MEMBER UNITS EXHIBIT NUMBER 91

QUICKBASIC

SYRM1296.BAS

SANTA YNEZ RIVER HYDROLOGY MODEL

MANUAL

SYRM1296.BAS Model Manual
Version 09/08/97

TABLE OF CONTENTS

Santa Ynez River

Hydrology Model Manual

Santa Barbara County Water Agency
123 East Anapamu Street
Santa Barbara, CA 93101-2058

Prepared by:
Matt Naftaly and Jon Ahlroth
(805) 568-3543
(805) 568-3541

ACKNOWLEDGEMENTS

The Water Agency acknowledges the members of the Santa Ynez River Hydrology Committee for their continuing participation in the development of the Model and this publication.

TABLE OF CONTENTS

Section | Page

Section	Page

FIGURES

FIGURES (cont.)

TABLES

SECTION 1

SECTION 1

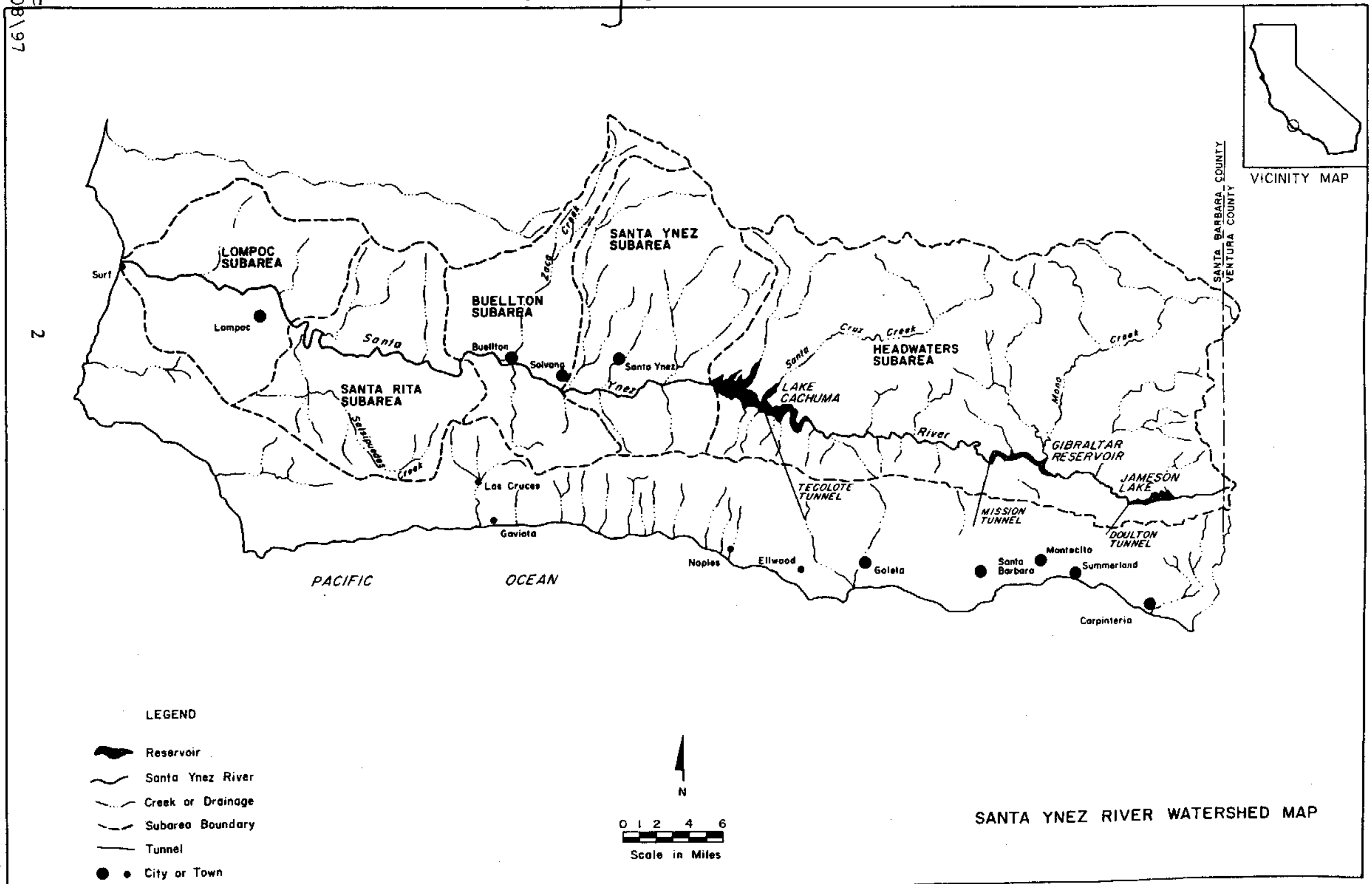
INTRODUCTION

The Santa Ynez River Watershed extends from the south slope of the San Rafael Mountain Range to the north slope of the Santa Ynez Mountains, westward from the Ventura County line to the Pacific Ocean (Figure 1-1). Practically all water used on the Santa Ynez River Watershed and most of the water used on the South Coast are currently supplied from the Santa Ynez River Watershed. **(1)** The water resources in the watershed include surface reservoirs, tunnels and groundwater aquifers. Operational guidelines and agreements govern the use of those resources.

There is an increasing concern over the impacts of water storage and use within the Santa Ynez River basin and increased water consumption on the South Coast. There is also the need to evaluate availability of Santa Ynez River water supplies in light of the institutional constraints and the complex agreements which regulate water resources within the basin. The Santa Ynez River Hydrology Model (SYRHM) was developed for the purpose of assessing the Santa Ynez River system and evaluating the long term management of water supply in the basin.

1) Introduction of State Water Project (SWP) water to the Central Coast will provide a limited additional supply of water to the Santa Ynez and, the South Coast.

Figure 1-1



VICINITY MAP
SANTA BARBARA COUNTY
VENTURA COUNTY
LOMPOC SUBAREA
SANTA YNEZ SUBAREA
BUELLTON SUBAREA
SANTA RITA SUBAREA
HEADWATERS SUBAREA
Surf
Lompoc
Santa
Buellton
Solvang
Santa Ynez
Ynez
Zaca Creek
Salsipuedes Creek
Santa Cruz Creek
Mono
Creek
LAKE CACHUMA
River
GIBRALTAR RESERVOIR
JAMESON LAKE
TECOLOTE TUNNEL
MISSION TUNNEL
DOULTON TUNNEL
Las Cruces
Gaviota
Naples
Ellwood
Goleta
Santa Barbara
Montecito
Summerland
Carpinteria
PACIFIC
OCEAN
LEGEND
Reservoir
Santa Ynez River
Creek or Drainage
Subarea Boundary
Tunnel
City or Town
N
0 1 2 4 6
Scale in Miles
SANTA YNEZ RIVER WATERSHED MAP

1.1 MODEL HISTORY

The SYRHM was developed in response to the need for comprehensive conjunctive use studies of the Santa Ynez River reservoirs and groundwater basins in the late 1970's. The first version of the model was developed in 1980 when the defeat of the State Water Project initiative in March, 1979 prompted a renewed interest in local reservoir enlargement studies. The model was developed by the Santa Barbara County Water Agency (SBCWA) using techniques and data from earlier models of the Santa Ynez River utilized by consulting firms and the United States Bureau of Reclamation (USBR). The model has developed in stages in consultation with members of the Santa Ynez River Hydrology Committee. The committee is comprised of water specialists and hydrologists, primarily representing local water interests.

The first version of the model developed by the SBCWA simulated the reservoir operations and utilized a modeling period extending from water year 1919 through 1979 (61 years). In 1981 operation of the riparian alluvial basin above the Lompoc Narrows was included in the model following the water accounting and Cachuma release requirements provided by State Water Resources Control Board Order WR 73-37. The model, however, did not include the below Lompoc Narrows percolation calculations and accounting required by the board Order. In 1985 water year 1918 was added to the modeling period thus providing initial conditions with essentially full reservoirs. In 1987 the model was expanded to include accounting for percolation of Santa Ynez River water below the Lompoc Narrows and the maintenance of a below Narrows account (BNA) based upon the State Board Order 73-37. Releases from Cachuma to deliver the BNA water were made (in the model) via an imaginary pipeline from Cachuma to Lompoc.

By 1988, cloud seeding calculations had been included and the model was converted from Hewlett Packard Basic to Microsoft Quick Basic software. During 1990 the SYRHM was expanded and modified to include a more sophisticated "Live Stream" determination for river flow below Cachuma Reservoir; the incorporation of State Board Order 89-18 amendments to Order 73-37; and the inclusion of a "Base Operations" Gibraltar Reservoir to simulate the Upper Santa Ynez River Operations Agreement which was finalized in mid 1989 (see Section 2.4.2). The SYRHM was modified in 1994 to allow BNA credit releases from Cachuma Reservoir to be made down the Santa Ynez River channel instead of through the imaginary pipeline as noted earlier. In 1995 and 1996, water years 1980 through 1993 were added to the model for the purpose of including the May 1986 through February 1991 drought. Since the mid-1980's, the SYRHM has been used for a variety of purposes including Cachuma Reservoir yield studies for evaluation of State Water Project alternatives.

1.2 SCOPE OF MANUAL

The Santa Ynez River Hydrology Model Manual has a number of purposes. Its primary functions are to provide instructions on the basic structure and use of SYRHM and development of the data base. Although this manual is intended as a guide to use the model, the Water Agency cannot be held responsible for results obtained or conclusions drawn by others.

Section 2 of this manual provides a brief history and general overview of the facilities and hydrologic features associated with the Santa Ynez River. Section 3 provides a general description of the data base (a detailed description of sources and techniques used for data development is provided in Appendix E, under a separate cover). Section 4 describes the model operation, basic functions and output. Section 5 provides a description of the model structure. Section 6 discusses model verification and model maintenance. A detailed description of the hydrologic model is included in Appendix B. It may be helpful to refer to Appendices A and C (Program Listing and Glossary of Model Terms) when reading Appendix B.

1.3 PLANS TO REFINE AND UPDATE

The SBCWA staff is developing a more detailed modeling of surface water/ground water interactions in the Santa Ynez River reach between Bradbury Dam and the Lompoc Narrows. The SBCWA anticipates that the SYRHM will be expanded to simulate the Above Narrow's groundwater basin in segments between tributaries. This manual will be updated periodically to include these improvements.

SECTION 2

SECTION 2

SANTA YNEZ RIVER HYDROLOGIC SYSTEM

The Santa Ynez River system includes reservoirs, tunnels and groundwater basins. Three reservoirs constructed on the Santa Ynez River supply most of the water used in the South Coast. Reservoir water is also supplied to the Santa Ynez River Water Conservation District, Improvement District #1 (also called ID#1) in the Santa Ynez River Valley. The Upper Santa Ynez River Operations Agreement (sometimes referred to as the Gibraltar Pass Through Agreement), and State Water Resources Control Board (SWRCB) Order Nos. WR 73-37 and WR 89-18 provide for downstream releases. Water is conveyed from each reservoir to the South Coast by means of separate tunnels through the Santa Ynez mountains. Infiltration of groundwater to these tunnels provides additional water to the South Coast. Demand within the Santa Ynez River Basin is primarily fulfilled through groundwater extraction, except for Cachuma Project water delivered to the ID#1 service area, including the City of Solvang. Cloud seeding has been conducted within the County of Santa Barbara for many years to increase the total amount of rain available for runoff to the reservoirs and infiltration to groundwater basins.

2.1 RESERVOIRS

Three water supply reservoirs are located on the upper Santa Ynez River: Jameson, Gibraltar, and Cachuma (Figure 1-1). All of the reservoirs are used for water supply and are not designed for flood control purposes. The characteristics of each reservoir are described briefly in the following sections.

2.1.1 Jameson Reservoir

Jameson Reservoir was formed by the construction of Juncal Dam in 1930. Juncal Dam is a 160 foot high concrete arch located about 88 river miles from the Pacific Ocean (Figure 1-1). The dam has a crest length of 447 feet at an elevation of 2,230 feet, MSL. The spillway is an overflow weir located mid-arch six feet below the dam crest which bridges the weir dividing it into twenty two 9.2 ft. bays, giving a total spillway width of 202 ft. An intake tower on the upstream face of the dam has selectable openings at four levels which permit the conveyance of lake water into an 18 inch conduit which carries water to the north portal of Doulton Tunnel, and includes an 18 inch blow off valve where the pipeline crosses the Santa Ynez River below Juncal Dam. Additionally, there are two 36 inch sluice gates in the center of the dam at elevation 2,140 ft, MSL which can be opened to lower the lake level or to increase the lake release capacity during times of very large inflows (as in January, 1969).

Beyond the south abutment of Juncal Dam, over a rock ridge, lies a 960 ft. long multiple arch auxiliary dam, maximum height 25 feet. This dam has a crest elevation of 2,231 feet and permits the operation of Jameson Reservoir with a normal full water surface elevation of 2,224 ft., MSL.

The watershed area above Juncal Dam is approximately fourteen square miles. Alder creek is a tributary to the Santa Ynez River located south of Jameson Lake and flowing into the river at a point downstream from Juncal Dam. At certain times a portion of the runoff from Alder Creek is diverted to Jameson Reservoir via an aqueduct. In 1994, the storage capacity of the reservoir was 5,235 acre feet, reduced from the original capacity of 7,228 acre feet by siltation. The water surface area of the full reservoir (elevation 2224 ft.) as surveyed in 1994 is 128 acres (see Appendix E for reservoir elevation-capacity tables). The reservoir is owned and operated by Montecito Water District and diversions to the South Coast are made through the 2.14 mile long Doulton Tunnel. In addition, a portion of the water from Fox Creek, a downstream tributary to the Santa Ynez River, is diverted into the tunnel. Currently, the long-term yield of the reservoir with a draft of 2,000 AFY is estimated to be about 1,800 AFY. Tunnel infiltration plus Fox Creek diversions provide an average supply of about 500 acre feet per year in addition to the reservoir yield.

2.1.2 Gibraltar Reservoir

Gibraltar Dam and Reservoir was constructed by the City of Santa Barbara in 1920 seventy-three river miles from the Pacific Ocean (Figure 1-1). Gibraltar Dam is a 180 ft high concrete arch with a crest length of 600 feet and a crest elevation, at the top of a continuous parapet, of 1405.3 ft, MSL. The crest walkway elevation is 1401.8 ft, MSL. The spillway is adjacent to the south abutment of the concrete arch on a rock ridge, and has five gates for the release of water. Four of the gates are large radial lift structures. The fifth gate is a 26 ft wide by 4 ft high "skimmer gate" used to pass low magnitude spill water and some floating debris washed into the reservoir from above Gibraltar Lake.

An intake tower is located on the upstream face of the main concrete arch with openings at selectable elevations allowing diversion of lake water into a 48 inch conduit which conveys water into a 900 ft. tunnel through the south abutment. From the tunnel outlet water is conveyed to a downstream release outlet and to a 36 inch pipeline into the north portal of Mission Tunnel about one half mile down river from Gibraltar Dam. The outlet works for downstream release allows metered releases into the Santa Ynez River.

Watershed area above Gibraltar Dam is approximately 216 square miles; the southeast fourteen square miles of which are located above Juncal Dam. Thus, the total Juncal to Gibraltar watershed area is 202 square miles, nearly equal to that of the Gibraltar to Cachuma Reservoir sub-watershed (201 square miles).

Siltation has been a continual problem at Gibraltar Reservoir due to the significant size and steep terrain of its watershed compared to reservoir capacity, as well as the occasional occurrence of wild fires in the watershed. Siltation reduced the original reservoir capacity of 14,500 acre feet to 7,600 acre feet by the year 1947. The reinforced concrete arch dam was raised 23 feet in 1948, increasing the storage capacity to 14,777 acre feet. In the 1980's the storage capacity of the reservoir was reported to be about 8,500 acre feet. In 1995, the reservoir capacity was 7,634 acre feet with a corresponding surface area, when full, of 248 acres (see Appendix E for reservoir elevation-capacity tables). The yield and operation of the reservoir are discussed in Section 2.4. Diversions from Gibraltar Reservoir to the City of Santa Barbara are made through the 3.7 mile long Mission Tunnel. In addition, some water from Devils Canyon Creek, a downstream tributary to the Santa Ynez River, is diverted into the tunnel. Currently, the long-term average yield of the reservoir with a draft of 5,000 AFY is estimated to be about 4,600 AFY. Tunnel infiltration plus diversions from Devils Canyon Creek produce an average additional supply of about 1,100 acre feet of water per year.

2.1.3 Cachuma Reservoir

Cachuma Reservoir, completed June 17, 1953, is the largest of the three reservoirs on the Santa Ynez River. The reservoir is formed by Bradbury Dam 48.7 river miles from the Pacific Ocean. The dam is a 205 foot high (structural height is 275 feet) earth-fill structure with a 2975 ft. crest length set at elevation 766 ft., MSL. The spillway is a broad-crested weir in the south abutment of the dam consisting of 4 bays, each with a 50 ft. wide by 31 ft. high radial gate. The gates are seated in the weir invert at elevation 720 ft., MSL. The normal full operating level of the reservoir is 750 ft., MSL (with the gates fully closed).

The storage capacity of Cachuma Reservoir, when constructed, was 204,874 acre feet with a surface area of 3,090 acres. Based on the 1990 silt survey, the capacity of the reservoir has been reduced to 190,409 acre feet with a corresponding surface area of 3,043 acres (see Appendix E for reservoir elevation-capacity tables). The watershed area above Bradbury Dam is approximately 417 square miles, 216 square miles of which are above Gibraltar Dam.

Downstream releases to the Santa Ynez River and pipeline diversions to the ID#1 service area are accomplished through outlet works containing the following basic features: an inlet box at elevation 600 feet in the reservoir; a 1500 ft. long, 7 ft. diameter tunnel running from beneath the inlet box to the outlet building on the downstream toe of the dam adjacent to the north side of the spillway stilling basin; a 30 inch delivery pipeline to ID#1 from the outlet building; two 30 inch hollow-jet valves, set at elevation 563 ft., MSL, which, when opened, direct water into the stilling basin for a downstream release. The 7 ft. diameter tunnel is divided into two sections separated by a thick bulkhead located about 750 feet downstream from the inlet box (vertically beneath the dam crest). Reservoir water fills the tunnel from the inlet box to the bulkhead. Downstream of the bulkhead the water is conveyed through a large gate valve into a 38 inch diameter steel pipeline running inside the 7 ft. diameter tunnel to the outlet building.

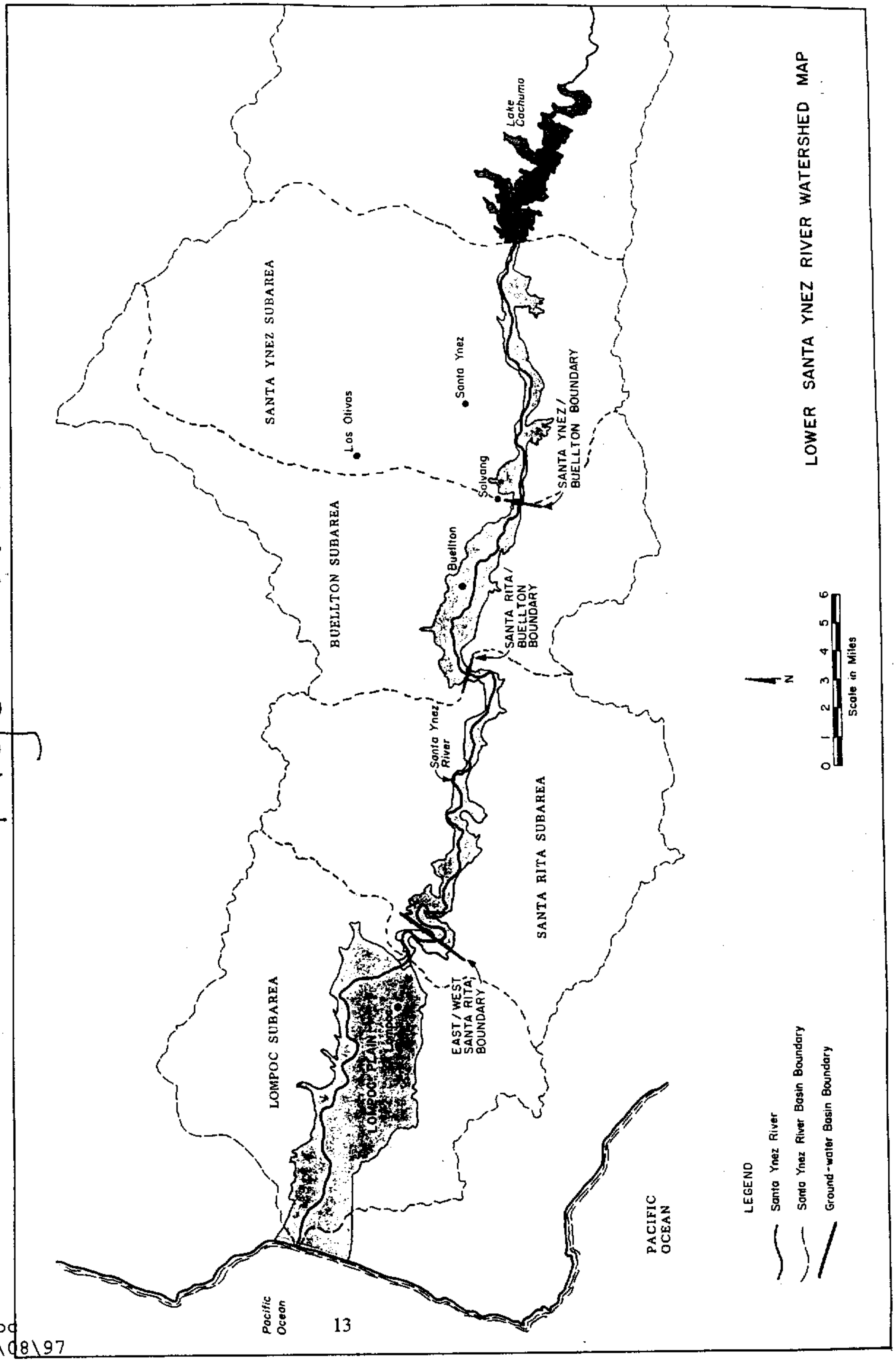
Minor lake diversions are made directly to the County park at the reservoir. Diversions to the South Coast are conveyed through the 6.4 mile long Tecolote Tunnel completed in 1956. Water infiltration into the tunnel is considered part of the Cachuma Project yield and averages about 2,000 AFY. The diverted lake water enters the tunnel via a pentagonal intake tower, with conduit from tower to tunnel, near the south bank of the reservoir, about 3.7 river miles upstream from Bradbury Dam. Tecolote Tunnel north portal elevation is about 660 ft., MSL (south portal elevation is 650 ft., MSL). When lake levels fall near this elevation, as they did during the 1986-'91 drought, diversions to the South Coast are continued by pumping from the lake through a floating conduit into the intake tower. Currently, the Cachuma Project average yield (sum of all the lake diversions plus Tecolote Tunnel infiltration water), with an annual draft of 25,714 acre feet, is about 25,500 AFY. The minimum pool for this yield is 12,000 acre feet.

2.2 ABOVE NARROWS ALLUVIAL GROUNDWATER BASIN

The Above Narrows Alluvial Groundwater Basin extends along the Santa Ynez River from Bradbury Dam to the Narrows east of Lompoc (Figure 2-1). Coarse grained, unconsolidated sand and gravel river channel and younger alluvium deposits comprise a groundwater basin approximately 35 miles long and of variable width from .2 to 1.5 miles. The estimated depth of the Above Narrows Alluvial Groundwater Basin (ANAGB) varies widely with a range from about 150 feet near the Lompoc Narrows, thinning eastward to about fifty feet near San Lucas Bridge below Bradbury Dam. Most of the basin is underlain by relatively non-water bearing shale.

The ANAGB is divided into three subareas based on geographic characteristics. The Santa Ynez subarea extends from Bradbury Dam to Alisal Bridge in Solvang, a distance of about 11 river miles. The Buellton subarea extends west from Alisal Bridge for a distance of about 7.4 river miles to a point on a major river bend, about three miles west of the City of Buellton. The Santa Rita subarea extends from the west end of the Buellton subarea to the Lompoc Narrows. For the purpose of this model, the Santa Rita subarea is divided into east and west reaches. Santa Rita East reach extends downstream 14.6 river miles from the Buellton subarea along the Santa Ynez River to a point located upstream from the confluence with Salsipuedes Creek. The Santa Rita West reach extends from this point downstream to the Lompoc Narrows (Figure 2-1). Storage calculations for these four alluvial basin reaches are arbitrarily referenced to the volume within the upper 50 feet of the aquifer. This upper 50 foot section has a storage capacity of about 90,000

Figure 2-1


LOWER SANTA YNEZ RIVER WATERSHED MAP
Lake Cachuma
SANTA YNEZ SUBAREA
Los Olivos
Santa Ynez
Solvang
SANTA YNEZ / BUELLTON BOUNDARY
BUELLTON SUBAREA
Buellton
SANTA RITA / BUELLTON BOUNDARY
Santa Ynez River
SANTA RITA SUBAREA
EAST / WEST SANTA RITA BOUNDARY
LOMPOC SUBAREA
LOMPOC PLAIN
Lompoc
PACIFIC OCEAN
Pacific Ocean
N
0 1 2 3 4 5 6
Scale in Miles
LEGEND
Santa Ynez River
Santa Ynez River Basin Boundary
Ground-water Basin Boundary

acre feet, and is considered to be the "working storage" of the basin.

Inflow to the ANAGB results from percolation of surface water and subsurface flow from geologic units surrounding the aquifer. Depletions occur through extractions by riparian vegetation (phreatophytes) and by wells within the alluvial basin.

For the purposes of this model, underflow in the alluvial basin is assumed to move parallel to the Santa Ynez River. It moves from east to west and from one subarea to another and flows through the Lompoc Narrows to the Lompoc basin (Figure 2-1). There is virtually no underflow into the eastern most end of the alluvial basin due to the construction of Bradbury Dam (which extends approximately 70 feet into bedrock below the stream bed and cuts off underflow beneath the dam.)

In order to achieve agreement between modeled and measured dewatered storage in the ANAGB, a hydrologic flow parameter representing bank infiltration was introduced. It is assumed that the bank infiltration occurs as subsurface inflow to ANAGB from less permeable, fractured, underlying shale and other deposits.

Under certain circumstances this flow may move from the alluvial basin into the underlying material. Within the Santa Ynez and Buellton subareas, inclusion of such an outflow mechanism in the model is necessary in times of high flows in order to achieve agreement between modeled and measured dewatered storage volumes. The modelling is based on the assumption that seepage from the ANAGB into the surrounding geologic formations occurs in times of high runoff following dry periods because of positive flow gradients created by mounding below the river bed. The bank outflow enters the surrounding fractured shale and older alluvial deposits.

Historically, there has been both surface and subsurface (groundwater) inflow to the ANAGB from adjacent upland groundwater basins. More recently, increased groundwater pumping from these basins has caused an overall lowering of groundwater levels and the resulting reduction of inflow to the Above Narrows Alluvial Groundwater Basin from these sources.

2.3 BELOW NARROWS GROUNDWATER BASIN

The Santa Ynez River flows into the Lompoc Plain west of the Narrows (Figure 2-1). In the Lompoc Plain the river flows in a northwest direction for about three miles and then turns west for ten miles before it empties into the Pacific Ocean. Most of the river percolation downstream from the Narrows occurs in the Lompoc Plain forebay (the eastern four mile reach beginning at Robinson Bridge). West of the City of Lompoc, percolation to the lower part of the younger alluvium (which comprises the main aquifer) is limited due to the upper fine grained silt and clay deposits.

2.4 CONCEPTUAL MODEL

The SYRHM was constructed to give an accounting of watershed runoff, using historic hydrologic data. The data base has been selected (and expanded) to present a period of sufficient length and climatic variability to be deemed useful for planning and analysis.

The model simulates the disposition of water at key points within the watershed utilizing a monthly time step. All hydrologic inflow and outflow quantities are, therefore, in monthly values (rainfall, runoff, evaporation, seepage, etc.). The monthly hydrologic calculations are sequential, in the direction of water flow within the watershed, from upper to lower (i.e. from Jameson Lake to Gibraltar, then to Cachuma, then to the Lompoc Narrows, and thence into Lompoc Valley). The monthly timestep is deemed to be adequate to provide good simulations of end of month storage (both surface and groundwater) and of monthly flow values at key points along the Santa Ynez River.

The database utilized in the SYRHM is historic data in so far as the data was available and/or appropriate. Some of the data was corrected for errors discovered after a research into the methods employed in its original recording. Runoff and rainfall data was adjusted for certain years after 1950, to remove the estimated effects of historic cloudseeding operations. Shorter term records of runoff and rainfall were extended by correlations with the long term historic data. Tributary flows between Cachuma and Lompoc have been adjusted slightly to account for the estimated historic upland depletions due to significant groundwater utilization in those areas. The database, in short, has been adjusted to represent historic unimpaired (by human developments) flows. Such adjustments included the removal of the effects of historic cloud seeding operations conducted on the watershed. In running the

SYRHM, the user may initiate varying levels of cloud seed operations and upland depletions, etc.

2.5 PERMITS, COURT DECISIONS AND AGREEMENTS

The water storage and delivery facilities on the Santa Ynez River have been in operation for many years. Operations of these facilities are subject to permits, court decisions, orders, and agreements. The SYRHM tries to emulate the effects (or directly uses certain applications) of the Upper Santa Ynez River Operations Agreement (USYROA) and the State Water Resources Control Board (State Board) orders. The model attempts to simulate the orders, and this manual attempts to describe the treatment of those orders. It is understood that the model simulations and/or manual summaries may not reflect the full dimensions of the orders, and that some parties may not agree with the descriptions offered here. With this understanding the summaries of the USYROA and the State Board orders and some of their relationships to the Model are discussed below.

2.5.1 Upper Santa Ynez River Operations Agreement

In 1986, the City of Santa Barbara and downstream interests entered into negotiations to determine if the City's need for stabilized yield from Gibraltar Reservoir and downstream interests' respective needs could be realized through a Gibraltar Reservoir operations agreement that included the use of Cachuma Reservoir to replace the diminishing capacity of Gibraltar Reservoir. The negotiations resulted in the Upper Santa Ynez River Operations Agreement in 1989.

The Upper Santa Ynez River Operations Agreement includes a "Base" Operation based on allowable diversions from a Gibraltar Reservoir with a fixed storage capacity of 8,567 acre feet (assuming no capacity loss due to siltation). In actual operation the City may choose to divert from Gibraltar Reservoir an amount of water in excess of that allowed under the "Base" Operation but has to mitigate its impact by reducing its diversion from Cachuma Reservoir.

Conversely, the City may reduce its diversion from Gibraltar Reservoir below the "Base" Operation amount and store and divert Gibraltar water at Cachuma Reservoir if appropriate arrangements are made with the USBR. The "Base" Operation allows maximum diversions of 4,189 acre-feet per year of ordinary flow and an additional amount of flood flow from Gibraltar Reservoir, if available. According to the USYROA, ordinary flows are deemed to be daily inflow (averaged over 24 hours) into Gibraltar Reservoir of less than 800 cubic feet per second (cfs-day). Daily inflows in excess of 800 cfs are deemed to be flood flows.

2.5.2 State Water Resources Control Board Orders

Decision No. 886 was adopted in 1958 by the State Water Rights Division {the predecessor to the State Water Resources Control Board (SWRCB)} and contained the initial permit conditions pertaining to the operation of Cachuma Reservoir. SWRCB Order WR 73-37 was established in March 1973 and amended in 1989 under SWRCB Order WR 89-18. Order WR 73-37 incorporated some of the provisions in Decision No. 886. Order WR 73-37 as amended by WR 89-18, provides procedures to store credit water in Cachuma Reservoir for subsequent releases to benefit downstream water users. Credits for downstream releases are established under Above and Below Narrows Accounts and water is later released to replenish the downstream groundwater basins. (In some instances, the credits may be reduced or lost.)

2.5.2.1 Above Narrows Account

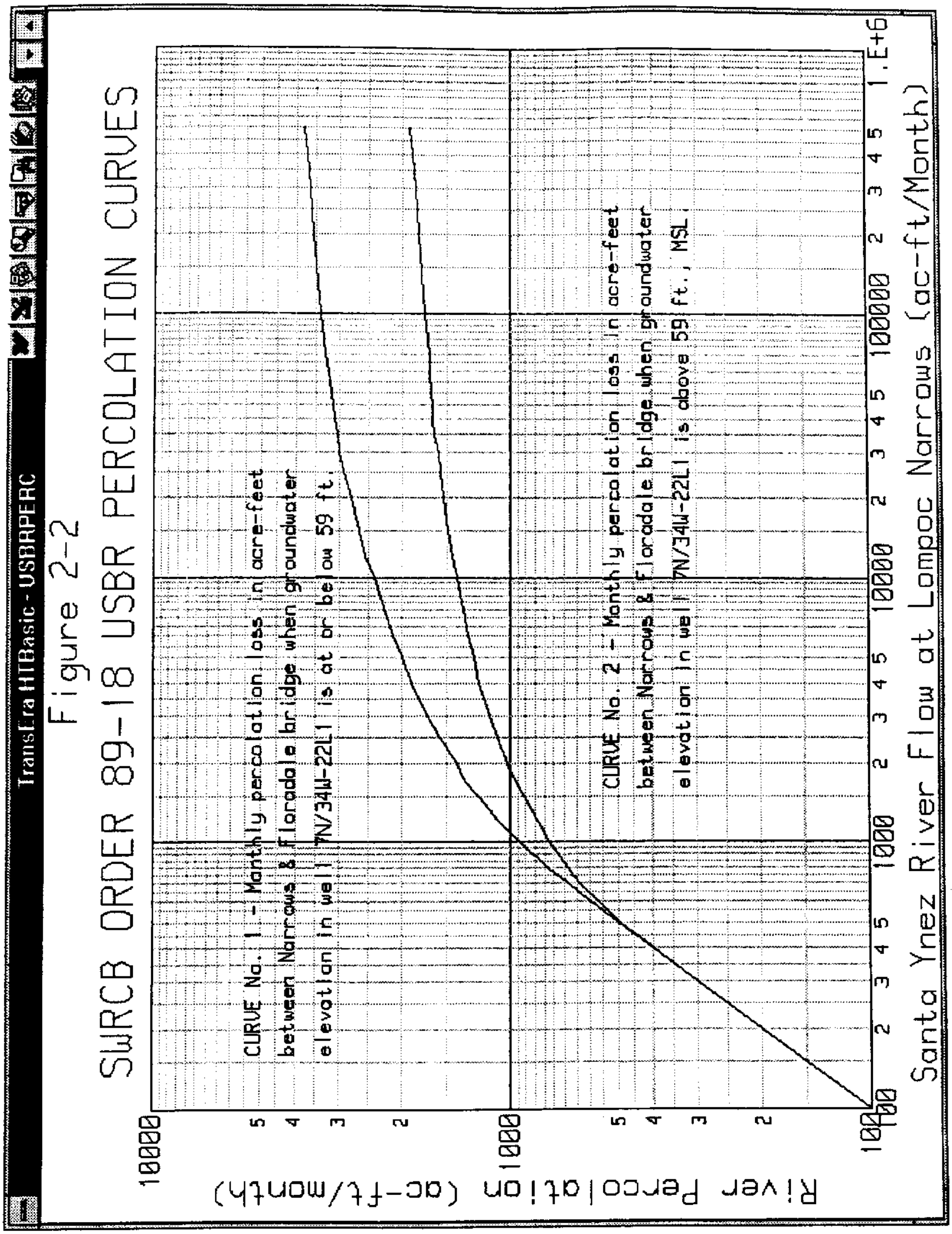
As provided in WR 73-37, as amended by WR 89-19, all of the inflow to Cachuma Reservoir is credited to the Above Narrows Account unless there is a live stream in the Santa Ynez River below Bradbury Dam to the Floradale Avenue Bridge in Lompoc Valley. Determination of live stream conditions is based on flow measurements and visual observation at a number of stations between the dam and the City of Lompoc. The live stream condition for the river northwest of the City of Lompoc at Floradale Bridge is determined by a correlation with the Santa Ynez River flows measured at the Narrows.

The Above Narrows Account may not exceed the total dewatered storage within the alluvial groundwater basin between Bradbury Dam and the Narrows (ANAGB). If the dewatered storage in the alluvial groundwater basin exceeds the operational dewatered storage (10,000 acre feet), releases from the Above Narrows Account may be requested and made from the reservoir. Maintenance of the dewatered storage allows for additional percolation of rainfall and runoff from the tributaries below Cachuma Reservoir. The actual dewatered storage is determined monthly by water level measurements of indicator wells in the ANAGB. For accounting purposes, water in the Above Narrows Account is not subject to evaporative losses in Cachuma Reservoir but is deemed the first water spilled to the extent the dewatered storage in the basin is reduced by such spills. The Order also specifies that, for the purpose of the Above Narrows Account, inflow to Cachuma Reservoir shall be deemed no less than 25 acre feet per month. This is the estimated monthly underflow at the Bradbury Dam site prior to construction of the Cachuma Reservoir Project.

2.5.2.2 Below Narrows Account

Calculations for the below Narrows credit are contingent upon the difference between estimated actual percolation below the Narrows and estimated percolation which would have occurred if the Santa Ynez River flows were not impounded by Cachuma Reservoir. The SWRCB Order No. WR73-37, as amended by WR 89-18, requires monthly calculation of "constructive" flow and "constructive" percolation. Percolation estimates corresponding to "constructive" and measured flows at the Narrows are determined using percolation curves (Figure 2-2) and the difference in the amount of percolation is credited to the Below Narrows Account.

The USBR currently uses the upper curve only but is collecting data on measured percolation and groundwater levels in indicator wells to develop criteria for using the lower curve. The Santa Ynez River Hydrology Model calculates percolation on the assumption that percolation rates decrease after sufficient occurrences of seasonal runoff passing through the Lompoc Narrows. Therefore, the model uses both the upper and lower curves to determine percolation as a function of cumulative seasonal flow. However, assumptions used in utilizing the lower curve have not been verified. The Below Narrows Account is reduced in the event of a spill from Cachuma Reservoir, taking into consideration spills reaching the Narrows, reduction in Below Narrows dewatered storage, and measured flows at the Narrows. The model may be modified when the USBR determines its criteria for utilizing each curve.


TransEra HTBasic - USBRPERC
Figure 2-2
SWRCB ORDER 89-18 USBR PERCOLATION CURVES
CURVE No. 1 - Monthly percolation loss in acre-feet
between Narrows & Floradale bridge when groundwater
elevation in well 7N/34W-22L1 is at or below 59 ft.
CURVE No. 2 - Monthly percolation loss in acre-feet
between Narrows & Floradale bridge when groundwater
elevation in well 7N/34W-22L1 is above 59 ft., MSL.
River Percolation (ac-ft/month)
10000
1000
100
Santa Ynez River Flow at Lompoc Narrows (ac-ft/Month)
100
1000
10000
100000
1.E+6

SECTION 3

SECTION 3

HYDROLOGIC DATA

This section provides a general description of the data used by the Santa Ynez River Hydrology Model including its development and adjustments, where needed. Appendix E presents the actual data and details regarding its development.

Hydrologic data for a base period, or modeling period, provides the basis for the model analysis. The modeling period extends from water year 1918 through 1993 (76 years). The base period 1918-1993 was selected because hydrologic records for this period are fairly complete and the period would begin and end with nearly full reservoirs and groundwater storage in the Santa Ynez River basin. In addition, this period includes the two most severe droughts for which adequate data is available (May, 1946 through December, 1951 and May, 1986 through February, 1991).

3.1 HYDROLOGIC COMPONENTS

Five primary operations, or hydrologic components, in the Santa Ynez River basin are simulated by the model. The first three components are the three reservoirs on the Santa Ynez River, which from upper to lower reaches of the river are Jameson Reservoir (Juncal Dam and Doulton Tunnel), Gibraltar Reservoir (Gibraltar Dam and Mission Tunnel), and Cachuma Reservoir (Bradbury Dam and Tecolote Tunnel). Modeling at Gibraltar Dam actually is performed for two reservoir operations; a base operation and an actual operation (see Section 2.5.2). The tunnels extend from each reservoir to the South Coast area and are used to transport water through the Santa Ynez mountain range. (The model treats each reservoir and tunnel separately.) The fourth component is the Above Narrows Alluvial Groundwater Basin (modeled in four segments) along the Santa Ynez River from Bradbury Dam to the Lompoc Narrows, and the fifth component is percolation into the Below Narrows Groundwater Basin. Several types of data are necessary to simulate each component of the watershed.

The hydrologic data required to simulate each of the three reservoirs located on the Santa Ynez River are: 1) incremental watershed runoff from each sub-watershed area (hereafter referred to as "accretions"); 2) rainfall and evaporation measurements ("pan evaporation") at each reservoir site; 3) groundwater infiltration to each tunnel; and 4) evapotranspiration correction data (in the case of Cachuma Reservoir).

If cloud seeding effects are to be included in a model run, additional data are utilized to calculate rainfall and runoff increments due to cloud seeding. These increments of increased watershed runoff and rain on the lake are included in the monthly reservoir accounting. Additionally, reservoir elevation-capacity tables (in one foot vertical increments) are provided for each of the surface reservoirs on the Santa Ynez River including the fixed operation at Gibraltar Reservoir utilized for the base operation.

The hydrologic data required to simulate the Above Narrows Alluvial Groundwater Basin (ANAGB) includes the incremental runoff generated between Bradbury Dam and the Lompoc Narrows (i.e. the Cachuma to Lompoc accretions) and the runoff of Salsipuedes Creek near Lompoc.

The modeled operations of Cachuma Reservoir determine spill and releases from Bradbury Dam which are treated as an imput to the ANAGB. The Cachuma to Lompoc accretion data was developed by using historic flows at the Bradbury Dam site as input to a calibrated ANAGB model, and adjusting the accretion data to reproduce historic ANAGB storage amounts and Narrows flows.

To model the percolation of the Santa Ynez River flows into the Below Narrows Groundwater Basin (BNGB) (also known as the Lompoc Groundwater Basin) no further hydrologic data is required. The monthly flows generated by the model at the Lompoc Narrows are used to calculate the amount of percolation into the BNGB based on the method set forth in WR73-37, as amended by WR89-18.

3.2 DATA ARRAYS

The Model requires numeric data input to be used in simulating the hydrologic components of the Santa Ynez River watershed. In the context of this computer model, an array of data is a group of numerical values, such as monthly rainfall, etc., represented by a single variable name. Five types of monthly hydrologic data are used in the simulation of the components of the Santa Ynez River watershed: rainfall, runoff, evaporation, evapotranspiration, and tunnel infiltration. Within the model, these data are organized in seven data arrays. Eighteen data items are included in these seven arrays. Each data item consists of 912 monthly values for the period from October 1917 through September 1993. The data items are grouped as follows:

- Runoff Data (five data items). Two arrays are used for the runoff items. One array contains incremental runoff data for four sections of the Santa Ynez River, and the other data array contains runoff from the Salsipuedes Watershed.

- Rainfall Data (six data items). Two arrays are used for the rainfall items. One array contains rainfall data for raingauges at each of the three reservoirs, and one array contains maximum possible rainfall increments due to cloud seeding at each reservoir site.

- Evaporation Data (three data items). One array is used for pan evaporation at each of the three reservoirs.

- Evapotranspiration Data (one data item). One array is used for correction of Cachuma Reservoir evapotranspiration.

- Tunnel Data (three data items). One array is used for tunnel infiltration into each of the three reservoir tunnels.

The next section is a brief description of each data grouping. Included is a discussion of derivation of the data as well as how the data are arranged and "read" by the model.

3.2.1 Runoff Data

Data files: ACCR96.HTB; Model array: Accret%(4,912)
SALP96.HTB; Model array: Salsi%(912)

The runoff data used by the model is based on historical stream flow records for numerous gages in the Santa Ynez Watershed, two of which have nearly continuous records back to 1904 ("Santa Ynez

River above Gibraltar Dam") and 1907 ("Santa Ynez River near Lompoc"). Stream flow gauging has been performed by the U.S. Geological Survey (USGS) and others.

Runoff data are developed for five separate areas: 1) runoff into Jameson Reservoir, 2) runoff from the watershed area between Juncal and Gibraltar Dams (Juncal to Gibraltar accretions), 3) runoff from the watershed between Gibraltar and Cachuma Dams (Gibraltar to Cachuma accretions), 4) runoff and subsurface inflow from the watershed area between Bradbury Dam and Lompoc (Cachuma to Lompoc accretions), and 5) runoff from the Salsipuedes Creek.

The Jameson Reservoir runoff consists of inflow to the reservoir including diversions from Alder Creek, and does not include rain on or evaporation from the lake.

Juncal to Gibraltar accretions are computed as inflow into Gibraltar Reservoir minus spills from Jameson Reservoir (no releases have been historically made from Juncal Dam). Similarly, Gibraltar to Cachuma accretions are computed by subtracting Gibraltar spills and releases from Cachuma inflows. In a similar manner, Cachuma to Lompoc accretions are computed using measurements by the USGS at the gage referred to as "Santa Ynez River near Lompoc" minus any spills, releases, and leakage from Bradbury Dam. The accretion amounts are adjusted for pumpage, bank, and phreatophyte consumptive use for the reach of Santa Ynez River between Bradbury Dam and Lompoc. Runoff from the Salsipuedes Creek is entered separately in the model.

Two files are used for runoff data; one, containing four data items, is for the Santa Ynez River; the other, comprising one data item, is for Salsipuedes Creek. All runoff data utilized in the model have been adjusted for the effect of cloud seeding. The Santa Ynez River runoff array contains four groups (tables) of runoff data representing 912 months (water years 1918-1993). These are, 1) runoff into Jameson Reservoir; 2) the Juncal to Gibraltar accretions; 3) the Gibraltar to Cachuma accretions; and 4) the Cachuma to Lompoc accretions. The accretions from any portion of the watershed are generally treated as total runoff at the downstream end minus any inflow at the up stream end of that portion of the watershed. In the case of the Gibraltar to Cachuma accretions, historic Gin Chow releases at Gibraltar reservoir from 1931 to 1990 are generally of such low flow levels as to be ignored, i.e. not subtracted from Cachuma inflow. However, in the years 1991, 1992, and 1993 the Gin Chow releases were subtracted from Cachuma inflow since those releases were made at higher flow rates and in part, reached Cachuma Reservoir. The current version of the model has been modified so that the volume of Gin Chow releases reaching Cachuma Reservoir is calculated when they occur.

Small adjustments called "upland depletions" were added to the Cachuma to Lompoc accretions runoff data. This was done in order to account for increasing consumptive use of local groundwaters outside the margins of the ANAGB over the 76 year modeling period which lowered groundwater levels and decreased inflow to the ANAGB. The resulting accretions are thus considered to be "unimpaired".

The monthly runoff data contained in the Salsipuedes Creek flow array was synthesized for years 1917-1940 (see Appendix E). The array contains monthly flow (from 1941 onward) measurements by the USGS at the stream gauge "Salsipuedes Creek near Lompoc."

3.2.2 Rainfall Data

Data files: PREC96.HTB; Model array Rain%(3,912)
CSNC96.HTB; Model array CsInc%(3,912)

Rainfall data is based on historic measurements of precipitation at each of the three reservoirs. Rainfall data for Jameson, Gibraltar, and Cachuma Reservoirs are available from 1925, 1920, and 1952, respectively. Rainfall data for Gibraltar was extended back to 1918 by correlation with the raingauge in the City of Santa Barbara. The data for Juncal and Cachuma was then extended back to 1918 by correlation with the actual or synthesized Gibraltar data. The model uses the two rainfall data files which are read into the model data arrays [Rain%(3,912) and CsInc%(3,912)] noted above. Both of these arrays contain data to be applied at each of the three surface reservoirs.

An adjustment of the rainfall data was made prior to its inclusion in the model. Rainfall data for the three reservoirs has been adjusted to remove the estimated effects of historic cloud seeding after 1951. Adjustments were provided by North American Weather consultants (NAWC) in May 1988 and June 1996 reports prepared for the Water Agency. The reports rely on the extensive experience of NAWC with cloud seeding programs and related studies. The reports provide estimates of historic effects of all of the cloud seeding performed in Santa Barbara County from 1951 through 1993.

The NAWC reports also provide estimated maximum precipitation augmentation (increments) for each month of the October through

April time window for 74 water years (1920 through 1993). These increments, along with estimates for October through April for water years 1918 and 1919 (based upon the NAWC figures), comprise the array of (incremental) rainfall increases due to cloudseeding (CSINC). The three items of the array correspond to rainfall as measured at Juncal (Jameson Reservoir), Gibraltar, and Cachuma reservoirs, and are used, if cloud seeding is selected when running the model, to augment the appropriate rainfall data items (Rain%).

The estimates of historic cloud seeding augmentation were employed with the cloud seeding incremental runoff calculation methodology described in Appendix B1. This allowed adjustment (i.e. reduction) of the runoff values to levels which would have occurred without cloud seeding for the 25 seeded years from 1951 through 1993 during which seeding actually occurred in the upper Santa Ynez Watershed (above Cachuma Reservoir), and for the 20 years during which seeding occurred in the lower watershed. (During five of the 25 years of historic seeding, the lower watershed was not targeted.) The methodology of appendix B1 also allows the inclusion of cloud seeding runoff benefits for the entire 76 year modeling period 1918-1993 (if selected by the model user).

3.2.3 Evaporation Data

Data file: EVP096.HTB; Model array Evap%(3,912)

Evaporation data is based on monthly measurements of evaporation pans located at each of the reservoirs. To estimate evaporation from the lake, the pan measurement is multiplied by a pan factor. The data file containing The pan evaporation data is labeled as EVPO96.HTB. The array representing this data in the model is named Evap%(3,912).

One adjustment to the Juncal pan data was necessary due to the growth of trees around the pan over a period of years. Utilizing a relationship between the Juncal and Gibraltar pan data, the Juncal pan evaporation data was adjusted for the effect of progressive shading. Then, both the Juncal and Gibraltar Reservoir pan records were extended back to 1918 (from the 1931 beginning of record for both of those pans) by using the Chula Vista pan deviations from mean annual evaporation. Chula Vista is located near the City of San Diego. The Chula Vista data are used because that is the closest site for which records extend back to 1918. The annual evaporation values thus developed were distributed to monthly pan values using the long term mean monthly pan evaporation data from 1935 through 1979 for each site.

The Cachuma Reservoir pan data record begins with the 1957 water year. Data for water years 1918 through 1956 was synthesized for the Cachuma Reservoir pan using the annual deviations from the mean based on historic and synthesized data for 1918 through 1956 from the Juncal and Gibraltar pans averaged. The annual Cachuma pan values developed from these deviations were distributed to monthly values using the mean monthly Cachuma pan evaporations for the year 1957 through 1985 (see Appendix E, Cachuma Pan).

3.2.4 Evapotranspiration Data

Data file: CHET96.HTB; Model array: CachET%(912)

Because of the large area covered by Lake Cachuma, evapotranspiration data is used to correct the monthly inflow to the Reservoir. The watershed area inundated by the reservoir is <u>not</u> subject to runoff losses due to evapotranspiration by vegetation, and detention by soil and subsequent evaporation from bare land surface areas (See Appendix B, Subsection B3). This correction is applied, based upon historic monthly lake areas, to the Gibraltar to Cachuma accretions for water years 1953 through 1993. (Cachuma Reservoir began impounding water in November of 1952.) The accretions for that period are thereby adjusted downward to reflect loss of flow values at the Cachuma Dam site which would be expected if Cachuma Reservoir did not exist.

Monthly evapotranspiration data used in the model is entirely synthetic; it is not based on direct measurements. Evapotranspiration from the reservoir area is estimated based on information on density and types of vegetation which occurred in the area now covered by Cachuma Reservoir. When running the model with various Cachuma operations and different (from existing) reservoir sizes, the evapotranspiration correction is added as a runoff increment. (As discussed in Section 3.2.3, evaporation from the surface of the reservoir is based upon the evaporation pan data which is accounted for separately within the model.)

3.2.5 Tunnel Infiltration Data

Data file: TNNL96.HTB; Model array: Tunnel%(3,912)

Direct measurements of tunnel infiltration for Doulton Tunnel were available beginning in 1925. Data for Mission Tunnel and Tecolote Tunnel were available starting in 1978 and 1960, respectively. As noted in Section 2.1 each of the three reservoirs has an associated tunnel through the Santa Ynez Mountains to convey Santa Ynez River water to the South Coast (The upper two tunnels at Juncal and Gibraltar Dams also convey small amounts of Santa Ynez River tributary water from watershed areas located immediately below the respective dams).

Due to various problems with tunnel infiltration data, extensive adjustments and synthesis of the data was required. The Doulton tunnel infiltration, which was relatively high after tunnel construction, appears to have recessed to a steady state by about 1940. The tunnel data from 1941 through 1979 (along with the measured diversions from Fox Creek) were used to create an algorithm for tunnel infiltration. This algorithm, which is based on monthly rainfall data (and for small tributary diversions is based on the Juncal to Gibraltar accretions), was used to synthesize monthly tunnel infiltration (and tributary diversions, if any) for the period October 1917 through September 1940. The same algorithm modified for Mission Tunnel and Devils Canyon was successfully employed to extend the limited Mission Tunnel infiltration records back to 1918. The Tecolote Tunnel infiltration values, which are considered part of the Cachuma Project yield, were synthesized using the tunnel infiltration algorithm adapted to match the observed infiltration deviations at that location (see Appendix E, Memorandum on Tecolote Tunnel infiltration dated January 8, 1994, with a June 26, 1997 update).

SECTION 4

SECTION 4

MODEL OPERATIONS

This section describes the Model operations, equipment needed to run the Model, the output, and a few of the possible applications. The version discussed in this manual is based on "Q-Basic" software, and is designated "SYRM1296.BAS".

4.0 ACCESSING THE PROGRAM

From the opening menu for Q-Basic, press "Alt-F" then "O" to access the available programs. The Tab key and then the arrow keys will move the cursor to the appropriate drive and directory program titles so that you may highlight the Santa Ynez River Hydrology Model (SYRM1296.BAS). "Alt-R" then "enter" will run the program. To exit the program at any time, press capital H. This will take you to the program language. Then type "Alt-F" and "X" to leave the Quick Basic environment. If a message appears asking if you want to save the program, you have altered some ASCII characters in the program language. Type "N" for No.

4.1 EQUIPMENT (HARDWARE AND SOFTWARE)

The Santa Ynez River Hydrology Model may be run using an IBM compatible Personal Computer equipped with Microsoft QuickBASIC 4.5. The QuickBASIC 4.5 version is entitled "SYRM1296.BAS". This version, along with all required data files, is available to authorized users of the Santa Ynez River Model. A 386 or faster computer with a math co-processor is preferred. A Desk-Jet or

Laser-Jet type printer is suitable for printing model output. In DOS environment GRAFLASR.COM is auxiliary software required to print the model graphs. Operating in the Windows environment allows the user to produce nicer (than GRAFLASR) presentation graphics through the use of PowerPoint.

4.2 MENU

The model is menu driven, that is, the menu allows the user to specify the system parameters including reservoir maximum capacity, diversion levels, and operational rules; beginning Above and Below Narrows Accounts; riparian alluvial basin M&I and Agricultural net pumpage levels; and the effectiveness of cloud seeding. The user may also specify the particular type of output to be displayed (see section 4.3, Model Output). Figure 4-1 displays a "default menu" which would be produced on the users screen. The "default menu" contains menu parameters which reflect existing conditions.

There are 36 menu parameters which may be changed by the user (these parameters are located as six rows of six variables in the menu). Upon first viewing the menu the cursor is located in row one, column one. The cursor may be moved throughout the grid by using the arrow keys on the computer keyboard. New entries may be made at any cell location by keying in the numbers and pressing either the "enter" or "arrow" keys. The backspace key is used to edit. Arrow keys operate in the circular mode; i.e. if the "right" arrow is pressed in the sixth column of any menu row, the cursor will move to the first column of that row. Only numeric data may be entered in the menu cells, although after removing the cursor, some cells will display a label corresponding to the number entry.

RESERVOIR	BegWSElev	MaxWSElev	ProjDraft	1=Lk2=L+T	StrtShort	May1Delv%
ResJUNCAL GIBRALTAR RsCACHUMA	2220.80 1399.30 745.90	2224.00 1400.00 750.00	2000 4500 25714	Lake Only Lake Only Lk + Tunl	2500 50 100000	16.350% 0.000% 75.810%
PIPE & CU	ID#1 Pipe	LompcPipe	M&ICnsUse	IrrAgAcrg	CSeedFlag	SeedEfcny
&Cld SEED	3000	0	2000	5677	1	0.50
Acnts&Etc	ShwDetYrs	BegRipStr	BegnngANA	ANAStrtRl	BegnngBNA	BNAStrtRl
RipACCNTS	1918.76	79100	2400	10600	600	1000
RUN TYPES	RunDETAIL	RunOUTPUT	TableTYPE	TabOUTPUT	GraphTYPE	DrouthADD
andOUTPUT	SUMMARY	To CRT	No Table!	To CRT	No Graph!	NONE!!!

Use CAPS!!! R to RUN; H to STOP. Output: 1=CRT; 2=Printer. Detailed output for Juncal, Base Gib, Exist Gib, Cachuma, Abv Nrrws, Blw Nrrws and Summry (1-7). 15 Tables are available for output: 1-5 = surface reservoir delivery shortages; 6-12 = river flows into Cachuma and @ 6 locations downstream to Floradale Bridge; 13-15 = Cachuma storg, elev & area. Of 11 Graphical displays, 1-5 = surface reservoir deliveries ranked; 6&7 show RESV & GWB hydrographs; 8-11 = ranked annual flows into reservoirs & at Lompoc Narrows... Use arrows to move about MENU. After RUN, S displays selected table &/or graph for viewing & output..

Figure 4 - 1

SYRM1296 Model Default Menu

This is true for column 4, rows 1 through 3 and all of row 6. For example, inputting a number 1 in Row 6, column 5 will cause the label "JunDelRnk" to be displayed when the cursor is removed from the cell, thus indicating the type of graph to be displayed in this case, a chart showing annual deliveries for Juncal Reservoir ranked from least to greatest. Tables 4-1 and 4-2 show the numeric value corresponding to the various model Graphical and Tabular outputs.

4.2.1 Reservoir Parameters

The top three rows of the menu specify parameters for the three reservoirs listed in the left column. Both the beginning and full water surface elevations for each reservoir may be entered in the first and second columns entitled "BegWSElev" and "MaxWSElev" (Beginning Water Surface Elevation and Maximum Water Surface Elevation, respectively). These values correspond to the initial and maximum storage elevations for the modeling period and are translated to storage volumes within the program based on elevation capacity tables which are listed in Appendix F. The default values for the maximum storage elevations reflect the most recent elevation to volume data available.

In the third column, the reservoirs' draft "ProjDraft" (Project Draft or annual water production) is selected. The reservoir draft is the amount of water taken from the reservoir each year for beneficial uses. The default values are estimates of mid 1990's diversion levels based on information from various water users. The fourth column allows the diversion level to be inclusive or exclusive of tunnel infiltration. Lake diversion only is specified by entering a number "1" in the box, and indicates that the entire

TABLE 4-1		
TABULAR OUTPUT		
NUMBER	**TABLE NAME**	**CONTENTS**
1	JuncShort	Shortages at Juncal Reservoir
2	BaseShort	Shortages at the Base Gibraltar Reservoir.
3	GibShort	Shortages at the actual Gibraltar Reservoir
4	CachShort	Shortages at Cachuma Reservoir
5	Combined S	Combined shortages from the three main reservoirs
6	CacInflow	Inflow to Cachuma Reservoir
7	QSnLucas	Flow at San Lucas Bridge
8	QAlisalB	Flow at Alisal Bridge
9	QBendWB	Flow at bend in Santa Ynez River west of Buellton
10	QAbvSals	Flow above confluence w Salsipuedes Creek
11	Q Narrows	Flow at the Lompoc Narrows
12	Qfloradl	Flow at Floradale Bridge
13	Cach Store	Cachuma Res End Of Month Storage
14	Cach Elev	Cachuma Res End Of Month elevs
15	Cach Area	Cachuma Res End Of Month areas

4-2		
GRAPHIC DISPLAYS		
NUMBER	**GRAPH**	**FUNCTION**
1	JunDelRank	Jameson Reservoir delivery rankings
2	BasDelRank	Base Gibraltar delivery rankings
3	GibDelRnk	Gibraltar Reservoir delivery rankings
4	CacDelRnk	Cachuma Reservoir delivery rankings
5	ComDelRnk	Combined source delivery rankings
6	Hydrograph	Juncal, Gibraltar, Cachuma and Alluvial Basin storage graphs
7	HydroGph2	ANAGB hydrographs for the Santa Ynez, Buellton, Santa Rita East, & Santa Rita West Subareas
8	RankQJunc	Jameson Reservoir inflow rankings
9	RankQGibr	Gibraltar Reservoir inflow rankings
10	RankQCach	Cachuma Reservoir inflow rankings
11	RankQLomp	Santa Ynez River flow at the Lompoc Narrows rankings

"project draft" is supplied by the reservoir. Entering a "2" indicates that the "project draft" includes water taken from the reservoir and water infiltration into the delivery tunnel.

Columns 5 and 6 of rows 1, 2, and 3 apply to operations wherein shortages in reservoir deliveries may be taken. For the purposes of the model, "Safe Yield" is defined as the amount of water that can be withdrawn each year from the reservoir through the worst drought of the modeling period without suffering shortages. If a "ramp" function is to be implemented (for example, if the reservoir draft exceeds the reservoir safe yield; see Appendix B), columns 5 and 6 are employed to define the way shortages are to be taken. The ramp is a controlled schedule of draft reductions readjusted on May 1 of each water year which allows for a predicted minimum reservoir volume during the driest year of the "critical drought". The annual production of the reservoir thus "ramps down" (along a sloped graph) according to the volume of water remaining in the reservoir on May 1st of the water year.

The parameters defining the ramp function that may be set in the menu include "StrtShort" (the volume below which shortages begin) and "May1Delv%" (May 1 delivery factor). The May 1 delivery factor is the percent of full draft to be taken during a planned water diversion year beginning May 1, at which time the reservoir storage is at a selected fixed low storage point. The start shortage point, and the fixed low storage point, with the associated May 1 delivery%, define the "ramp" function. The default Menu settings provide a delivery ramp function for Juncal, Gibraltar, and Cachuma reservoirs. The fixed low storage points used for these three reservoirs are, respectively, 500 acre feet, zero acre feet, and

20,000 acre feet. (see Figure 4-2 last row of upper box; and example "Ramp" function Figure B-7).

4.2.2 Additional Use And Cloud Seeding Parameters

The fourth row of the menu applies to water deliveries by pipeline to Santa Ynez Valley (and also a hypothetical pipeline to Lompoc); Riparian Alluvial Basin M & I consumptive use and irrigated agricultural acres; and parameters governing cloud seeding. The first column is agricultural type deliveries to Santa Ynez ID#1 from Cachuma Reservoir (whatever the value, this number is implicitly included in the "ProjDraft" of row 3, column 3). Column 2 is total deliveries assumed to be made to Lompoc City from Cachuma Reservoir via a hypothetical pipeline. Since this pipeline does not currently exist, the default value is zero. These two parameters allow various water supply scenarios to be evaluated.

Columns three and four of the fourth row allow for selection of "M&ICnsUse" (Municipal and Industrial Consumptive use of Water by ID#1, Solvang, Buellton, and private water companies) as well as "IrrAgAcrg" (irrigated agricultural acreage) which results in consumptive use of water pumped from the Above Narrows Alluvial Basin. These values influence the amount of water needed to satisfy the Above Narrows Account and, therefore, have some influence (although relatively small) on the Cachuma Reservoir Project yield (see Section 2.5.2 and Appendix B, sections B3.3.3 and B4). These parameters allow hypothetical future (or estimated past) water use conditions to be evaluated.

SANTA YNEZ RIVER MODEL SYRM1296:
Existing Cachuma Reservoir
With Cloudseeding at 0.50 efficiency

INITIAL RESRV/BASN CONDITIONS				MAXIMUM CONDITIONS			DIVERSION INFORMATION		
Reservoir	WS Elev	Area	Volume	WSElev	Area	Volume	Divert To	Mode	SysDemand
Jameson R	2220.80	115	4854	2224.0	128	5235	Montecito	LakeDraft	2,000
BaseGibrl	1397.80	271	7948	1400.0	292	8567	PhantCity	LakeDraft	7,278
Gibraltar	1399.30	244	7463	1400.0	249	7634	S B City	LakeDraft	4,580
Cachuma R	745.90	2899	178230	750.0	3042	190409	SC, SYnez	L+T Draft	25,714

Begining Cachuma- - Lompoc	Above Narrows Riparian						Lompoc	BelowNarrows	
	Storage	FullVolume	Ag CU	M&I CU	Strel	Accnt	Pipe	Strel	Acct
	79100	90000	10457	2000	10600	2400	0	1000	600

JunRedPt	%YrsDel@	LowPtAF	GibRedPt	%YrsDel@	LowPtAF	CacRedPt	%YrsDel@	LowPt AF
2500 af	16.350%	500 af	50 af	0.000%	0 af	100000af	75.787%	20000 af

SUMMARY: 1918-1993 AVERAGE VALUES (Vols[ac-ft], Areas[ac], Elevs[ft])

RESRV (bas)	PERIOD AVERAGE runoff	precp	evapo	Leak -age	Piped divrt	Dwnsr reles	Tunl infl	Resrvr spills	Systm yield	OVERALL AVERAGE WSEL	area	storag
James	4979	234	321	0	1778	0	541	3113	2319	2203.5	93	3379
BaseG	45744	529	909	0	4829	348	1125	40186	5953	1389.4	228	6378
Gibrl	45744	467	803	0	4314	377	1125	40717	5439	1389.3	202	5664
Cachm	74265	3926	11044	463	23428	6020	2046	37237	25474	728.11	2400	137591

A

GWB-Avgs CachLomp	Unimpr runoff	Runf depl	Bank depl	Ripar divrs	Agric C.U.	River perc.	Bank& Phrea	Undr flow	Narrow outflw	PERIOD AVERAGE ANA	Tds	Volum
Riparian	79627	842	358	2000	10457	12706	1609	1500	66079	2904	11027	78973
StrmSEEP	S Ynez = 6435			Buelltn = 2692			SRita E = 3051			SRita W = 529		

B

BelowNarrowsPeriodAvergs	Rnoff@ Narrws	Calcd Percl	Calcld Qincr	Cnstrcv NarrwsQ	Cnstr Percl	BlwNr Reles	RelTo Narws	Calcltd QFlorAv	BlwNr Credt	BNA Redu	BNA Acct
	66079	8240	31840	96779	8424	2528	1140	57839	1325	185	1718

C

	Jameson Lake	BaseGibraltar	GibraltarLake	Lake Cachuma	Riparian Volm
PeriodEndingVols	4,855 af	7,960 af	7,455 af	178,201 af	79,102 af
Min Vols	100 af	0 af	0 af	12,000 af	55,332 af
Min Date	Dec 1951	Jun 1949	Jun 1931	Dec 1951	Oct 1951
ShortMos	20.2 %	96.8 %	8.5 %	14.5 %	
MxyrShrt	1,688 af	0 af	4,580 af	4,516 af	
Wors%Sht	91.9 %	100.0 %	100.0 %	21.1 %	

D

Selected SYRM1296.BAS Run of 14:02:26, 01-21-1997...

Figure 4-2

Summary Printout

Columns 5 and 6 of row 4 refer to cloud seeding augmentation of rainfall which may be included in model calculations at the desired level of efficiency. Entering a "0" in the cell labeled "CSeedFlag" (Cloud Seeding Flag) will exclude seeding effects from model calculations and entering a "1" will include them. Cloud seeding efficiency refers to the fraction of the maximum possible precipitation increase over unaugmented conditions. The model defaults to a conservative estimate of one half (.5) of possible benefits for cloud seeding. The desired efficiency is entered as a decimal in the cell entitled "SeedEfcny" (Seeding Efficiency).

4.2.3 Detailed Monthly Printouts

The first column of row 5, "ShwDetYrs" (Show Detail Years), allows the user to choose the years of the modeling period to be output in a detailed (monthly and water year) format. The number before the decimal point is the water year at which the detailed printout begins and the number after the decimal point is the number of years to be displayed. For example, if the user wishes to see a detailed monthly display for only one year, the 1951 water year for example, the number entered for row 5, column 1, would be 1951.01. The default values shown on Figure 4.1 include the entire 76 year modeling period (1918 through 1993). This feature is only applicable if one of the detailed printouts is selected in row 6, column 1 of the menu (see Section 4.2.4). If only one year is selected for detailed display the model will pause on the display until the user presses any key. Two or more years selected for detailed display can be observed on the screen only by pressing the "pause" key (to continue after pausing the user can press any key, eg. the space bar, for example).

4.2.4 Alluvial Basin Parameters

The second column of row 5, entitled "BegRipStr" (Beginning Riparian Storage), allows specification of the storage in the Riparian Alluvial Basins at the beginning of the modeling period. Similarly, the third column "BegnngANA" (Beginning Above Narrows Account) and fifth column "BegnngBNA" (Beginning Below Narrows Account) refer to the credits in the Above and Below Narrows Accounts at the beginning of the modeling period. The default values listed (2400 and 600 acre feet, respectively) have been selected so that the beginning of modeling period credits are similar to those at the end of the modeling period. Thus the beginning of October, 1917 values for reservoir water levels and Riparian Accounts taken from a model run should be similar to the end of September, 1993 values. This is because 1917 and the preceding year and 1993 and the preceding year were both similar wet periods and would have similar beginning volumes of water in storage. "ANAStrtRl" and "BNAStrRl" (Above and Below Narrows Start Release), columns 4 and 6, specify the dewatered storage threshold and credit balance at which releases from Cachuma Reservoir are made to replenish the Above and Below Narrows Accounts, respectively.

4.2.5 Output Parameters

The sixth row of the menu controls the model display and output which occur while the model is running, and the tabular and graphical display and output performed after the run is finished. In addition, column 6 allows the user to repeat model input data during a model run in 12 month increments up to 34 years. The effect is that a given climatic sequence within the model, such as the worst case drought, may be repeated or extended in the modeling period.

Under "RunDETAIL" (Run Detail), a number of detailed printout tables may be selected. The model default printout is a summary table which includes 76 year summary values for the three reservoirs and the Above and Below Narrows Accounts. By entering a number, 1 through 7 in row 6 column 1, the model will produce a detailed monthly and water year printout of Juncal Reservoir, the Base Gibraltar Reservoir, the actual Gibraltar Reservoir, Cachuma Reservoir, the Above Narrows Alluvial Basin, the Below Narrows Alluvial Basin, or the summary table, respectively. The number of years of detailed printout or display may be altered from the 76 year default value to any lesser value down to one year (see section 4.2.2.1). If one year is selected for display of monthly detail on the screen the program will pause upon completion of the selected years monthly printout to allow the user to observe and/or record values of particular interest.

"RunOUTPUT" (Run Output) and "TabOUTPUT" (Table Output) direct the model output and selected tables to the PC screen or to the PC screen and an external printer. (All output is available at the PC screen). Entering a "1" causes output to the computer screen only. Entering a "2" causes external printing. The third and fifth columns contain the headings "TableTYPE" and "GraphTYPE" (Table Type and Graph Type). There are fifteen tables and eleven graphs which illustrate different components of the hydrologic system. The default values for "TableTYPE" and "GraphTYPE" are 16 and 12, respectively. (These values suppress all of the tabular and graphical displays.) A brief description of the available tables and graphs is listed in Table 4-1, and Table 4-2 above. A detailed description is included in Section 4.3, Model Output.

The last column of row 6 allows the user to experiment with different sequences of years following the end of the 1945-1951 drought. The default value is zero (i.e. no deviation from the historic hydrologic sequence). A value of 1 causes all hydrologic data pointers to be set back 12 months after completion of the 1951 water year. This causes the very dry year 1951 to be repeated during the model run, thus increasing the drought length by one year. A value of 34 will repeat the hydrologic sequence starting with water year 1918 after water year 1951 is completed. If a non-zero value is selected for this parameter, the model must be run for it to take effect. When the user returns to the menu after a model run and/or model output display this parameter is always reset to zero.

4.2.5 Menu Notes

Before starting a model computation (Run), the user should read the notes at the bottom of the menu. Be sure to put "Caps lock" on. In order to first start a model run, and/or after making any parameter changes that will change model results, the user must press "R" to run the model and make the model output reflect the menu selections. If "Caps lock" is not activated, an "r" will be entered in the cell with the cursor and the model will not run. When the cursor is removed from the cell the model will convert the entry of that cell to 0. To avoid this press the backspace key until the incorrect cell entry is blanked out, and then press

"Enter" or use the arrow keys to leave the cell allowing the former value in the cell to reappear.

After having made a desired run the user may observe (on the PC screen) and print out, if desired, the various available tables and graphs by selecting them with the menu and then pressing "S" to activate the selection. In all cases, a return to the menu from any run, table, or graph display is achieved by pressing any key except capital "H" which stops program execution and returns the screen display to the model code in the subprogram being executed when capital H was pressed.

To export graphs to an external printer, the Windows NT or 95 environment with PowerPoint is much preferred over the DOS environment. From Dos, the user must load in and set up GRAFLASR.COM prior to loading (into RAM) Microsoft QuickBASIC 4.5. With the software GRAFLASR in the machine, the graphical images on the PC screen will be printed on the external printer upon the user pressing the "Print Screen" key. In Windows environment, the user presses the PrintScreen key, then presses ALT Tab to leave QB45, then clicks on PowerPoint icon and sets up for a slide window which is filled with the selected graph by clicking on the clipboard icon. The graph colors must be edited using the right button (recolor) and then the left button to select colors. Titles, text, and page numbers can be added using text icon on side of screen (examples: Figures 4-1, 4-4, 5, & 6, and 5-3).

4.3 MODEL OUTPUT

As noted above, the model will display fifteen types of tables and eleven types of graphs. In addition, the model may be modified to provide various kinds of output for specific inquiries. What follows is a description of each type of table and graph which may be output by this version of the model.

4.3.1 Summary Printout

The model can produce either a summary or detailed printout. The summary printout (an example is shown as Figure 4-2) lists the model version, type of reservoir at Cachuma, and the cloud seeding operations status at the top. The upper part of the table lists the beginning of Model run system parameters including initial reservoir levels, maximum reservoir conditions, and reservoir diversion information. For each reservoir, the table provides the water surface elevation at the beginning of the modeling period and the corresponding area and volume. The same information is provided for maximum reservoir elevations.

The diversions, used in the model run, are listed under "Diversion Information" under "SysDemand". Under the "Mode" heading the model displays either "LakeDraft", i.e. the SysDemand value is applied entirely to lake diversions, the tunnel infiltration water being in addition to those diversions; or "L+T Draft" (Lake plus Tunnel Draft): the SysDemand value is met by water diverted from the lake and water infiltrated from the delivery tunnel. This information is specified in the menu by the user, See Section 4.2.1.

The riparian alluvial basin storage at the beginning of the modeling period and full capacity of the Basin is listed under the "Above Narrows Riparian section" of the printout. Next listed are pumpage diversions from the alluvial basin which consist of "Ag CU" (agricultural consumptive use) and "M&I CU" (municipal and industrial consumptive use). These values are the total water extracted minus return flows. The Ag CU value varies each year based on annual rainfall and evaporation and is a function of the "IrrAgAcrg" value from the model menu. The Ag CU figure shown is the 76 year modeling period average value. The M&I CU value represents annual consumptive use of alluvial basin pumpage by Santa Ynez ID#1, Solvang, and Buellton. Next listed is "Accnt" (Account) which denotes the volume in the Above Narrows Account at the beginning of the modeling period, and "Strel" (Start Release) which is the Above Narrows dewatered storage, above which releases from Cachuma Reservoir (from the Above Narrows Account) may be initiated. For the Below Narrows Account, Strel refers to the BNA account volume rather than the dewatered storage volume. The Lompoc Pipe column will have the "Lompoc Pipe" value from the model Menu.

The bottom row of the Initial Condition Table applies to ramp functions for each reservoir. "JunRedPt", "GibRedPt", and "CachRedPt" (Juncal, Gibraltar and Cachuma Reduction Points) are the storage volumes below which reductions in annual draft are initiated. These are the same values entered in the menu under "StrtShort". The "%YrsDel@" value (Percent of Years Delivery at) is the percent of the full draft that would occur over the next Cachuma water year if the May 1 storage is equal to the selected "LowPtAF" (Low Point in Acre Feet). The "%YrsDel@" parameter is the same as is entered in the menu under "May1Delv%" (May 1 Delivery Percentage - See section 4.2.1 "Reservoir Parameters" and Appendix B, pp. B13 and B14, Ramp Function).

The lower table on the Summary Printout is shown on the PC screen and may be printed upon completion of a model run. For the purposes of reference, it is broken into sections A through D (Figure 4-2). This table provides selected averaged values of hydrologic parameters, in acre feet, for the entire modeling period. For each reservoir, Section A displays average water year values for reservoir runoff, rain (precp) falling directly on the reservoir (including the contribution from cloud seeding), and evaporation (evapo) from the reservoir. Leakage refers to water that leaks from the spill gates of Cachuma Reservoir when the water elevation is over 720 feet. In addition, "Leakage" values for each reservoir are listed. Leakage is assumed to be zero for the upper two reservoirs (see Figure 4.-2 Section A).

Also listed in Section A of the lower table, are "Piped Divrt" (Piped, or Lake Diversions), "Dwnsr Reles" (Downstream Releases), "Tunl Infl" (Tunnel Infiltration), "Resrvr Spills" (Reservoir Spills), and "System Yield" (System Yield i.e. Lake diversions plus tunnel infiltration) for the modeling period. Piped diversions are deliveries made to the Member Units. Downstream releases are scheduled releases made to the Above and Below Narrows and Gin Chow accounts (Section 2.4.1). Spills occur in months when the reservoir inflow plus previous end of month storage plus rainfall on the reservoir surface less evaporation and diversions exceeds the reservoir capacity. The system yield is the average amount of water that was available from each reservoir and each associated mountain tunnel per year over the base period. The last three columns of the surface reservoir section provide period averages for SWELL (Water Surface Elevation), "area" (reservoir surface area), and "storage" (Reservoir Storage Volume).

Section B of the lower part of the Summary Table is labeled "GWB-Avgs/CachLomp" (Groundwater Basin Averages, Cachuma to Lompoc). This provides information on the Riparian Basin and Above Narrows Account. The first item, "Unimpr/runoff" (unimpaired runoff), is the average of total releases, spills, and leakage from Bradbury Dam plus unimpaired Cachuma to Lompoc accretions. "Runf/depl" (Runoff Depletions) is the decrease in surface flow to the Above Narrows Alluvial Groundwater Basin that results from groundwater pumping along areas adjacent to the basin. "Bank/depl" (Bank Depletion) is water lost to the less permeable shale and other deposits surrounding the alluvial basin due to the same causes as bring about runoff depletions. Calculated Municipal/industrial and agricultural consumptive use from development of the riparian groundwater basin are listed under "Ripar/divrs" and "Agric/C.U.", respectively. "River/perc." (Percolation), is the average amount of water that percolated into the Riparian Basin, and net water gain from side underflow to/from the ANAGB is listed under "Bank &/Phrea" (Bank and Phreatophyte). The water loss due to underflow "Undr/flow" and the outflow of surface water at the Narrows "Narrow/Outflw" follow.

The final three columns in the row provide period averages for the Above Narrows Account "ANA", the total dewatered storage "Tds" and the Riparian alluvial basins storage volume "Volum". The next row lists the period average stream seepage for each of the four riparian alluvial basin subareas that make up the total ANAGB in the Model.

Section C of the Summary Table applies to the Below Narrows area and the Below Narrows Account. Because the credit to the account is calculated based on the difference between the actual percolation and the percolation that would have existed in the absence of Cachuma Reservoir ("constructive" percolation), the model tracks both calculated (actual) and "constructive" data. Therefore, the table lists runoff at the Narrows "Rnoff@/Narrws" (period average Flow at Narrows), calculated percolation in the Lompoc Forebay "Calcd/Percl", and the difference between the actual flow at the Narrows and the "constructive" inflow increment "Calcld/Qincr" (Calculated Flow Increment). The fourth column lists the "constructive" flow at the Narrows and the fifth, column lists Constructive Percolation "Cnstr/Percl". Releases to the Below Narrows Account "BlwNr/Reles" from Lake Cachuma are shown in the next column, while the following column shows the portion of those releases which reach the Lompoc Narrows "RelTo/Narws". Next listed is the flow at Floradale Bridge "Calcltd/QFlorAv", the credit to the Below Narrows Account "BlwNr/Credt" (Below Narrows Credit), reductions in credit to the Below Narrows Account based on Cachuma Reservoir spills "BNA/Redu" (Below Narrows Reduction), and the average Below Narrows Account for the modeling period "BNA/Acct" (Below Narrows Account).

Section D of the Summary Table provides the volume of each reservoir and the Above Narrows Riparian Basin at the end of the modeling period "PeriodEn/dingVols" (Period Ending Volumes). In addition, modeled period minimum volumes "Min Vols" and the month and year they occurred "Min Date" (Minimum Date) are listed. Again, in the example provided, the minimum volume of Cachuma Reservoir is 12,000 acre feet (a value used by Cachuma Project Member Units for planning purposes). The number of modeling period months in which the full draft could not be maintained is given as a percentage, in the row labeled "ShortMos" (Short Months). The most severe shortage for any October through September water year of the modeling period is listed in the row labeled "MxYrShrt" (Maximum Year Shortage). The most severe shortage from the desired draft level for any month, or series of months in the driest year of the modeling period is listed in the row labeled "Wors%Sht" (worst monthly percent shortage).

4.3.2 Detailed Printout

In addition to the summary printout, a detailed printout option is available for each surface reservoir and for the Above and Below Narrows areas (Figure 4-3, Detailed Printout). For each month of each year for which detail is requested, the items displayed are the same as are shown in the summary printout. In the example for Gibraltar reservoir, the printout lists runoff, precipitation, evaporation, leakage, piped diversions, downstream releases, tunnel infiltration, reservoir spills, system yield, and the month's ending water surface elevation, area and storage. All of the quantities are totaled in the last row of each year's listing except for surface elevation, area, and storage which are averaged. If more than one year is selected for detailed display, the table scrolls rapidly but may be stopped by depressing the "pause" key. By selecting just one year for detailed display the model will pause, allowing the user to examine and record.

Figure 4-3
Detailed Printout

SANTA YNEZ RIVER MODEL SYRM1296:
Existing Cachuma Reservoir
With Cloudseeding at 0.50 efficiency

INITIAL RESRV/BASN CONDITIONS				MAXIMUM CONDITIONS			DIVERSION INFORMATION		
Reservoir	WS Elev	Area	Volume	WSElev	Area	Volume	Divert To	Mode	SysDemand
Jameson R	2220.80	115	4854	2224.0	128	5235	Montecito	LakeDraft	2,000
BaseGibrl	1397.80	271	7948	1400.0	292	8567	PhantCity	LakeDraft	7,278
Gibraltar	1399.30	244	7463	1400.0	249	7634	S B City	LakeDraft	4,580
Cachuma R	745.90	2899	178230	750.0	3042	190409	SC, SYnez	L+T Draft	25,714

Begining Cachuma- - Lompoc	Above Narrows Riparian						Lompoc	BelowNarrows	
	Storage	FullVolume	Ag CU	M&I CU	Strel	Accnt	Pipe	Strel	Acct
	79100	90000	10457	2000	10600	2400	0	1000	600

JunRedPt	%YrsDel@	LowPtAF	GibRedPt	%YrsDel@	LowPtAF	CacRedPt	%YrsDel@	LowPt AF
2500 af	16.350%	500 af	50 af	0.000%	0 af	100000af	75.787%	20000 af

Oct-Sep Water Year =1968-69 (flagged for monthly detail)

RESRV	MONTH & YEARS VALS			Leak	Piped	Dwnsr	Tunl	Resrvr	Systm	MONTHS ENDING		
Gibrl	runoff	precp	evapo	-age	divrt	reles	infl	spills	yield	WSEL	area	storag
Oct68	0	21	59	0	527	0	74	0	601	1390.6	205	5511
Nov68	0	14	34	0	431	0	72	0	503	1388.4	198	5060
Dec68	100	35	16	0	431	0	70	0	501	1386.8	193	4749
Jan69	123051	536	10	0	403	0	136	120289	539	1400.0	249	7634
Feb69	104059	333	5	0	385	0	191	104003	576	1400.0	249	7634
Mar69	46013	39	60	0	518	0	188	45474	706	1400.0	249	7634
Apr69	12153	52	92	0	536	0	189	11577	725	1400.0	249	7634
May69	5549	0	106	0	582	0	180	4861	762	1400.0	249	7634
Jun69	2527	0	224	0	481	0	172	1822	653	1400.0	249	7634
Jul69	1100	0	148	0	124	616	165	212	289	1400.0	249	7634
Aug69	400	0	130	0	101	0	158	169	259	1400.0	249	7634
Sep69	200	0	90	0	64	0	151	46	215	1400.0	249	7634
Gibrl	295151	1031	974	0	4580	616	1746	288453	6326	1397.1	236	7002

SUMMARY: 1918-1993 AVERAGE VALUES (Vols[ac-ft], Areas[ac], Elevs[ft])

RESRV	PERIOD AVERAGE			Leak	Piped	Dwnsr	Tunl	Resrvr	Systm	OVERALL AVERAGE		
(bas)	runoff	precp	evapo	-age	divrt	reles	infl	spills	yield	WSEL	area	storag
James	4979	234	321	0	1778	0	541	3113	2319	2203.5	93	3379
BaseG	45744	529	909	0	4829	348	1125	40186	5953	1389.4	228	6378
Gibrl	45744	467	803	0	4314	377	1125	40717	5439	1389.3	202	5664
Cachm	74265	3926	11044	463	23428	6020	2046	37237	25474	728.11	2400	137591

GWB-Avgs CachLomp	Unimpr runoff	Runf depl	Bank depl	Ripar divrs	Agric C.U.	River perc.	Bank& Phrea	Undr flow	Narrow outflw	PERIOD AVERAGE ANA	Tds	Volum
Riparian	79627	842	358	2000	10457	12706	1609	1500	66079	2904	11027	78973

StrmSEEP	S Ynez = 6435	Buelltn = 2692	SRita E = 3051	SRita W = 529

BelowNar rowsPeri odAvergs	Rnoff@ Narrws	Calcd Percl	Calcld Qincr	Cnstrcv NarrwsQ	Cnstr Percl	BlwNr Reles	RelTo Narws	Calcltd QFlorAv	BlwNr Credt	BNA Redu	BNA Acct
	66079	8240	31840	96779	8424	2528	1140	57839	1325	185	1718

PeriodEndingVols	Jameson Lake	BaseGibraltar	GibraltarLake	Lake Cachuma	Riparian Volm
PeriodEndingVols	4,855 af	7,960 af	7,455 af	178,201 af	79,102 af
Min Vols	100 af	0 af	0 af	12,000 af	55,332 af
Min Date	Dec 1951	Jun 1949	Jun 1931	Dec 1951	Oct 1951
ShortMos	20.2 %	96.8 %	8.5 %	14.5 %	
MxyrShrt	1,688 af	0 af	4,580 af	4,516 af	
Wors%Sht	91.9 %	100.0 %	100.0 %	21.1 %	

Selected SYRM1296.BAS Run of 15:30:53, 01-21-1997...

4.3.3 Shortage Table

Shortage tables are available for any of the surface reservoirs, the combined surface reservoirs or the Base Gibraltar reservoir. The shortage tables list the modeling period years as rows and the months as columns. For each month of each year the tables display the amount of water unavailable to satisfy the draft specified in the main menu. Negative numbers in the tables indicate the amount by which the system yield exceeds the desired draft. This can occur if the diversion mode (Lake only, or Lake plus tunnel) is set to Lake plus tunnel and the monthly portion of the project draft is smaller than that months tunnel infiltration.

Totals for each year's shortage are listed in the far right column and the average shortages for each month are listed in the bottom row. Table 4-3 is a Shortage Table printout for Gibraltar Reservoir under the conditions specified in Figure 4-2.

4.3.4 Cachuma Inflow Table

The Cachuma Reservoir Inflow Table displays the inflow to Cachuma Reservoir for each month of each year of the modeling period. The format is exactly the same as that of the Shortage Table with yearly totals in the right column and monthly averages in the bottom row (see Table 4-4). The inflow values listed do not include rain on the lake.

4.3.5 Narrows Flow Table

The Narrows Flow Table (Table 4-5) shows the volume of water in acre feet, which passes through the Santa Ynez River at the Narrows

Table 4-3

Actual Gibraltr Reservoir Shortages:
October thru September water years 1918 - 1993 (average values on last line)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTALS
1918	0	0	0	0	0	0	0	0	0	0	0	0	0
1919	0	0	0	0	0	0	0	0	0	0	0	0	0
1920	0	0	0	0	0	0	0	0	0	0	0	0	0
1921	0	0	0	0	0	0	0	0	0	0	0	0	0
1922	0	0	0	0	0	0	0	0	0	0	0	0	0
1923	0	0	0	0	0	0	0	0	0	0	0	0	0
1924	0	0	0	0	0	0	0	0	0	0	0	0	0
1925	0	0	0	0	0	0	0	0	0	0	0	0	0
1926	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	0	0	0	0	0	0	0	0	0	0	0	0	0
1928	0	0	0	0	0	0	0	0	0	0	0	0	0
1929	0	0	0	0	0	0	0	0	0	0	0	0	0
1930	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	0	0	0	0	0	0	0	0	278	124	101	64	567
1932	527	331	0	0	0	0	0	0	0	0	0	0	857
1933	0	0	0	0	0	0	0	0	0	0	0	0	0
1934	0	0	0	0	0	0	0	0	0	0	0	0	0
1935	0	0	0	0	0	0	0	0	0	0	0	0	0
1936	0	0	0	0	0	0	0	0	0	0	0	0	0
1937	0	0	0	0	0	0	0	0	0	0	0	0	0
1938	0	0	0	0	0	0	0	0	0	0	0	0	0
1939	0	0	0	0	0	0	0	0	0	0	0	0	0
1940	0	0	0	0	0	0	0	0	0	0	0	0	0
1941	0	0	0	0	0	0	0	0	0	0	0	0	0
1942	0	0	0	0	0	0	0	0	0	0	0	0	0
1943	0	0	0	0	0	0	0	0	0	0	0	0	0
1944	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	311	431	431	403	366	0	0	399	481	124	101	64	3109
1950	527	431	431	17	0	0	0	0	78	124	101	64	1771
1951	527	431	431	403	385	518	536	582	481	124	101	64	4580
1952	527	431	431	0	0	0	0	0	0	0	0	0	1388
1953	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	135	481	124	101	64	905
1962	527	431	331	163	0	0	0	0	0	0	0	0	1451
1963	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	131	385	518	536	582	481	124	101	64	2921
1991	527	431	431	403	385	518	0	0	0	0	0	0	2693
1992	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg.	46	38	33	20	20	20	14	22	30	10	8	5	266

Selected SYRM1296.BAS Run of 15:36:10, 01-21-1997...

Table 4-4

Lake Cachuma Monthly and Water Year Inflow (acrefeet):
October thru September water years 1918 - 1993 (average values on last line)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTALS
1918	0	0	0	105	75434	126564	20501	8888	4012	699	105	212	236519
1919	0	440	657	438	1851	1357	666	216	126	0	0	0	5751
1920	137	137	411	136	1889	10386	4739	1050	542	136	135	134	19832
1921	0	0	0	1143	1759	3746	858	655	794	162	159	157	9433
1922	108	0	19348	16928	59086	25008	10214	4319	1198	222	112	0	136543
1923	0	158	5534	2168	2954	1315	1681	642	626	317	156	154	15706
1924	0	223	221	221	440	1978	456	218	25	0	0	0	3780
1925	0	0	206	205	205	892	2500	407	226	0	0	0	4641
1926	0	0	111	111	3511	2556	62199	4729	993	242	115	0	74567
1927	0	2865	2016	2706	80744	17749	6849	1729	837	217	107	0	115819
1928	155	155	309	311	8365	4208	911	312	532	154	0	0	15412
1929	187	0	186	414	1753	2192	1577	552	15	0	0	0	6876
1930	0	0	0	0	19	4889	565	178	25	0	0	0	5675
1931	0	0	308	306	305	302	297	289	0	0	0	0	1808
1932	0	103	7817	5982	87732	11064	2531	856	634	213	0	0	116932
1933	0	0	0	7549	3594	1292	632	137	160	0	0	0	13364
1934	0	0	0	13251	5067	1841	138	0	25	0	0	0	20321
1935	0	0	0	13131	3533	9774	17288	2800	870	196	0	0	47592
1936	0	0	0	0	23345	5514	4377	462	140	0	0	0	33836
1937	0	106	3296	6607	68132	59483	19727	5030	1509	327	110	0	164325
1938	0	105	316	209	59046	184601	18400	6183	2490	1032	105	105	272592
1939	0	149	742	3406	4658	9490	2246	605	262	0	0	0	21558
1940	0	0	0	1223	6009	4372	2059	464	655	153	151	0	15086
1941	0	0	4432	27717	98666	189379	120294	21905	7278	3090	1241	422	474423
1942	522	650	6121	5666	3074	4411	8344	3041	967	130	129	0	33054
1943	0	0	0	69478	28771	66738	12863	3956	1394	322	107	107	183737
1944	112	112	447	1044	41471	37344	7218	3249	1414	225	112	0	92747
1945	0	1174	470	586	21064	11797	5557	1424	485	117	0	0	42673
1946	127	0	7435	1215	2340	17350	10136	1085	154	129	0	0	39972
1947	0	1965	6246	2739	1329	1258	372	180	593	0	0	0	14682
1948	0	0	351	349	347	346	343	337	0	0	0	0	2073
1949	0	0	328	327	331	539	520	310	0	0	0	0	2355
1950	0	0	0	47	2155	258	641	202	0	0	0	0	3304
1951	0	0	150	147	144	141	136	129	0	0	0	0	847
1952	0	0	203	98335	9132	73254	16091	4800	2045	884	758	107	205609
1953	397	396	3035	6976	2426	1403	845	596	639	393	260	258	17624
1954	137	136	274	3008	3677	7476	4774	831	438	274	135	133	21291
1955	0	205	204	648	826	823	448	1516	804	197	192	189	6050
1956	0	0	4316	11010	3567	1504	3195	2630	1231	499	116	232	28302
1957	140	277	138	552	949	1620	1021	822	711	268	263	259	7020
1958	309	103	1132	1268	32262	45724	106912	12736	3265	1144	322	107	205285
1959	0	0	0	1043	11955	2914	947	454	819	148	147	0	18426
1960	0	0	426	425	425	422	418	411	206	0	0	0	2734
1961	0	0	353	352	350	347	343	336	0	0	0	0	2081
1962	213	106	0	122	92808	16379	4982	1740	857	110	109	0	117426
1963	0	0	574	571	671	684	678	662	216	0	0	0	4055
1964	0	0	366	364	362	360	356	349	15	0	0	0	2173
1965	0	0	259	695	410	569	11038	1136	910	394	379	0	15790
1966	243	21755	29784	18311	8573	4060	1507	405	924	266	132	131	86090
1967	0	0	48070	37252	15969	31454	54369	24031	5131	2197	1126	212	219810
1968	142	424	423	562	1579	4053	1552	843	595	554	413	137	11277
1969	0	0	0	183735	184196	79196	20027	9324	4001	1886	479	148	482991
1970	0	629	252	2251	4049	16201	1460	739	759	126	0	0	26468
1971	0	2729	11508	7687	2921	2418	603	976	937	140	0	0	29920
1972	0	0	8015	2313	1144	557	425	414	577	136	0	0	13581
1973	0	432	231	13055	67397	27651	10565	3570	1425	114	0	0	124440
1974	0	0	264	19859	3225	8243	2810	1051	656	0	0	0	36107
1975	0	0	1127	625	8116	31887	7259	3148	1033	0	0	0	53195
1976	0	0	0	0	2662	1452	567	530	567	0	0	0	5778
1977	0	0	443	442	441	439	434	426	319	0	0	0	2945
1978	0	0	416	19028	95058	142111	36583	11503	3837	1566	530	424	311057
1979	0	0	361	6638	15219	21428	13938	3843	1360	364	122	0	63273
1980	0	0	0	3021	92187	41556	9643	4549	2060	872	105	0	153993
1981	0	0	0	760	1624	18433	3748	942	762	250	116	0	26636
1982	0	0	0	126	527	3437	19492	2179	1191	389	142	0	27484
1983	206	725	15559	53611	56038	193551	56863	32684	9229	4197	1960	767	425390
1984	3437	3877	17313	6024	3060	1970	1011	1021	401	250	249	114	38727
1985	0	0	679	643	1214	933	708	245	399	225	0	0	5045
1986	0	0	137	619	43715	34233	6908	2052	964	147	0	0	88773
1987	78	0	0	0	236	1025	747	264	113	48	0	0	2512
1988	16	0	0	817	439	5055	1449	698	359	0	317	154	9304
1989	0	0	143	335	1138	722	489	322	335	340	195	124	4143
1990	0	10	131	206	354	316	211	128	362	319	306	444	2788
1991	328	220	217	323	325	33885	10621	2021	1095	674	334	335	50379
1992	209	211	424	1627	84962	28104	12968	3727	1547	346	224	117	134467
1993	0	0	0	80531	111150	65434	31525	10414	4334	1770	635	110	305902
Ave.	95	534	2819	10153	21927	23334	10636	2995	1137	389	170	76	74265

Selected SYRM1296.BAS Run of 15:36:10, 01-21-1997...

for each month of each year of the modeling period. The format is identical to that of the Cachuma Inflow Table.

4.3.6 Delivery Ranking Graphs

The Delivery Ranking Graphs show the percentage of modeling period years that the specified yield cannot be maintained plotted against the percent below the specified draft level. Each vertical bar represents one year of the modeling period. Delivery Ranking Graphs are available for each reservoir, the Base Gibraltar Reservoir and the combined sources. A delivery ranking graph for Jameson Lake is exhibited in Figure 4-4.

4.3.7 Storage Hydrograph

The model also allows output of Storage Hydrographs for the three reservoirs and the overall Riparian Alluvial Basin that depict storage levels for a specified set of conditions (Figure 4-5). The vertical axis indicates acre feet of storage and the horizontal axis indicates modeling period years. On the CRT, the brown part of the line indicates periods in which a ramp function was in effect. An additional display of storage hydrographs for the Riparian Alluvial Basin subareas can be selected for display and output (see Figure 5-3, pg. 81).

4.3.8 Inflow Ranking Graphs

Inflow Ranking Graphs are available for each of the reservoirs. They show the percentage of the modeling base period years on the horizontal axis and the reservoir inflow on the vertical axis. The

Table 4-5

Santa Ynez River Flows @ Narrows Near Lompoc (Acre Feet):
October thru September water years 1918 - 1993 (average values on last line)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTALS
1918	444	437	425	799	102607	138719	23574	10076	3823	2869	1113	943	285830
1919	672	78	274	137	273	466	0	187	0	0	0	9	2094
1920	22	27	53	57	534	1616	1229	357	80	1267	1448	0	6689
1921	0	0	0	620	920	1295	331	268	0	51	0	0	3485
1922	0	0	11664	6149	16275	22031	11159	2333	1676	358	0	0	71644
1923	0	3	1788	397	510	387	557	440	97	76	1346	1882	7483
1924	1789	1310	77	83	78	999	290	85	81	0	0	0	4792
1925	0	0	0	0	0	212	706	431	61	0	0	0	1410
1926	2	9	27	66	5124	2105	10360	4147	546	92	0	0	22478
1927	0	1167	634	1262	35729	18421	6848	2693	808	91	0	0	67653
1928	12	588	5665	2216	1272	997	1082	492	87	1420	1939	1806	17574
1929	2	6	280	322	1666	1825	1071	155	0	0	0	0	5327
1930	0	0	0	12	60	1730	441	71	2	0	0	0	2315
1931	0	0	0	11	223	60	47	0	0	0	0	0	341
1932	0	0	6908	8830	11463	5645	1083	635	89	0	0	0	34654
1933	0	0	5	2413	1540	619	283	89	1582	2084	970	0	9586
1934	0	0	2	5653	854	1257	222	0	1497	0	0	0	9484
1935	0	0	0	6728	1136	2854	5322	751	102	0	1327	1474	19693
1936	0	0	5	99	7793	2124	888	209	0	1363	0	0	12481
1937	0	0	0	1606	25571	41019	25001	2828	720	129	2	2	96877
1938	0	2	50	467	67378	219010	22820	6542	993	261	88	75	317685
1939	15	17	568	1372	3392	5831	1528	460	90	1516	1979	0	16768
1940	0	0	2	1948	3493	3831	1750	353	0	0	0	0	11377
1941	0	0	3382	32757	109498	254032	143677	29001	6805	2446	1092	787	583476
1942	1026	1249	6878	7486	3747	8018	9506	2529	909	226	169	63	41807
1943	80	257	601	57783	40215	81217	14547	2094	847	356	84	74	198156
1944	77	98	846	1630	31810	44595	7624	2055	651	181	81	0	89649
1945	0	597	887	1104	6005	9686	4293	654	148	3	0	0	23378
1946	0	0	1563	1193	934	1003	7130	565	93	1654	2005	1783	17923
1947	0	756	1002	1495	1081	902	197	1746	2342	2061	0	0	11582
1948	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	1524	0	0	0	0	0	0	1524
1950	0	0	0	0	901	27	0	0	0	0	0	0	928
1951	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	23779	4435	35572	15925	1497	22	3	5	2316	83555
1953	38	884	4809	4878	1427	597	172	0	0	1220	0	0	14025
1954	0	0	0	166	687	3147	1058	0	71	1206	0	1	6337
1955	0	0	0	335	460	590	275	94	17	0	0	0	1770
1956	0	0	11315	11534	3929	1597	1256	809	85	71	1440	0	32035
1957	0	0	0	36	470	956	123	109	0	0	0	0	1693
1958	0	0	0	472	21605	26252	73764	14222	1978	185	74	67	138619
1959	84	83	264	1513	8393	2609	211	91	87	1335	0	0	14671
1960	0	0	0	20	535	297	305	62	0	0	0	0	1219
1961	0	51	112	0	0	0	0	0	0	0	0	0	163
1962	0	0	200	394	53087	12436	1385	350	87	74	2346	0	70359
1963	0	0	150	51	3694	3160	2022	998	186	101	0	0	10362
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	402	26	24	2152	264	0	2	51	10	2929
1966	3	8332	10427	9442	5100	1909	192	235	88	0	1088	0	36817
1967	0	0	2183	21311	17145	31323	54871	23442	933	0	1891	1806	154905
1968	103	0	129	378	829	884	633	0	1305	0	2	0	4263
1969	0	0	0	185726	241477	103446	22035	7855	1453	185	78	80	562334
1970	442	776	760	988	796	5058	117	0	0	1452	1557	0	11946
1971	0	9	477	1212	598	93	97	0	1389	2040	1778	0	7692
1972	0	0	975	774	432	0	0	1463	2224	0	0	0	5867
1973	0	99	0	7987	28272	26520	13602	920	202	85	0	0	77687
1974	0	0	88	7282	1587	6107	2993	701	92	0	0	0	18850
1975	0	0	2682	754	11079	38455	9352	1801	301	84	110	0	64618
1976	56	56	108	134	2393	1024	304	86	1418	2028	0	0	7607
1977	0	0	0	18	48	66	8	23	0	0	0	0	164
1978	0	0	0	6484	80434	207837	64871	14538	1441	552	217	70	376444
1979	140	500	1076	4647	12704	33557	16632	1957	425	82	0	0	71720
1980	0	0	35	1864	106827	68659	10021	2107	539	180	0	0	190232
1981	0	0	259	451	1246	18096	2471	428	113	0	0	0	23065
1982	0	0	63	489	522	876	3690	253	0	1461	1948	1738	11040
1983	1694	84	3045	52605	103078	219987	68573	36574	10170	1596	707	549	498662
1984	1315	1946	19376	9709	3040	1197	405	97	0	1520	0	0	38606
1985	0	0	1330	997	768	609	159	0	0	0	1107	0	4969
1986	0	0	171	123	12277	24791	5861	517	179	0	0	0	43919
1987	0	0	220	576	532	3078	301	0	0	0	0	0	4706
1988	0	0	41	221	186	1245	276	77	1194	1116	0	0	4355
1989	0	0	0	0	12	77	0	0	0	0	0	0	89
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	16221	1466	152	1140	0	0	0	18979
1992	0	0	1927	4779	39470	11034	2866	904	302	80	1353	1507	64222
1993	0	0	1521	58460	149847	85380	39042	8514	1248	262	90	19	344381
Ave.	105	256	1412	7443	18441	24590	9514	2545	695	466	388	224	66079

Selected SYRM1296.BAS Run of 15:36:10, 01-21-1997...

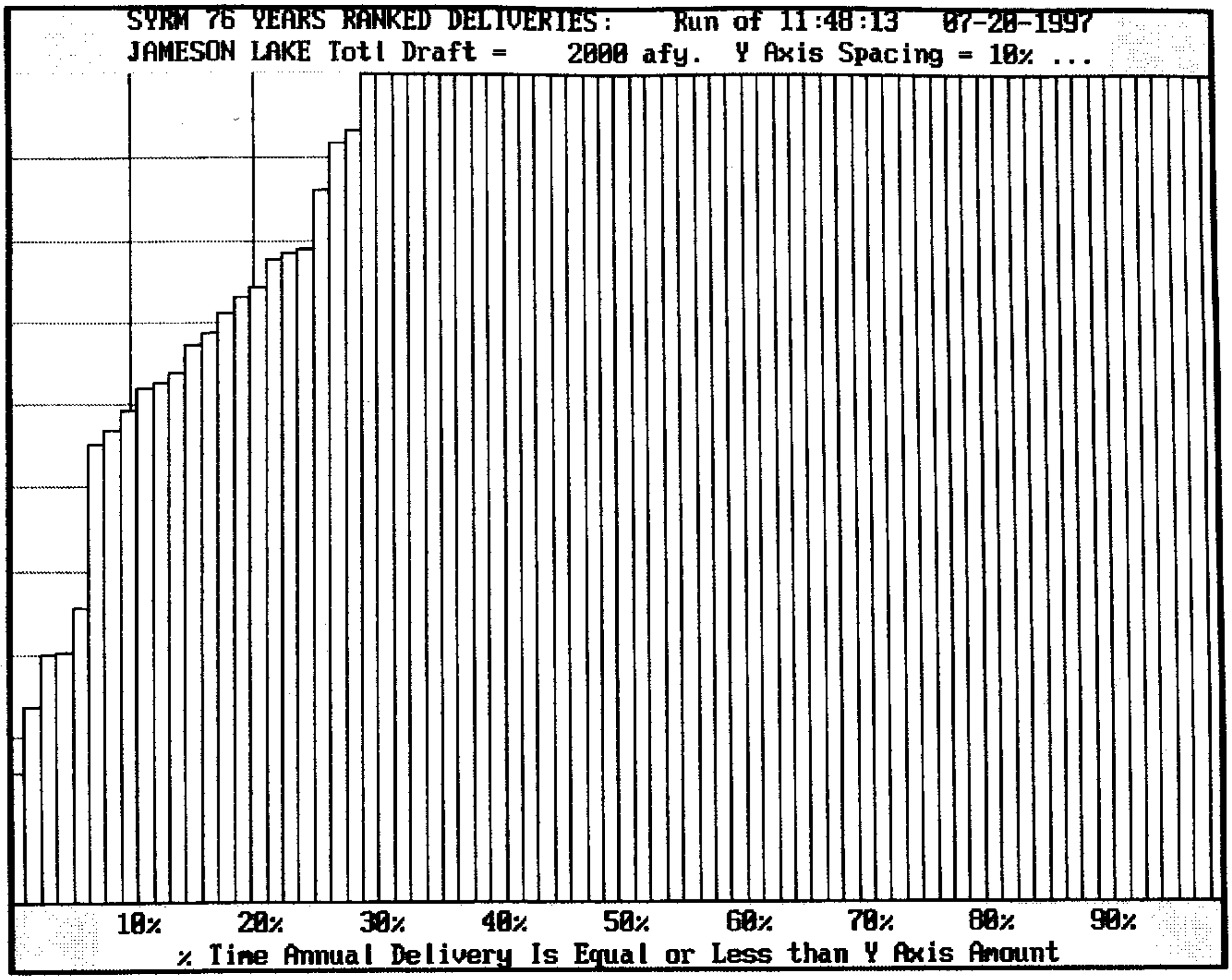
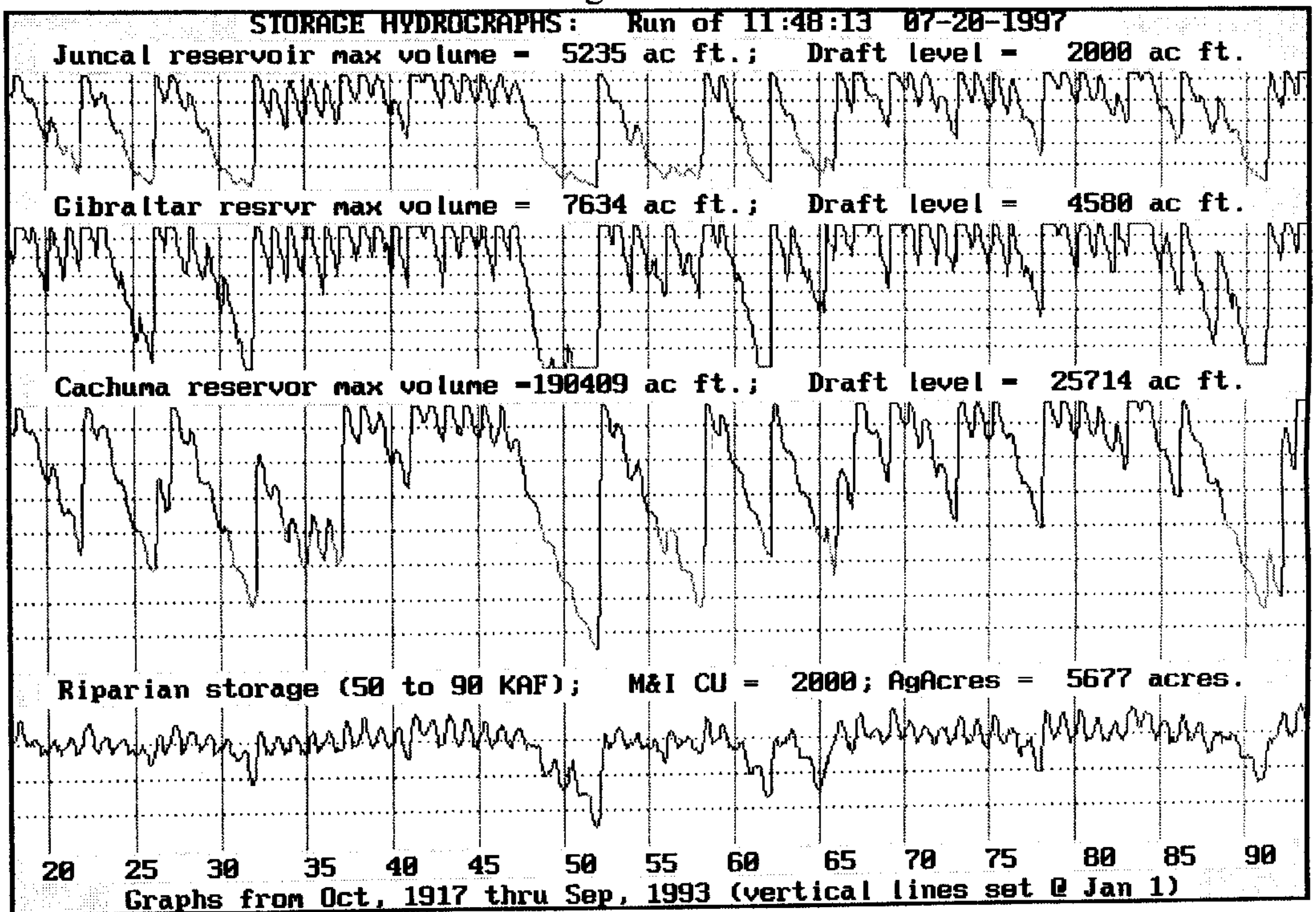


Figure 4 - 4
Jameson Lake Delivery Ranking Graph

Figure 4 - 5



Reservoirs & Alluvial Basin Hydrographs

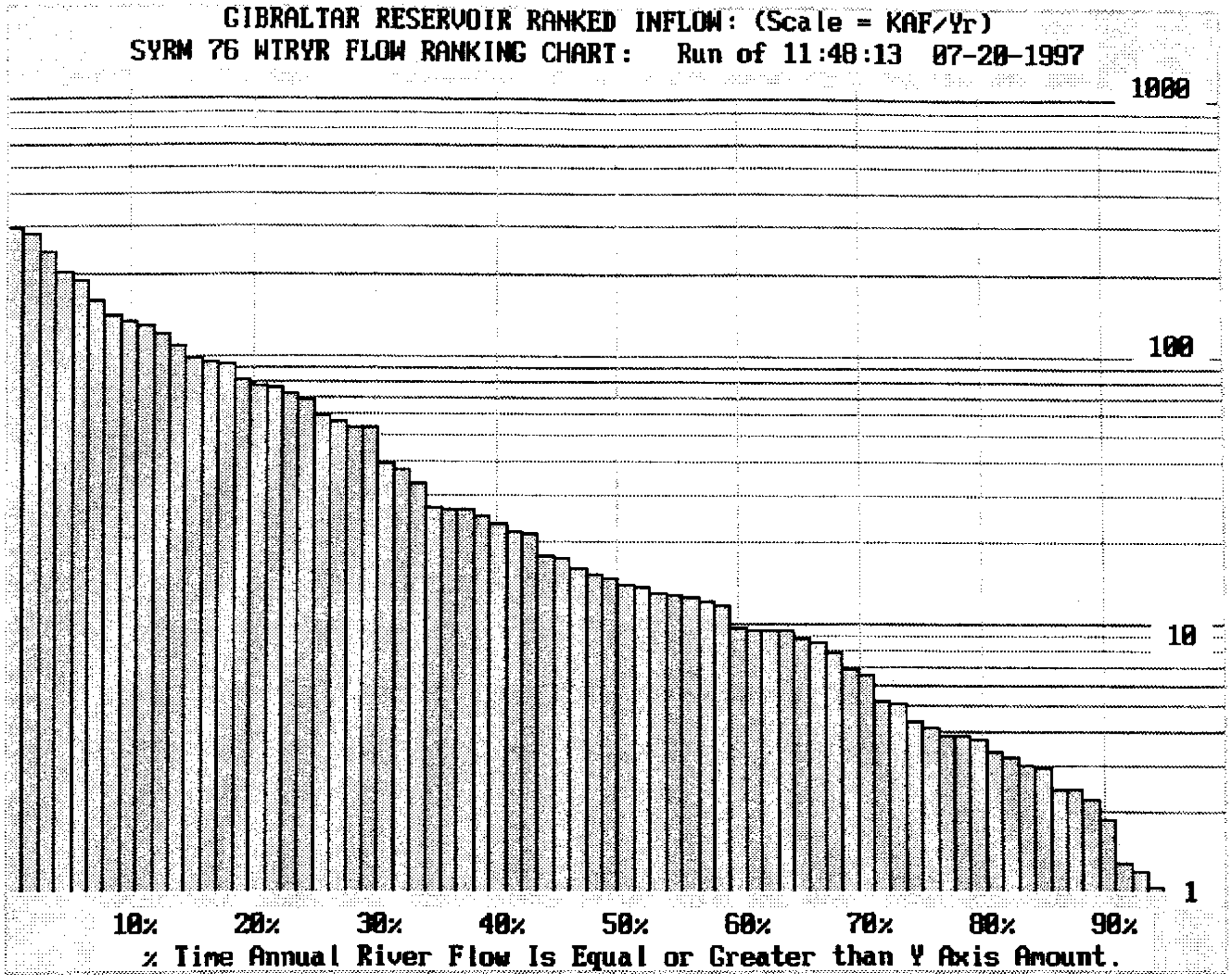


Figure 4 - 6
Gibraltar Inflow Ranking Graph

graph is plotted on a semi-log scale in thousands of acre feet. Each vertical bar represents one year of the modeling period (see Figure4-6). The bars are arranged in decreasing volume of inflow thus providing a visual presentation of inflow distribution.

4.4 PROGRAM APPLICATIONS

The Santa Ynez River Hydrology Model has a variety of applications. Some of these simply require manipulation of the data input in the menu. Others require the user to modify the approved program code. Examples of some of the most common applications are evaluation of conjunctive use scenarios, estimates of long term water supply, and studies of reservoir draft, and cloud seeding potential. Similarly, the effects of water utilization activities along the Above Narrows Alluvial Groundwater Basin, extension of the "critical drought" period, and reservoir enlargement or loss of capacity due to siltation may be investigated. Previously developed assessments using the model have been performed for the above applications. Two examples are given below.

4.4.1 Example 1; Reservoir Diversion And Yield

Evaluating the relationship between planned reservoir diversion (Draft) and Average Annual Yield is very useful for long term supply planning (see Appendix B, Section B2). Suppose a desired yearly draft has been identified for Cachuma Reservoir. It is possible to investigate the effects on the reservoir yield and on most extreme monthly shortages taken for operational scenarios using different "start shortage" volumes. In essence, this analysis shows the effect of modifying elements of the "Ramps".

Selection of a steep ramp (i.e. reduction in planned reservoir deliveries is initiated at a low reservoir storage level) allows for a high yield for a long period of time, but the draft diminishes quickly once ramping begins. The effect is to increase the percentage of time that the selected yield can be maintained, but at the cost of more severe shortages during years when the reservoir level is low. Incidental effects include reduced overall losses due to evaporation and increased storage capacity which allows increased capture of runoff during periods of high precipitation.

An alternative approach may be evaluated which would utilize a gradual ramp, thereby allowing more time for imposition of temporary conservation programs and emergency water supply planning if needed. The summary printout provides the values for average annual yield, the percentage of months with delivery shortages, the most extreme water year shortage, and the most extreme percent reduction in monthly deliveries. Figure 4-7 is a graph for Cachuma Reservoir depicting many such runs at different "start shortage" and draft values with a 12,000 acre foot minimum pool.

4.4.2 Example 2; Size Of Minimum Pool

The relationship between safe yield and minimum pool may be investigated by changing the reservoir draft value in the program menu. In order to determine the effect of a smaller minimum pool on the safe yield, (10,000 acre feet at Cachuma Reservoir, for example), zero is entered for Cachuma "StrtShort" and one hundred percent entered for the "May1Delv%" This specifies a safe yield operation. The model is run, adjusting the draft until the Summary

Printout indicates a minimum volume of close to 10,000 acre feet. The safe yield, for this scenario, turns out to be, to the nearest integer, 24,589 acre feet per year (with 50 percent effective cloud seeding).

4.5 ERROR RECOVERY

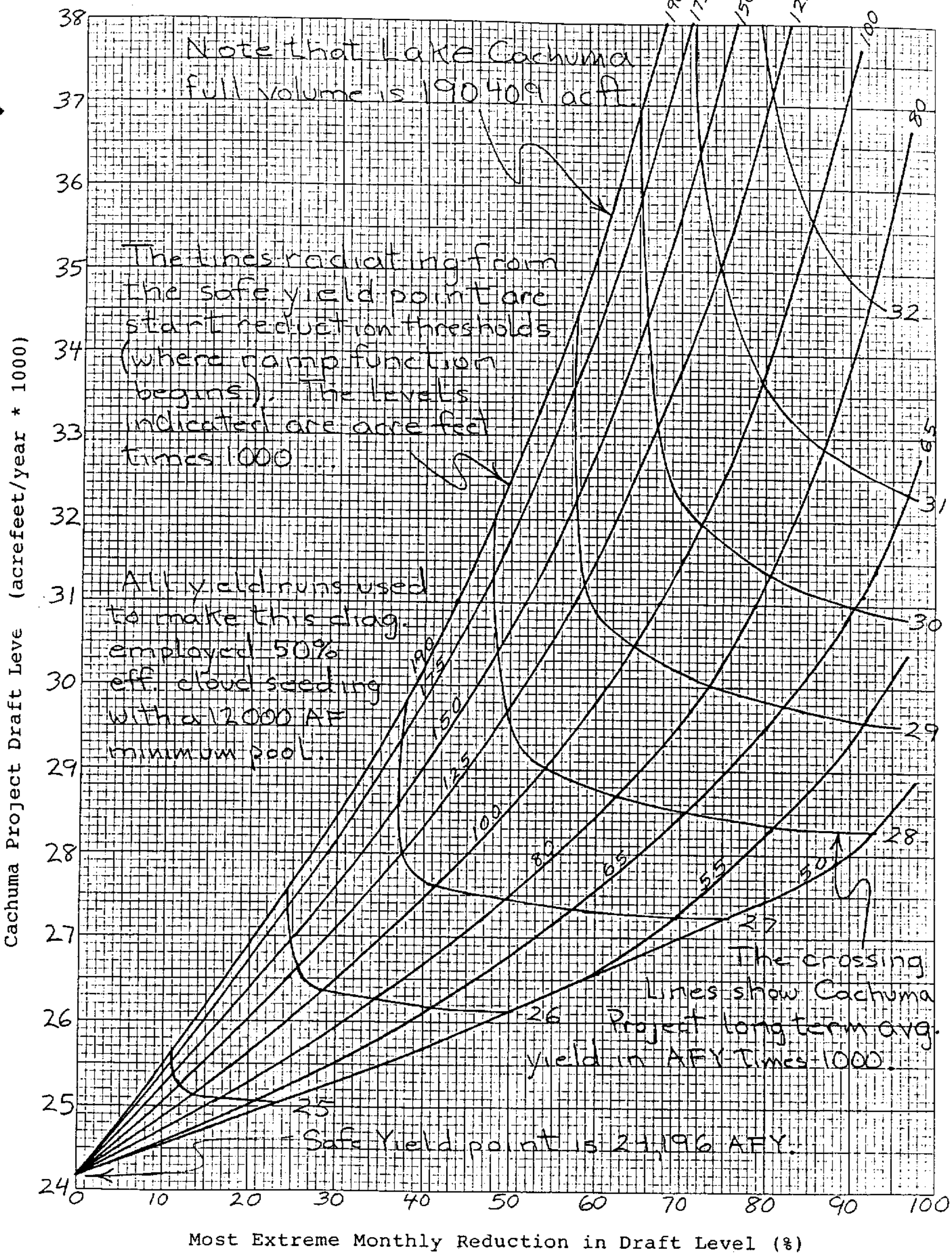
If at any time while running or using the model, the computer comes to a halt with module code and an error message displayed on the CRT, the user should perform the following steps.

1. Press Shift + F5 (to restart the model).
2. Re-enter desired menu parameters noting that the error was almost certainly caused by an improper menu entry.
3. Make the new run (by pressing R).

If at any time while running or using the model the user wishes to start over, then the following steps should be executed:

1) Press capital H (module code will appear on CRT).
2) Press Ctrl + Home (a cosmetic but desirable adjustment which sets the cursor to the beginning of the module).
3) Press Shift F5 (to restart the model).
4) Do not press any other keys when module code is displayed on the CRT!

FIGURE 4-7



Note that Lake Cachuma full volume is 190409 acft.
The Lines radiating from the safe yield point are start reduction thresholds (where ramp function begins). The Levels indicated are acre feet times 1000
All yield runs used to make this diag. employed 50% eff. cloud seeding with a 12000 AF minimum pool.
The crossing Lines show Cachuma Project long term avg. yield in AFY Times 1000.
Safe Yield point is 24,196 AFY.
190
175
150
125
100
80
65
55
50
32
31
30
29
28
27
26
25
Cachuma Project Draft Leve (acrefeet/year * 1000)
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
0
10
20
30
40
50
60
70
80
90
100
Most Extreme Monthly Reduction in Draft Level (%)

SECTION 5

SECTION 5

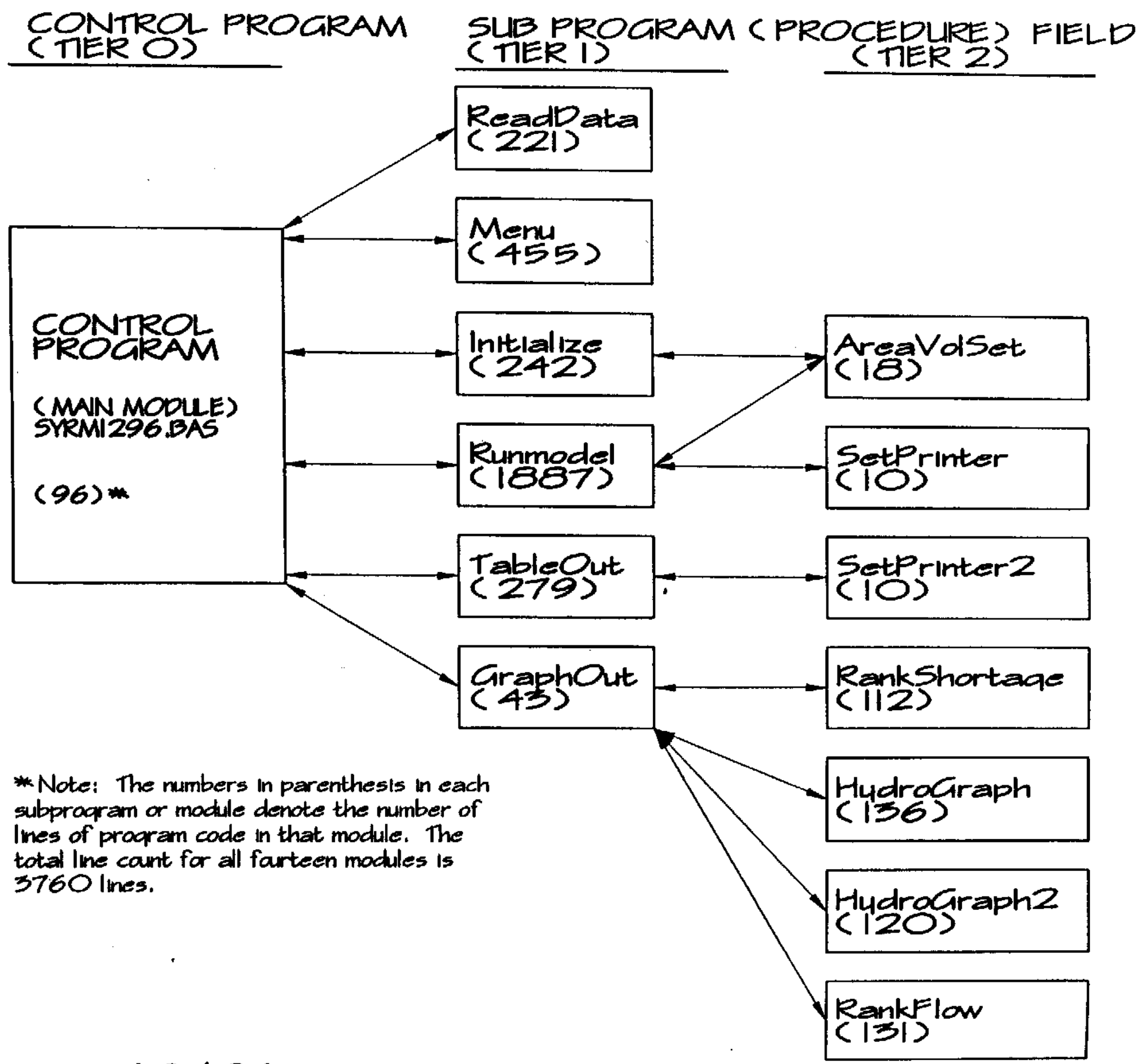
MODEL STRUCTURE AND MODULAR FUNCTIONS

This section provides a description of the structure and function of the modules which comprise the Santa Ynez River Model. A more detailed discussion of user input, Model output and special functions may be found in Section 4 and Appendix B. The discussion that follows will be based upon and follow the order of the model diagram presented in Figure 5-1.

The Santa Ynez River Model program has been constructed in modular form. There is a main control module (Main Module) and six principal satellite procedures (subprograms), with seven additional auxiliary procedures required to provide the various model outputs. The subprogram field comprises satellite and auxiliary procedures which are arranged in two tiers. The overall structure of the model subprograms and auxiliary procedures is shown in Figure 5-1.

In the SubProgram field, Tier 1 procedures are the six principle procedures noted above. Tier 2 shows the remaining procedures. The arrows show the relationship between the subprograms (procedures). The control program (Tier 0) calls subprograms in Tier 1. When each Tier 1 subprogram has completed its task, it returns to the control program. Each subprogram in each tier operates in a similar manner. Figure 5-1 shows the interaction between the various satellite and auxiliary procedures using "double headed" arrows to reflect this "call up" and return feature.

SANTA YNEZ RIVER MODEL



*Note: The numbers in parenthesis in each subprogram or module denote the number of lines of program code in that module. The total line count for all fourteen modules is 3760 lines.

SBCWA: 1/ 8/ 96

FIGURE 5-1

The Santa Ynez River Model is written in Microsoft QuickBASIC 4.5. The QuickBASIC model title is SYRM1296.BAS, and is available, along with all required data files, to authorized users of the Santa Ynez River Model. The model date is February 24, 1997. The model program listing is displayed in Appendix A, on a module by module basis in the Tier and vertical order of Figure 5.1.

Figure 5-2 shows more detail of Tiers 0 and 1 compared to Figure 5-1, and displays the relationships of the key subprograms and procedural logic of the Santa Ynez River Model program. The control program designates the order and the conditions under which the six principal subprograms are called. This conditional calling order in the Program Code for "Main Module" is listed on Page 2 of the program listing in Appendix A. A discussion of the modules displayed on Figure 5-2 is contained in Sections 5.1 and 5.2. Section 5.3 provides a discussion of the 7 modules in Tier 2.

5.1 CONTROL PROGRAM (Appendix A, pp. A1 & A2)

As shown on Figure 5-2, "Main Module" has four main functions. 1) It specifies all subprograms to be used; 2) It dimensions and declares all numeric and string variables to be shared (i.e., used by any two or more procedures). The word "dimensions" means to specify the size and number of numeric and other variables required for data storage by the Model. "Declares" means to identify numeric and other variables that are to be used by two or more subprograms. 3) It lists all data lines to be read into single or array variables (numeric and string) which have been dimensioned as shared variables (noted above). 4) It sets out the order and logic of the model procedures as depicted in Figure 5-2.

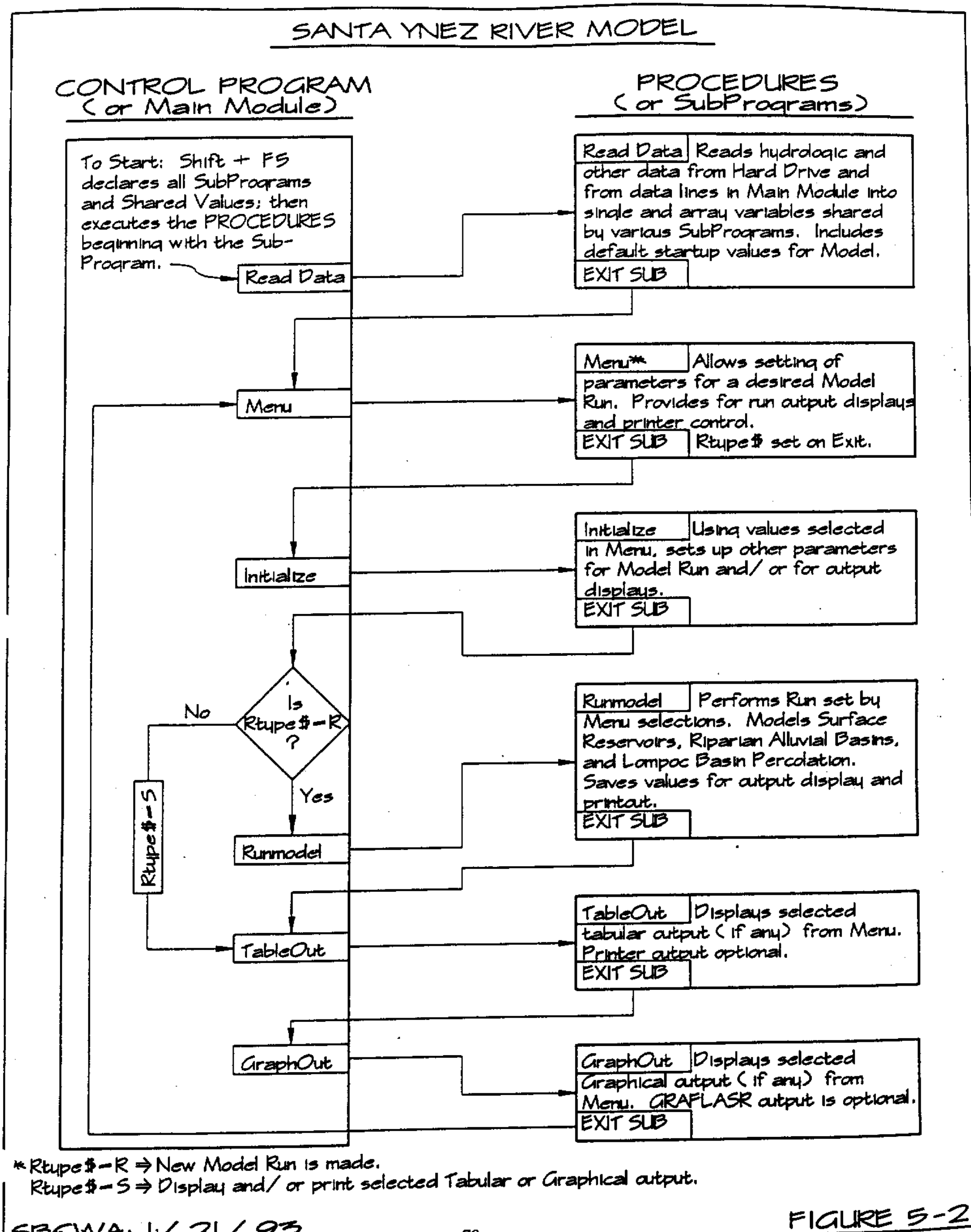

SANTA YNEZ RIVER MODEL
CONTROL PROGRAM
(or Main Module)
PROCEDURES
(or SubPrograms)
To Start: Shift + F5 declares all SubPrograms and Shared Values; then executes the PROCEDURES beginning with the Sub-Program.
Read Data
Menu
Initialize
Is Rtype$ = R ?
No
Yes
Rtype$ = S
Runmodel
TableOut
GraphOut
Read Data
Reads hydrologic and other data from Hard Drive and from data lines in Main Module into single and array variables shared by various SubPrograms. Includes default startup values for Model.
EXIT SUB
Menu*
Allows setting of parameters for a desired Model Run. Provides for run output displays and printer control.
EXIT SUB
Rtype$ set on Exit.
Initialize
Using values selected in Menu, sets up other parameters for Model Run and/ or for output displays.
EXIT SUB
Runmodel
Performs Run set by Menu selections. Models Surface Reservoirs, Riparian Alluvial Basins, and Lompoc Basin Percolation. Saves values for output display and printout.
EXIT SUB
TableOut
Displays selected tabular output (if any) from Menu. Printer output optional.
EXIT SUB
GraphOut
Displays selected Graphical output (if any) from Menu. GRAFLASR output is optional.
EXIT SUB
* Rtype$ = R ⇒ New Model Run is made.
Rtype$ = S ⇒ Display and/ or print selected Tabular or Graphical output.
SBCWA 6/ 21/ 93

FIGURE 5-2

5.2 TIER 1 SUBPROGRAMS

Tier 1 subprograms include four basic modeling functions and two functions which control and arrange model output. They are discussed individually in the following sections.

5.2.1 "ReadData" Subprogram (Appendix A, pp. A3-A5)

The "ReadData" procedure fills many of the shared variable locations dimensioned in "Main Module" with numeric and string data read off the computer hard disk drive and off of the data lines in "Main Module". From the hard drive, data specifying values for runoff, rainfall, evaporation, tunnel infiltration, evapotranspiration correction, cloud seeding increment, cloud seeding functions, and reservoir elevation-volume data are read into the appropriate model arrays. This numeric data comprises 18,032 values as shown in the INPUT instructions in Appendix A pp A3 and A4 of the Model Code listing ("ReadData" Subprogram), and is described in detail in Appendix "E" (Hydrologic Data Base). After data from the hard drive is read, the data lines listed in "Main Module" are read (see Pg. A2 of Model Code listing). The data from the "Main Module" fills small arrays and single variables used by "Runmodel" and by some of the tabular and graphical output sub programs, and also includes default values used in "Menu" (all of these values are dimensioned as "SHARED" in "Main Module").

5.2.2 "Menu" Subprogram (Appendix A, pp. A6-A11)

The "Menu" subprogram specifies reservoir, riparian alluvial basin, cloud seeding, and drought year repeat parameters. As discussed in

Section 4.2, the user may select "Menu" values resulting in many different outputs for a particular model run or which may allow comparison of effects of changes on different runs. For a detailed discussion of the menu and menu operations, please see Section 4 (Subsection 4.2).

5.2.3 "Initialize" Subprogram (Appendix A, pp. A12-A14)

The subprogram "Initialize" translates the menu selections into the starting levels, use levels, operation modes and output selections required by the "Runmodel" procedure to produce a desired model run. "Initialize" also sets certain other model parameters not suitable for manipulation through the menu subprogram. "Initialize" also serves as a translator which equates or converts the 36 numeric value array MenuVal!(6,6) set in the "Menu" subprogram into the named single and array numeric variables and string values required by "Runmodel" and several Tier 2 subprograms.

5.2.4 "Runmodel" Subprogram (Appendix A, pp. A15-A37)

The subprogram "Runmodel" is the principal element of the Santa Ynez River model version SYRM1296.BAS. All numerical simulation of the Santa Ynez River System occurs in this procedure. The "running" of the model occurs when this procedure is called (activated) by "MainModule." Its function is to utilize parameters specified by Menu selections to simulate monthly conditions in surface Reservoirs, Riparian Groundwater Basins, and Lompoc Basin Santa Ynez River percolation and to save values for output in the form of tables and graphs.

Upon entry into this subprogram, string and numeric arrays which will not be shared with other procedures are dimensioned and some single variable and fixed parameters are set. Next, surface reservoir and riparian alluvial basin size, initial storage, diversion information and cloud seeding status are displayed. Values set in the "Menu" and translated in the "Initialize" subprograms are displayed in this output. Total modeling period accumulators are initialized to zero, and other special function parameters are set at this point. Next the model enters the annual and monthly time loops (program listing pages A18 through A31).

At the beginning of the calculations for each annual loop, water year (October through September) numeric accumulators are set to zero or to the appropriate beginning of year value. Then the calculations for the first month (monthly loop) of the water year are performed. At the conclusion of calculations and accumulation of results for each month, the next month's analysis is performed in the same way, through to the end of the water year (September). In each of the monthly calculation loops the month's reservoir diversions are set for each of the three surface reservoirs and for the Base Operations reservoir at Gibraltar, and the month's groundwater pumpage is set for the below Cachuma riparian alluvial basins. Calculation of all hydrologic factors is then performed for the month starting with the upper watershed (Juncal Dam) and working down river to Lompoc. Six basic elements of the system are modeled:

1. Juncal (Jameson Lake plus Doulton Tunnel)

2. Base Gibraltar (a "phantom" Gibraltar reservoir representing "Base" operations at Gibraltar consistent with the "Upper Santa Ynez River Operations Agreement".

3. Gibraltar ("Actual" Gibraltar Reservoir and Mission Tunnel; compared with the "Base" Gibraltar operations for purposes of downstream water rights).

4. Cachuma (Lake Cachuma and Tecolote Tunnel).

5. Above Narrows Riparian Alluvial Basins (divided into four segments).

6. Below Narrows Santa Ynez River percolation.

The six elements listed are calculated in the order listed for each month. (Detailed output tables showing monthly values for any one of these six elements may be printed, if selected in the "Menu" subprogram.) Annual numeric accumulators add up the monthly values for each of the six elements during the monthly time loop. After all monthly values for the year are totaled, the bottom of the annual loop is entered. Here, modeling period numeric accumulators tally the annual values required to calculate modeling period ending and average values output in summary form at the end of a model run. After calculations for each of the months in the modeling period are completed (76 cycles through the annual loop; 912 cycles through the monthly loop), the final summary printout for the model run is output. The final summary printout includes period average and period ending level values which are calculated and displayed for each of the six elements listed above.

It should be noted that as element five listed above (the Riparian alluvial Basins) is actually divided into four distinct reservoirs (groundwater basins) in the model, the number of model elements calculated out with each pass through the monthly loop is nine. Therefore each "run" of the model entails 8208 (76 years x 12 months x nine elements modeled) sequential accounting procedures to be made. While the final summary printout is displayed on the CRT, the computer remains idling in "Runmodel" until the user presses a key (such as the space bar, etc.,) which then causes the exiting of the subprogram and return via the control program ("MainModule") to the "Menu" procedure.

5.2.5 "TableOut" Subprogram (Appendix A, pp. A38-A41)

The "TableOut" procedure is called by the control program after "Runmodel" has been exited or after "Initialize" has been exited with Rtype$ = S. Rtype$ is a variable which causes the program to make a new Model run when equal to R (i.e. the letter "R" is depressed on the keyboard). If RType$ is equal to "S", no new run is activated (see Model flow logic on Figure 5-2). Rtype$ is set in "Menu" upon exit back to the control program "MainModule". If the "Runmodel" procedure has been executed then Rtype$ will equal R. See logic diagram in Figure 5-2.

"TableOut" outputs to the CRT tables listed in Section 4, Table 4-1. This list is summarized as follows:

1. Delivery shortages from Jameson Lake (Doulton)
2. Delivery shortages from "Base" Gibraltar
3. Delivery shortages from "Actual" Gibraltar (Mission)

4. Delivery shortages from Cachuma (Tecolote)
5. Combined (Jun + Gib + Cach) delivery shortages
6. Cachuma monthly & water year runoff, 1918-1993.
7. Santa Ynez River @ San Lucas Bridge monthly and water year flows, 1918-1993
8. Santa Ynez River @ Alisal Bridge monthly and water year flows, 1918-1993
9. Santa Ynez River @ Bend W. of Buellton monthly & water year flows, 1918-1993
10. Santa Ynez River Above Salsipuedes monthly & water year flows, 1918-1993
11. Lompoc Narrows monthly & water year runoff, 1918-1993
12. Santa Ynez River @ Floradale Bridge monthly & water year flows, 1918-1993
13. Cachuma Reservoir end of month lake storage, 1918-1993
14. Cachuma Reservoir end of month lake elevation, 1918-1993
15. Cachuma Reservoir end of month lake area, 1918-1993
16. No Table

Tables 1,3, and 4 show associated mountain tunnel names in parentheses. This is to indicate that the shortage may be based upon a draft placed upon the lake alone, or placed upon the lake plus the mountain tunnel (i.e. "south portal" drafts) as determined by the menu selections made in rows 1 through 3, Column 4 of the menu.

In the above list, Table 5 is simply Tables 1,3, and 4 added together. If the TabOUTPUT (Row 6, Column 4) menu selection is set to "EXTRNAL" (Cell value = 2) then the table data is sent to both the external printer as well as the CRT. Otherwise the table data is sent only to the CRT. If the TableTYPE selection number is 16 then no table is output, and an exit is made from "TableOut" back to "MainModule".

5.2.6 "GraphOut" Subprogram (Appendix A, p. 42)

The "GraphOut" procedure is called by the control program after each exit from the "TableOut" subprogram. "GraphOut" simply acts as a multiposition switch, the first eleven of which allow selection of individual graphic printouts while the 12th position causes an exit of the procedure and return to "MainModule". Each switch position is selected in the model menu Row 6 - Column 5. For switch positions 1 through 11, "GraphOut" calls one of four tier 2 subprograms (see Figure 5-1) which then produce the selected graph on the CRT for display. Inclusion of the "GRAFLASR" software into the computer before loading Microsoft QuickBASIC will allow the user to print out the displayed graph onto the external printer when the "Print Screen" key is pressed. When the user is finished with observing the graph on the CRT, return to the control program (and thence to the model menu) is achieved by pressing any key (such as the space bar, etc.)

5.3 TIER 2 SUBPROGRAMS

Three of the Tier 2 subprograms (AreaVolSet, SetPrinter, and SetPrinter2) are required by the model to make and print out runs and to display and print out the 15 available table selections of the Model menu. The remaining four Tier 2 procedures are required for the output of the 11 menu selectable graphs displaying reservoir shortages (five selections), reservoir and alluvial basin hydrographs (two selections), and finally, Santa Ynez River flow ranking graphs (four selections).

5.3.1 "AreaVolSet" Subprogram (Appendix A, p. 43)

"AreaVolSet" is a Table "look up" procedure which is called using reservoir designator 1 for Juncal, 2 for Gibraltar, and 3 for Cachuma and a reservoir elevation as the input parameters. The subprogram is exited having set the reservoir volume and reservoir surface area corresponding to the input elevation. Also the selected reservoir elevation-capacity table pointer is set upon subprogram exit. "AreaVolSet" is used by the "Initialize" and "Runmodel" subprograms. It is used by the "Initialize" subprogram to establish maximum and initial lake areas and volumes using the elevation selections set in the model menu.

Note that for all three reservoirs and the Base Operations Reservoir at Gibraltar, the elevation capacity tables give a lake volume for every vertical foot of reservoir depth from the bottom of the reservoir to an elevation somewhat above the maximum possible reservoir enlargement. This allows reservoir enlargement as well as reservoir reduction to be evaluated.

5.3.2 "SetPrinter" Subprograms (Appendix A, p. 44)

The subprogram SetPrinter is called by "Runmodel" if the user has selected external printer output for the menu position in Row 6, Column 2. SetPrinter2 is called by the subprogram "TableOut" if the user has selected external printer output for the menu position

Row 6, Column 4. SetPrinter2 differs from SetPrinter in that it produces a higher density printed output.

5.3.3 "RankShortage" Subprogram (Appendix A, pp. A45-A46)

The "RankShortage" subprogram is used to display the frequency of surface reservoir delivery shortages which occur during a particular model run. This subprogram is called by "GraphOut" if the menu selection of Row 6, Column 5 (GraphTYPE) has a value of one through five. "RankShortage" creates any of five different surface reservoir bar charts showing ranked annual delivery volume (only one is available per menu selection) after any selected model run. The subprogram contains a five position switch with one common graphical display section and sort routine to produce the desired graphs. Section 4.3.6 describes the "RankShortage" graphs and Figure 4-4 is an example graph (selection #1 of five graphs).

5.3.4 "HydroGraph" Subprogram (Appendix A, pp. A47-A48)

The "HydroGraph" subprogram produces hydrographs based on model calculated values representing end of month storage for the entire modeling period for each of the three surface reservoirs (Juncal, Gibraltar, and Cachuma) and for the riparian alluvial basins from Cachuma to the Lompoc Narrows. Any particular model run will result in a unique set of hydrographs. As with the subprogram described above "HydroGraph" is called by the Tier 1 subprogram "GraphOut" (see Figure 5-1). The menu selection (GraphTYPE) is number 6 to produce the hydrograph display. Section 4.3.7 describes the hydrograph output and Figure 4-5 displays results from the Model run with default menu.

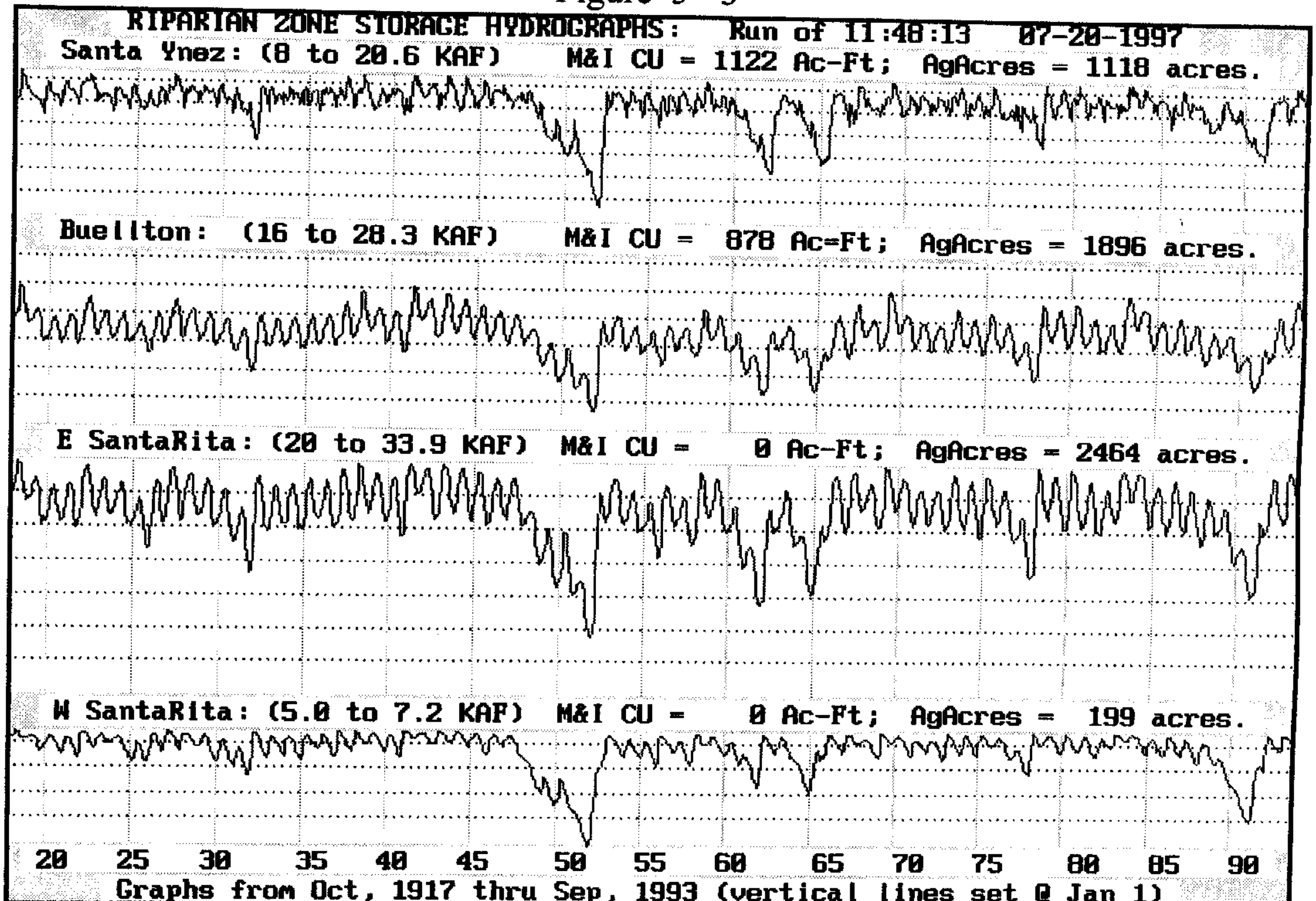
5.3.5 "HydroGrph2" Subprogram (Appendix A, pp. A49-50)

The "HydroGrph2" subprogram produces hydrographs based on model calculated values representing end of month storage for the entire modeling period for each of the four riparian alluvial basin sub-areas. The display constitutes an amplification of the forth hydrograph displayed when the "HydroGraph" subprogram (see 5.3.4, above) is utilized. The four hydrographs of this subprogram if added together month by month will give exactly the forth hydrograph of the section 5.3.4 subprogram. The menu selection (GraphTYPE) is number 7 to produce this display. See Figure 5-3, page 81 for an example of this display using the default menu values.

5.3.6 "RankFlow" Subprogram (Appendix A, pp. A51-A52)

Like the "RankShortage" subprogram, "RankFlow" produces graphical displays of ranked annual flow values depending upon the menu selection GraphTYPE (Row 6, Column 5 in the menu). The values displayed by "RankFlow" are water year flow volume totals of the Santa Ynez River at selected points. There are presently four selected points: inflow to each of the three modeled reservoirs (Juncal, Gibraltar and Cachuma), and flow of the Santa Ynez River at the Lompoc Narrows. These flow graphs are selected by entering the numbers 8 through 11 for GraphTYPE in the menu. Figure 4-6 is an example of this graphical output (GraphTYPE menu value = 9; default menu used). Note that the annual values are displayed on logarithmic scale (Y-axis) plotted against percent of time (X-axis).

Figure 5 - 3



Riparian Alluvial Basin Hydrographs

SECTION 6

APPENDIX A

```
'THIS IS MAIN PROGRAM MODULE OF SYRM0298.BAS...
DEFINT A-Z
DECLARE SUB ReadData ()
DECLARE SUB Menu ()
DECLARE SUB AreaVolSet ()
DECLARE SUB Initialize ()
DECLARE SUB Runmodel ()
DECLARE SUB SetPrinter ()
DECLARE SUB SetPrinter2 ()
DECLARE SUB TableOut ()
DECLARE SUB GraphOut ()
DECLARE SUB RankShortage ()
DECLARE SUB RankFlow ()
DECLARE SUB HydroGraph ()
DECLARE SUB HydroGrph2 ()
' - - - - - - - - - - - - Dimension Arrays - - - - - - - - - -
OPTION BASE 1
DIM SHARED Accret%(4, 912), Rain%(3, 912), Evap%(3, 912), Tunnel%(3, 912)
DIM SHARED Salsi%(912), CsInc%(3, 912), CachET%(912), JunPar!(2, 76), Native!(12)
DIM SHARED GibPar!(2, 76), CacPar!(2, 76), SalPar!(2, 76), LomPar!(2, 76)
DIM SHARED ResvCap!(3, 260), Pcnt%(6, 12), Leakage!(61), GinChowRelFlag%(12)
DIM SHARED DwnStrRelFlag%(12), AgDist!(12), MoDays%(12), PanFac!(3, 12), Rsum!(12)
DIM SHARED Datum%(3), Scale!(4), Ytic!(4), Eavg%(12), Ranker!(9, 76), PhanCap!(76)
DIM SHARED HighNarP%(36), LowNarP%(36), Image$(27), ShortName$(4), Name$(3)
DIM SHARED User$(3), Month$, MenuVal!(6, 6), Res$(6), Mode$(3), Pointer%(3)
DIM SHARED VolGrph!(8, 912), TabValue!(15, 912), EndMoVol!(4), TotalDraft!(4)
DIM SHARED Draft!(5), StartElev!(3), MaxVol!(4), MaxElev!(3), NarrowsQ!(36)
DIM SHARED ScrnType%, InitYr%, NumYears%, Resv%, Elev7!, Area7!, Volume7!
DIM SHARED JunStartShortage%, JunMinDelv!, JunLowVol%, JunRedFac!, Vjun!
DIM SHARED GibStartShortage%, GibMinDelv!, GibLowVol%, GibRedFac!, Vgib!
DIM SHARED CacStartShortage!, CacMinDelv!, CacLowVol%, CacRedFac!, Vcac!
DIM SHARED TotMI%, AgAcres%, SyMI!, BuMI!, SyRed!, BuRed!, SeRed!, SwRed!
DIM SHARED UplandDepl%, UnderflowOut%, Vrip!, AboveNarrwAcct!, StartRelease%
DIM SHARED BelowNarrwAcct!, StartRelBlw%, Seed%, CsEff!, TabVal%, ResvDet%
DIM SHARED Esc$, BeginDetPrint%, EndHardCopy%, RunType$, RunOut$, TabType$
DIM SHARED TabOut$, GphType$, DAdd%, PrinterType$, NumDetYrs%, MitigationFlag%
DIM SHARED YrsRipRain!(76), YrsRipEvap!(76), AgrCU!(76), Xpos%, Ypos%, Rtype$
DIM SHARED Timer$, Dater$, AvAg!
' - - - - - - - - - - - Small Data Array Values - - - - - - - - - -
Deed: DATA 100,75,58,45,39,44,74,104,116,120,115,110
      DATA  115,94,94,88,84,113,117,127,105,27,22,14
      DATA  83,58,56,53,50,67,83,100,108,125,117,100
      DATA   0, 0, 0, 0, 0,34,52,120,170,252,252,120
      DATA  83,58,56,53,50,67,78,108,116,116,112,103
      DATA  67,46,42,38,33,50,75,108,133,149,142,117
      DATA 9.9, 9.9, 7.9, 6, 6, 4
      DATA 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4
      DATA 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4
      DATA 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4
      DATA 1.4, 1.4, 1.4, 1.4, 1.4
      DATA .8, .8, .8, .8, .8, .8, .8, .8, .8, .8, .8, .8, .8, .8
      DATA .5, .5, .5, .5, .5, .5
      DATA 1,1,0,0,0,0,0,0,1,1,1,1
      DATA 1,1,0,0,0,0,0,1,1,1,1,1
      DATA .085,.014,0,0,0,.010,.030,.090,.190,.241,.200,.140
      DATA 31,30,31,31,28,31,30,31,30,31,31,30
      DATA .8,.8,.8,.8,.8,.8,.8,.8,.8,.8,.8,.8
      DATA .8,.8,.8,.8,.8,.8,.8,.8,.8,.8,.8,.8
      DATA .75,.72,.66,.65,.77,.76,.8,.81,.82,.81,.81,.76
      DATA 2139,1346,591
      DATA 3600,10000,40000,50000
      DATA 200,500,2000,2000
      DATA 559,365,273,266,131,453,591,746,861,964,911,715
      DATA 0,400,500,600,700,800,1000,1200,1500,1700,2000,2500,3000,4000,5000,6000,7000,8000,10000,120
      DATA 20000,25000,30000,35000,40000,45000,50000,60000,70000,90000,100000,200000,300000,400000,500
      DATA 0,400,500,595,690,780,935,1065,1215,1330,1410,1560,1690,1870,2000,2115,2200,2275,2400
      DATA 2530,2635,2780,2930,3020,3050,3090,3120,3160,3235,3290,3370,3400,3570,3650,3720,3790
      DATA 0,400,495,570,640,690,775,835,915,960,1015,1080,1135,1215,1260,1305,1340,1365,1405
      DATA 1445,1495,1535,1565,1590,1625,1640,1650,1660,1675,1685,1710,1730,1795,1835,1870,1910
      DATA "James","BaseG","Gibrl","Cachm"
      DATA "Jameson R","Gibraltar","Cachuma R"
      DATA "Montecito"
      DATA "S B City "
      DATA "SC, SYnez"
      DATA 2220.8,2224,2000,1,2500,16.35
      DATA 1399.3,1400,4580,1,50,0
      DATA 745.9,750,25714,2,100000,76.953
      DATA 3000,0,2000,5677,1,.50
      DATA 1918.76,79100,2400,10600,600,1000
      DATA 7,1,16,1,12,0
      DATA "|ResJUNCAL|","|GIBRALTAR|","|RsCACHUMA|","|&Cld SEED|","|RipACCNTS|","|andOUTPUT|"
      DATA 1,1
      DATA 3,1.2,.8,.4,.6,1.4,3.6,4.9,7,9,8.4,5.5
      DATA 1,3,7,36,82,130,63,23,5,1,0,0
```

```
'======================== BEGIN PROCEDURES =======================
    SCREEN 0
    CLS
    RESTORE Deed
    ReadData
Me: Menu
    Initialize
    IF Rtype$ = "R" THEN Runmodel
    TableOut
    GraphOut
    GOTO Me
    END
```

```
'READS DATA FROM HARD DISC & FROM MAIN MODULE DATA LINES....
DEFINT A-Z
SUB ReadData STATIC
   LOCATE 2, 8: COLOR 14, 0: PRINT "SBCWA Santa Ynez River Operations Model SYRM0298 by Jon Ahlroth,
   LOCATE 4, 20: PRINT "Translated to QuickBASIC 4.0 by Jim Stubchaer"
   Esc$ = CHR$(27)
   ScrnType% = 12
   PrinterType$ = "Laser"
   CHDIR "C:\QB45\PGM\DATA"
   OPEN "ACCR96.HTB" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 3, 0:  PRINT "              Reading CSACCR4 files"
           FOR Resv% = 1 TO 4
             FOR Mo% = 1 TO 912
               INPUT #1, Accret%(Resv%, Mo%)
             NEXT Mo%
           NEXT Resv%
   CLOSE #1
   OPEN "PREC96.HTB" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 1, 0:  PRINT "              Reading CSRAIN3 files"
           FOR Resv% = 1 TO 3
             FOR Mo% = 1 TO 912
               INPUT #1, Rain%(Resv%, Mo%)
             NEXT Mo%
           NEXT Resv%
   CLOSE #1
   OPEN "EVPO96.HTB" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 5, 0:  PRINT "                Reading EVAP3 files"
           FOR Resv% = 1 TO 3
             FOR Mo% = 1 TO 912
               INPUT #1, Evap%(Resv%, Mo%)
             NEXT Mo%
           NEXT Resv%
   CLOSE #1
   OPEN "TNNL96.HTB" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 6, 0:  PRINT "                Reading TUNL3 files"
           FOR Resv% = 1 TO 3
             FOR Mo% = 1 TO 912
               INPUT #1, Tunnel%(Resv%, Mo%)
             NEXT Mo%
           NEXT Resv%
   CLOSE #1
   OPEN "SALP96.HTB" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 2, 0:  PRINT "                 Reading CSSAL file"
             FOR Mo% = 1 TO 912
               INPUT #1, Salsi%(Mo%)
             NEXT Mo%
   CLOSE #1
   OPEN "CHET96.HTB" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 4, 0:  PRINT "                Reading CachET file"
             FOR Mo% = 1 TO 912
               INPUT #1, CachET%(Mo%)
             NEXT Mo%
   CLOSE #1
   LOCATE 12, 25: COLOR 2, 0:   PRINT "              Reading CS_INC files"
   OPEN "CSNC96.HTB" FOR INPUT AS #1
           FOR Resv% = 1 TO 3
             FOR Mo% = 1 TO 912
               INPUT #1, CsInc%(Resv%, Mo%)
             NEXT Mo%
           NEXT Resv%
   CLOSE #1
   OPEN "JUNPAR.HTB" FOR INPUT AS #1
   LOCATE 12, 25: COLOR 3, 0:   PRINT "           Reading Parabola files"
           FOR I% = 1 TO 2
             FOR Year% = 1 TO 76
               INPUT #1, JunPar!(I%, Year%)
             NEXT Year%
           NEXT I%
   CLOSE #1
   OPEN "GIBPAR.HTB" FOR INPUT AS #1
           FOR I% = 1 TO 2
             FOR Year% = 1 TO 76
               INPUT #1, GibPar!(I%, Year%)
             NEXT Year%
           NEXT I%
   CLOSE #1
   OPEN "CACPAR.HTB" FOR INPUT AS #1
           FOR I% = 1 TO 2
             FOR Year% = 1 TO 76
               INPUT #1, CacPar!(I%, Year%)
             NEXT Year%
           NEXT I%
   CLOSE #1
   OPEN "LOMPAR.HTB" FOR INPUT AS #1
```

```
            FOR I% = 1 TO 2
              FOR Year% = 1 TO 76
                INPUT #1, LomPar!(I%, Year%)
              NEXT Year%
            NEXT I%
   CLOSE #1
   OPEN "SALPAR.HTB" FOR INPUT AS #1
            FOR I% = 1 TO 2
              FOR Year% = 1 TO 76
                INPUT #1, SalPar!(I%, Year%)
              NEXT Year%
            NEXT I%
   CLOSE #1
'============== Read Dam Storage Data =====================
   OPEN "RESVCAP4.HPA" FOR INPUT AS #1
   LOCATE 12, 25: COLOR 3, 0:    PRINT "   Reading ResvCap!(Dams) data"
   FOR Resv% = 1 TO 3
     FOR Depth% = 1 TO 260
       INPUT #1, ResvCap!(Resv%, Depth%)
     NEXT Depth%
   NEXT Resv%
   CLOSE #1
   OPEN "PHANCAP.HPA" FOR INPUT AS #1
   FOR Depth% = 1 TO 76
     INPUT #1, PhanCap!(Depth%)
   NEXT Depth%
   CLOSE #1
' - - - - - - - - - Calc Riparian Water Year Rain, Evap ----------
   FOR Yr% = 1 TO 76
     YrsRipRain!(Yr%) = 0
     YrsRipEvap!(Yr%) = 0
     FOR Mo% = 1 TO 12
       K% = 12 * (Yr% - 1) + Mo%
       YrsRipRain!(Yr%) = YrsRipRain!(Yr%) + .8 * Rain%(3, K%) / 100
       YrsRipEvap!(Yr%) = YrsRipEvap!(Yr%) + Evap%(3, K%) / 100
     NEXT Mo%
   NEXT Yr%
' - - Read Monthly Distribution of Diversions [1000ths] (Pcnt made integer)-
   FOR Subarea% = 1 TO 6
            FOR WtrYrMo% = 1 TO 12
             READ Pcnt%(Subarea%, WtrYrMo%)
            NEXT WtrYrMo%
   NEXT Subarea%
' - - - - - - - - - Read  Leakage!(), Cachuma Leakage
   FOR J% = 1 TO 61
             READ Leakage!(J%)
   NEXT J%
' - - - - - - - - - Read   (Gibrl made integer)
   FOR WtrYrMo% = 1 TO 12
             READ GinChowRelFlag%(WtrYrMo%)
   NEXT WtrYrMo%
' - - - - - - - - - Read   (Dsrel made integer)
   FOR WtrYrMo% = 1 TO 12
             READ DwnStrRelFlag%(WtrYrMo%)
   NEXT WtrYrMo%
' - - - - - - - - - Read   Agr
   FOR WtrYrMo% = 1 TO 12
             READ AgDist!(WtrYrMo%)
   NEXT WtrYrMo%
' - - - - - - - - - Read   Phf
   FOR WtrYrMo% = 1 TO 12
             READ MoDays%(WtrYrMo%)
   NEXT WtrYrMo%
' - - - - - - - - - Read Evaporation Pan Factors - - - - - - - - - - - - - - - -
   FOR Resv% = 1 TO 3
     FOR WtrYrMo% = 1 TO 12
           READ PanFac!(Resv%, WtrYrMo%)
     NEXT WtrYrMo%
   NEXT Resv%
' - - - - - - - - - Read Reservoir Base Elev (Datum made integer) - - - - - - -
   FOR Resv% = 1 TO 3: READ Datum%(Resv%): NEXT Resv%
   FOR J% = 1 TO 4: READ Scale!(J%): NEXT J%
   FOR J% = 1 TO 4: READ Ytic!(J%): NEXT J%
   FOR WtrYrMo% = 1 TO 12
           READ Eavg%(WtrYrMo%)
   NEXT WtrYrMo%
' - - - - - - - - - Read Below Narrows SY River percolation Table - - - - - - -
   FOR J% = 1 TO 36: READ NarrowsQ!(J%): NEXT J%
   FOR J% = 1 TO 36: READ HighNarP%(J%): NEXT J%
   FOR J% = 1 TO 36: READ LowNarP%(J%): NEXT J%
AssignStringData:
' - - - - Assign Print Format Images, IBM BASIC style - - - - - - - - - - - - -
 Image$(1) = "|- Lompoc| ######## |######### |##### |##### |###### |#####|##### |###### |####|"
 Image$(2) = "|\    \|######|#####|#####|####|#####|#####|####|######|#####|####.#|####|######|"
 Image$(3) = "|##### af|###.###%|#### af||##### af|###.###%|#### af||######af|###.###%|##### af|"
```

```
 Image$(4)  = "|\         \|####.##|####|######|####.#|####|######|\        \|\       \|####  |"
 Image$(5)  = "\                 \####!##\                                                      \"
Image$(6)  = "|\         \|######|####|####|#####|#####|#####|#####|####|######|####|#####|#####|"
Image$(7)  = "|\ \####|######|#####|######|#######|#####|#####|#####|#######|#####|####|#####|"
Image$(8)  = "|\    \|######|#####|#####|####|#####|#####|####|######|#####|###.##|####|######|"
Image$(9)  = "|\       \|######|#####|######|#######|#####|#####|#####|#######|#####|####|#####|"
 nage$(10) = "|\ \##|######|#####|#####|####|#####|#####|####|######|#####|####.#|####|######|"
.mage$(11) = "|\    \|######|####|####|####|#####|#####|#####|####|######|    |#####|#####|#####|"
Image$(12) = "|\ \##|######|#####|#####|####|#####|#####|####|######|#####|###.##|####|######|"
Image$(13) = "|\    \|######|#####|#####|####|#####|#####|####|######|#####|####.#|####|######|"
Image$(14) = "|\         \|######|#####|######|#######|#####|#####|#####|#######|#####|####|####|"
Image$(15) = "\          \|   \ \ #####    |   \ \ #####    |   \ \ #####    |   \ \ #####    |   \ \ #####   |"
Image$(16) = "\          \|########.# % |########.# % |########.# % |########.# % |                  |"
Image$(17) = "|\    \|######|#####|#####|####|#####|#####|####|######|#####|###.##|####|######|"
Image$(18) = "\    \####|####|#####|#####|#####|#####|#####|#####|####|####|####|####|######|"
Image$(19) = "Avg                                                                            ######"
Image$(20) = "|\ \##|######|####|####|####|#####|#####|#####|####|######|##|#####|#####|#####|"
Image$(21) = "\          \|##,###,### af|##,###,### af|##,###,### af|##,###,### af|##,###,### af|"
Image$(22) = "\          \|##,###,### af|##,###,### af|##,###,### af|##,###,### af|              |"
Image$(23) = " \           \\                     \######\                  \#####\      \"
Image$(24) = " \           \\                                                   \#####\      \"
Image$(25) = "####|############         |############         |############         |#########   |"
Image$(26) = "\    \############         |############         |############         |#########   |"
Image$(27) = "\          \|########.# % |########.# % |########.# % |########.# % |              |"

    FOR Resv% = 1 TO 4
      READ ShortName$(Resv%)
    NEXT Resv%
    FOR Resv% = 1 TO 3
      READ Name$(Resv%)
    NEXT Resv%
    FOR I% = 1 TO 3
      READ User$(I%)
    NEXT I%
    Month$ = "OctNovDecJanFebMarAprMayJunJulAugSep"
    FOR Row = 1 TO 6
      FOR Col = 1 TO 6
        READ MenuVal!(Row, Col)
      NEXT Col
    NEXT Row
    FOR Row = 1 TO 6
      READ Res$(Row)
    NEXT Row
    READ Xpos%, Ypos%
    FOR I% = 1 TO 12
      READ Native!(I%)
    NEXT I%
    FOR I% = 1 TO 12
      READ Rsum!(I%)
      Rsum!(I%) = 100 * Rsum!(I%)
    NEXT I%
END SUB
```

```
'THIS IS THE MENU SUBPROGRAM...
SUB Menu STATIC
   CLS
   SCREEN ScrnType%         'Screen is 640 by 480 pixels
   PALETTE 0, 4144959       'Change Background from Black to White (0,15 is dark brown)
   COLOR 1                  'Changes White Text to Black
   BkGnd% = 10              'Background Color
   ForGnd% = 11             'Graph background color
   Xmin! = 0
   Xmax! = 640
   Ymin! = 0
   Ymax! = 480
   VIEW (0, 0)-(639, 479), BkGnd%
   WINDOW (Xmin!, Ymin!)-(Xmax!, Ymax!)
   LINE (Xmin + 20, Ymin + 9)-(Xmax - 24, Ymax - 9), ForGnd%, BF
   LINE (Xmin, Ymin)-(Xmax, Ymax), 6, B
   LINE (Xmin + 1, Ymin + 1)-(Xmax - 1, Ymax - 1), 1, B
   LINE (Xmin + 2, Ymin + 2)-(Xmax - 2, Ymax - 2), 1, B
   MenuVal!(5, 1) = 1918.76
   MenuVal!(6, 1) = 7
   MenuVal!(6, 2) = 1
   MenuVal!(6, 4) = 1
   MenuVal!(6, 6) = 0
   Out1$ = "  To CRT "
   Out2$ = "  To CRT "
   Out3$ = " NONE!!! "
   COLOR 1
   LOCATE 2, 5
   PRINT "┌─────────┬─────────┬─────────┬─────────┬─────────┬─────────┬─────────┐"
   LOCATE 3, 5
   PRINT "│RESERVOIR│BegWSElev│MaxWSElev│ProjDraft│1=Lk2=L+T│StrtShort│May1Delv%│"
   LOCATE 4, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   Image1$ = "\         \#####.## │#####.## │######## │\        \│######## │###.###% │"
   Image2$ = "\         \######## │######## │######## │######## │######## │#####.## │"
   Image3$ = "\         \#####.## │######## │######## │######## │######## │######## │"
   Image4$ = "\         \\        \│\       \│\       \│\       \│\       \│\       \│"
   COLOR 3
   FOR Row = 1 TO 3
     Mode$ = "Lake Only"
     IF MenuVal!(Row, 4) = 2 THEN Mode$ = "Lk + Tunl"
     LOCATE Row + 4, 5
     PRINT USING Image1$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), Mode$, Me
   NEXT Row
   COLOR 2
   LOCATE 8, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   LOCATE 9, 5
   PRINT "│PIPE & CU│ID#1 Pipe│LompcPipe│M&ICnsUse│IrrAgAcrg│CSeedFlag│SeedEfcny│"
   LOCATE 10, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   LOCATE 11, 5
   Row = 4
   COLOR 1
   PRINT USING Image2$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), MenuVal!(Ro
   COLOR 4
   LOCATE 12, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   LOCATE 13, 5
   PRINT "│Acnts&Etc│ShwDetYrs│BegRipStr│BegnngANA│ANAStrtRl│BegnngBNA│BNAStrtRl│"
   LOCATE 14, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   LOCATE 15, 5
   Row = 5
   COLOR 1
   PRINT USING Image3$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), MenuVal!(Ro
   SELECT CASE MenuVal!(6, 1)
   CASE 1
     Pout1$ = "Detl=Junc"
     GOTO Nxt
   CASE 2
     Pout1$ = "Detl=Base"
     GOTO Nxt
   CASE 3
     Pout1$ = "Detl=Gibr"
     GOTO Nxt
   CASE 4
     Pout1$ = "Detl=Cach"
     GOTO Nxt
   CASE 5
     Pout1$ = "Det=C-Lom"
     GOTO Nxt
   CASE 6
     Pout1$ = "Det=BlwNr"
```

```
      GOTO Nxt
    CASE 7
      Pout1$ = " SUMMARY "
      GOTO Nxt
    CASE ELSE
      Pout1$ = "WRONG ##!"
    END SELECT
xt: SELECT CASE MenuVal!(6, 3)
    CASE 1
      Pout2$ = "JuncShort"
      GOTO Typ
    CASE 2
      Pout2$ = "BaseShort"
      GOTO Typ
    CASE 3
      Pout2$ = "GibrShort"
      GOTO Typ
    CASE 4
      Pout2$ = "CachShort"
      GOTO Typ
    CASE 5
      Pout2$ = "CombinedS"
      GOTO Typ
    CASE 6
      Pout2$ = "CacInflow"
      GOTO Typ
    CASE 7
      Pout2$ = "Q SnLucas"
      GOTO Typ
    CASE 8
      Pout2$ = "Q AlisalB"
      GOTO Typ
    CASE 9
      Pout2$ = "Q Bend WB"
      GOTO Typ
    CASE 10
      Pout2$ = "Q AbvSals"
      GOTO Typ
    CASE 11
      Pout2$ = "Q Narrows"
      GOTO Typ
    CASE 12
      Pout2$ = "Q Floradl"
      GOTO Typ
    CASE 13
      Pout2$ = "Cach Stor"
      GOTO Typ
    CASE 14
      Pout2$ = "Cach Elev"
      GOTO Typ
    CASE 15
      Pout2$ = "Cach Area"
      GOTO Typ
    CASE 16
      Pout2$ = "No Table!"
      GOTO Typ
    CASE ELSE
      Pout2$ = "WRONG ##!"
    END SELECT
Typ: SELECT CASE MenuVal!(6, 5)
    CASE 1
      Pout3$ = "JunDelRnk"
      GOTO Zyp
    CASE 2
      Pout3$ = "BasDelRnk"
      GOTO Zyp
    CASE 3
      Pout3$ = "GibDelRnk"
      GOTO Zyp
    CASE 4
      Pout3$ = "CacDelRnk"
      GOTO Zyp
    CASE 5
      Pout3$ = "ComDelRnk"
      GOTO Zyp
    CASE 6
      Pout3$ = "HydroGrph"
      GOTO Zyp
    CASE 7
      Pout3$ = "HydroGph2"
      GOTO Zyp
    CASE 8
      Pout3$ = "RankQJunc"
      GOTO Zyp
    CASE 9
```

```
      Pout3$ = "RankQGibr"
      GOTO Zyp
    CASE 10
      Pout3$ = "RankQCach"
      GOTO Zyp
    CASE 11
      Pout3$ = "RankQLomp"
      GOTO Zyp
    CASE 12
      Pout3$ = "No Graph!"
      GOTO Zyp
    CASE ELSE
      Pout3$ = "WRONG ##!"
    END SELECT
Zyp: COLOR 1
    LOCATE 16, 5
    PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
    LOCATE 17, 5
    PRINT "│RUN TYPES│RunDETAIL│RunOUTPUT│TableTYPE│TabOUTPUT│GraphTYPE│DrouthADD│"
    LOCATE 18, 5
    PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
    LOCATE 19, 5
    Row = 6
    COLOR 3
    PRINT USING Image4$; Res$(Row); Pout1$; Out1$; Pout2$; Out2$; Pout3$; Out3$
    COLOR 1
    LOCATE 20, 5
    PRINT "└─────────┴─────────┴─────────┴─────────┴─────────┴─────────┴─────────┘"
    COLOR 8
    LOCATE 21, 5
    PRINT " Use CAPS!!! R to RUN; H to STOP.  Output: 1=CRT; 2=Printer.  Detailed "
    LOCATE 22, 5
    PRINT " output for Juncal, Base Gib, Exist Gib, Cachuma, Abv Nrrws, Blw Nrrws "
    LOCATE 23, 5
    PRINT " and Summry (1-7).  15 Tables are available for output:  1-5 = surface "
    LOCATE 24, 5
    PRINT " reservoir delivery shortages; 6-12 = river flows into Cachuma and @ 6 "
    LOCATE 25, 5
    PRINT " locations downstream to Floradale Bridge; 13-15 = Cachuma storg, elev "
    LOCATE 26, 5
    PRINT " & area.  Of 11 Graphical displays, 1-5 = surface reservoir deliveries "
    LOCATE 27, 5
    PRINT " ranked;  6&7 show RESV & GWB hydrographs;  8-11 = ranked annual flows "
    LOCATE 28, 5
    PRINT " into reservoirs & at Lompoc Narrows... Use arrows to move about MENU. "
    LOCATE 29, 5
    PRINT " After RUN, S displays selected table &/or graph for viewing & output..";
    Y = Ypos%
    X = Xpos%
48  Num$ = ""
    Row = Y
    GOSUB Locater
    COLOR 8
    PRINT USING "######.##"; MenuVal!(Y, X)
49  DO
    A$ = INKEY$
    LOOP WHILE A$ = ""
    IF A$ = CHR$(&H0) + CHR$(72) THEN GOTO MoveUp
    IF A$ = CHR$(&H0) + CHR$(75) THEN GOTO MoveLeft
    IF A$ = CHR$(&H0) + CHR$(77) THEN GOTO MoveRight
    IF A$ = CHR$(&H0) + CHR$(80) THEN GOTO MoveDown
    IF A$ = CHR$(72) THEN
      SOUND 97, 3
      STOP
    END IF
    IF A$ = CHR$(82) THEN
      Rtype$ = "R"
      Xpos% = X
      Ypos% = Y
      SOUND 220, 1: EXIT SUB
    END IF
    IF A$ = CHR$(83) THEN
      Rtype$ = "S"
      Xpos% = X
      Ypos% = Y
      SOUND 440, 1: EXIT SUB
    END IF
    IF A$ = CHR$(8) THEN GOTO Backspace
    IF A$ = CHR$(13) THEN GOTO Enter
    IF VAL(A$) >= 0 THEN
      IF VAL(A$) <= 9 THEN
        GOSUB Numbr
      END IF
    END IF
    GOTO 49
```

```
MoveUp: GOSUB Block
        Y = Y - 1
        IF Y < 1 THEN Y = 6
        GOTO 48
MoveLeft: GOSUB Block
        X = X - 1
        IF X < 1 THEN X = 6
        GOTO 48
MoveRight: GOSUB Block
        X = X + 1
        IF X > 6 THEN X = 1
        GOTO 48
MoveDown: GOSUB Block
        Y = Y + 1
        IF Y > 6 THEN Y = 1
        GOTO 48
Backspace: IF Num$ = "" THEN GOTO 49
        Length = LEN(Num$) - 1
        Num$ = LEFT$(Num$, Length)
        GOSUB Locater
        PRINT "         "
        GOSUB Locater
        COLOR 8
        PRINT Num$
        GOTO 49
Enter:  GOSUB Block
        GOTO 48
Block:  IF Num$ <> "" THEN MenuVal!(Y, X) = VAL(Num$)
        IF Row <= 3 THEN
          Mode$ = "Lake Only"
          IF MenuVal!(Row, 4) = 2 THEN Mode$ = "Lk + Tunl"
          LOCATE Row + 4, 5
          COLOR 3
          PRINT USING Image1$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), Mode$
          RETURN
        END IF
        IF Row = 4 THEN
          LOCATE 11, 5
          COLOR 3
          PRINT USING Image2$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), MenuV
          RETURN
        END IF
        IF Row = 5 THEN
          LOCATE 15, 5
          COLOR 3
          PRINT USING Image3$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), MenuV
          RETURN
        END IF
        IF Row = 6 THEN
          Out1$ = " EXTRNAL "
          IF MenuVal!(6, 2) = 1 THEN Out1$ = "  To CRT "
          Out2$ = " EXTRNAL "
          IF MenuVal!(6, 4) = 1 THEN Out2$ = "  To CRT "
          Out3$ = " NONE!!! "
          MenuVal!(6, 6) = INT(MenuVal!(6, 6))
          IF MenuVal!(6, 6) <> 0 THEN
            IF MenuVal!(6, 6) < 0 THEN
Rid:          Out3$ = "WRONG ##!"
              MenuVal!(6, 6) = 0
              GOTO Selct
            END IF
            IF MenuVal!(6, 6) > 34 THEN GOTO Rid
            Out3$ = STR$(MenuVal!(6, 6))
            Out3$ = " " + LTRIM$(RTRIM$(Out3$)) + " Years"
            IF LEN(Out3$) = 8 THEN Out3$ = " " + Out3$
          END IF
Selct:    SELECT CASE MenuVal!(6, 1)
          CASE 1
            Pout1$ = "Detl=Junc"
            GOTO Tip
          CASE 2
            Pout1$ = "Detl=Base"
            GOTO Tip
          CASE 3
            Pout1$ = "Detl=Gibr"
            GOTO Tip
          CASE 4
            Pout1$ = "Detl=Cach"
            GOTO Tip
          CASE 5
            Pout1$ = "Det=C-Lom"
            GOTO Tip
          CASE 6
            Pout1$ = "Det=BlwNr"
            GOTO Tip
```

```
         CASE 7
           Pout1$ = " SUMMARY "
           GOTO Tip
         CASE ELSE
           Pout1$ = "WRONG ##!"
         END SELECT
p:       SELECT CASE MenuVal!(6, 3)
         CASE 1
           Pout2$ = "JuncShort"
           GOTO Tsip
         CASE 2
           Pout2$ = "BaseShort"
           GOTO Tsip
         CASE 3
           Pout2$ = "GibrShort"
           GOTO Tsip
         CASE 4
           Pout2$ = "CachShort"
           GOTO Tsip
         CASE 5
           Pout2$ = "CombinedS"
           GOTO Tsip
         CASE 6
           Pout2$ = "CacInflow"
           GOTO Tsip
         CASE 7
           Pout2$ = "Q SnLucas"
           GOTO Tsip
         CASE 8
           Pout2$ = "Q AlisalB"
           GOTO Tsip
         CASE 9
           Pout2$ = "Q Bend WB"
           GOTO Tsip
         CASE 10
           Pout2$ = "Q AbvSals"
           GOTO Tsip
         CASE 11
           Pout2$ = "Q Narrows"
           GOTO Tsip
         CASE 12
           Pout2$ = "Q Floradl"
           GOTO Tsip
         CASE 13
           Pout2$ = "Cach Stor"
           GOTO Tsip
         CASE 14
           Pout2$ = "Cach Elev"
           GOTO Tsip
         CASE 15
           Pout2$ = "Cach Area"
           GOTO Tsip
         CASE 16
           Pout2$ = "No Table!"
           GOTO Tsip
         CASE ELSE
           Pout2$ = "WRONG ##!"
         END SELECT
Tsip:    SELECT CASE MenuVal!(6, 5)
         CASE 1
           Pout3$ = "JunDelRnk"
           GOTO Pyp
         CASE 2
           Pout3$ = "BasDelRnk"
           GOTO Pyp
         CASE 3
           Pout3$ = "GibDelRnk"
           GOTO Pyp
         CASE 4
           Pout3$ = "CacDelRnk"
           GOTO Pyp
         CASE 5
           Pout3$ = "ComDelRnk"
           GOTO Pyp
         CASE 6
           Pout3$ = "HydroGrph"
           GOTO Pyp
         CASE 7
           Pout3$ = "HydroGph2"
           GOTO Pyp
         CASE 8
           Pout3$ = "RankQJunc"
           GOTO Pyp
         CASE 9
           Pout3$ = "RankQGibr"
```

```
          GOTO Pyp
        CASE 10
          Pout3$ = "RankQCach"
          GOTO Pyp
        CASE 11
          Pout3$ = "RankQLomp"
          GOTO Pyp
        CASE 12
          Pout3$ = "No Graph!"
          GOTO Pyp
        CASE ELSE
          Pout3$ = "WRONG ##!"
        END SELECT
Pyp:    LOCATE 19, 5
        COLOR 3
        PRINT USING Image4$; Res$(Row); Pout1$; Out1$; Pout2$; Out2$; Pout3$; Out3$
      END IF
    RETURN
Numbr: IF LEN(Num$) < 9 THEN Num$ = Num$ + A$
      GOSUB Locater
      PRINT "          "
      GOSUB Locater
      COLOR 8
      PRINT Num$
    RETURN
Locater: IF Row <= 3 THEN LOCATE Y + 4, 10 * (X - 1) + 16, 1, 0, 7
      IF Row = 4 THEN LOCATE 11, 10 * (X - 1) + 16, 1, 0, 7
      IF Row = 5 THEN LOCATE 15, 10 * (X - 1) + 16, 1, 0, 7
      IF Row = 6 THEN LOCATE 19, 10 * (X - 1) + 16, 1, 0, 7
    RETURN
END SUB
```

```
'INITIALIZE WITH MENU & OTHER VALUES...
DEFINT A-Z
SUB Initialize STATIC
    InitYr% = 1917
    NumYears% = 76
  JUNCAL DAM & TUNNEL
    Draft!(1) = MenuVal!(1, 3)
    JunStartShortage% = MenuVal!(1, 5)
    JunMinDelv! = MenuVal!(1, 6) / 100
    JunLowVol% = 500
    JunRedFac! = 1
    MaxElev!(1) = MenuVal!(1, 2)
    StartElev!(1) = MenuVal!(1, 1)
    Resv% = 1
    Elev7! = MaxElev!(1)
    Pointer%(1) = Elev7! - Datum%(1)
    AreaVolSet
    MaxVol!(1) = Volume7!
    IF MenuVal!(1, 4) = 1 THEN
      IF JunMinDelv! = 1 THEN Mode$(1) = "LakeSfYld" ELSE Mode$(1) = "LakeDraft"
      GOTO Gibr
    END IF
    IF JunMinDelv! = 1 THEN Mode$(1) = "L+T SfYld" ELSE Mode$(1) = "L+T Draft"
' GIBRALTAR DAM & TUNNEL
Gibr: Draft!(2) = MenuVal!(2, 3)
    MitigationFlag% = 1
    IF Draft!(2) <= 4580 THEN MitigationFlag% = 0
    GibStartShortage% = MenuVal!(2, 5)
    GibMinDelv! = MenuVal!(2, 6) / 100
    GibLowVol% = 0
    GibRedFac! = 1
    MaxElev!(2) = MenuVal!(2, 2)
    StartElev!(2) = MenuVal!(2, 1)
    Resv% = 2
    Elev7! = MaxElev!(2)
    Pointer%(2) = Elev7! - Datum%(2)
    AreaVolSet
    MaxVol!(2) = Volume7!
    IF MenuVal!(2, 4) = 1 THEN
      IF GibMinDelv! = 1 THEN Mode$(2) = "LakeSfYld" ELSE Mode$(2) = "LakeDraft"
      GOTO Cacr
    END IF
    IF GibMinDelv! = 1 THEN Mode$(2) = "L+T SfYld" ELSE Mode$(2) = "L+T Draft"
' CACHUMA DAM AND TUNNEL
Cacr: Draft!(3) = MenuVal!(3, 3) - MenuVal!(4, 1) - MenuVal!(4, 2) ' S. Coast.
    Draft!(4) = MenuVal!(4, 1)              ' ID#1 summer Ag distribution
    Draft!(5) = MenuVal!(4, 2)              ' Lompoc Pipeline distribution
    CacStartShortage! = MenuVal!(3, 5)
    CacMinDelv! = MenuVal!(3, 6) / 100
    CacLowVol% = 20000
    CacRedFac! = 1
    MaxElev!(3) = MenuVal!(3, 2)
    StartElev!(3) = MenuVal!(3, 1)
    Resv% = 3
    Elev7! = MaxElev!(3)
    Pointer%(3) = Elev7! - Datum%(3)
    AreaVolSet
    MaxVol!(3) = Volume7!
    IF MenuVal!(3, 4) = 1 THEN
      IF CacMinDelv! = 1 THEN Mode$(3) = "LakeSfYld" ELSE Mode$(3) = "LakeDraft"
      GOTO Rp
    END IF
    IF CacMinDelv! = 1 THEN Mode$(3) = "L+T SfYld" ELSE Mode$(3) = "L+T Draft"
' RIPARIAN
Rp: TotMI% = MenuVal!(4, 3)
    AgAcres% = MenuVal!(4, 4)
    AvAg! = 0
    FOR Yr% = 1 TO 76
      AgLandsPerc! = 0
      IF YrsRipRain!(Yr%) > 12.4 THEN
        AgLandsPerc! = .827 * AgAcres% * (YrsRipRain!(Yr%) - 12.4) / 12
      END IF
      AgrCU!(Yr%) = .56 * AgAcres% * (30 * (YrsRipEvap!(Yr%) / 70.44) + YrsRipRain!(Yr%)) / 12 - AgL
      AvAg! = AvAg! + AgrCU!(Yr%)
    NEXT Yr%
    AvAg! = AvAg! / 76
    Seed% = MenuVal!(4, 5)
    CsEff! = MenuVal!(4, 6)
    IF CsEff! < 0 THEN CsEff! = 0
    IF CsEff! > 1 THEN CsEff! = 1
    BeginDetPrint% = INT(MenuVal!(5, 1))
    NumDetYrs% = 100 * (MenuVal!(5, 1) - BeginDetPrint%)
    EndMoVol!(4) = MenuVal!(5, 2)
    Vrip! = EndMoVol!(4)
```

```
      MaxVol!(4) = 90000
      AboveNarrwAcct! = MenuVal!(5, 3)
      StartRelease% = MenuVal!(5, 4)
      BelowNarrwAcct! = MenuVal!(5, 5)
      StartRelBlw% = MenuVal!(5, 6)
      IF TotMI% + 1.5 * AgAcres% < 360 THEN
        TotMI% = 0
        AgAcres% = 0
        SyMI! = 0
        BuMI! = 0
        SyRed! = 1
        BuRed! = 1
        SeRed! = 1
        SwRed! = 1
        GOTO Rc
      END IF
      SyMI! = 1300 + 748! * (TotMI% - 2400) / 1683   'annual SY Subarea M&IDivs.
      BuMI! = 1100 + 935! * (TotMI% - 2400) / 1683 'annual Buel Subarea M&IDivs.
  Rc: UplandDepl% = 100     'monthly
      IF TotMI% + AgAcres% = 0 THEN UplandDepl% = 0
      UnderflowOut% = 125  'monthly
      ResvDet% = MenuVal!(6, 1)
      SELECT CASE ResvDet%
      CASE 1
        RunType$ = "Juncal"
        GOTO Nx
      CASE 2
        RunType$ = "BaseGib"
        GOTO Nx
      CASE 3
        RunType$ = "Gibraltar"
        GOTO Nx
      CASE 4
        RunType$ = "Cachuma"
        GOTO Nx
      CASE 5
        RunType$ = "AbvNarrows"
        GOTO Nx
      CASE 6
        RunType$ = "BlwNarrows"
        GOTO Nx
      CASE 7
        RunType$ = "Summary"
        GOTO Nx
      CASE ELSE
        ResvDet% = 7
        RunType$ = "Summary"
      END SELECT
  Nx: RunOut$ = "CRT"
      IF MenuVal!(6, 2) = 2 THEN RunOut$ = "EXT"
      SELECT CASE MenuVal!(6, 3)
      CASE 1
        TabType$ = "JuncShort"
        GOTO Ty
      CASE 2
        TabType$ = "BaseShort"
        GOTO Ty
      CASE 3
        TabType$ = "GibrShort"
        GOTO Ty
      CASE 4
        TabType$ = "CachShort"
        GOTO Ty
      CASE 5
        TabType$ = "CombinedS"
        GOTO Ty
      CASE 6
        TabType$ = "CacInflow"
        GOTO Ty
      CASE 7
        TabType$ = "Q SnLucas"
        GOTO Ty
      CASE 8
        TabType$ = "Q AlisalB"
        GOTO Ty
      CASE 9
        TabType$ = "Q Bend WB"
        GOTO Ty
      CASE 10
        TabType$ = "Q AbvSals"
        GOTO Ty
      CASE 11
        TabType$ = "Q Narrows"
        GOTO Ty
      CASE 12
```

```
      TabType$ = "Q Floradl"
      GOTO Ty
    CASE 13
      TabType$ = "Cach Stor"
      GOTO Ty
    CASE 14
      TabType$ = "Cach Elev"
      GOTO Ty
    CASE 15
      TabType$ = "Cach Area"
      GOTO Ty
    CASE 16
      TabType$ = "No Table!"
      GOTO Ty
    CASE ELSE
      MenuVal!(6, 3) = 9
      TabType$ = "No Table!"
    END SELECT
Ty: TabOut$ = "CRT"
    IF MenuVal!(6, 4) = 2 THEN TabOut$ = "EXT"
    SELECT CASE MenuVal!(6, 5)
    CASE 1
      GphType$ = "JuncShort"
      GOTO Zy
    CASE 2
      GphType$ = "BaseShort"
      GOTO Zy
    CASE 3
      GphType$ = "GibrShort"
      GOTO Zy
    CASE 4
      GphType$ = "CachShort"
      GOTO Zy
    CASE 5
      GphType$ = "CombinedS"
      GOTO Zy
    CASE 6
      GphType$ = "HydroGrph"
      GOTO Zy
    CASE 7
      GphType$ = "HydroGph2"
      GOTO Zy
    CASE 8
      GphType$ = "JunQRank"
      GOTO Zy
    CASE 9
      GphType$ = "GibQRank"
      GOTO Zy
    CASE 10
      GphType$ = "CacQRank"
      GOTO Zy
    CASE 11
      GphType$ = "LomQRank"
      GOTO Zy
    CASE 12
      GphType$ = "No Graph!"
      GOTO Zy
    CASE ELSE
      MenuVal!(6, 5) = 13
      GphType$ = "No Graph!"
    END SELECT
Zy: DAdd% = 12 * INT(MenuVal!(6, 6))
    IF DAdd% > 408 THEN DAdd% = 0
    IF DAdd% < 0 THEN DAdd% = 0
    FOR Resv% = 1 TO 3
      Elev7! = StartElev!(Resv%)
      AreaVolSet
      EndMoVol!(Resv%) = Volume7!
    NEXT Resv%
    Vjun! = EndMoVol!(1)
    Vgib! = EndMoVol!(2)
    Vcac! = EndMoVol!(3)
END SUB
```

```
'SYRM0298.BAS Main Yearly & Monthly Model
DEFINT A-Z
SUB Runmodel STATIC
DIM SYRSeep!(4), MinMo$(4), Vavg!(4), Eavg!(3), Aavg!(3), GibOrdDiv!(12)
DIM JunDiv!(12), GibDiv!(12), CacDiv!(3, 12), CacDemand!(12), MinVol!(4)
DIM AnnRunoff!(3), Area!(3), YrRainOnLake!(3), YrSpil!(3), Rsumr!(12)
DIM AnnShort!(3), Sworst!(3), YrLeak!(3), GibFldDiv!(12), PShortMinYr!(3)
DIM MinMo%(4), MinYr%(4), YrTunl!(3), YrDivs!(3), YrRels!(3), YrSysYld!(3)
DIM YrEvpo!(3), SumRunoff!(3), SumPrecip!(3), SumEvap!(3), SumDiv!(3)
DIM SumRel!(3), SumTunl!(3), SumSpill!(3), SumLeak!(3), SyDiv!(12), BuDiv!(12)
DIM ShortMon%(3), SumYld!(4), SumVol!(4), SumElv!(3), SumAre!(3)
DIM AnnJun!(76), AnnGib!(76), AnnCac!(76)
  CLS
  SCREEN ScrnType%       'Screen is 640 by 480 pixels
  PALETTE 0, 4144959     'Change Background from Black to White (0,15 is dark brown)
  COLOR 1                'Changes White Text to Black
  BkGnd% = 14            'Background Color
  Xmin! = 0
  Xmax! = 640
  Ymin! = 0
  Ymax! = 480
  VIEW (0, 0)-(639, 479), BkGnd%
  WINDOW (Xmin!, Ymin!)-(Xmax!, Ymax!)
  IF RunOut$ = "EXT" THEN
    SetPrinter
  END IF
  LOCATE 2, 3
  Timer$ = TIME$
  Dater$ = DATE$
  PRINT " SANTA YNEZ RIVER MODEL SYRM0298:", Timer$; ",   "; Dater$; "                  "
  RipFullSyn% = 20600 'Full Riparian Storages
  RipFullBuel% = 28300
  RipFullSRitaE& = 33900
  RipFullSRitaW% = 7200
    TempDewatStor! = 1! * RipFullSyn% + 1! * RipFullBuel% + 1! * RipFullSRitaE& + 1! * RipFullSRitaW
'   Beginning Riparian Storages are set below...
    EndRipStorSYn! = RipFullSyn% - .252 * TempDewatStor!
    EndRipStorBuel! = RipFullBuel% - .485 * TempDewatStor!
    EndRipStorSRitaE! = RipFullSRitaE& - .244 * TempDewatStor!
    EndRipStorSRitaW! = RipFullSRitaW% - .019 * TempDewatStor!
    TunFac! = Tunnel%(3, 1) / 170
  SyLast! = .125 * TunFac! * (RipFullSyn% - EndRipStorSYn!) - 460
  BuLast! = TunFac! * (.102 * (RipFullBuel% - EndRipStorBuel!) - 370)
  SeLast! = TunFac! * (.05 * (RipFullSRitaE& - EndRipStorSRitaE!) + 30)
  SwLast! = TunFac! * (0 * (RipFullSRitaW% - EndRipStorSRitaW!) + 20)
    Beta! = .66
    Alpha! = 1 / Beta!
  SYnPerc! = 30
  SYnStr! = 4500
  SYnSpMx! = 3000
    BuePerc! = 30
    BueStr! = 12000
    BueSpMx! = 2500
  SRitaEPerc! = 30
  SRitaEStr! = 11000
  SRitaESpMx! = 2000
    SRitaWPerc! = 30
    SRitaWStr! = 1000
    SRitaWSpMx! = 300
  TotDewatStor! = MaxVol!(4) - EndMoVol!(4)
  OperDewatStor% = 10000
  AccumRelease! = 0
  CumPhanRel! = 0
  EndPhanGCRel% = 0
  SavePhanRelPtr% = 0
  EndGinChowRel% = 0
  SaveRelPtr% = 0
  Adp! = 0
  Image$ = "\                    \####\                                              \"
  COLOR 6
  LOCATE 3, 3
  IF MaxElev!(3) = 750 THEN
    PRINT " Existing Cachuma Reservoir                                              "
   ELSE
    IF MaxElev!(3) < 750 THEN
      PRINT USING Image$; " Reduced Cachuma, with "; 750 - MaxElev!(3); " foot reduction in height.
     ELSE
      PRINT USING Image$; " Enlarged Cachuma, with"; MaxElev!(3) - 750; " foot raise.
    END IF
  END IF
  LOCATE 4, 3
  IF Seed% = 1 THEN
    PRINT USING "\                   \#.##\                                              \"; " Wi
   ELSE
```

```
  PRINT " No cloudseeding
END IF
PRINT "┌──────────────────────────────────────────────────────────────────────────────────────────────┐"
PRINT "│INITIAL RESRV/BASN CONDITIONS│MAXIMUM CONDITIONS│     DIVERSION INFORMATION       │"
PRINT "│Reservoir│WS Elev│Area│Volume│WSElev│Area│Volume│Divert To│    Mode     │SysDemand│"
PRINT "├─────────┼───────┼────┼──────┼──────┼────┼──────┼─────────┼─────────────┼─────────┤"
COLOR 8
IF RunOut$ = "EXT" THEN
  LPRINT " SANTA YNEZ RIVER MODEL SYRM0298:"
  IF MaxElev!(3) = 750 THEN
    LPRINT " Existing Cachuma Reservoir                                                        "
   ELSE
    IF MaxElev!(3) < 750 THEN
      LPRINT USING Image$; " Reduced Cachuma, with "; 750 - MaxElev!(3); " foot reduction in heigh
     ELSE
      LPRINT USING Image$; " Enlarged Cachuma, with"; MaxElev!(3) - 750; " foot raise.
    END IF
  END IF
  IF Seed% = 1 THEN
    LPRINT USING "\                         \#.##\                                                \"; "
   ELSE
    LPRINT " No cloudseeding                                                                   "
  END IF
  LPRINT "┌──────────────────────────────────────────────────────────────────────────────────────────────┐"
  LPRINT "│INITIAL RESRV/BASN CONDITIONS│MAXIMUM CONDITIONS│     DIVERSION INFORMATION       │"
  LPRINT "│Reservoir│WS Elev│Area│Volume│WSElev│Area│Volume│Divert To│    Mode     │SysDemand│"
  LPRINT "├─────────┼───────┼────┼──────┼──────┼────┼──────┼─────────┼─────────────┼─────────┤"
END IF
FOR Resv% = 1 TO 3
  ShortMon%(Resv%) = 0
  SumRunoff!(Resv%) = 0
  SumPrecip!(Resv%) = 0
  SumEvap!(Resv%) = 0
  SumLeak!(Resv%) = 0
  SumDiv!(Resv%) = 0
  SumRel!(Resv%) = 0
  SumTunl!(Resv%) = 0
  SumSpill!(Resv%) = 0
  SumYld!(Resv%) = 0
  SumVol!(Resv%) = 0
  SumElv!(Resv%) = 0
  SumAre!(Resv%) = 0
  Sworst!(Resv%) = 0
  PShortMinYr!(Resv%) = 1
  MinVol!(Resv%) = 10000000
  IF Resv% = 2 THEN
    PhanShortCtr% = 0
    PhanWorst! = 0
    PhanMinPcnt! = 1
    PhanMinVol! = 10000000
    SumPhanRnf! = 0
    SumPhanROL! = 0
    SumPhanEvp! = 0
    SumPhanDiv! = 0
    SumPhanRel! = 0
    SumPhanSpl! = 0
    SumPhanYld! = 0
    SumPhanVol! = 0
    SumPhanElv! = 0
    SumPhanAre! = 0
    PhanDatum% = 1345
    PhanPointer% = 52
    PhanElev! = 1400
    GOSUB PhanAVSet
    Em! = PhanElev!
    Am! = PhanArea!
    Vm! = PhanVol!
    PhanElev! = 1397.8
    GOSUB PhanAVSet
    LastVol! = PhanVol!
    LastArea! = PhanArea!
    PRINT USING Image$(4); "BaseGibrl"; PhanElev!; PhanArea!; PhanVol!; Em!; Am!; Vm!; "PhantCity"
    IF RunOut$ = "EXT" THEN LPRINT USING Image$(4); "BaseGibrl"; PhanElev!; PhanArea!; PhanVol!; E
  END IF
  Elev7! = MaxElev!(Resv%)
  AreaVolSet
  Em! = Elev7!
  Am! = Area7!
  Vm! = Volume7!
  Elev7! = StartElev!(Resv%)
  AreaVolSet
  Area!(Resv%) = Area7!
  Temp = 0
  IF Resv% = 3 THEN Temp = Draft!(4) + Draft!(5)
  PRINT USING Image$(4); Name$(Resv%); Elev7!; Area!(Resv%); EndMoVol!(Resv%); Em!; Am!; Vm!; User
```

```
  IF RunOut$ = "EXT" THEN LPRINT USING Image$(4); Name$(Resv%); Elev7!; Area!(Resv%); EndMoVol!(Re
NEXT Resv%
LastEl! = StartElev!(3)
MinVol!(4) = 10000000
SumUnimpRunoff! = 0
SumRunoffDepl! = 0
SumBankDepl! = 0
SumMICU! = 0
SumAgCU! = 0
SumRivPerc! = 0
SumBank! = 0
SumUndrFlow! = 0
SumNarrowsQ! = 0
SumAbvNrwsAcct! = 0
SumDewatStor! = 0
SumVol!(4) = 0
SumCalcPerc! = 0
SumCalcQIncr! = 0
SumConstNarwQ! = 0
SumConstPerc! = 0
SumBelowNarwRel! = 0
SumBelowNrwsSat! = 0
SumQFlor! = 0
SumBelowNarwCred! = 0
SumBnRedu! = 0
SumBelowNarwAcct! = 0
LastMonthsSpill! = 0
LastMoLive! = 0
SwitchThresh! = 200000
CurveSpan! = LOG(500000) - LOG(1000)
Aspan! = -402.581
Bspan! = .03807
Kspan! = -226.68
A1K! = 324.32
B1K! = -.19459
K1K! = 520.67
Aon! = 547.05
Bon! = .003166
Kon! = 679.66
LOG1000! = LOG(1000)
Ordvol! = PhanVol! - 2500
Fldvol! = 2500
COLOR 4
PRINT "╒═════════╤═══════════╤═══════════╤════════╤═══════╤══════════╤═════════╤══════════╤════════════╕"
PRINT "│Begining│    A b o v e   N a r r o w s   R i p a r i a n    │Lompoc│BelowNarrows│"
PRINT "│Cachuma-│  Storage  │FullVolume│  Ag CU│M&I CU│  Strel│Accnt│ Pipe│  Strel│Acct│"
COLOR 8
PRINT USING Image$(1); EndMoVol!(4); MaxVol!(4); AvAg!; TotMI; StartRelease%; AboveNarrwAcct!; Dra
COLOR 6
PRINT "╞═════════╪═══════════╪═══════════╪════════╪═══════╪══════════╪═════════╪══════════╪════════════╡"
PRINT "│JunRedPt│%YrsDel@│LowPtAF║GibRedPt│%YrsDel@│LowPtAF║CacRedPt│%YrsDel@│LowPt AF│"
COLOR 8
PRINT USING Image$(3); JunStartShortage%; JunMinDelv! * 100; JunLowVol%; GibStartShortage%; GibMin
COLOR 6
PRINT "╘═════════╧═══════════╧═══════════╧════════╧═══════╧══════════╧═════════╧══════════╧════════════╛"
IF RunOut$ = "EXT" THEN
  LPRINT "╒═════════╤═══════════╤═══════════╤════════╤═══════╤══════════╤═════════╤══════════╤════════════╕"
  LPRINT "│Begining│    A b o v e   N a r r o w s   R i p a r i a n    │Lompoc│BelowNarrows│"
  LPRINT "│Cachuma-│  Storage  │FullVolume│  Ag CU│M&I CU│  Strel│Accnt│ Pipe│  Strel│Acct│"
  LPRINT USING Image$(1); EndMoVol!(4); MaxVol!(4); AvAg!; TotMI; StartRelease%; AboveNarrwAcct!;
  LPRINT "╞═════════╪═══════════╪═══════════╪════════╪═══════╪══════════╪═════════╪══════════╪════════════╡"
  LPRINT "│JunRedPt│%YrsDel@│LowPtAF║GibRedPt│%YrsDel@│LowPtAF║CacRedPt│%YrsDel@│LowPt AF│"
  LPRINT USING Image$(3); JunStartShortage%; JunMinDelv! * 100; JunLowVol%; GibStartShortage%; Gib
  LPRINT "╘═════════╧═══════════╧═══════════╧════════╧═══════╧══════════╧═════════╧══════════╧════════════╛"
END IF
IF RunType$ = "Summary" THEN LOCATE 13, 35: COLOR 3: PRINT " Computing "
TotalDraft!(1) = Draft!(1)
TotalDraft!(2) = Draft!(2)
TotalDraft!(3) = Draft!(3) + Draft!(4) + Draft!(5)
TotalDraft!(4) = Draft!(1) + Draft!(2) + Draft!(3) + Draft!(4) + Draft!(5)
FOR WtrYrMo% = 1 TO 12
  JunDiv!(WtrYrMo%) = Draft!(1) * Pcnt%(1, WtrYrMo%) / 1000
  GibDiv!(WtrYrMo%) = Draft!(2) * Pcnt%(2, WtrYrMo%) / 1000
  GibOrdDiv!(WtrYrMo%) = 4189! * Pcnt%(2, WtrYrMo%) / 1000
  GibFldDiv!(WtrYrMo%) = 3089! * Pcnt%(2, WtrYrMo%) / 1000
  CacDiv!(1, WtrYrMo%) = Draft!(3) * Pcnt%(3, WtrYrMo%) / 1000
  CacDiv!(2, WtrYrMo%) = Draft!(4) * Pcnt%(4, WtrYrMo%) / 1000
  CacDiv!(3, WtrYrMo%) = Draft!(5) * Pcnt%(5, WtrYrMo%) / 1000
  CacDemand!(WtrYrMo%) = CacDiv!(1, WtrYrMo%) + CacDiv!(2, WtrYrMo%) + CacDiv!(3, WtrYrMo%)
  SyDiv!(WtrYrMo%) = SyMI! * Pcnt%(6, WtrYrMo%) / 1000
  BuDiv!(WtrYrMo%) = BuMI! * Pcnt%(6, WtrYrMo%) / 1000
NEXT WtrYrMo%
SYRSeep!(1) = 0
SYRSeep!(2) = 0
SYRSeep!(3) = 0
```

```
    SYRSeep!(4) = 0
    DAdder% = 0
    Lastflddiv! = 0
    BNAFlag% = 0
    CarryOverRel! = 0
    AccumRelease! = 0
    PhanRelDone% = 0
    RelDone% = 0
    BNAFlag% = 0
    FOR I% = 1 TO 12
      Rsumr!(I%) = Rsum!(I%)
    NEXT I%
    LOCATE 20, 1
'==================== BEGIN ANNUAL LOOP =====================
    FOR Yr% = 1918 TO 1993
      IF Yr% = 1952 THEN
        DAdder% = DAdd%
      END IF
      IF RunType$ = "Summary" THEN GOTO 2970
      IF Yr% < BeginDetPrint% THEN GOTO 2970
      IF Yr% >= BeginDetPrint% + NumDetYrs% THEN GOTO 2970
      COLOR 1
      PRINT USING Image$(5); " Oct-Sep Water Year = "; Yr% - 1; "-"; Yr% - 1900; "    (flagged for mon
      IF RunOut$ = "EXT" THEN LPRINT USING Image$(5); " Oct-Sep Water Year = "; Yr% - 1; "-"; Yr% - 19
      SELECT CASE RunType$
      CASE "AbvNarrows"
        COLOR 4
        PRINT "┌──────┬──────┬────┬────┬────┬─────┬─────┬─────┬────┬──────┬──┬──────────────────────┐"
        PRINT "│C-Lom │Unimpr│Runf│Bank│Ripr│Agric│River│Bank&│Undr│Narrow│Lv│    MONTHS ENDING     │"
        PRINT "│Riprn │runoff│depl│depl│divs│ C.U.│perc.│Phrea│flow│outflw│fl│  ANA  │  Tds │Volum │"
        PRINT "├──────┼──────┼────┼────┼────┼─────┼─────┼─────┼────┼──────┼──┼───────┼──────┼──────┤"
        IF RunOut$ = "EXT" THEN
          LPRINT "┌──────┬──────┬────┬────┬────┬─────┬─────┬─────┬────┬──────┬──┬──────────────────────┐"
          LPRINT "│C-Lom │Unimpr│Runf│Bank│Ripr│Agric│River│Bank&│Undr│Narrow│Lv│    MONTHS ENDING     │"
          LPRINT "│Riprn │runoff│depl│depl│divs│ C.U.│perc.│Phrea│flow│outflw│fl│  ANA  │  Tds │Volum │"
          LPRINT "├──────┼──────┼────┼────┼────┼─────┼─────┼─────┼────┼──────┼──┼───────┼──────┼──────┤"
        END IF
        GOTO 2970
      CASE "BlwNarrows"
        COLOR 5
        PRINT "┌───────┬──────┬─────┬──────┬────────┬─────┬─────┬─────┬────────┬─────┬────┬─────┐"
        PRINT "│BelwNar│Rnoff@│Calcd│Calcld│Cnstrcv │Cnstr│BlwNr│RelTo│ Calc'd │BlwNr│ BNA│ BNA │"
        PRINT "│Subarea│Narrws│Percl│ Qincr│NarrwsQ │Percl│Reles│Nrrws│QFlorAv │Credt│Redu│Accnt│"
        PRINT "├───────┼──────┼─────┼──────┼────────┼─────┼─────┼─────┼────────┼─────┼────┼─────┤"
        IF RunOut$ = "EXT" THEN
          LPRINT "┌───────┬──────┬─────┬──────┬────────┬─────┬─────┬─────┬────────┬─────┬────┬─────┐"
          LPRINT "│BelwNar│Rnoff@│Calcd│Calcld│Cnstrcv │Cnstr│BlwNr│RelTo│ Calc'd │BlwNr│ BNA│ BNA │"
          LPRINT "│Subarea│Narrws│Percl│ Qincr│NarrwsQ │Percl│Reles│Nrrws│QFlorAv │Credt│Redu│Accnt│"
          LPRINT "├───────┼──────┼─────┼──────┼────────┼─────┼─────┼─────┼────────┼─────┼────┼─────┤"
        END IF
        GOTO 2970
      CASE ELSE
        COLOR 6
        PRINT "┌─────┬─────────────────┬────┬──────┬─────┬─────┬──────┬─────┬──────────────────────┐"
        PRINT "│RESRV│MONTH & YEARS VALS│Leak│Piped │Dwnsr│Tunl │Resrvr│Systm│    MONTHS ENDING     │"
        PRINT "│" + ShortName$(ResvDet%) + "│runoff│precp│evapo│-age│divrt│reles│infl│spills│yield│ WS
        PRINT "├─────┼─────────────────┼────┼──────┼─────┼─────┼──────┼─────┼─────┼────┼──────┼─────┤"
        IF RunOut$ = "EXT" THEN
          LPRINT "┌─────┬─────────────────┬────┬──────┬─────┬─────┬──────┬─────┬──────────────────────┐"
          LPRINT "│RESRV│MONTH & YEARS VALS│Leak│Piped │Dwnsr│Tunl │Resrvr│Systm│    MONTHS ENDING     │"
          LPRINT "│" + ShortName$(ResvDet%) + "│runoff│precp│evapo│-age│divrt│reles│infl│spills│yield│
          LPRINT "├─────┼─────────────────┼────┼──────┼─────┼─────┼──────┼─────┼─────┼────┼──────┼─────┤"
        END IF
      END SELECT
2970 FOR Resv% = 1 TO 3
        AnnRunoff!(Resv%) = 0
        YrLeak!(Resv%) = 0
        Vavg!(Resv%) = 0
        Eavg!(Resv%) = 0
        Aavg!(Resv%) = 0
        YrTunl!(Resv%) = 0
        YrDivs!(Resv%) = 0
        YrRels!(Resv%) = 0
        YrSysYld!(Resv%) = 0
        YrSpil!(Resv%) = 0
        YrRainOnLake!(Resv%) = 0
        YrEvpo!(Resv%) = 0
        AnnShort!(Resv%) = 0
      NEXT Resv%
      YrPhanRol! = 0
      YrPhanEvp! = 0
      YrPhanDiv! = 0
      YrPhanRel! = 0
      YrPhanSpl! = 0
      YrPhanYld! = 0
```

```
      YrPhanShort! = 0
      PhanAvgVol! = 0
      PhanAvgElv! = 0
      PhanAvgAre! = 0
      PhanVol! = LastVol!
      PhanArea! = LastArea!
      YrUnimpRunoff! = 0 'annual accumulators
      YrRunoffDepl! = 0
      YrBankDepl! = 0
      YrMICU! = 0
      YrAgCU! = 0
      YrRivPerc! = 0
      YrBank! = 0
      YrUnderFlow! = 0
      YrNarrowsQ! = 0
      YrAbvNrwsAcct! = 0
      YrTotDewatStor! = 0
      Vavg!(4) = 0
      YrCalcPerc! = 0
      YrCalcQincr! = 0
      YrConstNrwsQ! = 0
      YrConstPerc! = 0
      YrBelowNrwsRel! = 0
      YrBelowNrwsSat! = 0
      YrQFlor! = 0
      CumlNarrowsQ! = 0
      CumlConstNrwsQ! = 0
      YrBelowNrwsCred! = 0
      YrBnRedu! = 0
      YrBelowNrwsAcct! = 0
      CsFac! = CsEff!
      JpSum! = 0
      Gpsum! = 0
      CpSum! = 0
      LpSum! = 0
      SpSum! = 0
      Yn% = Yr% - 1917
      AnnJun!(Yn%) = 0
      AnnGib!(Yn%) = 0
      AnnCac!(Yn%) = 0
  '------------------ THIS BEGINS MONTHLY LOOP ------------------
    FOR WtrYrMo% = 1 TO 12
      Mo% = 12 * (Yr% - 1918) + WtrYrMo% - DAdder%
      Leakg! = 0
      BelowNrwsRel! = 0
      IF WtrYrMo% = 3 THEN BNAFlag% = 0
      CsFlag% = Seed%
      IF CsFac! < CsEff! - .01 THEN CsFlag% = 0
      IF WtrYrMo% < 3 THEN CsFlag% = 0
      IF WtrYrMo% > 7 THEN CsFlag% = 0
      IF WtrYrMo% > 8 THEN
        IF EndMoVol!(1) < JunStartShortage% THEN
          JunRedFac! = (EndMoVol!(1) - JunLowVol% + JunMinDelv! * (JunStartShortage% - EndMoVol!(1)))
          IF JunRedFac! < 0 THEN JunRedFac! = 0
          IF JunRedFac! < PShortMinYr!(1) THEN PShortMinYr!(1) = JunRedFac!
        END IF
        IF EndMoVol!(2) < GibStartShortage% THEN
          GibRedFac! = (EndMoVol!(2) - GibLowVol% + GibMinDelv! * (GibStartShortage% - EndMoVol!(2)))
          IF GibRedFac! < 0 THEN GibRedFac! = 0
          IF GibRedFac! < PShortMinYr!(2) THEN PShortMinYr!(2) = GibRedFac!
        END IF
        IF EndMoVol!(3) < CacStartShortage! THEN
          CacRedFac! = (EndMoVol!(3) - CacLowVol% + CacMinDelv! * (CacStartShortage! - EndMoVol!(3)))
          IF CacRedFac! < 0 THEN CacRedFac! = 0
          IF CacRedFac! < PShortMinYr!(3) THEN PShortMinYr!(3) = CacRedFac!
        END IF
      END IF
      IF JunRedFac! < 1 THEN
        IF EndMoVol!(1) > JunStartShortage% THEN JunRedFac! = 1
      END IF
      SELECT CASE Mode$(1)
      CASE "LakeSfYld"
  Dj:   JDiv! = JunDiv!(WtrYrMo%)
        GOTO Gb
      CASE "LakeDraft"
        JDiv! = JunRedFac! * JunDiv!(WtrYrMo%)
        GOTO Gb
      CASE "L+T SfYld"
        JDiv! = JunDiv!(WtrYrMo%) - Tunnel%(1, Mo%)
        GOTO Gb
      CASE "L+T Draft"
        JDiv! = JunRedFac! * JunDiv!(WtrYrMo%) - Tunnel%(1, Mo%)
        GOTO Gb
      CASE ELSE
        GOTO Dj
```

```
      END SELECT
Gb:   IF GibRedFac! < 1 THEN
        IF EndMoVol!(2) > GibStartShortage% THEN GibRedFac! = 1
      END IF
      SELECT CASE Mode$(2)
      CASE "LakeSfYld"
 j:     GDiv! = GibDiv!(WtrYrMo%)
        GOTO Ca
      CASE "LakeDraft"
        GDiv! = GibRedFac! * GibDiv!(WtrYrMo%)
        GOTO Ca
      CASE "L+T SfYld"
        GDiv! = GibDiv!(WtrYrMo%) - Tunnel%(2, Mo%)
        GOTO Ca
      CASE "L+T Draft"
        GDiv! = GibRedFac! * GibDiv!(WtrYrMo%) - Tunnel%(2, Mo%)
        GOTO Ca
      CASE ELSE
        GOTO Dg
      END SELECT
Ca:   IF CacRedFac! < 1 THEN
        IF EndMoVol!(3) > CacStartShortage! THEN CacRedFac! = 1
      END IF
      SELECT CASE Mode$(3)
      CASE "LakeSfYld"
Dc:     CDiv! = CacDemand!(WtrYrMo%)
        GOTO Juncal
      CASE "LakeDraft"
        CDiv! = CacRedFac! * CacDemand!(WtrYrMo%)
        GOTO Juncal
      CASE "L+T SfYld"
        CDiv! = CacDemand!(WtrYrMo%) - Tunnel%(3, Mo%)
        GOTO Juncal
      CASE "L+T Draft"
        CDiv! = CacRedFac! * CacDemand!(WtrYrMo%) - Tunnel%(3, Mo%)
        GOTO Juncal
      CASE ELSE
        GOTO Dc
      END SELECT
' - - - - - - - - - - - Juncal Reservoir Section - - - - - - -
Juncal: Resv% = 1
      UpStrmSpill! = 0
      RegulRelease! = 0
      RunoffInc! = 0
      RainInc! = 0
      IF CsFlag% = 1 THEN
        V7! = 100! * (Accret%(1, Mo%) + Accret%(2, Mo%) + Accret%(3, Mo%)) - (MaxVol!(1) - EndMoVol!(1
        IF V7! > MaxVol!(3) THEN
Zap:      CsFlag% = 0
          GOTO Nrj
        END IF
        IF Accret%(2, Mo%) > 600 THEN
          CsFac! = CsFac! * (1000 - Accret%(2, Mo%)) / 400
          IF CsFac! <= 0 THEN GOTO Zap
        END IF
        X! = JpSum! + Rain%(1, Mo%) / 300
        RainInc! = CsFac! * CsInc%(1, Mo%)
        IF X! < 9 THEN GOTO Nrj
        Slope! = 2 * JunPar!(1, Yn%) * X! + JunPar!(2, Yn%)
        IF Slope! <= 0 THEN GOTO Nrj
        IF Slope! >= .95 THEN Slope! = .95
        RunoffInc! = 7.413 * RainInc! * Slope!
      END IF
Nrj:  JpSum! = JpSum! + (Rain%(1, Mo%) + RainInc!) / 100
      Accr! = 100! * Accret%(Resv%, Mo%) + RunoffInc!
      Rainer! = Rain%(1, Mo%) + RainInc!
      JGa! = 100! * Accret%(2, Mo%) + 10 * RunoffInc!
      Rainer! = Rain%(1, Mo%) + RainInc!
      Tunnl% = Tunnel%(Resv%, Mo%)
      Rsumr!(WtrYrMo%) = JGa!
      Sumi! = 0
      FOR K% = 1 TO 12
        Sumi! = Sumi! + Rsumr!(K%)
      NEXT K%
      SmallRel! = 0
      SmallRelOut! = 0
      GOTO F
      Idli! = Sumi! / 2000
      IF Idli! > 25 THEN Idli! = 25
      Alder! = .3 * SQR(JGa!) + Idli!
      IF Alder! > 100 THEN Alder! = 100
      IF JGa! > 30000 THEN Alder! = 0
      Fox! = .00092 * JGa! + Idli!
      IF JGa! > 10000 THEN Fox! = 0
      IF Fox! > .5 * Tunnl% THEN Fox! = .5 * Tunnl%
```

```
    SmallRel! = Alder! + Fox!
F:  IF SmallRel! < .5 THEN
      SmallRel! = 0
      Alder! = 0
      Fox! = 0
    END IF
    TabValue!(1, Mo% + DAdder%) = SmallRel!
    Inflow! = Accr! - Alder!
    IF Inflow! < 0 THEN Inflow! = 0
    AnnRunoff!(Resv%) = AnnRunoff!(Resv%) + Inflow!
    Tunnl% = Tunnel%(Resv%, Mo%) - Fox!
    LakeDiv! = JDiv! - Alder!
    RegulRelease! = SmallRel!
Junset: GOSUB Reservoir
    SmallRelOut! = 0
    ReachesGib! = 0
    IF RegulRelease! > 0 THEN
      GOSUB JunGib
      ReachesGib! = SmallRelOut!
    END IF
    VolGrph!(Resv%, Mo% + DAdder%) = Volume7!
    SELECT CASE Mode$(1)
    CASE "LakeSfYld"
J1:   JunShort! = JunDiv!(WtrYrMo%) - LakeDiv!
      GOTO Fj
    CASE "LakeDraft"
      GOTO J1
    CASE "L+T SfYld"
J2:   JunShort! = JunDiv!(WtrYrMo%) - (LakeDiv! + Tunnl%)
      GOTO Fj
    CASE "L+T Draft"
      GOTO J2
    CASE ELSE
      GOTO J1
    END SELECT
Fj: IF JunShort! > .001 THEN ShortMon%(1) = ShortMon%(1) + 1
    AnnShort!(Resv%) = AnnShort!(Resv%) + JunShort!
    TabValue!(1, Mo% + DAdder%) = JunShort!
    IF Yr% >= BeginDetPrint% THEN
      IF Yr% < BeginDetPrint% + NumDetYrs% THEN
        IF RunType$ = "Juncal" THEN GOSUB DetailPrint
      END IF
    END IF
    AnnJun!(Yn%) = AnnJun!(Yn%) + LakeDiv! + Tunnl%
    UpStrmSpill! = Spill!
' - - - - - - - - - - - Gibraltar Lake Section - - - - - - - -
Gibraltar: Resv% = 2
    RegulRelease! = 0
    RunoffInc! = 0
    RainInc! = 0
    IF CsFlag% = 1 THEN
      X! = Gpsum! + Rain%(2, Mo%) / 300
      RainInc! = CsFac! * CsInc%(2, Mo%)
      IF X! < 8 THEN GOTO Nrg
      Slope! = 2 * GibPar!(1, Yn%) * X! + GibPar!(2, Yn%)
      IF Slope! <= 0 THEN GOTO Nrg
      RunoffInc! = 107.73 * RainInc! * Slope!
    END IF
Nrg: Rainer! = Rain%(2, Mo%) + RainInc!
    Accr! = 100! * Accret%(Resv%, Mo%) + RunoffInc!
    Inflow! = UpStrmSpill! + Accr! + ReachesGib!
    AnnRunoff!(Resv%) = AnnRunoff!(Resv%) + Inflow!
    Tunnl% = Tunnel%(Resv%, Mo%)
' - - - - - - - - - - - Phantom ops start here - - - - - - - -
    Phanrel! = 0
    Qfld! = 0
    A! = 0
    Prc! = Rainer! / 100
    IF Prc! < 1.67 THEN GOTO Nf
    IF Prc! < 4 THEN
      IF Prc! < 3 THEN
        IF Gpsum! < 43 THEN GOTO Nf
        GOTO 508
      END IF
      IF Gpsum! < 25 THEN GOTO Nf
    END IF
508 IF WtrYrMo% > 8 THEN GOTO Nf
    IF Inflow! < 2900 THEN GOTO Nf
    Xer! = Gpsum! + Prc! / 2
    IF Xer! < 8 THEN
      IF Prc! < 9 THEN GOTO Nf
    END IF
    Slope! = (Inflow! / 11520) / Prc!
    A! = .5 * Slope! / (Xer! - 5.5)
    IF A! < .002 THEN GOTO Nf
```

```
    IF A! < .0045 THEN
      IF Prc! < 8 THEN GOTO Nf
    END IF
    Qfld! = Inflow! * .988
    IF Qfld! < 50000 THEN
      Qfld! = Qfld! * (.26 + .74 * Qfld! / 50000)
      IF Qfld! < 1587 THEN Qfld! = 1587
    END IF
Nf: Gpsum! = Gpsum! + Prc!
    Qord! = Inflow! - Qfld!
    Orddiv! = GibOrdDiv!(WtrYrMo%)
    Flddiv! = GibFldDiv!(WtrYrMo%)
    IF Lastflddiv! = 0 THEN Flddiv! = Flddiv! / 2
    Del! = 8567 - LastVol!
    IF Del! > Inflow! THEN Del! = Inflow!
    Fdays! = 0
    IF Qfld! > 0 THEN
      Fdays! = Qfld! / 7800
      IF Fdays! < 1 THEN Fdays! = 1
      Fldvol! = Fldvol! + Del! * (Qfld! / Inflow!) ^ 1.4 + Fdays! * (Orddiv! + Flddiv!) / 30 - Flddi
      GOTO 546
    END IF
    Fldvol! = Fldvol! - Flddiv!
546 IF Fldvol! < 0 THEN
      Flddiv! = Flddiv! + Fldvol!
      Fldvol! = 0
    END IF
    Ordvol! = Ordvol! - Orddiv!
    IF Ordvol! < 0 THEN
      Orddiv! = Orddiv! + Ordvol!
      Ordvol! = 0
    END IF
    PhanDiv! = Orddiv! + Flddiv!
    Prc! = Prc! * LastArea! / 12
    Evp! = .8 * Evap%(Resv%, Mo%) * LastArea! / 1200
    PhanVol! = LastVol! + Inflow! + Prc! - Evp! - PhanDiv!
    IF PhanRelDone% = 1 THEN GOTO PNr
    IF GinChowRelFlag%(WtrYrMo%) = 1 THEN
      IF WtrYrMo% = 9 THEN
        PhanLastMo% = 100 * Accret%(2, Mo% + 3)
        IF Yr% = 1993 THEN
          PhanPreCarry! = 0
         ELSE
          PhanPreCarry! = 100 * (Accret%(2, Mo% + 4) + Accret%(2, Mo% + 5))
          IF Accret%(2, Mo% + 3) > Accret%(2, Mo% + 2) THEN
            PhanPreCarry! = PhanPreCarry! + PhanLastMo%
            PhanLastMo% = 0
          END IF
          IF PhanPreCarry! > 616 THEN PhanPreCarry! = 616
        END IF
      END IF
      IF PhanVol! > 8515 THEN          '8515 Corresponds to Lake Elev 1399.82
        PhanFullCount% = PhanFullCount% + 1
        GOTO PNr
      END IF
      SELECT CASE WtrYrMo%
      CASE 9        ' June
        CumPhanRel! = Inflow! + PhanLastMo% + 100 * (Accret%(2, Mo% + 1) + Accret%(2, Mo% + 2))
PSetRl: IF CumPhanRel! > 616 THEN CumPhanRel! = 616
        Phanrel! = CumPhanRel! + PhanCarryOverRel!
        IF Phanrel! > 616 THEN
          PhanCarryOverRel! = PhanCarryOverRel! - (616 - CumPhanRel!)
          Phanrel! = 616
          GOTO PGibset
        END IF
PDone:  PhanCarryOverRel! = 0
        PhanRelDone% = 1
        GOTO PGibset
      CASE 10       ' July
        IF CumPhanRel! = 0 THEN
          CumPhanRel! = Inflow! + PhanLastMo% + 100 * Accret%(2, Mo% + 1)
          GOTO PSetRl
        END IF
PMoTwo: Phanrel! = PhanCarryOverRel!
        GOTO PDone
      CASE 11        ' August
        IF CumPhanRel! > .1 THEN GOTO PMoTwo
        CumPhanRel! = Inflow! + PhanLastMo%
        GOTO PSetRl
      CASE 12        ' September
        IF CumPhanRel! > .1 THEN GOTO PMoTwo
        CumPhanRel! = Inflow!
        GOTO PSetRl
      END SELECT
    END IF
```

```
PNr: IF WtrYrMo% = 2 THEN
        IF PhanFullCount% = 6 THEN
          PhanCarryOverRel! = 0
         ELSE
          PhanCarryOverRel! = 616 - CumPhanRel!
          IF PhanCarryOverRel! > PhanPreCarry! THEN PhanCarryOverRel! = PhanPreCarry!
        END IF
        PhanFullCount% = 0
        PhanPreCarry! = 0
        CumPhanRel! = 0
        PhanRelDone% = 0
      END IF
PGibset: PhanSpl! = 0
      IF Phanrel! = 0 THEN Phanrel! = ReachesGib!
      PhanVol! = LastVol! + Inflow! + Prc! - Evp! - PhanDiv! - Phanrel!
      IF PhanVol! < 0 THEN
        PhanRol! = Prc!
        PhanEvp! = Evp!
PhanEmpty: Part! = LastVol! / (LastVol! - PhanVol!)
        Orddiv! = Orddiv! * Part!
        Flddiv! = Flddiv! * Part!
        PhanDiv! = PhanDiv! * Part!
        Phanrel! = Phanrel! * Part!
        PhanRol! = PhanRol! * Part!
        PhanEvp! = PhanEvp! * Part!
        PhanPointer% = 1
        PhanVol! = 0
        PhanArea! = 0
        PhanElev! = PhanDatum%
        Ordvol! = 0
        Fldvol! = 0
        GOTO Phanset
      END IF
      IF PhanVol! > 8567 THEN PhanVol! = 8567
      GOSUB PhanAESet
      PhanRol! = (Prc! + Rainer! * PhanArea! / 1200) / 2
      PhanEvp! = (Evp! + .8 * Evap%(Resv%, Mo%) * PhanArea! / 1200) / 2
      PhanVol! = LastVol! + Inflow! + PhanRol! - PhanDiv! - Phanrel! - PhanEvp!
      IF PhanVol! < 0 THEN GOTO PhanEmpty
      IF PhanVol! > 8567 THEN
        PhanSpl! = PhanVol! - 8567
        PhanVol! = 8567
      END IF
      GOSUB PhanAESet
      Ordvol! = PhanVol! - Fldvol!
Phanset: Lastflddiv! = Flddiv!
      LastVol! = PhanVol!
      LastArea! = PhanArea!
      YrPhanDiv! = YrPhanDiv! + PhanDiv!
      YrPhanRel! = YrPhanRel! + Phanrel!
      YrPhanRol! = YrPhanRol! + PhanRol!
      YrPhanEvp! = YrPhanEvp! + PhanEvp!
      YrPhanSpl! = YrPhanSpl! + PhanSpl!
      YrPhanYld! = YrPhanYld! + PhanDiv! + Tunnl%
      PhanAvgVol! = PhanAvgVol! + PhanVol!
      PhanAvgElv! = PhanAvgElv! + PhanElev!
      PhanAvgAre! = PhanAvgAre! + PhanArea!
      IF PhanMinVol! > PhanVol! THEN
        PhanMinVol! = PhanVol!
        PhanMinMo% = WtrYrMo%
        PhanMinYr% = Yr%
        IF WtrYrMo% < 4 THEN PhanMinYr% = PhanMinYr% - 1
      END IF
      PhanFlag% = 1
      SmallRelOut! = 0
      IF Phanrel! > 0 THEN GOSUB GibCac
      PhanReachesCac! = SmallRelOut!
      PhnShort! = GibOrdDiv!(WtrYrMo%) + GibFldDiv!(WtrYrMo%) - PhanDiv!
      IF PhnShort! > .001 THEN
        YrPhanShort! = YrPhanShort! + PhnShort!
        PhanShortCtr% = PhanShortCtr% + 1
        Fracto! = PhanDiv! / (GibOrdDiv!(WtrYrMo%) + GibFldDiv!(WtrYrMo%))
        IF PhanMinPcnt! > Fracto! THEN PhanMinPcnt! = Fracto!
      END IF
      TabValue!(2, Mo% + DAdder%) = PhnShort!
      IF Yr% >= BeginDetPrint% THEN
        IF Yr% < BeginDetPrint% + NumDetYrs% THEN
          IF RunType$ = "BaseGib" THEN GOSUB DetailPrint
        END IF
      END IF
' - - - - - - - - - - - Phantom ops end here - - - - - - - - -
      LakeDiv! = GDiv!
      NetEvap! = Area!(2) * (Rainer! - .8 * Evap%(2, Mo%)) / 1200
      VolEst! = EndMoVol!(2) + Inflow! + NetEvap! - LakeDiv!
      IF MaxVol!(2) < 100 THEN GOTO Nr
```

```
      IF RelDone% = 1 THEN GOTO Nr
      IF GinChowRelFlag%(WtrYrMo%) = 1 THEN
        IF WtrYrMo% = 9 THEN
          LastMo% = 100 * Accret%(2, Mo% + 3)
          IF Yr% = 1993 THEN
            PreCarry! = 0
            GOTO Trl
          END IF
          PreCarry! = 100 * (Accret%(2, Mo% + 4) + Accret%(2, Mo% + 5))
          IF Accret%(2, Mo% + 3) > Accret%(2, Mo% + 2) THEN
            PreCarry! = PreCarry! + LastMo%
            LastMo% = 0
          END IF
          IF PreCarry! > 616 THEN PreCarry! = 616
        END IF
Trl:    IF VolEst! > 7590 THEN          '7590 Corresponds to Lake Elev 1399.82
          FullCount% = FullCount% + 1
          GOTO Nr
        END IF
        SELECT CASE WtrYrMo%
        CASE 9        ' June
          AccumRelease! = Inflow! + LastMo% + 100 * (Accret%(2, Mo% + 1) + Accret%(2, Mo% + 2))
SetRl:    IF AccumRelease! > 616 THEN AccumRelease! = 616
          RegulRelease! = AccumRelease! + CarryOverRel!
          IF RegulRelease! > 616 THEN
            CarryOverRel! = CarryOverRel! - (616 - AccumRelease!)
            RegulRelease! = 616
            GOTO Gibset
          END IF
Done:     CarryOverRel! = 0
          RelDone% = 1
          GOTO Gibset
        CASE 10       ' July
          IF AccumRelease! = 0 THEN
            AccumRelease! = Inflow! + LastMo% + 100 * Accret%(2, Mo% + 1)
            GOTO SetRl
          END IF
MoTwo:    RegulRelease! = CarryOverRel!
          GOTO Done
        CASE 11       ' August
          IF AccumRelease! > .1 THEN GOTO MoTwo
          AccumRelease! = Inflow! + LastMo%
          GOTO SetRl
        CASE 12       ' September
          IF AccumRelease! > .1 THEN GOTO MoTwo
          AccumRelease! = Inflow!
          GOTO SetRl
        END SELECT
      END IF
Nr:   IF WtrYrMo% = 2 THEN
        IF FullCount% = 6 THEN
          CarryOverRel! = 0
        ELSE
          CarryOverRel! = 616 - AccumRelease!
          IF CarryOverRel! > PreCarry! THEN CarryOverRel! = PreCarry!
        END IF
        FullCount% = 0
        PreCarry! = 0
        AccumRelease! = 0
        RelDone% = 0
      END IF
Gibset: IF RegulRelease! = 0 THEN RegulRelease! = ReachesGib!
      GOSUB Reservoir
      PhanFlag% = 0
      SmallRelOut! = 0
      ReachesCac! = 0
      JunReachesCac! = 0
      IF RegulRelease! > 0 THEN
        GOSUB GibCac
        ReachesCac! = SmallRelOut!
        JunReachesCac! = SmallRelOut! * ReachesGib! / RegulRelease!
      END IF
      VolGrph!(Resv%, Mo% + DAdder%) = Volume7!
      SELECT CASE Mode$(2)
      CASE "LakeSfYld"
G1:     GibShort! = GibDiv!(WtrYrMo%) - LakeDiv!
        GOTO Fg
      CASE "LakeDraft"
        GOTO G1
      CASE "L+T SfYld"
G2:     GibShort! = GibDiv!(WtrYrMo%) - (LakeDiv! + Tunnl%)
        GOTO Fg
      CASE "L+T Draft"
        GOTO G2
      CASE ELSE
```

```
      GOTO G1
    END SELECT
Fg: IF GibShort! > .001 THEN ShortMon%(2) = ShortMon%(2) + 1
    AnnShort!(Resv%) = AnnShort!(Resv%) + GibShort!
    TabValue!(3, Mo% + DAdder%) = GibShort!
     TabValue!(3, Mo% + DAdder%) = JunReachesCac!
    IF Yr% >= BeginDetPrint% THEN
      IF Yr% < BeginDetPrint% + NumDetYrs% THEN
        IF RunType$ = "Gibraltar" THEN GOSUB DetailPrint
      END IF
    END IF
    Correction! = 0
Cr: IF MitigationFlag% = 1 THEN
      Correction! = PhanSpl! - Spill! + PhanReachesCac! - ReachesCac!
      IF Correction! < 0 THEN Correction! = 0
    END IF
    UpStrmSpill! = Spill!
    AnnGib!(Yn%) = AnnGib!(Yn%) + LakeDiv! + Tunnl%
' - - - - - - - - - - - Lake Cachuma Section - - - - - - - - - -
Cachuma: Resv% = 3
    Live! = 0
    LivStrmFlg0% = 0
    LivStrmFlg1% = 0
    LivStrmFlg2% = 0
    LivStrmFlg3% = 0
    RunoffInc! = 0
    RainInc! = 0
    IF CsFlag% = 1 THEN
      X! = CpSum! + (Rain%(2, Mo%) + Rain%(3, Mo%)) / 600
      RainInc! = CsFac! * (CsInc%(2, Mo%) + CsInc%(3, Mo%)) / 2
      IF X! < 7 THEN GOTO Nrc
      Slope! = 2 * CacPar!(1, Yn%) * X! + CacPar!(2, Yn%)
      IF Slope! <= 0 THEN GOTO Nrc
      RunoffInc! = 107.2 * RainInc! * Slope!
    END IF
Nrc: CpSum! = CpSum! + (Rain%(2, Mo%) + Rain%(3, Mo%)) / 200 + RainInc! / 100
    Etbegin! = Area!(Resv%) * CachET%(Mo%) / 1200
    Accr! = 100! * Accret%(Resv%, Mo%) + RunoffInc!
    Inflow! = UpStrmSpill! + Accr! + Etbegin! + ReachesCac!
    Rainer! = Rain%(3, Mo%) + RainInc!
    RegulRelease! = 0
    Pfac! = 1
    IF MaxElev!(3) > 628 THEN
      IF DwnStrRelFlag%(WtrYrMo%) = 1 THEN
        IF LastMonthsSpill! > 500 THEN GOTO Nrel
        IF WtrYrMo% < 10 THEN
          IF Accret%(4, Mo%) >= 5 THEN GOTO Nrel
        END IF
        IF WtrYrMo% < 3 THEN
          IF Accret%(4, Mo%) >= 10 THEN GOTO Nrel
        END IF
        IF QFlor! < 120 THEN
          IF Salsi%(Mo%) = 0 THEN
            IF BelowNarrwAcct! > StartRelBlw% THEN
              IF BNAFlag% = 1 THEN
                IF AboveNarrwAcct! > 2500 THEN
                  BelowNrwsRel! = 1000 + BelowNarrwAcct!
                  IF BelowNrwsRel! > 3000 THEN BelowNrwsRel! = 3000
                  Pfac! = .5
                  IF TotDewatStor! > 14000 THEN Pfac! = .5 - (TotDewatStor! - 14000) / 30000
                  IF Pfac! < .3 THEN Pfac! = .3
                END IF
                GOTO Nrel          ' GOTO RelAbv is optional here...
              END IF
              IF AboveNarrwAcct! > 5000 THEN
                BelowNrwsRel! = 5200
                IF TotDewatStor! < 14000 THEN BelowNrwsRel! = 5200 - .3 * (14000 - TotDewatStor!)
                IF BelowNrwsRel! < 3400 THEN BelowNrwsRel! = 3400
                Pfac! = 1
                IF TotDewatStor! > 14000 THEN Pfac! = 1 - (TotDewatStor! - 14000) / 15000
                IF Pfac! < .6 THEN Pfac! = .6
                BNAFlag% = 1
                GOTO Nrel
              END IF
            END IF
          END IF
        END IF
 lAbv:  IF TotDewatStor! > StartRelease% THEN
          RegulRelease! = (TotDewatStor! - OperDewatStor%)
          IF RegulRelease! > AboveNarrwAcct! THEN RegulRelease! = AboveNarrwAcct!
          IF RegulRelease! > 4000 THEN RegulRelease! = 4000
          IF RegulRelease! > 1000 THEN Pfac! = 1.4
        END IF
      END IF
    END IF
```

```
Nrel: Tunnl% = Tunnel%(Resv%, Mo%)
    LakeDiv! = CDiv!
    IF MaxElev!(3) > 628 THEN
      IF LastEl! > MaxElev!(3) - 30 THEN
        BufPtr! = 2 * (MaxElev!(3) - LastEl!) + 1.5
        Leakg! = MoDays%(WtrYrMo%) * Leakage!(BufPtr!)
      END IF
    END IF
Cachset: GOSUB Reservoir
    AnnRunoff!(Resv%) = AnnRunoff!(Resv%) + Inflow!
    VolGrph!(Resv%, Mo% + DAdder%) = Volume7!
    TabValue!(13, Mo% + DAdder%) = Volume7!
    TabValue!(14, Mo% + DAdder%) = Elev7!
    TabValue!(15, Mo% + DAdder%) = Area7!
    SELECT CASE Mode$(3)
    CASE "LakeSfYld"
C1:   CacShort! = CacDemand!(WtrYrMo%) - LakeDiv!
      GOTO Fc
    CASE "LakeDraft"
      GOTO C1
    CASE "L+T SfYld"
C2:   CacShort! = CacDemand!(WtrYrMo%) - (LakeDiv! + Tunnl%)
      GOTO Fc
    CASE "L+T Draft"
      GOTO C2
    CASE ELSE
      GOTO C1
    END SELECT
Fc: IF CacShort! > .001 THEN ShortMon%(3) = ShortMon%(3) + 1
    AnnShort!(Resv%) = AnnShort!(Resv%) + CacShort!
    TabValue!(4, Mo% + DAdder%) = CacShort!
    TabValue!(5, Mo% + DAdder%) = JunShort! + GibShort! + CacShort!
    TabValue!(6, Mo% + DAdder%) = Inflow!
    IF Yr% >= BeginDetPrint% THEN
      IF Yr% < BeginDetPrint% + NumDetYrs% THEN
        IF RunType$ = "Cachuma" THEN GOSUB DetailPrint
      END IF
    END IF
    CachNetIn! = Inflow! + Correction! - Leakg!
    IF CachNetIn! < 25 THEN CachNetIn! = 25
    YrLeak!(Resv%) = YrLeak!(Resv%) + Leakg!
    LastEl! = Elev7!
    AnnCac!(Yn%) = AnnCac!(Yn%) + LakeDiv! + Tunnl%
' - - - - - - - - - - - Start Riparian Section - - - - - - - - -
    IF Spill! > 0 THEN LivStrmFlg0% = 1
    IF Accret%(4, Mo%) >= 10 THEN LivStrmFlg0% = 1
    IF (RegulRelease! + BelowNrwsRel! + Leakg!) > 120 THEN LivStrmFlg0% = 1
    LroInc! = 0
    LrnInc! = 0
    SroInc! = 0
    SrnInc! = 0
    IF CsFlag% = 1 THEN
      Lx! = LpSum! + .003 * Rain%(3, Mo%)
      Sx! = SpSum! + .00367 * Rain%(3, Mo%)
      LrnInc! = CsFac! * .9 * CsInc%(3, Mo%)
      SrnInc! = CsFac! * 1.1 * CsInc%(3, Mo%)
      IF Lx! < 7 THEN GOTO Chksal
      Lslope! = 2 * LomPar!(1, Yn%) * Lx! + LomPar!(2, Yn%)
      IF Lslope! <= 0 THEN GOTO Chksal
      LroInc! = 198.4 * LrnInc! * Lslope!
 Chksal: IF Sx! < 8 THEN GOTO Nrl
      Sslope! = 2 * SalPar!(1, Yn%) * Sx! + SalPar!(2, Yn%)
      IF Sslope! <= 0 THEN GOTO Nrl
      IF Sslope! >= .95 THEN Sslope! = .95
      SroInc! = 25.12 * SrnInc! * Sslope!
    END IF
 Nrl: LpSum! = LpSum! + (.9 * Rain%(3, Mo%) + LrnInc!) / 100
    SpSum! = SpSum! + (1.1 * Rain%(3, Mo%) + SrnInc!) / 100
    Accr! = 100! * Accret%(4, Mo%) + LroInc! - UplandDepl%
    Salsipuedes! = 100! * Salsi%(Mo%) + SroInc!
    BankDepl! = 0
    IF Accr! < 0 THEN
     BankDepl! = -Accr!
     Accr! = 0
    END IF
    Resid! = 0
    Accr! = Accr! - Salsipuedes!
    IF Accr! < 0 THEN
     Resid! = Accr!
     Accr! = 0
    END IF
    TabValue!(7, Mo% + DAdder%) = Spill! + RegulRelease! + BelowNrwsRel! + Leakg! + .021 * Accr!
    UnimpRunoff! = Spill! + RegulRelease! + BelowNrwsRel! + Leakg! + 100! * Accret%(4, Mo%) + LroInc
    YrUnimpRunoff! = YrUnimpRunoff! + UnimpRunoff!
    YrRunoffDepl! = YrRunoffDepl! + UplandDepl% - BankDepl!
```

```
    YrBankDepl! = YrBankDepl! + BankDepl!
    TunFac! = Tunnl% / 170!
    AgUseMo! = AgrCU!(Yn%) * AgDist!(WtrYrMo%)
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
SantaYnez:
    TempDewatStor! = RipFullSyn% - EndRipStorSYn!
    PercRate! = SYnPerc!
    IF TempDewatStor! < SYnStr! THEN PercRate! = SYnPerc! * TempDewatStor! / SYnStr!
    PercRate! = PercRate! * Pfac!
    Qin! = .22 * Accr! + Spill! + RegulRelease! + BelowNrwsRel! + Leakg!
    QAlisal! = 0
    IF Qin! ^ Beta! > (4.285 * PercRate!) THEN QAlisal! = (Qin! ^ Beta! - 4.285 * PercRate!) ^ Alpha
    Seep! = Qin! - QAlisal!
    IF Seep! > SYnSpMx! THEN
     QAlisal! = QAlisal! + (Seep! - SYnSpMx!)
     Seep! = SYnSpMx!
    END IF
    IF TempDewatStor! > 6000 THEN
     Bank! = .96 * SyLast!
     GOTO SySet
    END IF
    Bank! = .125 * TunFac! * TempDewatStor! - 460
    'IF Bank! > 0 THEN Bank! = SyRed! * Bank!
SySet:
    SyLast! = Bank!
    Bank7! = Bank!
    EndRipStorSYn! = EndRipStorSYn! + Seep! + Bank! - 75 - SyDiv!(WtrYrMo%) - .16 * AgUseMo! - .78 *
    IF EndRipStorSYn! <= RipFullSyn% THEN GOTO Buellton
    Delta! = EndRipStorSYn! - RipFullSyn%
    Seep! = Seep! - Delta!
    QAlisal! = QAlisal! + Delta!
    EndRipStorSYn! = RipFullSyn%
' - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Buellton:
    TabValue!(8, Mo% + DAdder%) = QAlisal! + .18 * Accr!
    VolGrph!(5, Mo% + DAdder%) = EndRipStorSYn!
    Sp7! = Seep!
    SYRSeep!(1) = SYRSeep!(1) + Seep!
    IF QAlisal! > 120 THEN LivStrmFlg1% = 2
    TempDewatStor! = RipFullBuel% - EndRipStorBuel!
    IF TempDewatStor! < 5000 THEN
      PercRate! = TempDewatStor! * .005 * BuePerc! / (BueStr! / 1000) ^ 2
      GOTO Buein
    END IF
    PercRate! = BuePerc!
    IF TempDewatStor! < BueStr! THEN PercRate! = BuePerc! * (TempDewatStor! / BueStr!) ^ 2
Buein: PercRate! = PercRate! * Pfac!
    Qin! = .48 * Accr! + QAlisal!
    QBend! = 0
    IF Qin! ^ Beta! > 2.932 * PercRate! THEN QBend! = (Qin! ^ Beta! - 2.932 * PercRate!) ^ Alpha!
    Seep! = Qin! - QBend!
    IF Seep! > BueSpMx! THEN
     QBend! = QBend! + (Seep! - BueSpMx!)
     Seep! = BueSpMx!
    END IF
    IF TempDewatStor! > 12000 THEN
     Bank! = .96 * BuLast!
     GOTO BuSet
    END IF
    Bank! = TunFac! * (.102 * TempDewatStor! - 370)
    ' IF Bank! > 0 THEN Bank! = BuRed! * Bank!
BuSet:
    BuLast! = Bank!
    Bank7! = Bank7! + Bank!
    EndRipStorBuel! = EndRipStorBuel! + Seep! + Bank! - BuDiv!(WtrYrMo%) - .36 * AgUseMo! - .1 * Ban
     IF EndRipStorBuel! <= RipFullBuel% THEN GOTO EastSantaRita
    Delta! = EndRipStorBuel! - RipFullBuel%
    Seep! = Seep! - Delta!
    QBend! = QBend! + Delta!
    EndRipStorBuel! = RipFullBuel%
' - - - - - - - - - - - - - - - - - - - - - - - - - -
EastSantaRita:
    TabValue!(9, Mo% + DAdder%) = QBend!
    VolGrph!(6, Mo% + DAdder%) = EndRipStorBuel!
    Sp7! = Sp7! + Seep!
    SYRSeep!(2) = SYRSeep!(2) + Seep!
    IF QBend! > 120 THEN LivStrmFlg2% = 4
    TempDewatStor! = RipFullSRitaE& - EndRipStorSRitaE!
    PercRate! = SRitaEPerc!
    IF TempDewatStor! < SRitaEStr! THEN PercRate! = SRitaEPerc! * (TempDewatStor! / SRitaEStr!) ^ 1.
    PercRate! = PercRate! * Pfac!
    Qin! = .27 * Accr! + QBend!
    QabvSalsi! = 0
    IF Qin! ^ Beta! > 5.789 * PercRate! THEN QAbvSalsi! = (Qin! ^ Beta! - 5.789 * PercRate!) ^ Alpha
    Seep! = Qin! - QabvSalsi!
```

```
    IF Seep! > SRitaESpMx! THEN
     QabvSalsi! = QabvSalsi! + (Seep! - SRitaESpMx!)
     Seep! = SRitaESpMx!
    END IF
    IF TempDewatStor! > 11000 THEN
     Bank! = .96 * SeLast!
     GOTO SRitaESet
    END IF
    Bank! = TunFac! * (.05 * TempDewatStor! + 30)
    ' IF Bank! > 0 THEN Bank! = SeRed! * Bank!
SRitaESet:
    SeLast! = Bank!
    Bank7! = Bank7! + Bank!
    EndRipStorSRitaE! = EndRipStorSRitaE! + Seep! + Bank! - 15 - .45 * AgUseMo! - .02 * BankDepl!
    IF EndRipStorSRitaE! <= RipFullSRitaE& THEN GOTO WestSantaRita
    Delta! = EndRipStorSRitaE! - RipFullSRitaE&
    Seep! = Seep! - Delta!
    QabvSalsi! = QabvSalsi! + Delta!
    EndRipStorSRitaE! = RipFullSRitaE&
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
WestSantaRita:
    TabValue!(10, Mo% + DAdder%) = QabvSalsi!
    VolGrph!(7, Mo% + DAdder%) = EndRipStorSRitaE!
    Sp7! = Sp7! + Seep!
    SYRSeep!(3) = SYRSeep!(3) + Seep!
    IF QabvSalsi! > 120 THEN LivStrmFlg3% = 8
    TempDewatStor! = RipFullSRitaW% - EndRipStorSRitaW!
    PercRate! = SRitaWPerc!
    IF TempDewatStor! < SRitaWStr! THEN PercRate! = SRitaWPerc! * (TempDewatStor! / SRitaWStr!) ^ 1.
    PercRate! = PercRate! * Pfac!
    Qin! = .015 * Accr! + QabvSalsi! + Salsipuedes! + Resid!
    QNarrows! = 0
    IF Qin! ^ Beta! > 1.128 * PercRate! THEN QNarrows! = (Qin! ^ Beta! - 1.128 * PercRate!) ^ Alpha!
    Seep! = Qin! - QNarrows!
    IF Seep! > SRitaWSpMx! THEN
     QNarrows! = QNarrows! + (Seep! - SRitaWSpMx!)
     Seep! = SRitaWSpMx!
    END IF
    IF TempDewatStor! > 3000 THEN
     Bank! = .96 * SwLast!
     GOTO SRitaWSet
    END IF
    Bank! = TunFac! * (0 * TempDewatStor! + 20)
    ' IF Bank! > 0 THEN Bank! = SwRed! * Bank!
SRitaWSet:
    SwLast! = Bank!
    Bank7! = Bank7! + Bank!
    EndRipStorSRitaW! = EndRipStorSRitaW! + Seep! + Bank! - 35 - .03 * AgUseMo! - .1 * BankDepl!
    IF EndRipStorSRitaW! <= RipFullSRitaW% THEN GOTO Fin
    Delta! = EndRipStorSRitaW! - RipFullSRitaW%
    Seep! = Seep! - Delta!
    QNarrows! = QNarrows! + Delta!
    EndRipStorSRitaW! = RipFullSRitaW%
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Fin:
    QNarrows! = QNarrows! + .015 * Accr!
    TabValue!(11, Mo% + DAdder%) = QNarrows!
    VolGrph!(8, Mo% + DAdder%) = EndRipStorSRitaW!
    Sp7! = Sp7! + Seep!
    SYRSeep!(4) = SYRSeep!(4) + Seep!
    YrBank! = YrBank! + Bank7!
    YrRivPerc! = YrRivPerc! + Sp7!
    YrMICU! = YrMICU! + SyDiv!(WtrYrMo%) + BuDiv!(WtrYrMo%)
    YrAgCU! = YrAgCU! + AgUseMo!
    YrUnderFlow! = YrUnderFlow! + UnderflowOut%
    TempDewatStor! = RipFullSyn% - EndRipStorSYn! + RipFullBuel% - EndRipStorBuel! + RipFullSRitaE&
    Live! = LivStrmFlg0% + LivStrmFlg1% + LivStrmFlg2% + LivStrmFlg3%
    Qin! = QNarrows!
    BelowNrwsSat! = 0
    IF BelowNrwsRel! > 0 THEN
      AboveNarrwAcct! = AboveNarrwAcct! + CachNetIn! - (BelowNrwsRel! - Qin!)
      BelowNarrwAcct! = BelowNarrwAcct! - Qin!
      QFlor! = 0
      Percl1! = Qin!
      Percl2! = 0
      BNRedu! = 0
      ConstNrwsQ! = 0
      Qincr! = 0
      BnCred! = 0
      BelowNrwsSat! = Qin!
      GOTO 5220
    END IF
    CumlQ! = CumlNarrowsQ!
    GOSUB Lompoc
    Percl1! = Percl!
```

```
     QFlor! = Qin! - Percl!
     IF QFlor! < 0 THEN QFlor! = 0
     IF Live! = 15 THEN
       IF Qin! > 200 THEN
         Qincr! = CachNetIn! - Spill! - RegulRelease!
         GOTO Bom                    'Bypass old method
       END IF
     END IF
     Qincr! = CachNetIn! + AboveNarrwAcct! - TempDewatStor! - Spill! - RegulRelease!
Bom: IF Qincr! < 0 THEN Qincr! = 0
     Qin! = QNarrows! + Qincr!
     CumlQ! = CumlConstNrwsQ!
     GOSUB Lompoc
5200 Percl2! = Percl!
     IF Percl2! < Percl1! THEN Percl2! = Percl1!
     BnCred! = Percl2! - Percl1!
     ConstNrwsQ! = Qin!
     Y! = 1
     IF Live! = 15 THEN
       Y! = 0
       IF LastMoLive! > 15 THEN
         IF QNarrows! >= 3000 THEN GOTO CalcLive
         IF WtrYrMo% = 1 THEN
           Ratio! = (LOG(.001) - LOG1000!) / CurveSpan!
           GOTO Fim
         END IF
         Ratio! = (LOG(CumlNarrowsQ!) - LOG1000!) / CurveSpan!
Fim:     A! = Ratio! * Aspan! + A1K!
         B! = Ratio! * Bspan! + B1K!
         K! = Ratio! * Kspan! + K1K!
         Y! = K! / (QNarrows! - A!) + B!
         IF Y! < 0 THEN Y! = 0
         IF Y! > 1 THEN Y! = 1
         GOTO CalcLive
       END IF
       IF QNarrows! < 1229 THEN
         Y! = 1
         GOTO CalcLive
       END IF
       Y! = Kon! / (QNarrows! - Aon!) + Bon!
     END IF
CalcLive: Live! = Live! + 16 * (1 - Y!)
     CachNetIn! = Y! * CachNetIn!
     IF MaxElev!(3) > 628 THEN
       AboveNarrwAcct! = AboveNarrwAcct! + CachNetIn! - RegulRelease!
       BelowNarrwAcct! = BelowNarrwAcct! + BnCred!
       BNRedu! = 0
       IF Spill! = 0 THEN GOTO 5220
       Decrease! = TotDewatStor! - TempDewatStor!
       IF Decrease! > 0 THEN
         IF Decrease! > Spill! THEN Decrease! = Spill!
         AboveNarrwAcct! = AboveNarrwAcct! - Decrease!
         SplRchingNrrws! = Spill! - Decrease!
         IF SplRchingNrrws! > 0 THEN
           IF SplRchingNrrws! > QNarrows! THEN SplRchingNrrws! = QNarrows!
           IF SplRchingNrrws! <= BelowNarrwAcct! THEN
             BNRedu! = SplRchingNrrws! * Percl1! / QNarrows!
             BelowNarrwAcct! = BelowNarrwAcct! - BNRedu!
             GOTO 5220
           END IF
           BNRedu! = BelowNarrwAcct! * Percl1! / QNarrows!
           BelowNarrwAcct! = BelowNarrwAcct! - BNRedu!
         END IF
       END IF
     END IF
5220 IF AboveNarrwAcct! < 0 THEN AboveNarrwAcct! = 0
     TotDewatStor! = TempDewatStor!
     IF AboveNarrwAcct! > TotDewatStor! THEN AboveNarrwAcct! = TotDewatStor!
     EndMoVol!(4) = MaxVol!(4) - TotDewatStor!
     Vavg!(4) = Vavg!(4) + EndMoVol!(4)
     VolGrph!(4, Mo% + DAdder%) = EndMoVol!(4) / 1000
     IF MinVol!(4) <= EndMoVol!(4) THEN GOTO 5330
     MinVol!(4) = EndMoVol!(4)
     MinMo%(4) = WtrYrMo%
     MinYr%(4) = Yr%
     IF WtrYrMo% < 4 THEN MinYr%(4) = Yr% - 1
5330 YrAbvNrwsAcct! = YrAbvNrwsAcct! + AboveNarrwAcct!
     YrTotDewatStor! = YrTotDewatStor! + TotDewatStor!
     YrNarrowsQ! = YrNarrowsQ! + QNarrows!
     YrCalcPerc! = YrCalcPerc! + Percl1!
     YrCalcQincr! = YrCalcQincr! + Qincr!
     YrConstNrwsQ! = YrConstNrwsQ! + ConstNrwsQ!
     YrConstPerc! = YrConstPerc! + Percl2!
     YrBelowNrwsRel! = YrBelowNrwsRel! + BelowNrwsRel!
     YrBelowNrwsSat! = YrBelowNrwsSat! + BelowNrwsSat!
```

```
     YrQFlor! = YrQFlor! + QFlor!
     TabValue!(12, Mo% + DAdder%) = QFlor!
     YrBelowNrwsCred! = YrBelowNrwsCred! + BnCred!
     YrBnRedu! = YrBnRedu! + BNRedu!
     YrBelowNrwsAcct! = YrBelowNrwsAcct! + BelowNarrwAcct!
     IF Yr% < BeginDetPrint% THEN GOTO Ok
     IF Yr% >= BeginDetPrint% + NumDetYrs% THEN GOTO Ok
     IF RunType$ = "AbvNarrows" THEN GOSUB DetailPrint
     IF RunType$ = "BlwNarrows" THEN GOSUB DetailPrint
Ok:  LastMoLive! = Live!
     LastMonthsSpill! = Spill!
     CumlNarrowsQ! = CumlNarrowsQ! + QNarrows!
     CumlConstNrwsQ! = CumlConstNrwsQ! + ConstNrwsQ!
  NEXT WtrYrMo%
'----------------- THIS ENDS MONTHLY LOOP ------------------
FOR Resv% = 1 TO 3
     IF AnnShort!(Resv%) > Sworst!(Resv%) THEN Sworst!(Resv%) = AnnShort!(Resv%)
     IF Resv% = 2 THEN
       IF 7278 - YrPnanDiv! > PhanWorst! THEN PhanWorst! = 7278 - YrPhanDiv!
       SumPhanRnf! = SumPhanRnf! + AnnRunoff!(2)
       SumPhanROL! = SumPhanROL! + YrPhanRol!
       SumPhanEvp! = SumPhanEvp! + YrPhanEvp!
       SumPhanDiv! = SumPhanDiv! + YrPhanDiv!
       SumPhanRel! = SumPhanRel! + YrPhanRel!
       SumPhanSpl! = SumPhanSpl! + YrPhanSpl!
       SumPhanYld! = SumPhanYld! + YrPhanYld!
       SumPhanVol! = SumPhanVol! + PhanAvgVol!
       SumPhanElv! = SumPhanElv! + PhanAvgElv!
       SumPhanAre! = SumPhanAre! + PhanAvgAre!
     END IF
     SumRunoff!(Resv%) = SumRunoff!(Resv%) + AnnRunoff!(Resv%)
     SumPrecip!(Resv%) = SumPrecip!(Resv%) + YrRainOnLake!(Resv%)
     SumEvap!(Resv%) = SumEvap!(Resv%) + YrEvpo!(Resv%)
     SumLeak!(Resv%) = SumLeak!(Resv%) + YrLeak!(Resv%)
     SumDiv!(Resv%) = SumDiv!(Resv%) + YrDivs!(Resv%)
     SumRel!(Resv%) = SumRel!(Resv%) + YrRels!(Resv%)
     SumTunl!(Resv%) = SumTunl!(Resv%) + YrTunl!(Resv%)
     SumSpill!(Resv%) = SumSpill!(Resv%) + YrSpil!(Resv%)
     SumYld!(Resv%) = SumYld!(Resv%) + YrSysYld!(Resv%)
     SumVol!(Resv%) = SumVol!(Resv%) + Vavg!(Resv%)
     SumElv!(Resv%) = SumElv!(Resv%) + Eavg!(Resv%)
     SumAre!(Resv%) = SumAre!(Resv%) + Aavg!(Resv%)
 EXT Resv%
     Ranker!(1, Yn%) = AnnShort!(1)
     Ranker!(2, Yn%) = YrPhanShort!
     Ranker!(3, Yn%) = AnnShort!(2)
     Ranker!(4, Yn%) = AnnShort!(3)
     Ranker!(5, Yn%) = AnnShort!(1) + AnnShort!(2) + AnnShort!(3)
     Ranker!(6, Yn%) = AnnRunoff!(1)
     Ranker!(7, Yn%) = AnnRunoff!(2)
     Ranker!(8, Yn%) = AnnRunoff!(3)
     Ranker!(9, Yn%) = YrNarrowsQ!
'- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
RiparianPrint:
     YrAbvNrwsAcct! = YrAbvNrwsAcct! / 12
     YrTotDewatStor! = YrTotDewatStor! / 12
     Vavg!(4) = Vavg!(4) / 12
     YrBelowNrwsAcct! = YrBelowNrwsAcct! / 12
     IF Yr% < BeginDetPrint% THEN GOTO Py
     IF Yr% >= BeginDetPrint% + NumDetYrs% THEN GOTO Py
     SELECT CASE ResvDet%
     CASE 7
       GOTO Py
     CASE 1
       Resv% = 1
Rg:    Volume7! = Vavg!(Resv%) / 12
       Elev7! = Eavg!(Resv%) / 12
       Area7! = Aavg!(Resv%) / 12
       COLOR 6
       PRINT "├────┼─────┼────┼────┼───┼────┼────┼───┼─────┼────┼─────┼───┼─────┤"
       COLOR 8
       IF Resv% = 3 THEN
         PRINT USING Image$(8); ShortName$(ResvDet%); AnnRunoff!(Resv%); YrRainOnLake!(Resv%); YrEvpo
        ELSE
         PRINT USING Image$(2); ShortName$(ResvDet%); AnnRunoff!(Resv%); YrRainOnLake!(Resv%); YrEvpo
       END IF
       COLOR 6
       PRINT "└────┴─────┴────┴────┴───┴────┴────┴───┴─────┴────┴─────┴───┴─────┘"
       IF RunOut$ = "EXT" THEN
         LPRINT "├────┼─────┼────┼────┼───┼────┼────┼───┼─────┼────┼─────┼───┼─────┤"
         IF Resv% = 3 THEN
           LPRINT USING Image$(8); ShortName$(ResvDet%); AnnRunoff!(Resv%); YrRainOnLake!(Resv%); YrE
          ELSE
           LPRINT USING Image$(2); ShortName$(ResvDet%); AnnRunoff!(Resv%); YrRainOnLake!(Resv%); YrE
         END IF
```

```
      LPRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    END IF
    GOTO ChkPause
  CASE 2
    Resv% = 2
    PhanVol! = PhanAvgVol! / 12
    PhanElev! = PhanAvgElv! / 12
    PhanArea! = PhanAvgAre! / 12
    COLOR 6
    PRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
    COLOR 8
    PRINT USING Image$(2); ShortName$(ResvDet%); AnnRunoff!(Resv%); YrPhanRol!; YrPhanEvp!; YrLeak
    COLOR 6
    PRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    IF RunOut$ = "EXT" THEN
      LPRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
      LPRINT USING Image$(2); ShortName$(ResvDet%); AnnRunoff!(Resv%); YrPhanRol!; YrPhanEvp!; YrL
      LPRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    END IF
    GOTO ChkPause
  CASE 3
    Resv% = 2
    GOTO Rg
  CASE 4
    Resv% = 3
    GOTO Rg
  CASE 5
    COLOR 4
    PRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
    COLOR 8
    PRINT USING Image$(11); "C_Lom|"; YrUnimpRunoff!; YrRunoffDepl!; YrBankDepl!; YrMICU!; YrAgCU!
    COLOR 4
    PRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    IF RunOut$ = "EXT" THEN
      LPRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
      LPRINT USING Image$(11); "C_Lom|"; YrUnimpRunoff!; YrRunoffDepl!; YrBankDepl!; YrMICU!; YrAg
      LPRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    END IF
    GOTO ChkPause
  CASE 6
    COLOR 5
    PRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
    COLOR 8
    COLOR 4: PRINT USING Image$(9); "BelwNar"; YrNarrowsQ!; YrCalcPerc!; YrCalcQincr!; YrConstNrws
    COLOR 5
    PRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    IF RunOut$ = "EXT" THEN
      LPRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
      LPRINT USING Image$(9); "BelowNar|"; YrNarrowsQ!; YrCalcPerc!; YrCalcQincr!; YrConstNrwsQ!;
      LPRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    END IF
  END SELECT
ChkPause: IF NumDetYrs% = 1 THEN
    DO
    A$ = INKEY$
    LOOP WHILE A$ = ""
  END IF
Py: SumUnimpRunoff! = SumUnimpRunoff! + YrUnimpRunoff!  'Period Accumulators [76 years]
  SumRunoffDepl! = SumRunoffDepl! + YrRunoffDepl!
  SumBankDepl! = SumBankDepl! + YrBankDepl!
  SumMICU! = SumMICU! + YrMICU!
  SumAgCU! = SumAgCU! + YrAgCU!
  SumRivPerc! = SumRivPerc! + YrRivPerc!
  SumBank! = SumBank! + YrBank!
  SumUndrFlow! = SumUndrFlow! + YrUnderFlow!
  SumNarrowsQ! = SumNarrowsQ! + YrNarrowsQ!
  SumAbvNrwsAcct! = SumAbvNrwsAcct! + YrAbvNrwsAcct!
  SumDewatStor! = SumDewatStor! + YrTotDewatStor!
  SumVol!(4) = SumVol!(4) + Vavg!(4)
  SumCalcPerc! = SumCalcPerc! + YrCalcPerc!
  SumCalcQIncr! = SumCalcQIncr! + YrCalcQincr!
  SumConstNarwQ! = SumConstNarwQ! + YrConstNrwsQ!
  SumConstPerc! = SumConstPerc! + YrConstPerc!
  SumBelowNarwRel! = SumBelowNarwRel! + YrBelowNrwsRel!
  SumBelowNrwsSat! = SumBelowNrwsSat! + YrBelowNrwsSat!
  SumQFlor! = SumQFlor! + YrQFlor!
  SumBelowNarwCred! = SumBelowNarwCred! + YrBelowNrwsCred!
  SumBnRedu! = SumBnRedu! + YrBnRedu!
  SumBelowNarwAcct! = SumBelowNarwAcct! + YrBelowNrwsAcct!
NEXT Yr%
  COLOR 8
'================= THIS ENDS ANNUAL LOOP =======================
 FOR Resv% = 1 TO 3
  SumRunoff!(Resv%) = SumRunoff!(Resv%) / NumYears%
  SumPrecip!(Resv%) = SumPrecip!(Resv%) / NumYears%
```

```
      SumEvap!(Resv%) = SumEvap!(Resv%) / NumYears%
      SumLeak!(Resv%) = SumLeak!(Resv%) / NumYears%
      SumDiv!(Resv%) = SumDiv!(Resv%) / NumYears%
      SumRel!(Resv%) = SumRel!(Resv%) / NumYears%
      SumTunl!(Resv%) = SumTunl!(Resv%) / NumYears%
      SumSpill!(Resv%) = SumSpill!(Resv%) / NumYears%
      SumYld!(Resv%) = SumYld!(Resv%) / NumYears%
      SumVol!(Resv%) = SumVol!(Resv%) / (12 * NumYears%)
      SumElv!(Resv%) = SumElv!(Resv%) / (12 * NumYears%)
      SumAre!(Resv%) = SumAre!(Resv%) / (12 * NumYears%)
    NEXT Resv%
    SumPhanRnf! = SumPhanRnf! / NumYears%
    SumPhanROL! = SumPhanROL! / NumYears%
    SumPhanEvp! = SumPhanEvp! / NumYears%
    SumPhanDiv! = SumPhanDiv! / NumYears%
    SumPhanRel! = SumPhanRel! / NumYears%
    SumPhanSpl! = SumPhanSpl! / NumYears%
    SumPhanYld! = SumPhanYld! / NumYears%
    SumPhanVol! = SumPhanVol! / (12 * NumYears%)
    SumPhanElv! = SumPhanElv! / (12 * NumYears%)
    SumPhanAre! = SumPhanAre! / (12 * NumYears%)
    SumUnimpRunoff! = SumUnimpRunoff! / NumYears%
    SumRunoffDepl! = SumRunoffDepl! / NumYears%
    SumBankDepl! = SumBankDepl! / NumYears%
    SumMICU! = SumMICU! / NumYears%
    SumAgCU! = SumAgCU! / NumYears%
    SumRivPerc! = SumRivPerc! / NumYears%
    SumBank! = SumBank! / NumYears%
    SumUndrFlow! = SumUndrFlow! / NumYears%
    SumNarrowsQ! = SumNarrowsQ! / NumYears%
    SumAbvNrwsAcct! = SumAbvNrwsAcct! / NumYears%
    SumDewatStor! = SumDewatStor! / NumYears%
    SumVol!(4) = SumVol!(4) / NumYears%
    SumCalcPerc! = SumCalcPerc! / NumYears%
    SumCalcQIncr! = SumCalcQIncr! / NumYears%
    SumConstNarwQ! = SumConstNarwQ! / NumYears%
    SumConstPerc! = SumConstPerc! / NumYears%
    SumBelowNarwRel! = SumBelowNarwRel! / NumYears%
    SumBelowNrwsSat! = SumBelowNrwsSat! / NumYears%
    SumQFlor! = SumQFlor! / NumYears%
    SumBelowNarwCred! = SumBelowNarwCred! / NumYears%
    SumBnRedu! = SumBnRedu! / NumYears%
    SumBelowNarwAcct! = SumBelowNarwAcct! / NumYears%
' - - - - - - - - - - - - - - - - - - - - - - - - - - -
PrintFinal: SOUND 110, 1
    Image0$ = "|StrmSEEP| S Ynez = ##### | Buelltn = ##### | SRita E = ##### |SRita W = ##### |"
    FOR I% = 1 TO 4
      MinMo$(I%) = MID$(Month$, 3 * MinMo%(I%) - 2, 3 * MinMo%(I%))
    NEXT I%
    PMinMo$ = MID$(Month$, 3 * PhanMinMo% - 2, 3 * PhanMinMo%)
    COLOR 1
    SYS1! = SYRSeep!(1) / NumYears%
    SYS2! = SYRSeep!(2) / NumYears%
    SYS3! = SYRSeep!(3) / NumYears%
    SYS4! = SYRSeep!(4) / NumYears%
    LOCATE 24, 1
    PRINT " SUMMARY: 1918-1993 AVERAGE VALUES (Vols[ac-ft], Areas[ac], Elevs[ft])              "
    COLOR 6
    PRINT " ┌─────┬──────┬─────┬─────┬────┬─────┬─────┬────┬──────┬─────┬──────┬────┬──────┐"
    PRINT " │RESRV│Runoff│Precp│Evapo│Leak│divrs│DSRel│Tunl│Spills│Yield│ WSEL │Area│Storag│"
    PRINT " ├─────┼──────┼─────┼─────┼────┼─────┼─────┼────┼──────┼─────┼──────┼────┼──────┤"
    COLOR 8
    Del% = 0
    FOR Resv% = 1 TO 3
      IF Resv% > 1 THEN Del% = 1
      IF Resv% = 2 THEN
        PhanVol! = SumPhanVol!
        PhanElev! = SumPhanElv!
        PhanArea! = SumPhanAre!
        PRINT USING Image$(13); "BaseG"; SumPhanRnf!; SumPhanROL!; SumPhanEvp!; 0; SumPhanDiv!; SumPha
      END IF
      Volume7! = SumVol!(Resv%)
      Elev7! = SumElv!(Resv%)
      Area7! = SumAre!(Resv%)
      IF Resv% = 3 THEN
        PRINT USING Image$(17); ShortName$(Resv% + Del%); SumRunoff!(Resv%); SumPrecip!(Resv%); SumEva
       ELSE
        PRINT USING Image$(13); ShortName$(Resv% + Del%); SumRunoff!(Resv%); SumPrecip!(Resv%); SumEva
      END IF
    NEXT Resv%
    COLOR 4
    PRINT " ├────────┬──────┬────┬────┬─────┬──────┬─────┬─────┬────┬──────┬─────┬────┬─────┤"
    PRINT " │CACH-LOM│Runoff│RDep│BDep│M&ICU│Ag  CU│Percl│Bnk&P│UFlw│QNarrw│ ANA │Tds │Volum│"
    PRINT " ├────────┼──────┼────┼────┼─────┼──────┼─────┼─────┼────┼──────┼─────┼────┼─────┤"
    COLOR 8
```

```
    PRINT USING Image$(6); "Riparian"; SumUnimpRunoff!; SumRunoffDepl!; SumBankDepl!; SumMICU!; SumAgC
    PRINT "├──────────┼────────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼────────┼──────────────────┤"
    PRINT USING Image0$; SYS1!; SYS2!; SYS3!; SYS4!
    COLOR 5
    PRINT "╒═════════╤═══════╤═════╤═══════╤═══════╤═════╤══════╤══════╤═══════╤══════╤═════╤═════╕"
    PRINT "│BELOWNAR│QNarws│Percl│Qincrm│ConstrQ│ConsP│BNRel│BNSat│QFlorAv│BNCrd│Redu│ BNA│"
    COLOR 8
    PRINT USING Image$(14); "Averages│"; SumNarrowsQ!; SumCalcPerc!; SumCalcQIncr!; SumConstNarwQ!; Su
    COLOR 6
    PRINT "╒════════╤═══════════════╤═════════════╤════════════╤═══════════════╤══════════════╕"
    PRINT "│ PERIOD │ Jameson Lake│BaseGibraltar│GibraltarLake│ Lake Cachuma│Riparian Volm│"
    COLOR 8
    PRINT USING Image$(21); "│End Vols│"; EndMoVol!(1); LastVol!; EndMoVol!(2); EndMoVol!(3); EndMoVol
    PRINT USING Image$(21); "│Min Vols│"; MinVol!(1); PhanMinVol!; MinVol!(2); MinVol!(3); MinVol!(4)
    PRINT USING Image$(15); "│Min Date│"; MinMo$(1); MinYr%(1); PMinMo$; PhanMinYr%; MinMo$(2); MinYr%
    PRINT USING Image$(16); "│ShortMos│"; ShortMon%(1) / 9.12; PhanShortCtr% / 9.12; ShortMon%(2) / 9.
    PRINT USING Image$(22); "│MxyrShrt│"; Sworst!(1); PhanWorst!; Sworst!(2); Sworst!(3)
    PRINT USING Image$(27); "│Wors%Sht│"; 100 * (1 - PShortMinYr!(1)); 100 * (1 - PhanMinPcnt!); 100 *
    PRINT "└────────┴──────────────┴─────────────┴────────────┴──────────────┴─────────────┘";
  IF RunOut$ = "EXT" THEN
    LPRINT
    LPRINT " SUMMARY: 1918-1993 AVERAGE VALUES (Vols[ac-ft], Areas[ac], Elevs[ft])                 "
    LPRINT "╒═════╤══════════════════════╤═════╤═════╤═════╤════╤══════╤══════╤═══════════════════╕"
    LPRINT "│RESRV│   PERIOD AVERAGE    │Leak │Piped│Dwnsr│Tunl│Resrvr│Systm│  OVERALL AVERAGE  │"
    LPRINT "│(bas)│runoff│precp│evapo │-age │divrt│reles│infl│spills│yield│ WSEL │area │storag│"
    LPRINT "├─────┼──────┼─────┼──────┼─────┼─────┼─────┼────┼──────┼─────┼──────┼─────┼──────┤"
    Del% = 0
    FOR Resv% = 1 TO 3
      IF Resv% > 1 THEN Del% = 1
      IF Resv% = 2 THEN
        PhanVol! = SumPhanVol!
        PhanElev! = SumPhanElv!
        PhanArea! = SumPhanAre!
        LPRINT USING Image$(13); "BaseG"; SumPhanRnf!; SumPhanROL!; SumPhanEvp!; 0; SumPhanDiv!; Sum
      END IF
      Volume7! = SumVol!(Resv%)
      Elev7! = SumElv!(Resv%)
      Area7! = SumAre!(Resv%)
      IF Resv% = 3 THEN
        LPRINT USING Image$(17); ShortName$(Resv% + Del%); SumRunoff!(Resv%); SumPrecip!(Resv%); Sum
       ELSE
        LPRINT USING Image$(13); ShortName$(Resv% + Del%); SumRunoff!(Resv%); SumPrecip!(Resv%); Sum
      END IF
    NEXT Resv%
    LPRINT "╞════════╪═══════╪═════╪═════╪══════╪══════╪══════╪══════╪═════╪═══════╪══════════════════╡"
    LPRINT "│GWB-Avgs│Unimpr│Runf │Bank │Ripar │Agric │River │Bank& │Undr │Narrow │  PERIOD AVERAGE  │"
    LPRINT "│CachLomp│runoff│depl │depl │divrs │ C.U. │perc. │Phrea │flow │outflw │ ANA│ Tds │Volum│"
    LPRINT "├────────┼───────┼─────┼─────┼──────┼──────┼──────┼──────┼─────┼───────┼────┼─────┼─────┤"
    LPRINT USING Image$(6); "Riparian"; SumUnimpRunoff!; SumRunoffDepl!; SumBankDepl!; SumMICU!; Sum
    LPRINT "├────────┴───────┴─────┴─────┴──────┴──────┴──────┴──────┴─────┴───────┴────┴─────┴─────┤"
    LPRINT USING Image0$; SYS1!; SYS2!; SYS3!; SYS4!
    LPRINT "╞═════════╤═══════╤══════╤═══════╤════════╤══════╤══════╤══════╤═══════╤══════╤═════╤═════╡"
    LPRINT "│BelowNar│Rnoff@│Calcd │Calcld │Cnstrcv │Cnstr │BlwNr │RelTo │Calcltd│BlwNr │ BNA │ BNA │"
    LPRINT "│rowsPeri│Narrws│Percl │ Qincr │NarrwsQ │Percl │Reles │Narws │QFlorAv│Credt │Redu │Acct │"
    LPRINT USING Image$(14); "odAvergs│"; SumNarrowsQ!; SumCalcPerc!; SumCalcQIncr!; SumConstNarwQ!;
    LPRINT "╞════════╪═══════════════╪═════════════╪═════════════╪═══════════════╪══════════════╡"
    LPRINT "│PeriodEn│ Jameson Lake│BaseGibraltar│GibraltarLake│ Lake Cachuma│Riparian Volm│"
    LPRINT USING Image$(21); "│dingVols│"; EndMoVol!(1); LastVol!; EndMoVol!(2); EndMoVol!(3); EndMo
    LPRINT USING Image$(21); "│Min Vols│"; MinVol!(1); PhanMinVol!; MinVol!(2); MinVol!(3); MinVol!(
    LPRINT USING Image$(15); "│Min Date│"; MinMo$(1); MinYr%(1); PMinMo$; PhanMinYr%; MinMo$(2); Min
    LPRINT USING Image$(16); "│ShortMos│"; ShortMon%(1) / 9.12; PhanShortCtr% / 9.12; ShortMon%(2) /
    LPRINT USING Image$(22); "│MxyrShrt│"; Sworst!(1); PhanWorst!; Sworst!(2); Sworst!(3)
    LPRINT USING Image$(27); "│Wors%Sht│"; 100 * (1 - PShortMinYr!(1)); 100 * (1 - PhanMinPcnt!); 10
    LPRINT "└────────┴──────────────┴─────────────┴─────────────┴──────────────┴─────────────┘";
    LPRINT " Selected SYRM0298.BAS Run of "; Timer$; ",  "; Dater$; "..."
    LPRINT CHR$(12) 'form feed
  END IF
  GOTO BypassSave
  OPEN "JUND1297.ASC" FOR OUTPUT AS #1
  OPEN "GIBD1297.ASC" FOR OUTPUT AS #2
  OPEN "CACD1297.ASC" FOR OUTPUT AS #3
  OPEN "TIMEDATE.ASC" FOR OUTPUT AS #4
  FOR Yn% = 1 TO 76
    WRITE #1, AnnJun!(Yn%)
    WRITE #2, AnnGib!(Yn%)
    WRITE #3, AnnCac!(Yn%)
  NEXT Yn%
  WRITE #4, Timer$, Dater$
  CLOSE #1, #2, #3, #4
BypassSave:
  DO
  A$ = INKEY$
  LOOP WHILE A$ = ""
  IF A$ = CHR$(72) THEN
    SOUND 97, 3
```

```
      STOP
    END IF
    EXIT SUB
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Reservoir:
    IF LakeDiv! < 0 THEN LakeDiv! = 0
    Spill! = 0
    Area7! = Area!(Resv%)
    Volume7! = EndMoVol!(Resv%)
    Vsave! = Volume7!
    Prc! = Rainer! * Area7! / 1200
    Evp! = PanFac!(Resv%, WtrYrMo%) * Evap%(Resv%, Mo%) * Area7! / 1200
    Volume7! = Volume7! + Inflow! + Prc! - LakeDiv! - RegulRelease! - Evp! - Leakg! - BelowNrwsRel!
    IF Volume7! < 0 THEN
      Prcl! = Prc! / 2
      Evpr! = Evp! / 2
      Volume7! = Vsave! + Inflow! + Prcl! - Evpr! - LakeDiv! - RegulRelease! - BelowNrwsRel!
      IF Volume7! < 0 THEN
        Prc! = Prcl!
        Evp! = Evpr!
EmptyRes: Pointer%(Resv%) = 1
        Volume7! = 0
        Area7! = 0
        Elev7! = Datum%(Resv%)
        Part! = 0
        IF (LakeDiv! + RegulRelease! + BelowNrwsRel!) > 0 THEN Part! = (Vsave! + Inflow! + Prcl! - Evp
        LakeDiv! = LakeDiv! * Part!
        RegulRelease! = RegulRelease! * Part!
        BelowNrwsRel! = BelowNrwsRel! * Part!
        GOTO Set
      END IF
    END IF
    IF Volume7! > MaxVol!(Resv%) THEN Volume7! = MaxVol!(Resv%)
    GOSUB AreaElevSet
    IF Resv% = 3 THEN
      Etend! = Area7! * CachET%(Mo%) / 1200
      Inflow! = Inflow! + (Etend! - Etbegin!) / 2
      Volume7! = Volume7! + (Etend! - Etbegin!) / 2
      IF Volume7! > MaxVol!(3) THEN Volume7! = MaxVol!(3)
      IF MaxElev!(3) > 628 THEN
        Lek = 0
        IF Elev7! > MaxElev!(3) - 30 THEN
          BufPtr! = 2 * (MaxElev!(3) - Elev7!) + 1.5
          Lek = MoDays%(WtrYrMo%) * Leakage!(BufPtr!)
        END IF
        Leakg! = (Leakg! + Lek) / 2
      END IF
    END IF
    Prc! = (Prc! + Rainer! * Area7! / 1200) / 2
    Evp! = (Evp! + PanFac!(Resv%, WtrYrMo%) * Evap%(Resv%, Mo%) * Area7! / 1200) / 2
    Volume7! = Vsave! + Inflow! + Prc! - Evp! - LakeDiv! - RegulRelease! - Leakg! - BelowNrwsRel!
    IF Volume7! < 0 THEN
      Prcl! = Prc!
      Evpr! = Evp!
      GOTO EmptyRes
    END IF
    IF Volume7! > MaxVol!(Resv%) THEN
      Spill! = Volume7! - MaxVol!(Resv%) + Leakg!
      Leakg! = 0
      Volume7! = MaxVol!(Resv%)
    END IF
    GOSUB AreaElevSet
' - - - - - - - - - - - - - - - - - - - - - - - - - - -
Set: YrDivs!(Resv%) = YrDivs!(Resv%) + LakeDiv!
    YrRels!(Resv%) = YrRels!(Resv%) + RegulRelease! + BelowNrwsRel!
    YrRainOnLake!(Resv%) = YrRainOnLake!(Resv%) + Prc!
    YrEvpo!(Resv%) = YrEvpo!(Resv%) + Evp!
    YrSpil!(Resv%) = YrSpil!(Resv%) + Spill!
    Area!(Resv%) = Area7!
    EndMoVol!(Resv%) = Volume7!
    IF MinVol!(Resv%) <= Volume7! THEN GOTO BpMin
    MinVol!(Resv%) = Volume7!
    MinMo%(Resv%) = WtrYrMo%
    MinYr%(Resv%) = Yr%
    IF WtrYrMo% < 4 THEN MinYr%(Resv%) = Yr% - 1
BpMin: Vavg!(Resv%) = Vavg!(Resv%) + Volume7!
    Eavg!(Resv%) = Eavg!(Resv%) + Elev7!
    Aavg!(Resv%) = Aavg!(Resv%) + Area7!
    YrTunl!(Resv%) = YrTunl!(Resv%) + Tunnl%
    YrSysYld!(Resv%) = YrSysYld!(Resv%) + LakeDiv! + Tunnl%
    RETURN
' - - - - - - - - - - - - - - - - - - - - - - - - - - -
AreaElevSet:
    Depth% = Pointer%(Resv%)
Up: IF ResvCap!(Resv%, Depth%) > Volume7! THEN GOTO Down
```

```
    Depth% = Depth% + 1
    GOTO Up
Down: Depth% = Depth% - 1
    IF ResvCap!(Resv%, Depth%) > Volume7! THEN GOTO Down
    IF Depth% = 1 THEN
      Diff! = Volume7! / ResvCap!(Resv%, 2)
      IF Diff! <= 0 THEN Diff! = 1
      Area7! = 3 * Volume7! / Diff!
      GOTO 10790
    END IF
    Diff! = (Volume7! - ResvCap!(Resv%, Depth%)) / (ResvCap!(Resv%, Depth% + 1) - ResvCap!(Resv%, Dept
    Area7! = (ResvCap!(Resv%, Depth% + 1) - ResvCap!(Resv%, Depth% - 1) + Diff! * (ResvCap!(Resv%, Dep
10790   Elev7! = Datum%(Resv%) + Depth% + Diff! - 1
    Pointer%(Resv%) = Depth%
   RETURN
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
PhanAESet:
Pup: IF PhanCap!(PhanPointer%) > PhanVol! THEN GOTO Pdown
      PhanPointer% = PhanPointer% + 1
      GOTO Pup
Pdown: PhanPointer% = PhanPointer% - 1
      IF PhanCap!(PhanPointer%) > PhanVol! THEN GOTO Pdown
      IF PhanPointer% = 1 THEN
        Diff! = PhanVol! / PhanCap!(2)
        IF Diff! <= 0 THEN Diff! = 1
        PhanArea! = 3 * PhanVol! / Diff!
        GOTO SetE
      END IF
      Diff! = (PhanVol! - PhanCap!(PhanPointer%)) / (PhanCap!(PhanPointer% + 1) - PhanCap!(PhanPointer
      PhanArea! = (PhanCap!(PhanPointer% + 1) - PhanCap!(PhanPointer% - 1) + Diff! * (PhanCap!(PhanPoi
SetE: PhanElev! = PhanDatum% + PhanPointer% + Diff! - 1
    RETURN
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
PhanAVSet:
      Del! = PhanElev! - PhanDatum% + 1
Pupr: IF Del! < PhanPointer% THEN GOTO Pdwnr
      PhanPointer% = PhanPointer% + 1
      GOTO Pupr
Pdwnr:
      PhanPointer% = PhanPointer% - 1
      IF Del! < PhanPointer% THEN GOTO Pdwnr
Pcalcr:
      Diff! = Del! - INT(Del!)
      PhanVol! = Diff! * (PhanCap!(PhanPointer% + 1) - PhanCap!(PhanPointer%)) + PhanCap!(PhanPointer%
      PhanArea! = (PhanCap!(PhanPointer% + 1) - PhanCap!(PhanPointer% - 1) + Diff! * (PhanCap!(PhanPoi
    RETURN
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
DetailPrint:
    M$ = MID$(Month$, 3 * WtrYrMo% - 2, 3 * WtrYrMo%)
    Y% = Yr%
    IF WtrYrMo% < 4 THEN Y% = Y% - 1
SELECT CASE ResvDet%
    CASE IS <= 4
      Rnff! = Inflow!
      IF ResvDet% = 2 THEN
        COLOR 8
        PRINT USING Image$(10); M$; Y% - 1900; Rnff!; PhanRol!; PhanEvp!; Leakg!; PhanDiv!; Phanrel!;
        IF RunOut$ = "EXT" THEN LPRINT USING Image$(10); M$; Y% - 1900; Rnff!; PhanRol!; PhanEvp!; Lea
        RETURN
      END IF
      SysYld! = LakeDiv! + Tunnl%
      IF ResvDet% = 4 THEN
        COLOR 8
        PRINT USING Image$(12); M$; Y% - 1900; Rnff!; Prc!; Evp!; Leakg!; LakeDiv!; RegulRelease! + Be
        IF RunOut$ = "EXT" THEN LPRINT USING Image$(12); M$; Y% - 1900; Rnff!; Prc!; Evp!; Leakg!; Lak
        RETURN
      END IF
      COLOR 8
      PRINT USING Image$(10); M$; Y% - 1900; Rnff!; Prc!; Evp!; Leakg!; LakeDiv!; RegulRelease!; Tunnl
      IF RunOut$ = "EXT" THEN LPRINT USING Image$(10); M$; Y% - 1900; Rnff!; Prc!; Evp!; Leakg!; LakeD
      RETURN
    CASE 5
      MiCU! = SyDiv!(WtrYrMo%) + BuDiv!(WtrYrMo%)
      COLOR 8
      PRINT USING Image$(20); M$; Y% - 1900; UnimpRunoff!; UplandDepl% - BankDepl!; BankDepl!; MiCU!;
      IF RunOut$ = "EXT" THEN LPRINT USING Image$(20); M$; Y% - 1900; UnimpRunoff!; UplandDepl% - Bank
      RETURN
    CASE 6
      COLOR 8
      PRINT USING Image$(7); M$; Y%; QNarrows!; Percl1!; Qincr!; ConstNrwsQ!; Percl2!; BelowNrwsRel!;
      IF RunOut$ = "EXT" THEN LPRINT USING Image$(7); M$; Y%; QNarrows!; Percl1!; Qincr!; ConstNrwsQ!;
      RETURN
END SELECT
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
JunGib:
```

```
    SmallRelOut! = RegulRelease!                   ' in Etn!, 80 = width (feet)...
'    Etn! = 1.21 * Native!(WtrYrMo%) * 80 / 198 ' 1 / 198 = 2640 / (43560 * 12)
    Etn! = .844 * PanFac!(3, WtrYrMo%) * Evap%(3, Mo%) * 80 / 19800
    Acr! = .006 * JGa!
    CumlAcr! = 0
    Qin! = Spill! + SmallRelOut!
    FOR K% = 1 TO 13
      SmallRelOut! = SmallRelOut! * (1 - Etn! / (Qin! + Etn!))
      IF SmallRelOut! < .001 THEN
RelGone: SmallRelOut! = 0
        RETURN
      END IF
      CumlAcr! = CumlAcr! + Acr!
      Qin! = Spill! + CumlAcr! + SmallRelOut!
    NEXT K%
    Etn! = 5 * Etn! / 4                        ' 100 ft wide...
    CumlAcr! = CumlAcr! + .27 * JGa!           ' Add in Caliente Creek...
    Qin! = Qin! + .27 * JGa!                   ' Ditto for Qin!...
    FOR K% = 14 TO 18
      SmallRelOut! = SmallRelOut! * (1 - Etn! / (Qin! + Etn!))
      IF SmallRelOut! < .001 THEN GOTO RelGone
      CumlAcr! = CumlAcr! + Acr!
      Qin! = Spill! + CumlAcr! + SmallRelOut!
    NEXT K%
    Etn! = Etn! * 1.5                          ' 150 ft wide...
    CumlAcr! = CumlAcr! + .06 * JGa!           ' Add in Blue Canyon...
    Qin! = Qin! + .06 * JGa!                   ' Ditto for Qin!...
    FOR K% = 19 TO 22
      SmallRelOut! = SmallRelOut! * (1 - Etn! / (Qin! + Etn!))
      IF SmallRelOut! < .001 THEN GOTO RelGone
      CumlAcr! = CumlAcr! + Acr!
      Qin! = Spill! + CumlAcr! + SmallRelOut!
    NEXT K%
    Etn! = 5 * Etn! / 3                        ' 250 ft wide...
    CumlAcr! = CumlAcr! + .43 * JGa!           ' Add in Mono Creek...
    Qin! = Qin! + .43 * JGa!                   ' Ditto for Qin!...
    FOR K% = 23 TO 25
      SmallRelOut! = SmallRelOut! * (1 - Etn! / (Qin! + Etn!))
      IF SmallRelOut! < .001 THEN GOTO RelGone
      CumlAcr! = CumlAcr! + Acr!
      Qin! = Spill! + CumlAcr! + SmallRelOut!
    NEXT K%
    RETURN
' - - - - - - - - - - - - - - - - - - - - - - - -
GibCac:
    SmallRelOut! = RegulRelease!
'    Etn! = 1.4 * Native!(WtrYrMo%) * 78 / 198                ' 78 ft wide...
    Etn! = PanFac!(3, WtrYrMo%) * Evap%(3, Mo%) * 78 / 19800
    Acr! = .005625 * JGa!
    CumlAcr! = 0
    Qin! = SmallRelOut! + Spill!
    IF PhanFlag% = 1 THEN
      SmallRelOut! = Phanrel!
      Qin! = SmallRelOut! + PhanSpl!
    END IF
    FOR K% = 1 TO 16
      SmallRelOut! = SmallRelOut! * (1 - Etn! / (Qin! + Etn!))
      IF SmallRelOut! < .001 THEN GOTO RelGone
      CumlAcr! = CumlAcr! + Acr!
      Qin! = Spill! + CumlAcr! + SmallRelOut!
    NEXT K%
    Etn! = 100 * Etn! / 78                     ' 100 ft wide...
    CumlAcr! = CumlAcr! + .04 * JGa!           ' Add in Oso Cyn Creek...
    Qin! = Qin! + .04 * JGa!                   ' Ditto for Qin!
    FOR K% = 17 TO 23
      SmallRelOut! = SmallRelOut! * (1 - Etn! / (Qin! + Etn!))
      IF SmallRelOut! < .001 THEN GOTO RelGone
      CumlAcr! = CumlAcr! + Acr!
      Qin! = Spill! + CumlAcr! + SmallRelOut!
    NEXT K%
    Etn! = 11 * Etn! / 10                      ' 110 ft wide...
    CumlAcr! = CumlAcr! + .05 * JGa!           ' Add in Redrock Cyn Creek...
    Qin! = Qin! + .05 * JGa!                   ' Ditto for Qin!
    FOR K% = 24 TO 32
      SmallRelOut! = SmallRelOut! * (1 - Etn! / (Qin! + Etn!))
      IF SmallRelOut! < .001 THEN GOTO RelGone
      CumlAcr! = CumlAcr! + Acr!
      Qin! = Spill! + CumlAcr! + SmallRelOut!
    NEXT K%
    RETURN
' - - - - - - - - - - - - - - - - - - - - - - - -
Lompoc:
    IF Qin! <= 0 THEN
     Percl! = 0
     RETURN
```

```
      END IF
      I% = 18
ChkLower: IF Qin! < NarrowsQ!(I%) THEN
        I% = I% - 1
        GOTO ChkLower
      END IF
 ıkHigher: IF Qin! >= NarrowsQ!(I%) THEN
        I% = I% + 1
        GOTO ChkHigher
      END IF
      Ratio! = (Qin! - NarrowsQ!(I% - 1)) / (NarrowsQ!(I%) - NarrowsQ!(I% - 1))
      IF CumlQ! <= SwitchThresh! THEN
        Percl! = HighNarP%(I% - 1) + Ratio! * (HighNarP%(I%) - HighNarP%(I% - 1))
      ELSE
        Percl! = LowNarP%(I% - 1) + Ratio! * (LowNarP%(I%) - LowNarP%(I% - 1))
      END IF
      RETURN
END SUB
```

```
' This Subprogram PRINTS out the run results selected in the Menu...
DEFINT A-Z
SUB TableOut STATIC
  DIM MonthVal!(12), MonthCuml!(12), AvgMoVal!(12), AnnualVal!(76)
  CLS
  SCREEN ScrnType%        'Screen is 640 by 480 pixels
  PALETTE 0, 4144959      'Change Background from Black to White (0,15 is dark brown)
  COLOR 1                 'Changes White Text to Black
  BkGnd% = 14             'Background Color
  Xmin! = 0
  Xmax! = 640
  Ymin! = 0
  Ymax! = 480
  VIEW (0, 0)-(639, 479), BkGnd%
  WINDOW (Xmin!, Ymin!)-(Xmax!, Ymax!)
  Resv% = ShortDet%
  CumAnnVal! = 0
  FOR WtrYrMo% = 1 TO 12
     MonthCuml!(WtrYrMo%) = 0
  NEXT WtrYrMo%
  LOCATE 1, 10
  COLOR 1
  SELECT CASE TabType$
  CASE "JuncShort"
    PRINT "  Jameson Lake Shortages:         Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "           Juncal Reservoir Shortages:"
    END IF
    Ptr% = 1
Gi: Format% = 1
    GOTO Ch
  CASE "BaseShort"
    PRINT "  Base Gibraltar Lake Shortages:  Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "           Base Gibraltar Reservoir Shortages:"
    END IF
    Ptr% = 2
    GOTO Gi
  CASE "GibrShort"
    PRINT "  Actual Gibraltr Lake Shortages: Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "           Actual Gibraltr Reservoir Shortages:"
    END IF
    Ptr% = 3
    GOTO Gi
  CASE "CachShort"
    PRINT "  Lake Cachuma Shortages:         Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "           Cachuma Reservoir Shortages:"
    END IF
    Ptr% = 4
    GOTO Gi
  CASE "CombinedS"
    PRINT "  Junc + Gibr + Cach Shortages:   Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "           Juncal + Gibraltar + Cachuma Reservoirs Combined Shortages:"
    END IF
    Ptr% = 5
    GOTO Gi
  CASE "CacInflow"
    PRINT "  Lake Cachuma Inflow (Ac Ft/10): Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "            Lake Cachuma Monthly and Water Year Inflow (acrefeet):"
    END IF
    Ptr% = 6
Gt: Format% = 2
    GOTO Ch
  CASE "Q SnLucas"
    PRINT "  S Y River @ San Lucas Br. (AF/10): Run of "; Timer$; "  "; Dater$; "  "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "            Santa Ynez River Flows @ San Lucas Bridge (Acre Feet):"
    END IF
    Ptr% = 7
    GOTO Gt
  CASE "Q AlisalB"
    PRINT "  SantaYnez River @ Alisal (AF/10): Run of "; Timer$; "  "; Dater$; "  "
    IF TabOut$ = "EXT" THEN
```

```
      SetPrinter2
      LPRINT "              Santa Ynez River Flows @ Alisal Bridge (Acre Feet):"
    END IF
    Ptr% = 8
    GOTO Gt
  CASE "Q Bend WB"
    PRINT "  S Y River @ Bend W of Buell (AF/10): Run "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "              Santa Ynez River Flows @ Bend West of Buellton (Acre Feet):"
    END IF
    Ptr% = 9
    GOTO Gt
  CASE "Q AbvSals"
    PRINT "  SY River Abv Salsipuedes, AF/10:  Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "              Santa Ynez River Flows Above Salsipuedes Creek (Acre Feet):"
    END IF
    Ptr% = 10
    GOTO Gt
  CASE "Q Narrows"
    PRINT "  SantaYnez River @ Narrows (AF/10): Run "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "              Santa Ynez River Flows @ Narrows Near Lompoc (Acre Feet):"
    END IF
    Ptr% = 11
    GOTO Gt
  CASE "Q Floradl"
    PRINT "  SY River @ Floradale Bridge (AF/10): Run "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "              Santa Ynez River Flows @ Floradale Bridge (AF):"
    END IF
    Ptr% = 12
    GOTO Gt
  CASE "Cach Stor"
    PRINT "  Cachuma E.O.M. Storage  (AF/10): Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "              Cachuma End Of Month Reservoir Storage (Acre Feet):"
    END IF
    Ptr% = 13
    GOTO Gt
  CASE "Cach Elev"
    PRINT "  Cachuma E.O.M. Elevation (Ft,MSL): Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "              Cachuma End Of Month Lake Elevation (Feet, MSL):"
    END IF
    Ptr% = 14
    GOTO Gt
  CASE "Cach Area"
    PRINT "  Cachuma E.O.M. Area (Acres):    Run of "; Timer$; "  "; Dater$; " "
    IF TabOut$ = "EXT" THEN
      SetPrinter2
      LPRINT "              Cachuma End Of Month Lake Area (Acres):"
    END IF
    Ptr% = 15
    GOTO Gt
  CASE ELSE
    EXIT SUB
  END SELECT
Ch: IF TabOut$ = "EXT" THEN
    IF Ptr% > 5 THEN
      LPRINT "              October thru September water years 1918 - 1993  (average values on last lin
      GOTO Sc
    END IF
    LPRINT "            October thru September water years 1918 - 1993  (average values on last line)"
  END IF
Sc: LOCATE 2, 1
  PRINT "  October thru September water years 1918 - 1993  (average values on last line) "
  Image1$ = "          |####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|###
  Image2$ = "          \    \#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|###
  Image3$ = "|####|######|######|######|######|######|######|######|######|######|######|######|####
  Image4$ = "\    \######|######|######|######|######|######|######|######|######|######|######|####
  Image5$ = "|####|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.
  Image6$ = "\    \###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.##|###.
  Image1C$ = "|####|#####|#####|#####|####|####|####|####|#####|#####|#####|#####|#####|#####|"
  Image2C$ = "\    \#####|#####|#####|####|####|####|####|#####|#####|#####|#####|#####|#####|"
  Image3C$ = " |####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|"
  Image4C$ = " \    \#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|#####|"
  Image5C$ = " |####|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|"
  Image6C$ = " \    \###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|###.#|"
```

```
    IF Format% = 2 THEN
      PRINT " ┌────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┐"
      PRINT " │YEAR│ OCT │ NOV │ DEC │ JAN │ FEB │ MAR │ APR │ MAY │ JUN │ JUL │ AUG │ SEP │"
      PRINT " ├────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┤"
      IF TabOut$ = "EXT" THEN
        LPRINT "┌────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬──
        IF Ptr% < 13 THEN
          LPRINT "|YEAR| OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG
          GOTO Odri
        END IF
        LPRINT "|YEAR| OCT |- NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG |
Odri:   LPRINT "├────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼──
      END IF
      GOTO Vw
    END IF
    PRINT "┌────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┐"
    PRINT "│YEAR│ OCT │ NOV │ DEC │ JAN │ FEB │ MAR │ APR │ MAY │ JUN │ JUL │ AUG │ SEP │TOTAL│"
    PRINT "├────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┤"
    IF TabOut$ = "EXT" THEN
      LPRINT "        ┌────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬──
      LPRINT "        │YEAR│ OCT │ NOV │ DEC │ JAN │ FEB │ MAR │ APR │ MAY │ JUN │ JUL │ AUG │ SEP │TO
      LPRINT "        ├────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼──
    END IF
Vw: VIEW PRINT 6 TO 30
  FOR Yr% = 1 TO NumYears%
    AnnualVal!(Yr%) = 0
    Y% = Yr% + 1917
    FOR WtrYrMo% = 1 TO 12
      Mo% = 12 * (Yr% - 1) + WtrYrMo%
      MonthVal!(WtrYrMo%) = TabValue!(Ptr%, Mo%)
      MonthCuml!(WtrYrMo%) = MonthCuml!(WtrYrMo%) + MonthVal!(WtrYrMo%)
      AnnualVal!(Yr%) = AnnualVal!(Yr%) + MonthVal!(WtrYrMo%)
    NEXT WtrYrMo%
    IF Format% = 2 THEN
      IF Ptr% > 12 THEN
        IF TabType$ = "Cach Elev" THEN
          PRINT USING Image5C$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal
          IF TabOut$ = "EXT" THEN LPRINT USING Image5$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3)
          GOTO Ed
        END IF
        IF TabType$ = "Cach Area" THEN
          PRINT USING Image3C$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal
          IF TabOut$ = "EXT" THEN LPRINT USING Image3$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3)
          GOTO Ed
        END IF
        PRINT USING Image3C$; Y%; MonthVal!(1) / 10; MonthVal!(2) / 10; MonthVal!(3) / 10; MonthVal!
        IF TabOut$ = "EXT" THEN LPRINT USING Image3$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3);
        GOTO Ed
      END IF
      PRINT USING Image3C$; Y%; MonthVal!(1) / 10; MonthVal!(2) / 10; MonthVal!(3) / 10; MonthVal!(4
      IF TabOut$ = "EXT" THEN LPRINT USING Image3$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); Mo
      GOTO Ed
    END IF
    PRINT USING Image1C$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal!(5);
    IF TabOut$ = "EXT" THEN LPRINT USING Image1$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); Mont
Ed: CumAnnVal! = CumAnnVal! + AnnualVal!(Yr%)
  NEXT Yr%
  AvgAnnVal! = CumAnnVal! / NumYears%
  FOR WtrYrMo% = 1 TO 12
    AvgMoVal!(WtrYrMo%) = MonthCuml!(WtrYrMo%) / NumYears%
  NEXT WtrYrMo%
  IF Format% = 2 THEN
    PRINT " ├────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┤"
    IF TabOut$ = "EXT" THEN LPRINT "├────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼──
    IF Ptr% > 12 THEN
      IF TabType$ = "Cach Elev" THEN
        PRINT USING Image6C$; "|Ave.|"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3); AvgMoVal!(4); AvgM
        IF TabOut$ = "EXT" THEN LPRINT USING Image6$; "|Ave.|"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal
        GOTO Bl
      END IF
      IF TabType$ = "Cach Area" THEN
        PRINT USING Image4C$; "|Ave.|"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3); AvgMoVal!(4); AvgM
        IF TabOut$ = "EXT" THEN LPRINT USING Image4$; "|Ave.|"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal
        GOTO Bl
      END IF
      PRINT USING Image4C$; "|Ave.|"; AvgMoVal!(1) / 10; AvgMoVal!(2) / 10; AvgMoVal!(3) / 10; AvgMo
      IF TabOut$ = "EXT" THEN LPRINT USING Image4$; "|Ave.|"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(
      GOTO Bl
    END IF
    PRINT USING Image4C$; "|Ave.|"; AvgMoVal!(1) / 10; AvgMoVal!(2) / 10; AvgMoVal!(3) / 10; AvgMoVa
    IF TabOut$ = "EXT" THEN LPRINT USING Image4$; "|Ave.|"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3)
Bl: PRINT " └────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┘"
    IF TabOut$ = "EXT" THEN
      LPRINT "└────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴──
      LPRINT " Selected SYRM0298.BAS Run of "; Timer$; ",  "; Dater$; "... "
```

```
      LPRINT CHR$(12)
    END IF
    GOTO Fi
  END IF
  PRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
  PRINT USING Image2C$; "|Avg.|"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3); AvgMoVal!(4); AvgMoVal!(
  PRINT "╘════╧════╧════╧════╧════╧════╧════╧════╧════╧════╧════╧════╧════╛"
  IF TabOut$ = "EXT" THEN
    LPRINT "        ├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────
    LPRINT USING Image2$; "|Avg.|"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3); AvgMoVal!(4); AvgMoVal
    LPRINT "        ╘════╧════╧════╧════╧════╧════╧════╧════╧════╧════╧════╧════
    LPRINT "        Selected SYRM0298.BAS Run of "; Timer$; ",  "; Dater$; "..."
    LPRINT CHR$(12)
  END IF
Fi:
  VIEW PRINT
  DO
  A$ = INKEY$
  LOOP WHILE A$ = ""
  IF A$ = CHR$(72) THEN
    SOUND 97, 3
    STOP
  END IF
  EXIT SUB
END SUB
```

```
'THIS IS GRAPHICAL DISPLAY SELECT SUB PROGRAM...
DEFINT A-Z
SUB GraphOut
    SELECT CASE GphType$
    CASE "JuncShort"
      RankShortage
      GOTO Back
    CASE "BaseShort"
      RankShortage
      GOTO Back
    CASE "GibrShort"
      RankShortage
      GOTO Back
    CASE "CachShort"
      RankShortage
      GOTO Back
    CASE "CombinedS"
      RankShortage
      GOTO Back
    CASE "HydroGrph"
      HydroGraph
      GOTO Back
    CASE "HydroGph2"
      HydroGrph2
      GOTO Back
    CASE "JunQRank"
      RankFlow
      GOTO Back
    CASE "GibQRank"
      RankFlow
      GOTO Back
    CASE "CacQRank"
      RankFlow
      GOTO Back
    CASE "LomQRank"
      RankFlow
      GOTO Back
    CASE "No Graph!"
      GOTO Back
    CASE ELSE
Back: EXIT SUB
    END SELECT
END SUB
```

```
'GOTO THIS PROCEDURE WITH Elev7! SET....
DEFINT A-Z
SUB AreaVolSet STATIC
  Depth% = Pointer%(Resv%)
  Del! = Elev7! - Datum%(Resv%) + 1
  r:
  IF Del! < Depth% THEN GOTO Dwnr
  Depth% = Depth% + 1
  GOTO Upr
Dwnr:
  Depth% = Depth% - 1
  IF Del! < Depth% THEN GOTO Dwnr
Calcr:
  Diff! = Del! - INT(Del!)
  Volume7! = Diff! * (ResvCap!(Resv%, Depth% + 1) - ResvCap!(Resv%, Depth%)) + ResvCap!(Resv%, Depth
  Area7! = (ResvCap!(Resv%, Depth% + 1) - ResvCap!(Resv%, Depth% - 1) + Diff! * (ResvCap!(Resv%, Dep
  Pointer%(Resv%) = Depth%
END SUB
```

```
'THIS SUBROUTINE SELECTS LASER PRINTER OUTPUT FONT...
DEFINT A-Z
SUB SetPrinter
    WIDTH LPRINT 81
    LPRINT Esc$ + "(10U" + Esc$ + "(s0p10.9h12.0v0s0b3T";
    LPRINT Esc$ + "&l5E";          ' SETS TOP MARGIN (@ 5 lines down from top).
    LPRINT Esc$ + "&l6.5C";        ' SETS VERTICAL MOTION INDEX.
    LPRINT Esc$ + "&a4L";          ' LEFT MARGIN SET (4 cols. from left default).
    LPRINT Esc$ + "&a0R";          ' SETS CURSOR TO TOP MARGIN (must have this).
END SUB

'THIS SUBROUTINE SELECTS LASER PRINTER OUTPUT FONT (Fine Print)...
DEFINT A-Z
SUB SetPrinter2
    WIDTH LPRINT 103
    LPRINT Esc$ + "(10U" + Esc$ + "(s0p13.1h10.0v0s0b3T";
    LPRINT Esc$ + "&l2E";         ' SETS TOP MARGIN (@ 2 lines down from top).
    LPRINT Esc$ + "&l5.7C";       ' SETS VERTICAL MOTION INDEX.
    LPRINT Esc$ + "&a4L";         ' LEFT MARGIN SET (4 cols. from left default).
    LPRINT Esc$ + "&a0R";         ' SETS CURSOR TO TOP MARGIN (must have this).
END SUB
```

```
' This SUB displays selected SYR Reservoir shortages...
DEFINT A-Z
SUB RankShortage STATIC
DIM Sort!(76)
    CLS
    SCREEN ScrnType%        'Screen is 640 by 480 pixels
    PALETTE 0, 4144959      'Change Background from Black to White (0,15 is dark brown)
    COLOR 1                 'Changes White Text to Black
    BkGnd% = 14             'Background Color
    ForGnd% = 15            'Graph background color
    TopBot% = 5             'Top & Bottom of hydrograph box color
    Vert% = 2               'Graph vertical time lines color
    Xmin = 0
    Xmax = 100
    Ymin = 0
    Ymax = 100
    Image1$ = "\                    \########\                         \"
    VIEW (0, 0)-(639, 479), BkGnd%
    WINDOW (Xmin, Ymin - 8.252427)-(Xmax, Ymax + 8.252427)
    LINE (Xmin, Ymin)-(Xmax, Ymax), ForGnd%, BF
    LOCATE 1, 8: PRINT " SYRM 76 YEARS RANKED DELIVERIES:    Run of "; Timer$ + "    "; Dater$ + " "
    LOCATE 29, 7: PRINT " 10%      20%      30%      40%      50%      60%      70%      80%      90% ";
    LOCATE 30, 7: PRINT "      % Time Annual Delivery Is Equal or Less than Y Axis Amount       ";
    LINE (Xmin, Ymin)-(Xmax, Ymax), TopBot%, B
    X! = 10
    FOR Y! = 10 TO 90 STEP 10
      LINE (Xmin, Y!)-(Xmax, Y!), 8
    NEXT Y!
    FOR X! = 10 TO 90 STEP 10
      LINE (X!, Ymin)-(X!, Ymax), Vert%
    NEXT X!
    SELECT CASE GphType$
    CASE "JuncShort"
      LOCATE 2, 8: PRINT USING Image1$; " JAMESON LAKE Totl Draft ="; TotalDraft!(1); " afy.  Y Axis
      FullD! = TotalDraft!(1)
      Ptr% = 1
      GOTO Sel
    CASE "BaseShort"
      LOCATE 2, 8: PRINT USING Image1$; " PHANTOM Gibraltar Draft ="; 7278; " afy.  Y Axis Spacing =
      FullD! = 7278
      Ptr% = 2
      GOTO Sel
    CASE "GibrShort"
      LOCATE 2, 8: PRINT USING Image1$; " GIBRALTAR RES Tot Draft ="; TotalDraft!(2); " afy.  Y Axis
      FullD! = TotalDraft!(2)
      Ptr% = 3
      GOTO Sel
    CASE "CachShort"
      LOCATE 2, 8: PRINT USING Image1$; " CACHUMA PROJ Totl Draft ="; TotalDraft!(3); " afy.  Y Axis
      FullD! = TotalDraft!(3)
      Ptr% = 4
      GOTO Sel
    CASE "CombinedS"
      LOCATE 2, 8: PRINT USING Image1$; " JUN+GIB+CACH Totl Draft ="; TotalDraft!(4); " afy.  Y Axis
      FullD! = TotalDraft!(4)
      Ptr% = 5
      GOTO Sel
    CASE ELSE
      EXIT SUB
    END SELECT
Sel: Ptr1% = 0
    Ptr2% = NumYears%
    FOR I% = 1 TO NumYears%
      IF Ranker!(Ptr%, I%) = 0 THEN
        Sort!(Ptr2%) = FullD!
        Ptr2% = Ptr2% - 1
        GOTO N
      END IF
      Ptr1% = Ptr1% + 1
      Sort!(Ptr1%) = FullD! - Ranker!(Ptr%, I%)
N:  NEXT I%
    IF Ptr2% = 0 THEN
      LOCATE 12, 24
      PRINT " THERE ARE NO SHORTAGES IN THIS DATA!!!"
      GOTO D
    END IF
    FOR K% = 1 TO Ptr1%
      V! = 1000000!
      FOR I% = K% TO Ptr1%
        IF Sort!(I%) < V! THEN
          V! = Sort!(I%)
          Sort!(I%) = Sort!(K%)
          Sort!(K%) = V!
        END IF
```

```
        NEXT I%
      NEXT K%
      PSET (Xmin, 100 * Sort!(1) / FullD!), 1
      X! = 0!
      FOR I% = 1 TO NumYears%
        X! = X! + 100! / NumYears%
        Y! = 100! * Sort!(I%) / FullD!
        LINE (X! - 100! / NumYears%, 0)-(X!, Y!), 11, BF
        LINE (X! - 100! / NumYears%, 0)-(X!, Y!), 1, B
  Ni: NEXT I%
      X! = 0
      FOR I% = 1 TO NumYears%
        X! = X! + 100! / NumYears%
        Y! = 100! * Sort!(I%) / FullD!
        LINE (X!, .3)-(X!, Y!), 1
      NEXT I%
  D:  LINE (Xmin, Ymin - 8.252427)-(Xmax, Ymax + 8.252427), 6, B
      LINE (Xmin + .156, Ymin - 8.131068)-(Xmax - .156, Ymax + 8.131068), 6, B
      LINE (Xmin + .3, Ymin - 8.009709)-(Xmax - .3, Ymax + 8.009719), 6, B
      DO
      A$ = INKEY$
      LOOP WHILE A$ = ""
      IF A$ = CHR$(72) THEN
        SOUND 97, 3
        STOP
      END IF
      EXIT SUB
  END SUB
```

```
' This SUB Displays the Reservoir & Riparian GWB hydrographs...
DEFINT A-Z
SUB HydroGraph
   CLS
   SCREEN ScrnType%          'Screen is 640 by 480 pixels
   PALETTE 0, 4144959        'Change Background from Black to White (0,15 is dark brown)
   COLOR 1                   'Changes White Text to Black
   BkGnd% = 11               'Background Color
   ForGnd% = 15              'Graph background color
   TopBot% = 5               'Top & Bottom of hydrograph box color
   Vert% = 2                 'Graph vertical time lines color
   Xmn% = 0
   Xmx% = 912
   Ymn4% = 0
   Ymx4% = 152
   Ymn3% = 192
   Ymx3% = 472
   Ymn2% = 512
   Ymx2% = 664
   Ymn1% = 704
   Ymx1% = 824
   TopLine% = 860
   BotLine% = -36
   JunFac! = 1000! * (Ymx1% - Ymn1%) / MaxVol!(1)
   GibFac! = 1000! * (Ymx2% - Ymn2%) / MaxVol!(2)
   CacFac! = 1000! * (Ymx3% - Ymn3%) / MaxVol!(3)
   RipFac! = 1000! * (Ymx4% - Ymn4%) / (MaxVol!(4) - 50000!)
   DeltaX% = 60
   Gim1$ = "\                                    \######\                   \######\      \"
   Gim2$ = "\                                              \######\         \######\      \"
   VIEW (0, 0)-(639, 479), BkGnd%
   WINDOW (Xmn%, -68)-(Xmx%, 892)
   LINE (Xmn%, Ymn4%)-(Xmx%, Ymx4%), ForGnd%, BF
   LINE (Xmn%, Ymn3%)-(Xmx%, Ymx3%), ForGnd%, BF
   LINE (Xmn%, Ymn2%)-(Xmx%, Ymx2%), ForGnd%, BF
   LINE (Xmn%, Ymn1%)-(Xmx%, Ymx1%), ForGnd%, BF
   LOCATE 1, 15: PRINT " STORAGE HYDROGRAPHS:   Run of "; Timer$ + "  "; Dater$ + " "
   LOCATE 2, 3
   IF JunMinDelv! = 1 THEN
     PRINT USING Gim1$; " Juncal reservoir max volume ="; MaxVol!(1); " ac ft.;    Safe Yield = "; D
     GOTO 6591
   END IF
   PRINT USING Gim1$; " Juncal reservoir max volume ="; MaxVol!(1); " ac ft.;   Draft level = "; Dra
6591 : LOCATE 7, 3
   IF GibMinDelv! = 1 THEN
     PRINT USING Gim1$; " Gibraltar resrvr max volume ="; MaxVol!(2); " ac ft.;    Safe Yield = "; D
     GOTO 6592
   END IF
   PRINT USING Gim1$; " Gibraltar resrvr max volume ="; MaxVol!(2); " ac ft.;   Draft level = "; Dra
6592 : LOCATE 13, 3
   IF CacMinDelv! = 1 THEN
     PRINT USING Gim1$; " Cachuma reservor max volume ="; MaxVol!(3); " ac ft.;    Safe Yield = "; D
     GOTO 6593
   END IF
   PRINT USING Gim1$; " Cachuma reservor max volume ="; MaxVol!(3); " ac ft.;   Draft level = "; Dra
6593 : LOCATE 23, 3
   PRINT USING Gim2$; " Riparian storage (50 to 90 KAF);   M&I CU ="; SyMI! + BuMI!; "; AgAcres =";
   LOCATE 29, 2: PRINT " 20    25    30    35    40    45    50    55    60    65    70    75    80    85    9
   LOCATE 30, 7: PRINT " Graphs from Oct, 1917 thru Sep, 1993 (vertical lines set @ Jan 1) ";
   LINE (Xmn%, Ymn4%)-(Xmx%, Ymn4%), TopBot%
   LINE (Xmn%, RipFac! * (MaxVol!(4) / 1000 - 50))-(Xmx%, RipFac! * (MaxVol!(4) / 1000 - 50)), TopBo
   LINE (Xmn%, Ymn3%)-(Xmx%, Ymn3%), TopBot%
   LINE (Xmn%, CacFac! * MaxVol!(3) / 1000 + Ymn3%)-(Xmx%, CacFac! * MaxVol!(3) / 1000 + Ymn3%), Top
   LINE (Xmn%, Ymn2%)-(Xmx%, Ymn2%), TopBot%
   LINE (Xmn%, GibFac! * MaxVol!(2) / 1000 + Ymn2%)-(Xmx%, GibFac! * MaxVol!(2) / 1000 + Ymn2%), Top
   LINE (Xmn%, Ymn1%)-(Xmx%, Ymn1%), TopBot%
   LINE (Xmn%, JunFac! * MaxVol!(1) / 1000 + Ymn1%)-(Xmx%, JunFac! * MaxVol!(1) / 1000 + Ymn1%), Top
   FOR X! = 27 TO 867 STEP 60
     LINE (X!, Ymn4%)-(X!, Ymx4%), Vert%
     LINE (X!, Ymn3%)-(X!, Ymx3%), Vert%
     LINE (X!, Ymn2%)-(X!, Ymx2%), Vert%
     LINE (X!, Ymn1%)-(X!, Ymx1%), Vert%
   NEXT X!
   Y! = Ymn4% + 10 * RipFac!
   Ylast% = Ymx4%
   Ystep! = 10 * RipFac!
   GOSUB Hdraw
   Y! = Ymn3% + 25 * CacFac!
   Ylast% = Ymx3%
   Ystep! = 25 * CacFac!
   GOSUB Hdraw
   Y! = Ymn2% + GibFac!
   Ylast% = Ymx2%
   Ystep! = GibFac!
```

```
    GOSUB Hdraw
    Y! = Ymn1% + JunFac!
    Ylast% = Ymx1%
    Ystep! = JunFac!
    GOSUB Hdraw
    LINE (Xmn%, TopLine%)-(Xmx%, TopLine%), BkGnd%
    LINE (Xmn%, TopLine% + 2)-(Xmx%, TopLine% + 2), BkGnd%
    LINE (Xmn%, BotLine% + 2)-(Xmx%, BotLine% + 2), BkGnd%
    LINE (Xmn%, BotLine%)-(Xmx%, BotLine%), BkGnd%
    LINE (Xmn%, -68)-(Xmx%, 892), 6, B
    LINE (Xmn% + 1.4, -66)-(Xmx% - 1.4, 890), 6, B
    Vj! = Vjun! / 1000
    Vg! = Vgib! / 1000
    Vc! = Vcac! / 1000
    Vr! = Vrip! / 1000
    PSET (Xmn%, (Vr! - 50) * RipFac!), 1
    FOR J0% = 1 TO Xmx%
     LINE -(J0%, (VolGrph!(4, J0%) - 50) * RipFac!), 8
    NEXT J0%
    PSET (Xmn%, Ymn3% + Vc! * CacFac!), 1
    FOR J0% = 1 TO Xmx%
     IF VolGrph!(3, J0%) < CacStartShortage! THEN Colr% = 4 ELSE Colr% = 8
     LINE -(J0%, Ymn3% + VolGrph!(3, J0%) * CacFac! / 1000), Colr%
    NEXT J0%
    PSET (Xmn%, Ymn2% + Vg! * GibFac!), 1
    FOR J0% = 1 TO Xmx%
     IF VolGrph!(2, J0%) < GibStartShortage% THEN Colr% = 4 ELSE Colr% = 8
     LINE -(J0%, Ymn2% + VolGrph!(2, J0%) * GibFac! / 1000), Colr%
    NEXT J0%
    PSET (Xmn%, Ymn1% + Vj! * JunFac!), 1
    FOR J0% = 1 TO Xmx%
     IF VolGrph!(1, J0%) < JunStartShortage% THEN Colr% = 4 ELSE Colr% = 8
     LINE -(J0%, Ymn1% + VolGrph!(1, J0%) * JunFac! / 1000), Colr%
    NEXT J0%
    DO
    A$ = INKEY$
    LOOP WHILE A$ = ""
    IF A$ = CHR$(72) THEN
      SOUND 97, 3
      STOP
    END IF
    EXIT SUB
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Hdraw:
   LINE (Xmn%, Y!)-(Xmx%, Y!), 8, , &H8888
   Y! = Y! + Ystep!
   IF Y! >= Ylast% THEN GOTO R
   LINE (Xmx%, Y!)-(Xmn%, Y!), 8, , &H8888
   Y! = Y! + Ystep!
   IF Y! < Ylast% THEN GOTO Hdraw
R: RETURN
END SUB
```

```
' This SUB Displays the Riparian GWB hydrographs...
   DEFINT A-Z
SUB HydroGrph2
   CLS
   SCREEN ScrnType%          'Screen is 640 by 480 pixels
   PALETTE 0, 4144959        'Change Background from Black to White (0,15 is dark brown)
   COLOR 1                   'Changes White Text to Black
   BkGnd% = 10               'Background Color
   ForGnd% = 15              'Graph background color
   TopBot% = 5               'Top & Bottom of hydrograph box color
   Vert% = 2                 'Graph vertical time lines color
   Xmn% = 0
   Xmx% = 912
   Ymn4% = 0
   Ymx4% = 120
   Ymn3% = 160
   Ymx3% = 408
   Ymn2% = 448
   Ymx2% = 632
   Ymn1% = 672
   Ymx1% = 824
   TopLine% = 860
   BotLine% = -36
   SYnFac! = 1000! * (Ymx1% - Ymn1%) / 12600!
   BUeFac! = 1000! * (Ymx2% - Ymn2%) / 12300!
   SReFac! = 1000! * (Ymx3% - Ymn3%) / 13900!
   SRwFac! = 1000! * (Ymx4% - Ymn4%) / 2200!
   DeltaX% = 60
   Gim2$ = "\                                        \####\                  \####\      \"
   VIEW (0, 0)-(639, 479), BkGnd%
   WINDOW (Xmn%, -68)-(Xmx%, 892)
   LINE (Xmn%, Ymn4%)-(Xmx%, Ymx4%), ForGnd%, BF
   LINE (Xmn%, Ymn3%)-(Xmx%, Ymx3%), ForGnd%, BF
   LINE (Xmn%, Ymn2%)-(Xmx%, Ymx2%), ForGnd%, BF
   LINE (Xmn%, Ymn1%)-(Xmx%, Ymx1%), ForGnd%, BF
   LOCATE 1, 7: PRINT " RIPARIAN ZONE STORAGE HYDROGRAPHS:   Run of "; Timer$ + "   "; Dater$ + " "
   LOCATE 2, 3
   PRINT USING Gim2$; " Santa Ynez: (8 to 20.6 KAF)     M&I CU ="; SyMI!; " Ac-Ft;  AgAcres = "; .197
6691 : LOCATE 8, 3
   PRINT USING Gim2$; " Buellton:   (16 to 28.3 KAF)    M&I CU ="; BuMI!; " Ac=Ft;  AgAcres = "; .334
 692 : LOCATE 15, 3
   PRINT USING Gim2$; " E SantaRita: (20 to 33.9 KAF)   M&I CU ="; 0; " Ac-Ft;  AgAcres = "; .434 * A
6693 : LOCATE 24, 3
   PRINT USING Gim2$; " W SantaRita: (5.0 to 7.2 KAF)   M&I CU ="; 0; " Ac-Ft;  AgAcres = "; .035 * A
   LOCATE 29, 2: PRINT " 20   25   30   35   40   45   50   55   60   65   70   75   80   85   9
   LOCATE 30, 7: PRINT " Graphs from Oct, 1917 thru Sep, 1993 (vertical lines set @ Jan 1) ";
   LINE (Xmn%, Ymn4%)-(Xmx%, Ymn4%), TopBot%
   LINE (Xmn%, SRwFac! * (7.2 - 5))-(Xmx%, SRwFac! * (7.2 - 5)), TopBot%
   LINE (Xmn%, Ymn3%)-(Xmx%, Ymn3%), TopBot%
   LINE (Xmn%, SReFac! * (33.9 - 20) + Ymn3%)-(Xmx%, SReFac! * (33.9 - 20) + Ymn3%), TopBot%
   LINE (Xmn%, Ymn2%)-(Xmx%, Ymn2%), TopBot%
   LINE (Xmn%, BUeFac! * (28.3 - 16) + Ymn2%)-(Xmx%, BUeFac! * (28.3 - 16) + Ymn2%), TopBot%
   LINE (Xmn%, Ymn1%)-(Xmx%, Ymn1%), TopBot%
   LINE (Xmn%, SYnFac! * (20.6 - 8) + Ymn1%)-(Xmx%, SYnFac! * (20.6 - 8) + Ymn1%), TopBot%
   FOR X! = 27 TO 867 STEP 60
     LINE (X!, Ymn4%)-(X!, Ymx4%), Vert%
     LINE (X!, Ymn3%)-(X!, Ymx3%), Vert%
     LINE (X!, Ymn2%)-(X!, Ymx2%), Vert%
     LINE (X!, Ymn1%)-(X!, Ymx1%), Vert%
   NEXT X!
   Y! = Ymn4% + .5 * SRwFac!
   Ylast% = Ymx4%
   Ystep! = .5 * SRwFac!
   GOSUB Hdraw2
   Y! = Ymn3% + 2 * SReFac!
   Ylast% = Ymx3%
   Ystep! = 2 * SReFac!
   GOSUB Hdraw2
   Y! = Ymn2% + 2 * BUeFac!
   Ylast% = Ymx2%
   Ystep! = 2 * BUeFac!
   GOSUB Hdraw2
   Y! = Ymn1% + 2 * SYnFac!
   Ylast% = Ymx1%
   Ystep! = 2 * SYnFac!
   GOSUB Hdraw2
   LINE (Xmn%, TopLine% + 2)-(Xmx%, TopLine% + 2), BkGnd%
   LINE (Xmn%, TopLine%)-(Xmx%, TopLine%), BkGnd%
   LINE (Xmn%, BotLine%)-(Xmx%, BotLine%), BkGnd%
   LINE (Xmn%, BotLine% + 2)-(Xmx%, BotLine% + 2), BkGnd%
   LINE (Xmn%, -68)-(Xmx%, 892), 6, B
   LINE (Xmn% + 1.4, -66)-(Xmx% - 1.4, 890), 6, B
   Vs! = (20600 - 8000 - .252 * (90000 - Vrip!)) / 1000
   Vb! = (28300 - 16000 - .485 * (90000 - Vrip!)) / 1000
```

```
    Ve! = (33900 - 20000 - .244 * (90000 - Vrip!)) / 1000
    Vw! = (7200 - 5000 - .019 * (90000 - Vrip!)) / 1000
    PSET (Xmn%, Vw! * SRwFac!), 1
    FOR J0% = 1 TO Xmx%
     LINE -(J0%, (VolGrph!(8, J0%) / 1000 - 5) * SRwFac!), 8
    NEXT J0%
    PSET (Xmn%, Ymn3% + Ve! * SReFac!), 1
    FOR J0% = 1 TO Xmx%
     LINE -(J0%, Ymn3% + (VolGrph!(7, J0%) / 1000 - 20) * SReFac!), 8
    NEXT J0%
    PSET (Xmn%, Ymn2% + Vb! * BUeFac!), 1
    FOR J0% = 1 TO Xmx%
     LINE -(J0%, Ymn2% + (VolGrph!(6, J0%) / 1000 - 16) * BUeFac!), 8
    NEXT J0%
    PSET (Xmn%, Ymn1% + Vs! * SYnFac!), 1
    FOR J0% = 1 TO Xmx%
     LINE -(J0%, Ymn1% + (VolGrph!(5, J0%) / 1000 - 8) * SYnFac!), 8
    NEXT J0%
    DO
    A$ = INKEY$
    LOOP WHILE A$ = ""
    IF A$ = CHR$(72) THEN
      SOUND 97, 3
      STOP
    END IF
    EXIT SUB
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Hdraw2:
  LINE (Xmn%, Y!)-(Xmx%, Y!), 8, , &H8888
  Y! = Y! + Ystep!
  IF Y! >= Ylast% THEN GOTO R2
  LINE (Xmx%, Y!)-(Xmn%, Y!), 8, , &H8888
  Y! = Y! + Ystep!
  IF Y! < Ylast% THEN GOTO Hdraw2
R2: RETURN
END SUB
```

```
' SUBROUTINE TO RANK FLOWS @ POINTS ALONG THE SANTA YNEZ RIVER.....
DEFINT A-Z
SUB RankFlow
DIM Sort!(76), Rnker!(4, 76)
    CLS
    SCREEN ScrnType%        'Screen is 640 by 480 pixels
    PALETTE 0, 4144959      'Change Background from Black to White (0,15 is dark brown)
    COLOR 1                 'Changes White Text to Black
    BkGnd% = 14             'Background Color
    ForGnd% = 15            'Graph background color
    TopBot% = 5             'Top & Bottom of hydrograph box color
    Vert% = 4               'Graph vertical time lines color
    SELECT CASE GphType$
    CASE "JunQRank"
      Ptr% = 6
      Title$ = "   JAMESON LAKE RANKED INFLOW: (Scale in KAF per year)    "
      Ymin! = 100
      Ymax! = 100000
      Y1$ = ".1 "
      Y2$ = " 1 "
      Y3$ = " 10 "
      Y4$ = " 100 "
      GOTO Sly
    CASE "GibQRank"
      Ptr% = 7
      Title$ = "   GIBRALTAR RESERVOIR RANKED INFLOW: (Scale = KAF/Yr)    "
      Ymin! = 1000
      Ymax! = 1000000
      Y1$ = " 1 "
      Y2$ = " 10 "
      Y3$ = " 100 "
      Y4$ = " 1000 "
      GOTO Sly
    CASE "CacQRank"
      Ptr% = 8
      Title$ = "   CACHUMA RESERVOIR RANKED INFLOW: (Y Scale = KAF/Yr)    "
      Ymin! = 1000
      Ymax! = 1000000
      Y1$ = " 1 "
      Y2$ = " 10 "
      Y3$ = " 100 "
      Y4$ = " 1000 "
      GOTO Sly
    CASE "LomQRank"
      Ptr% = 9
      Title$ = "   SY RIVER @ LOMPOC NARROWS RANKED FLOWS:  (KAF/Year)    "
      Ymin! = 1000
      Ymax! = 1000000
      Y1$ = " 1 "
      Y2$ = " 10 "
      Y3$ = " 100 "
      Y4$ = " 1000 "
      GOTO Sly
    CASE ELSE
      EXIT SUB
    END SELECT
Sly: Xmin = 0
    Xmax = 100
    Ymn! = LOG(Ymin!) / LOG(10#)
    Ymx! = LOG(Ymax!) / LOG(10#)
    Delta! = (Ymx! - Ymn!) / 800
    VIEW (0, 0)-(639, 479), BkGnd%
    WINDOW (Xmin, Ymn! - 80 * Delta!)-(Xmax, Ymx! + 80 * Delta!)
    LINE (Xmin, Ymn!)-(Xmax, Ymx!), ForGnd%, BF
    LOCATE 1, 12: PRINT Title$
    LOCATE 2, 8: PRINT " SYRM 76 WTRYR FLOW RANKING CHART:   Run of "; Timer$ + "  "; Dater$ + " "
    LOCATE 29, 7: PRINT " 10%     20%     30%     40%     50%     60%     70%     80%     90% ";
    LOCATE 30, 7: PRINT "   % Time Annual River Flow Is Equal or Greater than Y Axis Amount.  ";
    COLOR 8
    FOR Y! = Ymn! + 1 TO Ymx! STEP 1
      LINE (Xmin, Y!)-(Xmax, Y!)
    NEXT Y!
    FOR J! = Ymn! TO Ymx! - .999999 STEP 1
      FOR Yer! = 2 * (10 ^ J!) TO 9 * (10 ^ J!) STEP 10 ^ J!
        LINE (Xmin, LOG(Yer!) / LOG(10#))-(Xmax, LOG(Yer!) / LOG(10#))
      NEXT Yer!
    NEXT J!
    FOR X! = 10 TO 90 STEP 10
      LINE (X!, Ymn!)-(X!, Ymx!), Vert%
    NEXT X!
    K% = 1
    Ptr% = Ptr% - 5
    FOR I% = 1 TO NumYears%
      Rnker!(Ptr%, I%) = Ranker!(Ptr% + 5, I%)
```

```
      NEXT I%
      FOR I% = 1 TO NumYears%
        Max! = 0
        FOR J% = I% TO NumYears%
          IF Rnker!(Ptr%, J%) > Max! THEN
            Max! = Rnker!(Ptr%, J%)
            K% = J%
          END IF
        NEXT J%
        Sort!(I%) = Max!
        IF Sort!(I%) = 0 THEN Sort!(I%) = .00001
        Rnker!(Ptr%, K%) = Rnker!(Ptr%, I%)
  En: NEXT I%
      PSET (Xmin, LOG(Sort!(1)) / LOG(10#)), 1
      X! = 0!
      FOR I% = 1 TO NumYears%
        X! = X! + 100! / NumYears%
        Y! = LOG(Sort!(I%)) / LOG(10#)
        IF Y! >= Ymn! THEN
          LINE (X! - 100! / NumYears%, Ymn!)-(X!, Y!), 11, BF
          LINE (X! - 100! / NumYears%, Ymn!)-(X!, Y!), 1, B
        END IF
      NEXT I%
      LINE (Xmin, Ymn!)-(Xmax, Ymx!), TopBot%, B
      COLOR 1
      IF GphType$ = "JunQRank" THEN
        LOCATE 28, 77: PRINT Y1$
        LOCATE 20, 77: PRINT Y2$
        LOCATE 11, 76: PRINT Y3$
        LOCATE 3, 75: PRINT Y4$
       ELSE
        LOCATE 28, 77: PRINT Y1$
        LOCATE 20, 76: PRINT Y2$
        LOCATE 11, 75: PRINT Y3$
        LOCATE 3, 74: PRINT Y4$
      END IF
      LINE (Xmin, Ymn! - 80 * Delta!)-(Xmax, Ymx! + 80 * Delta!), 4, B
      LINE (Xmin + .16, Ymn! - 78 * Delta!)-(Xmax - .16, Ymx! + 78 * Delta!), 4, B
      DO
      A$ = INKEY$
      LOOP WHILE A$ = ""
      IF A$ = CHR$(72) THEN
        SOUND 97, 3
        STOP
      END IF
      EXIT SUB
  END SUB
```

APPENDIX B

APPENDIX B

"Runmodel" SUBPROGRAM SPECIAL FUNCTIONS

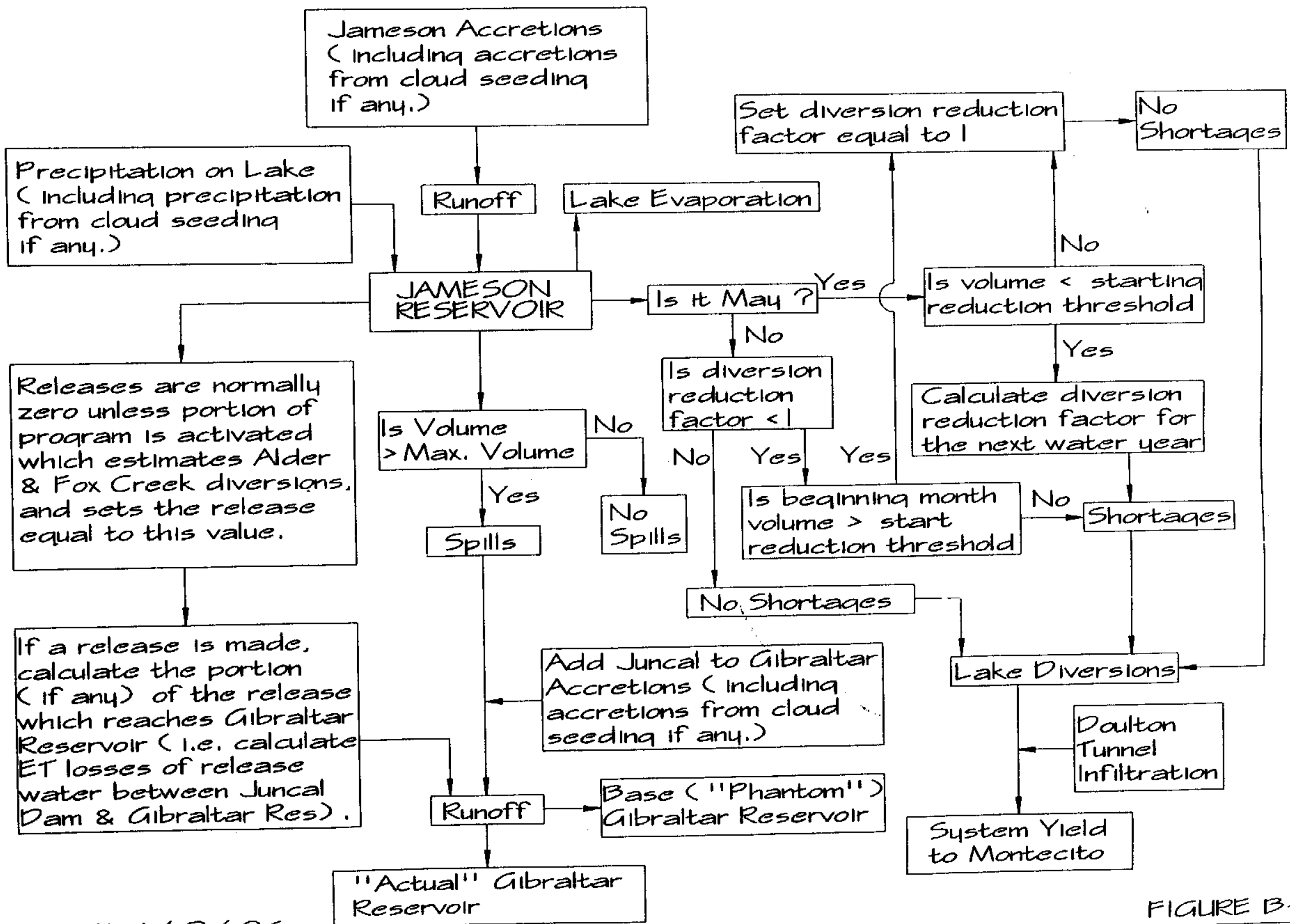
This Appendix provides a detailed discussion of the model simulation of the Santa Ynez River Hydrologic System described in Section 2. A flow chart representation of the model simulation is included in Figures B-1 through B-5. Many of the Model fixed and variable numeric terms are discussed here, and with their definitions are listed in Appendix C. While it is not practical within this document to explain the origin and basis of each of the hydrologic constants used in the model, it may be noted that the constants were discussed and agreed upon by the various interests making up the Santa Ynez River Hydrology Committee before being incorporated into the model. Justification for many of the constants may be found in Appendix E, the Data Base.

In the following discussions the constants and variables named are in bold print. Here and in the model code printout (Appendix A) these names are followed by % or ! indicating that the constant or variable is an integer or a short precision (7 digit accuracy) number respectively. Array variable names are followed by () indicating two or more numbers in a dimensioned array.

B1 CLOUD SEEDING AUGMENTATION

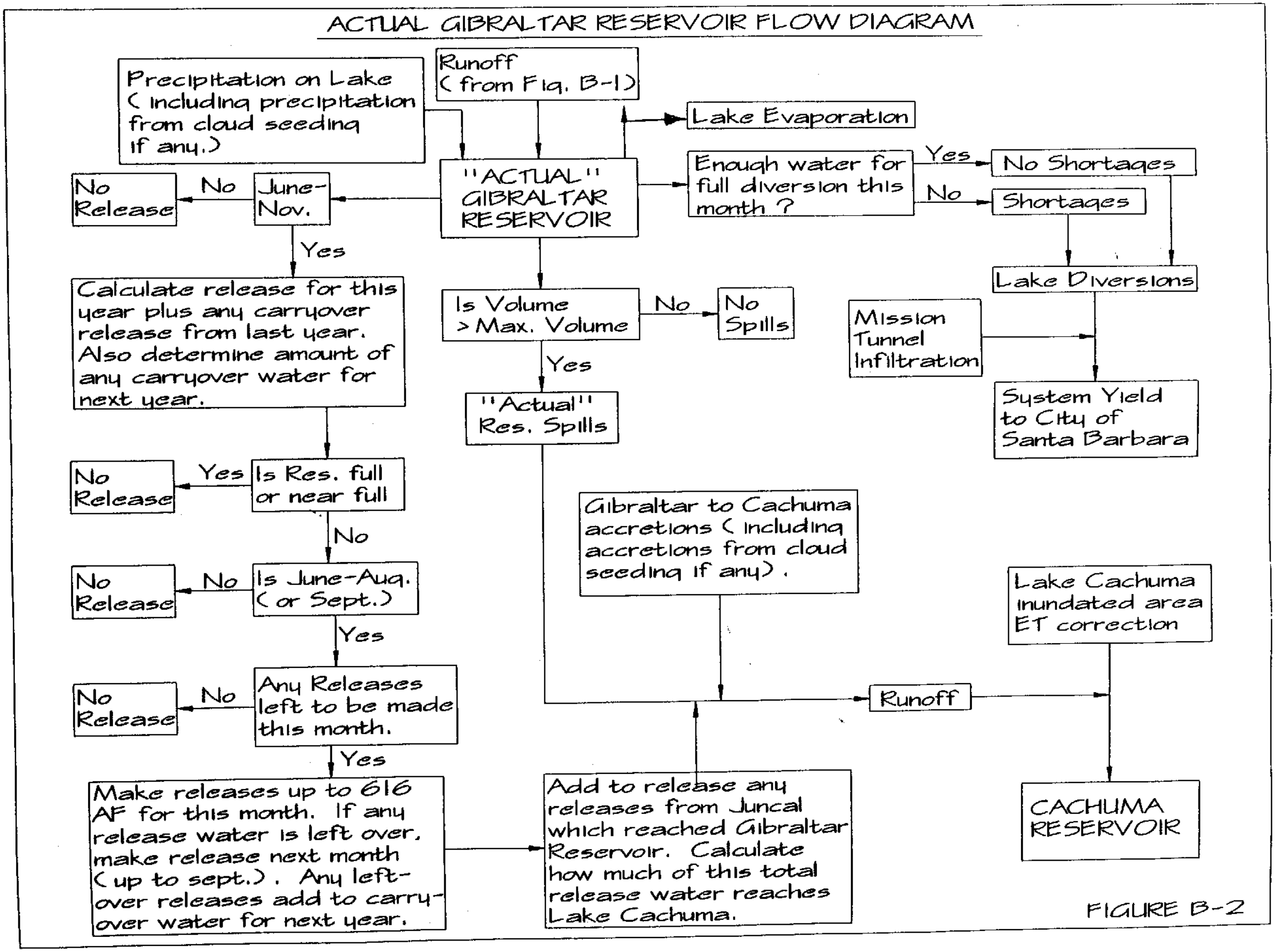
At the beginning of the monthly loop, the model runs a number of tests to establish whether cloud seeding operations are to be conducted for the current month (Current month refers to the month upon which the model is currently running calculations). The model

JAMESON RESERVOIR FLOW DIAGRAM



SBCWA: 1/ 8/ 96

FIGURE B-1



ACTUAL GIBRALTAR RESERVOIR FLOW DIAGRAM
Precipitation on Lake (including precipitation from cloud seeding if any.)
Runoff (from Fig. B-1)
Lake Evaporation
"ACTUAL" GIBRALTAR RESERVOIR
Enough water for full diversion this month ?
Yes
No
No Shortages
Shortages
Lake Diversions
Mission Tunnel Infiltration
System Yield to City of Santa Barbara
No Release
No
June-Nov.
Yes
Calculate release for this year plus any carryover release from last year. Also determine amount of any carryover water for next year.
Is Volume > Max. Volume
No
No Spills
Yes
"Actual" Res. Spills
No Release
Yes
Is Res. full or near full
No
No Release
No
Is June-Aug. (or Sept.)
Yes
No Release
No
Any Releases left to be made this month.
Yes
Make releases up to 616 AF for this month. If any release water is left over, make release next month (up to sept.). Any left-over releases add to carry-over water for next year.
Gibraltar to Cachuma accretions (including accretions from cloud seeding if any).
Lake Cachuma inundated area ET correction
Runoff
Add to release any releases from Juncal which reached Gibraltar Reservoir. Calculate how much of this total release water reaches Lake Cachuma.
CACHUMA RESERVOIR

FIGURE B-2

BASE GIBRALTAR RESERVOIR FLOW DIAGRAM

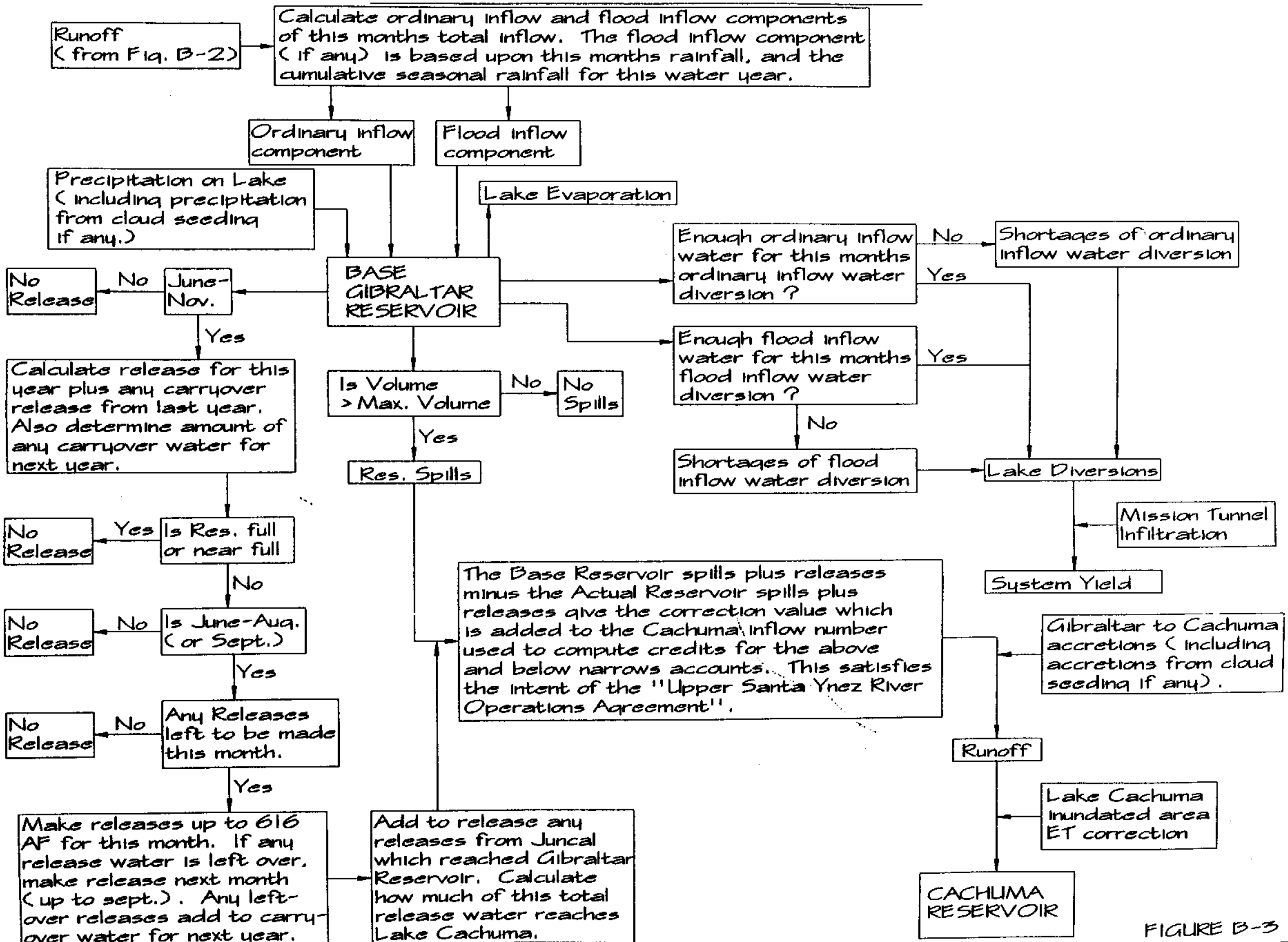
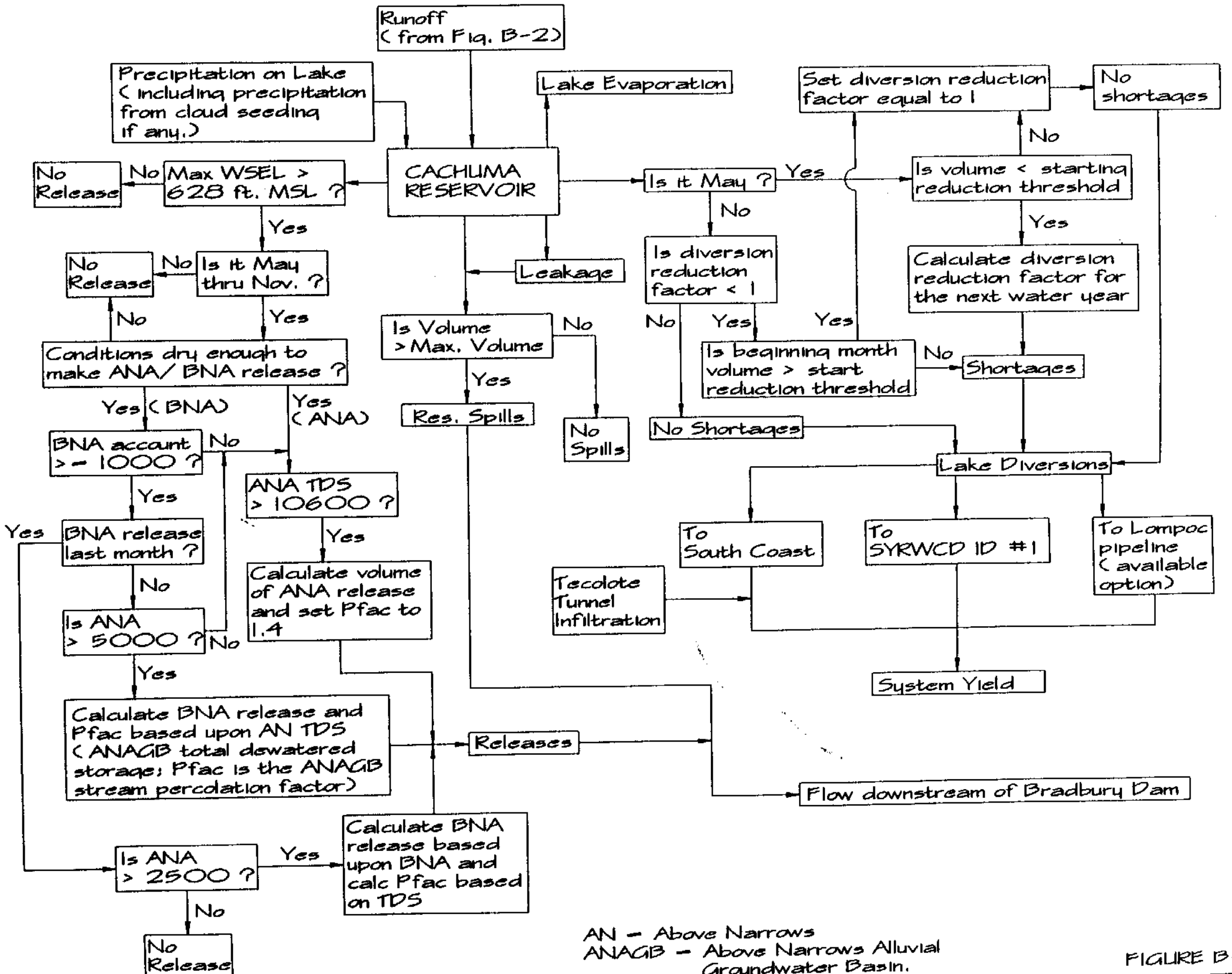


FIGURE B-3

For continuation see Cachuma Reservoir on next page

CACHUMA RESERVOIR FLOW DIAGRAM



AN – Above Narrows
ANAGB – Above Narrows Alluvial Groundwater Basin.

FIGURE B-4

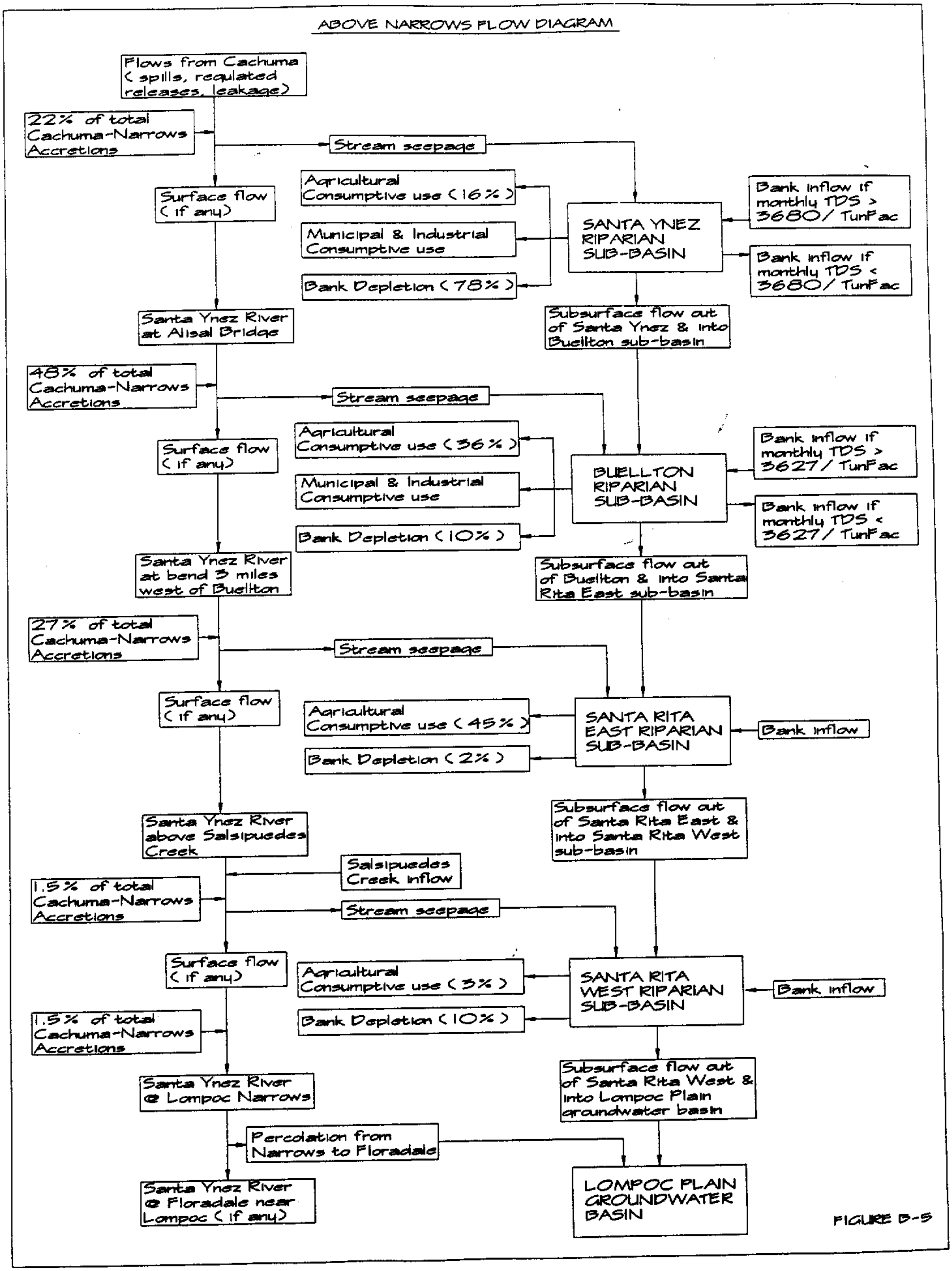

ABOVE NARROWS FLOW DIAGRAM
Flows from Cachuma (spills, regulated releases, leakage)
22% of total Cachuma-Narrows Accretions
Stream seepage
Surface flow (if any)
Agricultural Consumptive use (16%)
Municipal & Industrial Consumptive use
Bank Depletion (78%)
SANTA YNEZ RIPARIAN SUB-BASIN
Bank inflow if monthly TDS > 3680 / TunFac
Bank inflow if monthly TDS < 3680 / TunFac
Santa Ynez River at Alisal Bridge
Subsurface flow out of Santa Ynez & into Buellton sub-basin
48% of total Cachuma-Narrows Accretions
Stream seepage
Surface flow (if any)
Agricultural Consumptive use (36%)
Municipal & Industrial Consumptive use
Bank Depletion (10%)
BUELLTON RIPARIAN SUB-BASIN
Bank inflow if monthly TDS > 3627 / TunFac
Bank inflow if monthly TDS < 3627 / TunFac
Santa Ynez River at bend 3 miles west of Buellton
Subsurface flow out of Buellton & into Santa Rita East sub-basin
27% of total Cachuma-Narrows Accretions
Stream seepage
Surface flow (if any)
Agricultural Consumptive use (45%)
Bank Depletion (2%)
SANTA RITA EAST RIPARIAN SUB-BASIN
Bank inflow
Santa Ynez River above Salsipuedes Creek
Subsurface flow out of Santa Rita East & into Santa Rita West sub-basin
Salsipuedes Creek inflow
1.5% of total Cachuma-Narrows Accretions
Stream seepage
Surface flow (if any)
Agricultural Consumptive use (3%)
Bank Depletion (10%)
SANTA RITA WEST RIPARIAN SUB-BASIN
Bank inflow
1.5% of total Cachuma-Narrows Accretions
Santa Ynez River @ Lompoc Narrows
Subsurface flow out of Santa Rita West & into Lompoc Plain groundwater basin
Percolation from Narrows to Floradale
Santa Ynez River @ Floradale near Lompoc (if any)
LOMPOC PLAIN GROUNDWATER BASIN

FIGURE B-5

uses a water year from October through September in order to conform to historic practices. The maximum cloud seeding time window is October through April. In the model the default time window is December through April, only. In any case, the model checks if the current month falls within the permissible cloud seeding time period. If not, the model turns off the "cloud seeding flag" **CsFlag%** used to initiate cloud seeding calculations. **CsFlag%** is the mechanism by which the program determines whether to include calculations of the effects of cloud seeding for a given month. It has a value of zero, in the non-active mode, or one, in the active-mode.

If **CsFlag%** is activated for the current month, the model makes a preliminary calculation of the month's ending storage volume at Cachuma Reservoir. In making that calculation, the potential sources of inflow (accretions) to the reservoir must be evaluated. The accretions (**Accret%**(N,*), **Salsi%**(*); where N may vary from 1 to 4, and *,the modelling period month, varies from 1 to 912) are separated into five areas or files. **Accret%**(1,*), **Accret%**(2,*), **Accret%**(3,*), **Accret%**(4,*), and **Salsi%**(*) refer to accretions to Jameson Reservoir, from Juncal Dam to Gibraltar Reservoir, from Gibraltar Dam to Cachuma Reservoir, from Cachuma Dam to Lompoc, and Salsipuedes Creek near Lompoc, respectively. Within the model, if cloud seeding is activated, the decision of whether to cloud seed is based on the available storage space in Cachuma Reservoir. Therefore, accretions into Jameson Reservoir, between Juncal Dam and Gibraltar Reservoir, and between Gibraltar Dam and Cachuma Reservoir are added to the last month's ending storage volume at Cachuma Reservoir. Subsequently, the sum of the Lake diversions planned for the current month from Jameson, Gibralter, and Cachuma reservoirs is added to the dewatered slab volumes (the volume of water required to fill the reservoir) at Jameson and Gibraltar and this combined sum is subtracted from the above total. If the resulting volume is greater than the maximum capacity of Cachuma Reservoir, there will be a spill at Bradbury Dam (a potential high flow condition), and therefore, **CsFlag%** is set to zero (inactive) for current and succeeding months (through April) calculations. This prevents the effects of cloud seeding from being included in calculations during very wet periods during which, in reality, seeding operations would be discontinued. (In reality, seeding may also be suspended or limited in response to environmental conditions such as recently burned or flood sensitive areas).

The cloud seeding factor (**CsFac!**), which is set to **CsEff!** for each water year indicates the effectiveness of cloud seeding operations for a given month in terms of a percent of the maximum possible incremental precipitation by cloud seeding (**CsInc%**(N,*)). **CsInc%**() was determined by North American Weather Consultants (NAWC) using historical storm and precipitation data (See Section 3 and Appendix E). **CsEff!** allows selection of a conservative estimate of cloud seeding benefits in order to provide for the possibility that not all of the storms would be seeded nor would they be seeded to the maximum extent possible.

If the accretions between Juncal Dam and Gibraltar Reservoir for the current month exceed 60,000 acre feet (indicating a year wet enough that seeding efforts may be limited), then the model provides a mechanism to further reduce **CsFac!** below the **CsEff!** level. This reduction mechanism ramps down **CsFac!** by multiplying **CsEff!** by the quantity 100,000 acre feet, minus the Juncal to Gibraltar accretions, quantity divided by 40,000 acre feet. If the accretions are greater than 60,000 acre feet, **CsFac!** will be reduced to some fraction of **CsEff!**. If this equation should result in a **CsFac!** that is less than or equal to zero, then **CsFlag%** is set to zero thereby eliminating the effects of cloud seeding. In the subsequent month's loop, the model checks the previous month's

CsFac! value. If it has been reduced, **CsFlag%** is again set to zero. Again, the purpose of these calculations is to eliminate or reduce augmentation of rainfall within the model during years with significant runoff or full reservoir conditions, thereby providing a reasonable simulation of actual procedures.

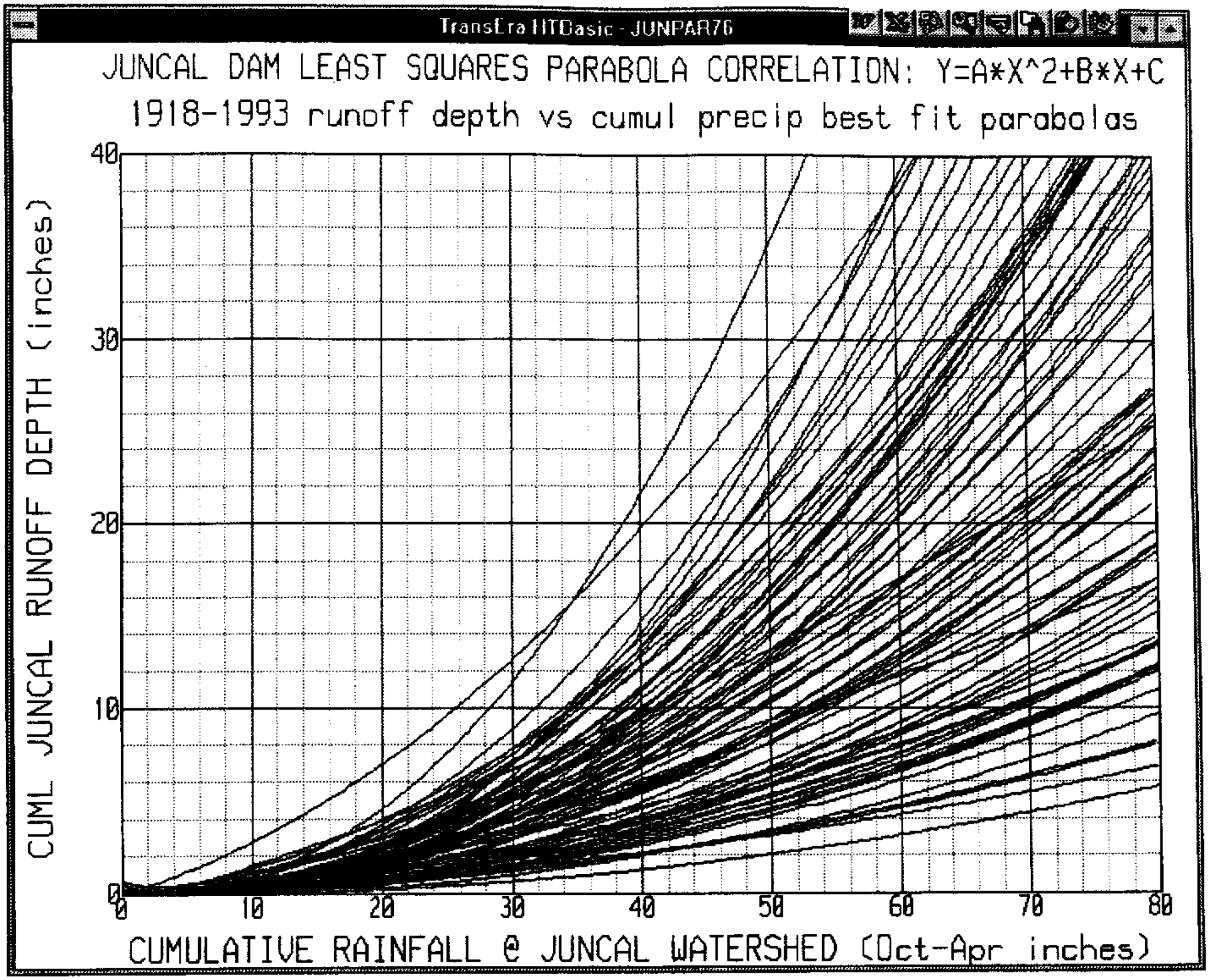
For all three of the reservoirs, the model uses a least squares parabola correlation method to determine the incremental runoff increase due to cloud seeding (**RunoffInc!**). Historical runoff (**Accret%**()) and precipitation data (**Rain%**()) were used to produce a family of seventy six, yearly, computer generated parabolas for each of the five accretion items described above (For an example of these parabolas see Figure B-6). A unique curve is used for each year (1918 through 1993) to account for differences in the precipitation-stream flow relationship that actually occurred during these years. The year to year variations occur as a result of changes in precipitation which affects the amount of moisture that is held by the watershed soil and thus the amount of water available for runoff. Runoff depth is the depth of water, from the entire watershed area, needed to produce a specific amount of runoff to a reservoir or to the downstream end of the watershed. Each parabola represents the cumulative seasonal runoff depth in inches (the Y-axis) plotted against the cumulative seasonal precipitation (the X-axis) also expressed in inches.

These parabolas are used by the model to estimate the total amount of inflow to the reservoir resulting from cloud seeding. The general equation describing these parabolas is:

$$Y = A*X^2 + B*X + C$$

Where Y is the total runoff depth in inches (Y - axis) for the cumulative amount of seasonal precipitation at point X (X - axis).

Figure B - 6



Runoff Depth vs Seasonal Rainfall Relationships at Juncal Dam

The constants A, B, and C determine a specific parabola for a given year. **X!** is equal to the accumulated rainfall for the water year **JpSum!** (including the effects of cloud seeding) plus the current month's un-agumented precipitation (**Rain%**()) divided by three. For Jameson Reservoir:

X! = **JpSum!** + **Rain%**()/3

Rain%() is divided by three in the above, in order to reduce, slightly, the point along the parabola at which the runoff is determined, thereby providing a somewhat more conservative estimate of **RunoffInc!** than if **Rain%**() was divided by two.

The derivative of the general parabola equation yields the equation for the slope of the parabola which is used to calculate **RunoffInc!**. The derivative equation for the parabola is:

dY/dX = 2*A***X!** + B

The model equivalent of dX is **RainInc!** which is **CsEff!** multiplied by **CsInc%**(1,*) for the current month. dY can be determined algebraically as follows:

dY = (2*A***X!** + B) * dX

For Jameson Reservoir the model generated equivalent of the slope equation is:

Slope! = 2*(**JunPar![A]**)***X!** + **JunPar![B]**

where **Junpar![A]** and **Junpar![B]** refer to constants for the specific parabola for Jameson Reservoir for the current year. The model limits the value of the slope to between zero and .95. If **X!** is less than nine inches (derived by review of data), no **RunoffInc!** is calculated because the benefit from cloud seeding is considered insignificant (i.e. the slope of the parabola is small). Finally, **RunoffInc!** is the product of the Juncal Watershed Factor **741.3** acre feet per inch (of runoff depth) times **RainInc!** times **Slope!** (as determined above). The 741.3 equals 13.9 sq. mi. (watershed area) times 640 (acres per sq. mi.) divided by 12 (in. per foot). These equations indicate that the contribution to runoff from cloud seeding increases in direct proportion to the cumulative seasonal rainfall and also in direct proportion to the effective cloud seeding rainfall increment for this month.

Cloud Seeding calculations for Gibraltar and Cachuma Reservoirs are similar to those for Jameson Reservoir with a few exceptions. No **RunoffInc!** is calculated for Gibraltar Reservoir and Cachuma Reservoir when the **X!** values are less than eight and seven inches, respectively. This is to compensate for the measured decrease in average precipitation at the lower reservoirs to the west of Juncal Reservoir. Due to the variation in watershed areas, the Gibraltar Watershed Factor is **10,773** acre feet per inch and the Cachuma Watershed Factor is **10,720** acre feet per inch. In addition, calculations of **X!**, **RainInc!**, and the current augmented rainfall for Cachuma Reservoir (**CpSum!**) utilize the average rainfall and cloud seeding increment values from Gibraltar and Cachuma Reservoirs.

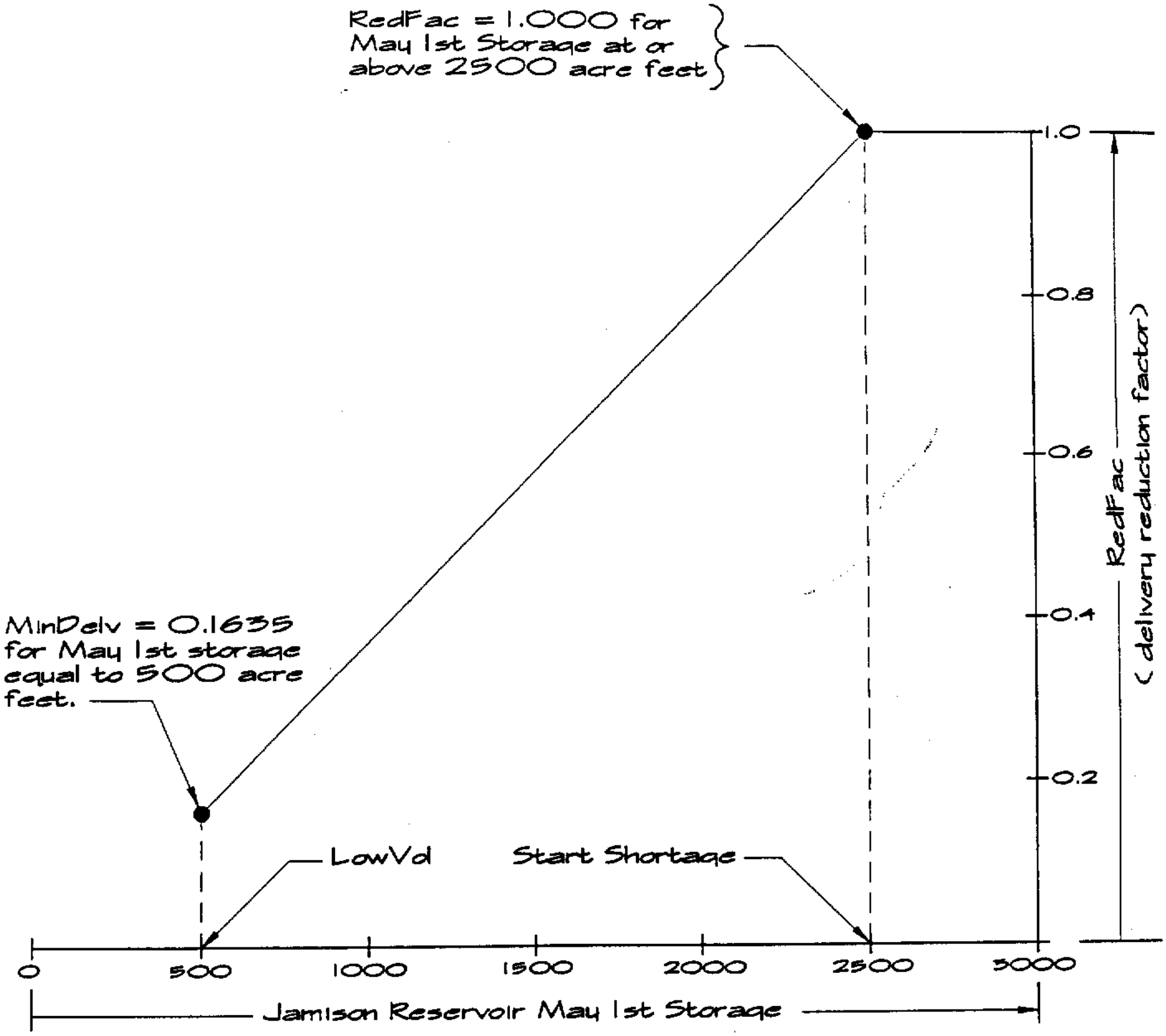
B2 DRAFT REDUCTION

In the following discussion the names for various model numeric constants are, in the actual model code, all prefixed by **Jun**, **Gib**, or **Cac** (in reference to operations performed at Juncal, Gibraltar, or Cachuma reservoirs; see model code in Appendix A, p. A-19).

The ramp function or draft reduction factor **RedFac!** (prefixed by **Jun, Gib,** or **Cac**) executes a reduction in reservoir draft which is proportional to each years May 1st storage volume of the reservoir below a menu specified start reduction threshold (See Section 4.2.1). If an annual draft is chosen which is to be maintained through the "critical drought" without reductions, no ramp function is used (This is called a "safe yield" operation). A ramp function is employed when the desired reservoir diversion is greater than the safe yield. This is the means by which long term average yields larger than the safe yield may be achieved. The ramp function is fixed by specifying three variables. These are the storage volume at which shortages are to be initiated (**StartShortage%** [for Cachuma, **StartShortage!**]), an arbitrarily selected low storage point (**LowVol%** [lower than **StartShortage%**]), and the delivery factor (**MinDelv!**) which would equal **RedFac!** if the May 1st reservoir storage were equal to **LowVol%**.

The relationship between these variables is illustrated in Figure B-7. Note that the ramp is determined by the position of **StartShortage%, MinDelv!,** and **LowVol%**. Below the **StartShortage%** point, the annual draft (as determined on the 1st of each May) decreases as the May 1st reservoir volume decreases. The modeling period minimum storage volume is determined by the ramp, and may be changed by adjusting the reservoir draft level and/or the **MinDelv!** value. Manipulation of these variables allows for selection of a minimum reservoir volume through the "critical drought" including the effects of evaporation and diversions.

At the beginning of the program, **RedFac!** for each reservoir is set to one (100 percent of requested draft) and no ramp is implemented.



Default Menu "Ramp" Function at Juncal

FIGURE B-7

Upon entering the monthly loop, the model checks if the current month is May. If so, it checks if the end of the month volume (**EndMoVol!**()) for the previous month is less than the predetermined **StartShortage%** value for each reservoir. If it is, the ramp function is initiated. The equation to calculate **RedFac!** is:

RedFac! = (**EndMoVol!**(N) - **LowVol!** + **MinDelv!** * (**StartShortage%** - **EndMoVol!**(N))) / (**StartShortage%** - **LowVol%**)

Note that EndMoVol!(N) is an array variable where N varies from 1 to 3 (for the three reservoirs). For each month other than May for each reservoir (See Figures B1 and B4), the program restores **RedFac!** to one if **EndMoVol!**(N) exceeds **StartShortage%,** thereby eliminating the ramp effect for the subsequent month.

The model output provides, in tabular form, the system yield over the 76 year modeling period and indicates what percentage of months in those years result in water yields below the desired draft amount (Table 4-3). The actual water year delivery distribution for each reservoir is also output in the form of a ranked bar graph (Figure 4-4). If no values are selected for the above parameters, the computer assigns default values for each reservoir. The default values are included in Figure 4-2 under "INITIAL RESRV/BASN CONDITIONS".

B3 RESERVOIR WATER ACCOUNTING

A key function of the model is to keep track of all of the sources of reservoir inflow and outflow for each month and each year of the modeling period. The model does this using accumulators for each hydrologic component required to account for all water entering and leaving each reservoir. In the subprogram entitled "Runmodel" (Appendix A, Pgs. 15-18), all of the hydrologic component accumulators effecting reservoir storage are set to zero and various reservoir and groundwater basin variables are assigned an appropriate initial value. New values for all of the variables are calculated for each month of the modeling period within the monthly loop. One such variable, Reservoir Accretions (**Accr!**) refers to all of the runoff into the reservoir (except upstream spills) plus the runoff resulting from cloud seeding (**RunoffInc!**), excluding rainfall directly on the lake. Total reservoir surface inflow (**Inflow!**) is equal to **Accr!** plus upstream spills (**UpStrmSpill!**). Rain on the lake is accounted for separately in the **"Reservoir"** subroutine (See Pg. 34, Appendix A). The current month's total rain (**Rainer!**) is equal to the current month's natural rainfall plus the rain due to cloud seeding augmentation (**RainInc!**). **RunoffInc!** and **RainInc!** are discussed in section B1. The yearly accumulated total runoff (**Annrunoff!**()) for each reservoir is simply the previous month's **Annrunoff!**() plus the current month's inflow as calculated above. **UpStrmSpill!** is always zero for Jameson Reservoir because there are no upstream reservoirs.

The model keeps track of the total number of months in which the specified yield cannot be maintained and keeps a running total volume for each reservoir, **Volume7!** (saved as **EndMoVol!**() each month). **Short!** when preceded by **Jun**, **Gib**, or **Cac** to indicate the specific reservoir, is equal to the current month's diversion shortages. This quantity is stored as **TabValue!**(N,*) (see Table 4-1 on p. 38; N may vary from 1 to 15, but shortages are saved in the first 5 tables representing the three reservoirs plus the base operations at Gibraltar plus the combined shortages for the three reservoirs). **AnnShort!**() is equal to the current year accumulated shortage plus the current month shortage. **AnnShort!**() is compared to earlier years greatest deficit within the annual loop of the model and the most extreme shortage during the 76 year modeling period is saved as **Sworst!**() and listed in the printout as 'Maxyrshrt" (see Manual Section 4, p. 42, Figure 4-2, part D).

The "**Reservoir**" Subroutine establishes an end of the month area, elevation, and volume for each reservoir, provides a mechanism for emptying a given reservoir in proportion to all of the reservoir hydrologic inflows and outflows, and provides accounting for all of the hydrologic variables. Each of the three reservoir sections are directed to the subroutine within the monthly loop. The "Base" operations Gibralter reservoir accounting is performed each month in a separate part of the monthly code loop.

Rainfall directly on the lake (**Prc!**) is equal to the current month's total rain (**Rainer!**) multiplied by reservoir area (**Area7!**). Monthly pan evaporation is multiplied by a pan factor (**PanFac!**()) and the reservoir area to determine Lake evaporation. The pan factor compensates for differences in physical conditions between the pan and reservoir. The pan factor for Juncal and Gibraltar have been determined to be .8 for each month. Cachuma Reservoir's pan factor values range from a minimum of .65 in January to a maximum of .82 in June. The evaporation data used in the model for the base years prior to reservoir construction or pan measurements was synthesized (See Section 3.2.3).

Two iterations of volume calculations are included in the "**Reservoir**" Subroutine. The first iteration calculates volume using rain on (**Prc!**), and evaporation from (**Evp!**), the reservoir based on the beginning of the current month's reservoir area. The equation is as follows:

Volume7! = Volume7! + Inflow! + Prc! - LakeDiv! - RegulRelease!
- Evp! - Leakg! - BelowNrwsRel!

RegulRelease! and **BelowNrwsRel!** are releases made to satisfy the Above Narrows and Below Narrows Accounts, respectively. **Leakg!** applies to Cachuma Reservoir only and refers to water that leaks from the flood gates of Bradbury Dam when the water elevation exceeds 720 feet. The leakage value increases incrementally with reservoir elevation due to increased head. When the reservoir is spilling, the model includes leakage water in the total amount of spill water and returns **Leakg!** to zero.

The first iteration volume is used with the **"AreaElevSet"** subroutine to determine a preliminary end of month reservoir area (**Area7!**). This area is then used to calculate rain on and evaporation from the reservoir reflecting an end of month reservoir area that has been averaged with the beginning of the month reservoir area as per the following:

Prc! = (**Prc!** + **Rainer!** * **Area7!**)/2

Evp! = (**Evp!** + **PanFac!**(N,WtrYrMo%) * **Evap%**(N,*) * **Area7!**)/2

[Note N is reservoir (1 to 3) and **WtrYrMo%** (1 thru 12) is water year month] The second iteration for the volume then becomes:

Volume7! = **Vsave!** + **Inflow!** + **Prc!** - **Evp!** - **LakeDiv!** - **RegulRelease!** - **Leakg!** - **BelowNrwsRel!**

If this new value for **Volume7!** is less than zero, the **"EmptyRes"** section of the **"Reservoir"** subroutine is utilized (Appendix A, pg. 34). This loop provides a means to empty the reservoir in proportion to the relative values of all the flows into and out of the reservoir. **Prcl!** and **Evpr!** are set equal to **Prc!/2** and **Evp!/2**, respectively. The loop multiplies **LakeDiv!**, **RegulRelease!**, and

BelowNrwsRel! by a fraction (**Part!**) which is zero if (**LakeDiv!** + **RegulRelease!** & **BelowNrwsRel!**) = 0; otherwise:

Part! = (**Vsave!** + **Inflow!** + **Prcl!** - **Evpr!**) / (**LakeDiv!** + **RegulRelease!** + **BelowNrwsRel!**)

Where **Vsave!** is equal to the beginning of the month reservoir volume. **Volume7!** and **Area7!** are then set to zero and the water surface elevation (**Elev7!**) is set equal to the elevation of the bottom of the lake (**Datum%**(N)). If **Volume7!** is greater than **MaxVol!**(N), then **Spill!** is equal to the difference between **MaxVol!**(N) and **Volume7!** plus leakage. **Leakg!** is then set to zero and **Volume7!** is set equal to **MaxVol!**(N).

B3.1 Jameson Reservoir

Water accounting for Jameson Reservoir, often referred to as "Juncal", deviates little from the general description above. The model menu allows the monthly diversion value to include or exclude tunnel infiltration. The present default menu selection places the monthly diversion value upon the reservoir alone.

Included in the Juncal section of the monthly accounting loop is a section of model code which calculates theoretical diversion water from Alder and Fox creeks (Alder Creek being diverted into the Lake, and Fox Creek into Doulton Tunnel). These theoretical diversion flows are calculated based upon a 12 month running sum (up to this month) of Juncal to Gibraltar accretions, and this month's Juncal to Gibralter accretions (see model code pg A-20 bottom, pg A-21 top). The two diversion flows are added to give a variable called **Addback!**. The variables **Alder!**, **Fox!**, **and Addback!** as determined by this modeling code are normally set to zero each month and this portion of the program is bypassed. By deleting (or "Remming out") the bypass code line (**GOTO F**) in the program the user can examine the impacts on the Juncal system yield and estimated impacts on downstream conditions if **Alder!** is subtracted from the Lake inflow and the Lake diversions, and if **Fox!** is substracted from the tunnel infiltration, and these two flows are released downstream from Juncal Dam.

Further, two subroutines in Runmodel called "**JunGib**" and "**GibCac**" will calculate how much if any of this release or "addback" water (or any other type of release water) reaches Gibraltar and from there, Cachuma reservoirs. These subrountines are transmission loss models custom fit to the two sub-watersheds Juncal to Gibraltar (**JunGib**), and Gibraltar to Cachuma (**GibCac**). The transmission loss routines are described in detail in a December 20th, 1994 (revised July 28th, 1997) Santa Ynez River Hydrology Committee memorandum a copy of which is contained in Appendix E.

B3.2 Gibraltar Reservoir

Simulation of water accounting practices for Gibraltar Reservoir is distinct from the other reservoirs in that it must comply with provisions of the Upper Santa Ynez River Operations Agreement (See Section 2.5.1). The agreement compares the actual Gibraltar Reservoir diversions by the City of Santa Barbara with a "base" operation in order to determine the water credit (or debit) that the City must take (or pay) at Cachuma Reservoir. If the City's Gibraltar Reservoir draft exceeds 4,580 acre feet per year, which is the "zero effect" or zero mitigation draft level, the operation is deemed to be in the "mitigation" mode. In the "mitigation" mode, the City must pay an annual debit which amounts to a reduction in the City's Cachuma Reservoir entitlement in direct proportion to the magnitude of the over diversion (i.e. Gibraltar

Reservoir diversions over 4,580 acre feet per year). As the Actual Gibraltar Reservoir volume is reduced through siltation, the City will eventually operate Gibraltar Reservoir in a "pass through" mode (annual draft level less than 4,580 acre feet per year). In this "under diversion" mode the Actual Gibraltar Reservoir spills plus releases will generally exceed the "Base" Reservoir spills plus releases. This spill differential, subject to conveyance losses between Gibraltar and Cachuma, is water that is "passed through" to Cachuma Reservoir where, conditions permitting, the City of Santa Barbara may put it to use. In the Santa Ynez River Model the Actual Gibraltar Reservoir operations may be varied as desired. The "Base" operation remains fixed, as in the agreement. The spill plus release differential between the Actual and "Base" operations is transmitted to Cachuma Reservoir to be algebraically added (for below Cachuma riparian accounting purposes only) to the Cachuma Reservoir computed inflow each month. This operation keeps the Cachuma Reservoir inflow, from the point of view of all downstream users of Santa Ynez River water, the same as if the operation at Gibraltar Reservoir was always identical to the "Base" operation, no matter what the actual operation may be.

B3.2.1 Gin Chow Releases

According to the Upper Santa Ynez River Operations Agreement, releases from Gibraltar Reservoir, in accordance with the Gin Chow Settlement, must be made between the beginning of June and the end of November. The model uses a **"GinChowRelFlag%()"** to specify the months in which releases may be made. If the flag has a value of one, releases may be made. Each month a preliminary end of month reservoir volume estimate (without any Gin Chow releases) is made for both the Base and the Actual Gibraltar reservoirs.

VolEst! = EndMoVol!() + Inflow! + NetEvap! - LakeDiv!

Where **NetEvap!** is a preliminary estimate of rain on the lake minus evaporation from the Lake based upon beginning of month Lake area. Given the preliminary months ending storage (**VolEst!**), the model executes (for both Base and Actual Operations) Gin Chow releases in the following manner (see Figure B-2):

1) each June potential carryover Gin Chow release water is calculated by adding the Gibraltar inflows for the coming October and November and also September inflows (if they are greater than August inflows). If this sum is greater than zero then these late summer and fall inflows may be carried over to the next years Gin Chow release period. The carryover amount is limited to 616 acre feet minus any Gin Chow releases made in June, July, August, or September (if September inflow is less than August inflow).

2) The first month from June through August (or September) that the estimated end of the month Gibraltar Lake volume is less than the volume corresponding to a lake elevation of 1399.82 feet MSL, the Gin Chow release is executed. The release value is equal to the Gibraltar inflow for that month plus the inflow for succeeding months up through August (or September). The release value is, however, limited to 616 acre feet. If the release is 616 acre feet then there will be no carryover release water for next year. Any carryover water from the previous year will be released with the Gin Chow release for this year except the months release will not exceed 616 acre feet. Any remaining carryover water from the previous year will be released in the next month of this year (through September).

3) The Effect of these rules actually limits the physical release window to June through September. The amount of water

credited as Gin Chow release water in the form of an actual release and/or as a carryover release for the next year is always limited to 616 acre feet in any one year. Many years will have Gin Chow releases less than 616 acre feet, but with the carryover release water from the previous years late summer and fall months, there will be some years with Gin Chow releases being made in two months and thus totaling up to 1232 acre feet. The largest Gin Chow release with the model menu default conditions is June and July of 1970, totaling 1216 acre feet (for both Base and Actual Gibraltar operations).

Excepting the Gin Chow release procedures the rest of the Actual Gibraltar Reservoir operations are modeled similar to the Juncal and Cachuma projects. The Actual Gibraltar operations default menu parameters employ a ramp function, but the StartShortage reservoir volume is only 50 acre feet. This is virtually the same as no ramp at all, and under menu default conditions is in fact never used (remember that in SYRM model operations, draft reduction is tested for only once each year in the mouth of May, and is activated only if the May 1st reservoir storage is less than the StartShortage ramp volume).

B3.2.2 The "Base" Gibraltar

As noted above, the purpose of the "Base" operation in the Gibraltar Reservoir Section of the monthly time loop and in the Upper Santa Ynez River Operations Agreement is to provide a monthly correction to Cachuma Reservoir inflow so as to provide for all water users below Cachuma Reservoir an unvarying upper Santa Ynez operational condition no matter what the Actual Gibraltar Reservoir operations may be now or in the future. The "Base" operation allows a maximum diversion of 4,189 acre feet per year of "ordinary inflow volume" water, and 3,089 acre feet per year of "flood inflow volume" water. Ordinary flow is defined to be average daily inflow to the reservoir of less than 800 cubic feet per second (cfs-days). Actual reservoir operations use the same monthly reservoir diversion distribution as "Base" operations, but do not differentiate "flood flow" (**Qfld!**) and "ordinary flow" (**Qord!**). The actual Gibraltar Reservoir is subject to siltation and diminution of capacity. The "Base" Gibraltar's capacity is fixed. Figure B-3 is a flow diagram depicting the "Base" Gibraltar Reservoir model simulation.

The "base" operation reservoir balancing, and Gin chow Release model code is the same as that employed for the "Actual" Gibraltar reservoir. Base operations water accounting does not use the "**Reservoir**" subroutine, but has an equivalent within the Base Gibraltar part of the monthly loop. The elevation - capacity table (**PhanCap%**()) employed by the Base Gibraltar will remain forever invariant. The Actual Gibraltar modeling will require a revision from time to time as the reservoir volume is diminished due to siltation.

What is different about the Base operation and modeling code, is that the inflow each month must be divided into an "ordinary inflow" (**Qord!**) and a "flood inflow" (**Qfld!**) component, and those two components in whole or in part, added to two parallel components of reservoir storage, **OrdVol!** and **FldVol!**, which are, respectively, "orindary inflow volume" water, and "flood inflow volume" water. In any month the total volume of water in the reservoir is the sum of these two components. The methodology for making the division of inflow water and reservoir storage into these two (ordinary and flood) components using a monthly model, is in Appendix E and entitled "Base Operations at Gibraltar Reservoir".

Water accounting for the Base operations is performed first in the model monthly loop followed by the Actual operations. Releases (not including spills) from both the Base and the Actual Gibraltar reservoirs are comprised of Gin Chow release water and any water released from Juncal which reached Gibraltar Reservoir (as determined by the transmission loss subroutine "**JunGib**", discussed above and described in Appendix E). These release waters for both Gibraltar operations pass through the second transmission loss subroutine "**GibCac**", the amount for each reservoir operation that reaches Cachuma Reservoir being determined. Each month a number (**Correction!**) is calculated. It is a set equal to Base operations spills plus any releases reaching Cachuma, minus Actual operations spills plus any releases reaching Cachuma. If the Actual Gibraltar lake diversions are greater than the zero mitigation level (4580 AFY or greater; called the "over diversion mode") than **Correction!**, if less than zero is set equal to zero. The Cachuma model computed inflow for the month (equal to the Lake inflow resulting from the Actual operation at Gibraltar) is added to the number **Correction!** to produce a Cachuma "inflow" value to be used in crediting the below Cachuma riparian accounts.

B3.3 Cachuma Reservoir

Due to the complex nature of Cachuma Reservoir agreements and operations, inclusion of a number of variations was necessary within the Cachuma Section and Reservoir Subroutine of the monthly loop. Leakage water from Bradbury Dam was accounted for and the downstream releases were included in accordance with the SWRCB Order No. WR 89-18 (Section 2.5.2). Another variation was included because the size and volume of Cachuma Reservoir is much greater than that of the other reservoirs and hydrologic effects considered insignificant for smaller reservoirs must be accounted for in the Cachuma Reservoir section of the model. This refers to the reduction of evapotranspiration due to inundation of watershed land by Cachuma Reservoir.

B3.3.1 Leakage Accounting

Leakage from Bradbury Dam is accounted for within the Cachuma Reservoir section and the "**Reservoir**" subroutine of the monthly loop. Leakage based on the beginning of the current month reservoir elevation and the end of the current month's reservoir elevation are calculated using a leakage look-up table [**Leakage!**(n); (n varies from 1 to 61 as Cachuma lake elevation varies from full to full - 30 ft.)]. The two values are averaged to give the month's leakage (**Leakg!**). See Cachuma Reservoir Leakage Table B-1. The beginning of the month and the end of the month leakage values (**Leakg!** and **Lek!**) are equal to the number of days in the current month (**MoDays**) multiplied by the leakage value determined in the table. The final leakage value for the month (**Leakg!**) is equal to the beginning of the month's value (also **Leakg!**) plus the end of the month value (**Lek!**) divided by two.

B3.3.2 Evapotranspiration Correction

Within the Cachuma Reservoir Section of the monthly loop there is an evaporanspiraton correction (**CachET%**(*)) which corrects for the change in watershed evapotranspiration due to the inundation of land and the resulting loss of vegetation and/or exposed land serface area. The correction is necessary to account for the water not lost to bare land or vegetative evapotranspiration. Therefore, the correction is related to the size of the land area covered by the reservoir. As the area of the reservoir increases, the evapotranspiration decreases. Therefore, the total amount of water available to the reservoir from rainfal and runoff increases. The monthly evapotranspiration value **CachET%**(*) is from the

TABLE B-1
USBR LEAKAGE/WATER ELEVATION TABLE

CACHUMA PROJECT LAKE LEAKAGE LOOKUP TABLE

ELEVATION From (ft, MSL)	RANGE to (ft, MSL)	LEAKEAGE (acre_feet per day)	ELEVATION From (ft, MSL)	RANGE To (ft, MSL)	LEAKAGE (acre_feet per day)
749.5	750.0	9.9	734.5	735.0	1.4
749.0	749.5	7.9	734.0	734.5	1.4
748.5	749.0	6.0	733.5	734.0	1.4
748.0	748.5	6.0	733.0	733.5	1.4
747.5	748.0	4.0	732.5	733.0	1.4
747.0	747.5	1.4	732.0	732.5	1.4
746.5	747.0	1.4	731.5	732.0	1.4
746.0	746.5	1.4	731.0	731.5	1.4
745.5	760.0	1.4	730.5	731.0	1.4
745.0	745.5	1.4	730.0	730.5	1.4
744.5	745.0	1.4	729.5	730.0	0.8
744.0	744.5	1.4	729.0	729.5	0.8
743.5	744.0	1.4	728.5	729.0	0.8
743.0	743.5	1.4	728.0	728.5	0.8
742.5	743.0	1.4	727.5	728.0	0.8
742.0	742.5	1.4	727.0	727.5	0.8
741.5	742.0	1.4	726.5	727.0	0.8
741.0	741.5	1.4	726.0	726.5	0.8
740.5	741.0	1.4	725.5	726.0	0.8
740.0	740.5	1.4	725.0	725.5	0.8
739.5	740.0	1.4	724.5	725.0	0.8
739.0	739.5	1.4	724.0	724.5	0.8
738.5	740.0	1.4	723.5	724.0	0.8
738.0	738.5	1.4	723.0	723.5	0.8
737.5	738.0	1.4	722.5	723.0	0.5
737.0	737.5	1.4	722.0	722.5	0.5
736.5	737.0	1.4	721.5	722.0	0.5
736.0	736.5	1.4	721.0	721.5	0.5
735.5	736.0	1.4	720.5	721.0	0.5
735.0	735.5	1.4	720.0	720.5	0.5

hydrologic data items discussed in Chapter 3 and Appendix E. Precipitation upon and water evaporated from the surface of the reservoir is accounted for separately (See pp. B16 - B18).

In the Cachuma part of the monthly time loop the ET correction is calculated based intially on the beginning of month's lake area and then, in the "**Reservoir**" subroutine, based upon the first estimate of end of month lake area (the same procedure as that employed for the leakage determination except area is used). The two corrections are averaged and then added to the Lake inflow for that mouth to proceed with final months ending reservoir accounting.

B3.3.3 Downstream Releases

In the accounting for Cachuma Reservoir the model must determine under which circumstances to make releases. The **DwnStrRelFlag%**() functions the same as the **GinChowRelFlag%**() having allowable values of zero (non-activated) and one (activated). However, the flag is activated for the months of May through November rather than June through November as in Gin Chow case.

RegulRelease! and **BelowNrwsRel!** refer to releases to satisfy the Above and Below Narrows Accounts, respectively. By agreement, neither of these accounts are subject to evaporative losses. Both **RegulRelease!** and **BelowNrwsRel!** are set to zero at the beginning of each monthly loop. If the current month is May through November, then the model runs a number of "wetness" tests to determine if conditions are too wet to warrant downstream releases. If the previous month's spill (**LastMonthsSpill!**) was greater than 500, as determined in the Reservoir Subroutine, no releases are made. Similarly if the current month is before July, and the Cachuma Reservoir to Lompoc Accretions (**Accret%**(4.*)) are greater than or equal to 500 acre feet, no releases are made. If the current month is before December (i.e. October or November) and Cachuma Reservoir to Lompoc accretions are greater than or equal to 1,000 acre feet, no releases are made.

Two more wetness tests allow checking for a possible release for the Below Narrows Account. These test are as follows: if last months flow past Floradale bridge (in Lompoc valley) is less than 120 acre feet, then if this months Salsipuedes flow is zero (to nearest 100 acre foot increment), then test for a Below Narrows release. To make this release the Below Narrows Account (**BNA**) must be greater than **StartRelBlw%** which has a model menu default value of 1000 acre feet. Furthermore, the Avove Narrows Account (**ANA**) must, if this is the first month for the BNA release, have a value greater than 5000 acre feet (2500 acre feet for second and subsequent months **BNA** releases). The requirement for significant **ANA** water prior to a **BNA** release, especially during the 1st release month, is because much of the **BNA** release water will percolate in the Above Narrows subareas thus being deducted from the **ANA**. Only release water passing the Narrows will be deducted from the **BNA**. The model program code for both the **BNA** and **ANA** releases may be seen on pg. A-25 of Appendix A.

If any criteria in the above paragraph prevent a Below Narrows release, a release from the **ANA** may still be executed. Following the SWRCB Order No. 89-18, if the total dewatered storage in the Above Narrows Account (**TotDewatStor!**) is more than the start release volume (**StartRelease%**; 10,600 acre feet from the menu), than **RegulRelease!** is equal to the **TotDewatStor!** minus the operational dewatered storage (**OperDewatStor%**). **OperDewatStor%** is 10,000 acre feet and represents the dewatered storage threshold for Above Narrows releases that is normally used with the Above Narrows Account to allow for more capture of local runoff (generated below Cachuma Reservoir) as it occurs. Should **RegulRelease!** exceed **AboveNarrwAcct!**, then **RegulRelease!** is set equal to **AboveNarrwAcct!**. Similarly, the model limits the **RegulRelease!** value to 4,000 acre feet in any one month. The reason for this is that releases of greater volumes are not likely to percolate into the aquifer before reaching the Narrows and, therefore, are not commonly requested.

B4 ABOVE NARROWS ALLUVIAL GROUNDWATER BASIN

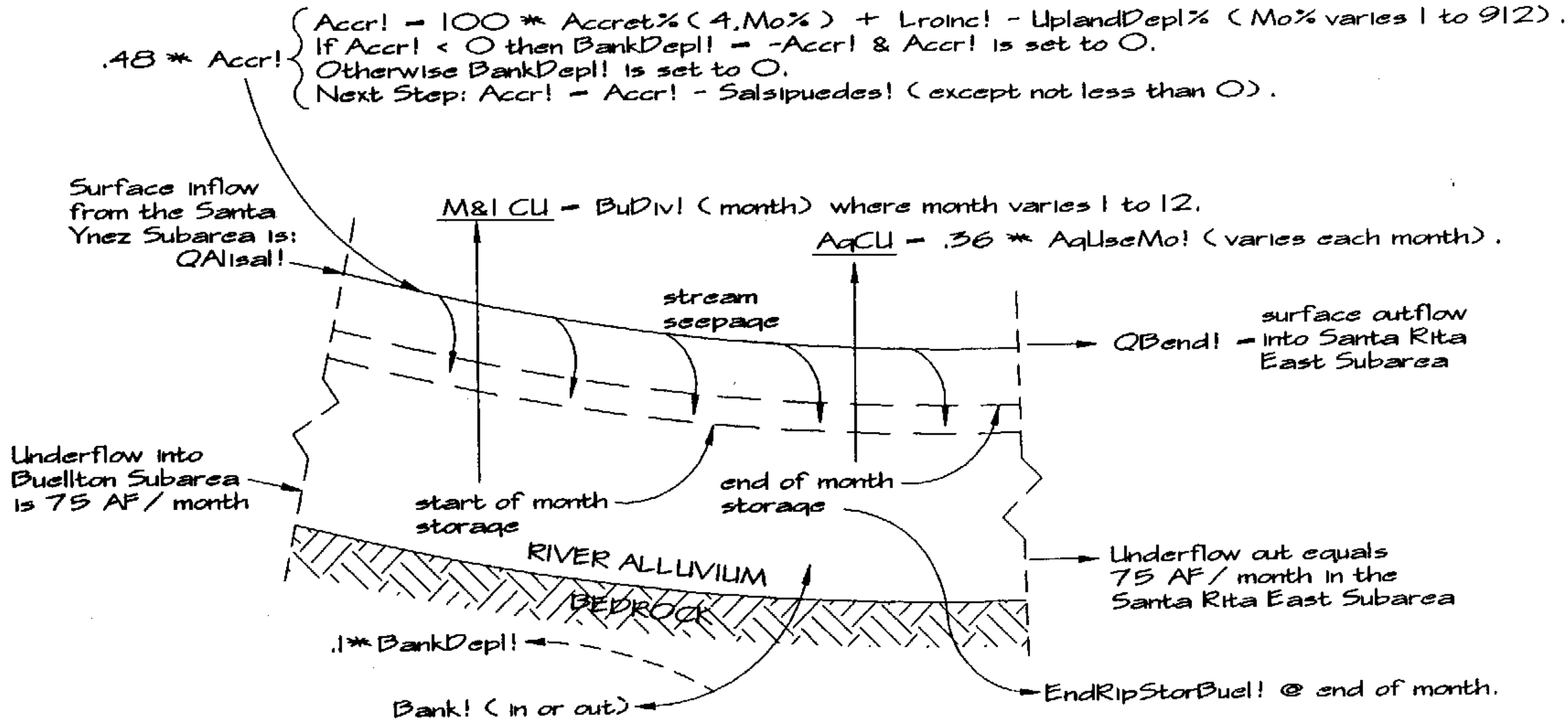
The Above Narrows Alluvial Groundwater Basin (**ANAGB**) extends from Bradbury Dam to Lompoc along the Santa Ynez River. For the purpose of the model this section is divided into four subareas (See Section 2.2, Figure 2-1, and Figure B-5). The sections of the program addressing the **ANAGB** calculations are entitled "Start Riparian Section", "Santa Ynez", "Buellton", "East Santa Rita", and "West Santa Rita". Each subarea is similar to a reservoir system in that it has a specific storage capacity to which accretions and diversions are added or subtracted. Therefore, some of the model components of the **ANAGB** are similar to those of the Santa Ynez River surface reservoirs. Hydrologic components that are unique to the **ANAGB** include underflow, percolation, upland depletions and ground water pumping. Figure B-8 is a flow diagram depicting the model simulation of one subarea of the Above Narrows Alluvial Groundwater Basin.

B4.1 Live Stream Determination

According to the SWRCB Order No. WR 89-18, the **ANAGB** below Cachuma Reservoir is credited with (into the Above Narrows Account) all of the inflow into Cachuma Reservoir up to, but not exceeding, the volume of dewatered storage as measured monthly in the four

EXAMPLE RIPARIAN SUBAREA FLOW DIAGRAM

(for the Buellton Subarea)



Definitions:

1) Accret%(4,Mo%) is the Cachuma to Lompoc accretions for this month (acre feet * 100).
2) LroInc! is the Cachuma to Lompoc runoff increment due to cloudseeding (if any) for this month.
3) Upland Depl% (monthly upland depletions) is set at 100 ac. ft. per month.
4) Salsipuedes! is this months flow from Salsipuedes Creek near Lompoc.
5) Seep! = QAlisal! + .48 * Accr! - QBend!
6) EndRipStorBuel! = EndRipStorBuel! + Seep! + Bank! - BuDiv!(month) - .36 * AgUseMo! - .1 * BankDepl! + Underflow into - Underflow out

FIGURE B-8

subareas of the **ANAGB** and providing there is not a live stream below Cachuma Reservoir (See Section 2.5.2). This Order necessitates a method of determining when and where the Santa Ynez River is flowing and when and how to initiate the appropriate actions in accordance with the agreements. In SYRM, this is done through the use of live stream flags that indicate stream conditions at four locations. **LivStrmFlg0%**, **LivStrmFlg1%**, **LivStrmFlg2%**, and **LivStrmFlg3%** represent flow conditions at San Lucas Bridge, Alisal Bridge, three miles west of Buellton, and above confluence with Salsipuedes, respectively. Except for San Lucas Bridge, these locations correspond to the Above Narrows subarea boundaries. In the Riparian part of the monthly loop, the model sets the flags at values of 1, 2, 4, and 8 for Flag 0, 1, 2, and 3 if the stream is live during the current month at these locations. The variable (**Live!**) is set equal to the sum of the four live stream flags. Therefore, if **Live!** has a value of three, there is a live stream through Alisal Bridge. If **Live!** has a value of fifteen there is a live stream through the Santa Ynez River confluence with Salsipuedes Creek. **Live!** and all of the live stream flags are set to zero each month at the beginning of the Cachuma Reservoir section of the model.

At the beginning of the Riparian Section of the program, the model runs three tests to determine if there is a live stream at San Lucas Bridge; that is to determine if **LivStrmFlg0%** has a value of one. The first of these tests simply checks if Cachuma Reservoir is spilling in the current month. If so, there is a live stream at San Lucas Bridge (**LivStrmFlg0%** = 1) due to the close proximity of San Lucas Bridge to Bradbury Dam. By the second test, if Cachuma Reservoir to Lompoc accretions (**Accret%**(4,*)) are greater than 1,000 acre feet, **LivStrmFlg0%** = 1. Furthmore, if releases to the Above Narrows Account (**RegulRelease!**) plus any Leakage from

Bradbury Dam total at least 120 acrefeet, **LivStrmFlg0%** = 1. Similary, at the beginning of the Buellton (Alisal Bridge), Santa Rita east (bend 3 mi. west of Buellton), and Santa Rita west (above confluence with Salsipuedes) subareas, **LivstrmFlg1%** through **3%** are set to 2, 4, and 8, respectively, if the current months flow at those points is at or above 120 acrefeet.

After balancing the water budget for the Santa Rita west subarea and determining a flow at the Lompoc Narrows, the model tests for a live stream condition in the current calculation month. The method employed determines how much of the adjusted Cachuma reservior net inflow (**CachNetIn!**) must be credited to the Above Narrows Account (**ANA**). Note that **CachNetIn!** equals Cachuma reservoir actual surface water inflow, plus any Upper Santa Ynez River Operations Agreement **Correction!** to that inflow, minus any Leakage from Bradbury Dam. For there to be any live stream at all for the current month, **LivStrmFlg0%** through **3%** must be Set; ie **Live!** must equal 15 for the month (1 + 2 + 4 + 8). If live equals 15, and last months stream was <u>not</u> Live, and if the current months Lompoc Narrows flow is equal or greater than 1229 acrefeet, then, as determined by an onset month hyperbolic relationship, some portion of **CachNetIn!** will be credited to the **ANA**. As that portion varies from just under one to nearly zero, one minus that portion multiplied by 16 varies from just above zero to nearly 16. This number is added to **Live!**. Thus, for an onset (of Live stream conditions) month, the value **Live!** varies from slightly above 15 to nearly 31 as that Narrows flow varies from 1229 acre feet up to the highest values possible in the model. The value **Live!** is displayed in the detailed monthly printout of the Above Narrows Riparian Alluvial Basins. It gives the model user the ability, at a glance, to see the disposition of river flows below Cachuma down to Floradale Bridge for any particular month of modeling period.

To continue, however, if **Live!** equals 15 and last month was live (i.e. above 15), and if this months Narrows flow is equal or greater than 3,000 acrefeet, then 16 is added to the value **Live!** which then equals 31, and none of **CachNetIn!** will be credited to the **ANA**. If last month was Live and if this month's Narrows flow is less than 3,000 acrefeet, then a recession from Live stream condition exists. In this case a portion of **CachNetIn!** will be credited to the **ANA**. The portion is determined by utilizing a hyperbolic field function (a continuous family of hyperbolas) wherein the multiplier is determined by this months Narrows flow, and by the cumulative seasonal Narrows flow, starting with October, through the previous month. As in the onset month case, 16 multiplied by one minus the portion, added to **Live!** will give a number from slightly below 31 to just above 15 as the Narrows flow varies from less than 3,000 down to a few hundred, or less, acre feet depending upon antecedent flow conditions (how wet the season has been). See model code p. A-29 below line 5200, and "Partial Memorandum on SYRM Modeled Live Stream Criteria, Dated November 9th, 1990" in Appendix E.

B4.2 Cloud Seeding

As with the three surface reservoirs, effects of cloud seeding on the Above Narrows Alluvial Groundwater Basin may be simulated. The model accomplishes this using a least squares parabola method identical to that of the Reservoir Section of the monthly loop. **LroInc!** and **LrnInc!** refer to the Cachuma Reservoir to Lompoc incremental runoff and incremental rainfall due to cloud seeding, respectively. Similarly, **SroInc!** and **SrnInc!** denote Salsipuedes incremental runoff and rainfall due to cloud seeding. All of these values are initially set to zero. If the current month is one in which cloud seeding may be conducted (**CsFlag%** = 1) then cloud seeding impacts are calculated.

The cumulative Cachuma Reservoir to Lompoc precipitation (**Lx!**) is equal to the previous month's Cachuma Reservoir to Lompoc total augmented precipitation (**LpSum!**) plus three tenths of the current month's unaugmented precipitation at Cachuma Reservoir (**Rain%**(3,*)). Three tenths is used as a reduction factor (from the Cachuma Reservoir factor of one third) to compensate for the average precipitation at Cachuma Reservoir being slightly higher than at the Narrows. This relationship gives the point on the x-axis of the parabola at which the slope is calculated. **LrnInc!** is then equal to the cloud seeding factor (**CsFac!**), as set in the Reservoir Section of the monthly loop, multiplied by ninety percent of the cloud seeding increment at Cachuma Reservoir (**CsInc%**(3,*)). Again, ninety percent is a reduction factor used to account for the decrease in average precipitation downstream from Cachuma Reservoir.

The slope of the parabola (**Lslope!**) calculated at a point on the x-axis **Lx!** is:

Lslope! = 2 * **Lompar!**(A) * **Lx!** + **Lompar!**(B)

Lompar! A and B in the above equation refer to constants A and B defining the parabola Y = AX^2 + BX + C. **LroInc!** is the product of the Cachuma Reservoir to Lompoc Watershed factor, **LrnInc!**, and **Lslope!**. The Cachuma Reservoir to Lompoc Watershed factor (**19,840**) is a constant equal to the area of the Watershed in acres divided by twelve inches and expressed in acre feet (of runoff) per inch (of runoff depth). The current month's **LpSum!** is equal to last month's **LpSum!** plus ninety percent of the current month's total rainfall at Cachuma Reservoir plus **LrnInc!**. If **Lx!** is less than seven inches, the runoff increment is considered negligible and the program is directed to the calculation for **LpSum!**.

Calculations for cloud seeding effects on the Salsipuedes Watershed are nearly identical to those for Cachuma Reservoir to Lompoc. One exception is that precipitation in the Salsipuedes Watershed exceeds that of the Cachuma Reservoir Watershed. Therefore, the modification factor on **Rain%**(3,*) used in the calculation of **Sx!** is .367 rather than .3. Similarly, **CsInc%**(3,*) is multiplied by 1.1 in **SrnInc!** calculations rather than .9 used in the **LrnInc!** calculation. In addition, the watershed factor for the Salsipuedes Watershed is **2,512** acre feet per inch and the minimum precipitation for calculation of **SroInc!** is eight inches. As with reservoir calculations, both **Lslope!** and **Sslope!** are limited to between 0 and .95.

B4.3 Water Accounting

Upland depletion (**UplandDepl!**) is the term used to describe the effects of increased consumptive use due to urban and agricultural development along the banks north and south of the Santa Ynez River. Increased pumping of groundwater for agriculture and residential use in these areas has lowered the water levels in aquifers adjacent to the Above Narrows Alluvial Groundwater Basin, resulting in a reduction of the amount of water which historically has discharged into the Basin. The Above Narrows Alluvial Groundwater Basin accretions (**Accr!**) are equal to the Cachuma Reservoir to Lompoc accretions (**Accret%**(4,*)) plus **LroInc!** minus the Upland Depletions. **UplandDepl!** has been estimated at 100 acre feet per month, seventy eight percent of which occurs in the Santa Ynez subarea. The remaining twenty two percent is divided among the remaining subareas. The model includes a mechanism that forces this reduction to occur, either through a decrease in surface flows or through bank depletions (**BankDepl!**). To accomplish this, the model checks if **Accr!** minus **UplandDepl!** is less than zero. If so, **BankDepl!** is set equal to negative **Accr!** and **Accr!** is set to zero.

Because Salsipuedes Creek enters the Santa Ynez River in the Santa Rita West subarea not far from the Lompoc Narrows (Figure 1-1), its flows are accounted for separately. Accretions to the Salsipuedes watershed are equal to this month's Salsipuedes Creek flows (**Salsi%**(*)) plus **SroInc!**. Because they effect only the western most subarea of the Above Narrows Alluvial Groundwater Basin, Salsipuedes Creek flows are subtracted from the total Cachuma Reservoir to Lompoc Accretions and added back into the upstream end of the West Santa Rita subarea. The remainder of the Cachuma to Lompoc accretion is distributed among the four subareas as inflow, Santa Ynez receiving 22 percent, Buellton receiving 48 percent, East Santa Rita receiving 27 percent, and West Santa Rita receiving 3 percent of the total (1.5 percent of which appears as flow at the Lompoc Narrows). If this month's accretions (**Accr!**) minus Salsipuedes results in a negative number, then that number is stored as **Resid!** and **Accr!** is set to zero. **Resid!** is then added to the inflow equation for West Santa Rita in order to make the Cachuma to Lompoc incremental flow equal the original value of **Accr!**. Within each subarea of the model, the end of month Riparian storage (**EndRipStorSYn!**, **EndRipStorBuel!**, **EndRipStorSRitaE!**, and **EndRipStorSRitaW!**) is calculated. There are several influences affecting the final storage balance within each subarea. These are the seepage of surface flows into the aquifer (**Seep!**), infiltration of water from the fractured shale and other deposits forming the aquifer banks (**Bank!**), underflow within the aquifer from one subarea to another and out of the last subarea, and aquifer depletion via municipal, industrial, and agricultural pumping.

B4.3.1 Seepage/Percolation

"**Seep!**" is the quantity of water that enters the Above Narrows Alluvial Groundwater Basin from percolation of surface flows. Therefore, it is dependent on the surface flow (**Qin!**) into each subarea and the subareas percolation rate (**PercRate!**). For the Santa Ynez subarea:

PercRate! = SynPerc! * TempDewatStor! / SynStr!

The difference between the full Above Narrows Alluvial Groundwater Basin volume for the Santa Ynez subarea (**RipfullSYn%**) and the end of last month's storage volume (**EndRipStorSYn!**) is the temporary dewatered storage (**TempDewatStor!**). The full (hypothetical upper 50 feet) Santa Ynez subarea storage volume is set to 20,600 acre feet. At the beginning of the modeling period each subarea's storage is set to a percentage of the total **ANAGB** beginning storage which is approximately equal to the end of modeling period (September, 1993) percentage of total **ANAGB** ending storage.

The maximum percolation rate (**SynPerc!**) is a constant equal to 30 feet per month. **SynStr!** is a calibration constant equal to 4,500 acre feet. For **TempDewatStor!** at or above **SynStr!**, the percolation rate equals **SynPerc!**. As **TempDewatStor!** drops below **SynStr!**, the percolation rate decreases. The **PercRate!** equation simulates the reduction in percolation with decreased aquifer storage. **PercRate!** calculations for the other subareas are identical to those for the Santa Ynez subarea except that some of the constants are different and the starting storage volumes vary according to the size of the subarea. Table B-2 lists the four subareas and the associated values.

Table B-2

ANAGB PERCOLATION PARAMETERS

PERC RATE (AF/Month)		PERC REDUCTION THRESHOLD (AF)		MAX SEEPAGE (AF/Month)	
SynPerc!	30	**SynStr!**	4,500	**SYnSpMx!**	3000
BuePerc!	30	**BueStr!**	12,000	**BueSpMx!**	2500
SRitaEPerc!	30	**SRitaEStr!**	11,000	**SRitaESpMx!**	2000
SRitaWPerc!	30	**SRitaWStr!**	1,000	**SRitaWSpMx!**	300

Inflow to the Santa Ynez subarea (**Qin!**) is equal to 22 percent of the Cachuma Reservoir to Lompoc accretions plus Cachuma Reservoir spills, releases and leakage from Bradbury dam or:

Qin! = .22 * **Accr!** + **Spill!** + **RegulRelease!**
+ **BelowNrwsRel!** + **Leakg!**

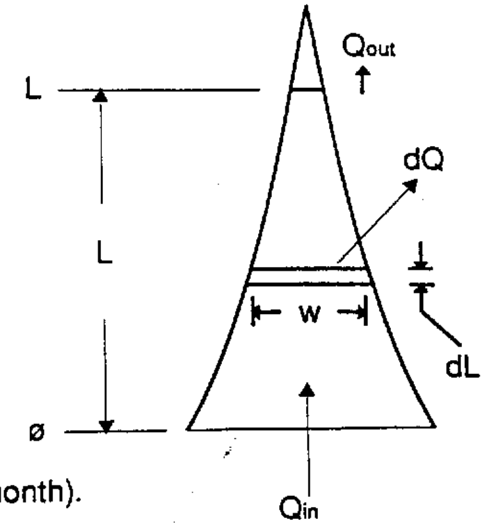
Each Month, the flow out of the Santa Ynez subarea at Alisal Bridge (**QAlisal!**) is initially set to zero. Based on inflow and the Stream Seepage Formula, this value may be revised. The Stream Seepage Formula is a resultant of an integral equation which is used to calculate how much outflow there will be for a section of stream given a length, inflow and percolation rate (See Figure B-9). The Santa Ynez Subarea Stream Seepage Formula is:

IF: **Qin!** ^ **Beta!** > (4.285 * **PercRate!**), THEN:
Qalisal! = (**Qin!** ^ **Beta!** - 4.285 * **PercRate!**) ^ **Alpha!**

Alpha! and **Beta!** are constants in a power function relating stream width to flow levels. In Figure B-9 Alpha equals 1/(1-Beta), and Beta epuals .34 for the Santa Ynez River. In the model code (see Appendix A, p. A-15) **Beta!** equals .66 (equal to 1 minus the Figure

STREAM SEEPAGE FORMULA

This formula, as shown, is developed for use with monthly data.



A) Assume seepage is proportional to wetted surface area.

stream width (w) $= \alpha \times Q^{\beta}$ (in feet)

differential area = dA = w x dL (ft.^{2})

from area dA the stream seepage is dQ.

dQ (in acrefeet/month) is a minus number representing a loss.

Let Pm = the monthy perc. rate (in feet per month).

Note: in $w = \alpha \times Q^{\beta}$, w is derived from air photos and Q is from USGS records and is in cfs-days. So, for the monthly case simply convert cfs months to acrefeet/month and adjust the α parameter for equivalency (the β parameter remains the same).

B) From the above figure and definitions we have:

$$-dQ = dA \times \frac{Pm \text{ (ft/month)}}{43560 \text{ (ft}^2\text{/acrefoot)}} = \alpha \times Q^{\beta} \times dL \times \frac{Pm}{43560}$$

$$\text{so, } -\frac{dQ}{Q^{\beta}} = \frac{Pm}{43560} \times \alpha \times dL$$

(adjusted α parameters)

C) As dL slides from ø to L, Q varies from Q_{in} to Q_{out}.

$$-\int_{Q_{in}}^{Q_{out}} \frac{dQ}{Q^{\beta}} = \int_{\text{ø}}^{L} \frac{\alpha \times Pm}{43560} dL = \frac{\alpha \times Pm \times L}{43560} = \frac{1}{1-\beta} \times Q^{1-\beta} \Big|_{Q_{out}}^{Q_{in}}$$

(order switch makes positive)

$$\text{so,} \quad Q_{in}^{1-\beta} - Q_{out}^{1-\beta} = \frac{(1-\beta) \times \alpha \times Pm \times L)}{43560}$$

$$\text{\&,} \quad Q_{out} = \left[Q_{in}^{1-\beta} - \frac{(1-\beta) \times \alpha \times Pm \times L)}{43560} \right]^{\left(\frac{1}{1-\beta}\right)}$$

and, seepage equals $Q_{in} - Q_{out}$.

B-9 Beta), and **Alpha!** equals 1/**Beta!**. The inflow **Qin!** for the other **ANAGB** subareas varies with the tributary water sources available. **Qin!** at Buellton is equal to 48 percent of **Accr!** plus any inflow from the Santa Ynez subarea (**QAlisal!**) and **Qin!** at East Santa Rita is 27 percent of **Accr!** plus inflow from Buellton (**QBend!**). West Santa Rita subarea inflows include Salisipuedes Creek. Thus **Qin!** at West Santa Rita is equal to 1.5 percent of **Accr!** (the other 1.5% of **Accr!** is assumed to reach the Lompoc Narrows) plus inflow from East Santa Rita (**QabvSalsi!**) plus Salisipuedes Creek inflow (**Salsipuedes!**) plus the correction factor **Resid!** if **Accr!** is zero.

Seepage is then equal to the inflow minus the outflow. The maximum possible seepage for the Santa Ynez subarea (**SYnSpMx!**) is set at 3,000 acre feet (Table B-2 above). If **Seep!** exceeds that value, **QAlisal!** is set equal to the previous **QAlisal!** plus **Seep!** minus **SYnSpMx!** and **Seep!** is set equal to **SYnSpMx!**.

B4.3.2 Bank Flows

"**Bank!**" accounts for water that enters or leaves the Above Narrows Alluvial Groundwater Basin through the surrounding banks of each subarea (excluding adjacent subarea's alluvial aquifers). For the Santa Ynez Subarea, **RipfullSYn!** has a value of 20,600 acre feet. If **TempDewatStor!** is greater than 6,000 acre feet, **Bank!** is set equal to .96 times the last month's **Bank!** value (**SyLast!**). This allows for a reduction in bank infiltration with large increases in dewatered storage. As a general principle, bank infiltration increases with storage reduction when the adjacent aquifers are sufficiently full. However, in times of drought, when adjacent aquifers are dewatered, the bank infiltration will decrease accordingly. The decreasing value **Bank!** = .96 * **SyLast!** provides for monthly recession of bank infiltration in the latter case. In the event that **TempDewatStor!** is less than 6,000 acre feet, the infiltration (or outflow) **Bank!** is:

Bank! = **.125* TunFac!** * **TempDewatStor!** - 460

TunFac! is equal to the last month's Tecolote tunnel infiltration (**Tunnl%(3,*)**) divided by 170 (the average monthly infiltration at Tecolote Tunnel). This equation provides an additional method to reduce the value of **Bank!** in times of drought (i.e., when **TunFac!** is small, **Bank!** is small). When **TempDewatStor!** is low the aquifer has considerable water in storage and **Bank!** is a negative number indicating a loss of water to the adjacent bank deposits.

B4.3.3 Underflow Between Subareas

Underflow refers to water within the aquifer that flows from one subarea to another. It does not include water exchange with the adjacent lithologically distinctive aquifers (which exchanges are incorporated in calculations of **Bank!**). Bradbury Dam effectively blocks underflow from the east end of the Above Narrows Alluvial Groundwater Basin. Therefore, underflow into the Santa Ynez subarea is zero. Approximately 75 acre feet flow out of the subarea. The net effect of underflow on the Buellton, East Santa Rita, and West Santa Rita subareas per month is 0, -15, and -35, respectively.

B4.3.4 Groundwater Diversions

Communities located adjacent to both the Santa Ynez and Buellton subareas of the Above Narrows Alluvial Groundwater Basin divert water (via ground water extraction wells) from the Santa Ynez River for municipal and industrial use. (**SyMI!**) and (**BuMI!**) refer to municipal and industrial (M&I) water year net pumpage from the Santa Ynez and Buellton riparian subareas, respectively. The Menu default value for the total Above Narrows Alluvial Groundwater Basin M&I diversions (**TotMI%**) is 2,000 acre feet per year; 1,122 acre feet of this is removed from the Santa Ynez subarea and 878 acre feet from the Buellton subarea. This was the areas estimated M&I diversions, minus return flows, in the early 1990's. There are no substantial communities located along the East and West Santa Rita subareas and therefore, no M&I diversions. The model allows for adjustment of **TotMI%** upward or downward from 2,000 acre feet per year via the following equations:

SyMI! = 1300 + 748 * (**TotMI%** - 2400) / 1683

BuMI! = 1100 + 935 * (**TotMI%** - 2400) / 1683

Notice that at the **TotMI%** default value, **SyMI!** and **BuMI!** equal 1,122 and 878 acre feet (rounded), respectively. Given a **TotMI%** value of 4,083 acre feet the right part of the equation is equal to one and **SyMI!** and **BuMI!** become 2,048 and 2,035 acre feet. The 4,083 acre foot value was selected as a reasonable buildout projection of municipal and industrial diversions in the future. Diversions of more than 4,083 acre feet will result in greater values of **SyMI!** and **BuMI!**.

(**SyDiv!**()) and (**BuDiv!**()) are the monthly portions of **SyMI!** and **BuMI!** and are derived from the annual diversions through the following equations (**WtrYrMo%** varies from 1 to 12 in the monthly cycle within the water year modelling loop):

SyDiv!(WtrYrMo%) = **SyMI!** * (**Pcnt%**(6,WtrYrMo%)) / 1000

BuDiv!(WtrYrMo%) = **BuMI!** * (**Pcnt%**(6,WtrYrMo%)) / 1000

(**Pcnt%**()) is an array of 6 twelve monthly values representing the annual distribution of M&I drafts for six areas within the purview of the model. The above equations convert the integer values to monthly fractions by dividing them by 1,000. M&I diversions are considered to be constant from year to year but to vary monthly.

Agricultral diversions are drived from the model menu value for irrigated agricultral acreage (**AgAcres%**; default value 5,677 acres). Upon model start up the ReadData subprogram calculates 76 water year values for the riparian area rainfall (**YrsRipRain!**()) and for annual pan evaoration at Lake Cachuma (**YrsRipEvap!**()). Next, in the Initialize subprogram, these annual values are used to produce 76 water year values for agricultrual consumptive use (**AgrCU!**()). The formulas used to produce **AgrCU!**() each year are as follows:

AgLandsPerc! = .827 * **AgAcres%** * (**YrsRipRain!**() - 12.4)/12
(if **YrsRipRain!** > 12.4", otherwise **AgLandsPerc!** = 0)

AgrCU!(Yr%) = .56 * **AgAcres%** * {30 * **YrsRipEvap!**(Yr%)/70.44
+ **YrsRipRain!**(Yr%)}/12 - **AgLandsPerc!**

Where 30 = typical applied irrigation water, inches, and 70.44 = average annual evaporation pan at Lake Cachuma, in inches.

Each year in Runmodel, in the beginning of the riparian section of the monthly loop, **AgrCU!** is converted to the total monthly riparian agricultrual CU value (**AgUseMo!**) by multiplication with **AgDist!**(), the monthly agricultural pumpage distribution factor. The monthly value **AgUseMo!** is then distributed to the four riparian subareas as per the subarea balancing equations on the next page.

Finally, calculation of the end of the month storage is made for each subarea of the Above Narrows Alluvial Groundwater Basin, taking into account the influence of all of the hydrologic factors described above. **Seep!** and **Bank!** are added to the previous month's storage. **SyDiv!**() and **BuDiv!**() are subtracted for the Santa Ynez and Buellton subareas (**EndRipStorSYn!** and **EndRipStorBuel!**). **AgUseMo!** is divided up among the four subareas and subtracted according to the amount of agricultural extractions each area is subjected to. Similarly, **BankDepl!** is subtracted from each subarea in proportion to the amount of human development surrounding them. The net underflow into and out of each subarea is included as a constant. The **EndRipStor!** equation for each subarea is listed as follows (**Seep!** and **Bank!** are recalculated in each subarea):

EndRipStorSYn! = **EndRipStorSYn!** + **Seep!** + **Bank!** - 75 -**SyDiv!**()
- .16 * **AgUseMo!** - .78 * **BankDepl!**

EndRipStorBuel! = **EndRipStorBuel!** + **Seep!** + **Bank!** - **BuDiv!**()
- .36 * **AgUseMo!** - .10 * **BankDepl!**

EndRipStorSRitaE! = **EndRipStorSRitaE!** + **Seep!** + **Bank!** - 15
- .45 * **AgUseMo!** - .02 * **BankDepl!**

EndRipStorSRitaW! = **EndRipStorSRitaW!** + **Seep!** + **Bank!** - 35
- .03 * **AgUseMo!** - .10 * **BankDepl!**

B5 BELOW NARROWS GROUNDWATER BASIN

Credits to the Below Narrows Account (**BNA**) are based on the difference between the actual and "constructive" percolation of Santa Ynez River flows at the Lompoc Narrows into the Below Narrows Groundwater Basin. "Constructive" percolation is the percolation that would have occurred if the Cachuma Reservoir project did not exist. Calculations of the **BNA** within the model are based on flow verses percolation curves used by the USBR (Figure 2-2). The model simulates the curves from tables included as arrays in the model. The actual flow at the Narrows is that flow generated in any month at the Lompoc Narrows by the model for a particular model run. The "Constructive" flow is calculated by the model based upon adding the Cachuma Reservoir net inflow (less any spills or releases from Cachuma Reservoir) to the actual flow at the Narrows with or without some adjustments. In both cases, percolation is calculated using the "**Lompoc**" Subroutine. The program is directed to the **Lompoc** Subroutine twice within the "**Fin**" section of the program; once for calculation of actual percolation and once for calculation of "constructive" percolation.

B5.1 Below Narrows Percolation

The purpose of the **Lompoc** Subroutine is to calculate percolation. This is done, within the model, using flow verses percolation curves used by the USBR based on historic USGS stream gaging in the Lompoc area. The model uses three tables to simulate the curves and the area bracketed by them. If the cumulative seasonal flow at the Narrows is less than or equal to 200,000 acre feet (**SwitchThresh!**) then percolation is determined by the upper curve. If the flow is equal to or greater than 400,000 acre feet (**MaxPThresh!**) then the low curve is used. The model includes a mechanism which allows use of intermediate values which lay between the bracketing curves (The USBR method determines percolation based on the higher or lower curve, only. No intermediate values are used). The continuum of percolation curves are employed to account for the "mounding" affect which causes reduction in percolation rates with increased groundwater storage.

The first table consists of thirty six monthly flow values at the Narrows (**NarrowsQ!**()) ranging from zero to 500,000 acre feet. The second table, (**HighNarP%**()) contains the 36 values defining the upper curve, and the third table, (**LowNarP%**()) contains the corresponding values defining the lower curve. The flow at the Narrows (**Qin!**) is calculated in the West Santa Rita subarea section of the program (See Appendix A, p. A28). If **Qin!** is equal to zero, percolation is set to zero. Otherwise, a table look up of the **NarrowsQ!**() array is performed such that **NarrowsQ!**(I%-1) ≤ **Qin!** < **NarrowsQ!**(I%) where **I%** is an integer from 2 to 36. For each value of **NarrowsQ!**() there is a corresponding percolation value for **LowNarP%**() and **HighNarP%**(). A ratio between the flow values bracketing **Qin!** is then calculated according to the following equation:

Ratio! = (**Qin!**-**NarrowsQ!**(I%-1)) / (**NarrowsQ!**(I%) - **NarrowsQ!**(I%-1)

If the seasonal Narrows flow (**CumlQ!**) is less than 200,000 acre feet, the equation for **Percl!** is:

Percl! = **HighNarP%**(I%-1) + {**Ratio!** *
(**HighNarP%**(I%) - **HighNarP%**(I%-1))}

If **CumlQ!** lies somewhere between 200,000 and 400,000 acre feet, a proportion (**Prop!**) is calculated to determine the percolation value between the curves or the vertical position of the calculation point on the graph.

Prop! = (**CumlQ!** - **SwitchThresh!**) / (**MaxPThresh!** - **SwitchThresh!**)

Where **SwitchThresh!** equals 200,000 acre feet and **MaxPThresh!** equals 400,000 acre feet. The model limits the value of **Prop!** from zero to one. Calculations of **Percl!** for the High curve are shown above. Low curve **Percl!** calculations are identical except that **LowNarP%**() is used in place of **HighNarP%**(). The high and low curve percolation calculations are renamed **P1!** and **P2!**, respectively. **Percl!** for intermediate curves (or the low curve) is:

Percl! = **P2!** + ((1 - **Prop!**) * (**P1!** - **P2!**))

Notice that if **Prop!** is equal to one (**CumlQ!** is equal or greater than 400,000), and **Percl!** is equal to **P2!**. If not, the equation yields a **Percl!** value between the upper and lower curves.

B5.2 Credit Calculations

Credit to the Below Narrows Account is, with some restrictions, the difference between the actual and "constructive" percolation values which are determined from flow information. The difference between the actual and "constructive" flow at the Narrows (**Qincr!**) is calculated differently for wet and dry months. If **Live!** is equal to fifteen (See Section B4.1) and **Qin!** is greater than 200 acre feet than it is considered "wet" and **Qincr!** is set equal to the total inflow to Cachuma Reservoir (**CachNetIn!**) minus any spills or scheduled releases. In drier months, **Qincr!** is:

Qincr! = **CachNetIn!** + **AboveNarrwAcct!** - **TempDewatStor!**
- **Spill!** - **RegulRelease!**

In this equation, **AboveNarrwAcct!** refers to last month's account whereas **TempDewatStor!** refers to this month's dewatered storage. Therefore, if **AboveNarrwAcct!** is larger than **TempDewatStor!** and the Cachuma Reservoir Project does not exist, the **AboveNarrwAcct!** is used to fill **TempDewatStor!** and the remaining account is transferred to the Narrows as inflow to be added to the flow at Cachuma Dam (**CachNetIn!**). Conversely, if the **AboveNarrwAcct!** is smaller than **TempDewatStor!**, part of **CachNetIn!** is used to fill **TempDewatStor!** and **Qincr!** has the potential to be a negative number. If **Qincr!** is less than zero then the model sets it equal to zero.

With the "constructive" flow, **Qin!** is set equal to the actual flow (**QNarrows!**) plus **Qincr!**. The program is then directed to the **Lompoc** Subroutine where the "constructive" flow is used to calculate the "constructive" percolation (**Percl2!**). The credit to be applied to the Below Narrows Account for this month (**Bncred!**) is simply **Percl2!** minus the actual percolation (renamed **Percl1!**). The total current month's Below Narrows Account is equal to the previous month's account plus this month's **Bncred!**.

According to the existing agreements, the Above and Below Narrows Accounts are reduced in the event of a Cachuma Reservoir spill. **Spill!** is calculated previously in the Reservoir Section of the monthly loop. **Decrease!** is defined as the previous month's Above Narrows total dewatered storage minus the current month's dewatered storage. The reduction in dewatered storage may be partially or completely attributable to water spilled from Cachuma Reservoir. Therefore, if **Decrease!** exceeds **Spill!** then **Decrease!** is set equal to **Spill!** so as not to include flows originating below Bradbury Dam or other potential sources of percolation.

The current month's **AboveNarrwAcct!** is reduced by **Decrease!**. The amount of the Cachuma Reservoir spill that reaches the Narrows (**SplRchingNrrws!**) is equal to **Spill!** minus **Decrease!**. If **SplRchingNrrws!** is less than or equal to the **BelowNarrwAcct!** then

BelowNarrwAcct! is reduced by the amount of Cachuma Reservoir spill water that percolated into the Lompoc Forebay (**BnRedu!**). Then **BnRedu!** is calculated by the following equation:

BnRedu! = **SplRchingNrrws!** * (**Percl1!/QNarrows!**)

On the other hand, if **SplRchingNrrws!** is greater than **BelowNarrwAcct!**, then **BnRedu!** is:

BnRedu! = **BelowNarrAcct!** * (**Percl1!/QNarrows!**)

and **BelowNarrwAcct!** is reduced by **BnRedu!**.

APPENDIX C

APPENDIX C:

GLOSSARY OF MODEL ACRONYMS

Note: The symbol % following the term indicates that the variable or constant is an integer value from -32768 to + 32767. The symbol ! following the term indicates a short precision (7 significant figure accuracy) real number. After the % or ! there may be the symbols (*) which indicate that the term name is for an array of two or more numbers. The words "annual" and "yearly" (or "years") as applied with the following definitions always refer to a water year beginning in October and ending with the following September. The term **ANAGB** (in bold) refers to the Cachuma to Lompoc Riparian Alluvial Groundwater Basins, also called the **A**bove **N**arrows **A**lluvial **G**roundwater **B**asins. The term **CU** (in bold) means "consumptive use".

AboveNarrwAcct! - End of Last month's Above Narrows Account (recalculated each month). See Manual, p. 19, and Appendix B, p. B-30 et seq.

Accr! - Accretions: All the surface runoff into a reservoir excepting any upstream reservoir spill water (includes any extra surface runoff due to cloudseeding operations, but does not include any rainfall directly on the water surface of the reservoir). See Appendix A, p. A-20 et seq.

Accret%(*) - Accretions: Basic historic surface runoff data (less estimated historic cloudseeding effects) file used in model. See Manual, p. 26.

AccumRelease! - All of this years "Actual" Gibraltar Reservoir Gin Chow water to be released for the current year (does not include any carryover Gin Chow water from an earlier year, which may be released after the **AccumRelease!** water). See Appendices p. A-24, and pp. B-21 to B-23.

AgAcres% - **ANAGB** agricultural acreage: Set in Model Menu.

Determines AgrCU! value to be employed in model run. See Appendix B, p. B-44.

AgDist!(*) - Ag **CU** monthly Distribution: Twelve values representing each month's percentage of the yearly agricultural **CU**. See Appendix B, p. B-44.

AgLandsPerc! - Annual percolation of rainfall on Ag lands: Used to calculate each years **AgrCU!(*)** value in model Initialize subprogram. See Appendix B, p. B-44.

AgrCU!(*) - Agricultural Consumptive Use: The **ANAGB** ground water **CU** for agricultural purposes (76 annual values). See Appendix B, p. B-44.

AgUseMo! - Agricultural Monthly **CU**: Total monthly consumptive use by agriculture in the Cachuma to Lompoc Riparian Alluvial Basins. See Appendix B, p. B-44.

AnnRunoff!(*) - Annual Runoff: Yearly surface runoff accumulator for Juncal, "actual" Gibraltar, & Cachuma reservoirs. Reset to zero at beginning of each yearly loop. See Appendix A, pp. A-18, A-21, and A-26.

AnnShort!(*) - AnnualShortage: Yearly reservoir (or reservoir + tunnel) delivery shortage accumulators for the three reservoirs noted above. Also reset each year to zero. See Appendix A, pp. A-18, A-21, A-25, and A-26.

BankDepl! - Bank Depletions: Loss of inflow to the **ANAGB** through the surrounding geologic units (compared to totally unimpaired, pre-devlopment conditions) due to groundwater use in the surrounding basins. See Appendix B, p. B-36 and B-37.

Bank! - Bank Infiltration: Water that infiltrates into or out from the ANAGB subareas. See Appendix B, pp. B-41 and B-42.

BelowNarrwAcct! - Below Narrows Account: End of last months Below Narrows Account (recalculated monthly). See Manual p. 20 & 21, and Appendix B, p. B-45 et seq.

BelowNrwsRel! - Below Narrows Release: Releases from Cachuma Reservoir to satisfy the Below Narrows Account. See Appendix B, pp. B-28 and B-29.

Bncred! - Below Narrows Credit: Credit to be applied to the Below Narrows Account for the current month. See Appendix B, pp. B-49 and B-50.

BnRedu! - Below Narrows Reduction". Calculated possible reduction in the Below Narrows Account at times when Cachuma Reservoir is spilling. See Appendix B, pp. B-49 and B-50.

BufPtr! - Leakage table Pointer: Table pointer, calculated off Cachuma lake elevations, used to determine leakage from Cachuma Reservoir. See Appendix A, p. 34.

BuDiv!(*) - Buellton diversions: Monthly M&I pumpage **CU** from the Buellton **ANAGB** subarea (twelve values). See Appendices, p. A-27, and p. B-42 et seq.

BuMI! - Buellton M&I: Annual M&I pumpage CU for Buellton subarea set in Initialize subprogram off Model Menu value. See Appendices, p. A-13, and p. B-43.

CachEt!(*) - Cachuma Evapotranspiration correction: Factor which corrects for inundation of vegetation at Cachuma Reservoir. See Manual p. 31 et seq, and Appendix B, p. B-26 et seq.

CachNetIn! - Cachuma Net Inflow: The monthly inflow to Cachuma Reservoir plus **Correction!** (from Gibraltar ops) minus any leakage from Cachuma Dam. See Appendices, p. A-26, and B-33.

ConstNrwsQ! - Constructive Narrows Q (or flow): This is the monthly estimated flow at the Lompoc Narrows which would have occurred absent the Cachuma Project. Used to determine credits for the Below Narrows Account. Note definitions for **CumlQ!**, and **CumlNarrowsQ!**, etc. below. See Manual p. 20, and Appendices, pp. A-29, & 30, and B-45 et seq.

Correction! - The difference between spills plus releases from the "Base" Gibraltar and the "actual"

Gibraltar Reservoir. This quantity is applied to the Cachuma Reservoir net inflow for the proper maintenance of the Above and Below Narrows Accounts. See Appendices, p. A-25, and p. B-25, and B-33.

Cpsum! - Cachuma precipitation sum: Annual accumulator for rainfall at Cachuma Dam used to calculate cloud seeding runoff increments. Includes the rainfall produced by cloud seeding. Reset to zero each water year. See Appendices, pp. A-19 and A-25, and p. B-12.

CsEff! - Cloud seeding Efficiency: The effectiveness of cloud seeding expressed as a fraction of the maximum possible precipitation due to cloud seeding. Value may be changed in Menu. See Manual p. 43, and Appendix B, p. B-8.

CsFac! - Cloud seeding Factor: Set to equal CsEff! at the beginning of each year. May be reduced. See Appendix B, p. B-8 et seq.

CsFlag% - Cloud seeding Flag: A switch used by the Model to initiate cloud seeding calculations. See Manual p. 43, and Appendix B, p. B-7 et seq.

CsInc%(*) - Cloud seeding Increment: The maximum incremental precipitation possible from cloud-seed ops for each month of the modelling period. Has value zero for all months outside October through April time window. See Manual, p. 29 and 30. and Appendix B, pp. B-8 through B-11.

CumlConstNrwsQ! - Cumulative Constructive Narrows Q (or flow): Cumulative seasonal Lompoc Narrows Constructive flow (through previous calculation month) used to determine "Constructive percolation" in the Lompoc Basin using the Lompoc routine. See Manual, p. 20, and Appendices, pp. A-29, and 30, and p. B-46 et seq.

CumlNarrowsQ! - Cumulative Narrows Q (or flow): Same definition as for "Constructive" flows above except determines "actual" percolation. Same page references plus p. A-28.

CumlQ! - Cumulative Q (or flow): Cumulative seasonal (October through previous calculation month)

Lompoc Narrows flow. Used for "actual" and for "constructive" flows. Employed in Lompoc subroutine. See Appendices, pp. A-28, 29, and 37, and B-47 and B-48.

CumPhanRel! - All of this years "Base" Gibraltar Reservoir Gin Chow water to be released for the current year (does not include any carryover Gin Chow water from an earlier year, which may be released after the **AccumRelease!** water). See Appendices p. A-24, and pp. B-21 to B-23.

Datum(*) - The elevation of the bottom of the reservoir. Pg.

Decrease - The reduction in the Above and Below Narrows Account that occurs when Cachuma Reservoir spills. It is the previous month's total dewatered storage minus the current month's temporary dewatered storage. Pg.

Deficit(*) - See Short. Pg.

Modelling Period - The historic time period used by the Model to predict current or future responses. Pg.

Diff - Interpolation Factor used in Area Elev & AreaVol Set routines.

DwnStrRelFlag(*) - "Downstream Release Flag". The device used by the model to allow downstream releases from Cachuma. Pg.

Eavg(*) - "Evaporation Average". The current month Cachuma Pan evaporation value averaged over the Modelling period. Pg.

Elev7 - "Elevation". The elevation of the water surface within the reservoir. Pg.

EndMoVol(*) - "End of Month Volume". The reservoir volume at the end of the current month. Pg.

EndRipStorSYn - "End of the Month Riparian Storage". The end of the month storage in each subarea of the Riparian Strip (also EndRipStorBu, EndRipStorSRitaE, and EndRipStorSRitaW). Pg.

Et - "Evapotranspiration". The total

evapotranspiration value for the month; equal to the lake area multiplied by CachET. Pg.

Evapr - "Evaporation". See **Evp.** Pg.

Evp - "Evaporation". Evaporation from the surface of the reservoir. Pg.

Fin -

Fj - "Juncal Watershed Factor". A constant used in calculation of **Jpsum.** Gj and Cj for Gibraltar and Juncal . Pg.

FldDiv - "Flood Diversions". Diversions from the "Base" Gibraltar Reservoir which are taken from storage volumes derived from Flood Flows (see **Qfld**). Pg.

FldVol - "Flood Volume". The storage volume in the "Base" Gibraltar Reservoir derived from Flood Flows (see **Qfld**). Pg.

GinChowRelFlag - "Gin Chow Release Flag". The device used by the Model to initiate releases for the Gin Chow Agreement. Pg.

HighNarP(*) - "High Narrows Percolation". Percolation values used to determine percolation for the Below Narrows Account at low seasonal flows. Pg.

Inflow - "Inflow". All surface runoff to a reservoir including upstream reservoir spills. Pg.

Jpsum - "Juncal precipitation sum". The total rainfall at Juncal Reservoir including cloud seeding. Gpsum and Cpsum for Gibraltar and Cachuma . Pg.

JunDiv - "Juncal Diversions." The total amount of water diverted from a reservoir. **JunDiv** = **LakeDiv** + **Tunnl.** GibDiv and CacDiv for Gibraltar and Cachuma . Pg.

JunShort - "Juncal Shortage". The amount by which reservoir demand exceeds reservoir supply. GibShort and CacShort for Gibraltar and Cachuma . Pg.

LakeDiv - "Lake Diversions". Water diverted from a reservoir. Pg.

LastEl - "Last Elevation". The end of last month's Cachuma Reservoir elevation. Pg.

LastMonthsSpill -

LastVol - "Last Volume". The last month's storage volume of the "Base" Gibraltar Reservoir. Pg.

Leakage - Water that escapes the flood gates of Bradbury Dam when the elevation of Cachuma Reservoir exceeds 720 feet. Pg.

Leakg - "Leakage". Beginning of the current month leakage from Bradbury Dam. Also, the final leakage value derived from averaging beginning and end of the month values. Pg.

Lek - "Leakage". End of the current month leakage from Bradbury Dam. Pg.

Live - "Live". The sum of the four Live Stream Flags used to determine where the Santa Ynez River is flowing. Pg.

LivStrmFlg - "Live Stream Flag". The device used by the Model to determine if a live stream exists at a number of points along the Santa Ynez River below Cachuma Reservoir.

Lompar(*) - "Lompoc Parabola". Constants used in calculation of parabolas for cloud seeding effects from Cachuma Reservoir to Lompoc (also Gibpar and Junpar). Pg.

LowNarP(*) - "Low Narrows Percolation". Percolation values used to determine percolation for the Below Narrows Account at high seasonal flows. Pg.

LowPt - "Low Point". The low reservoir storage volume used to establish the ramp function. Pg.

LowVol - "Low Volume". See **LowPt**. Pg.

LrnInc - "Lompoc Rain Increment". Cachuma Reservoir to Lompoc incremental rain due to cloud seeding. Pg.

LroInc - "Lompoc Runoff Increment". Cachuma Reservoir to Lompoc incremental runoff due to cloud seeding. Pg.

Lslope - "Lompoc Slope". The slope of the parabola used to calculate Cachuma Reservoir to Lompoc cloud seeding effects. Pg.

Lx - "Lompoc X". Cachuma Reservoir to Lompoc precipitation. Pg.

MaxThresh - "Maximum Threshold". The flow value at which the percolation is determined by the lower percolation curve. Pg.

MaxVol(*) - "Maximum Volume". The maximum volume of the reservoir. Pg.

MaxWSElev - "Maximum Water Surface Elevation"

MinDelv - "Minimum Delivery". The draft level dictated by a ramp function if the beginning of May storage equals **LowPt** expressed as percent of full delivery. Pg.

MoDays(*) - "Month Days". The number of days in a given month of the modelling period. Pg.

NarrowsQ - "Narrows flow". Monthly flow values at the Narrows used to determine percolation for the Below Narrows account. Pg.

NetEvap -

Nprel -

Nrel - "No Release". The program section in which much of the water accounting is conducted. Pg.

OperDewatStor - "Operational Dewatered Storage". The normal amount of dewatered storage maintained in the Above Narrows Account before releases from Cachuma are made (Default = 10,000 af). Pg.

OrdDiv - "Ordinary Diversions". Diversions from the "Base" Gibraltar Reservoir which are taken from storage volumes derived from Ordinary

Flows (see Qord). Pg.

OrdVol - "Ordinary Volume". The storage volume in the "Base" Gibraltar Reservoir derived from Ordinary Flows (see Qord). Pg.

PanFac(*) - "Pan Factor". A multiplier to compensate for physical differences between the pan evaporation and the reservoir. Pg.

Part - A fraction which is multiplied by reservoir variables in order to reduce them in the event that the reservoir goes dry. Pg.

Part - A fractional multiplier used to proportionally reduce diversions and other hydrologic influences on the "Base" Gibraltar Reservoir in the event that the Reservoir goes dry. Pg.

Percl2 - "Percolation 2". The "constructive" percolation above the Narrows. Pg.

PercRate - "Percolation Rate". Pg.

Pfac - "Percolation Factor". A multiplier for the percolation of releases to the Riparian Strip. Pg.

PhanAEset - "Phantom Gibraltar area-elevation Set". Subroutine which returns a lake area and elevation for a given "Base" reservoir volume estimate volume. Pg.

PhanArea - "Phantom Gibraltar Area". The area of the "Base" Gibraltar Reservoir. Pg.

PhanAvgVol - "Average Volume". The average volume of the "Base" Gibraltar Reservoir for each water year. Pg.

PhanDiv - "Phantom Diversions". The total "Phantom" diversion including Flood Flows and Ordinary Flows. Pg.

PhanEvap - "Phantom Gibraltar Evaporation". Evaporation from the "Base" Gibraltar Reservoir. Pg.

PhanRel - "Phantom Releases". Releases made from the "Base" Gibraltar Reservoir. Pg.

PhanRol - "Phantom Gibraltar Rain On Lake". Second iteration terminology for calculation of the "Base" Gibraltar storage volume due to rain on the reservoir. Pg.

PhanSet -

PhanSpill - "Phantom Spill". The amount of water that spills from the "Base" Gibraltar Reservoir. Pg.

PhanVol - "Phantom Gibraltar Reservoir Volume". The calculated volume of the "Base" Gibraltar Reservoir. Pg.

Prc - "Precipitation on the Reservoir". The storage volume due to rainfall directly on the reservoir. **Prc** = **Rainer** * Area7. Pg.

ProjDraft - "Project Draft"

Prop - "Proportion". A ratio used to calculate the percolation value between the bracketing curves for the Below Narrows Account. Pg.

QabvSalsi - "Flow above Salsipuedes". The flow out of the East Santa Rita subarea. Pg.

QAlisal - "Flow at Alisal". The flow out of the Santa Ynez subarea of the Riparian Strip at Alisal Bridge. Pg.

QBend - "Flow at the Bend". The flow out of the Buellton subarea. Pg.

Qfld - "Flood Flows". Average daily inflow into Gibraltar Reservoir of greater than 800 cubic feet per second. Pg.

Qin - "Inflow". Total inflow to the four subareas between Cachuma Reservoir and Lompoc. Pg.

Qincr - "Incremental Flow". The difference between the Actual and "Constructive" flow at the Narrows (**Qincr**). Pg.

QNarrows - "Flow at the Narrows". The actual flow at the

Narrows. Pg.

QOrd - "Ordinary Flows". Average daily inflow into Gibraltar Reservoir of less than 800 cubic feet per second. Pg.

Rain - "Rain". The current month's precipitation at the reservoir excluding cloud seeding. Pg.

Rainer - The current month's total rainfall including cloud seeding.

RainInc - "Rain Increment." The incremental increase in rainfall due to cloud seeding, as modified by the efficiency factor. **RainInc** = **CsEff** * **CsInc**. Pg.

RainOnLake - "Rain on the Lake". See **Prc**.

Ratio - A fractional multiplier equal to **Qfld** divided by **Inflow** (see **Qfld**). Also, a fractional multiplier used to determine percolation for the Below Narrows Account Pg.

RedFac - "Reduction Factor". A multiplication factor, between 0 and one, to reduce reservoir draft during ramping. Pg.

RegulRelease - "Regular Release". Releases from Cachuma or Gibraltar to satisfy the Above Narrows or Gin Chow Accounts. Pg.

ResevCap -

Reservoir - The subroutine which performs the monthly accounting for Juncal, Gibraltar, and Cachuma Reservoir.

Resid - "Residual". Amount of accretion added to inflow for West Santa Rita subarea in order to balance with Accr.

RipfullSYn - "Full Riparian Strip, Santa Ynez". The full Riparian Strip storage value for the Santa Ynez area (also RipfullBu, RipfullSRitaW, and RipfullSRitaE). Pg.

Rto - "Ratio". A fractional multiplier used to proportionally reduce diversions and other hydrologic influences on a reservoir in the event that the reservoir goes dry. Pg.

RunoffInc - "Runoff Increment". The incremental runoff resulting from cloud seeding. Pg.

Salpar(*) - "Salsipuedes Parabola". Constants used in calculation of parabolas for cloud seeding effects at Salsipuedes (Also CacPar). Pg.

Salsi(*) - "Salsipuedes". Accretions to Salsipuedes Watershed excluding effects of cloud seeding. Pg.

Salsipuedes - Refers to the Salsipuedes watershed. Pg.

Seep - "Seepage". The seepage of Santa Ynez River surface flows into the Riparian Strip. Pg.

Spill - The amount of water that spills from the Reservoir. Pg.

SplRchingNrrws - "Spill Reaching Narrows". The amount of Cachuma Reservoir spill that reaches the Narrows. Pg.

Spsum - "Salsipuedes Precipitation Sum". Total augmented Salsipuedes precipitation. Pg.

SrnInc - "Salsipuedes Rain Increment". Salsipuedes incremental rain due to cloud seeding. Pg.

SroInc - "Salsipuedes Runoff Increment". Salsipuedes incremental runoff due to cloud seeding. Pg.

Sslope - "Salsipuedes Slope". The slope of the parabola used to calculate Salsipuedes cloud seeding effects. Pg.

StartRelease - "Start Release". The dewatered storage at which releases may be are made to the Above Narrows Account (Default = 10,600 af). Pg.

StartShortage - "Start Shortage Volume". The volume at which cut-backs in Reservoir draft is initiated. Pg.

StrtRelVol - "Start Release Volume". The volume of water in the Below Narrows Account at which releases are made to the account. Pg.

SwitchThresh - "Switch Threshold". The flow value at which the percolation is determined by the upper percolation curve. Pg.

Sx - "Salsipuedes X". Salsipuedes precipitation accumulator used to calculate cloud seeding runoffinc. Pg.

SyDiv - "Santa Ynez Diversions". The monthly groundwater pumpage from the Riparian strip for municipal and Industrial use (Also Budiv). Pg.

SyLast - "Santa Ynez Last". Last month's Santa Ynez bank infiltration value.

SyMI - "Santa Ynez Municipal and Industrial". Yearly groundwater pumpage for municipal and industrial use (also BuMI).

SynPerc - "Percolation". Total percolation into each subarea of the Riparian Strip (also BuePerc, SRitaEPerc, and SRitaWPerc).

SynStr - "**SynStr**". A calibration constant used in the calculation of **PercRate** (also BuStr, SRitaEstr, and SRitaWStr).

SYnSpMx - "Santa Ynez Maximum Seepage". The maximum possible seepage into the Santa Ynez subarea. Pg.

SyRed - "Santa Ynez Reduction Factor". A limiting factor for Bank Infiltration. Pg.

TempDewatStor - "Temporary Dewatered Storage". This month's calculated dewatered storage volume in the Riparian Strip.

TotDewatStor - "Total Dewatered Storage". The amount of dewatered available storage in the Above Narrows Aquifer.

TotMI - "Total Municipal and Industrial". The total riparian municipal and industrial diversions. Pg.

TunFac - "Tunnel Factor". Tunnel infiltration divided by 2500 to reduce Bank in times of drought. pg.

Tunnl - "Tunnel Infiltration". Groundwater that infiltrates into a delivery tunnel and contributes to a reservoirs projects overall yield. Pg.

UplandDepl - "Upland Depletions". The loss of inflow to the Riparian Basin due to development along the banks of the Santa Ynez River. Pg.

UpStrmSpill - "Up Stream Spills". Inflow resulting from spills from reservoirs located upstream. Pg

VolEst - "Volume Estimate". A preliminary estimate of the current month's ending reservoir volume. Pg.

Volume7 - The total current volume of a reservoir. Pg.

VSave -

YrPhanYld - "Yearly Phantom Gibraltar Yield". The accumulated "Base" Gibraltar Reservoir yield including diversions and tunnel infiltration. Pg.

YrsRipEvap!(*) - Years Riparian Evaporation: 76 yearly values of Cachuma pan evaporation made into an annual factor by dividing by the 76 year average pan evap value at Cachuma (70.44 in.). Used with **AgAcres%**, **YrsRipRain!(*)**, and **AgLandsPerc!** to calculate annual **AgrCU!(*)** values. Pg. B-44.

YrsRipRain!(*) - Years Riparian Rainfall: **ANAGB** 76 yearly rain values used to calculate the rain percolation on agricultural lands (**AgLandsPerc!**). Equal to eight tenths of the annual Cachuma rainfall. Pg. B-44.

APPENDIX D:

APPENDIX D

APPENDIX D:

SOURCES

The following publications were used in the preparation of this report:

1) Water-Resources Investigation Report 91-4172. United States Geological Survey

2) Enlargement Of Lake Cachuma and Bradbury Dam Safety Modifications - November 1990, California Department of Water Resources, United States Bureau of Reclamation

3) County of Santa Barbara Water And Sewerage Facilities Plan, June 1971, Boyle Engineering

4) Gibraltar Pass Through Agreement

5) Groundwater and Percolation Data For Use in Determining Downstream Releases, Santa Ynez River, Cachuma Project, CA, United States Department of the Interior, Bureau of Reclamation, March 1973 pp. 3-15.

6) A Water History and the Cachuma Project, Santa Barbara Water Agency, September, 1949

7) Precipitation Augmentation Potential from Convection Band Cloud Seeding in Santa Barbara County, North American Weather Consultants Report WM-87-7, May 1988