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U.S. DISTRICT COURT
DISTRICT OF NEVADA
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CLERK, U.S. DISTRICT COURT
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IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEVADA

UNITED STATES OF AMERICA, Plaintiff, WALKER RIVER PAIUTE TRIBE, Plaintiff-Intervenor, vs. WALKER RIVER IRRIGATION DISTRICT, a corporation, et al. Defendants.	IN EQUITY NO. ~~C-125s~~ Subfile No. ~~C-125-B~~ C-125-C **MINERAL COUNTY'S PROPOSED PETITION TO INTERVENE**

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WALKER RIVER IRRIGATION DISTRICT,	)
Petitioner,	)
vs.	)
CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, W. DON MAUGHAN, EDWIN H. FINSTER, ELISEO M. SAMANIEGO, JOHN CAFFREY and DARLENE E. RUIZ, Members of the California Water Resources Control Board,	)
Respondents.	)

COMES NOW, Intervenor-Petitioner, MINERAL COUNTY OF NEVADA, by and through its attorneys of record, on its own behalf and for benefit of the citizens, residents, and users of Walker Lake, and claims as follows:

I.

INTRODUCTION

1. This claim is made for recognition of a right of minimum level of water for Walker Lake by means of certain right being reserved and allowed to flow down the Walker River both east and west forks, in sufficient quantity to reach, replenish, and maintain Walker Lake. Such minimum levels are requested based upon sufficient water to sustain naturally occurring fish population.

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II.

JURISDICTION

2. Jurisdiction over this claim is pursuant to the continuing jurisdiction of this Court over the waters of the Walker River and its tributaries in California and Nevada; and the matter in controversy arises under the Constitution, laws, or treaties of the United States.

III.

PARTIES

3. Intervenor-Petitioner, MINERAL COUNTY OF NEVADA, appears in this case on its own behalf and for the benefit of the citizens and residents of Mineral County and users of Walker Lake for recreational, aesthetic, preservation of wildlife, and economic purposes. Mineral County is duly established under the laws of the State of Nevada and retains all rights delegated pursuant to NRS 244.165 with the capacity to sue in its own name.

4. Respondents are all water users on the Walker River and its tributaries as set forth in the Final Decree.

IV.

GENERAL ALLEGATIONS

5. Petitioner-Intervenor, MINERAL COUNTY OF NEVADA, hereinafter referred to as, "County," currently benefits from the presence of sufficient levels of

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water in Walker Lake. The Nevada Department of Wildlife holds in trust for Mineral County, the right to 700 cfs. of surplus flows annually, Certificate No. 10860, granted by the State Engineer of Nevada on December 28, 1983.

6. Walker Lake and approximately 16 linear miles of Walker River are totally contained within the legal boundaries of Mineral County. The elevation of Walker Lake in 1908 was 4,077 feet. The elevation of Walker Lake in 1993 was 3,950 feet which is equivalent to a loss of one-half of the Lake. The levels required to maintain Walker Lake as a viable fishery are at an elevation of 3,972 feet. At the present rate of depletion Walker Lake will be dry by the year 2020.

7. Walker Lake supports recreational fishing, boating, and wildlife habitat. Activities and businesses attributable to the presence and use of Walker Lake represents approximately 50% of the economy of Mineral County.

8. The current and consistent total loss of flows from Walker River into Walker Lake has degrated the quality of water in Walker Lake substantially.

9. The public interest requires the maintenance of minimum levels in Walker Lake that will sustain the naturally occurring fish population and provide for the preservation of Walker Lake for the citizens and residents of the County for recreational values, preservation of wildlife, and maintenance of the economy of Mineral County.

10. Without reallocation of the waters to insure priority minimum flows to sustain the Lake, Walker Lake, its users and the citizens of Mineral County will suffer substantial and irreparable damage.

11. Minimum flowage guaranteed to Walker Lake was not dealt with, resolved, or considered in the original decree (C-125) of 1936.

12. Paragraph XIV of the Final Decree provides that this Court retain jurisdiction.

V.

FIRST CLAIM FOR RELIEF

11. An adjudication and reallocation of the waters of Walker River to preserve the minimum levels in Walker Lake, as a condition to the water rights licenses of all upstream users -- such requirements of minimum levels of Walker Lake to be a condition to each license and certificate presently held by upstream license holders in California and Nevada.

12. The right to, at least, 103,000 acre feet of flows annually reserved from the Walker River that will reach Walker Lake.

WHEREFORE, Petitioner-Intervenor, prays:

1. The Court, pursuant to its continuing jurisdiction under paragraphs XIV of the Final Decree, reopen and modify the final Decree to recognize the rights of Mineral County, its citizens and residents and other users of Walker Lake to have minimum levels to maintain the viability of Walker Lake as a body of water to sustain its naturally occurring fish population and for recreational benefits, wildlife preservation, aesthetic and economic beneficial use.

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2. That the Court order the State of Nevada to grant a certificate to Mineral County for the benefit of Walker Lake in the amount of 103,000 acre/feet per year.

3. That the Court recognize that the minimum levels necessary to maintain the viability of Walker Lake as a body of water to sustain its naturally occurring fish population and for recreational benefits, wildlife preservation, aesthetic and economic benefits is a beneficial use and in the public interest and required under the doctrine of maintenance of the public trust.

4. That the Court grant such other and further relief as it deems just and proper.

DATED this 21st day of October, 1994.

RESPECTFULLY SUBMITTED,

ZEH, SPOO & HEARNE

BY _____
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MINERAL COUNTY OF NEVADA

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CERTIFICATE OF MAILING

Pursuant to FRCP 5(b), I certify that I am an employee of the Law Office of ZEH, SPOO & HEARNE, and that on this date I caused to be mailed a copy of the attached **MINERAL COUNTY'S PROPOSED PETITION TO INTERVENE**, with postage fully prepaid to:

See attached Service List

DATED this 25th day of October, 1994.

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IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEVADA

UNITED STATES OF AMERICA, Plaintiff, WALKER RIVER PAIUTE TRIBE, Plaintiff-Intervenor, vs. WALKER RIVER IRRIGATION DISTRICT, a corporation, et al. Defendants.	IN EQUITY NO. C-125s Subfile No. C-125-B **MEMORANDUM OF POINTS AND AUTHORITIES IN SUPPORT OF MINERAL COUNTY'S PROPOSED PETITION TO INTERVENE**

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I.

INTRODUCTION

Since the dawn of the ice age, Walker Lake, an arm of the Pleistocene Lake Lahontan, has graced the desert landscape of Mineral County. Throughout pre-recorded human history and into the twentieth century, Walker Lake continued to support the naturally occurring cut throat trout, Lahontan suckers, and tui chub, enough so that the Indian tribes living on the banks of this lake were actually named for their consumption of the bounty of the Lake. Walker Lake is a terminal lake fed by the waters of the Walker River. This river represents 84% of the lake's source of recharge with the balance made up from rainwater and groundwater. (See, Declaration of Kelvin J. Buchanan filed herewith, hereinafter referred to as, "Buchanan Declaration".)

In 1989, there were a series of events beginning with the release of sediment-laden irrigation water from Bridgeport Reservoir. This dewatering of the Reservoir resulted in litigation by upstream interests, initiated by the State Water Resources Control Board of California (SWRCB), which began the death of the Walker Lake, quickly and certainly, without further consideration. By the actions taken to retain minimum levels at Bridgeport Reservoir, a man-made trout fishery, the SWRCB essentially decreed a death sentence to Walker Lake, a naturally created trout fishery.

Simultaneously, in conjunction with this action by the SWRCB, the Walker River Irrigation District (WRID), manager of the allocations along the River, has failed in its stewardship. WRID has failed to mitigate waste of water resources along

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the River, failed to monitor and require returns of irrigation water to the river channel, and failed to require that the diversions be technically efficient, thereby, preserving the river to the extent possible with twentieth century technology. This failure has reduced the available waters to flow through the Walker River to Walker Lake. (See, Buchanan Declaration.)

The State of Nevada has issued certificates for diversions that result in the overall location of the waters of the River which deprives any natural or excess flows from reaching Walker Lake. WRID, the State of Nevada, and the Walker River Paiute Tribe (the "Tribe") have not contracted with the United States to install and maintain accurate measuring devices along the Walker River so that lawful and proper allocations of water will be made (see, Declaration of Buchanan). As a result, Walker Lake has been denied flows that might have survived the treacherous path along the River to its inlet.

Without sufficient flows through the Walker River arriving at Walker Lake, the Lake has dropped so precipitously that, some scientists predict, within two years the Lake will not be able to support its naturally occurring fish population (see, Declaration of Buchanan). Mineral County depends on this resource for recreation, wildlife habitat, and other economic and aesthetic reasons for both the citizens of Mineral County and the users of the Lake.

Mineral County requests intervention into this case in order to represent interests for the preservation of this irreplaceable natural resource, Walker Lake, which is nearly totally dependent on adequate flows from the Walker River.

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II.

ARGUMENT

A. MINERAL COUNTY MEETS THE REQUIREMENTS FOR INTERVENTION AS OF RIGHT UNDER RULE 24(a)(2), F.R.C.P.

1. Mineral County Has Not Delayed in Moving to Intervene in the Pertinent Federal Case Affecting the Adjudication of the Waters of the Walker River, Case C-125.

Intervention as of right under Rule 24(a)(2) Federal Rules of Civil Procedure[1] requires that the applicant claim an interest, the protection of which may as a practical matter be impaired or impeded if the lawsuit proceeds without him. The Ninth Circuit has enunciated the test to be administered for applying these elements of Rule 24, F.R.C.P.:

> We (the 9th Circuit Court of Appeals) apply a four-part test under this rule: (1) the motion must be timely; (2) the applicant must claim a "significant protectable" interest relating to the property or transaction which is the subject of the action; (3) the applicant must be so situated that the disposition of the action may as a practical matter impair or impede its ability to protect that interest; and (4) the applicant's interest must be inadequately represented by the parties to the action. Sierra Club v. U.S. E.P.A., 995 F.2d 1478 (9th Cir. 1993) at page 1481.

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[1]Rule 24 Federal Rules of Civil Procedure: (a) Intervention of Right. Upon timely application anyone shall be permitted to intervene in an action: (2) when the applicant claims an interest relating to the property or transaction which is the subject of the action and the applicant is so situated that the disposition of the action may as a practical matter impair or impede the applicant's ability to protect that interest, unless the applicant's interest is adequately represented by existing parties.)

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Moreover, Rule 24, F.R.C.P., is to be liberally applied:

> The rule is construed "broadly in favor of the applicants for intervention." Sierra Club v. U.S. E.P.A., supra at page 1481.

Taking the elements of the Ninth Circuit's test, *seriatum*, and then tempering that by the liberal construction to be given Rule 24, F.R.C.P., it is evident that Mineral County satisfied the requirements of Rule 24, F.R.C.P., and should be allowed to intervene as of right in this case as developed, below.

A decision on the appropriation of the waters of the Walker River materially affects the preservation of Walker Lake. Mineral County cannot protect the interests of the Lake unless it can represent those interests in the present litigation.

The Court must, in its discretion, based upon the circumstances, determine if the motion to intervene is timely:

> Timeliness of intervention is a matter for the sound discretion of the trial court, NAACP v. New York, 413 U.S. 345, 365-66, 93 S.Ct. 2591, 2602-03, 37 L.Ed.2d 648(1973), but a court should be more reluctant to refuse when intervention is sought of right, as here. United Sates v. American Telephone and Telegraph Co., 642 F.2d 1285, 1295 (D.C. Cir.1980). Williams and Humbert Limited v. W.&H. Trade Marks (Jersey) Ltd., 840 F.2d 72 (D.C. Cir. 1988) at pp. 74-75.

The Ninth Circuit has also set forth the standard for assessing the timeliness of a motion to intervene:

> In determining whether a motion to intervene is timely, we evaluate three factors: (1) the stage of the proceeding at which an applicant seeks to intervene; (2) the prejudice to

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> other parties; and (3) the reason for and length of the delay. County of Orange v. Air California, 799 F2d 535 (9th Cir. 1986), cert. denied, 480 U.S. 946, 107 S.Ct. 1605, 94 L.Ed2d 791 (1987) (citing United States v. Oregon, 745 F.2d 550 (9th Cir.1984).

Sierra Club v. U.S. E.P.A., supra at p. 1481.

Without a doubt, Mineral County's motion under Rule 24, F.R.C.P. is timely, first and foremost, because Mineral County began the process for intervention as soon as the Commissioners learned of the litigation. Mineral County had no knowledge of the litigation until September 1, 1994, and has never had written notice by any of the other parties of this litigation (see, Declaration of Herman F. Staat filed concurrently herewith). The County has clearly acted immediately upon the information, once supplied them. The County's immediate actions could not be construed as dilatory or less than vigilant in protecting their rights. Rule 24, F.R.C.P., demands no more of a potential intervenor in the timely pursuit of a claim.

Furthermore, Mineral County seeks to intervene in these proceedings at a time that notice is being given to other parties that may wish to intervene. By November 25, 1994, the Tribe, Plaintiff-Intervenor, will give notice to all surface water diversion license holders of the Walker River, pursuant to order of the Court (see, May 23, 1994, Stipulation and Order for Enlargement of Time). After this Notice any certified holder may wish to intervene to protect his interest or water diversion. Mineral County's intervention at this time will not be any different than the other potential interventions that may join after this Court ordered notice.

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Moreover, these proceedings have not progressed to an agreement on the merits or substance of the case. Neither actual diversions, the request by the Tribe for additional quantities, the unlawful conditions imposed upon the Walker River Irrigation District ("WRID") by the SWRCB, nor the change of diversion requested by WRID has been heard, nor has discovery been commenced by any of the parties. The preliminary stage in the proceedings also argues in favor of intervention. See, Mille Lacs Band of Indians v. State of Minn., 989 F.2d 994 (8th Cir. 1993).

No prejudice to other parties could possibly arise because of the intervention of Mineral County. Its presence will not cause to unravel a complex settlement since none has been completed and entered into by the parties. The parties will remain essentially in the same position as if Mineral County had intervened earlier. See, U.S. ex rel. McGough v. Covington Technologies, 967 F.2d 1391 (9th Cir. 1992).

Each element of the three-pronged timeliness test set forth in the Sierra Club case is manifestly satisfied, here. There is no plausible basis for denying the motion of Mineral County to intervene because it is delinquent. Having engaged counsel, approved its intervention and voted to go forward to protect the interests of Walker Lake within less than 60 days from the date Mineral County learned of this litigation, Mineral County has been diligent. For these reasons, the intervention of Mineral County is timely and should be allowed by this Court.

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B. MINERAL COUNTY HAS A SIGNIFICANT PROTECTABLE INTEREST IN THE PRESERVATION OF WALKER LAKE

1. Mineral County Has Water Rights in the Surplus Flows of the Walker River That Directly Feed the Waters of Walker Lake and, Moreover, Mineral County Asserts the Right to Minimum Sustainable Levels in Walker Lake on Behalf of the Public.

Mineral County is the only party representing the preservation of Walker Lake. Nevada State Law recognizes that recreational purpose is a beneficial use, NRS 533.030(c). This recreational, beneficial use can be a right to flows in situ without the requirement of diversion from the source. A similar fact situation arose in Humbolt County, Nevada:

> The Blue Lake application is for a water grant to waters of Blue Lake in situ, in place as a natural body of water. The BLM manages the land surrounding the lake and desires this water right to assure maintenance of Blue Lake for public recreation and fishery purposes.

State v. Morros, 766 P.2d 263, 265 (Nev. 1988).

The State of Nevada recognizes the recreational purpose and the in situ appropriation. Pursuant to this recognition, the State of Nevada issued a certificate for 795.2 Cfs to the Nevada Department of Fish and Game (now the Department of Wildlife) on December 28, 1983. The Department of Wildlife holds the certificate in trust for the benefit of Mineral County. (See, Exhibit "A.") This trust relationship where a state agency holds rights for the benefit of the public has been recognized by other states. Permit No. 36-7200 In the Name of the Idaho

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Department of Parks & Recreation, 828 P.2d 848 (Id. 1992).

The Court must determine beneficial use from the circumstances before it. United States v. Alpine Land and Reservoir Co., 697 F.2d 851 (9th Cir. 1983). Beneficial use is a dynamic concept and should not allow waste. Circumstances in 1994 are different than in 1936 when the Walker River Decree was last considered; different, in that society has determined that preservation of our natural waterways are critical to environmental balance and ecological survival. A summary of the conflict between in-stream flow preservation and appropriative rights is found in "Reallocation" Chapter 16, Water and Water Rights.

A reallocation of the waters of Walker River is required to preserve the public's right to the natural body of water existing in Mineral County known as Walker Lake. The State holds land in its sovereign capacity in trust for the public purposes of navigation and fisheries. Any conveyance of trust property to a private individual, as in the case of a certificate of appropriation for waters, is subject to the public trust and the State remains trustee with the duty to supervise the trust. See, National Audubon Society v. Superior Court, 33 Cal.3d 419, 189 Cal.Rptr. 346, 658 P.2d 709 (Cal. 1983). Mineral County requests intervention to insure that the State of Nevada performs its duties and obligations as trustee of the waters of Walker Lake for the benefit of the public.

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2. Mineral County Has a Great Financial Stake in the Property Values of Mineral County's Taxable Private Property, Which Are Inexorably Attached to the Presence of Walker Lake and Would, Likewise, Be Devalued by Loss of the Lake.

Mineral County has the right to tax the property of the private owners situated in and around Walker Lake since it is totally located within the political and legal boundaries of the County. N.R.S., Section 244.150. Any devaluation of the property values in Mineral County because of loss of Walker Lake will substantially reduce the budget of Mineral County which is dependent upon property tax revenues (see, Declaration of Marlene Bunch, hereinafter referred to as "Declaration of Bunch," filed concurrently herewith). "These taxing and regulatory interests are inherently ripe for protection by intervention as a practical means for a political subdivision to protect its financial and administrative affairs. Scotts Valley Band of Pomo Indians of the Sugar Bowl Rancheria v. U.S., 921 F.2d 924, 928 (9th Cir.1990).

3. Mineral County Has a Significant Protectable Interest in the Recreation, Wildlife Habitat, Aesthetic and Other Economic Concerns That Support Mineral County Because of the Presence of Walker Lake.

Mineral County has participated in many federal and state actions to preserve and enhance the Lake. (See, Exhibit "B.") Mineral County has always been very interested and active in Lake matters (see, Declaration of Buchanan).

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Likewise, the federal courts have recognized these are significant protectable interests justifying the right to intervene by other public agencies that have actively participated in the issue that will be affected by the litigation. See, Sagebrush Rebellion, Inc. v. Watt, 713 F.2d 525 (9th Cir. 1983).

Mineral County has a more critical concern than a public advocacy group as was the intervenor in Sagebrush Rebellion in protecting the interests of its citizens and the users of Walker Lake. A substantial percentage of Mineral County's businesses is related to Walker Lake and its available recreation (see, Declaration of Louis Thompson (hereinafter referred to as "Declaration of Thompson") filed concurrently herewith). Significant decreases in the revenues to these businesses have been realized already because of the damage to the Lake by the loss of flows into the Lake from the Walker River. (See, Declarations of Bunch and Thompson.)

The loss of flows of the Walker River into Walker Lake has so degraded the quality of the water of the Lake that fish no longer flourish and other wildlife have disdained to make Walker Lake their home or transient stop in migratory journeys. Besides the inability for the businesses to survive because of the loss of fishing in the Lake, other tourists are lost because the pathetic condition of reduced Lake levels does not entice those who came before to witness the pristine beauty of the Lake and the abundance of waterfowl and other wildlife present. Tourists do not come to witness the death of a Lake.

/ / /

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Only Mineral County is so affected by the loss of tourism and the presence of a naturally occurring desert lake with the exceptional beauty of the water itself and the incumbent wildlife populations. The loss of the familiar view of the Lake to a community that has little else in its vista cannot be measured in property terms alone, but must also be measured in sentimental and historical terms. Flows from Walker River are the only means by which Walker Lake can be rejuvenated and maintained. (See, Declaration of Buchanan.)

> "[T]he determination of whether an interest is sufficient for Rule 24(a)(2) purposes is colored to some extent by the third factor-whether disposition of the action may, as a practical matter, impair or impede the applicant's ability to protect its interest." Conservation Law Foundation v. Mosbacher, 966 F.2d 39 (1st Cir. 1992).

One of the allegations of the Mineral County position is that the waters of Walker River are allocated beyond the capacity of the River, leaving no natural flows left to enter the Lake. The instant litigation is where the issues of allocation will be adjudicated. Mineral County must be allowed to intervene in order to preserve and protect Walker Lake in the forum where reallocations can and will be determined, the instant case.

C. MINERAL COUNTY IS NOT ADEQUATELY REPRESENTED BY ANY OF THE PRESENT PARTIES TO THE LITIGATION

Mineral County may very well have interests coincident with some of the parties to the present litigation to contest the right of the SWRCB to entrap flows to

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protect the man-made fishery of Bridgeport Reservoir at the cost of the natural fishery in Walker Lake. But no other party to this litigation has expressed even a casual reference to the protection of the levels of Walker Lake.

> Whether a party may intervene turns, in part, upon a comparison of the adequacy of representation primarily by comparing the interests of the proposed intervenor with the current parties to the action. Sierra Club v. Robertson, 960 F.2d 83, 86 (8th Cir. 1992). To satisfy the adequacy of representation test, an intervenor . . . need only show that representation may be inadequate, not that it is inadequate. Conservation Law Foundation v. Mosbacher, 966 F.2d 39 (1st Cir. 1992). (Emphasis added.)

The State of Nevada is required by its very position to protect all of its citizens. The interests of its citizens are not necessarily identical and may become competing. Some residents may not favor the preservation of Walker Lake, if other, more immediate, pronounced, or self-serving interests are at stake. The burden of showing inadequate representation by a political sub-entity of a State when that State is a party also, may be more than minimal; however, Mineral County can more than show why its interests differ from all of the interests that the State of Nevada must represent upstream. See, Environmental Defense Fund v. Higginson, 631 F.2d 738 (D.C. Cir. 1979). The State must protect its own decisions regarding the appropriation of the waters of the Walker River which may in large part have deprived Walker Lake of its critical recharge. Further the State of Nevada only listed its concern for protection of the Mason Valley Wildlife Preserve as any specific reason for its intervention. (See, State of Nevada Motion for Intervention, Page 3,

Lines 12-15.) Walker Lake, indeed, has no protector but Mineral County.

D. MINERAL COUNTY HAS NO OTHER MEANS TO PROTECT ITS INTEREST IN WALKER LAKE THAN TO ENTER THIS PROCEEDING AND PRAY THAT THIS COURT REALLOCATE THE WATERS OF THE WALKER RIVER

The Walker River is a stream the headwaters of which rise on the eastern slopes of the Sierra Nevada mountains in California. United States v. Walker River Irr. Dist., 104 F.2d 334 (9th Cir. 1939). The River flows through lands that are arid, mostly rough or mountainous into the Walker River Paiute Reservation for a distance of approximately thirty miles where the stream empties into Walker Lake. See, United States v. Walker River Irr. Dist., supra at p. 335. The River has been the subject of litigation culminating in the Decree of C-125 entered on April 14, 1936, which is the basis for the continuing jurisdiction of this Court and the instant litigation. In order for Mineral County to claim minimum flows and in situ rights for the Lake, Mineral County must be a party to this action. An adjudication is a quiet title action in equity for the purpose of settling all claims to the waters of the watercourse that is the subject of the adjudication. (United States v. Truckee-Carson Irrigation District, 649 F.2d 1286, 1308 (9th Cir. 1981), United States v. Alpine Land and Reservoirs Co., 697 F.2d 851 (9th Cir. 1983). When the matters brought before this Court are determined and the waters of the Walker River reallocated accordingly, the fate of Walker Lake will be in the balance.

/ / /

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E. IN THE EVENT THAT THIS COURT DOES NOT ALLOW MINERAL COUNTY INTERVENTION AS OF RIGHT, IN THE ALTERNATIVE MINERAL COUNTY ASKS FOR PERMISSIVE INTERVENTION PURSUANT TO F.R.C.P. 24(b)(2)

1. Mineral County Meets Each and Every Element of Permissive Intervention Pursuant to F.R.C.P. 24(b)(2).[2]

Permissive intervention is allowed a party that has a claim that involves a question of law or fact that is common to the main action. In both the claims presently filed, Mineral County's request for flows to Walker Lake will impact the outcome and the considerations. Because Walker Lake is located in Mineral County and comprises such an integral part of the economy and well-being of Mineral County, the County Commission considered it part of their public duty to protect and preserve the Lake as a healthy, viable recreational asset and fishery.

> It is a living tenet of our society and not mere rhetoric that a public office is a public trust. While a public official may not intrude in a purely private controversy, permissive intervention is available when sought because an aspect of the public interest with which he is officially concerned is involved in the litigation. Nuesse v. Camp, 385 F.2d 694, 702 (D.C. Dist. 1967).

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[2]Rule 24. Intervention (b) Permissive Intervention. Upon timely application anyone may be permitted to intervene in an action: . . .(2) when an applicant's claim or defense and the main action have a question of law or fact in common.)

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2. The Intervention of Mineral County at this Stage of These Proceedings Will Not Unduly Delay the Litigation And, Moreover, Will Significantly Contribute to the Underlying Factual and Legal Issues.

No party to this litigation presently can offer the intimate knowledge of the Lake that Mineral County can. Mineral County has accumulated as much information as it can find regarding the scientific studies involving the biology, geology, hydrology and history of Walker Lake. Starting when the Bureau of Land Management indicated an interest in funding the recreational aspects of the Lake, and particularly through the last years when the loss of the Lake has been imminent, Mineral County has requested assistance in analysis from United States Senator Harry Reid, the Office of Technology Assistance, the University of Nevada at Reno, the State of Nevada Division of Wildlife, the Bureau of Land Management, the United States Geologic Survey and other engineers and other governmental and non-profit agencies. See, Natural Resources Defense Council v. Tennessee Valley Authority, 340 F.Supp. 400 (S.D.N.Y.1971); and Levin v. Ruby Trading Corporation, 333 F.2d 592 (2d Cir. 1964). In those cases the Court gave weight to the knowledge and expertise of those seeking intervention in its granting of their motion to intervene.

> Other factors to be considered in connection with permissive intervention are: the nature and extent of the intervenor's interest, whether the intervention will unduly delay or prejudice the adjudication of the rights of the original parties, whether the applicant will benefit by the intervention, whether the intervenor's interests are adequately represented by the other parties, and whether the intervenors will significantly contribute to the full development of the underlying factual issues in the suit and

to the just and equitable adjudication of the legal questions presented. State of Utah v. Kennecott Corp., 801 F.Supp. 553, 572 (D.Utah 1992).

As discussed heretofore, granting intervention to Mineral County will in no way delay these proceedings. Granting intervention to Mineral County will add an aspect to the adjudication of the waters of Walker River that has been neglected to this point in history and is a very necessary consideration to save Walker Lake.

III.

CONCLUSION

As stated hereinabove, Mineral County seeks intervention as of right or, in the alternative, as permissive intervention pursuant to Rule 24, F.R.C.P. For the foregoing reasons, Mineral County respectfully requests that the Court grant its motion for intervention.

DATED this 21st day of October, 1994.

RESPECTFULLY SUBMITTED,

LAW OFFICES OF
ZEH, SPOO & HEARNE

By _____
TREVA J. HEARNE
Attorney for Intervenor-Petitioner
MINERAL COUNTY OF NEVADA

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Application No. 25792 Certificate Record No. 108 Book 37 Page 10860

THE STATE OF NEVADA
CERTIFICATE OF APPROPRIATION OF WATER

WHEREAS, Roger E. Grable, Agent has presented to the State Engineer of the State of Nevada Proof of Application of Water to Beneficial Use, from East Walker River, West Walker River, Walker River and Tributaries through Walker River natural channel to Walker Lake for Fish, Game and Recreation purposes. The point of diversion of water from the source is as follows: SE¼ SE¼ Section 16, T.11N., R.29E., M.D.B.&M., or at a point from which the meander corner common to Sections 20 and 21, T.11N., R.29E., M.D.B.&M., bears S. 69° 58' 16" W., a distance of 5113.8 feet situated in Mineral County, State of Nevada.

NOW KNOW YE, That the State Engineer, under the provisions of NRS 533.425, has determined the date, source, purpose, amount of appropriation, and the place where such water is appurtenant, as follows:

Name of appropriator State of Nevada, Department of Fish and Game

Post-office address Reno, Nevada

Amount of appropriation 795.2 c.f.s., but not to exceed 575,870 acre-feet

Period of use, from January 1st to December 31st per annum of each year

Date of priority of appropriation September 17, 1970

Description of place and manner of use:

The place of use is described as Walker Lake downstream from Schurz, Nevada, where the water is used to help maintain the lake at a stable level to support public use for recreation and improve water quality and quantity to sustain and help prevent loss of the fishery in Walker Lake.

This certificate is issued subject to the terms of the permit.

The right to water hereby determined is limited to the amount which can be beneficially used, not to exceed the amount above specified, and the use is restricted to the place and for the purpose as set forth herein.

IN TESTIMONY WHEREOF, I PETER G. MORROS, State Engineer of Nevada, have hereunto set my hand and the seal of my office, this 28th day of DECEMBER, A.D. 19 83.

Compared bc/bl

Recorded ..... Bk..... Page.....

.....County Records.

1923

State Engineer

A RESOLUTION

WHEREAS, Walker Lake, situated in Mineral County, Nevada, is a large naturally created body of water of imposing majesty and beauty; and,

WHEREAS, Walker Lake is one of the few remaining mountain/desert lakes still extant in the Western States in essentially the same condition (except for volume) as it was when first explored in 1845 by the Joseph Walker Expedition; and,

WHEREAS, Walker Lake has proven to be a natural resource of inestimable value to humanity, both prehistorically and historically, by providing food and fiber to the ancients and unlimited and diversified recreation to current generations; and,

WHEREAS, in 1962 the U.S. Bureau of Land Management, the agency of primary jurisdiction, saw the need for, and the advantage of, providing camping and other facilities for public use on the lake and created such facilities; and,

WHEREAS, ever-increasing use of the lake and the accomodations by boaters, hunters, fishermen, water-skiers, campers and nature-lovers and because of the limited funds available to the USBLM for maintenance or expansion of the facilities over their 20 year life span. They have now proven to be inadequate to meet current public demand; and,

WHEREAS, the Carson City district of the USBLM (Nevada) has developed and created a comprehensive and commendable plan for improvement of its Walker Lake facilities entitled "Walker Lake Recreation Management Plan" copies of which are attached hereto as a part of this resolution; and,

WHEREAS, because Walker Lake is both an economic and esthetic resource and asset for both the State of Nevada and the County of Mineral which is of primary and overriding importance; now therefore,

BE IT RESOLVED, and it hereby is, that U.S. Senator Paul Laxalt, U.S. Senator Chic Hecht, U.S. Congresswoman Barbara Vucanovich and U.S. Congressman Harry Reid are hereby respectfully requested by the Mineral County Board of Commissioners to urgently intercede with the Honorable James Watt and the United States Department of Interior and attempt to obtain special funding in the full amount needed as well as accelerated construction authorization for immediate initiation

and completion of the facilities and operational measures set forth in the "Walker Lake Recreation Management Plan"; and,

BE IT FURTHER RESOLVED, and it hereby is, that by copy hereof the Honorable Richard Bryan, Governor of the State of Nevada, is respectfully requested to lend his vigorous and continuing support toward early accomplishment and execution of the "Walker Lake Recreation Management Plan" as conceived and designed by the U.S. Bureau of Land Management.

Board of Mineral County Commissioners

By: _____
Harry L. Poe, Chairman

By: _____
Donald F. Seevers, Vice-Chairman

By: _____
Allen E. Conelly, Member

Attest: _____
Clerk

Copy to:
U.S. Senator Paul Laxalt
U.S. Senator Chic Hecht
U.S. Representative Barbara Vucanovich
U.S. Representative Harry Reid
Governor Richard Bryan

Approved June 16th., 1983 by the Board of Mineral County Commissioners.

CERTIFIED COPY
The document to which this certificate is attached is a full, true and correct copy of the original on file and of record in my office.

DATE: September 22, 1994
MARLENE S. BUNCH, Clerk of the Fifth Judicial District Court, in and for the county of Mineral, State of Nevada.

By _____ CLERK Deputy

CERTIFICATE OF MAILING

Pursuant to FRCP 5(b), I certify that I am an employee of the Law Office of ZEH, SPOO & HEARNE, and that on this date I caused to be mailed a copy of the attached **MEMORANDUM OF POINTS AND AUTHORITIES IN SUPPORT MINERAL COUNTY'S PROPOSED PETITION TO INTERVENE**, with postage fully prepaid to:

See attached Service List

DATED this 25th day of October, 1994.

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Attorneys for Intervenor-Petitioner
MINERAL COUNTY

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEVADA

UNITED STATES OF AMERICA, Plaintiff, WALKER RIVER PAIUTE TRIBE, Plaintiff-Intervenor, vs. WALKER RIVER IRRIGATION DISTRICT, a corporation, et al., Defendants.	IN EQUITY NO.C-125 AFFIDAVIT OF KELVIN J. BUCHANAN
WALKER RIVER IRRIGATION DISTRICT, Petitioner, vs. CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, W. DON MAUGHAN, EDWIN H. FINSTER, ELISEO M. SAMANIEGO, JOHN CAFFREY and DARLENE E. RUIZ, Members of the California State Water Resources Control Board, Respondents.	

1. I am a Nevada Registered Professional Engineer with twenty (20) years experience and have been a Nevada resident since 1975.

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2. I have researched and compiled documents and papers authored by the U.S. Geological Survey (USGS), the Nevada Department of Wildlife (NDOW), the U.S. Bureau of Reclamation, the Nevada State Engineers' office, the California Division of Water Resources, in addition to Federal Decree C-125. I have reviewed scientific papers authored by Alex Horne, limnologist, and Mike Sevon, NDOW employee, in addition to perusing pertinent press releases on the subject of Walker Lake.

3. I have personally visited USGS gauge stations and reservoirs on the Walker River system prior to and including 1994. I am told there are no gauge stations on the Walker River System downstream from Wabuska. (J. Thomas, USGS, personal communication)

4. I concur with the findings of the report, *Walker River Basin Water Rights Model, Nevada Department of Conservation and Resources, June, 1993*, that the readings derived for inflow into Walker Lake from the Walker River represent 84% of the lake's recharge (Attachment A).

5. I concur with the *Office of Assessment Technology Memorandum, August, 1993*, that the diversions in the Walker River Irrigation District (WRID) source areas are not technically efficient and that irrigation ditches should be lined with impervious material to prevent leakage. (Attachment B)

6. I concur with the report *Walker River Basin Water Rights Model, Nevada Department of Conservation and Resources, June, 1993*, that if Walker Lake does not continue to receive at least 84% (or 103,000 acre feet per annum) of its recharge from the Walker River system, it will eventually be unable to support fish life. This demise of Walker Lake will result in the financial collapse of tourist facilities in Mineral County which depend on fishing.(Attachment A)

7. I conclude that the lack of gauge stations downstream from the Wabuska station would make it difficult to accurately estimate C.P.S. rates of water flow on the Walker River Paiute Reservation.

I declare under penalty of perjury that the foregoing is true and correct. Executed this 5th day of October, 1994, at Reno, Nevada.

Kelvin J. Buchanan

SUBSCRIBED and SWORN to before me
this 5th day of October, 1994

NOTARY PUBLIC

CAROLE J. THOMAS
Notary Public - State of Nevada
Appointment Recorded in Washoe County
MY APPOINTMENT EXPIRES APR 2, 1995

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Treva J. Hearne, Esq.
James Spoo, Esq.
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Attorneys for MINERAL COUNTY OF NEVADA

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEVADA

UNITED STATES OF AMERICA, Plaintiff, WALKER RIVER PAIUTE TRIBE, Plaintiff-Intervenor, vs. WALKER RIVER IRRIGATION DISTRICT, a corporation, et al. Defendants.	IN EQUITY NO. C-125s Subfile No. C-125-B **AFFIDAVIT**

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WALKER RIVER IRRIGATION DISTRICT,

Petitioner,

/vs.

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, W. DON MAUGHAN, EDWIN H. FINSTER, ELISEO M. SAMANIEGO, JOHN CAFFREY and DARLENE E. RUIZ, Members of the California Water Resources Control Board,

Respondents.

STATE OF NEVADA)
) ss.
COUNTY OF MINERAL)

I, HERMAN F. STAAT, being duly sworn, say:

1. I am a duly elected Commissioner of Mineral County, Nevada. I currently serve as a Commissioner of Mineral County and at all times relevant to the statements made herein, have served as Commissioner of Mineral County. I have served in this capacity since I was elected in 1991.

2. Walker Lake is a terminal, desert lake totally contained within the political and legal boundaries of Mineral County, Nevada.

3. The information that Walker Lake has been diminished in total water quantity and, therefore, quality has been made known to me in my official capacity as a

Commissioner of Mineral County. I have personally observed the loss of water in Walker Lake over the last three years and the loss of flow through the Walker River reaching Walker Lake.

4. Since 1991 until on or about July 1994, no information had been presented to me as a Commissioner nor to the Commission of Mineral County in its official capacity nor to me personally that federal litigation had been initiated regarding the water of Walker River affecting Walker Lake. Other litigation had been discussed or considered regarding the waters of Walker River affecting Walker Lake in State Courts of California and Nevada.

5. To my best knowledge and belief, September 1 was the first time that the possibility of intervention by Mineral County in a federal lawsuit was discussed with the Mineral County Commission in its official capacity.

6. After discussing this matter on September 1, 1994, the Mineral County authorized certain attorneys and engineers on September 15, 1994, to go forward and prepare an intervention on behalf of Mineral County in the federal lawsuit to protect and preserve Walker Lake for the citizens and residents of Mineral County and other

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users of Walker Lake for recreation, wildlife preservation, and other economic interests.

DATED this 22nd day of September, 1994.

HERMAN F. STAAT, Chairman
County Commissioners Mineral County

SUBSCRIBED and SWORN to
before me this 22nd
day of September, 1994.

NOTARY PUBLIC

My commission expires August 13, 1995

JEAN JUSTUS
Notary Public - State of Nevada
Appointment Recorded in Mineral County
MY APPOINTMENT EXPIRES AUG. 13, 1995

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CERTIFICATE OF MAILING

Pursuant to FRCP 5(b), I certify that I am an employee of the Law Office of ZEH, SPOO & HEARNE, and that on this date I caused to be mailed a copy of the attached **AFFIDAVIT**, with postage fully prepaid to:

See attached Service List

DATED this 25th day of October, 1994.

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IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEVADA

UNITED STATES OF AMERICA, Plaintiff, WALKER RIVER PAIUTE TRIBE, Plaintiff-Intervenor, vs. WALKER RIVER IRRIGATION DISTRICT, a corporation, et al. Defendants.	IN EQUITY NO. C-125s Subfile No. C-125-B **AFFIDAVIT OF MARLENE BUNCH**

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WALKER RIVER IRRIGATION DISTRICT,

Petitioner,

vs.

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, W. DON MAUGHAN, EDWIN H. FINSTER, ELISEO M. SAMANIEGO, JOHN CAFFREY and DARLENE E. RUIZ, Members of the California Water Resources Control Board,

Respondents.

STATE OF NEVADA)
) ss.
COUNTY OF MINERAL)

I, MARLENE BUNCH, being duly sworn, say:

1. I am a duly elected and presently serving Clerk and Treasurer of Mineral County, Nevada, and have served in that capacity for approximately the last four years and have served at all times relevant to the statement herein.

2. As Treasurer, I am in charge of accounting for the property tax revenues due, owing, and received by Mineral County. 30% of Mineral County's general fund budget is made up of revenues from property taxes.

3. I am also in charge of accounting for the receipts from the State remitted to the County for sales tax. A significant percentage of the sales tax received in

/ / /

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Mineral County is attributable to businesses associated with recreation, fishing or other sales to persons using Walker Lake.

4. I am a resident of Mineral County and have been for the last 31 years. I have personally observed the loss of water in the Lake and have personally observed that business has declined in the County because fishing and other recreational activities have decreased because Walker Lake is a less desirable destination for tourists because of the loss of water in the Lake.

I declare upon penalty of perjury that the foregoing is true and correct.

EXECUTED this 5th day of October, 1994, at Hawthorne, Nevada.

Marlene S. Bunch
MARLENE BUNCH, Affiant

SUBSCRIBED and SWORN to before

before me this 5th day of October, 1994.

Jean Justus
Notary Public in and for said
County and State

JEAN JUSTUS
Notary Public - State of Nevada
Appointment Recorded in Mineral County
MY APPOINTMENT EXPIRES AUG. 13, 1995

My commission expires: Aug. 13, 1995

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CERTIFICATE OF MAILING

Pursuant to FRCP 5(b), I certify that I am an employee of the Law Office of ZEH, SPOO & HEARNE, and that on this date I caused to be mailed a copy of the attached **AFFIDAVIT OF MARLENE BUNCH**, with postage fully prepaid to:

See attached Service List

DATED this 25th day of October, 1994.

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MINERAL COUNTY

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEVADA

UNITED STATES OF AMERICA, Plaintiff, WALKER RIVER PAIUTE TRIBE, Plaintiff-Intervenor, vs. WALKER RIVER IRRIGATION DISTRICT, a corporation, et al., Defendants.	IN EQUITY NO. C-125 AFFIDAVIT OF LOUIS THOMPSON
WALKER RIVER IRRIGATION DISTRICT, Petitioner, vs. CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, W. DON MAUGHAN, EDWIN H. FINSTER, ELISEO M. SAMANIEGO, JOHN CAFFREY and DARLENE E. RUIZ, Members of the California State Water Resources Control Board, Respondents.	

1. I am a member of a not-for-profit organization known as "The Walker Lake Working Group." I am also a teacher and management consultant. I am a resident of Mineral County, Nevada.

2. I have worked with the Walker Lake Working Group for the last two years and pursuant to that work, I have gathered statistics and information regarding

the economic benefits of the presence of Walker Lake as a viable fishery and recreational facility in Mineral County, Nevada.

3. Attached hereto are the graphs that I personally prepared based upon the information that I gathered from documents from the Nevada Department of Wildlife containing the annual count of fishermen, the Nevada Commission on Tourism, and other agencies.

4. The graphs are from information that was gathered within the last two years and relates to the present and immediate past economic situation in Mineral County.

5. The graphs were fashioned from a computer program that I am familiar with and which has been used by me before. It is a standard program for illustrating information such as economic statistics and in my opinion the graphs prepared are an adequate illustration of the information that was the basis of the graphs. I am experienced and knowledgeable in graph preparation and to my best information and belief these graphs accurately illustrate the information.

6. In my opinion the economy of Mineral County is dependent upon the existence of Walker Lake. Walker Lake will only support recreation and tourism if the Lake is able to support its naturally occurring fish population, the cutthroat trout, Lahontan suckers, and tui chub. The Walker Lake Working Group as a whole supports this opinion and has worked to preserve and maintain minimum levels in Walker Lake so that the fish population will survive.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 5th day of October, 1994, at Hawthorne, Nevada.

Louis Thompson

SUBSCRIBED and SWORN to before me
this 5th day of October, 1994

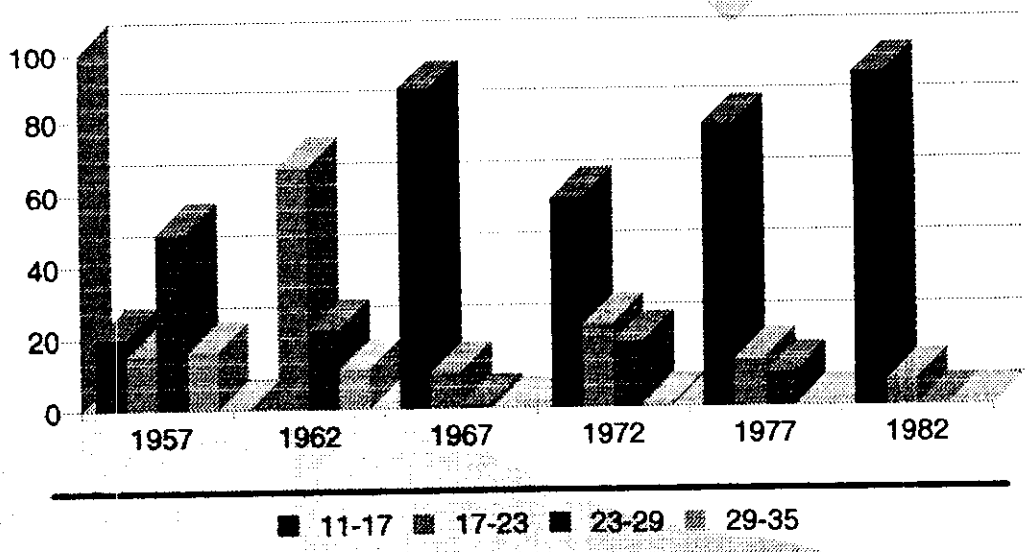
NOTARY PUBLIC

CAROLE J. THOMAS
Notary Public - State of Nevada
Appointment Recorded in Washoe County
MY APPOINTMENT EXPIRES APR. 2, 1995

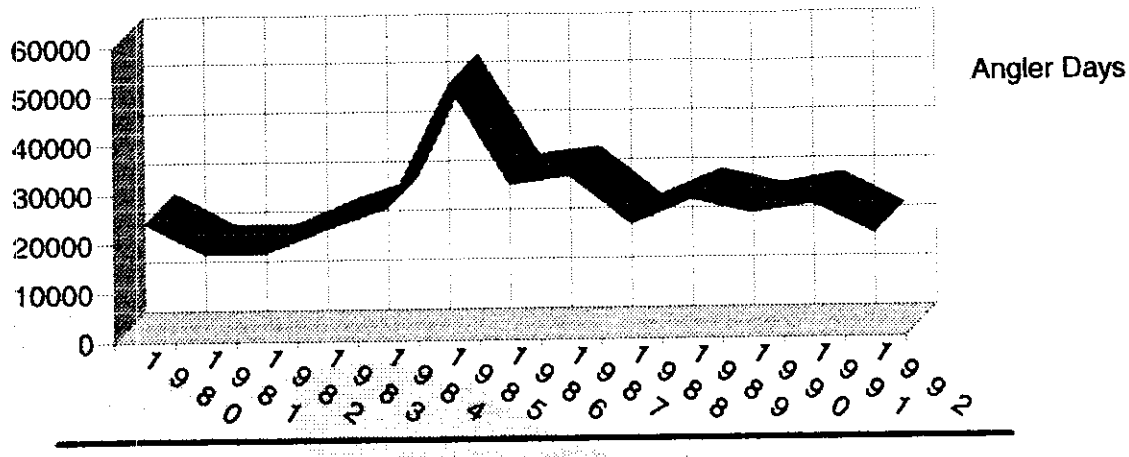
Lake Impact on County Business

- Businesses related to Walker Lake/recreation
  - 50%
- Walker Lake Important to Business?
  - Yes = 75%
- Development Help Business? How Much?
  - Yes = 77% Increase 25%

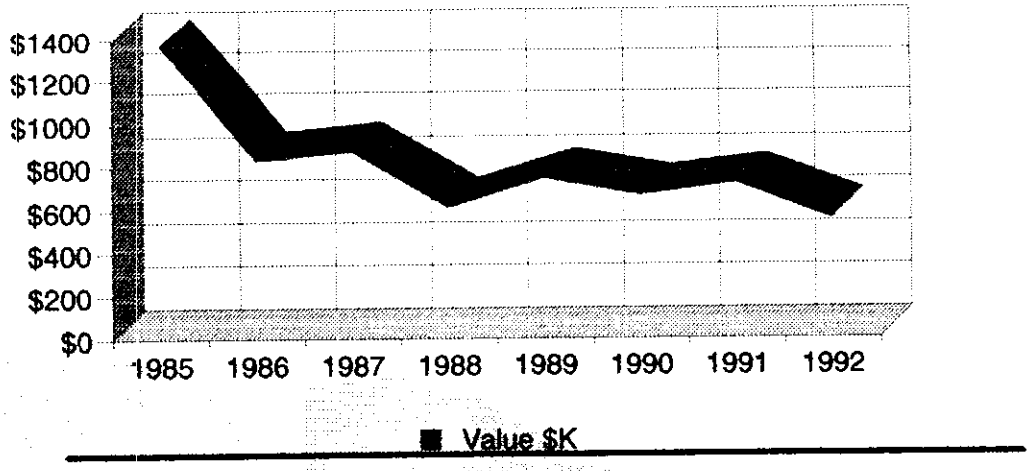
Fish Size Trends (% Caught)



Walker Lake Angler Days



Economic Impact of Fishing



Angler Impact

Angler Origin	1968	1982	1998
Mineral County	17,183	10,666	0
Other Nevada	10,956	5,288	0
Out of State	3,237	1,742	0
TOTAL	31,376	17,696	0
Non-County Total	14,193	7,040	0
Economic Value	$1,632,195	$809,600	0

Walker Lake Visitors

- Total visitors to Lake:
  - BLM Recreation Area, 1990 = 82,700 Visitor Days
  - Walker Lake State Park, 1987 = 85,434 Visitor Days

Economic Potential

- Mineral County & State of Nevada:
  - Commercial Growth
    200 to 500 new jobs
  - Tourism
    Increase of Hundreds/Thousands of Tourists per Year

CERTIFICATE OF MAILING

Pursuant to FRCP 5(b), I certify that I am an employee of the Law Office of ZEH, SPOO & HEARNE, and that on this date I caused to be mailed a copy of the attached **AFFIDAVIT OF LOUIS THOMPSON**, with postage fully prepaid to:

See attached Service List

DATED this 25th day of October, 1994.

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IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEVADA

UNITED STATES OF AMERICA, Plaintiff, WALKER RIVER PAIUTE TRIBE, Plaintiff-Intervenor, vs. WALKER RIVER IRRIGATION DISTRICT, a corporation, et al. Defendants.	IN EQUITY NO. C-125s Subfile No. C-125-B **PROPOSED ORDER**

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WALKER RIVER IRRIGATION DISTRICT,

Petitioner,

vs.

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, W. DON MAUGHAN, EDWIN H. FINSTER, ELISEO M. SAMANIEGO, JOHN CAFFREY and DARLENE E. RUIZ, Members of the California Water Resources Control Board,

Respondents.

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Respondents.

The Court, having considered MINERAL COUNTY OF NEVADA'S Motion for Intervention, and having reviewed the briefs on the motion and all relevant pleadings and documents, and good cause appearing,

IT IS HEREBY ORDERED, ADJUDGED AND DECREED that MINERAL COUNTY OF NEVADA's Motion to Intervene is granted and that the State may hereafter participate as a party to this action.

DATED this ___ day of _____, 1994.

_____
UNITED STATES DISTRICT JUDGE

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CERTIFICATE OF MAILING

Pursuant to FRCP 5(b), I certify that I am an employee of the Law Office of ZEH, SPOO & HEARNE, and that on this date I caused to be mailed a copy of the attached **PROPOSED ORDER**, with postage fully prepaid to:

See attached Service List

DATED this 25th day of October, 1994.

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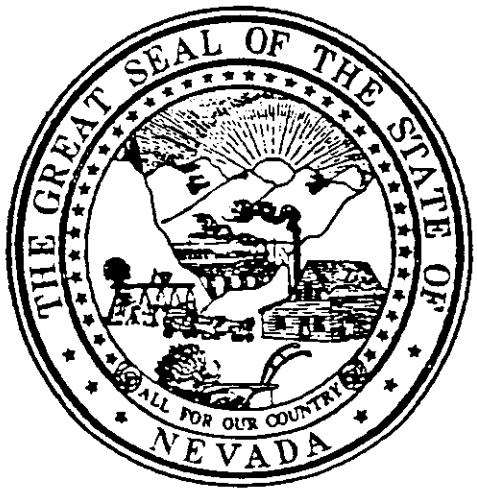
BOB MILLER
GOVERNOR

STATE OF NEVADA

WALKER RIVER BASIN WATER RIGHTS MODEL



Randy Pahl

JUNE, 1993

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
Director:
Peter G. Morros, P.E.

DIVISION OF WATER PLANNING
State Water Planner:
Everett A. Jesse, P.E.

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    ** TO BE COMPLETED LATER **

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1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this modeling study was to develop a planning tool for evaluating the impacts of operational and water use changes within the Walker River basin. With the aid of the model, planners will be able to:

- evaluate the effects of changes in reservoir and river operations
- study the impact of changes in land and water use in the basin
- analyze the effects of water right purchases
- develop information useful for placing a monetary value on water rights that may be offered for sale
- evaluate additional storage reservoir options

More specifically, the model will be useful for: 1) evaluating the impacts of ongoing litigation involving the Walker River Irrigation District (WRID) and other parties; 2) developing options for preventing further decline of Walker Lake levels.

1.1.1 Litigation. The rights to divert and use water from the Walker River system, both in Nevada and California, were determined in an adjudication proceedings in the federal district court in Nevada. These water rights are set forth in the Final Decree entered on April 14, 1936, as amended on April 24, 1940. The Walker River Decree Court has continuing jurisdiction to administer the distribution of these waters.

In 1988, the Walker River Irrigation District (WRID) released all active storage water in Bridgeport Reservoir, which was already at low levels because of the drought, to supply District irrigators. This release of warm water containing large quantities of sediment had caused a fish kill in the East Walker downstream. Following this release, California Trout, Inc., a sport-fishing association, filed a complaint with the California State Water Resources Control Board alleging that the District's dewatering of the reservoir violated several state fish protective statutes and caused a loss of fisheries in the reservoir and in the East Walker (Calif. Dept. of Water Resources, June 1992). In 1990, the California State Water Resources Control Board (State Board) issued three orders in response to the dewatering of Bridgeport Reservoir. The three orders require, in part, a minimum pool in and minimum releases from Bridgeport Reservoir.

In response, WRID filed an action for declaratory and injunctive relief with the Walker River Decree Court. WRID seeks a declaration that the three orders of the State Board are inconsistent with the Final Decree and interfere with the Decree Court's jurisdiction over the Walker River system. WRID also seeks to enjoin the State Board from enforcing those portions of the orders inconsistent with the Final Decree. The Walker River Paiute Tribe (Tribe), the United States and the State of Nevada are also involved in this action on the side of WRID and California Trout, Inc. intervened on behalf of the State Board.

The Tribe and the United States also asserted claims for the use of additional waters for the Tribe from the Walker River system. The Court ordered that the Tribe and the United States join as parties all claimants to the waters of the Walker River system. These two actions are proceeding separately before the Walker River Decree Court.

1.1.2 Walker Lake. Walker Lake, a remnant of the ancient Lake Lahontan at the terminus of Walker River, is rapidly declining in both volume and quality. Since 1920 the surface elevation of Walker Lake has dropped over 110 feet, and the alkalinity of the water has increased to a point which affects the longevity of the existing cutthroat trout population. If the current trend continues, trout habitat in the lake will no longer exist (Cooper and Koch, 1984).

1.2 Scope of Study

A computer model was developed which simulates historic monthly operations of the Walker River basin for the period 1961-90. There are a number of computer programs available for an application of this nature. The model selected for this study was the Wyoming Integrated River System Operation Study (WIRSOS) Model. WIRSOS is computer model developed for the State of Wyoming as a tool for defining and quantifying the impact of Federal claims for reserved rights, including Indian rights, on State-awarded water rights in connection with the general adjudication of water rights in the Bighorn River Basin of Wyoming. The WIRSOS Model is essentially a monthly accounting model that simulates river and reservoir operations in accordance with the doctrine of prior appropriation.

Use of the WIRSOS model required the development of an extensive input data set describing several aspects of the river including:

- Water right demands and priorities
- Reservoir area-capacity data, priority, evaporation, and water righted storage amounts
- Monthly inflows and losses
- Locations of confluences, inflow and demand points, return flow points

This report describes the steps taken in the development of these data and the general use of the WIRSOS model.

1.3 Background

The Walker River Basin is located in eastern California and western Nevada (Figure 1-1) and has a total area of approximately 4,270 square miles, of which 3,340 square miles are in Nevada. The river system within the basin consists of the East and West Walker River, Walker River, and several small tributaries.

1.3.1 Climate. Climatic conditions vary widely from the valley floors to the higher mountains in the Sierra Nevada. Annual precipitation ranges from over 50 inches in the Sierra Nevada to a low of about 4 inches near Walker Lake. At the higher elevations, a majority of the precipitation is in the form of snow. Growing seasons vary from an average of about 90 days at Bridgeport to over 200 days at Hawthorne.

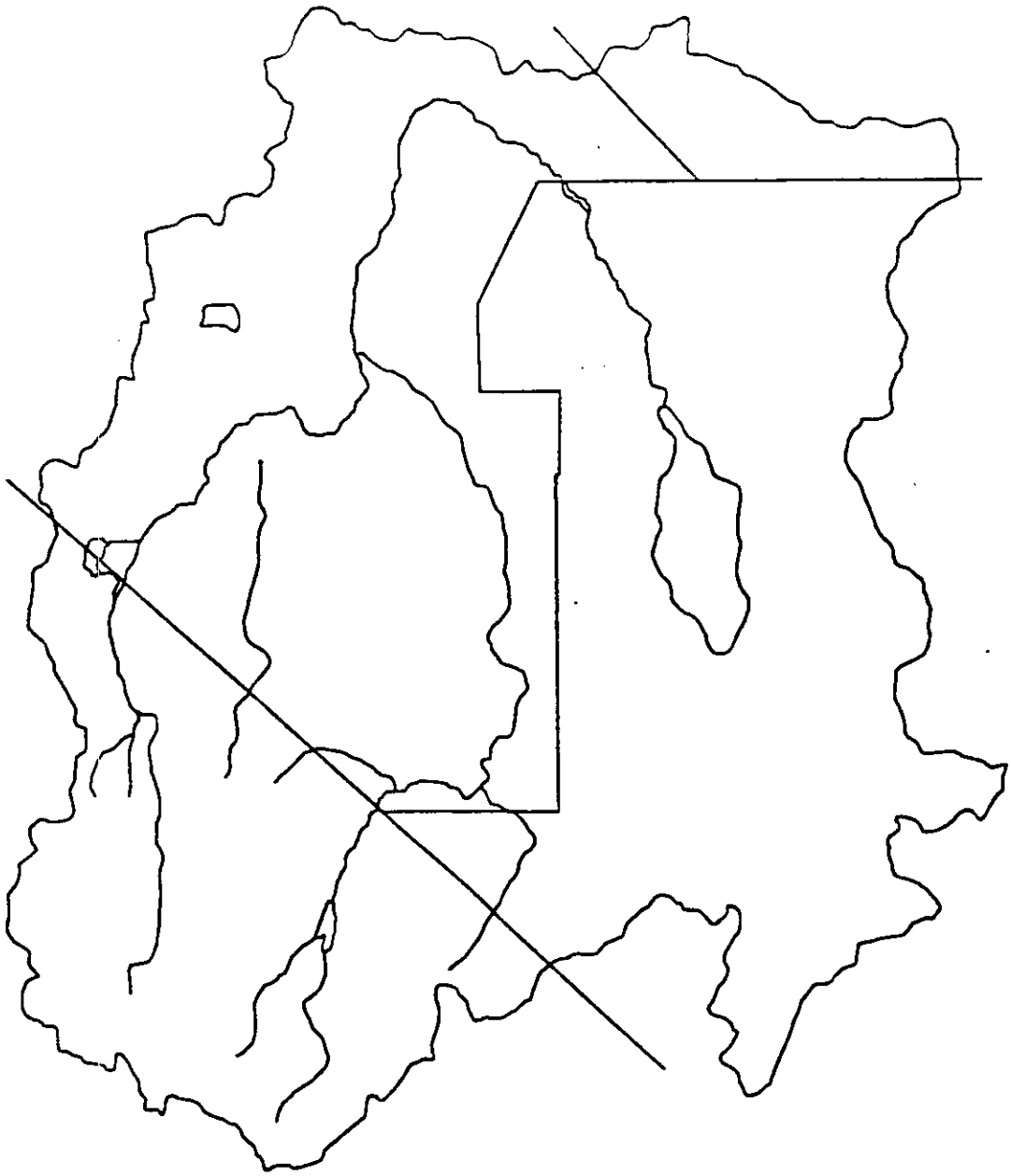

FIG. 1-1 WALKER RIVER BASIN

1.3.2 Water Resources. The hydrology of the Walker River Basin is typical for basins in the eastern Sierra Nevada rain shadow. Precipitation varies seasonally with most occurring in the winter as snow. Streamflows are also seasonal with peak flows in late spring as a result of snowmelt.

Under uncontrolled, conditions, runoff typically reaches a peak flow in late spring. The wide ranges in flow create multiple problems. Seasonal high flows often cause flood damage with serious erosion and sedimentation problems. At the other end of the flow regime, low flows limit agricultural production and result in higher water temperatures. Both sedimentation, low flows and high water temperatures adversely impact fish and wildlife, and water quality in the area.

1.3.3 Surface Water Rights. Federal Court records indicate the white man began irrigating lands on the upper tributaries of the Walker River Basin during 1860. Irrigation increase rapidly over next 20 years and by the turn of the century the natural flow of the river was deemed insufficient to meet the increasing demand. On March 24, 1919, under Decree 731 of the Federal District Court for Nevada, the amount of water to which each party was entitled, the source of the water, the area to which it was to be applied, and the priority for each use were established.

In April 1919, the Walker River Irrigation District (WRID) was organized. The District included all irrigated areas in Nevada on the East and West Walker, and main Walker Rivers, except for those lands within the Walker River Indian Reservation. Soon after formation of WRID, construction of Topaz and Bridgeport Reservoirs began. Topaz Reservoir was completed first and storage began the end of June 1922. Its capacity was originally 45,000 acre-feet, but in 1937 was increased to the present capacity of 59,440 acre-feet. Bridgeport was constructed to a 42,460 acre-foot capacity and storage began in December 1923.

Floodwater storage rights in the amount of 50,000 and 42,000 acre-feet were granted for Topaz Reservoir and Bridgeport Reservoir, respectively. Refill rights of 35,000 acre-feet for Topaz and 15,000 acre-feet for Bridgeport are also available, but can only be utilized when flows are in excess of the total demand by decreed rights.

Following the construction of Topaz and Bridgeport Reservoirs, duties of either 3.2 or 4.3 acre-feet per acre were established for the 120,000 acres within WRID. However, the available surface water in the system could only satisfy about 1/2 of these irrigation demands. As a result, about 80,000 acres are actually served by WRID. The remaining 40,000 acres have been stripped of associated water rights. A summary of these irrigated acres is given below:

Location	Acres
Smith Valley	20,750
East Walker River above Mason Valley	8,810
Mason Valley	
West Walker River	6,660
East Walker River	15,125
Walker River	28,955
Total	80,300

Source: Walker River Irrigation District database

In Decree 731, rights for many of the tributaries and several locations on the East and West Walker Rivers were considered. Also, Decree 731 granted the United States for the Walker River Indian Reservation rights to 22.93 cubic feet per second (cfs) for 1,906 acres with priorities ranging from 1868 to 1886. The U.S. Government did not accept these rights as being in the best interest of the Reservation.

Consequently, in July 1924 the United States initiated a new action to determine the rights of the upstream water users. This lengthy action was concluded in June 1939 with Decree C-125, which entitled the Reservation to a right of 26.25 cfs for 2,100 acres with an 1859 priority during a 180 day irrigation season.

The Decree further stated that the irrigation season in the Walker River Basin extends from March 1 to October 31, except for those areas above Bridgeport Reservoir on the East Walker and above the Coleville gaging station on the West Walker, where the irrigation season shall run from March 1 to September 15.

The California-Nevada Interstate Compact, which has been ratified by both states with U.S. Congressional ratification pending, further granted 13,000 acre-feet per year for storage in Weber Reservoir and later rediversion for use on the Walker River Indian Reservation. The Compact allocated all "unused water" physically available above the head of Mason Valley to the State of California and the State of Nevada on 35-65 percent split, respectively. Subsequently, the State Engineer's Office has issued water rights to WRID for this "unused water."

In addition to the rights discussed above, the Nevada Department of Wildlife has appropriated 795.2 cfs of river flow into Walker Lake for fish, game and recreation purposes with a priority date of September 17, 1970

A Board of U.S. Water Commissioners acts as watermaster, and has the duty of apportioning and distributing the waters of the Walker River system in both states, including water for storage and stored water, in accordance with all provisions of the Decree.

1.3.4 Ground Water Rights. In Nevada, ground water, as with surface water, is considered the property of the State. The Nevada State Engineer has established a duty of water to be applied to a beneficial use when issuing permits and certificates for irrigation purposes. In the Nevada portion of the Walker River Basin, this duty is 4 acre-feet per acre per season. The courts determine the quantity or duty of water to be applied to a beneficial use in the adjudication of water rights.

The most extensive groundwater development in the Walker River Basin has taken place in Smith and Mason Valleys. Portions of the ground water are used to supplement surface supplies during times of low flows. Due to increased development of groundwater, the State Engineer classified 3 of the valleys as designated basins (Smith Valley in 1960, Mason Valley in 1977, and Antelope Valley in 1978). Once designated, the State Engineer has additional authority in the administration of groundwater in the basin.

A summary of groundwater rights in the Nevada portion of the Walker River Basin is given below.

Area	Permitted Withdrawals, acre-feet		
	Irrigation	Other	Total
Antelope Valley	5,980	1,437	7,417
Smith Valley	57,109	1,979	59,088
Mason Valley	119,776	29,399	149,175
East Walker Area	8,266	742	9,008
Total	191,131	33,557	224,688

Source: Hydrographic Basin Summaries, 1992, Divisions of Water Planning and Water Resources.

2.0 WATER BUDGET

Prior to the development of the model, average annual water budgets for each of the 6 subareas were developed. The water budget of a basin can be expressed as a balance of the water entering the system with the amount of water leaving the system and any associated change in storage. The water budget can be expressed as the equation:

$$I = O \pm \Delta S \qquad (1)$$

where: I = inflow to the system
O = outflow leaving the system
ΔS = change in storage

The change in storage component can be either an addition of depletion of water. For the 30-year water budgets presented in this report, the budgets are assumed to be in steady-state conditions (inflow = outflow); therefore, the change in storage term in Equation (1) is assumed negligible with the exception of the Walker Lake subarea.

Inflows considered in the calculations included:

- river inflows
- local surface runoff
- groundwater recharge
- groundwater inflow

Outflows considered in the budgets included:

- river outflows
- diversions/withdrawals
- irrigation consumptive use
- phreatophyte evapotranspiration
- evaporation

Estimates of each of these components of the water budgets were taken from previous studies, if available, and adjusted as necessary to achieve a balance between inflows and outflows. As needed, the Division of Water Planning estimated other component values. The average annual water budgets for the 6 subareas of the Walker River basin are presented in Table 2-1. Figure 2-1 provides a schematic representation of the average budget for the entire study area. Following is a discussion of each component of the water budgets.

Table 2-1. Summary of Average 1961-90 Water Budgets
(All values in acre-feet per year)

Antelope Valley	
Inflow	
River inflow	199,000
Other surface inflow	7,000
Groundwater recharge	22,300
TOTAL	228,300
Outflow	
River outflow	188,100
Irrig. consumptive use	29,200
Phreatophyte ET	5,000
Lake evaporation	6,000
TOTAL	228,300
Smith Valley	
Inflow	
River inflow	188,100
Other surface inflow	
Artesia Lake basin	1,600
West Walker basin	6,400
Groundwater recharge	
Artesia Lake basin	3,000
West Walker basin	12,000
TOTAL	211,100
Outflow	
River outflow	142,000
Irrig. consumptive use	
Surface water	
Artesia Lake basin	10,000
West Walker basin	
W. Walker water	24,300
Local runoff	2,900
Groundwater	
Artesia Lake basin	1,800
West Walker basin	7,400
Phreatophyte ET	
Artesia Lake basin	9,000
West Walker basin	7,700
Artesia Lake evaporation	6,000
TOTAL	211,100

Table 2-1. Summary of Average 1961-90 Water Budgets (cont'd)
(All values in acre-feet per year)

East Walker River Basin	
Inflow	
River inflow	120,900
Other surface inflow	7,000
Recharge	17,900
TOTAL	145,800
Outflow	
River outflow	120,800
Irrig. consumptive use	10,600
Lake evaporation	4,000
Phreatophyte ET	10,400
TOTAL	145,800
Mason Valley	
Inflow	
River inflow	
West Walker River	142,000
East Walker River	120,800
Other surface inflow	6,000
Groundwater recharge	2,000
TOTAL	270,800
Outflow	
River outflow	136,900
Irrig. consumptive use	
Surface water	65,000
Groundwater	14,500
Phreatophyte ET	54,400
TOTAL	270,800
Schurz Area	
Inflow	
River inflow	136,900
Groundwater recharge	1,000
TOTAL	137,900
Outflow	
River outflow	103,000
Weber Reservoir evaporation	3,000
Irrig. consumptive use	15,000
Phreatophyte ET	16,900
TOTAL	137,900

Table 2-1. Summary of Average 1961-90 Water Budgets (cont'd)
(All values in acre-feet per year)

Walker Lake

Inflow	
River inflow	103,000
Precipitation	13,000
Local surface runoff	3,000
Groundwater inflow	3,000
TOTAL	122,000
Outflow	
Walker Lake evaporation	155,000
Storage deficit	-33,000
TOTAL	122,000

2.1 Antelope Valley

West Walker River flows. Based upon U.S.G.S. records (Sta. 10296500 and Sta. 10297500), an average of 199,000 AFY entered the valley and 188,100 AFY flowed from the valley (Appendix A).

Groundwater Recharge and Surface Water Inflow. Glancy (1971) estimated average recharge to be about 18,000 AFY and surface water inflow at 7,000 AFY. For this study, recharge and surface water inflows were assumed to be 22,100 AFY and 7,000 AFY, respectively. This adjustment was made in an effort to balance basin inflows and outflows.

Irrigation Diversions and Consumptive Use. Based upon W.R.I.D. records, an average of 64,800 AFY was diverted from the West Walker River within Antelope Valley (Appendix C). It was assumed that 29,000 AFY (45 %) of the diversions was consumed with the remainder entering the groundwater.

Phreatophyte Evapotranspiration. Glancy (1971) estimated phreatophyte evapotranspiration at 6,000 AFY. A value of 5,000 was used in this study.

Topaz Lake Net Evaporation. Utilizing USGS end-of-month storage data and the Topaz Lake storage-area relationship, an average water surface area value was estimated. Average evaporation in the Topaz Lake area of 4 feet per year was used (Navoy and others, November 1980). Based upon NOAA records, the 1961-90 average precipitation at Topaz Lake is about 9 inches per year (Appendix B). Applying a net evaporation rate of about 3.25 feet per year to the average lake surface area yields an average net evaporation of about 6,000 acre-feet per year.

2.2 Smith Valley

West Walker River Flows. Based upon USGS records and Division of Water Planning estimates, an average of 188,100 AFY entered the valley (Sta. 10297500) and 142,000 AFY flowed from the valley (Sta. 10300000) (Appendix A). For the period 1979-90, the USGS collected streamflow data at Sta. 10300000 only during the months April through September. The Division of Water Planning estimated flows for the missing months using equations developed from regression analyses of Sta. 10297500 and Sta. 10300000 data. This estimation process is described in more detail in Section 3.2.6.

Groundwater Recharge and Surface Water Inflow. Rush and Schroer (1976) estimated average recharge to be about 17,000 AFY. Snowmelt produces most of the streamflow that is generated within Smith Valley. For this report a total recharge figure of 15,000 AFY was used, with 12,000 AFY (80%) to the West Walker groundwater system and 3,000 AFY (20%) to the Artesia Lake basin groundwater system.

Rush and Schroer also calculated local surface runoff to average 12,000 AFY but stated that much of this contributes to recharge, is diverted for irrigation, and is consumed by phreatophytes and evaporation. An adjusted value of 8,000 AFY was selected for this study. Average surface inflows of 6,400 AFY (80%) and 1,600 AFY (20%) were assumed for the West Walker basin and Artesia Lake basin, respectively.

Surface Water Irrigation Diversions and Consumptive Use. WRID records indicate that an average of 76,300 AFY was diverted from the West Walker River within Smith Valley (Appendix C).

Rush and Schroer identified a groundwater divide between West Walker River and Artesia Lake. Groundwater north of this divide flows towards Artesia Lake, and groundwater south of the divide flows towards Walker River.

Of the 76,300 AFY diverted from the West Walker, 29,600 AFY were diverted into Colony Ditch on the north side of the river. It was assumed that 75% (22,200 AFY) of the Colony Ditch diversions served lands in the Artesia Lake basin (area north of groundwater divide), with the other 25% used in the West Walker drainage. Of the 54,100 AFY (76,300 - 22,200) used for irrigation in the West Walker drainage, about 24,300 AFY (45%) was assumed to be consumptively used with the remainder entering the groundwater system. In the Artesia Lake basin, approximately 10,000 AFY (45%) is consumptively used by irrigation activities.

In the West Walker basin, local runoff contributes about 6,400 AFY. It was assumed that all of this water is diverted for irrigation before it can enter the West Walker River. Additional irrigation consumptive use losses were estimated at 2,900 AFY (45%) with the remaining 3,500 AFY entering the groundwater system.

Groundwater Irrigation Pumpage and Consumptive Use.

Previous studies have estimated irrigation groundwater withdrawals for various years:

1961 - 18,200 AFY (Domenico and others, 1966)
1962 - 4,700 AFY
1963 - 3,500 AFY
1964 - 11,200 AFY

1965 - 2,300 AFY (USDA, June 1969)

1972 - 20,000 AFY (Rush and Schroer, 1972)

1974 - 12,600 AFY (Navoy and others, 1980)
1975 - 10,000 AFY
1976 - 30,000 AFY
1977 - 36,500 AFY

In general the above withdrawals were calculated using the following equation:

$$\text{Acre-feet pumped} = \frac{(0.976 \times KWH \times E)}{H} \qquad (2)$$

where: KWH = electrical energy consumption, in kilowatt hours
E = efficiency of the pump, in decimal
H = pumping lift, in feet

Using a similar methodology, the Division of Water Planning calculated annual groundwater pumpage for the period 1985-90 using Equation 2. Due to the lack of detailed information, many assumptions were required in this estimation process. Following is a discussion of the steps taken in deriving groundwater pumpage estimates.

Energy consumption data

The Division of Water Planning obtained energy consumption data from SPPCo for the period 1985-90. Data prior to this period were not readily available. SPPCo provided monthly energy consumption data for each of the 4 meter reading routes in Smith Valley. Because of customer privacy concerns, it was not possible to obtain more detailed information, such as customer name, account number and location.

Even though monthly power consumption data were available, the lack of other monthly data, such as pump lift, restricted pumpage estimates to an annual basis.

Efficiency

For this study, an efficiency of 50 percent was used for pumps. The normal efficiency range is about 50 to 80 percent (Navoy and others, November 1980). This efficiency term is for the pump motor and turbine, and not the well. Well efficiency was included in the pumping lift.

Pump lift

Determining actual pumping lift was the most difficult part of calculating pumpage. Pumping lift is the sum of 1) depth to the water table; 2) formation and well loss; and 3) head needed to drive a sprinkler system if one exists. Unfortunately the various components of pumping lift need to be approximated based upon limited data.

Some historic water level data are available for Smith Valley for the period 1985-90. However, without individual irrigation pump power consumption and well location information, it was

necessary to assume an average groundwater level for each meter reading route.

Average drawdowns in the irrigation wells (or formation losses) were developed from aquifer specific capacity estimates. Using some assumptions, Rush and Schroer (1976) demonstrated that specific capacity can be related to transmissivity as follows:

$$\text{Specific capacity, in gpm} = \frac{T}{2000} \qquad (3)$$

where: T = transmissivity, in gallons per day per foot (gpd/ft)

Based upon a map presented by Huxel (1969), transmissivity in Smith Valley varies from less than 50,000 gpd/ft to over 100,000 gpd/ft. Formation losses increase with decreasing transmissivity. For this study, a transmissivity of 50,000 gpd/ft was assumed. Next, average formation losses within the meter routes were estimated using the following equation:

$$\text{Formation loss, in feet} = \frac{\text{Pump rate, in gpm}}{\text{Specific Capacity, in gpm/ft}} \qquad (4)$$

Assuming an average pump discharge of 2000 gpm, an average formation loss of 80 feet was estimated for each meter reading route.

An additional component of pumping lift is the head required to drive a sprinkler system. In Smith Valley, pumped groundwater is applied to the fields through flood irrigation and sprinkler systems. Due to the lack of data, it was necessary to make an assumption of additional head required in each of the meter reading routes. For this study, an additional 50 feet was added to the pumping lift in the pumpage calculation.

Results

Annual groundwater pumpage volumes for each meter reading route were estimated using Equation 2 and the various assumptions discussed above. The aggregated results of these calculations are:

1985 - 21,000 AF
1986 - 13,000 AF
1987 - 23,000 AF
1988 - 32,000 AF
1989 - 28,000 AF
1990 - 34,000 AF

The next step was estimation of groundwater withdrawals for the years 1966-71, 1973, 1978-84. Figure 2-2 is a plot of the above groundwater withdrawals figures and corresponding surface water irrigation diversions. As expected, these data indicate that groundwater withdrawals increase with decreases in surface water diversions. There appears to have been an upward shift in the groundwater withdrawal-surface water withdrawal relationship from the early 1960s to the 1970s. This shift is probably indicative of increases in groundwater development during this period.

To serve as an upper bound of the data, the following equation was developed (See Figure 2-2):

$$AGW = 40,000 - (0.235 \times ASW) \quad (5)$$

where: AGW = annual groundwater withdrawals, in acre-feet per year
ASW = annual surface water withdrawals, in acre-feet per year

Using this equation, groundwater withdrawals for the years 1966-71, 1973, 1978-84 were calculated. An average valley-wide groundwater pumpage of 18,400 AFY (14,700 AFY in West Walker drainage, 3,700 AFY in Artesia Lake basin) was then estimated for the study period 1961-90. It was assumed that 9,200 AFY (50%) is consumptively used.

Phreatophyte Evapotranspiration. Rush and Schroer (1976) estimated phreatophyte evapotranspiration at 14,000 AFY (5,000 AFY in the West Walker drainage; 9,000 AFY in the Artesia Lake basin). This value was adjusted to 16,700 AFY to facilitate the balancing of Smith Valley inflows and outflows. Of this total, 7,700 AFY was assumed to consumptively used by phreatophytes in the West Walker drainage, and 5,000 AFY in the Artesia Lake basin.

Artesia Lake Evaporation. Based upon Rush and Schroer (1976), an average Artesia Lake evaporation amount of 6,000 AFY was assumed.

2.3 East Walker River Basin

East Walker River flows. Based upon USGS records and Division of Water Planning estimates, an average of 116,900 AFY was released from Bridgeport Reservoir (Sta. 10293000) and 120,800 AFY flowed from the valley into Mason Valley (Sta. 10293500) (Appendix A). For the period 1979-90, the USGS collected streamflow data only during the months April through September. The Division of Water Planning estimated flows for the missing months using equations developed from regression analyses of Sta. 10293000 and Sta.

10293500 data. This estimation process is described in more detail in Section 3.2.6.

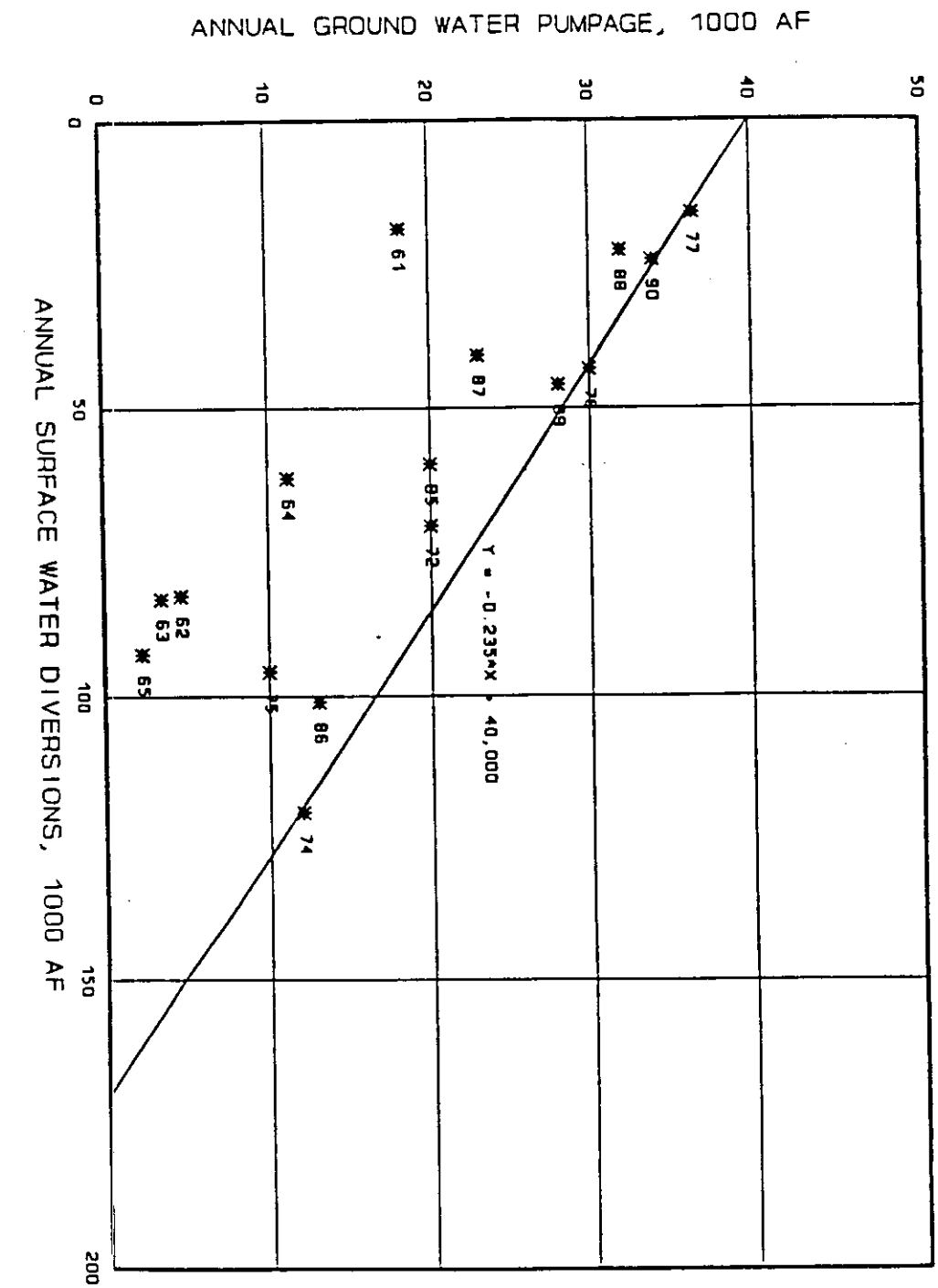

FIGURE 2-2. SMITH VALLEY GROUND WATER PUMPAGE VS. SURFACE WATER DIVERSIONS

Average annual stream inflows to Bridgeport Reservoir were estimated at 120,900 AFY by adding net reservoir evaporation (discussed under Bridgeport Reservoir Net Evaporation) from the average reservoir release of 116,900 AFY.

Groundwater Recharge and Surface Water Inflow. Glancy (1971) estimated average recharge to be about 31,000 AFY, and surface water runoff at 30,000. However, Glancy stated that the surface runoff contributes to the recharge with minimal flow entering the East Walker River. In the total water budget, Glancy assumed that the only inflow was the 31,000 AFY attributed to recharge. Even with this assumption, his estimated water budget was not balanced with total basin inflows exceeding outflows by 13,000 AFY. For this study, it was assumed that recharge is a lower value of 17,900 AFY and a runoff volume of 7,000 AFY reaches the East Walker River.

Irrigation Diversions and Consumptive Use. Based upon WRID records, an average of 23,800 AFY was diverted from the East Walker River (Appendix C). It was assumed that 10,700 AFY (45%) of the diversions are consumed with the remainder entering the groundwater system.

Phreatophyte Evapotranspiration. Glancy (1971) estimated phreatophyte evapotranspiration at 7,500 AFY. A higher value of 10,400 was used in this study as part of the inflow/outflow balancing adjustments.

Bridgeport Reservoir Net Evaporation. Utilizing USGS end-of-month storage data and the Bridgeport Reservoir storage-area relationship, an average water surface area value was estimated. Applying an evaporation rate of 3 feet per year and an average precipitation rate of about 10 inches per year (Appendix B), and average annual net evaporation of about 4,000 AFY was estimated.

2.4 Mason Valley

Walker River Flows. Based upon U.S.G.S. records, an average of 262,800 AFY (Sta. 10293500 - 120,800 AFY; Sta. 10300000 - 142,000 AFY) entered the valley and 136,900 AFY (Sta. 10301500) flowed from the valley (Appendix A).

Groundwater Recharge and Surface Water Inflow. Based upon Huxel (1969), average recharge and local surface water inflow values of 2,000 AFY and 6,000 AFY, respectively, were assumed.

Surface Water Irrigation Diversions and Consumptive Use. Based upon W.R.I.D. records, an average of 21,100 AFY was diverted from the West Walker River within Mason Valley; 51,400 AFY from the East Walker River within Mason Valley; and 71,800 AFY from the Walker River (Appendix C). Of the total 144,300 AFY diverted, it was assumed that approximately 65,000 AFY (45%) was consumptively used.

Groundwater Irrigation Pumpage and Consumptive Use. Groundwater irrigation pumpage was estimated by Huxel (1969) for the period 1961-65:

1961 - 20,000 AFY
1962 - 9,200 AFY
1963 - 6,700 AFY
1964 - 21,000 AFY
1965 - 1,200 AFY

To estimate groundwater pumpage, Huxel used Equation 2 and energy consumption data supplied by Sierra Pacific Power Company (SPPCo), estimates of pumping lift and a wire-to-water efficiency. For the period 1985-90, the Division of Water Planning used a similar methodology in estimating groundwater withdrawals in Mason Valley. A detailed discussion of the methodology is presented in Section 2.2.

Energy Consumption Data

The Division of Water Planning obtained energy consumption data from SPPCo for the period 1985-90.

Efficiency

For this study, an efficiency of 50% was used. As discussed in Section 2.2, this efficiency term is for the pump motor and turbine, and not the well. Well efficiency was included in the pump lift term.

Pump Lift

Pumping lift includes 1) depth to the water table; 2) formation and well loss; and 3) head needed to operate a sprinkler system. As discussed in Section 2.2, there were numerous problems encountered in estimating pump lift. For instance, water level data are available for Mason Valley for the period 1985-90. However, without individual irrigation pump power consumption and well location information, it was necessary to assume an average groundwater level for each meter reading route.

Based upon a map of aquifer transmissivity presented by Huxel (1969), transmissivity in Mason Valley ranges from less than 50,000 gpd/ft to over 200,000 gpd/ft in limited areas. For this study, a transmissivity of 50,000 gpd/ft was applied to each meter reading route. From Equation 3, an average specific capacity of 25 gpm/ft was calculated. It was assumed that the average pump discharge was 2000 gallons per minute. From Equation 4, an average formation loss of 80 feet was calculated.

An additional component of pumping lift is the head required to drive a sprinkler system. In Mason Valley, pumped groundwater

is applied to the fields through flood irrigation and sprinkler systems. Without energy consumption data for specific wells with a known location, it was necessary to make an assumption of additional head required in each of the meter reading routes. For this study, an additional 50 feet was added to the pumping lift in the pumpage calculation.

Results

Annual groundwater pumpage volumes for each meter reading route were estimated using Equation 2 and the various assumptions discussed above. The aggregated results of these calculations are:

1985 - 28,000 AF
1986 - 16,000 AF
1987 - 43,000 AF
1988 - 59,000 AF
1989 - 48,000 AF
1990 - 63,000 AF

The next step was estimation of groundwater withdrawals for the years 1966-84. Figure 2-3 is a plot of the above groundwater withdrawals and corresponding surface water irrigation diversions. As anticipated, these data indicate that groundwater withdrawals increase with decreases in surface water diversions. There appears to have been an upward shift in the groundwater withdrawal-surface water withdrawal relationship from the 1960s to the 1980s. This shift was also identified in Smith Valley (Figure 2-2) and is probably indicative of increases in groundwater development between the 1960s and 1980s.

To serve as an upper bound of the data, the following equation was developed (See Figure 2-3):

$$AGW = 80{,}000 - (0.320 \times SWD) \qquad (6)$$

where: AGW = annual groundwater withdrawals, in acre-feet per year
ASW = annual surface water withdrawals, in acre-feet per year

Using this equation, groundwater withdrawals for the years 1966-84 were calculated. An average valley-wide groundwater pumpage of about 29,000 AFY was then estimated for the study period. Of this amount, it was assumed that 14,500 AFY (50%) was consumptively used.

Phreatophyte Evapotranspiration. Huxel (1969) estimated phreatophyte evapotranspiration at 57,000 AFY. For this study it was assumed that 54,400 AFY is lost through phreatophyte ET in Mason Valley. This value was adjusted in order to balance

estimated water budget inflows and outflows.

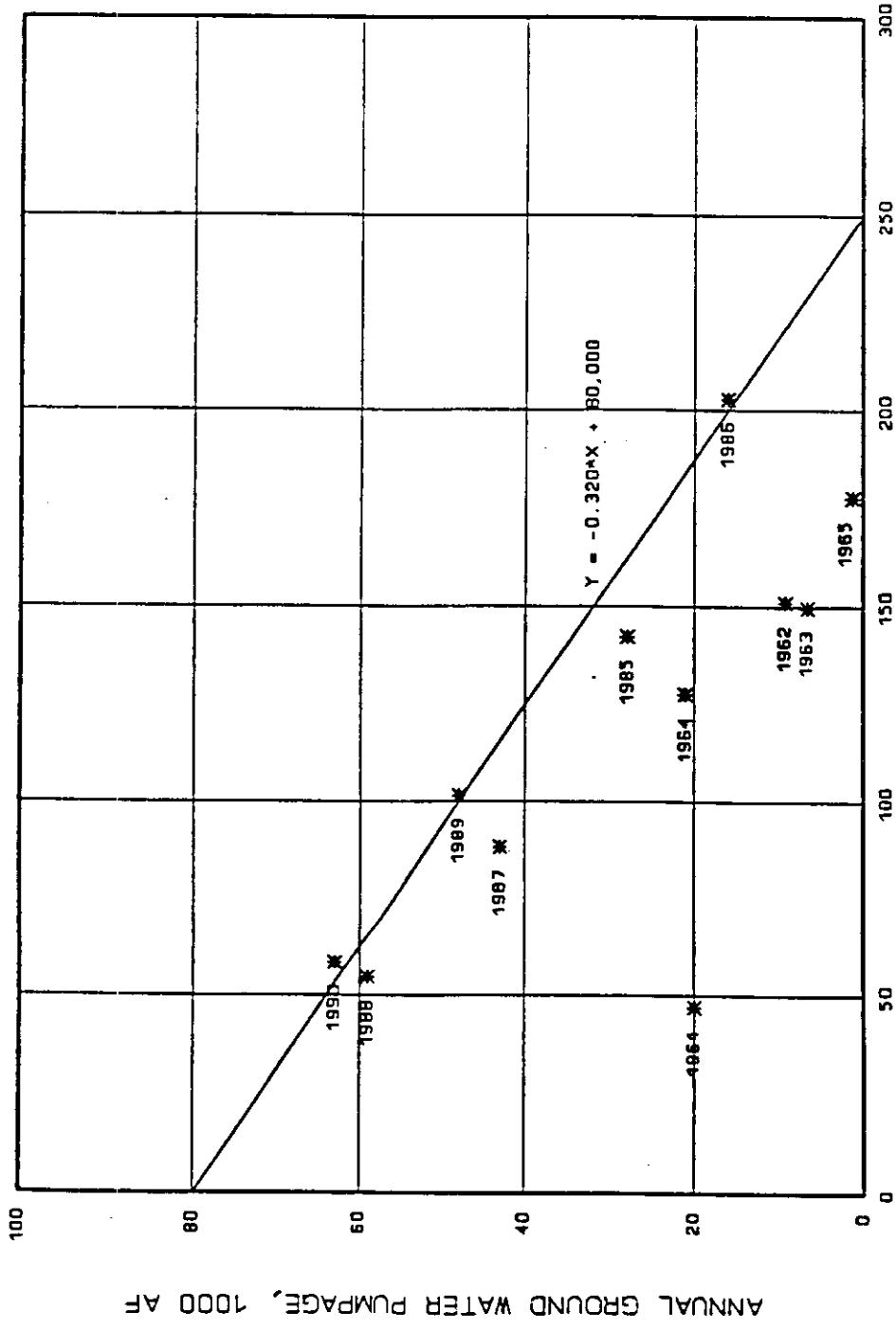

FIGURE 2-3. MASON VALLEY GROUND WATER PUMPAGE VS. SURFACE WATER DIVERSIONS

2.5 Schurz Area

Walker River Flows. Based upon USGS records and Division of Water Planning estimates, a 1961-90 average inflow of 136,900 AFY was measured at Sta. 10301500 (Appendix A). The Division of Water Planning has estimated an average outflow of about 103,000 AFY from the Schurz Area to Walker Lake (See Section 2.6).

Groundwater Recharge and Surface Water Inflow. Schaefer (December 1980) estimated groundwater recharge at 650 AFY. A value of 1,000 AFY was used for this study.

Irrigation Diversions and Consumptive Use. According to Schaefer (December 1980), an average of 32,000 AF is diverted annually for irrigation within the Walker River Indian Reservation. Of this amount, he assumed 12,000 AFY was consumptively used. As part of the inflow/outflow balance process, the consumptive use was increased to 15,000 AFY (about 45% efficiency) for this report.

Phreatophyte Evapotranspiration. Schaefer (1980) estimated phreatophyte evapotranspiration at 14,000 AFY. A higher value of 16,900 was used in this study as part of the inflow/outflow balancing adjustments.

Weber Reservoir Net Evaporation. An average net evaporation from Weber Reservoir of about 3,000 AFY was estimated (Schaefer, 1980).

2.6 Walker Lake

As Walker River flows into Walker Lake are not gaged, the Division of Water Planning estimated annual inflows for the 30-year study period.

For Walker Lake, where the change in storage has been an overall depletion, Equation 1 is modified as follows:

$$I_R + I_L + I_{GW} + P = E - \Delta S \qquad (7)$$

where: I_R = Walker River inflow
I_L = local surface runoff
I_{GW} = groundwater inflow
P = precipitation directly on the lake surface
E = lake evaporation
ΔS = change in storage

Solving for I_R, Equation (7) becomes:

$$I_R = E - I_L - I_{GW} - P - \Delta S \quad (8)$$

From Equation (8), annual Walker River inflows were calculated for each year of the study period 1961-90. Local surface inflow, I_R, was estimated by Everett and Rush (1967) to be 3,000 AFY. I_{GW} was estimated by Rush (1974) at 3,000 AFY.

Utilizing USGS end-of-month storage data and the Walker Lake storage-area relationship, the annual water surface area for each year in the study period was calculated. Applying a precipitation rate of 4 inches per year, an average precipitation inflow, P, of 13,000 AFY was estimated. Assuming an evaporation rate of 4 feet per year, a 30-year average evaporation, E, of 155,000 AFY was estimated.

USGS end-of-month storage data indicate that Walker Lake has declined an average of 33,000 AFY (ΔS) during the study period.

Solving equation 8 yielded an average Walker River inflow of 103,000 AFY.

3.0 MODEL INPUT DEVELOPMENT

Required input for the WIRSOS Model can be divided into 5 main categories :

Stream network, identifying:

- Flow direction and stream confluences
- Points of inflow, losses, diversions

Inflows/losses, such as:

- River and local surface water inflows
- Ground water recharge
- Phreatophyte consumptive use
- Other inflows and losses

Water rights data, i.e. priority dates and allowable diversion amounts, for:

- Direct flow diversions
- Supplemental storage water diversions
- Storage water diversions
- Instream flow requirements

Return flow data, describing:

- Percentage of diversion that is consumed
- Delay pattern by which unconsumed portion returns to river

Reservoir and lake data, such as:

- Storage water rights
- Maximum and minimum storage volumes
- Outlet works capacity
- Evaporation rates
- Area-capacity curves

3.1 Stream Network Numbering System

For WIRSOS to simulate a river basin, a modeling system is necessary to define the network of stream which comprise the river basin study area. The stream network identified determines the direction of flow in the river and facilitates the distribution of runoff and the superposition of diversions, instream flows, and reservoirs. As part of this step, a schematic representation of the study area was defined (See Figure 3-1). Within the schematic, station numbers were assigned at points of inflows, diversions, return flows, losses, reservoirs, and any other point where an accounting of the water is desired.

WIRSOS does not directly handle interaction between the ground

water and surface water. In order to account for ground water recharge, ground water pumpage, phreatophyte losses, etc., artificial ground water "tributaries" were included in the WIRSOS network.

3.2 Inflows and Losses

One of the first steps in developing the WIRSOS input data set is the estimation of inflows to and losses within the study area. Monthly inflows and losses that were developed included:

- East and West Walker River inflows
- Ground water irrigation consumptive use
- Ground water recharge
- Local surface water inflows
- Phreatophyte losses

As discussed in Section 2.0 WATER BUDGET, there are system losses other than those listed above, such as surface water irrigation consumptive use, and reservoir evaporation. However, these items are estimated by the WIRSOS model and therefore are not included in the input data set.

For this draft version of the model, natural monthly inflows and losses within the Schurz subarea were not included. All local inflows and losses were lumped into the irrigation diversions calculated by WIRSOS. It was assumed that 100% of the surface water diversions are consumed by irrigation activities, phreatophytes, and other losses with no return flows. According to the average annual water budget (Section 2.0), the difference between the Schurz inflows and outflows is approximately equal to the surface water diversions. It may be desirable to modify this portion of the model in future versions.

Following is a discussion of the annual and monthly data compiled and generated for WIRSOS input. Monthly West Walker River inflows were taken from USGS gaging records. Monthly values for the other components were estimated by the Division of Water Planning.

3.2.1 River Inflows. Monthly West Walker River inflows were compiled from USGS gaging records for Sta. 10296500 - West Walker River near Coleville, CA. East Walker River inflows into Bridgeport Reservoir were estimated using the following equation:

$$\begin{aligned} \textit{Bridgeport Reservoir inflow} = {} & \textit{Change in storage} \\ & + \textit{Reservoir outflow} \\ & + \textit{Lake evaporation} \\ & - \textit{Precipitation on lake surface} \end{aligned} \qquad (9)$$

In this equation, the "change in storage" component was calculated from USGS end-of-month storage data for Sta. 10292500 - Bridgeport Reservoir near Bridgeport, CA. Monthly reservoir outflow volumes were compiled from USGS records for Sta. 10293000 - East Walker

River near Bridgeport, CA. Average monthly water surface areas were calculated utilizing the Bridgeport Reservoir storage-area relationship. By applying monthly evaporation rates listed below:

January	0.06 ft.	July	0.50 ft.
February	0.07 ft.	August	0.53 ft.
March	0.16 ft.	September	0.40 ft.
April	0.18 ft.	October	0.25 ft.
May	0.27 ft.	November	0.14 ft.
June	0.38 ft.	December	0.06 ft.
		TOTAL	3.00 ft.

and the monthly precipitation amounts (Appendix B) to these areas, the remaining components of Equation 9 were estimated. Estimated monthly reservoir inflows are presented in Appendix D.

3.2.2 Ground Water Irrigation Consumptive Use. Annual ground water irrigation withdrawals were estimated as discussed in Section 2.0. Monthly withdrawals were assumed to vary in direct proportion to the surface water diversions and were calculated as follows:

$$MGWW_{Year=X,\ Month=Y} = \frac{MSWD_{Year=X,\ Month=Y}}{ASWD_{Year=X}} \times AGWW_{Year=X} \qquad (10)$$

where:

$AGWW_{Year=X}$ = Annual groundwater withdrawals for Year X, in acre-feet per year.

$ASWD_{Year=X}$ = Annual surface water diversions for Year X, in acre-feet per year.

$MGWW_{Year=X,\ Month=Y}$ = Monthly groundwater withdrawals for Year X, Month Y, in acre-feet per year.

$MSWD_{Year=X,\ Month=Y}$ = Monthly surface water diversions for Year X, Month Y, in acre-feet per year.

Estimated monthly ground water irrigation withdrawals are presented in Appendix E. Assuming an efficiency of 50%, monthly groundwater consumptive use amounts were estimated.

3.2.3 Groundwater Recharge. For the 6 subareas in WRID, it was assumed that recharge is directly proportional to flows at Sta. 10296000 - "West Walker River below Little Walker River near Coleville, CA," at which flows are assumed indicative of natural flow conditions. Annual and monthly recharge figures for model input were calculated using the following equations:

$$AGWR_{Year\text{-}X} = \frac{Annual\ Flow\ @\ Sta.\ 10296000_{Year\text{-}X}}{Avg.\ Annual\ Flow\ @\ Sta.10296000} \times AVGWR \qquad (11)$$

$$MGWR_{Year\text{-}X,\ Month\text{-}Y} = \frac{Monthly\ flow\ @\ Sta.10296000_{Year\text{-}X,\ Month\text{-}Y}}{Annual\ flow\ @\ Sta.10296000_{Year\text{-}X}} \times AGWR_{Year\text{-}X} \qquad (12)$$

where: $AGWR_{Year=X}$ = Annual groundwater recharge for year X, in acre-feet per year.

AVGWR = Average annual groundwater recharge for years 1961-90, in acre-feet per year.

$MGWR_{Year=X,\ Month=Y}$ = Monthly groundwater recharge for Year X, Month Y, in acre-feet per year.

Estimated monthly ground water recharge values are presented in Appendix F.

3.2.4 Local Surface Water Inflow. As with recharge, it was assumed that local surface water inflow is directly proportional to flows at Sta. 10296000 - "West Walker River below Little Walker River near Coleville, CA." Annual and monthly local surface inflow figures for model input were calculated using the following equations:

$$ASWI_{Year\text{-}X} = \frac{Annual\ Flow\ @\ Sta.10296000_{Year\text{-}X}}{Avg.\ Annual\ Flow\ @\ Sta.10296000} \times AVSWI \qquad (13)$$

$$MSWI_{Year\text{-}X,\ Month\text{-}Y} = \frac{Monthly\ flow\ @\ Sta.10296000_{Year\text{-}X,\ Month\text{-}Y}}{Annual\ flow\ @\ Sta.10296000_{Year\text{-}X}} \times ASWI_{Year\text{-}X} \qquad (14)$$

where: $ASWI_{Year=X}$ = Annual surface water inflow for Year X, in acre-feet per year

AVSWI = Average annual surface water inflow for period 1961-90, in acre-feet per year

$MSWI_{Year=X,\ Month=Y}$ = Monthly surface water inflow for

Year X, Month Y, in acre-feet per year

Estimated monthly local surface runoff values are presented in Appendix G.

3.2.5 Phreatophyte Evapotranspiration. Annual phreatophyte evapotranspiration was assumed to vary with flows at Sta. 10296000 - "West Walker River below Little Walker River near Coleville, CA."

$$APET_{Year-X} = \left(\left(\frac{Annual\ Flow \bullet Sta.\ 10296000_{Year-X}}{Avg.\ Annual\ Flow \bullet Sta.\ 10296000} - 1\right) \times 0.5 \times AVPET\right) + AVPET \qquad (15)$$

where: $APET_{Year-X}$ = Annual phreatophyte evapotranspiration for Year X, in acre-feet per year

AVPET = Average annual phreatophyte evapotranspiration for period 1961-90, in acre-feet per year

Monthly phreatophyte evapotranspiration amounts were calculated by distributing the annual figures by the following percentages:

January	1%	July	18%
February	3%	August	17%
March	5%	September	10%
April	8%	October	7%
May	11%	November	3%
June	16%	December	1%

This distribution follows the monthly distribution of crop evapotranspiration in the Yerington area as presented by the SCS (1981). Estimated monthly phreatophyte evapotranspiration values are presented in Appendix H.

3.2.6 Inflows and Losses Calibration. The purpose of this step was to test the suitability of the input data described in Sections 3.2.1 through 3.2.5. With the aid of spreadsheets, the monthly water budgets for Antelope, Smith and Mason Valleys, and the East Walker River subarea were simulated. Due to the lack of monthly streamflow data in the Schurz and Walker Lake subareas, monthly water budgets were not developed for these areas.

Utilizing the equations in Table 3-1, the spreadsheets

calculated annual and monthly river outflows from Antelope, Smith and Mason Valleys, and the East Walker River subarea. These predicted outflows were compared to actual gaged flows. Statistics performed on the historic and predicted outflows were used as a measure of input suitability.

Spreadsheet input included those data described in Section 3.2.1 through 3.2.5 and other additional data needed for solving the equations in Table 3-1:

- River inflows to and outflows from valleys
- Surface water irrigation diversions and return flows
- Topaz Lake diversions and releases

River Inflows and Outflows

Monthly data were compiled for the following USGS gaging stations (See Appendix A):

Sta. 10293500 - East Walker River above Strosnider Ditch near Mason, NV
Sta. 10297500 - West Walker River at Hoye Bridge near Wellington, NV
Sta. 10300000 - West Walker River near Hudson, NV
Sta. 10301500 - Walker River near Wabuska, NV

For those years after 1978, data were not collected by the USGS at Sta. 10293500 and Sta. 10300000 during the non-irrigation season (October through March). In order to estimates these missing flows, regression equations were developed which related monthly flows at Sta. 10293500 to those at Sta. 10293000, and monthly flows at Sta. 10300000 to flows at Sta. 10297500 (Table 3-2). The resulting equations had high coefficients of determination, R^2, and therefore were deemed suitable for purposes of this study.

Table 3-1. Monthly Water Budget Equations

River Outflow Equations

Antelope Valley only

River outflow = River inflow
- Surface water diversions
+ Local surface water runoff (16)
- Topaz Lake diversions(+)/releases(-)
+ Groundwater discharge to river

Smith Valley, East Walker River & Mason Valley

River outflow = River inflow
- Surface water diversions
+ Local surface water runoff (17)
+ Groundwater discharge to river

Groundwater Discharge Equation

Antelope Valley and East Walker River

Groundwater discharge to river = Irrigation return flow
+ Recharge (18)
- Phreatophyte evapotranspiration

Smith and Mason Valleys

Groundwater discharge to river = Irrigation return flow
+ Recharge
- Phreatophyte evapotranspiration (19)
- Groundwater withdrawals
+ Groundwater irrigation return flow

Table 3-2. Regression Equations for Estimating Monthly Flows at Sta. 10293500 and Sta. 10300000

Equation for estimating flows at Sta. 10293500:

Flow at 10293500 = A x (Flow at 10293000) + B

Month	Equation Coefficients A	B	R^2
October	1.102	700	0.893
November	1.014	1,300	0.889
December	0.941	1,400	0.901
January	0.984	1,200	0.984
February	1.116	850	0.925
March	1.025	200	0.974

Equation for estimating flows at Sta. 1030000:

Flow at 10293500 = A x (Flow at 10293000) + B

Month	Equation Coefficients A	B	R^2
October	0.716	850	0.884
November	1.149	750	0.818
December	1.003	1,050	0.900
January	0.985	1,150	0.959
February	1.074	1,100	0.983
March	1.053	1,100	0.989

Surface Water Irrigation Diversions and Return Flows

Monthly diversions for each of the canals within the Walker River Irrigation District and Antelope Valley were compiled from records at the WRID office in Yerington. Return flows were set equal to 55% of diversions (45% efficiency - See Section 2.0 WATER BUDGET).

Topaz Lake Diversions and Releases

Monthly diversions to and releases from Topaz Lake were calculated using the following equation:

$$\textit{Topaz Lake diversions}(+)/\textit{releases}(-) = \textit{Change in storage} + \textit{Lake evaporation} - \textit{Precipitation on lake surface} \quad (20)$$

In this equation, the "change in storage" component was calculated from USGS end-of-month storage data for Sta. 10297000 - Topaz Lake near Topaz, CA. Average monthly water surface areas were calculated utilizing the Topaz Lake storage-area relationship. By applying monthly evaporation rates listed below (Navoy and others, November 1980):

January	0.08 ft.	July	0.68 ft.
February	0.09 ft.	August	0.72 ft.
March	0.21 ft.	September	0.53 ft.
April	0.24 ft.	October	0.33 ft.
May	0.36 ft.	November	0.18 ft.
June	0.50 ft.	December	0.08 ft.
		TOTAL	4.00 ft.

and the monthly precipitation amounts (Appendix *) to these areas, the remaining components of Equation 20 were estimated.

Calibration Process

Initial monthly spreadsheet runs were performed using the input previously described. Resulting monthly and annual outflows are graphically compared with historic outflows on Figure 3-2 through 3-5. In all cases, predicted monthly inflows were higher than measured during the runoff months May, June and July, and lower than measured during the fall and winter. A better correlation between measured and simulated monthly flows was desired.

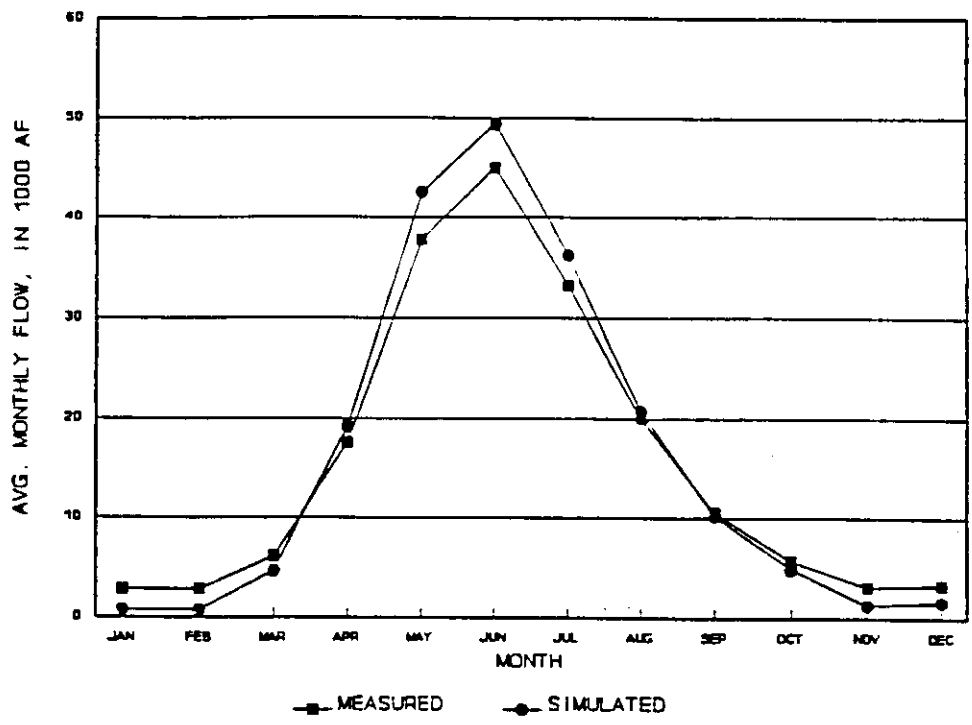

FIGURE 3-2. MEASURED AND SIMULATED (INITIAL) AVERAGE MONTHLY OUTFLOW FROM ANTELOPE VALLEY - STA. 10297500

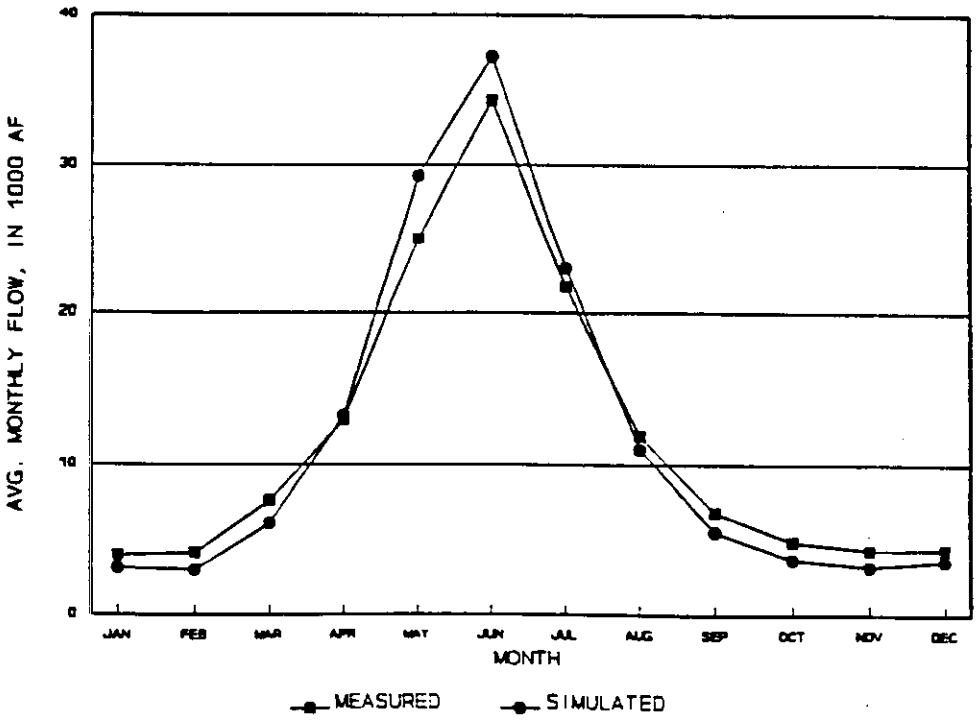

FIGURE 3-3. MEASURED AND SIMULATED (INITIAL) AVERAGE MONTHLY OUTFLOW FROM SMITH VALLEY - STA. 10300000

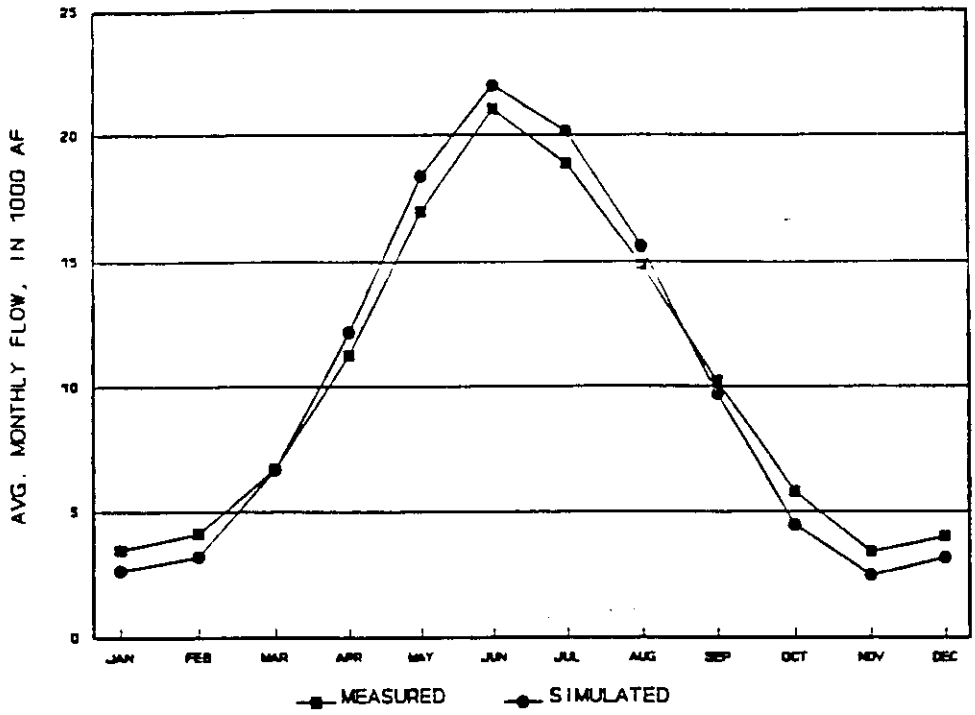

FIGURE 3-4. MEASURED AND SIMULATED (INITIAL) AVERAGE MONTHLY OUTFLOW FROM EAST WALKER RIVER SUBAREA - STA. 10293500

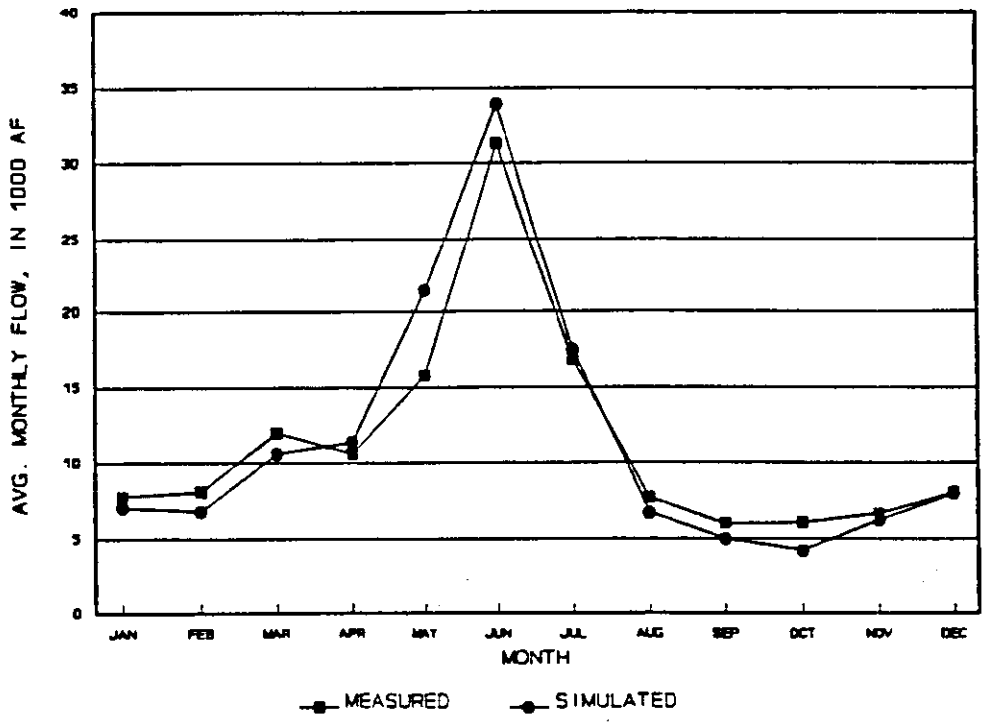

FIGURE 3-5. MEASURED AND SIMULATED (INITIAL) AVERAGE MONTHLY OUTFLOW FROM MASON VALLEY - STA. 10301500

In an attempt to improve the correlation between measured and simulated monthly flows, the monthly water budget spreadsheets were reworked with trial and error changes in some of the original input and assumptions.

One of the assumptions inherent with the initial spreadsheet runs was that the net ground water aquifer inflows for a given month discharged to the river during the same month. A more appropriate assumption for ground water flow is that the inflows are lagged while traveling through the subsurface formation with discharges to the river spread out over time. It was soon discovered that changes in these ground water return flow patterns alone did little to improve the correlation between measured and simulated monthly flows. Therefore, changes in the timing of the recharge entering the groundwater aquifers were made in addition to the modified return flow patterns.

Utilizing the monthly water budget spreadsheets, various combinations of return flow patterns and recharge timing shifts were evaluated. Seven different groundwater discharge patterns were evaluated. The patterns define the fraction of the groundwater inflow for a given month that discharges to the river in the same month and fractions for subsequent months. For instance, under Pattern 2 it is assumed that 80% of June inflows discharge to the river in June with the remaining 20% discharging in July.

	1st	2nd	3rd	4th	5th
Pattern 1	1.00	0.00	0.00	0.00	0.00
Pattern 2	0.80	0.20	0.00	0.00	0.00
Pattern 3	0.60	0.30	0.10	0.00	0.00
Pattern 4	0.50	0.40	0.10	0.00	0.00
Pattern 5	0.50	0.30	0.20	0.00	0.00
Pattern 6	0.40	0.30	0.20	0.10	0.00
Pattern 7	0.30	0.30	0.20	0.10	0.10

For all of the valleys, shifting the monthly groundwater recharge values up in time improved model calibration. A shift of 1 month resulted in the June recharge value, as calculated in Section 3.1.3, entering the groundwater aquifer in May (1 month earlier). Shifts of 0 to 3 months were evaluated as part of the calibration process.

Using the individual monthly water budget spreadsheets, a total of 28 calibration runs were performed for each valley. This represents all possible combinations of the selected recharge timing shifts and the groundwater discharge patterns. For each run, the average monthly absolute errors (AMAE) were calculated using the following equation:

$$AMAE = \frac{\sum (|S - M|)}{n} \qquad (21)$$

where: AMAE = average monthly absolute error, in acre-feet per month.
S = simulated monthly river outflow from basin, in acre-feet per month.
M = measured (gaged) monthly river outflow from basin, in acre-feet per month.
n = 360 (30 years x 12 months/year).
$|S-M|$ = the absolute value (all numbers are positive) of the simulated monthly flows minus measured monthly flows, in acre-feet per month.
$\Sigma|S-M|$ = sum of the 360 absolute values, in acre-feet per month.

Those runs with the lowest AMAE were selected as the final individual simulations. For Antelope, Smith and Mason Valleys, use of "Ground Water Discharge Pattern 7" and a shift in the recharge values of 3 months in the monthly water budget calculations yielded river flows with the least AMAE. Use of "Pattern 7" and a recharge shift of 1 month in modeling the East Walker River basin produced the lowest AMAE of the 28 runs. The statistics comparing measured and simulated monthly flows for these 4 individual runs are presented in Table 3-3.

It was interesting that shifting the recharge values improved simulation results. These results suggest that the recharge peak occurs 1 to 3 months earlier than the surface runoff. Considering the dynamics involving snowmelt and surface runoff, this shift may have some basis in the physical world. As snow begins melting, infiltration and percolation losses occur reducing the potential for runoff. Runoff does not occur until the snowmelt rate exceeds the loss rate. Over time, runoff from snowmelt increases however infiltration tends to decrease as the surface and subsurface materials reach saturation. Declining infiltration and percolation losses coupled with increasing runoff result in the difference between the recharge and runoff hydrograph peaks.

Though the recharge hydrograph may peak before the surface runoff hydrograph, the contribution recharge water eventually makes to the river flow is lagged several months during its travel through the aquifer.

By combining the 4 individual water budget spreadsheets, a joint monthly water budget model for the entire study area was developed. The joint model incorporated the same monthly water budget equations in Table 3-1. However with the joint model, the only gaged inflows to the study area were as measured at Sta.

10293500 (East Walker River basin inflow) and Sta. 10296500 (Antelope Valley inflow). Other valley inflows were replaced with simulated outflows from the upstream basins, i.e. Smith Valley inflows were set equal to simulated Antelope Valley outflows rather than Sta. 10297500 gaged flows. Utilizing Equation 21, the AMAEs for the predicted flows were calculated.

The results of both the individual and joint simulation runs are graphically compared with measured streamflows in Figures 3-6 through 3-15. Table 3-3 presents a summary of the errors associated with the individual and joint simulations. Pertinent statistics have been provided for annual flows, monthly flows (January-December), and the irrigation season monthly flows (March-October). Statistics have been presented for those months with flows greater than 5,000 and 10,000 acre-feet per month. The model accuracy tends to increase for these higher flows.

In general, model results are favorable for the purposes of this study. The predicted 30-year average annual river outflows from each valley compare well with actual historic flows. This is not surprising as the monthly inputs developed for the model were derived from the average water budgets discussed in Section 2.1. The joint model also does a good job of predicting annual flows for a given year. On the average, predicted annual flows are within 4.5 to 11.7 percent of the measured flows, close to the accuracy of the USGS gaging stations. Gaging records for Stations 10293000, 10296000, 102965000 and 10300000 have been rated as good (95% of the daily discharge measurements are within 10% of actual). Gaging records for Stations 10293500, 10297500 and 10301500 have been rated as fair (95% of the daily discharge measurements are within 15% of actual).

Joint model predictions of Mason Valley monthly outflows were the least accurate with an AMAE of 30.7%. However, it must be noted that this value is based upon the absolute values of the monthly errors. For a given year, the model will overpredict river flows in some months and underpredict in others with the negative errors canceling out the positive. Therefore, the model performs better when predicting annual flows. As discussed above, simulated annual Mason Valley outflows for a given year are, on the average, within 11.7 percent of the historic flows.

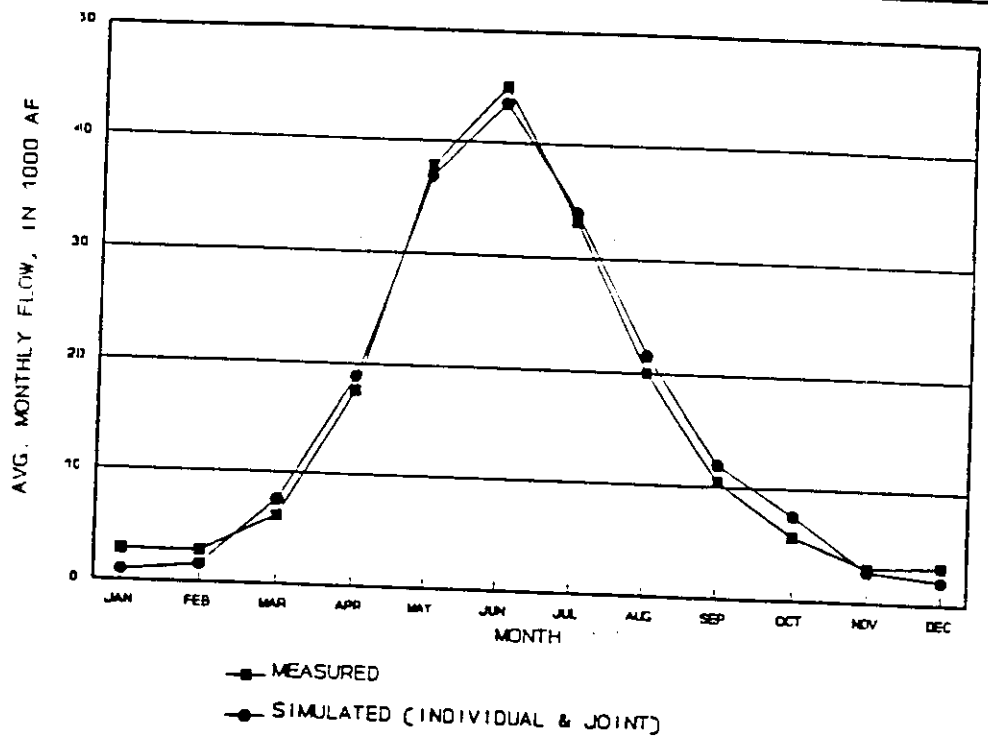

FIGURE 3-6. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) AVERAGE MONTHLY OUTFLOW FROM ANTELOPE VALLEY - STA. 10297500

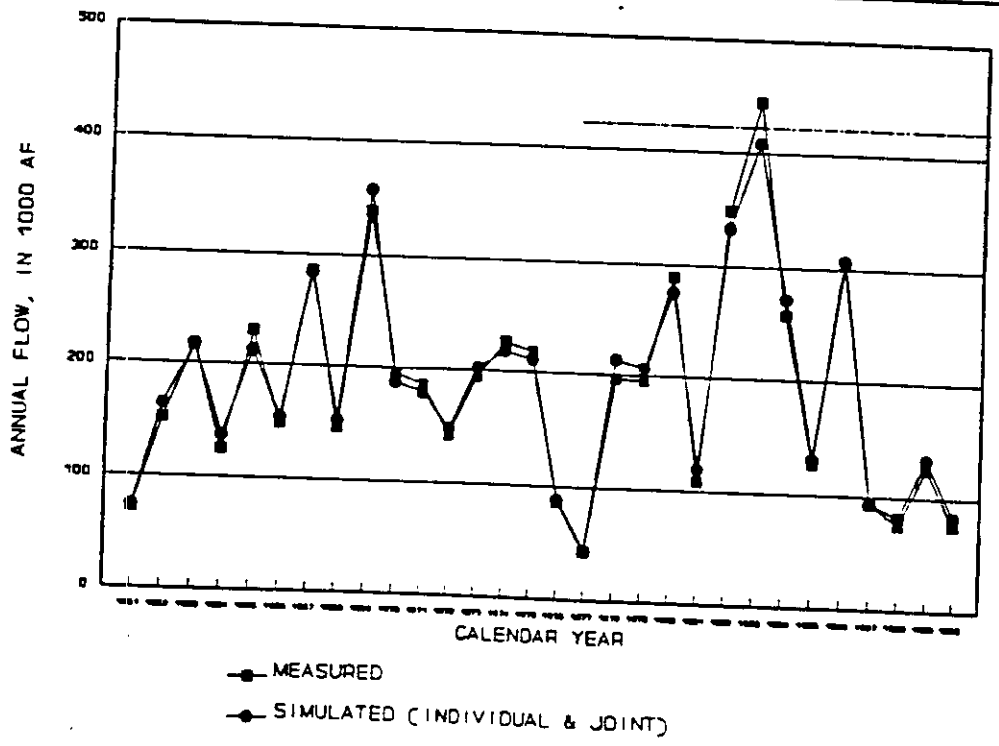

FIGURE 3-7. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) ANNUAL OUTFLOW FROM ANTELOPE VALLEY - STA. 10297500

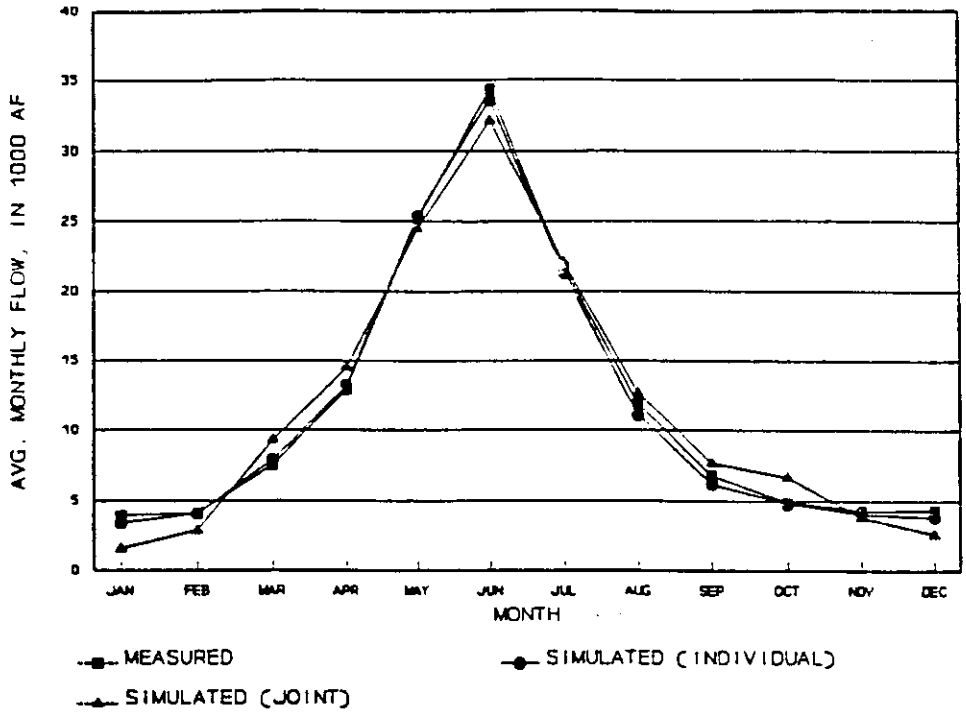

FIGURE 3-8. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) AVERAGE MONTHLY OUTFLOW FROM SMITH VALLEY - STA. 10300000

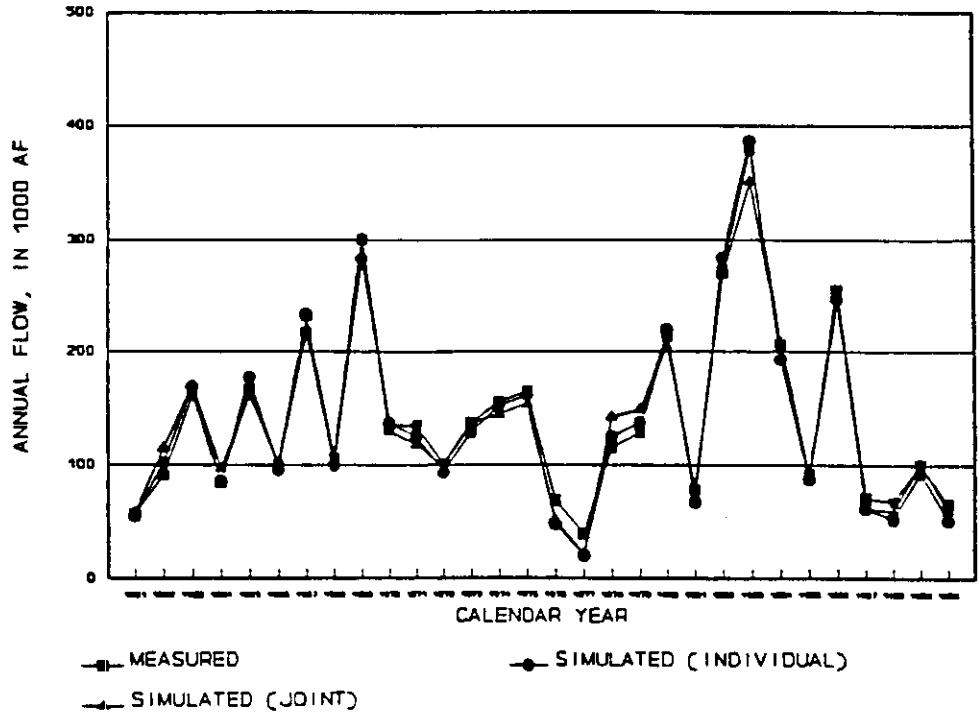

FIGURE 3-9. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) ANNUAL OUTFLOW FROM SMITH VALLEY - STA. 10300000

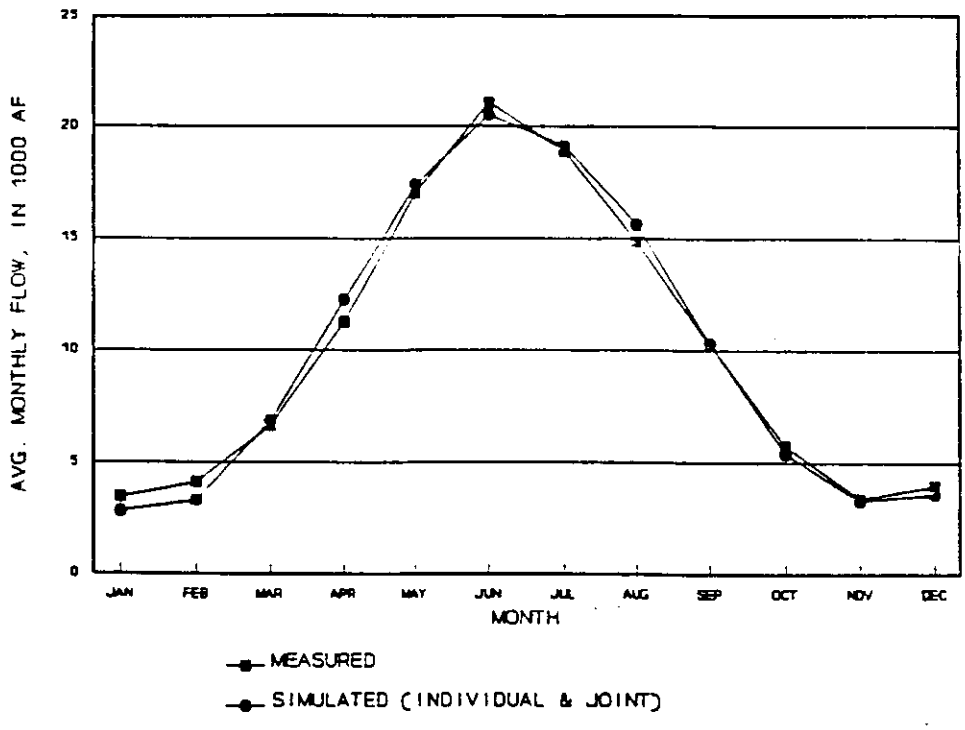

FIGURE 3-10. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) AVERAGE MONTHLY OUTFLOW FROM EAST WALKER RIVER BASIN - STA. 10293500

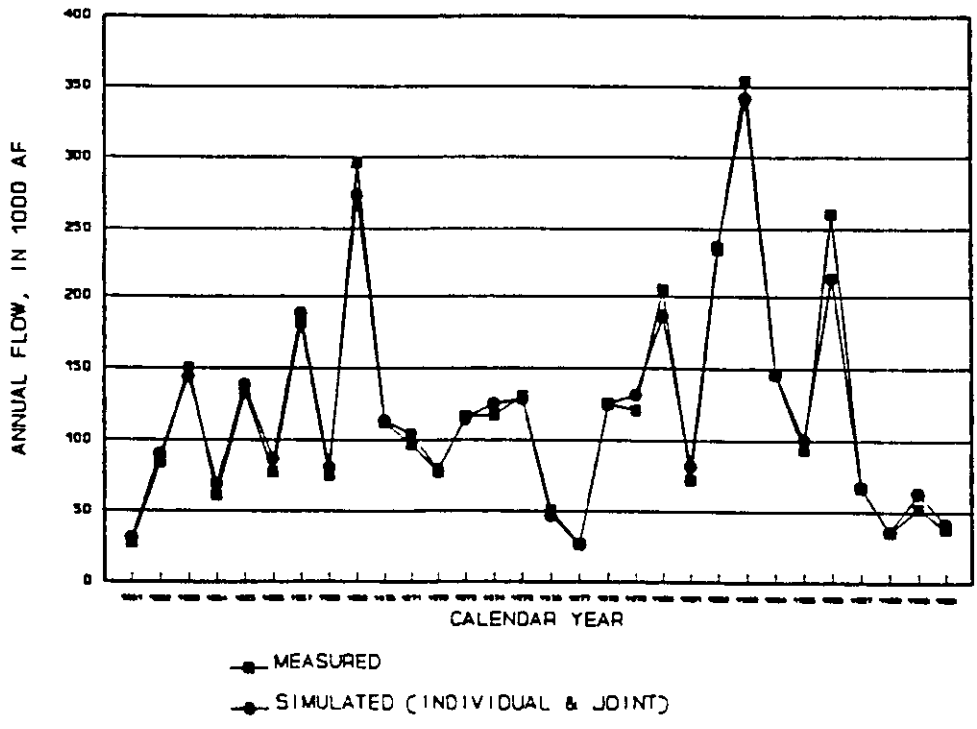

FIGURE 3-11. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) ANNUAL OUTFLOW FROM EAST WALKER RIVER BASIN - STA. 10293500

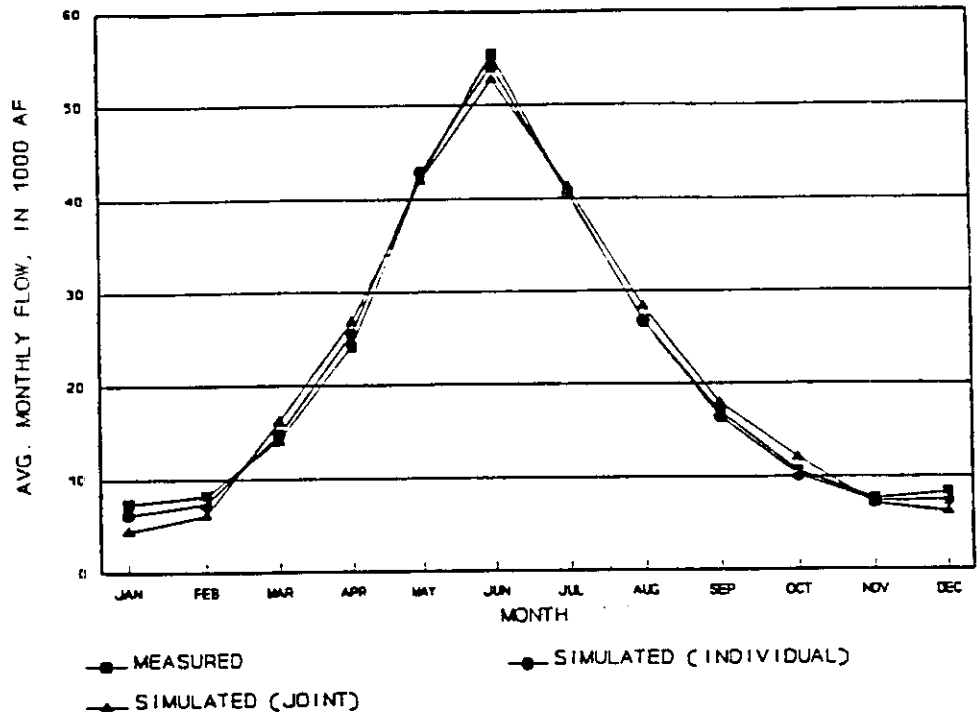

FIGURE 3-12. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) AVERAGE MONTHLY INFLOW TO MASON VALLEY - STA. 10293500 AND 10300000

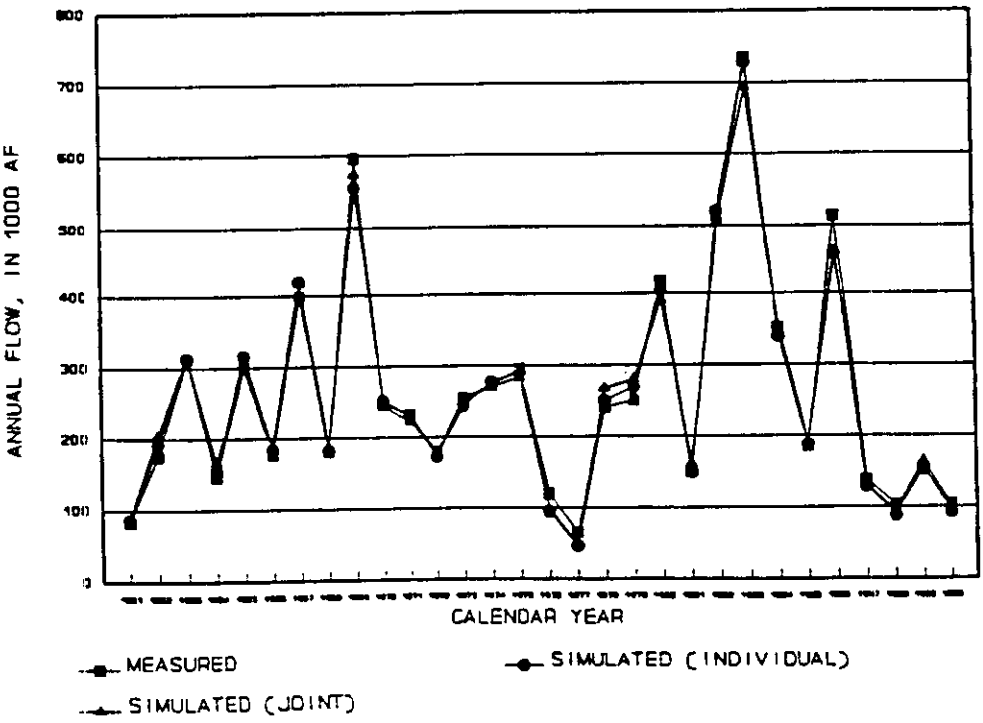

FIGURE 3-13. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) ANNUAL INFLOW TO MASON VALLEY - STA. 10293500 AND 10300000

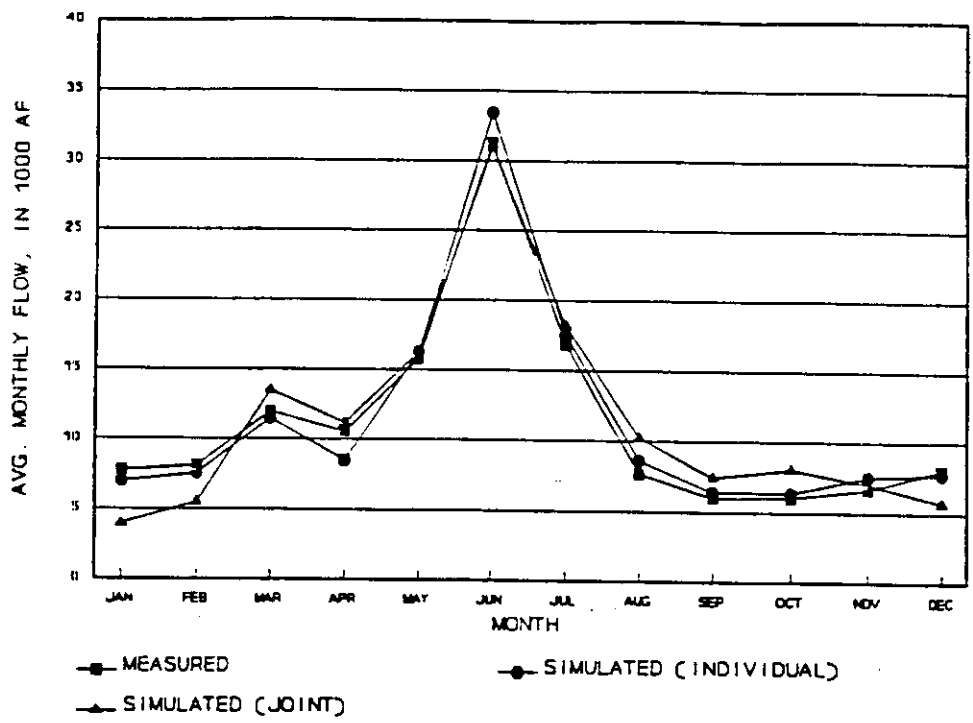

FIGURE 3-14. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) AVERAGE MONTHLY OUTFLOW FROM MASON VALLEY - STA. 10301500

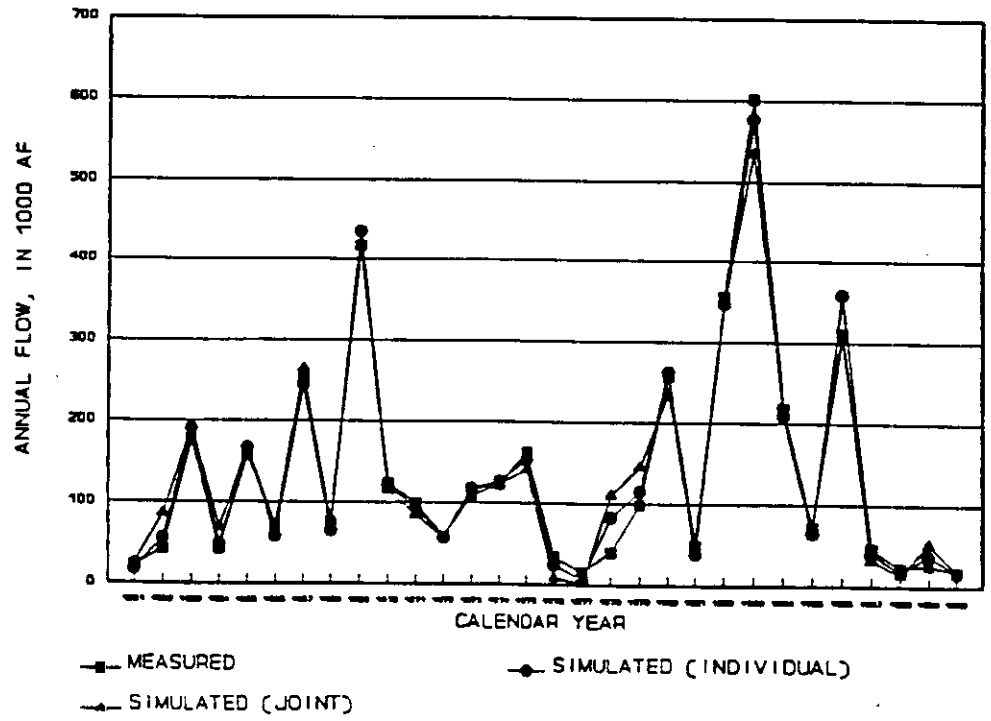

FIGURE 3-15. MEASURED AND SIMULATED (INDIVIDUAL & JOINT) ANNUAL OUTFLOW FROM MASON VALLEY - STA. 10301500

Summary

As stated earlier, the intent of the calibration process was to test and refine monthly inflows and losses for input into WIRSOS. Based upon the calibration results, it was decided to use the input data described in Sections 3.1.1 through 3.1.5, with the exception of the ground water recharge values. The recharge values described in Section 3.1.3 were shifted 1 month for East Walker River subarea and 3 months for Antelope, Smith and Mason Valleys.

The calibration runs suggest that the ground water discharge to the river, as calculated by Equations 18 and 19 (Table 3-1), enters the river in a delayed fashion (Pattern 7 of the calibration runs). WIRSOS has the capability to delay surface water irrigation return flows (See discussion in Section 3.4 Return Flow Data), but can not directly delay inflows and losses, such as ground water recharge, ground water irrigation consumptive use, and phreatophyte evapotranspiration. For these input items, additional pre-processing of the data was required prior to use in WIRSOS. With the aid of a spreadsheet template, the monthly values for these 3 items were manually lagged in accordance with Delay Pattern 7, i.e. 30% - 1st month; 30% - 2nd month; 20% - 3rd month; 10% - 4th month; and 10% - 5th month. These adjusted WIRSOS input values are presented in Appendices I, J and K.

There are a number of potential problems associated with the calibration methodology used to estimate ground water inflow and return flow patterns:

1. The main foundation for the calibration process is the average annual water budget presented in Chapter 2.0. Any errors in the average annual water budget result in errors in the calibration process.

2. Various assumptions were made in the development of monthly values for ground water recharge, surface water inflow, phreatophyte evapotranspiration, and ground water irrigation consumptive use. Errors associated with these assumptions affect the calibration results.

3. This approach assumed a consistent irrigation return flow pattern (Delay Pattern 7) for each year in the study period. It is more likely that the pattern varies with time and is dependent upon numerous factors. A ground water model would be required to more accurately simulate return flows.

4. Changes in ground water storage from year to year and its impacts upon the ground water contribution to streamflow are not taken into account. With the above approach, it is assumed that all valley inflows for a particular year are generally discharged in that same year. This is not the case in the real world. During times of drought, groundwater

storage declines. When followed by a higher water year, inflows serve to replenish the groundwater rather than discharge to the river. Unfortunately, the WIRSOS Model and other similar models are not capable of accounting for changes in ground water storage and its effect upon streamflow. Here again, a ground water model would be required to more accurately simulate the ground water and surface water interaction.

The amount of error these assumptions introduce into the calibration results is not known. Some of the errors may cancel each other out while others will cause results to deviate from actual conditions.

Table 3-3. Summary of Individual and Joint Flow Simulations

	ANTELOPE V. OUTFLOW			SMITH VALLEY OUTFLOW						E. WALKER R. OUTFLOW		
	INDIVIDUAL & JOINT			INDIVIDUAL			JOINT			INDIVIDUAL & JOINT		
	ALL	>5 KAFM	>10 KAFM	ALL	>5 KAFM	>10 KAFM	ALL	>5 KAFM	>10 KAFM	ALL	>5 KAFM	>10 KAFM
Annual												
Avg. Measured, KAFY	188.1	---	---	142.0	---	---	142.0	---	---	120.8	---	---
Avg. Simulated, KAFY	189.7	---	---	139.0	---	---	140.6	---	---	120.7	---	---
Avg. Absolute Error, KAFY	9.1	---	---	9.0	---	---	9.2	---	---	7.4	---	---
% Avg. Absolute Error, %	4.8	---	---	6.3	---	---	6.5	---	---	6.1	---	---
All Months												
Avg. Measured, KAFM	15.7	25.1	30.0	11.8	18.7	24.3	11.8	18.7	24.3	10.1	16.1	21.1
Avg. Simulated, KAFM	15.8	25.4	30.4	11.6	18.5	24.1	11.7	18.8	24.1	10.1	16.2	21.0
Avg. Absolute Error, KAFM	2.1	2.6	2.7	1.2	1.6	1.9	2.4	3.0	3.1	1.2	1.7	2.0
% Avg. Absolute Error, %	13.4	10.4	9.0	10.2	8.6	7.8	20.3	16.0	12.8	11.9	10.6	9.5
Irrigation Season												
Avg. Measured, KAFM	22.0	26.5	30.6	15.7	19.5	24.6	15.7	19.5	24.6	13.2	16.6	21.6
Avg. Simulated, KAFM	22.9	27.3	31.1	15.5	19.3	24.5	16.3	20.0	24.7	13.4	16.8	21.4
Avg. Absolute Error, KAFM	2.4	2.5	2.7	1.6	1.7	1.9	2.6	2.8	3.1	1.5	1.7	2.1
% Avg. Absolute Error, %	10.9	9.4	8.8	10.2	8.7	7.7	16.6	14.4	12.6	11.4	10.2	9.7

KAFY = 1,000 acre-feet per year
KAFM = 1,000 acre-feet per month
Avg. Absolute Error = $\Sigma(|\text{Simulated flow} - \text{Measured flow}|) \div \text{number of observations}$
% Avg. Absolute Error = (Avg. Absolute Error)/(Avg. Measured) x 100

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Table 3-3. Summary of Individual and Joint Flow Simulations (cont'd.)

	MASON VALLEY INFLOW						MASON VALLEY OUTFLOW					
	INDIVIDUAL			JOINT			INDIVIDUAL			JOINT		
	ALL	>5 KAFM	>10 KAFM	ALL	>5 KAFM	>10 KAFM	ALL	>5 KAFM	>10 KAFM	ALL	>5 KAFM	>10 KAFM
Annual												
Avg. Measured, KAFY	262.8	---	---	262.8	---	---	136.8	---	---	136.8	---	---
Avg. Simulated, KAFY	259.7	---	---	261.3	---	---	138.7	---	---	138.4	---	---
Avg. Absolute Error, KAFY	11.9	---	---	13.9	---	---	11.2	---	---	16.0	---	---
% Avg. Absolute Error, %	4.5	---	---	5.3	---	---	8.2	---	---	11.7	---	---
All Months												
Avg. Measured, KAFM	21.9	26.7	33.3	21.9	26.7	33.3	11.4	18.3	31.8	11.4	18.3	31.8
Avg. Simulated, KAFM	21.6	26.6	33.2	21.8	26.9	33.6	11.6	18.1	32.1	11.5	17.4	30.5
Avg. Absolute Error, KAFM	1.8	2.1	2.4	3.0	3.3	3.8	2.2	2.7	3.6	3.5	4.1	5.0
% Avg. Absolute Error, %	8.2	7.9	7.2	13.7	12.4	11.4	19.3	14.8	11.3	30.7	22.4	15.7
Irrigation Season												
Avg. Measured, KAFM	28.9	30.0	34.3	28.9	30.0	34.3	13.3	21.9	34.0	13.3	21.9	34.0
Avg. Simulated, KAFM	28.9	30.0	34.4	29.7	30.8	35.1	13.6	22.0	34.7	14.6	22.2	33.8
Avg. Absolute Error, KAFM	2.3	2.3	2.5	3.4	3.4	3.7	2.6	3.2	3.9	3.9	4.3	4.9
% Avg. Absolute Error, %	8.0	7.7	7.3	11.8	11.3	10.8	19.6	14.6	11.5	29.3	19.6	14.4

KAFY = 1,000 acre-feet per year
KAFM = 1,000 acre-feet per month
Avg. Absolute Error = $\Sigma(|\text{Simulated flow} - \text{Measured flow}|) \div \text{number of observations}$
% Avg. Absolute Error = (Avg. Absolute Error)/(Avg. Measured) x 100

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3.3 Water Rights

Surface water irrigation water rights were compiled for 3 different sections (8 subareas) of the Walker River basin:

- Walker River Irrigation District
  - Smith Valley - south of river
  - Smith Valley - north of river
  - East Walker River
  - West Walker River in Mason Valley
  - East Walker River in Mason Valley
  - Mason Valley
- Schurz subarea
- Walker Lake subarea

From the available water right information, the necessary WIRSOS input was developed. Historic Antelope Valley diversions were used as model input rather the water rights. In otherwords, it was assumed that Antelope Valley diversions will not change with changes in downstream operations.

From the available water right information, the necessary WIRSOS input was developed. WIRSOS input required for diversions includes:

- Station number of diversion
- Percentage of diversion that is consumed
- Priority date
- Monthly diversion demands for 12 months, in cfs
- Station where return flows enter the river

3.3.1 Walker River Irrigation District

Lands within the WRID are classified as either bottom or bench land and are irrigated with 3 types of water: 1) decree (or direct flow) water; 2) storage water; and 3) permit water.

The decree and storage water is distributed in accordance with Decree 731 which assigned annual duties of 3.28 AF/ac and 4.21 AF/ac for bottom and bench land, respectively. A summary of bench and bottom lands within WRID and associated duties is presented in Table 3-4. Total acres within each subarea were taken from a database maintained by WRID, and were broken into the bench and bottom categories based upon the bench/bottom distribution presented by Sharp, Krater & Assoc. (Feb. 26, 1969).

Table 3-4. Bench and Bottom Lands within WRID

	Bottom Land		Bench Land		Total	
	Acres[1]	Duty, AF[2]	Acres[1]	Duty, AF[2]	Acres[3]	Duty, AF[4]
Smith Valley						
South of river	3,560	11,430	9,815	42,010	13,375	53,440
North of river	1,960	6,290	5,415	23,175	7,375	29,465
East Walker	80	225	8,730	36,755	8,810	37,010
Mason Valley						
West Walker River	0	0	6,660	28,505	6,660	28,505
East Walker River	9,785	31,410	5,340	22,855	15,125	54,265
Walker River	27,855	89,415	1,100	4,710	28,955	94,125
Total	43,240	138,800	37,060	158,010	80,300	296,810

Note: Duties do not include water appropriated under Permit 5528 and 25017

[1] Calculated from Total Acres based upon bench/bottom distribution in Sharp, Krater & Assoc. (Feb. 26, 1969)

[2] Bottom duty = acres x 3.21 AF/ac

[3] From WRID database

Decree Water

Decree 731 assigned allowable irrigation diversion rates of 0.012 cfs/acre and 0.016 cfs/acre for bottom and bench land, respectively, within the Walker River Irrigation District. Total allowable diversion rates for the WRID decree water are presented in Table 3-5. For the entire irrigation season of 245 days (March 1 to October 31), WRID irrigators are limited to a total duty of 3.21 acre-feet/acre for bottom land and 4.28 acre-feet/acre for bench. If diversions were made at the maximum allowable rates for a continuous period, the seasonal duty would be met in 135 days, about one-half the length of the irrigation season. In actual practice diversions are distributed over most of the irrigation season.

From the water rights listing in Table 3-5, annual water duties for each priority date were calculated using the following equation:

$$\textit{Annual diversion demand, in AF} = \textit{Allowable CFS} \times 135\ \textit{days} \times 1.98 \qquad (22)$$

From WRID diversions records, average monthly diversions as a percentage of annual diversions were calculated (Table 3-6). Monthly diversions demands were then calculated using the following equation:

$$\textit{Monthly demand, in cfs} = \frac{\textit{Annual demand, in AF} \times \%\ \textit{of Annual demand}}{1.98 \times \textit{No. of days in month}} \qquad (23)$$

The resulting values were used as water right demand input in the WIRSOS Model.

The water rights listed on Table 3-5 are for the irrigation of approximately 45,800 acres in WRID. These lands are irrigated with direct flow (decree water) from the river by priority. Supplemental storage water from Topaz Lake and Bridgeport Reservoir are available to those rights with priority dates later than 1872. In WIRSOS, these rights are provided supplemental storage water when insufficient decree water exists to meet the duties. WIRSOS limits the total diversion of decree and storage water for a particular right to the duty of that right.

In Mason Valley, supplemental storage can be supplied by Topaz Lake and/or Bridgeport Reservoir. Unfortunately, WIRSOS does not allow a particular water right to call for supplemental storage water from more than 1 reservoir. In order to work within the constraints of WIRSOS, the post-1872 water right demands in Mason Valley calculated from Equation 23 were divided into 2 groups, one group that calls on Topaz Lake for supplemental water, and another that calls on Bridgeport Reservoir. The Topaz Lake group was assigned 2/3 of the Equation 23 demands, and the Bridgeport group was assigned the remaining 1/3. This division of demands was

selected because historically Topaz Lake has provided about 2/3 of the storage water used in Mason Valley with the other 1/3 from Bridgeport Reservoir.

TABLE 3-5. Summary of WRID Decree Water Rights in CFS

	SMITH VALLEY						MASON VALLEY						TOTAL WRID	
	WITH COLONY		WITHOUT COLONY		EAST WALKER		WEST WALKER		EAST WALKER		WALKER RIVER			
	RIGHTS	ACCUM.	RIGHTS	ACCUM.	RIGHTS	ACCUM.	RIGHTS	ACCUM.	RIGHTS	ACCUM.	RIGHTS	ACCUM.	RIGHTS	ACCUM.
1861	0.08	0.08	0.00	0.00	0.13	0.13	1.45	1.45	0.00	0.00	0.00	0.00	1.66	1.66
1862	0.16	0.24	0.00	0.00	7.68	7.81	0.95	2.40	0.00	0.00	1.20	1.20	9.99	11.65
1863	18.71	18.95	0.00	0.00	1.28	9.09	2.95	5.35	0.00	0.00	2.85	4.05	25.79	37.44
1864	11.62	30.57	0.00	0.00	0.00	9.09	1.19	6.54	0.00	0.00	7.98	12.03	20.79	58.23
1865	4.16	34.73	0.00	0.00	5.30	14.39	0.00	6.54	21.10	21.10	4.96	16.99	35.52	93.75
1866	2.54	37.27	0.00	0.00	0.00	14.39	0.00	6.54	0.00	21.10	0.00	16.99	2.54	96.29
1867	0.00	37.27	0.00	0.00	0.14	14.53	0.00	6.54	0.00	21.10	0.00	16.99	0.14	96.43
1868	1.81	39.08	0.00	0.00	0.00	14.53	7.36	13.90	0.00	21.10	9.60	26.59	18.77	115.20
1869	0.37	39.45	0.00	0.00	0.00	14.53	1.99	15.89	0.00	21.10	6.96	33.55	9.32	124.52
1870	2.40	41.85	0.00	0.00	3.20	17.73	0.64	16.53	18.01	39.11	28.19	61.74	52.44	176.96
1871	0.00	41.85	0.00	0.00	0.00	17.73	0.00	16.53	0.80	39.91	3.33	65.07	4.13	181.09
1872	0.00	41.85	0.00	0.00	0.00	17.73	10.23	26.76	1.36	41.27	14.55	79.62	26.14	207.23
1873	0.00	41.85	0.00	0.00	0.00	17.73	0.00	26.76	0.12	41.39	8.72	88.34	8.84	216.07
1874	0.00	41.85	0.00	0.00	3.76	21.49	0.00	26.76	0.00	41.39	33.60	121.94	37.36	253.43
1875	2.24	44.09	0.00	0.00	7.30	28.79	0.43	27.19	19.71	61.10	27.09	149.03	56.77	310.20
1876	0.00	44.09	0.00	0.00	0.00	28.79	0.00	27.19	1.24	62.34	0.00	149.03	1.24	311.44
1877	9.60	53.69	0.00	0.00	1.76	30.55	7.55	34.74	1.46	63.80	7.03	156.06	27.40	338.84
1878	14.44	68.13	0.00	0.00	0.00	30.55	0.00	34.74	0.00	63.80	3.95	160.01	18.39	357.23
1879	0.00	68.13	0.00	0.00	1.57	32.12	2.89	37.63	0.24	64.04	13.89	173.90	18.59	375.82
1880	5.95	74.08	0.00	0.00	5.84	37.96	0.00	37.63	17.20	81.24	40.60	214.50	69.59	445.41
1881	0.00	74.08	0.00	0.00	1.60	39.56	0.00	37.63	0.00	81.24	0.48	214.98	2.08	447.49
1882	0.91	74.99	0.00	0.00	0.00	39.56	2.08	39.71	0.00	81.24	1.88	216.86	4.87	452.36
1883	0.93	75.92	0.00	0.00	0.00	39.56	2.77	42.48	2.40	83.64	0.36	217.22	6.46	458.82
1884	1.92	77.84	0.00	0.00	0.00	39.56	0.00	42.48	0.00	83.64	0.48	217.70	2.40	461.22
1885	3.52	81.36	0.00	0.00	4.80	44.36	2.40	44.88	6.98	90.62	12.46	230.16	30.16	491.38
1886	0.00	81.36	0.00	0.00	0.00	44.36	0.00	44.88	0.00	90.62	0.00	230.16	0.00	491.38
1887	0.00	81.36	0.00	0.00	1.44	45.80	0.00	44.88	0.00	90.62	0.81	230.97	2.25	493.63
1888	0.00	81.36	0.00	0.00	0.00	45.80	0.80	45.68	1.92	92.54	0.96	231.93	3.68	497.31
1889	0.00	81.36	0.00	0.00	0.16	45.96	0.00	45.68	0.00	92.54	0.60	232.53	0.76	498.07
1890	0.74	82.10	22.08	22.08	5.16	51.12	2.10	47.78	3.77	96.31	4.38	236.91	38.23	536.30
1891	0.96	83.06	0.00	22.08	0.00	51.12	0.00	47.78	1.12	97.43	2.83	239.74	4.91	541.21
1892	0.56	83.62	0.00	22.08	0.00	51.12	0.00	47.78	2.01	99.44	1.06	240.80	3.63	544.84
1893	0.00	83.62	0.00	22.08	0.64	51.76	0.00	47.78	0.00	99.44	0.18	240.98	0.82	545.66
1894	0.00	83.62	0.00	22.08	1.47	53.23	0.51	48.29	4.80	104.24	0.18	241.16	6.96	552.62
1895	0.00	83.62	3.36	25.44	2.29	55.52	0.00	48.29	6.81	111.05	3.08	244.24	15.54	568.16
1896	0.00	83.62	0.00	25.44	0.00	55.52	0.00	48.29	0.48	111.53	1.10	245.34	1.58	569.74
1897	3.54	87.16	0.00	25.44	2.72	58.24	0.00	48.29	1.28	112.81	0.09	245.43	7.63	577.37
1898	0.00	87.16	0.00	25.44	0.00	58.24	0.00	48.29	0.48	113.29	1.26	246.69	1.74	579.11
1899	0.00	87.16	0.00	25.44	0.00	58.24	0.16	48.45	3.04	116.33	0.14	246.83	3.34	582.45
1900	0.32	87.48	0.48	25.92	0.64	58.88	1.49	49.94	0.87	117.20	10.66	257.49	14.46	596.91
1901	0.00	87.48	0.00	25.92	0.00	58.88	0.00	49.94	0.40	117.60	0.18	257.67	0.58	597.49
1902	0.00	87.48	0.00	25.92	0.00	58.88	0.00	49.94	1.80	119.40	0.11	257.78	1.91	599.40
1903	0.00	87.48	0.00	25.92	0.00	58.88	0.43	50.37	1.44	120.84	0.00	257.78	1.87	601.27
1904	0.00	87.48	0.00	25.92	0.00	58.88	0.00	50.37	1.24	122.08	0.91	258.69	2.15	603.42
1905	0.00	87.48	1.43	27.35	0.00	58.88	1.52	51.89	0.60	122.68	8.75	267.44	12.30	615.72
1906	0.00	87.48	0.00	27.35	0.72	59.60	0.00	51.89	0.00	122.68	0.16	267.60	0.88	616.60
1907	0.00	87.48	0.00	27.35	0.00	59.60	0.00	51.89	0.32	123.00	0.00	267.60	0.32	616.92
1908	0.00	87.48	0.00	27.35	0.00	59.60	0.00	51.89	0.00	123.00	0.00	267.60	0.00	616.92
1909	0.00	87.48	1.80	29.15	0.00	59.60	0.00	51.89	0.00	123.00	0.00	267.60	1.80	618.72
1910	0.00	87.48	3.33	32.48	0.00	59.60	0.00	51.89	0.00	123.00	0.00	267.60	3.33	622.05
1911	0.00	87.48	0.00	32.48	0.00	59.60	0.00	51.89	4.37	127.37	0.00	267.60	4.37	626.42
1912	0.00	87.48	1.85	34.33	0.00	59.60	0.00	51.89	0.00	127.37	0.00	267.60	1.85	628.27
1913	0.00	87.48	0.00	34.33	0.00	59.60	0.00	51.89	0.80	128.17	0.00	267.60	0.80	629.07
1914	0.00	87.48	2.60	36.93	0.00	59.60	0.00	51.89	0.00	128.17	0.00	267.60	2.60	631.67
1915	0.00	87.48	0.00	36.93	0.00	59.60	0.00	51.89	1.91	130.08	0.00	267.60	1.91	633.58
1916	0.00	87.48	0.00	36.93	0.47	60.07	0.00	51.89	0.00	130.08	0.75	268.35	1.22	634.80
1917	0.00	87.48	0.00	36.93	1.00	61.07	0.00	51.89	0.00	130.08	0.00	268.35	1.00	635.80

Table 3-6. Average Monthly Distribution of Diversions as Percentage of Annual Total

Month	Smith Valley	E. Walker River	Mason Valley		
			West Walker R.	East Walker R.	Walker R.
January	0.0	0.0	0.0	0.0	0.0
February	0.0	0.0	0.0	0.0	0.0
March	0.8	1.1	1.7	0.8	2.6
April	10.1	9.6	11.2	11.7	12.6
May	21.6	18.6	20.2	20.5	22.6
June	20.8	19.6	19.5	19.7	21.0
July	20.6	20.2	18.6	20.6	17.3
August	14.7	16.5	15.2	15.1	12.8
September	8.1	11.1	9.8	8.5	7.5
October	3.3	3.3	3.8	3.1	3.6
November	0.0	0.0	0.0	0.0	0.0
December	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0

Storage Water

There are approximately 34,500 acres of land within WRID that have rights to storage water but no decree river water. These lands are assigned annual duties of 3.21 AF/ac (bottom land) and 4.28 AF/ac (bench land), and can be irrigated between March 1 and October 31. At the time of this study, detailed annual duty information for storage-irrigated lands was not readily available. For the WIRSOS modeling, storage duties for the 6 WRID subareas were calculated by subtracting decree water duties from total duties (Table 3-7). A more accurate estimate of the seasonal duty would require considerable effort reviewing the water rights cards in the WRID office. This may be a necessary step as the modeling process evolves.

Using Equation 23, the monthly storage demands (in cfs) were developed for WIRSOS input.

Permit Water

In addition to the decree and storage water, WRID has rights to flood water in the basin under State of Nevada permits 5528 (priority date of June 6, 1919) and 25017 (priority date of April 11, 1969) for the irrigation of about 64,200 acres. A breakdown of these acres between the various valleys was estimated by the Division of Water Planning based upon State Engineer's records (Table 3-8).

When available, permit water can be diverted between May 1 and July 31 and applied to most of the lands irrigated with decree and storage water in WRID. The State Engineer has restricted the total combined duty of permit water and other sources (decree, storage, groundwater) to 4 AF/ac. Because of the junior priority dates, permit water is available only after the decree demands are met and Topaz and Bridgeport storage rights have been satisfied.

In WIRSOS, each water right is assigned its own demand (duty) schedule as defined by the user. WIRSOS will not allow diversions for a particular right to exceed the defined demand and annual duty for that right. Unfortunately, WIRSOS is not capable of directly limiting the diversion for 2 or more rights to a combined duty amount. One way around this limitation of WIRSOS is to assign one of the water rights a portion of the combined duty, and the other water right the remainder.

In a given year if sufficient water was available to meet all decree and storage demands for the entire year, permit water would only be available for bottom lands. Under this scenario, bench lands would be receiving 4.28 AF/ac of decree and/or storage water, an amount greater than the 4 AF/ac combined duty set by the State Engineer. Therefore, for this fictitious year, bottom lands could receive an additional 0.79 AF/ac (4 - 3.21) of permit water. Based upon the assumption that permit water is used as a supplemental source for bench land, additional permit water duties for the WRID subarea were calculated (Table 3-9). These calculations result in

an additional 29,375 acre-feet of permit water over and above the decree and storage amount of 296,810 acre-feet.

For WIRSOS input, these demands for permit water were distributed as follows:

May	30%
June	40%
July	30%

As described earlier, a limitation in WIRSOS required that only a portion of the combined duty of 4 AF/ac be assigned to the permit water rights. For this draft document, it was assumed that permit water is used as a supplemental source for only bench land with a duty of 0.79 AF/ac. This assumption is valid for the higher water years, when sufficient decree and storage water exists to satisfy the annual decree and storage duties, i.e. 296,810 acre-feet of decree and storage water is delivered to WRID lands. Using higher permit rights in the WIRSOS would result in modeled diversion amounts greater than the annual duties.

During lower years the 3.21 and 4.28 acre-feet/acre duties can not be met with decree and storage water. For these years, the assumed permit water rights (Table 3-9) result in modeled diversions lower than allowable. The impact this has upon the model results have yet to be quantified as the WIRSOS model is not complete. It is anticipated that the permit water portion of the WIRSOS model will need to be modified for the final model.

Table 3-7 Decree and Storage Lands within WRID

	Decree Land		Storage Land		Total	
	Acres[1]	Duty, AF[2]	Acres[1]	Duty, AF[3]	Acres[1]	Duty, AF[4]
Smith Valley						
South of river	6,340	23,385	7,035	30,055	13,375	53,440
North of river	2,565	9,870	4,810	19,595	7,375	29,465
East Walker	3,725	16,325	5,085	20,685	8,810	37,010
Mason Valley						
West Walker River	3,135	13,870	3,525	14,635	6,660	28,505
East Walker River	9,040	34,770	6,085	19,495	15,125	54,265
Walker River	21,000	71,730	7,955	22,395	28,955	94,125
Total	45,805	169,950	34,495	126,860	80,300	296,810

[1] From WRID database

[2] Calculated from Equation 22

[3] Storage duty = total duty - decree duty

[4] From Table 3-4

Table 3-8. Summary of Acres under Permit 5528 and 25017

	No. 5528	No. 25017	Total
Smith Valley			
North of river	10,100	----	10,100
South of river	11,100	----	11,100
East Walker River	----	3,700	3,700
Mason Valley			
West Walker River	4,200	----	4,200
East Walker River	----	13,300	13,300
Mason Valley	14,400	21,600	21,800[1]
Total	39,800	38,600	64,200

[1] Approximately 14,200 acres shared in common between 5528 and 25107

Table 3-8 Estimate of Additional Permit Water Duty and Total WRID Duty

	Bottom Acres	Permit Acres	Permit Duty, AF[1]	Decree & Storage Duty, AF	Total Duty, AF
Smith Valley					
North of river	3,560	11,100	2,810[2]	53,400	56,250
South of river	1,960	10,100	1,550[2]	29,465	31,015
East Walker River	80	3,700	65[3]	37,010	37,075
Mason Valley					
West Walker River	0	4,200	0	28,505	28,505
East Walker River	9,785	13,300	7,730[3]	54,265	61,995
Walker River	27,855	21,800[4]	17,220[4]	94,125	111,345
Total	43,240	64,200	29,375	296,810	326,185

[1] (Lesser of Bottom acres and Permit acres) x (4 - 3.21)

[2] June 6, 1919 priority (Permit 5528)

[3] April 11, 1969 priority (Permit 25017)

[4] Assumed 14,400 acres - 11,375 AFY under Permit 5528
7,400 acres - 5,845 AFY under Permit 25017

3.3.2 Schurz Subarea

Decree C-125, concluded in June 1939, entitles the United States, for the Walker River Indian Reservation, to a right of 26.25 cfs for 2,100 acres with an 1859 priority during an irrigation season of 180 days (April 15 to October 15). This gave the Walker River Indian Reservation to right to divert a total of 9,450 acre-feet from natural flows. According to Roger Bezayiff, Federal Watermaster, the river system is regulated such that a minimum of 26.25 cfs of natural flow is provided, if available, at the Wabuska gaging station (Sta. 10301500) every day of the 180 day period.

For WIRSOS input, a constant water right demand of 26.25 cfs was used for each month of the 180 day irrigation season. The WIRSOS model operates on a monthly time step so it was necessary to assume an average demand of 13.13 cfs for the months of April and October.

In addition to the decreed water, the Walker River Indian Reservation holds a State of Nevada water right for 0.32 cfs (Application 182, Certificate 98, priority date August 12, 1906). This water is for the irrigation of 8 acres with an irrigation season from April 1 to October 1.

3.3.3 Walker Lake Subarea

The Nevada Department of Wildlife has appropriated 795.2 cfs of river flow into Walker Lake for fish, game and recreation purposes (Certificate No. 10860). This right has a priority date of September 17, 1970 and the annual duty is limited to 575,870 acre-feet per year.

Permit #35732

For WIRSOS input, a constant water right demand of 795.2 cfs at the mouth of the Walker River was used for each month of the year.

3.4 Return Flow Data

WIRSOS requires input describing: 1) the percentage of irrigation diversions that is consumptively used; and 2) the pattern by which the unconsumed portion returns to the river.

3.4.1 Consumptive Use

For all surface water diversions, an irrigation efficiency of 45% was assumed (See Section 2.0 WATER BUDGET). Therefore, 55% of these diversions enter the ground water system. The only exception is Colony Ditch (north of river) diversions in Smith Valley. As described in Section 2.0, it was assumed that 75% of the Colony Ditch diversions are used for irrigation in the Artesia Lake basin. Therefore, only 25% of the Colony Ditch diversions produce return flows back to the West Walker River. Assuming an overall

consumptive use rate of 45% results in return flows to the West Walker River of about 13% of the total Colony Ditch diversions. As a result, about 87% (100% - 13%) of the Colony Ditch diversions are lost to the West Walker River drainage. Therefore for WIRSOS input, a "consumptive use" rate of 87%, instead of 45%, was used in the WIRSOS Model for Colony Ditch diversions.

For the Schurz Subarea, it was assumed that 100% of the surface water diversions are consumed by irrigation activities, phreatophytes, and other losses with no return flows. According to the average annual water budget (Section 2.0), the difference between the Schurz inflows and outflows is approximately equal to the surface water diversions. It may be desirable to modify this portion of the model in future versions.

3.4.2 Return Flow Patterns

As discussed in Section 3.1, artificial ground water "tributaries" were defined in the WIRSOS modeling network. Inflows into these tributaries include irrigation return flows. The irrigation return flows (non-consumptive portion of the diversions) for a given month enters the ground water tributary and returns to the river. Within WIRSOS, these flows are returned to the river per Pattern 7 as defined in Section 3.1.6 Inflows and Losses Calibration:

1st month 30%
2nd month 30%
3rd month 20%
4th month 10%
5th month 10%

This pattern defines the fractions of irrigation return flows for a given month that discharge to the river in the same month and in subsequent months.

3.5 Reservoir and Lake Data

Included in this category of WIRSOS input are the data describing the physical characteristics of the reservoirs, water rights, and other operational constraints. The WIRSOS input data are summarized in Tables 3-10 and 3-11.

Area-storage curves for Topaz Lake and Bridgeport Reservoir were developed by the Division of Water Planning from USGS elevation-storage rating tables. These curves were then fitted with equations suitable to meet the input requirements of WIRSOS. The area-storage curves based upon USGS data and those based upon the fitted equations are depicted on Figures 3-16 and 3-17.

Both Topaz Lake and Bridgeport Reservoir have 2 storage water rights. The first rights allow storage from November 1 to March 1, during the non-irrigation season. The refill rights allow storage

after the first storage rights have been met, and anytime there is water available in excess of downstream decreed water rights.

Topaz Lake is an off-channel reservoir. Water is diverted from the West Walker River and conveyed in a canal to Topaz for storage. In WIRSOS, Topaz was defined as an on-channel reservoir as WIRSOS does not have the ability to directly handle off-channel reservoirs. To ensure that WIRSOS does not allow water to be stored in Topaz when not in priority, the outlet works capacity was changed from 1,800 cfs to 3,000 cfs. At this capacity, all modeled West Walker River flows into Topaz can be passed through the outlet works as required to meet downstream senior rights.

Weber Reservoir on the Walker River Indian Reservation was not included in this draft version of the model. Additional data are needed before this reservoir is incorporated into WIRSOS.

Table 3-10. Bridgeport Reservoir WIRSOS Input Data

Bridgeport Reservoir

Reservoir code	10
Station number	080040
Minimum storage volume, AF	0
Maximum storage volume, AF	42,460
Maximum outlet capacity, cfs	1,600
Initial storage at beginning of study period, AF	6,540

Evaporation rate:

January	0.06 ft.	July	0.50 ft.
February	0.07 ft.	August	0.53 ft.
March	0.16 ft.	September	0.40 ft.
April	0.18 ft.	October	0.25 ft.
May	0.27 ft.	November	0.14 ft.
June	0.38 ft.	December	0.06 ft.
		TOTAL	3.00 ft.

Storage water rights:

First fill, AF	42,000
Priority date	April 1919
Refill, AF	15,000
Priority date	April 1919

Area-capacity relationship:

$$Area,\ in\ acres = 1.6448 \times (Storage,\ in\ AF)^{0.7071} \quad (24)$$

Table 3-11. Topaz Lake WIRSOS Input Data

Topaz Lake

Reservoir code	20
Station number	150001
Minimum storage volume, AF	0
Maximum storage volume, AF	59,440
Maximum outlet capacity, cfs	1,800
Initial storage at beginning of study period, AF	6,660

Evaporation rate:

January	0.08 ft.	July	0.68 ft.
February	0.09 ft.	August	0.72 ft.
March	0.21 ft.	September	0.53 ft.
April	0.24 ft.	October	0.33 ft.
May	0.36 ft.	November	0.18 ft.
June	0.50 ft.	December	0.08 ft.
		TOTAL	4.00 ft.

Storage water rights:

First fill, AF 50,000
Priority date April 1919

Refill, AF 35,000
Priority date April 1919

Area-capacity relationship:

For storage amounts 0 to 34,325 AF:

$$Area,\ in\ acres = 0.0079 \times (Storage,\ in\ AF) + 1{,}526 \quad (25)$$

For storage amounts 34,325 to 40,065 AF:

$$Area,\ in\ acres = 3.1480 \times (Storage,\ in\ AF)^{0.6091} \quad (26)$$

For storage amounts 40,065 to 59,440 AF:

$$Area,\ in\ acres = 49.0943 \times (Storage,\ in\ AF)^{0.3499} \quad (27)$$

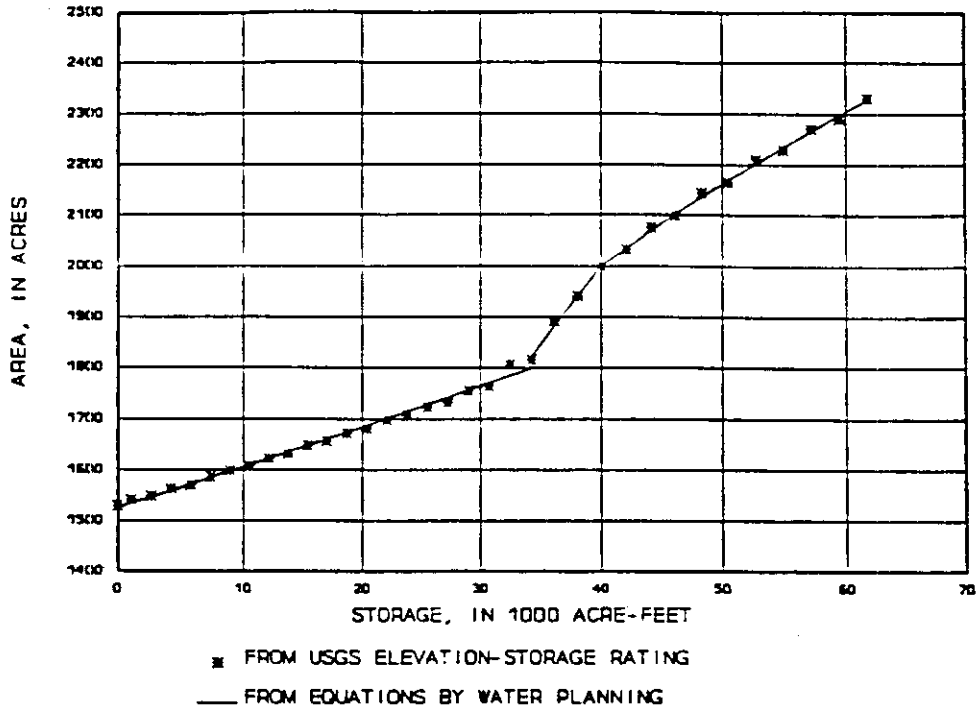

FIGURE 3-16. TOPAZ LAKE AREA-STORAGE CURVES

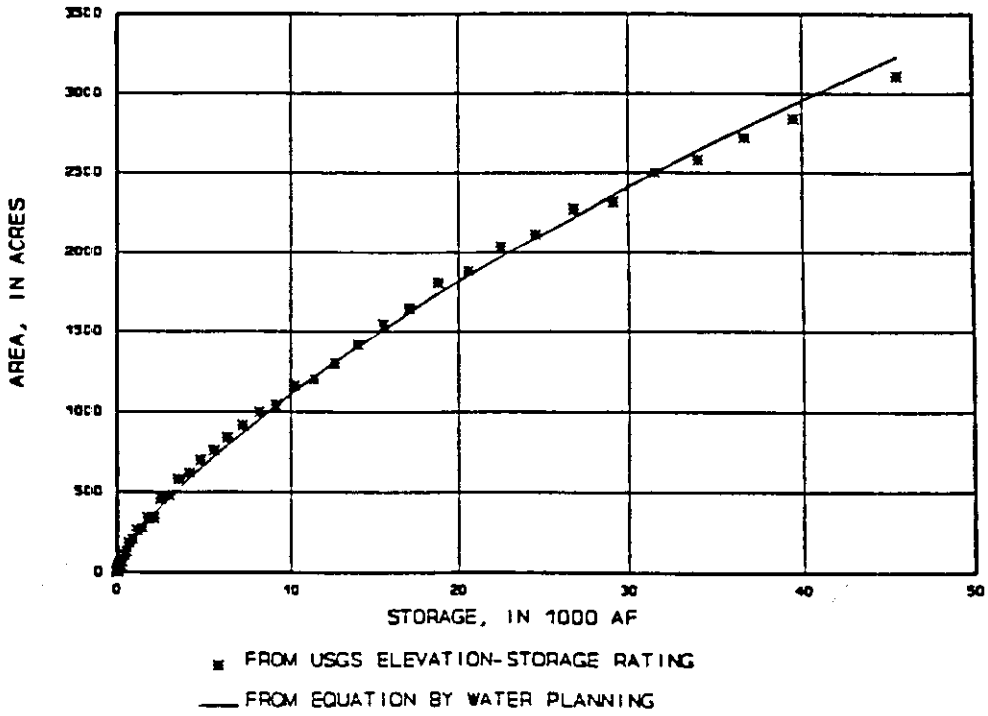

FIGURE 3-17. BRIDGEPORT RESERVOIR AREA-STORAGE CURVES

3.6 Modifications of WIRSOS Input Data

WIRSOS is a powerful tool for simulating water system operations under the prior appropriation doctrine. However, as with most models of this nature, some tailoring of the input data is required to force the model to more accurately simulate actual operations. Following is a discussion of specifics of the river operations and the input modifications needed to match as close as possible these operations.

1. In Mason Valley, there are lands irrigated with storage water (as a supplemental source and a primary source) from Bridgeport Reservoir and Topaz Lake. Under current operations, a given parcel of land with storage rights could receive water from either Bridgeport or Topaz or both. Historically, Topaz Lake has provided about 2/3 of the storage water in Mason Valley.

   WIRSOS does not allow a water right to be linked to more than 1 reservoir. For WIRSOS input, each Mason Valley right with rights to storage water was divided into 2 parts: 1) 2/3 of storage demand from Topaz; and 2) 1/3 of storage demand from Bridgeport.

2. The first fill rights in Bridgeport and Topaz allow storage to be added only during the non-irrigation season, November 1 to March 1. During the irrigation season, water can be stored under the refill rights provided water is available in excess of downstream senior rights. In addition, the reservoirs are operated for flood control. For instance if runoff much greater than normal is expected, the operator may release water in excess of downstream storage demands to provide storage space for the anticipated flood water. During runoff, the flood water is then stored to make up for the water released earlier.

   WIRSOS operates on the priority system and allows storage to occur when all downstream senior rights have been met and the reservoirs are in priority. WIRSOS will not limit reservoir diversions to a particular time period. If water is available and the reservoir is in priority, storage is allowed.

   At the time this report was written, no input modifications have been made to address this problem.

3. In WRID, storage water is the primary source of irrigation water for some of the lands. If insufficient storage water exists to meet these demands, river water is not an available source.

   WIRSOS is designed to process three different types of diversions: 1) normal diversions; 2) senior project right diversions; and 3) junior project right diversions. The

normal diversion right is comparable to the pre-1873 decree rights which receive only river water. Senior project rights are first satisfied with river water, and supplemented by storage water as available and needed. These are comparable to the post-1872 decree rights.

The closest match to the WRID storage rights are the WIRSOS junior project rights (JPR). Therefore, they were classified as JPRs for the WIRSOS input. JPRs are water rights "linked" to a reservoir where the JPR priority date is junior to the reservoir's water right. There are 2 scenarios affecting the handling of JPRs by WIRSOS.

Reservoir is not full:

> Under this condition, the JPR will be satisfied first with storage water. If there is insufficient storage water available, WIRSOS will attempt to satisfy the unfilled portion of the right with river water.

Reservoir is full and spilling:

> Under this condition, WIRSOS will attempt to satisfy the JPR rights with river water and then storage water as needed.

Neither of these WIRSOS operations accurately simulate the allocation of storage water within WRID. The desire is to force strictly storage water diversions for the WRID storage diversion rights, and not allow river water to be utilized as a supplemental source. Note that these lands may receive permit water from the river as a supplemental source, but these demands have been defined separately from the storage demands (See Section 3.3.1, subsection Permit Water).

In order to force these rights to divert only storage water under their storage right, it was necessary to assign an artificially late priority date to these rights. The actual priority date of these storage diversion rights is April 1919. As part of the WIRSOS input, the storage diversion rights were assigned priority dates in 1990. It must be noted that the priority dates for the Topaz and Bridgeport storage rights were not changed, only the priority dates of the rights diverting storage water released from the reservoirs were modified.

WIRSOS will still attempt to satisfy these storage rights with river water but with the late priority date of January 1990, there are minimal months when river water is available for diversion, especially with the large 795.2 cfs right for Walker Lake inflows (priority date of September 17, 1970).

At the time this report was written, the river water diversions (by these storage rights) as allowed by WIRSOS have not been quantified. Once the model is complete, this problem

will be examined further. It may be necessary to create a large fictitious senior water right (priority date between 1970 and 1990) below WRID to further restrict river water diversions by the storage rights.

4. For those WRID diversion rights with storage only rights, all have the same priority date (1990 - see item 3 above) and the available water is to be shared equally between all rights.

   WIRSOS does not equally apportion the available water to rights with the same priority dates. In WIRSOS, if 2 rights have the same priority date the upstream most right will be satisfied first and any remaining water is available for the downstream right. This can result in one right being fully satisfied and the other one shorted.

   To force WIRSOS to spread out the available storage deliveries more equitable between West and East Walker Rivers, and Walker River, the storage rights in each subarea were divided into 10 rights with equal diversion demands (each 10% of total) with priority dates ranging from January 1, 1990 to January 10, 1990.

5. The permit rights have one of two priority dates, either June 6, 1919 or April 11, 1969. For those rights with the same priority dates, the available permit water is to be shared equally.

   As discussed in Item 4 (above), WIRSOS does not equally apportion the available water to rights with the same priority dates. To force a more equitable distribution, the permit rights in each subarea were divided into 10 rights with equal diversion demands (each 10% of total) with priority dates ranging from June 6, 1919 to June 15, 1969 for Permit 5528 rights, and from April 11, 1969 to April 20, 1969 for Permit 21507 rights.

6. Water rights under Permit 21507 have a priority date of April 11, 1969. The Nevada Department of Wildlife (NDOW) holds a right (Walker Lake inflows) with a 1970 priority. The study period runs from 1961-90.

   WIRSOS models the system assuming Permit 21507 and the NDOW water rights are in existence during the entire study period. WIRSOS is not capable of handling water rights that are established in the middle of the modeling period. This may make it difficult to compare model results to historic operations, however does not pose a problem for modeling of future operations. At the time this report was written, the impact of this modeling limitation has not be quantified.

7. The Nevada Department of Wildlife (NDOW) right of 795.2 cfs for Walker Lake inflow is basically an instream flow requirement.

WIRSOS has the capability of handling instream flows, but trial run indicated a problem with this portion of the program. To circumvent this problem, the NDOW right was defined as a non-consumptive use diversion with all water returning to river in the same month (no return flow delay).

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WALKER RIVER IRRIGATION DISTRICT
LEGISLATIVE COMMITTEE MEETING
JANUARY 7, 1994

EXHIBIT NO. 5

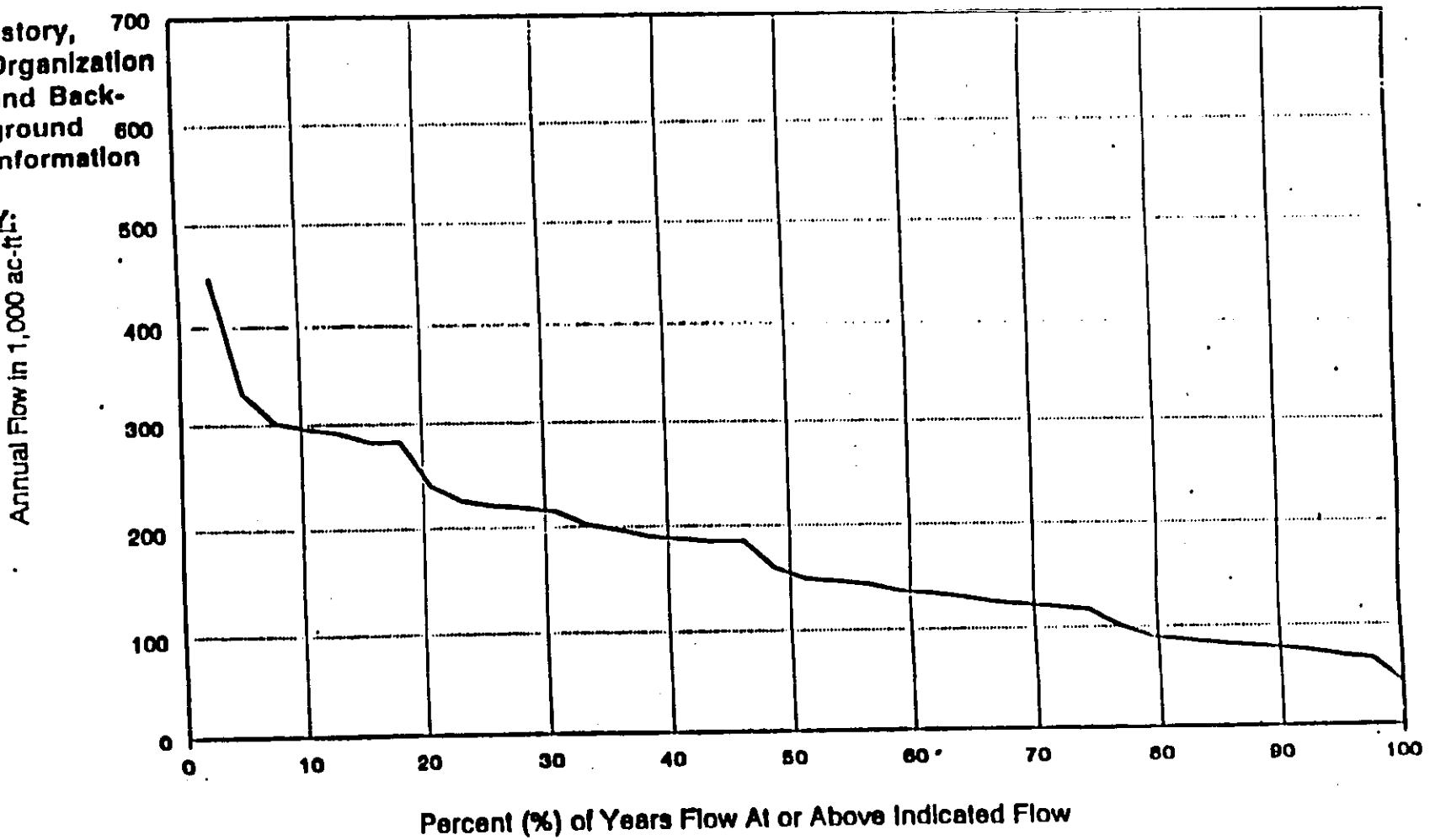
Topic No. 3 - History, Organization and Background Information

WATER SUPPLY:

West Walker River at Hoye Bridge

Frequency Analysis of Annual Flow

Water Years 1926-29, 1958-92 (39 years)



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WALKER RIVER IRRIGATION DISTRICT
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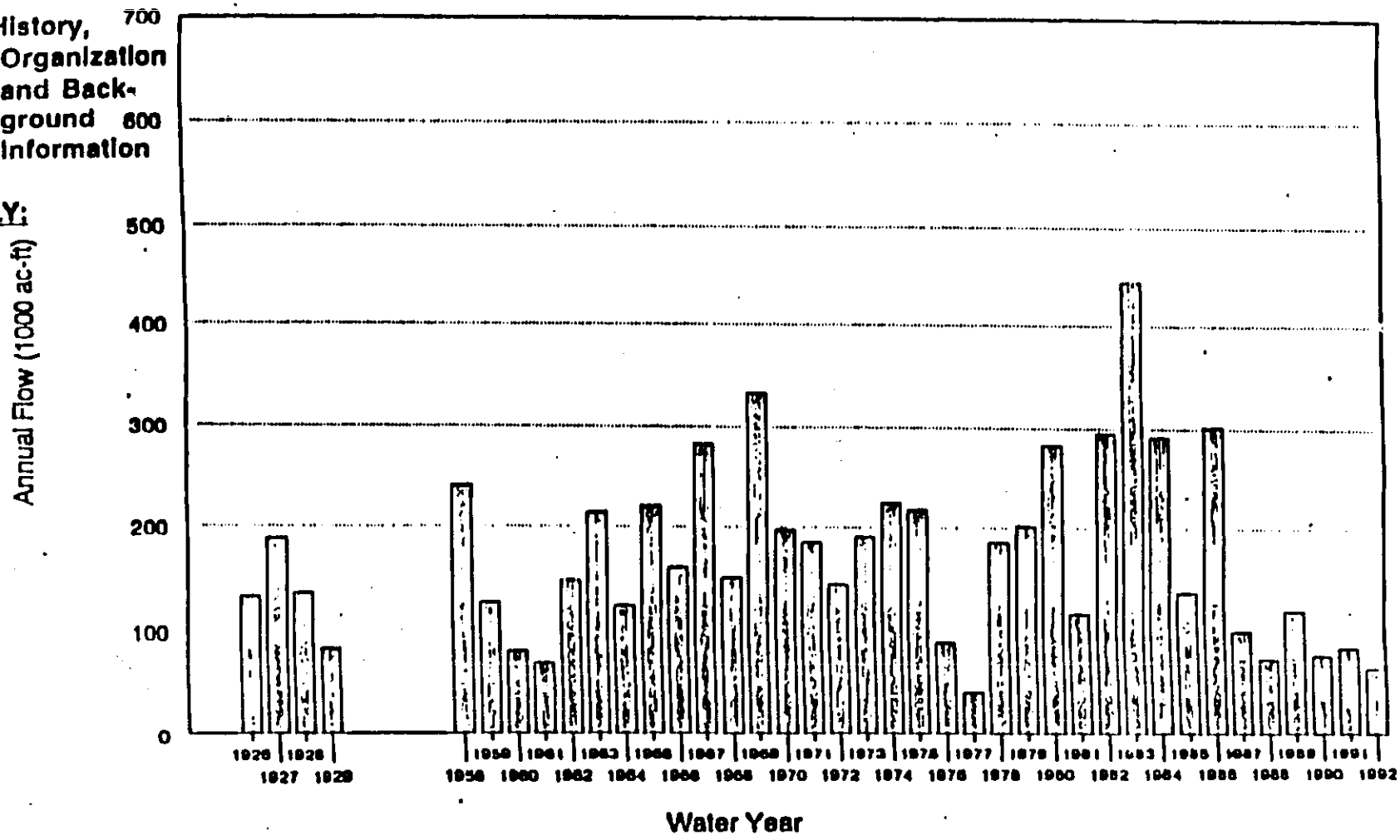
EXHIBIT NO. 6

Topic No. 3 - History, Organization and Background Information

WATER SUPPLY:



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XHIBIT NO. 7

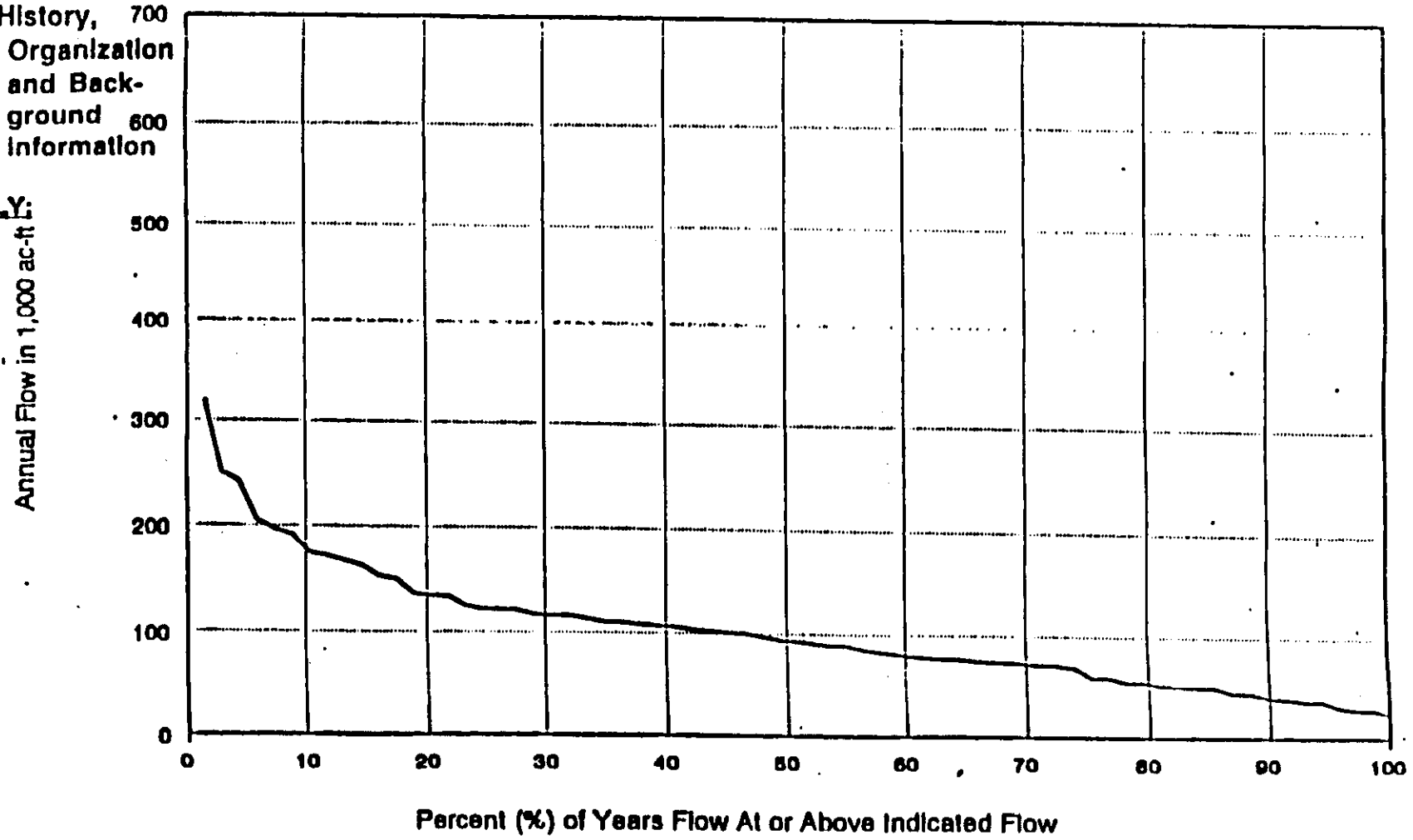
opic No. 3 - History, Organization and Background information

'ATER SUPPLY:

East Walker River near Bridgeport, CA

Frequency Analysis of Annual Flow

Water Years 1923-24, 1926-92 (69 years)



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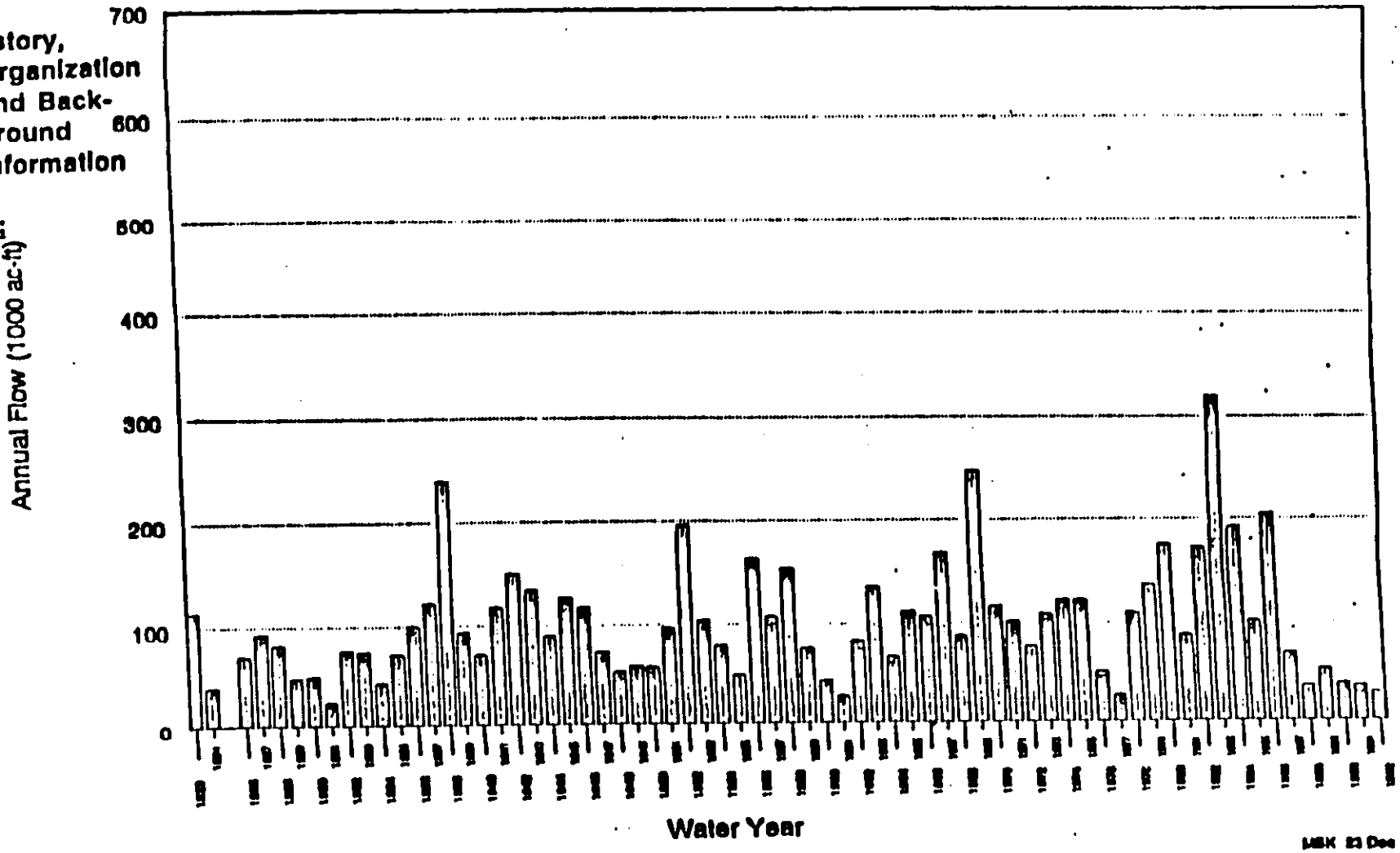
TER SUPPLY;

East Walker River near Bridgeport, CA
Annual Flow



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WALKER RIVER IRRIGATION DISTRICT
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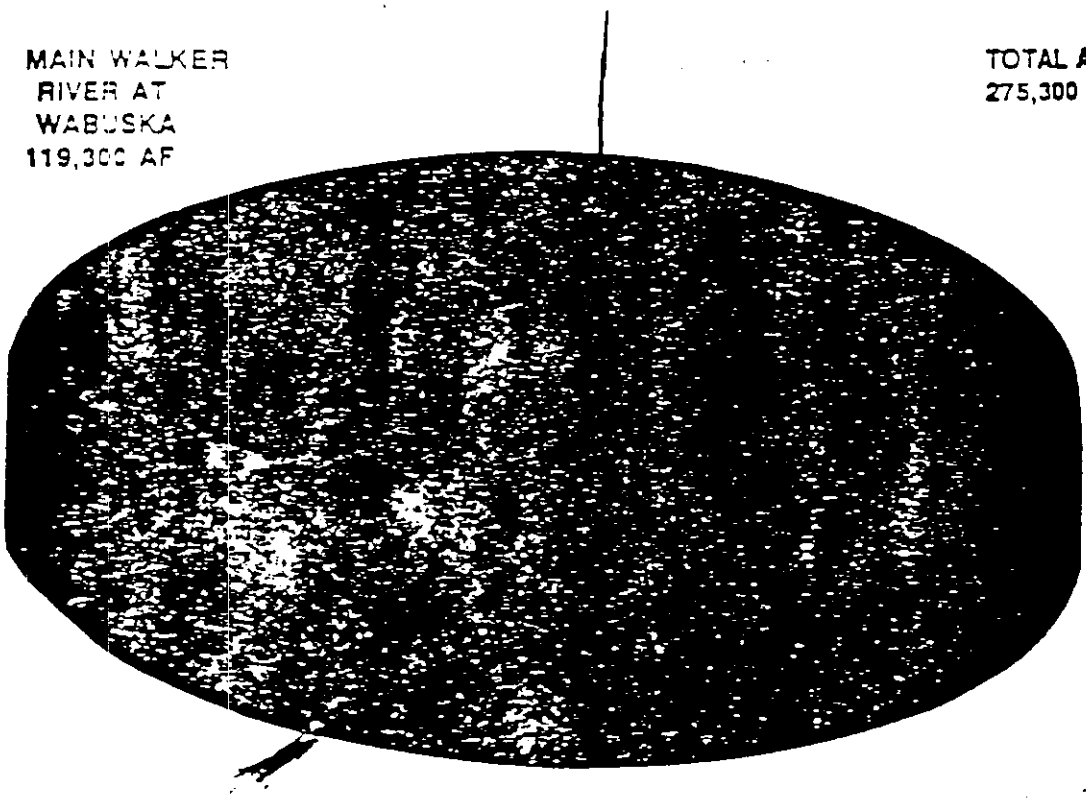
JANUARY 7, 1994

EXHIBIT NO. 4

Topic No. 3 History, Organization and Background Information

WATER SUPPLY:

WRID GROSS RIVER INFLOW/OUTFLOW*



GROSS RIVER INFLOW:

EAST WALKER RIVER BELOW BRIDGEPORT	102,900 Acre Feet
WEST WALKER RIVER AT HOYE BRIDGE	172,400 Acre Feet
	275,300 Acre Feet

GROSS RIVER OUTFLOW:

MAIN WALKER RIVER AT WABUSKA	119,300 Acre Feet

*1992 Water Resources Data - Nevada, USGS, Water Data Report **NV-92-1**

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HIBIT NO. 10

pic No. 3 - History, Organization and Background Information

CREATION - Topaz Reservoir

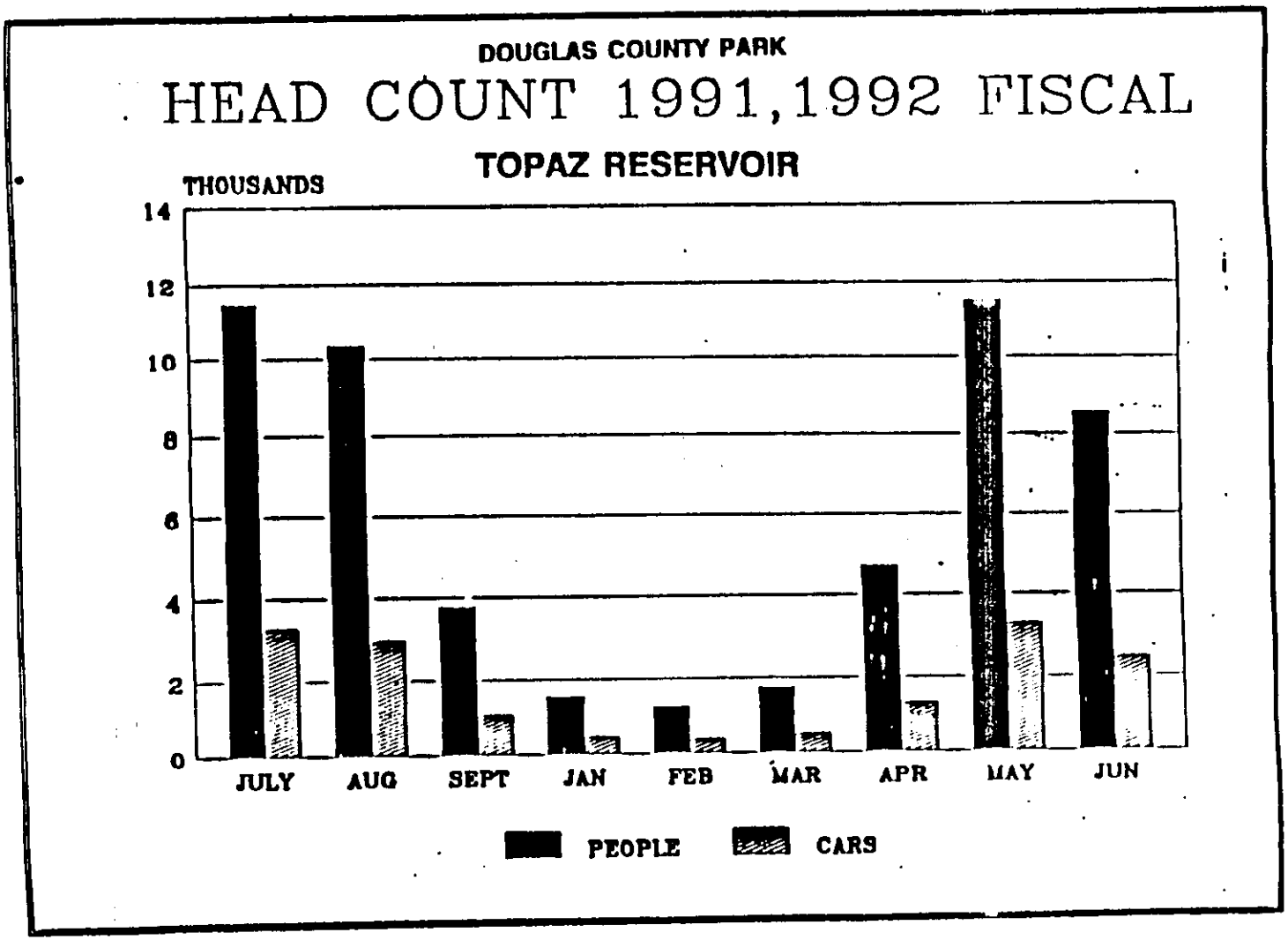

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EXHIBIT NO. 10
Page 2

LEGENDS 1991 - 1992

MONTH	PEOPLE	CARS
JULY	11,466	3,276
AUGUST	10,346	2,956
SEPTEMBER	3,762.5	1,075
JANUARY	1,557.5	445
FEBRUARY	1,295	370
MARCH	1,753.5	501
APRIL	4,693.5	1,341
MAY	11,501	3,286
JUNE	8,585.5	2,453
	54,960.5	15,703

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August 23, 1993

MEMORANDUM

To: Ms. Mimi Guernica
Ms. Blaine Rose

From: William Westermeyer WW
Office of Technology Assessment

I have completed a brief investigation of Walker Lake and enclose my findings and recommendations with this memo. Briefly, the preservation of Walker Lake does not seem to be an insoluble problem, but neither is it one that lends itself to a quick and easy solution. Technically, solutions are available; however, in order to make progress in implementing these solutions, a continuing dialogue among the different interest groups needs to be established, and additional waterflow data needs to be acquired. OTA's suggestions, therefore, address these needs.

Although I do not mention this in the memo, I feel it is also important to point out that future site visits would likely be more valuable if such visits included discussions with representatives of the Walker River Irrigation District. (Specifically, the visit to the Mason Valley Wildlife Refuge, which resulted in no new insights, could be eliminated in favor of a meeting with irrigators). I believe an opportunity was missed on the tour in which I participated by not introducing the environmental representatives to the farmers' representatives.

WATER FOR WALKER LAKE

Background

The Walker River flows through an arid and sparsely populated part of the western United States. Water in general is scarce in this region, and even in years of above average snowpack in the Sierras, there is little water available in the watershed for all those who would like to use it. Agriculture is by far the major user of Walker River water. Water began to be diverted from the river for agriculture in the last half of the 19th century in the Smith and Mason Valleys in Nevada and Antelope Valley in California.

Several water rights decrees, culminating in Decree C-125 in 1936, have allocated water rights according to the prior appropriation doctrine. Typical of most early water rights agreements, instream beneficial uses of water were not protected. Thus, in allocating rights to Walker River water, little thought was given to the effect that diversions would have on Walker Lake at the terminus of the river. As a result largely of agricultural diversions, the level of Walker Lake has fallen more than 120 feet since the early 1900s. The Nevada Department of Conservation and Natural Resources (NDCNR) has estimated that the average annual deficit (i.e., the difference between water entering the lake and water evaporating from it) over the last 30 years has been about 33,000 acre-feet per year.[1]

Since 1930, the average annual rate of decline of the surface elevation has been about 1.4 feet, according to the Nevada Department of Wildlife (NDW).[2] However, there is some disagreement and/or confusion over the rate at which the lake is falling, and indeed, the rate calculated depends on the span of years used for the calculation. The Walker River Irrigation

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[1] See State of Nevada, Department of Conservation and Natural Resources, Water River Basin Water Rights Model, June 1993 (Draft).

[2] M. Sevon, Supervising Fisheries Biologist, Nevada Department of Wildlife, "Walker Lake, 'An Endangered Ecosystem.' How Much Time is Left for the Lahontan Cutthroat Trout Fishery?" draft report, July 1993, p. 5.

District suggests the historic rate of decline is 0.9 feet per year. Between 1987 and 1992, a period of severe drought throughout the West, the level of Walker Lake fell about 3.7 feet per year.[3]

The current maximum depth of Walker Lake is about 110 feet. The U.S. Geological Survey estimates that Walker Lake will eventually stabilize at a maximum depth of about 40 feet absent any changes in how water is allocated among competing users.[4] At that point, the lake would have a much smaller surface area, and inflow would balance evaporation. However, since minerals become concentrated in terminal lakes through evaporation, Walker Lake would slowly become saltier than seawater.[5]

Long before the lake level stabilizes, however, the concentration of total dissolved solids (TDS) will become too high for the Lahontan cutthroat trout and other fish species in the lake to tolerate. The NDW has calculated that at historic levels of decline, the fishery could be lost in from 5 to 11 years; at levels of decline experienced during the 1987-92 drought, the concentration of TDS could be too high for the fish in as few as 2 years.[6]

The potential disappearance of the cutthroat trout fishery has served as a "wake up call" to recognition of the inherent problems associated with current management practices on the Walker River. Although Walker Lake has been declining for decades, concern had been minimal, probably because no vital interests had been threatened. Now that the threshold lake

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[3] Sevon, op. cit., p. 5.

[4] See California Department of Water Resources (DWR), Walker River Atlas (Sacramento, CA: DWR, 1992), p. 34.

[5] Note that even if extra water is allocated to Walker Lake, the concentration of minerals through evaporation will continue, although this process may be stretched out over a much longer time span.

[6] Sevon, op. cit., p. 5

level, below which fish will not be able to survive, appears to be rapidly approaching, the situation has changed. As with other western water problems, different interest groups have a stake in the management of the river, and their interests are not always compatible.

Farmers in the Walker River Irrigation District. Agriculture is long-established in the Mason and Smith valleys, and towns such as Yerington depend heavily on an agricultural economy. Farmers have acquired senior rights to irrigate some 80,000 acres and to divert almost 300,000 acre-feet of water per year (afy).[7] Pasture irrigation and alfalfa production are the largest agricultural water uses. Like some other rivers in the West, water rights on the Walker have been *over*allocated. The Walker River Task Force notes that during a normal water year (i.e., when the snowpack is 100 percent of normal) only 84 percent of agricultural water rights can be satisfied. A snow pack of 120 percent of normal is required to provide the full allocation of water rights, and historically this situation has occurred only 45 percent of the time.[8] Overallocation of water rights may make finding a solution to Walker Lake's decline more difficult, since the rights of more senior water users may have to be satisfied before additional water could be made available for the lake.

Water now used in agriculture is likely the largest potential source of additional water for Walker Lake. Additional water could be made available through improvements in irrigation practices, retirement of some marginal land, and conjunctive management of ground and surface water. How much additional water might be acquired through these means has not been determined. In its Walker River Atlas, the California Department of Water Resources notes that water rights purchases sufficient to yield an average of 60,000 to 85,000 afy would be needed to maintain the lake at close to or slightly above its 1992 elevation. This represents roughly 20 to 30 percent of water currently consumed by a combination of agriculture, other

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[7] State of Nevada, op. cit. See table 3-4, p. 57

[8] Walker River Task Force, draft discussion paper, April 1993.

vegetation (i.e., phreatophytes), and evaporation from 3 small lakes.[9] Of the amount consumed, 60 percent is through irrigation, 34 percent through phreatophyte evapotranspiration, and 6 percent through lake evaporation.

Farmers and farming communities understandably wish to preserve their way of life and will likely resist any fundamental changes that could affect that. However, they appear willing to discuss water problems with other interest groups in the watershed. They recognize that irrigation efficiencies can be improved. They also note that some marginal agricultural land could be retired, but prefer to be compensated for doing so.

Walker River Paiute Indian Reservation. After leaving Mason Valley and just before entering Walker Lake, the Walker River flows through the Walker River Paiute Indian Reservation. The Walker River Paiutes divert a relatively small amount of water to irrigate some 2,100 acres of land on their reservation. As with the Walker River Irrigation District, accounting for water flows on the reservation is not very accurate. NDCNR has estimated inflows and outflows to the reservation, but their estimates do not accord with amounts the Indians say they are diverting nor with recent observations about the amount of water reaching Walker Lake. Lack of streamflow data in the area greatly limits an understanding of water movements on the surface and in the ground.

The Indians are concerned about the decrease in size of Walker Lake and wish to work with other groups to help stem the decrease. At the same time, they feel they have been unfairly treated by past water rights rulings and would like to expand the amount of irrigated land on their reservation. They also believe the Walker River Irrigation District, upstream, has not been delivering the amount of water specified in Decree C-125 (i.e., 26.25 cubic feet per second (cfs)) to the reservation.

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[9] State of Nevada, op. cit., Table 2-1.

Residents of Hawthorne. The residents of the town of Hawthorne, to the south of Walker Lake, are concerned about the effect the potential demise of the Walker Lake fishery could have on their local economy. Recreational boating and fishing are major sources of revenue for this small town and are seen as the key to economic development in an area that doesn't have many alternatives.

Some citizens of Hawthorne have organized into the Walker Lake Working Group. The goal of this group is to seek a guaranteed volume of water to maintain the lake at a suitable level to sustain fish life. They hope to be able to convince upstream water users to change water use practices so the lake can be saved.

The environment. Preservation of Walker Lake is deemed desirable by all interest groups. However, local habitat preservation *per se* has not, until recently, had its own champion, and offstream users have at least a partial conflict of interest with environmental concerns. Nationally, concern about environmental preservation has grown dramatically in recent years, and it has become increasingly difficult to neglect environmental (or instream) uses of water. The recent examples of water reallocation for environmental purposes in California's Central Valley, in the Mono Lake area, and in the Carson and Truckee watersheds of California and Nevada point to a trend that, to one degree or another, is likely to continue in the Walker River watershed.

Several environmental groups have recently become concerned about Walker Lake. These include the Nature Conservancy, the Sierra Club, and the Environmental Defense Fund. Members active in Walker Lake discussions have, for the most part, also been involved in the Truckee-Carson negotiations. Environmental organizations are at an early stage in assessing Walker Lake's environmental problems, and to OTA's knowledge no group has yet formulated detailed policy proposals.

Recommendations

Technically, many opportunities exist to increase the inflow of water to Walker Lake and to reduce the concentration of total dissolved solids in the lake, thus improving the habitat for the lake's threatened fish (see table 1). Some opportunities could be implemented without penalizing the water usage of any stakeholders; other opportunities would require the sacrifice of some water (although not necessarily significant amounts) on the part of one or more stakeholders, usually irrigators; still other opportunities might call for significant sacrifice on the part of certain groups and would likely be vigorously resisted. The costs to implement these opportunities have not been evaluated, but some would be less expensive than others. In its cursory investigation, OTA noted several problems that need to be addressed in order to lay the groundwork to take advantage of available opportunities.

First, the various interest groups in the watershed need to begin talking with one another 1) to develop a common understanding of the problem, 2) to more precisely identify areas of agreement and disagreement, 3) to promote development of information that can reduce factual disputes, and 4) to identify solutions and seek ways to implement them. A Walker River Task Force has been formed, but its structure and composition do not appear to be ideal for fostering trust among stakeholders. A principal concern is the fact that the chairman of the task force is the manager of the Walker River Irrigation District rather than a neutral party.

One possibility to make progress in addressing Walker Lake's problems would be to convene a workshop or forum at some neutral location in Nevada, bringing together representatives of all stakeholders and technical agencies. Ideally, the workshop should be convened, sponsored, and chaired by a neutral, mutually acceptable third party. Among those who should be included are representatives of: 1) Hawthorne and Yerington, 2) the Walker

River Irrigation District, 3) the Walker River Paiute Tribe, 4) environmental groups such as the Nature Conservancy and the Sierra Club, 5) the Nevada State Engineer, 6) the Nevada Department of Wildlife, 7) U.S. Geological Survey, 8) U.S. Soil Conservation Service, 9) U.S. Bureau of Land Management, 10) U.S. Army, 11) California Department of Water Resources, 12) U.S. Board of Water Commissioners, and 13) any others with a stake in resolving the problem. A minimal goal would be to clarify any misunderstandings among stakeholders and to share and jointly assess relevant information about the river's water budget.

If a workshop (or series of workshops) is deemed desirable, one possibility would be to utilize the services of the newly established Environmental Conflict Resolution program at the University of Arizona's Udall Center for Studies in Public Policy. Managing this program is one function of a new national foundation established by the "Morris K. Udall Scholarship and Excellence in National Environmental and Native American Public Policy Act of 1992" (P.L. 102-259). Among the foundation's purposes are to foster greater recognition and understanding of the role of the environment, public lands, and resources in the development of the United States. Congress has recently appropriated $10 million to endow the foundation, but the conflict resolution program has not yet begun operations. Among the advantages of convening a workshop under the auspices of this new foundation would be its neutrality and the substantial expertise on western water problems that currently exists at the Udall Center. The director of the Udall Center, Dr. Helen Ingram, is a nationally recognized water expert. She recently chaired OTA's Advisory Panel for its climate change adaptation study, and, as part of this study, chaired OTA's 1992 workshop on water resources and climate change.

It would be prudent to hold a workshop at the earliest possible date (e.g., in late 1993 or early 1994), since the stress on the fishery is steadily increasing, and, according to the Nevada Department of Wildlife, the fishery may collapse in 5 years or less if changes are not made soon in how the water resources in the basin are managed.

Second, some of the differences of perceptions of the problem and possible solutions that currently exist among interest groups can be accounted for by lack of good streamflow data. The State of Nevada's Department of Conservation and Natural Resources has used what data are available to estimate a budget for water inflow and outflow at various points in the watershed.[10] However, lack of streamflow gauges at key points along the river and deterioration of at least one key gauge make it impossible to know with precision what is happening in the system. Better understanding of how much water is being diverted at particular points and how much water is reentering the river after diversion is essential in order to identify and assess the best measures for managing the river.

Three data problems seem especially important to address. First, estimating inflow to Walker Lake is problematic because the nearest streamflow gauge is more than 30 miles upstream at Wabuska and significant irrigation diversions and channel losses occur along the river below this last gauge.[11] A gauge much nearer the lake would be desirable–*if*, given the meandering nature of the river along this stretch, a suitable location can be found.

Second, the key Wabuska gauge north of the Walker River Indian Reservation needs upgrading.[12] Over the years, a shifting channel and sedimentation has rendered data acquired from the gauge less and less accurate. The USGS rates the accuracy of this data as only "fair to poor." The readings at the Wabuska gauge are important because it is here that the water allocation for the Indian Reservation is measured. Indeed, the Indians prefer to move the gauge closer to the north end of Weber Reservoir (or to construct an additional gauge) because

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[10] See State of Nevada, Department of Conservation and Natural Resources, Water River Basin Water Rights Model, June 1993 (Draft).

[11] California Department of Water Resources (DWR), Walker River Atlas (Sacramento, CA: DWR, 1992), p. 32.

[12] R. Hayes, U.S. Geological Survey, Carson City, NV., personal telephone communication, August 12, 1993.

they believe significant channel losses occur between the Wabuska gauge and Weber Reservoir for which they are inappropriately being charged. Others believe--even though no streamflow data are available--that substantial losses are occurring on the reservation itself. (Note that the USGS believes that even though a gauge can be installed in this area, the accuracy of the data will be no greater than plus or minus 20 percent, given the shifting nature of the stream).

Finally, it would be extremely helpful to install small gauges at irrigation diversion points. Farmers in the Walker River Irrigation District have not been concerned with irrigation operating efficiencies and hence do not have good information about where adjustments might be made to improve efficiency. Installation of gauges would help identify where blocks of water are unnecessarily being lost.[13]

The cost of new gauges could be substantial relative to available funds. The USGS notes that upgrading the Wabuska gauging station could cost several hundred thousand dollars. It seems likely that the cost of installation of additional gauging stations on the main stem of the river would also be in this range. Installation of gauges to measure irrigation diversions would cost on the order of 3 thousand dollars each, and several dozen would likely be needed. The USGS has a small amount of money available for matching State funds budgeted for installing gauging stations. The USGS has indicated, however, that all available "co-op" funds for this program have already been committed. If new gauges are to be installed, additional funds may need to be appropriated for the USGS's Nevada district's gauging program. The State would, of course, have to come up with matching funds. Also, if a workshop is held, one topic of discussion might be how to pay for additional gauges, especially those needed at diversion sites.

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[13] Jim Weishaupt, Walker River Irrigation District, personal communication, August 5, 1993.

It should be noted that it generally takes a number of years to develop good data from a newly installed gauge and that the longer the time series of data available, the more accurate the determination of average flow will be. USGS says, however, that it can begin publishing data 1 to 2 years after installation of a gauge. Given the precarious nature of the Walker Lake fishery, it would be prudent to install additional gauges soon.

Third, negotiations leading to an interstate compact between Nevada and California concerning allocation of water in the Walker River watershed should be reconvened. In 1990, Public Law 101-618 established a framework for an interstate allocation of waters of the Truckee and Carson rivers, the two other rivers with headwaters in California that flow into Nevada. The Walker River was not included in the final legislation, ostensibly because "pressure created by proposed water development projects [in the watershed] had abated by the 1980s."[14] Indeed, the portion of the Walker River watershed in California has very few people in it, and major increases in water use in that area are not anticipated. Nevertheless, California still has a potential right to use additional water in the Walker River watershed and could some day assert rights to a portion of the water now being used in Nevada. Any agreement concerning Walker River water reached by interest groups in Nevada could potentially be undermined if California some day claims the right to use additional water, and, as the saying goes, "a shovel upstream is better than a decree downstream." A compact would clarify the water rights of both states and ensure that efforts to protect Walker Lake and the various Walker River stakeholders in Nevada would not later be undermined.

A final comment

Saving Walker Lake, and especially doing so without affecting other longstanding interests in water from the Walker River, is not likely to be easy. In OTA's view, saving the lake will likely require more than just implementation of the relatively easy steps that could be

[14] California Department of Water Resources, op. cit., p. 70.

taken, but saving it does not appear to be a hopeless cause. The problems experienced in the Walker River watershed are similar to those that have been faced with some success in the Carson and Truckee watersheds to the north. That the Walker situation does not appear to be as complex is a hopeful sign. Other recent water rights settlements (e.g., regarding Mono Lake and California's Central Valley) are beginning to firmly estabish the principal that the environment matters, and these precedents make it increasingly difficult for major water users to conduct business as usual. The best solution attainable may well be one that entirely pleases no one—farmers may have to change water use practices more than they are currently willing to do, Indians may have to forego irrigating significantly increased acreage, and environmentalists and residents of Hawthorne may have to be satisfied with a somewhat lower lake level than they would prefer.

Table 1

Possibilities for Increasing the Flow of Water to Walker Lake

A. Relatively Easy:
- o Line diversion ditches: ditch lining would help prevent some seepage losses
- o Upgrade distribution systems: improved valving systems would also increase irrigation efficiency; installing pipes in selected parts of the system possible but more costly
- o Schedule irrigation: would regulate irrigation so crops receive water only when they need it
- o Establish a water bank: would allow water to be bought from farmers in drought years that could be used for environmental purposes; has been successful in California
- o Remove non-native plants from the stream channel: high-water-using-plants, such as salt cedar, have proliferated in the stream channel; their removal would make more water available but would also affect some (non-native) habitat
- o Manage ground water and surface water conjunctively: would help improve efficiency and flexibility of system and enhance yields through less conservative operation of storage facilities

B. More Difficult
- o Purchase existing agriculture rights (e.g., in marginal areas): a potentially important option, but funds could be a problem
- o Change crops, e.g., from alfalfa to onions: alfalfa uses much more water than crops such as onions, but the market is not large for such crops
- o Renegotiate Decree C-125: although desirable from the point of view of residents of Hawthorne and Indians, would likely be strongly resisted by farmers
- o Line river channel between Wabuska and Weber Reservoir: much water is apparently "lost" in this area, but turning the river into a canal would likely be resisted by environmentalists

C. Other types of options--not shown to be technically feasible
- o Breed a strain of hatchery trout that can tolerate Walker Lake's high alkalinity
- o Install devices on side streams to control alkaline minerals from entering Walker Lake

Ground water / surface water

CERTIFICATE OF MAILING

Pursuant to FRCP 5(b), I certify that I am an employee of the Law Office of ZEH, SPOO & HEARNE, and that on this date I caused to be mailed a copy of the attached **AFFIDAVIT OF KELVIN J. BUCHANAN**, with postage fully prepaid to:

See attached Service List

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