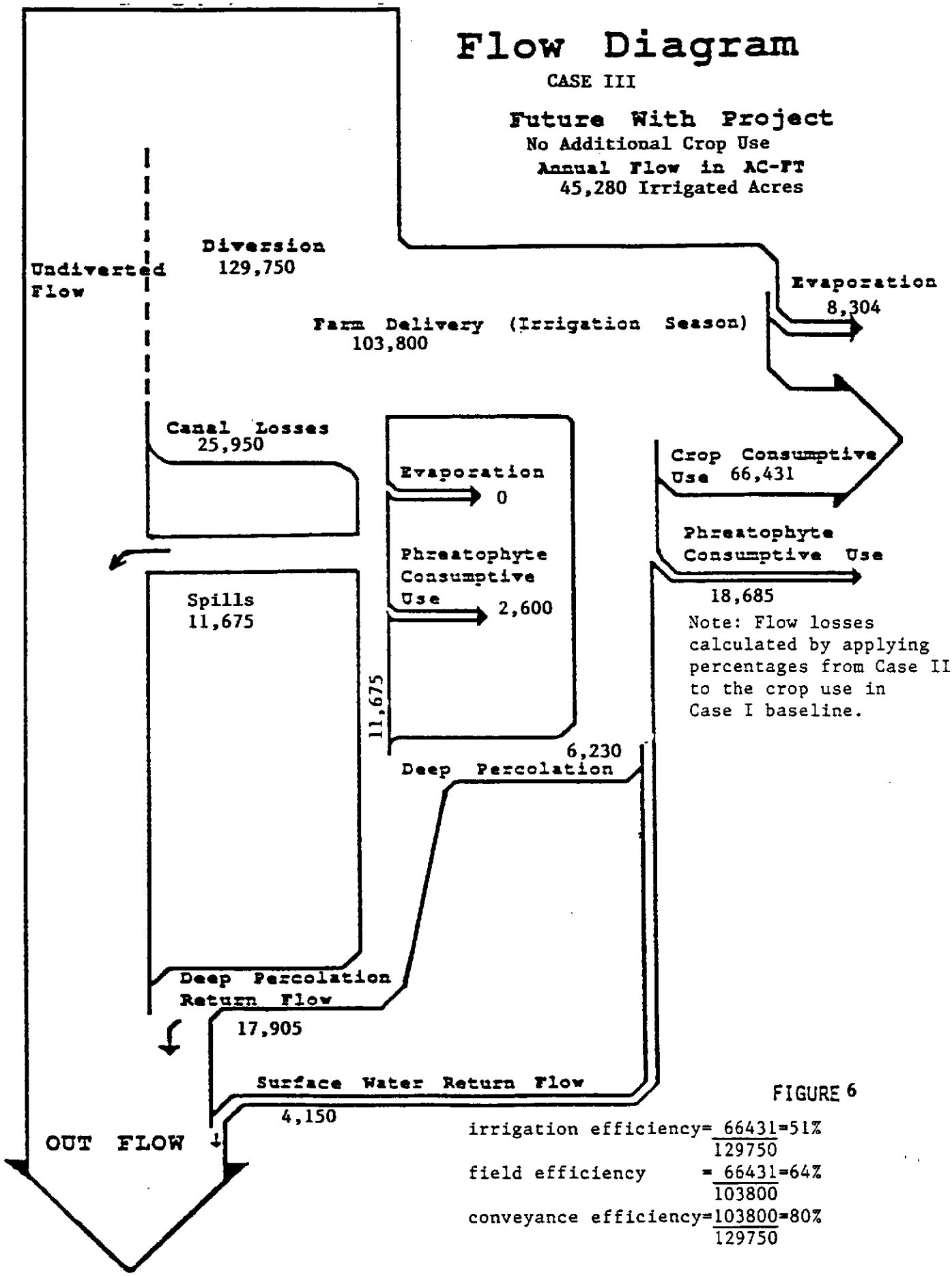
CASE III

Future With Project

No Additional Crop Use

Annual Flow in AC-FT

45,280 Irrigated Acres



Note: Flow losses calculated by applying percentages from Case II to the crop use in Case I baseline.

FIGURE 6

irrigation efficiency = $\frac{66431}{129750}$ = 51%

field efficiency = $\frac{66431}{103800}$ = 64%

conveyance efficiency = $\frac{103800}{129750}$ = 80%

	UINTAH BASIN UNIT								PRICE SAN RAFAEL RIVERS UNIT							
	Existing I		Improved II[2]		Improved III[3]		Change (AF)		Existing I		Improved II[2]		Improved III[3]		Change (AF)	
	AF	%[1]	AF	%[1]	AF	%[1]	II-I	III-I	AF	%[1]	AF	%[1]	AF	%[1]	II-I	III-I
DIVERSION	74,960	100%	68,650	100%	56,770		- 6,310	-18,190	178,100	100%	178,100	100%	129,750	100%	0	-48,350
CONVEYANCE LOSSES																
Spills	0		0		0				19,795	11	15,702	9	11,675	9	- 4,093	- 8,120
Phreatophytes	1,180	2	1,020	2	935	2	- 160	- 245	3,400	2	3,118	2	2,600	2	- 282	- 800
Evaporation	250		220	0	200		- 30	- 50	0		0		0		0	0
Deep Percolation	6,970	9	6,030	9	5,110	9	- 940	- 1,860	18,700	11	17,152	9	11,675	9	- 1,548	- 7,025
SUBTOTAL	8,400	11%	7,270	11%	6,245	11%	- 1,130	- 2,155	41,895	24%	35,972	20%	25,950	20%	- 5,923	-15,945
FARM DELIVERY	66,560	89%	61,380	89%	50,525	89%	- 5,180	-16,035	136,205	76%	142,128	80%	103,800	80%	+ 5,923	-32,405
FARM LOSSES																
Tailwater	4,820	7	3,000	5	2,515	5	- 1,820	- 2,305	6,462	5	6,269	4	4,150	4	- 193	- 2,312
Phreatophytes	5,190	8	3,530	6	3,020	6	- 1,660	- 2,170	30,016	22	25,001	18	18,685	18	- 5,015	-11,331
Evaporation [4]	4,080	6	5,510	9	4,540	9	+ 1,430	+ 460	6,211	4	12,129	8	8,304	8	+ 5,918	+ 2,093
Deep Percolation	20,720	31	10,770	17	8,700	17	- 9,950	-12,020	27,085	20	7,610	6	6,230	6	-19,475	-20,855
SUBTOTAL	34,810	52%	22,810	37%	18,775	37%	-12,000	-16,035	69,774	51%	51,009	36%	37,369	36%	-18,765	-32,405
CROP CONSUMPTIVE USE	31,750	48%	38,570	63%	31,750	63%	+ 6,820	0	66,431	49%	91,119	64%	66,431	64%	+24,688	0
LOSSES BY FATE																
Incidental Depletion																
Evaporation [4]	4,330	10	5,730	19	4,740	19	+ 1,400	+ 410	6,211	5	12,129	14	8,304	13	+ 5,918	+ 2,093
Phreatophyte	6,370	15	4,550	15	3,955	16	- 1,820	- 2,415	33,416	30	28,119	32	21,285	34	- 5,297	-12,131
SUBTOTAL	10,700	25%	10,280	34%	8,695	35%	- 420	- 2,005	39,627	35%	40,248	46%	29,589	47%	+ 621	-10,038
Return Flows																
Surface	4,820	11	3,000	10	2,515	10	- 1,820	- 2,305	26,257	24	21,971	25	15,825	25	- 4,286	-10,432
Groundwater	27,690	64	16,800	56	13,810	55	-10,890	-13,880	45,785	41	24,762	29	17,905	28	-21,023	-27,880
SUBTOTAL	32,510	75%	19,800	66%	16,325	65%	-12,710	-16,185	72,042	65%	46,733	54%	33,730	53%	-25,309	-38,312
TOTAL LOSSES	43,210	100%	30,080	100%	25,020	100%	-13,130	-18,190	111,669	100%	86,981	100%	63,319	100%	-24,688	-48,350

Salvage. tab

Irrigation Water Budgets

Table 1

Notes to Table 1 Irrigation Budgets

1/ Percentages shown for "conveyance losses" and "farm delivery" based on diversions. Percentages shown for "farm losses" and "crop consumptive use" based on farm delivery.

2/ Improved Case II is salinity project as proposed, allowing crop consumptive use to increase where irrigation supplies have historically been inadequate.

3/ Improved Case III is modified project holding crop consumptive use at baseline levels based on assumption that historical irrigation supplies provided maximum crop demand.

4/ On-farm evaporation increases when sprinkler spray irrigation replaces flood irrigation methods.

SUMMARY OF SALVAGED AND SAVED WATER
POTENTIALLY AVAILABLE FROM UINTAH AND
PRICE-SAN RAFAEL SALINITY CONTROL PROJECTS

Irrigation Efficiency Improvement Levels	"Saved" Water Reduction in Diversions		Saved Water Annual Cost	Salvaged Water Reduction in Cons. Use			% 1/	Salvage Annual Cost	Reduction Return Flow	Change in River Flow below	
										headgate	return flow entry
	AF	% 1/	$/AF/yr 2/	Crop c.u.	Incid.c.u.	Net c.u.	% 1/	$/AF/yr 2/		AF	AF
UINTAH BASIN Case II Improved - Case I Existing System	6,310	8%	$100	<6,820>	420	3/	--	---	12,710	+ 6,310	-6,400
Case III Improved (no additional crop cons. use) - Case I	18,190	24%	$ 35	0	2,005	2,005	3%	$325	16,185	+18,190	+2,005
PRICE SAN RAFAEL Case II Improved - Case I Existing System	0	-	--	<24,688>	<621>	3/	--	---	25,309	0	-25,309
Case III Improved (no additional crop cons. use) - Case I	48,350	27%	$125	0	10,038	10,038	6%	$595	38,312	+48,350	+10,038

1/ Percent of pre-improvement diversion levels: Uintah at 74,960 AF/yr, Price-San Rafael at 178,100 AF/yr

2/ Annual Project Costs from USDA/USBR Planning Documents
Uintah Basin Construction Cost = $6.74 million, Annual Cost = $652,000
Price-San Rafael Construction Cost = $72.14 million, Annual Cost = $5,986,000

3/ Consumptive Use Increases because area has a current shortfall in irrigation water availability, no salvage results.

BJSALVAGE2.TAB

Table 2

Appendix C - Definitions

1. Terms defined by Statute:

abandonment - "the termination of a water right in whole or in part as a result of the intent of the owner thereof to discontinue permanently the use of all or part of the water available thereunder." Section 37-92-103(2), C.R.S. [F]ailure for a period of ten years or more to apply to a beneficial use the water available under a water right when needed by the person entitled to use same shall create a rebuttable presumption of abandonment of a water right with respect to the amount of such available water which has not been so used;" Section 37-92-402(11), C.R.S.

appropriation - "the application of a specified portion of the waters of the state to a beneficial use pursuant to the procedures prescribed by law;" Section 37-92-103(3), C.R.S.

beneficial use - "the use of that amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the appropriation is lawfully made...." Section 37-92-103(4), C.R.S.

change of water right - "a change in the type, place, or time of use, a change in the point of diversion, ... a change in the means of diversion, a change in the place of storage, a change from direct application to storage and subsequent application, ... or any combination of such changes." Section 37-92-103(5), C.R.S.

diversion - "removing water form its natural course or location ... by means of a ditch, canal, flume, reservoir, bypass, pipeline, conduit, well, pump, or other structure or device." Section 37-92-103(7), C.R.S.

plan for augmentation - "a detailed program to increase the supply of water available for beneficial use ... by the development of new or alternate means or points of diversion, by a pooling of water resources, by water exchange projects, by providing substitute supplies of water, by the development of new sources of water, or by any other appropriate means. "Plan for augmentation" does not include the salvage of tributary waters by the eradication of phreatophytes, nor does it include the use of tributary water collected from land surfaces which have been made impermeable, thereby increasing the runoff, but not adding to the existing supply of tributary water.: Section 37-92-103(9), C.R.S.

water right - "a right to use in accordance with its priority a certain portion of the waters of the state by reason of the appropriation of the same." Section 37-92-103(12), C.R.S.

2. Terms specifically defined in case law:

developed water - "new water not previously part of the river system, i.e., it is imported or non-tributary water." R.J.A., Inc., v. Water Users, 690 P.2d 823 (Colo. 1984). (relying on Shelton Farms).

"duty of water" - "measure of water which by careful management and use, without wastage is reasonably required to be applied to any given tract of land ... variable according to conditions." Weibert v. Rothe Brothers, 618 P.2d 1367 (Colo. 1980).

expanded use - increase in historical consumptive use even if the amount diverted is unchanged or does not exceed that amount stated in decree Danielson v. Kerbs Ag. Inc., 646 P.2d 363 (Colo. 1982).

historical consumptive use - diversions minus return flows, Danielson.
amount of water applied to a beneficial use minus return flows. May v. U.S., 756 P.2d 362 (Colo. 1988).

historical use - actual diversion over a period of time
SECWCD v. Fort Lyon Canal, 720 P.2d 133 (Colo. 1986).
This term has sometimes been used interchangeably with "historical consumptive use" creating some confusion and uncertainty as discussed in the Ft. Lyon case.

return flow - water not fully consumed by a beneficial use Water Supply & Storage Co. v. Curtis, 733 P.2d 680 (Colo. 1987).

salvaged water - "water in the river or its tributaries (including aquifer) which ordinarily would go to waste, but somehow are made available for beneficial use." SECWCD v. Shelton Farms 529 P.2d 1321 (Colo. 1974). Tributary water made available for beneficial use through elimination of waste." R.J.A., Inc.

waste - "to divert more than can be used beneficially." Weibert

3. Terms with commonly accepted technical meanings:

conveyance loss - That portion of a diversion that does not reach the crop area due to evaporation, seepage, and/or spills from the ditch system, sometimes called carriage water. Diversions - conveyance loss = farm delivery.

deep percolation - The downward movement of infiltrated water below the vegetation root zone, eventually reaching the water table. Deep percolation may enter tributary or non-tributary aquifers depending on geology of an area.

depletion - The net reduction to stream flow caused by the consumptive use of an activity, and after accounting for return flows.

evaporation - The process by which liquid water becomes vapor and enters the atmosphere.

evapotranspiration (ET) - The combination of evaporation from soil and water surfaces and plant transpiration that occurs on a vegetated area. Equivalent to consumptive use.

farm delivery - The portion of a diversion which reaches the farm field and is applied for crop use.

infiltration - The process by which surface water enters the soil profile.

phreatophyte - Deep rooted plant which consumes water from the water table. Examples include willows, cottonwood, and salt cedar.

root zone - That portion of the soil profile from which crops can withdraw water through their roots. The depth of the root zone varies with vegetation types.

salt balance - Maintaining the salt concentration in the root zone at an acceptable level by flushing the salt added to the soil with irrigation water out of the root zone. Accomplished by applying an amount of water above crop needs and causing intentional deep percolation.

soil moisture - the percent by weight of water in a unit of soil, that will not freely drain out of the soil under the force of gravity.

tailwater - Surface runoff from a farm field, generally collected in drainageways and returned to the stream.

transpiration - The process by which plants withdraw water from the soil, utilize it and expel water into the atmosphere.

water table - The elevation below which the soil and underlying material is constantly saturated and from which water will freely drain if given an outlet.

appendix A