Santa Ynez River

Hydrology Model Manual

Draft 8

EXHIBIT CT21

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Santa Ynez River Hydrology Model Manual
Draft #8

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.

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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 in the Santa Ynez River Watershed and most of the water used in the South Coast are currently supplied from the Santa Ynez River Watershed. The watershed hydrologic system includes surface reservoirs, tunnels and groundwater aquifers. Operational guidelines and agreements govern the distribution and use of those resources. Water from the Santa Ynez River Watershed is used extensively within the watershed and South Coast to supply the increasing and varied interests. Additional sources of water under development include the Coastal Branch of the State Water Project and the ocean desalination facility developed by the City of Santa Barbara.

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

1.1 HISTORY OF THE MODEL

The Santa Ynez River Hydrology Model was conceived 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 renewed interest in reservoir enlargement studies. The model was developed by the Santa Barbara County Water Agency

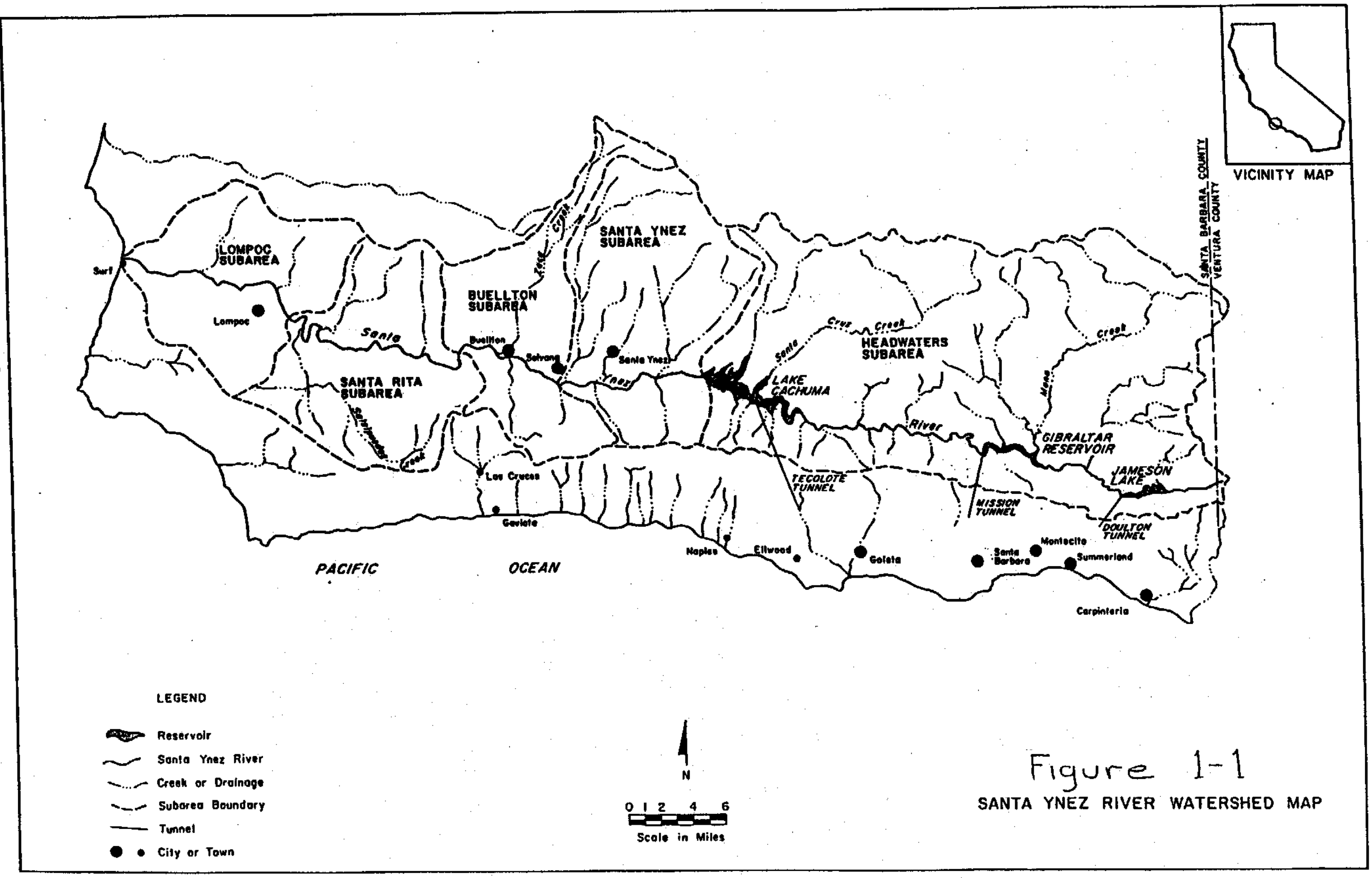


Figure 1-1
SANTA YNEZ RIVER WATERSHED MAP

(SBCWA) using techniques and data from earlier models of the Santa Ynez River Watershed developed by consulting firms and the United States Bureau of Reclamation (USBR). The model has developed in stages often utilizing advise and consultation from members of the Santa Ynez River Hydrology Committee. This committee is comprised of water specialists and hydrologists many of whom are representatives of local water interests.

The first version of the model developed by SBCWA included only the reservoirs and utilized a base period of 1919 through 1979. In 1981, operation of the groundwater basin above the Lompoc Narrows was included in the model. In 1985, the year 1918 was added to the modeling period which allowed for initial and final conditions in which the reservoirs were essentially full.

In 1987 the model was expanded to include accounting for percolation of Santa Ynez River water below the Lompoc Narrows. In 1988, cloud seeding calculations had been included and the model converted from Hewlett Packard Basic to Microsoft Quick Basic. By May of 1990, the Santa Ynez River Hydrology Model was modified to reflect the operation of Gibraltar Reservoir under the Upper Santa Ynez River Operations Agreement which was finalized in mid 1989 (see Page___, Upper Santa Ynez River Operations Agreement). Since the mid-1980's, the model has been used for a myriad 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 instruction on the use of the Santa Ynez River Hydrology Model and information on the origin and development of the data base. The manual is also intended to provide an understanding of limitations in the use of the model.

Section 2 of this manual provides a brief history and general overview of the reservoir facilities and hydrologic features of the Santa Ynez River Watershed. 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). Section 4 describes the model operation, basic functions and output. Section 5 provides a description of the model structure. A detailed description of the modelling of the hydrological system ("RunModel" Subprogram) 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

Future plans for the model include verification based on data from 1976 through 1991. This verification will be used to confirm the validity of the model. Based on the results of this comparison, the model may be adjusted. Concurrently, additional data will be used to extend the base period of the model. A base period that begins and ends with full system conditions will be incorporated into the model when the reservoirs spill. In addition, the model will be expanded to simulate conveyance of the Below Narrow's releases from Cachuma Reservoir via the Santa Ynez River rather than a theoretical pipeline.

SECTION 2

THE SANTA YNEZ RIVER HYDROLOGIC SYSTEM

The Santa Ynez River Hydrologic system includes reservoirs, 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 in the central Santa Ynez River Basin. The Upper Santa Ynez River Operations Agreement (sometimes referred to as the Gibraltar Pass Through Agreement), Gin Chow Decision and State Water Resources Control Board (SWRCB) Order No. WR 89-18 (also known as the Cachuma Modified Live Stream Agreement) regulate operations of the reservoirs in the Basin. Water is delivered from each reservoir to the South Coast by means of a tunnel through the Santa Ynez mountains. Groundwater infiltration to these tunnels provides additional water to the South Coast. Demand within the Santa Ynez River Basin is primarily fulfilled through groundwater extraction. 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 structure with an auxiliary dam, located about 88 river miles upstream from the Pacific Ocean (Figure 1-1). The Jameson Reservoir Watershed is approximately fourteen square miles. Runoff from Alder Creek, a tributary of the Santa Ynez River is diverted to Jameson Reservoir via an aqueduct. Currently, the storage capacity of the reservoir is approximately 5,000 acre feet, reduced from the original capacity of 7,228 acre feet by siltation. The water surface area of the full reservoir is about 131 acres. 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, water from Fox Creek, a downstream tributary to the Santa Ynez River, is diverted into the tunnel. Tunnel infiltration supplies an average of 500 acre feet per year in addition to the reservoir yield.

2.1.2 GIBRALTAR RESERVOIR

Gibraltar Reservoir was constructed by the City of Santa Barbara in 1920 about 73 river miles upstream from the Pacific Ocean (Figure 1-1). The Gibraltar Reservoir Watershed is approximately 216 square miles; the southeast fourteen square miles of which are located above Juncal Dam. The total Juncal to Gibraltar Watershed area is 202 square miles, nearly equal to that of the Gibraltar to Cachuma Reservoir Watershed (201 square miles). Siltation has been a continual problem at Gibraltar Reservoir since its construction due to the significant size of its watershed compared to the reservoir capacity and the occasional occurrence of burn in the watershed.

The original reservoir capacity of 14,500 acre feet was reduced to 7,600 acre feet by the year 1947. The reinforced concrete arch dam was raised 23 feet in 1948 resulting in an increased storage capacity of 14,777 acre feet. Currently, the reservoir capacity is approximately 8,500 acre feet with a corresponding surface area of about 290 acres. The yield and operation of the reservoir are discussed in Section 2.4, Permits, Court Decisions and Agreements.
Diversions to the City of Santa Barbara are made through the 3.7 mile long Mission Tunnel. Tunnel infiltration produces an average additional supply of about 1,100 acre feet of water per year.

2.1.3 CACHUMA RESERVOIR

Cachuma Reservoir, completed in 1953, is the largest of three reservoirs in the Santa Ynez River Watershed. Bradbury Dam is 48.7 river miles upstream from the Pacific Ocean. The reservoir is formed by Bradbury Dam, a 205 foot high earth-fill embankment with a gated overflow spillway. The storage capacity of Cachuma Reservoir, when constructed, was 204,874 acre feet. Based on the 1990 silt survey, the capacity of the reservoir has been reduced to approximately 190,409 acre feet with a corresponding surface area of nearly 3,043 acres (see Appendix F for reservoir elevation-capacity tables). The Cachuma Reservoir Watershed is approximately 417 square miles, 216 square miles of which are above Gibraltar Dam.

Diversions from Cachuma Reservoir to the South Coast are made through the 6.4 mile long Tecolote Tunnel which was completed in 1956. Water infiltration into the tunnel provides an average of 3,000 acre feet per year to the project. Diversions to Santa Ynez Improvement District #1 are made from Cachuma Reservoir by means of a downstream pipeline. Minor diversions are made directly to the county park at the reservoir. In accordance with WR No. 89-18, water is released from the reservoir to replenish downstream groundwater basins.

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 36 miles long and of variable width. The estimated depth of the Above Narrows Alluvial Groundwater Basins 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 impermeable, non-water bearing shale.

The Above Narrows Alluvial Groundwater Basin is divided into three subareas based on geographical 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 extends 14.6 river miles along the Santa Ynez River and is located upstream of the confluence of Salsipuedes Creek. The Santa Rita West extends 2.8 miles along the river downstream of the confluence of Salsipuedes Creek (Figure 2-1). Only the upper 50 feet of the basin is included in the model having a corresponding storage capacity of 90,000 acre feet.

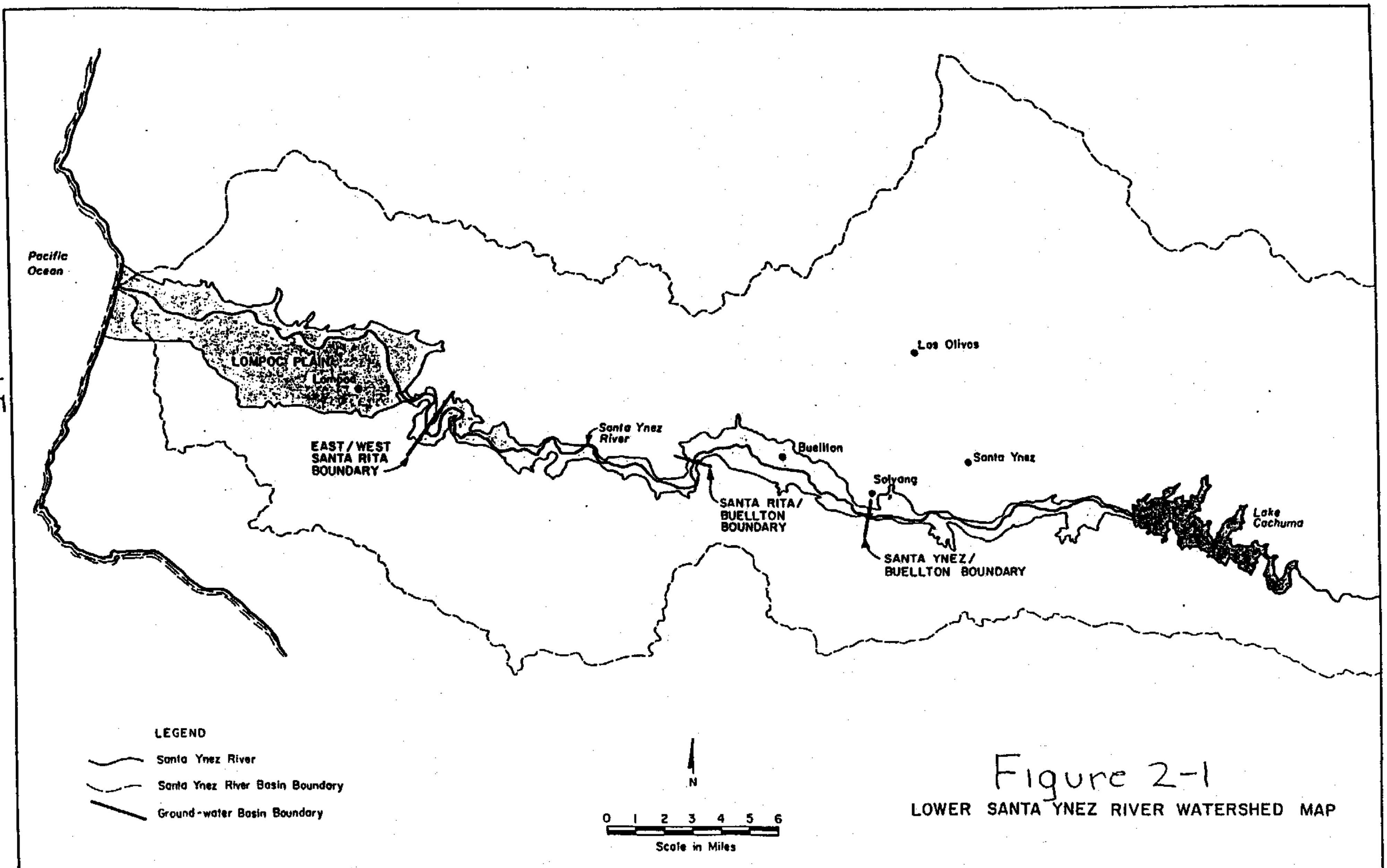


Figure 2-1
LOWER SANTA YNEZ RIVER WATERSHED MAP

Inflow to the Above Narrows Alluvial Groundwater Basin results from percolation of surface water and subsurface flow from geologic units surrounding the aquifer. Depletions occur through extractions from wells within the alluvial basin. For the purposes of the 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 out through the Lompoc Narrows to the Lompoc basin (Figure 2-1). There is no underflow into the east end of the alluvial basin due to the construction of Bradbury Dam which extends approximately 70 feet below the stream bed.

In order to achieve agreement between modelled and measured dewatered storage in the Above Narrows Alluvial Groundwater Basin, a hydrologic flow parameter representing bank infiltration was required. It is assumed that the bank infiltration occurs as subsurface inflow to the Above Narrows Alluvial Groundwater Basin from less permeable, fractured, underlying shale and other deposits. Under certain circumstances the bank infiltration may occur in reverse as subsurface outflow 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 modelled and measured dewatered storage volumes. The model is based on the assumption that seepage from the Above Narrows basin into the surrounding geologic formations occurs in times of high precipitation and runoff. The bank depletion results in loss of water into the surrounding fractured shale. It may be that water loss to the surrounding shale occurs primarily in isolated fracture or fault zones. In addition, bank depletion includes water consumption by phreatophytes along the Santa Ynez River which depletes the Above Narrows Alluvial Groundwater Basin. Phreatophytes are plants that grow in areas of shallow groundwater and have root systems that tap into the water table.

Historically, there has been both surface inflow and groundwater inflow to the Above Narrows Alluvial Basin from adjacent upland groundwater basins. More recently, increased groundwater pumping from these basins has caused an overall lowering of groundwater levels and the consequential loss of inflow to the Above Narrows Basin.

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 below the Narrows occurs in the Lompoc Plain forebay. 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 PERMITS, COURT DECISIONS AND AGREEMENTS

The water storage and delivery facilities of the Santa Ynez River Watershed were constructed over many years. Operation of these facilities have been subject to decisions, orders, and agreements which are discussed below and summarized in Table 2-1.

2.4.1 GIN CHOW DECISION

In August 1928, the owners of 38 parcels of land located adjacent to the Santa Ynez River brought suit against the Montecito Water District and the City of Santa Barbara over the construction of Gibraltar Reservoir and consequent reduction in the natural river flow. According to the California Supreme Court decision dated September, 1930 the City of Santa Barbara is required to release up to 616 acre feet per year of Gibraltar Reservoir inflow during the summer and fall months. The decision also recognized the City's diversion right to 4,189 acre feet annually of ordinary flow and up to 14,000 acre feet of annual diversion including storm, flood and freshet flow.

2.4.2 UPPER SANTA YNEZ RIVER OPERATIONS AGREEMENT

In the mid 1986, the City 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 result was the Upper Santa Ynez River Operations Agreement of 1989.

The Upper Santa Ynez River Operations Agreement, signed in 1989, sets the diversion by the City of Santa Barbara from Gibraltar Reservoir at the amount that would be allowed under the "Base" Operation. The "Base" Operation includes a theoretical Gibraltar Reservoir with a fixed storage of 8,567 acre feet (and undergoes no capacity loss due to siltation). 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 the 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 diversion of a maximum of 4,189 acre feet per year of ordinary flow plus flood flow, if available, consistent with the Gin Chow Decision. According to the Upper Santa Ynez River Operations Agreement, ordinary flow is deemed to be average daily inflow into Gibraltar Reservoir of less than 800 cubic feet per second (cfsday). Daily inflow in excess of 800 cfs is deemed to be flood flow. Note: Within the program, "Phantom" is used in reference to the "Base" Operation.

2.4.3 STATE WATER RESOURCES CONT. BOARD ORDER NO. WR 89-18

Order No. WR 886 was adopted in 1958 by the State Water Rights Board (the predecessor to the SWRCB) and contained the initial conditions pertaining to the operation of Cachuma Reservoir. SWRCB Order No. WR 73-37 was established in March 1973 and amended in 1989 under SWRCB Order No. WR 89-18. The Order incorporates provisions of Orders No. WR

886 and No. WR 73-37 and provides procedures to store credit water in Cachuma Reservoir for the benefit of downstream water users. Credits are established under Above and Below Narrows accounts and later released to replenish the downstream groundwater basins. In some instances, the credits are converted to Cachuma Reservoir Project water for the benefit of all Cachuma Reservoir contractors (This provision has not been incorporated into the Model).

ABOVE NARROWS ACCOUNT

The most recent SWRCB order provides a 10,000 acre foot operational dewatered storage for the Above Narrows Basin. This dewatered storage allows for additional percolation of runoff from the tributaries below Cachuma Reservoir. The actual dewatered storage is determined monthly by water level measurements of indicator wells in the Basin. 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.

As Provided in the Order, 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 Pacific Ocean. Determination of live stream conditions is based on flow measurements and visual observation at a number of stations between the reservoir and the City of Lompoc. The live stream condition for the river downstream of North 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 basin. If the dewatered storage in the basin exceeds the operational dewatered storage (10,000 acre feet), releases from the Above Narrows Account may be made from the reservoir. For accounting purposes, water in the Above Narrows Account is not subject to evaporative losses but is deemed the first water spilled to the extent the dewatered storage in the basin is reduced by such spills.

BELOW NARROWS ACCOUNT

Calculations for the Below Narrows Account are contingent upon the difference between actual hydrologic conditions below the Narrows and the estimated conditions which would have existed if the Santa Ynez River flows were not affected by Cachuma Reservoir. The SWRCB Order No. WR 89-18 requires monthly calculation of "constructive" flow and "constructive" percolation. Percolation values corresponding to "constructive" and measured flows 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 developing criteria to switch to the lower curve based on measured percolation and groundwater levels in indicator wells. The Santa Ynez River Hydrology Model calculates percolation on the assumption that percolation rates decrease after sufficient occurrence of seasonal flow passes through the Lompoc Narrows. Therefore, the model uses both the upper and lower curves to determine percolation as a function of cumulative seasonal flow. The Below Narrows Account is reduced in the event of a spill from Cachuma Reservoir according to calculations considering spills reaching the Narrows, reduction in Below Narrows dewatered storage, and measured flows at the Narrows.

Figure 2-2

USBR PERCOLATION CURVES

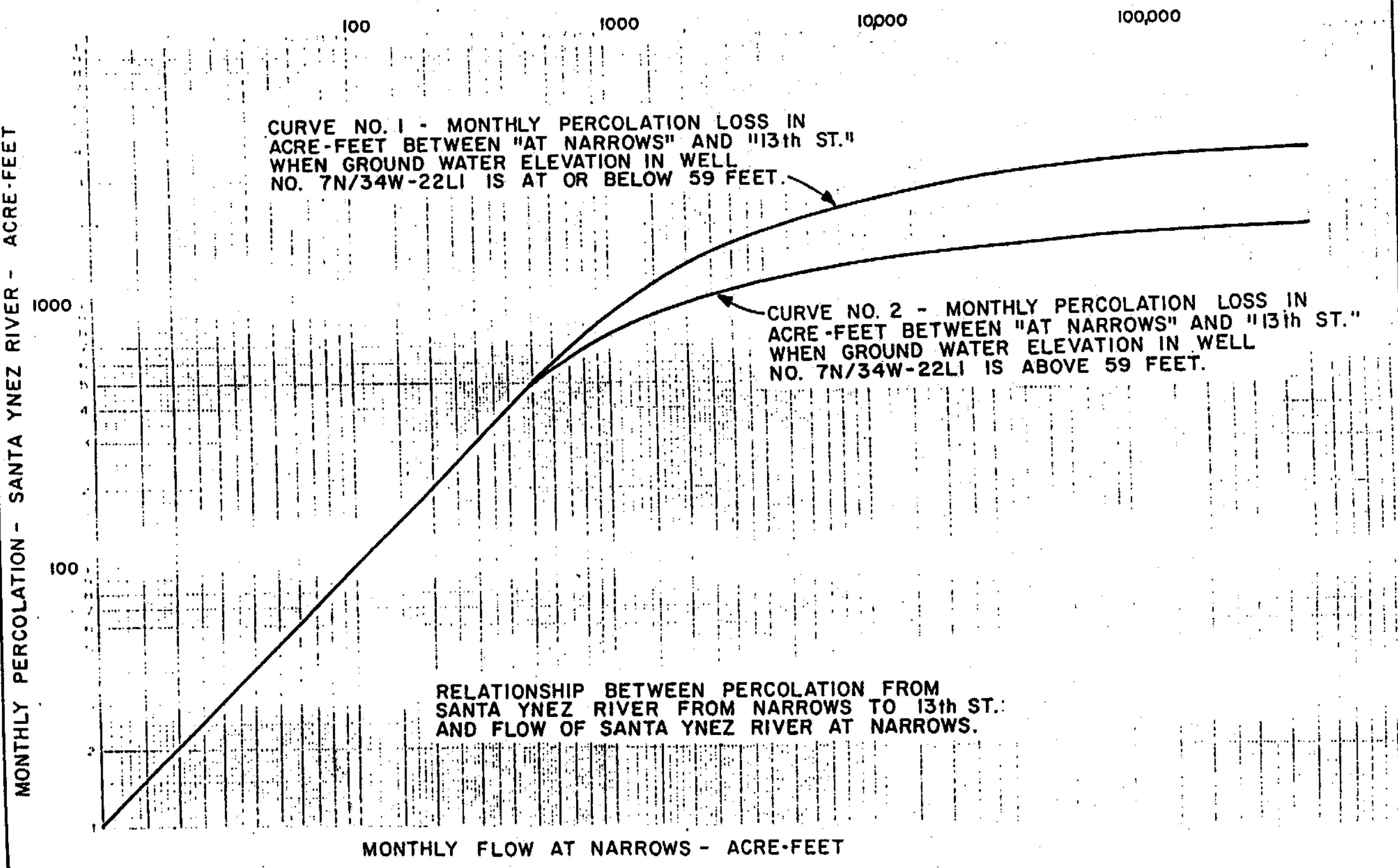


TABLE 2-1
SUMMARY OF PERMITS, DECISIONS AND AGREEMENTS

Decision	Date	Effect
Gin Chow Decision	1930	Requires the City of Santa Barbara to release up to 616 acre feet per year of Gibraltar Reservoir Inflow during summer and fall and specifies the City's annual diversion rights.
Decision 886	1958	Adopted by the State Water Rights Board (a predecessor of the State Water Resources Control Board), this decision contained the initial conditions pertaining to the operation of Cachuma Reservoir requiring a live stream determination. In addition, the Board retained jurisdiction over the project for a fifteen year period for the purposes of determining the amounts, timing, and release rates of Reservoir water required to satisfy downstream rights without resulting in waste to the ocean.
Order No. WR 73-37	1973	Adopted by the State Water Resources Control Board (SWRCB), the order establishes Above and Below Narrows Accounts for which water is released from Cachuma Reservoir for the benefit of downstream users and specifies operations in order to maximize benefit from tributaries downstream of Bradbury Dam and reduce waste to the ocean.
Order No. WR 89-18	1989	Amendment to WR 73-37. Contained adjustments to methods of calculating Above and Below Narrows accounts and other operational specifications.
USYROA	1989	The Upper Santa Ynez River Operations Agreement stabilized the yield of Gibraltar Reservoir by establishing a "Base" Reservoir which is unaffected by siltation or other capacity fluctuations. The City of Santa Barbara may divert more or less water than is available from the "Base" operation but must mitigate by adjusting its take from Cachuma Reservoir.

SECTION 3
HYDROLOGIC DATA

This section provides a general description of the data used by the Santa Ynez River Hydrology Model including its origin and method of adjustment, where needed. Appendix F presents the actual data along with details regarding its development.

Hydrologic data from an historic time period, or base period, provides the foundation for the model. The base period extends from 1918 through 1979 and was selected because hydrologic records for this period are fairly complete and because the period begins and ends with nearly full reservoir and groundwater storage in the Santa Ynez River Watershed. In addition, this period includes the most severe drought for which adequate data is available (1946-1951).

3.1 HYDROLOGIC COMPONENTS

Five primary features, or hydrologic components, of the Santa Ynez River Watershed are simulated by the model. The first three components are the three reservoirs on the Santa Ynez River, which from upper to lower are, Jameson Reservoir (Juncal Dam and Doulton Tunnel), Gibraltar Reservoir (Gibraltar Dam and Mission Tunnel), and Cachuma Reservoir (Bradbury Dam and Tecolote Tunnel). The fourth component is the Above Narrows Alluvial Groundwater Basin along the Santa Ynez River from Bradbury Dam to the Lompoc Narrows and the fifth component is the Below Narrows Groundwater Basin.

The hydrologic data required to simulate each of the three reservoirs located on the Santa Ynez River are incremental tributary watershed runoff (hereafter referred to as "accretions"), rainfall, evaporation pan data, tunnel infiltration data and evapotranspiration correction data in the case of Cachuma Reservoir. If cloud seeding effects are to be included, additional data requirements are rainfall increments and calculated runoff increments due to cloud seeding which are included in the reservoir monthly water accounting.

Cachuma accretions for which historic Gin Chow releases from 1931 to 1979 are generally of such low flow levels as to be ignored; i.e. not subtracted).

The Jameson Reservoir runoff is simply all surface runoff into Jameson Reservoir and does not include rain on the Lake or evaporation for this or any other runoff item. The Juncal to Gibraltar accretions are computed as all surface inflow into Gibraltar reservoir minus historic spills from Jameson Reservoir (no releases have been historically made at Juncal Dam). Similarly, the Gibraltar to Cachuma accretions are Cachuma Reservoir computed inflow minus historic spills from Gibraltar Reservoir. The Cachuma to Lompoc accretions are also computed as historic "Santa Ynez River near Lompoc" minus any spills, releases, and leakage from Bradbury Dam.

Adjustments to the Runoff data were made in order to reflect the changing consumptive use along the Cachuma to Lompoc section of the Santa Ynez River over the 62 year modelling period. The resulting accretions are thus considered to be "unimpaired". Initially, it was necessary to synthesize some of the monthly runoff data contained in the Salsi%(744) array. The array also contains historic data (from 1941 onward) as measured by the USGS stream "Salsipuedes Creek near Lompoc" gauge.

3.2.2 Rainfall Data

Rainfall data is derived from historic measurements made at each of the three reservoirs. Rainfall data for Jameson, Gibraltar, and Cachuma Reservoirs are available from 1925, 1920, and 1952, respectively. The model uses two rainfall data files (CSRAIN3.HPA, and CS_INC.HPA) which are read into the model data arrays Rain%(3,744) and CsInc%(3,744). The Rain% array contains three rainfall data items for the three surface reservoirs (1 is for Juncal, 2 for Gibraltar, and 3 for Cachuma).

A number of adjustments to the rainfall data were necessary prior its inclusion in the model. For example, rainfall data for the three reservoirs has been adjusted to remove the estimated effects of historic cloud seeding. The adjustment data was provided by North American Weather consultants (NAWC) in a May 1988 report prepared for the Water Agency. The report, drawing on the extensive experience of NAWC in Santa Barbara County cloud seeding programs and studies, provides estimates of historic effects of all of the cloud seeding performed in Santa Barbara County from 1951 through 1978.

The report further provides estimated maximum precipitation augmentation increments for each month of the October through April time window for 61 years (1920 through 1980). These increments comprise the CsInc% array. Again, the three items of the array correspond to Juncal (Jameson Reservoir), Gibraltar, and Cachuma reservoirs and, factored down, are used if cloud seeding is selected when running the model, to augment the appropriate Rain% data items.

The estimates of historic cloud seeding augmentation were employed with the cloud seeding incremental runoff calculation methodology described in Appendix B1.1. This allowed adjustment (i.e. reduction) of the runoff values to levels which would have occurred without cloud seeding for 15 of the 15 seeded years from 1951 through 1979 in the upper Santa Ynez Watershed (above Cachuma Reservoir), and for 10 of the 15 seeded years in the lower watershed of Cachuma to Lompoc and Salsipuedes (During 5 of the 15 years of historic seeding, the lower watershed was not targeted).

3.2.3 Evaporation Data

Evaporation data utilized by the model is derived from monthly evaporation pan measurements obtained at each of the reservoirs. The pan measurement is multiplied by a factor which takes into account variables such as reservoir temperature and size. The computer data file containing these three data items is EVAP3.HPA. The model array that this data is read into is named Evap%(3,744). In developing this data all available historic monthly pan readings were used.

One adjustment to the pan data was necessary due to the growth of trees around the Jameson Reservoir Pan over a period of many years. Utilizing a relationship to solar cycles in both the Juncal and Gibraltar pan data, the Juncal pan data was "corrected" to remove the effects of progressive shading. Then, both the Juncal and Gibraltar Reservoir pan records were extended back to 1919 (from the 1931 beginning of record for both of those pans) by using the Chula Vista pan deviations from mean annual evaporation.

The annual values thus developed were distributed to the monthly pan values using the long term mean monthly pan evaporation data from 1935 through 1979. The Cachuma Reservoir pan data was available beginning in 1957. Data for 1918 through 1956 was synthesized for the Cachuma Reservoir pan using the deviations from long term mean (defined here as 1935 through 1979) displayed by the Juncal and Gibraltar pans averaged for each year. The annual values thus obtained were distributed to monthly values using the mean monthly Cachuma pan evaporations for the year 1957 through 1985 (see Appendix B, Subsection B3).

3.2.4 Evapotranspiration Data

Evapotranspiration data is used to correct the monthly inflow to Cachuma Reservoir, to account for watershed area inundated by the reservoir <u>not</u> being subject to loss by evapotranspiration of vegetation and evaporation from bare land surface areas (See Appendix B, Subsection B3). Monthly evapotranspiration data used in the model is entirely synthetic; it is not based on direct measurements but is developed from a knowledge of watershed evapotranspiration in the area now covered by Cachuma Reservoir. Evaporation from the surface of the reservoir is based upon the evaporation pan data which is accounted for separately within the model.

The evapotranspiration computer data file is CACHET.HPA, and is read into the model array named CachET%(744). Use of this data requires that the Cachuma Reservoir inflow be adjusted to remove the effects of historic watershed inundation by Cachuma Reservoir. This correction was applied, based upon historic monthly Cachuma Reservoir areas, to the Gibraltar to Cachuma accretions for water years 1953 through 1979 (Cachuma Reservoir began impounding water in November of 1952). The accretions are thereby adjusted to result in flow values at the Cachuma Dam site which would be expected if Cachuma Reservoir did not exist.

3.2.5 Tunnel Infiltration Data

Direct measurements of tunnel infiltration for Doulton Tunnel were available beginning in 1925. Data for Mission Tunnel and Tecolote Tunnel were available from 1978 and 1960, respectively. The computer data file for this tunnel group is TUNL3.HPA, which is read into the model data array named Tunnel%(3,744). 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 Reservoirs also convey small amounts of Santa Ynez River tributary water from small watersheds located immediately below the respective dams).

Due to poor availability and reliability of tunnel infiltration data, adjustment and synthesis of much 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 1940. The tunnel data from 1941 through 1979 (along with the measured diversions from Fox Creek) were used to create a tunnel infiltration computer algorithm. This algorithm, which is based on monthly rainfall data, 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 few years of available 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.

SECTION 4
MODEL OPERATIONS

This section describes the Model operations, equipment needed to run the Model, the available output, and a few of the possible applications.

4.1 EQUIPMENT

The Santa Ynez River Hydrology Model may be run using an IBM compatible Personal Computer equipped with Microsoft QuickBASIC 4.0 or 4.5. The QuickBASIC 4.0 and 4.5 versions are entitled "SYRMO193.BAS" and "SYRMQB45.BAS", respectively. Both versions, along with all required data files, are available to authorized users of the Santa Ynez River Model. A 386 or faster computer with a math co-processor is preferred. A Laser-Jet type printer is suitable for model output. In addition, GRAFLASER is auxiliary software required to print some of the model hydrographs.

4.2 MENU

The model is menu driven, that is, the menu allows the user to specify the system parameters including conditions for the reservoirs, the Above and Below Narrows Accounts, cloud seeding and drought. 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 produced on the CRT (cathode Ray Tube).

There are 36 menu locations which may be changed by the user (6 rows of 6 variables). In Figure 4-1, the curser is located in row 1, column 1. (Note the offset of the number columns there.) The curser may be moved throughout the grid by using the arrow keys on the computer keyboard. New entrees 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; ie if the "right" arrow is pressed in the sixth column of any menu row, the

Column

Row		1	2	3	4	5	6
	RESERVOIR	BegWSElev	MaxWSElev	ProjDraft	1=Lk2=L+T	StrtShort	May1Delv%
1	ResJUNCAL	2217.60	2224.00	1600	Lake Only	2500	22.270%
2	GIBRALTAR	1393.80	1400.00	6000	Lake Only	50	0.000%
3	RsCACHUMA	743.30	750.00	25715	Lk + Tunl	100000	56.764%
	PIPE & CU	ID#1 Pipe	LompcPipe	M&ICnsUse	AgConsUse	CSeedFlag	SeedEfcny
4	&Cld SEED	3000	0	2500	9000	0	0.75
	Acnts&Etc	ShwDetYrs	BegRipStr	BegnngANA	ANAStrtRl	BegnngBNA	BNAStrtRl
5	RipACCNTS	1918.62	77972	25	10600	362	200
	RUN TYPES	RunDETAIL	RunOUTPUT	TableTYPE	TabOUTPUT	GraphTYPE	DrouthADD
6	andOUTPUT	SUMMARY	To CRT	No Table!	To CRT	No Graph!	NONE!!!

PUT Caps Lock ON!!! OUTPUTS: 1=CRT; 2=Laser. RunDETAIL (1 thru 7): Junc, Base, Gibr, Cach, AbvN, BlwN, Sumry. TableTYPES: see Tab list. GraphTYPES: see Gph list. Use ARROWS to move. Press R to make RUN. After RUN, S displays selected table &/or graph for viewing & output..

Figure 4-1
Default Menu

curser will move to the first column of that row. Only numeric data may be entered in the menu cells, although after removing the curser, some cells will display a label corresponding to the number entry. 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 "JunDelRank" to be displayed when the curser is removed from the cell, thus indicating the type of graph to be displayed (see table 4-1).

4.2.1 RESERVOIR PARAMETERS

The top three rows of the menu specify parameter of the three reservoirs which are listed in the left column. Both the beginning and maximum possible 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 base period and are translated to storage volumes within the program based on elevation capacity tables. The default values for the maximum storage elevations reflect the most recent volume surveys.

In the third column, the reservoirs draft "ProjDraft" (ProjectDraft) is selected. The default values are estimates of current day (1992-1993) usage based on purveyor estimates. The fourth column allows selection of lake draft only or lake draft plus tunnel. Lake draft only is specified by entering a number "1" in the box and indicates that the entire project draft is supplied by the reservoir. Entering a "2" indicates that the project draft includes water taken from the reservoir and water generated in the delivery tunnel.

Columns 5 and 6 apply only to draft values in excess of the safe yield. For the purposes of the model, "Safe Yield" is defined as the amount of water that can be withdrawn from the reservoir through the worst drought of the base period without suffering shortages. If the draft exceeds the safe yield, a ramp function may be implemented (See Appendix B, B2). 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 base period drought or "critical drought".

The parameters defining the ramp function that may be set in the menu include "StrtShort" (the volume at which shortages begin) and "May1Delv%" (the May 1 delivery factor). The May 1 delivery factor is the percent of full draft deliverable over a May through April "Cachuma water year" if the May 1 storage is at a specified volume, arbitrarily selected but much smaller than StrtShort (see Figure 4-2).

4.2.2 ADDITIONAL USE AND CLOUD SEEDING PARAMETERS

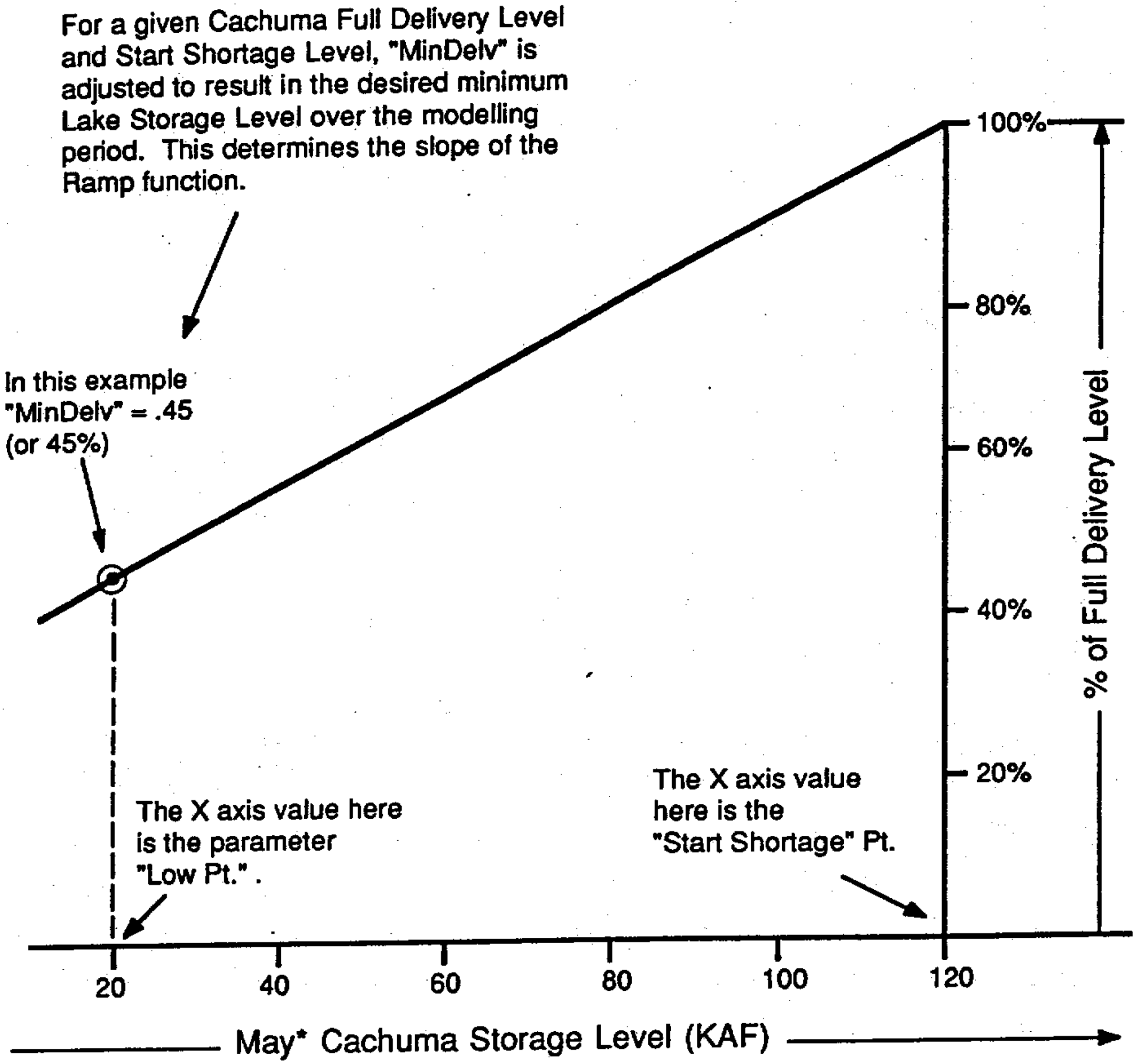
The forth row applies to water pipeline deliveries, consumptive use and cloud seeding. The first column is agricultural type deliveries to Santa Ynez ID#1 from Cachuma Reservoir (whatever the value, this number is implicitly included in the "ProjDraft" of row 3, column 3). Column 2 is Municipal and Industrial type deliveries to Lompoc City from Cachuma Reservoir via a pipeline not currently existing. Therefore, the default value is zero.

Columns three and four of the forth row allow for selection of "M&ICnsUse" (the municipal and industrial consumptive water use by ID#1, Solvang, Buellton, and private water companies) as well "AgConsUse" (the agricultural consumptive use of water pumped from the riparian alluvial basin). These values influence the amount of water needed to satisfy the Above Narrows Account and, therefore, have an influence (although relatively small) on the yield of Cachuma Reservoir (see Section 2).

Columns 5 and 6 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 percent of the maximum possible precipitation increase over unaugmented conditions. The model defaults to a reasonable estimate of seventy five percent of possible benefits for cloud seeding. The desired efficiency is entered as a decimal in the box entitled "SeedEfcny" (Seeding Efficiency).

Figure 4-2

EXAMPLE RAMP FUNCTION



*Beginning of May in SYR Model, May 15th in actual operations......

4.2.3 RIPARIAN BASIN PARAMETERS

The fifth row mostly concerns the Above and Below Narrows Accounts. However, the first column of row five, "ShwDetYrs" (Show Detail Years), allows the user to choose the years of the design period to be output in a detailed format. The number before the decimal point is the 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, the number entered for row 5, column 1, would be 1951.01. The default values shown on Figure 4.1 include the entire 62 year base period (1918 through 1979). This feature is only applicable if a one of the detailed printouts is selected in row 6, column 1 of the menu (see Section 4.2.4).

The second column, entitled "BegRipStr" (Beginning Riparian Storage), allows specification of the beginning storage in the Riparian Basin. 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 base period. The default values listed (25 and 362 acre feet, respectively) are selected so that the beginning of modelling period credits are the same as those at the end of the base period. Thus the end of September, 1979 values for reservoir water levels and Riparian Accounts taken from a model run should be close to the menu default values. "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.

4.2.4 OUTPUT PARAMETERS

The sixth row of the menu deals with the model display and output which occur while the model is running and with the tabular and graphical display and output performed after the run is finished. In addition, column 6 allows the user to cause all hydrologic data pointers to be set back during a model run in 12 month increments up to 34 years. The effect is that a given climatic sequence, such as the worst case drought, may be repeated in the base period.

Under "RunDETAIL" (Run Detail), a detailed printout may be selected. The model defaults to a summary table which includes information for the three reservoirs and the Above and Below Narrows Accounts. By in-putting a number, 1 through 7, the model will produce a detailed printout of Juncal Reservoir, the Base Gibraltar Reservoir, the actual Gibraltar Reservoir, Cachuma Reservoir, the Above Narrows Riparian Basin, the Below Narrows Alluvial Basin or a summary table, respectively. (Note that tunnel infiltration is displayed in the monthly water accounting for the surface reservoirs).

"RunOUTPUT" (Run Output) and "TabOUTPUT" (Table Output) direct the model output and selected tables to the screen or to the screen and an external printer (all output is directed to the CRT). Entering a "1" causes output to the computer terminal only while entering a "2" causes external printing. The third and fifth columns contain the headings "TableTYPE" and "GraphTYPE" (Table Type and Graph Type). There are eight tables and twelve graphs which illustrate different components of the hydrologic system. The default values for "TableTYPE" and "GraphTYPE" are 9 and 13, respectively. These values suppress all tabular and graphical displays. A brief description of the available tables and graphs is listed in Table 4-1, below. A detailed description is included in Section 4.3, Model Output.

TABLE 4-1

AVAILABLE TABLES

NUMBER	TABLE	FUNCTION
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	CombinedS	Combined shortages from the three main reservoirs
6	CacInflow	Inflow to Cachuma Reservoir
7	Q Narrows	Flow at the Narrows
8	GWBasnTab	Elements of ground water recharge for the City of Santa Barbara only
9	No Table	No Table

AVAILABLE GRAPHIC DISPLAYS

NUMBER	GRAPH	FUNCTION
1	JunDelRank	Jameson Reservoir delivery rankings
2	BasDelRnk	Base Gibraltar delivery rankings
3	GibDelRnk	Gibraltar Reservoir delivery rankings
4	CacDelRnk	Cachuma Reservoir delivery rankings
5	ComDelRnk	Combined source delivery rankings
6	Hydrogrph	Juncal, Gibraltar, Cachuma and Riparian strip storage hydrographs.
7	RankQJunc	Jameson Reservoir inflow rankings
8	RankQGibr	Gibraltar Reservoir inflow rankings
9	RankQCach	Cachuma Reservoir inflow rankings
10	RankQLomp	Santa Ynez River flow near Lompoc Rankings
11	GWB Plots	Santa Barbara City elements of supply and impact on groundwater supply (Displays 2 graphs sequentially).
12	RankDeliv	Santa Barbara City supply rankings
13	No Graph	No Graph

The last Column of row 6 allows the user to experiment with different sequences of years following the end of the drought, year 1951. 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. 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. Return to the menu after a model run and/or model output display always resets this parameter to zero.

4.2.5 MENU NOTES

Read the notes at the bottom of the menu. Be sure to put "Caps lock" on. Upon first starting the model, 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. After having made a desired run the user may observe (on the CRT) 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.

To output graphs to an external printer, the user must load in and set up GRAFLASR.COM prior to loading (into RAM) Microsoft QuickBASIC 4.0 or 4.5. With GRAFLASR in the machine, the graphical images on the CRT will be printed on the external printer upon the user pressing the "Print Screen" key. This graph printout takes about 6 to 7 minutes to make a full reproduction of the screen onto a LaserJet printout.

4.3 MODEL OUTPUT

As noted above, the model will display eight types of tables and twelve 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 the current version of the model.

4.3.1 SUMMARY PRINTOUT

The model outputs either a summary or detailed printout. The summary printout (an example is shown as Table 4-2) lists the model version, date, time, and the cloud seeding status at the top. The upper part of the table lists the system parameters including initial reservoir conditions, maximum reservoir conditions, and reservoir diversion information. For each reservoir, the table provides the water surface elevation at the beginning of the base period and the corresponding area and volume. Similar information is provided for maximum reservoir conditions. The diversions, specified in the menu, are listed under "Diversion Information" where "Mode" refers to the water source; i.e. whether the draft includes "LakeDraft" (Lake Draft), water taken from the lake only or "L+T Draft" (Lake plus Tunnel Draft), water taken from the lake and delivery tunnel. Much of this information is specified in the menu by the user (See Section 4.2).

The storage at the beginning of the base period and full capacity of the Above Narrows Basin is listed under the "Above Narrows Riparian section" of the printout. Riparian diversions 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. "Accnt" (Account) denotes the volume in the Above Narrows Account at the beginning of the base period and "Strel" (Start Release) is the Above Narrows dewatered storage above which releases from Cachuma Reservoir (from the Above Narrows Account) may be initiated. Similar information is provided for the Below Narrows Account (Strel refers to the BNA account volume rather than the dewatered storage volume).

The bottom row of the Initial Condition Table applies to ramp functions for each reservoir. "JunRedPt", "GibRedPt", and "CachRedPt" (Juncal, Gibraltar and Cachuma Redistribution Points) are the volumes at which draft reductions are initiated. These are the same values entered in the menu under "StrtShort". "%YrsDel@" (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). "%YrsDel@" is entered in the menu under "May1Delv%" (May 1 Delivery Percentage - See Appendix B, B2, Ramp Function).

SANTA YNEZ RIVER MODEL SYRM0193 (01/93) 08:54:00, 03-16-1993

Existing Cachuma Reservoir
No cloudseeding

INITIAL RESV/BASN CONDITIONS				MAXIMUM CONDITIONS			DIVERSION INFORMATION		
Reservoir	WSElev	Area	Volume	WSElev	Area	Volume	Divert To	Mode	SysDemand
Jameson R	2217.6	119	4205	2224.0	131	5003	Montecito	LakeDraft	1,600
BaseGibrl	1395.4	250	7324	1400.0	292	8567	PhantCity	LakeDraft	7,278
Gibraltar	1393.8	233	7118	1400.0	255	8621	S B City	LakeDraft	6,000
Cachuma R	743.3	2808	170812	750.0	3042	190409	SC, SYnez	L+T Draft	25,715

Begining Cachuma- - Lompoc	Above Narrows Riparian Storage	FullVolume	Ag CU	M&I CU	Strel	Accnt	Lompoc Pipe	BelowNarrows Strel	Acct
	77972	90000	9000	2500	10600	25	0	200	362

JunRedPt	%YrsDel@	LowPtAF	GibRedPt	%YrsDel@	LowPtAF	CacRedPt	%YrsDel@	LowPt AF
2500 af	22.270%	500 af	50 af	0.000%	0 af	100000af	56.764%	20000 af

SUMMARY: 1918-1979 AVERAGE VALUES (Vols[ac-ft], Areas[ac], Elevs[ft])

A

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	4369	233	344	0	1474	0	512	2785	1985	2210.8	107	3430
BaseG	41806	486	908	0	4864	344	1072	36162	5936	1391.4	218	6395
Gibrl	41806	428	793	0	.5502	358	1072	35582	6573	1388.7	216	5971
Cachm	66817	3580	10923	438	22327	5522	3013	31188	25340	729.8	2388	135903

B

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	69849	874	326	2500	9011	12405	931	1500	56569	2711	10706	79294

StrmSEEP	S Ynez = 4562	Buelltn = 5355	SRita E = 1879	SRita W = 609

C

BelowNar rowsPeri odAvergs	Runoff@ Narrows	Calc'd Percol	Calc'd Qinc	Cnstrcv NarrwsQ	Cnstrc Percol	BlwNr Reles	Calc'd QFlorAv	BlwNar Credit	Redctn In BNA	BNA Acct
	56569	5858	34022	90592	7540	1569	50711	1682	112	1316

D

	Jameson Lake	BaseGibraltar	GibraltarLake	Lake Cachuma	Riparian Volm
PeriodEndingVols	4,208 af	7,320 af	7,122 af	170,722 af	77,973 af
Min Vols	100 af	0 af	0 af	20,000 af	57,589 af
Min Date	Dec 1951	Nov 1931	Feb 1925	Dec 1951	Oct 1951
ShortMos	18.5 %	79.2 %	10.2 %	11.3 %	
MxyrShrt	1,141 af	7,278 af	6,000 af	7,581 af	
Wors%Sht	81.2 %	100.0 %	100.0 %	35.1 %	

Table 4.2

The lower table on the Summary Printout is output 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 averaged values, in acre feet, for the entire base period. For each reservoir, the storage volume resulting from runoff into the reservoir "Runoff", rain falling directly on the reservoir including the contribution from cloud seeding "Precp" (Precipitation), and evaporation from the reservoir "Evapo" (Evaporation) are listed. In addition, "Leakage" values for each reservoir are listed. Leakage refers to water that leaks from the flood gates of Cachuma Reservoir when the water elevation is over 720 feet. Therefore, leakage is zero for all of the other reservoirs (see Table 4.2 Section A).

Also listed in Section A of the lower table, are "Piped Divrt" (Piped Diversions), "Dwnsr Reles" (Downstream Releases), "Tunl Infl" (Tunnel Infiltration), "Resrvr Spills" (Reservoir Spills), and "Systm Yield" (System Yield) for the base period. Downstream releases are scheduled releases made to the Above and Below Narrows and Gin Chow accounts (Section 2.4.1). Spills occur in wet years when the reservoir inflow plus previous storage exceeds capacity. The system yield is the average amount of water that was available from each reservoir per year over the base period. The last three columns of the surface reservoir section provide period averages for "WSElev" (Water Surface Elevation), "Area" (reservoir surface area), and "Storage" (Reservoir Storage Volume).

Section B of the lower part of the Summary Table is labelled "GWB-Avgs CACHLOM" (Groundwater Basin Averages - Cachuma to Lompoc). This provides information on the Riparian Basin and Above Narrows Account. The first item, "Runoff", is the total Cachuma Reservoir releases to the Above Narrows Account plus the spills and Leakage from Bradbury Dam plus Cachuma to Lompoc accretions. "R Dep" (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.

"B dep" (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.

Municipal/industrial and agricultural consumptive use are listed under "M&ICU" and "Ag CU", respectively. "Percl" (Percolation), the average amount of water that percolated into the Riparian Basin, as well as the net water gain is listed under "Bank & P" (Bank and Phreatophyte). The average water loss due to underflow "Uflw" and the outflow of water at the Narrows "QNarrw" 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 Strip storage volume "Volum". The next row lists the period average stream seepage for the four riparian alluvial basin subareas 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 and "constructive" data. Therefore, the table lists runoff at the Narrows "QNarrows" (Flow at Narrows), calculated percolation in the Lompoc Forebay "ActPerc" (Actual Percolation), and the difference between the actual flow at the Narrows and the "constructive" inflow "Qincrm" (Flow Increment). The fourth, fifth and sixth columns list "Constructive" inflow "CnstrQ" and "constructive" percolation "CnstP", and releases to the Below Narrows Account "BNRel" (Below Narrows Releases). Also listed is the flow at Floradale Bridge "QFlorAv" (Flow at Floradale Avenue), the credit to the Below Narrows Account "BNCred" (Below Narrows Credit), reductions in credit to the Below Narrows Account based on Cachuma Reservoir spills "BNRedu" (Below Narrows Reduction), and the period average Below Narrows Account "BNA" (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 base period "PERIOD End Vols" (Period Ending Volumes). In addition, base period minimum volumes "Min Vols" and the month and year they occurred "Min Date" (Minimum Date) are listed. Notice that the minimum volume of the base period may be different than the "Low point" used to determine the ramp. This is because the low point is simply an arbitrary low storage point used to fix the slope of the ramp function. The actual minimum volume may occur in another month. Again, in the example provided, the minimum volume of Cachuma Reservoir is 20,000 acre feet (a value selected by Cachuma Project Member Units). The number of base period months in which the full draft could not be maintained is given, as a percentage, in the column labelled "ShortMos" (Short Months). The most severe shortage for any October through September water year of the base period is listed in the column labelled "MaxYrShort" (Maximum Year Shortage). "WorstShort%" (Worst Year Shortage) is the maximum shortage from the desired draft for any month of the base period.

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 (Table 4-3, Detailed Printout). 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 for each month of each year for which detail is requested. All of the quantities are totalled in the last row of each year's listing except for surface elevation, area, and storage which are averaged. The table scrolls rapidly and may be stopped by depressing the "pause" key.

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 base 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 may occur in the case of Jameson and Gibraltar reservoirs during extremely wet years when there is significant tunnel infiltration and a low water demand. 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 4-4 is a Shortage Table printout for Gibraltar Reservoir under the conditions specified in Table 4-2.

SANTA YNEZ RIVER MODEL SYRM0193 (01/93) 09:06:20, 03-16-1993

Existing Cachuma Reservoir
No cloudseeding

INITIAL RESV/BASN CONDITIONS				MAXIMUM CONDITIONS			DIVERSION INFORMATION		
Reservoir	WSElev	Area	Volume	WSElev	Area	Volume	Divert To	Mode	SysDemand
Jameson R	2217.6	119	4205	2224.0	131	5003	Montecito	LakeDraft	1,600
BaseGibrl	1395.4	250	7324	1400.0	292	8567	PhantCity	LakeDraft	7,278
Gibraltar	1393.8	233	7118	1400.0	255	8621	S B City	LakeDraft	6,000
Cachuma R	743.3	2808	170812	750.0	3042	190409	SC, SYnez	L+T Draft	25,715

Begining Cachuma- - Lompoc	A b o v e N a r r o w s R i p a r i a n						Lompoc	BelowNarrows	
	Storage	FullVolume	Ag CU	M&I CU	Strel	Accnt	Pipe	Strel	Acct
	77972	90000	9000	2500	10600	25	0	200	362

JunRedPt	%YrsDel@	LowPtAF	GibRedPt	%YrsDel@	LowPtAF	CacRedPt	%YrsDel@	LowPt AF
2500 af	22.270%	500 af	50 af	0.000%	0 af	100000af	56.764%	20000 af

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

RESRV	MONTH & YEARS VALS			Leak	Piped	Dwnsr	Tunl	Resrvr	Systm	MONTHS ENDING		
Cachm	runoff	precp	evapo	-age	divrt	reles	infl	spills	yield	WSEL	area	storag
Oct68	0	280	788	43	1653	1987	232	0	1885	731.7	2443	140451
Nov68	0	136	545	42	1087	1094	230	0	1317	730.6	2411	137818
Dec68	0	256	377	43	1044	0	228	0	1272	730.1	2396	136610
Jan69	183138	3886	370	0	945	0	259	131911	1204	750.0	3042	190409
Feb69	184108	3032	468	0	848	0	288	185824	1136	750.0	3042	190409
Mar69	79052	324	815	0	1331	0	293	77231	1624	750.0	3042	190409
Apr69	19889	608	1197	0	1739	0	302	17562	2041	750.0	3042	190409
May69	9181	3	1394	0	2333	0	299	5457	2632	750.0	3042	190409
Jun69	3891	0	1340	297	2668	0	295	0	2963	749.9	3037	189995
Jul69	1926	13	1768	246	3303	0	292	0	3595	748.7	2999	186616
Aug69	444	0	1819	115	3125	500	289	0	3414	747.0	2939	181502
Sep69	126	34	1187	42	2347	386	285	0	2632	745.7	2893	177701
Cachm	481756	8572	12068	828	22423	3966	3292	417984	25715	744.9	2863	175228

SUMMARY: 1918-1979 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	4369	233	344	0	1474	0	512	2785	1985	2210.8	107	3430
BaseG	41806	486	908	0	4864	344	1072	36162	5936	1391.4	218	6395
Gibrl	41806	428	793	0	5502	358	1072	35582	6573	1388.7	216	5971
Cachm	66817	3580	10923	438	22327	5522	3013	31188	25340	729.8	2388	135903

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	69849	874	326	2500	9011	12405	931	1500	56569	2711	10706	79294

StrmSEEP	S Ynez =	4562	Buelltn =	5355	SRita E =	1879	SRita W =	609

BelowNar rowsPeri odAvergs	Runoff@ Narrows	Calc'd Percol	Calc'd Qinc	Cnstrcv NarrwsQ	Cnstrc Percol	BlwNr Reles	Calc'd QFlorAv	BlwNar Credit	Redctn In BNA	BNA Acct
	56569	5858	34022	90592	7540	1569	50711	1682	112	1316

	Jameson Lake	BaseGibraltar	GibraltarLake	Lake Cachuma	Riparian Volm
PeriodEndingVols	4,208 af	7,320 af	7,122 af	170,722 af	77,973 af
Min Vols	100 af	0 af	0 af	20,000 af	57,589 af
Min Date	Dec 1951	Nov 1931	Feb 1925	Dec 1951	Oct 1951
ShortMos	18.5 %	79.2 %	10.2 %	11.3 %	
MxyrShrt	1,141 af	7,278 af	6,000 af	7,581 af	
Wors%Sht	81.2 %	100.0 %	100.0 %	35.1 %	

Table 4.3

Actual Gibraltr Lake Shortages: Run of 09:09:12 03-16-1993
October thru September water years 1918 - 1979 (average values on last line)

YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTALS
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	28	0	0	0	93	162	132	84	499
26	690	514	264	328	0	0	0	0	0	0	0	0	1796
27	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
31	369	551	564	428	4	578	602	762	515	162	132	84	4751
32	690	514	0	0	0	0	0	0	0	0	0	0	1204
33	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	114	129	84	327
49	690	564	564	528	504	0	295	658	630	162	132	84	4811
50	690	564	564	446	0	0	0	198	622	162	132	84	3463
51	690	564	564	528	504	678	702	762	630	162	132	84	6000
52	690	564	564	0	0	0	0	0	0	0	0	0	1818
53	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	13	504	578	702	762	566	160	132	84	3501
62	690	564	464	428	0	0	0	0	0	0	0	0	2146
63	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	112	0	0	0	473	0	0	0	0	0	0	585
66	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0	0	0	0	0
79	0	0	0	0	0	0	0	0	0	0	0	0	0
Av	84	73	57	44	25	37	37	51	49	17	15	9	498

Table 4.4

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 Base 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 4-5). The inflow values listed do not include rain on the lake.

4.3.5 NARROWS FLOW TABLE

The Narrows Flow Table shows the volume of water in acre feet, which passes through the Santa Ynez River at the Narrows for each month of each year of the Base period. The format is identical to that of the Cachuma Inflow Table.

4.3.6 GROUNDWATER BASIN TABLE

The version of the Groundwater Basin Table included herein is for the City of Santa Barbara. In addition, Groundwater Basin Tables for Carpinteria, Montecito, and Goleta are available. This Table displays the factors influencing the basin and the net effect for each year of the base period years. This is especially useful for studies of overdraft, recharge, and conjunctive use. The left column lists the year and each subsequent column the volume of water in acre feet for each factor. The following factors are listed:

RAINPC	The amount of rainfall that percolates into the basin.
STRMSP	The volume of water entering the basin from stream recharge.
UNDRFL	Ground water that enters the basin from adjacent basins or the mountains via underflow.
INJECT	Water that is injected into the basin for recharge purposes. The model will include this parameter only for base period years in which Cachuma Reservoir is spilling and at the rate of flow input in the program.
PUMPIN	Return flows from water extracted from the basin. Irrigation is the primary source.

Lake Cachuma Inflow (acrefeet): Run of 09:14:27 03-16-1993
October thru September water years 1918 - 1979 (average values on last line)

YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTALS
18	0	0	0	105	73015	126433	20361	8745	3904	318	105	212	233197
19	0	439	657	438	1745	1312	655	216	0	0	0	0	5462
20	137	136	411	136	1637	6102	4321	862	137	136	135	134	14284
21	0	0	0	1136	1627	2282	816	651	486	161	160	157	7475
22	108	0	18101	14162	55919	24808	10075	4177	715	222	112	0	128400
23	0	157	4959	1636	2694	1130	1045	638	317	315	155	154	13201
24	0	223	221	220	440	1971	440	219	0	0	0	0	3733
25	0	0	205	205	204	814	2436	407	202	0	0	0	4472
26	0	0	111	111	3104	1111	52938	4569	463	230	115	0	62751
27	0	2533	1468	1865	80266	17596	6710	1547	433	217	107	0	112743
28	155	154	308	308	6469	3525	779	310	309	153	0	0	12471
29	188	0	186	372	1667	2039	1485	555	0	0	0	0	6492
30	0	0	0	0	0	4656	543	180	0	0	0	0	5378
31	0	0	323	321	320	318	314	309	0	0	0	0	1905
32	0	103	7141	2699	82318	10749	2104	856	428	212	0	0	106611
33	0	0	0	6541	3451	1066	544	136	135	0	0	0	11873
34	0	0	0	10951	4293	1586	137	0	0	0	0	0	16967
35	0	0	0	10194	3237	8256	15435	2607	347	115	0	0	40191
36	0	0	0	0	20772	4364	3742	459	114	0	0	0	29451
37	0	105	3133	4605	61980	59037	19587	4887	1074	328	110	0	154845
38	0	105	316	209	58833	184471	18262	6040	2383	845	105	105	271674
39	0	149	737	2174	4273	8493	2053	601	150	0	0	0	18631
40	0	0	0	1218	3597	3785	1473	461	153	152	151	0	10990
41	0	0	4019	25540	98878	189249	120163	21763	7170	3095	1234	520	471631
42	522	650	5285	5365	2968	4266	8209	2899	656	130	129	0	31079
43	0	0	0	68828	28672	66598	12725	3813	1006	322	107	107	182178
44	112	112	446	895	41027	37200	7080	3066	904	225	112	0	91178
45	0	1173	469	585	18328	11639	5417	1426	355	117	0	0	39510
46	127	0	6552	1014	1864	15059	9975	1043	130	130	0	0	35895
47	0	1972	4641	2578	1089	725	362	181	180	0	0	0	11728
48	0	0	359	357	355	354	352	349	0	0	0	0	2125
49	0	0	330	329	328	526	524	319	0	0	0	0	2357
50	0	0	0	0	2100	211	629	207	0	0	0	0	3147
51	0	0	162	160	158	156	153	148	0	0	0	0	937
52	0	0	204	86515	8910	66312	15931	4616	1966	842	759	107	186163
53	398	397	1935	6501	2305	1233	699	597	530	395	262	260	15513
54	138	137	275	3014	1672	6332	4546	833	415	275	136	134	17905
55	0	206	205	616	821	820	410	1527	406	200	196	192	5600
56	0	0	4312	8200	2252	1338	2170	2443	708	470	117	233	22243
57	140	278	138	553	867	1597	967	827	410	271	267	262	6579
58	309	103	1133	1140	25762	39928	106060	12594	3157	839	322	107	191456
59	0	0	0	1041	10292	2836	757	454	299	149	148	0	15975
60	0	0	422	420	420	419	416	411	0	0	0	0	2508
61	0	0	351	350	349	347	344	339	0	0	0	0	2079
62	213	106	0	0	81102	14247	4796	1551	331	109	109	0	102565
63	0	0	559	557	655	656	654	650	100	0	0	0	3831
64	0	0	358	356	355	352	350	346	0	0	0	0	2116
65	0	0	258	644	386	514	6542	905	386	382	377	0	10394
66	242	20495	27087	16392	7902	3832	1330	402	400	264	131	130	78609
67	0	0	44870	31475	15836	31315	54239	23888	4979	2155	653	299	209709
68	144	426	425	565	1129	2910	1209	846	562	559	417	138	9329
69	0	0	0	183138	184108	79052	19889	9181	3891	1926	444	126	481756
70	0	629	252	1507	3477	15535	1321	636	255	127	0	0	23739
71	0	2089	10415	7448	2492	2170	332	643	716	141	0	0	26446
72	0	0	7337	2184	1016	560	419	418	277	138	0	0	12348
73	0	433	217	9972	61070	27485	10425	3427	935	0	0	0	113964
74	0	0	263	18503	3102	8091	2642	945	135	0	0	0	33680
75	0	0	1120	622	6230	31870	7122	2966	511	0	0	0	50441
76	0	0	0	0	2639	1330	532	529	262	0	0	0	5292
77	0	0	450	448	448	446	444	438	0	0	0	0	2674
78	0	0	417	12550	95295	141983	36447	11359	3729	1447	530	424	304182
79	0	0	362	4870	15238	21291	13798	3700	852	365	122	0	60598
Av	47	537	2644	9110	19415	21076	10107	2615	780	298	126	61	66817

Table 4.5

IMPTIN	Return flows of all imported water including State Water, Cachuma and all other Reservoirs plus reclaimed waste water and ocean desal.
RECHARG	The sum of all of the above sources of inflow.
LOSSES	Water that leaves the basin area, particularly when the basin is full. A typical source is outflow to the ocean during wet years.
PUMPAGE	All extractions from the basin.

The last column lists the end of the year volume "EOY VOL" . The numbers listed are acre feet below full (see Table 4-6).

4.3.7 DELIVERY RANKING GRAPHS

The Delivery Ranking Graphs show the percentage of base 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 base period. Delivery Ranking Graphs are available for each reservoir, the Base Gibraltar Reservoir and the combined sources. A delivery ranking graph for Gibraltar Reservoir is exhibited in Figure 4-3.

4.3.8 STORAGE HYDROGRAPH

The model also allows output of Storage Hydrographs for the three reservoirs and the Riparian Basin that depict storage levels for a specified set of conditions (Figure 4-4). The vertical axis indicates acre feet of storage and the horizontal axis indicates base period years. On the CRT, the brown part of the line indicates periods in which a ramp function was in effect.

BASIN: SBCity GWB Time = 13:16:06. Date = 01-24-1993

YEAR	RAINPC	STRMSP	UNDRFL	INJECT	PUMPIN	IMPTIN	RECHARG	LOSSES	PUMPAGE	EOY VOL
1918	1174	890	22	0	57	993	3137	1004	1137	-1004
1919	0	393	19	0	82	968	1462	408	1638	-1588
1920	99	561	26	0	97	953	1736	102	1943	-1896
1921	148	456	31	0	101	949	1685	0	2020	-2231
1922	542	781	29	0	79	971	2402	302	1572	-1702
1923	354	498	26	0	85	965	1928	261	1704	-1739
1924	0	357	37	0	145	905	1444	0	2909	-3204
1925	0	378	50	0	88	962	1478	0	1755	-3481
1926	312	689	63	0	175	835	2074	0	3500	-4906
1927	988	794	66	0	93	957	2898	0	1860	-3868
1928	63	498	63	0	119	931	1674	0	2375	-4569
1929	147	428	81	0	165	885	1707	0	3308	-6170
1930	105	399	87	0	44	1006	1640	0	872	-5401
1931	194	294	95	0	175	836	1595	0	3500	-7306
1932	890	815	114	0	175	856	2851	0	3500	-7955
1933	0	525	133	0	173	877	1708	0	3462	-9710
1934	74	504	159	0	175	872	1783	0	3500	-11426
1935	819	687	173	0	144	906	2728	0	2875	-11573
1936	495	672	171	0	105	945	2389	0	2105	-11289
1937	1217	811	161	0	108	942	3239	0	2167	-10218
1938	1391	913	137	0	70	980	3491	0	1393	-8119
1939	71	546	123	0	100	950	1790	0	2009	-8338
1940	157	483	128	0	109	941	1818	0	2187	-8707
1941	3601	941	96	0	55	995	5688	0	1098	-4117
1942	32	685	57	0	63	987	1824	0	1253	-3546
1943	1163	743	41	0	67	983	2998	60	1344	-1952
1944	418	651	29	0	102	948	2148	74	2049	-1926
1945	195	550	32	0	110	940	1827	0	2209	-2308
1946	0	317	38	0	94	956	1405	0	1873	-2776
1947	70	277	54	0	152	898	1450	0	3036	-4361
1948	0	40	75	0	123	927	1165	0	2457	-5654
1949	0	202	101	0	175	846	1324	0	3500	-7829
1950	137	252	132	0	175	860	1556	0	3500	-9773
1951	0	132	164	0	175	776	1247	0	3500	-12026
1952	1965	827	172	0	148	902	4015	0	2961	-10972
1953	35	617	164	0	90	960	1867	0	1803	-10908
1954	202	430	165	0	100	950	1847	0	2009	-11070
1955	321	496	158	0	46	1004	2024	0	923	-9969
1956	608	735	147	0	108	942	2540	0	2151	-9580
1957	103	512	148	0	118	932	1813	0	2363	-10130
1958	2081	909	135	0	98	952	4175	0	1955	-7910
1959	0	420	121	0	96	954	1591	0	1912	-8231
1960	0	340	136	0	157	893	1526	0	3146	-9851
1961	0	290	163	0	175	842	1470	0	3500	-11881
1962	1377	701	179	0	174	876	3307	0	3472	-12046
1963	297	582	180	0	98	952	2108	0	1966	-11903
1964	0	412	177	0	72	978	1639	0	1441	-11706
1965	485	611	181	0	150	900	2326	0	3003	-12383
1966	137	649	187	0	109	941	2023	0	2176	-12536
1967	1256	913	175	0	80	970	3394	0	1607	-10748
1968	73	523	164	0	106	944	1810	0	2128	-11066
1969	1884	909	145	0	59	991	3988	0	1177	-8255
1970	0	605	122	0	76	974	1777	0	1527	-8005
1971	110	529	120	0	88	962	1809	0	1770	-7966
1972	0	399	126	0	121	929	1575	0	2420	-8811
1973	1071	850	122	0	88	962	3094	0	1756	-7473
1974	347	662	109	0	86	964	2167	0	1718	-7024
1975	523	724	101	0	88	962	2398	0	1761	-6386
1976	30	414	106	0	144	906	1599	0	2888	-7675
1977	0	405	130	0	175	832	1543	0	3500	-9633
1978	3272	922	117	0	88	962	5361	0	1751	-6022
1979	843	693	80	0	67	983	2666	0	1332	-4688
Avgs	514	568	110	0	112	933	2238	36	2246	-7379

Averages for: Ocean Desal = 531; Swp Imports = 2591

Table 4 G (50)

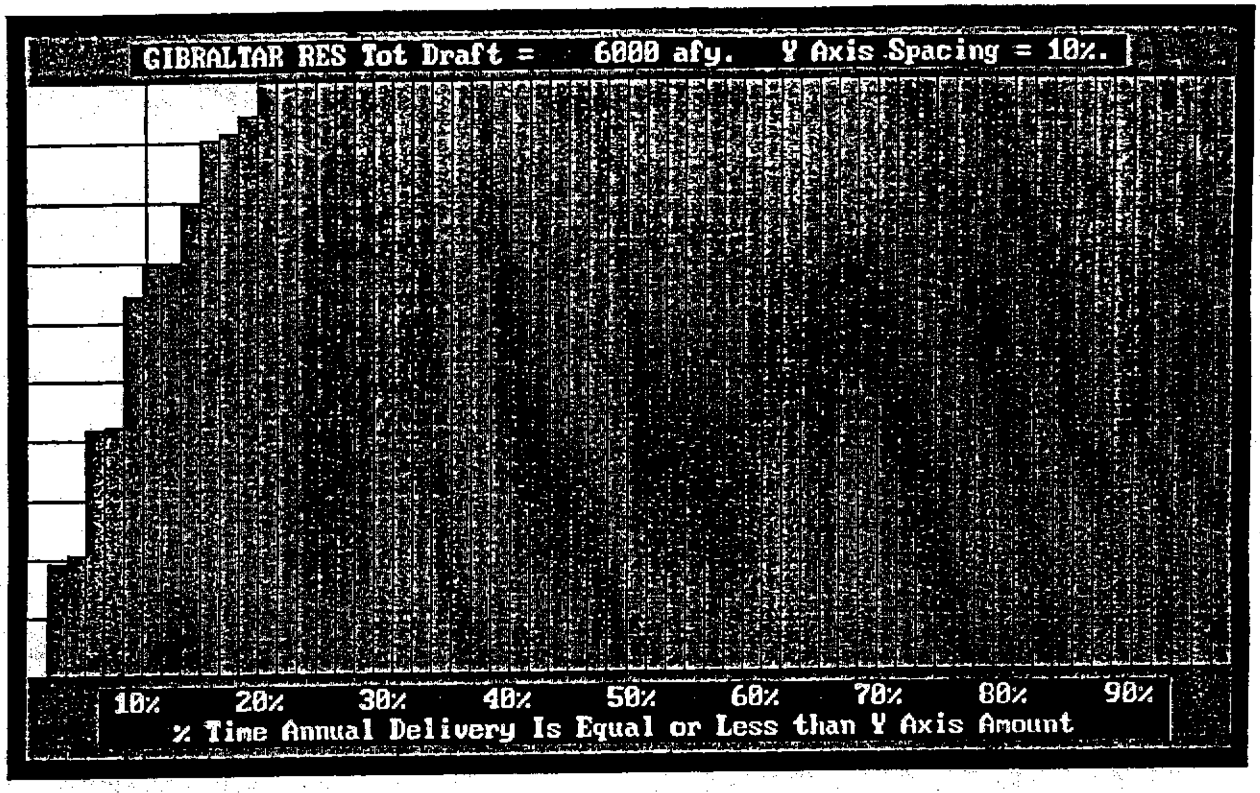

GIBRALTAR RES Tot Draft = 6000 afy. Y Axis Spacing = 10%.
10% 20% 30% 40% 50% 60% 70% 80% 90%
% Time Annual Delivery Is Equal or Less than Y Axis Amount

Figure 4-3

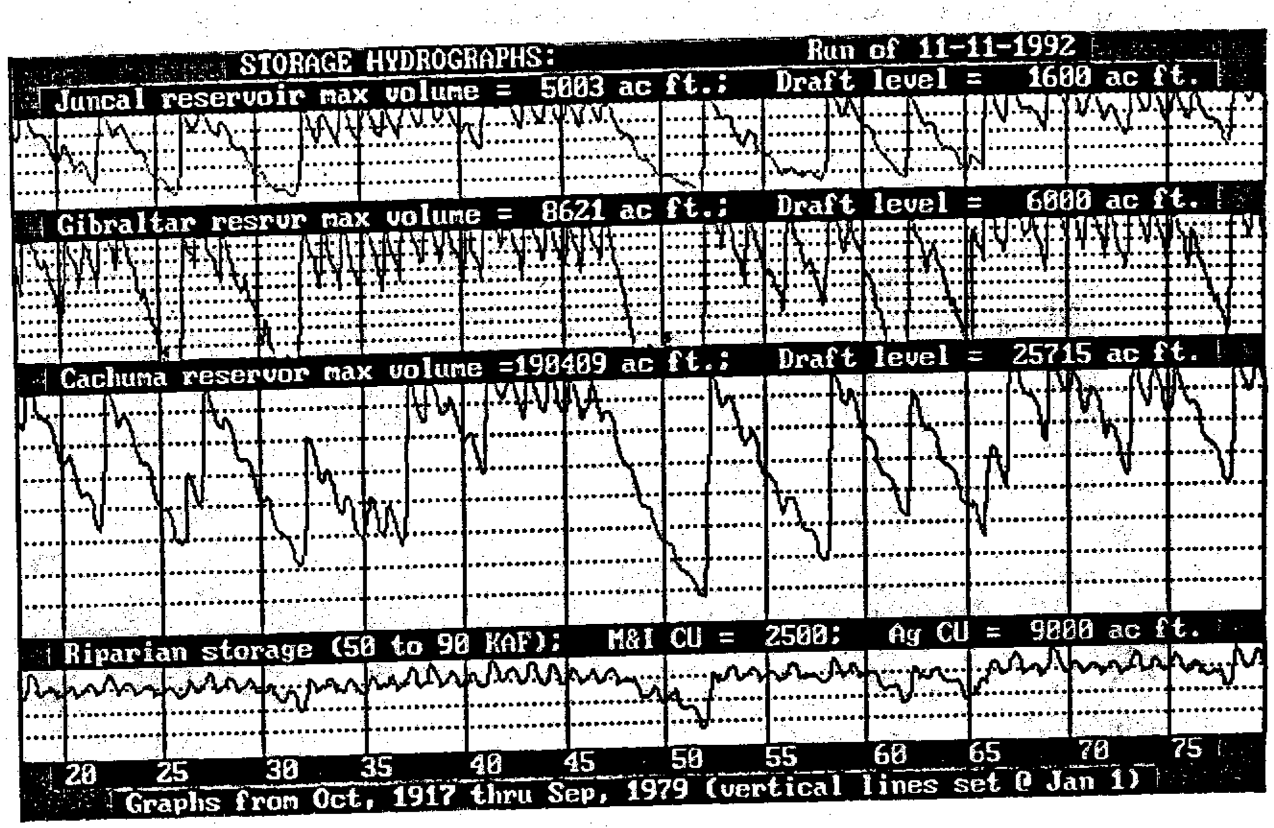

STORAGE HYDROGRAPHS:
Run of 11-11-1992
Juncal reservoir max volume = 5003 ac ft.; Draft level = 1600 ac ft.
Gibraltar resrvr max volume = 8621 ac ft.; Draft level = 6000 ac ft.
Cachuma reservor max volume =198409 ac ft.; Draft level = 25715 ac ft.
Riparian storage (50 to 90 KAF): M&I CU = 2500; Ag CU = 9000 ac ft.
20 25 30 35 40 45 50 55 60 65 70 75
Graphs from Oct, 1917 thru Sep, 1979 (vertical lines set @ Jan 1)

Figure 4-4

4.3.9 INFLOW RANKING GRAPHS

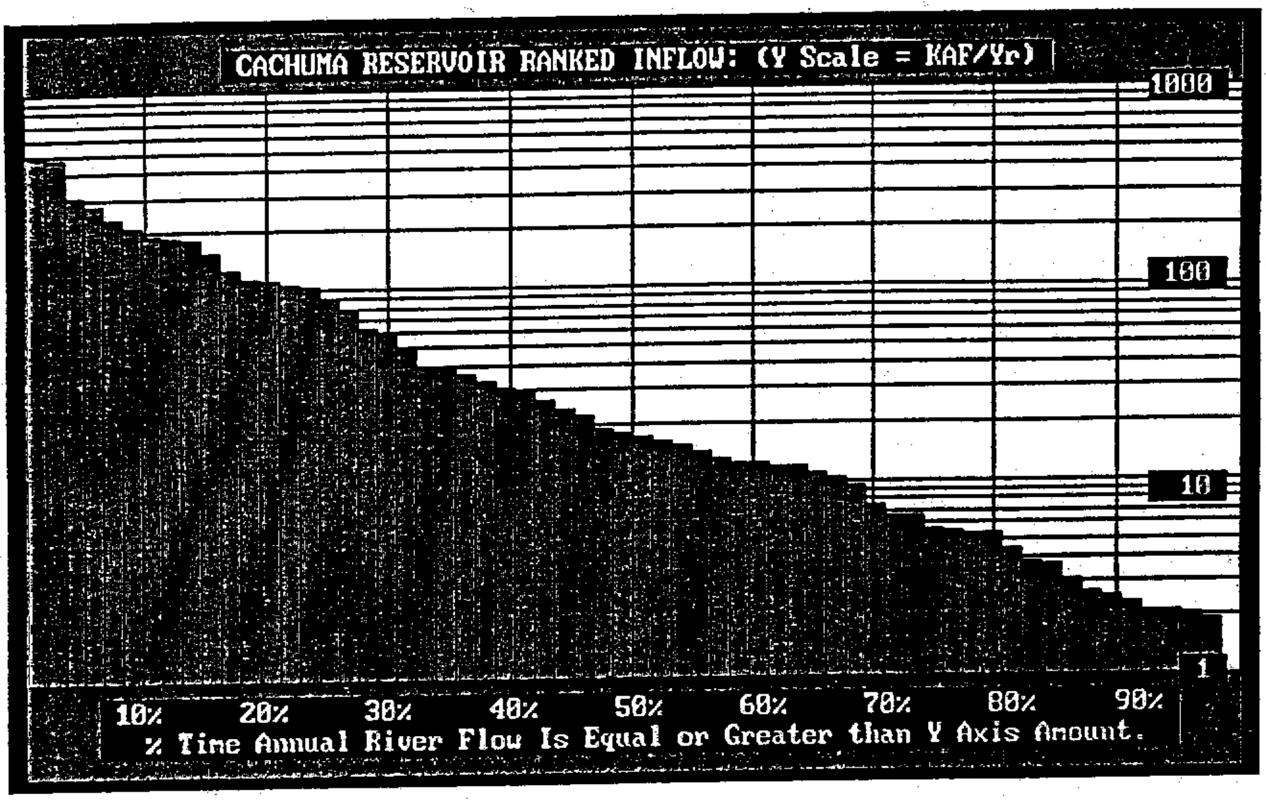
Inflow Ranking Graphs are available for each of the reservoirs. They show the percentage of base years on the horizontal axis and the reservoir inflow on the vertical axis. The graph is plotted is on a semi-log scale in thousands of acre feet. Each vertical bar represents one year of the base period (see Figure 4-5).

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 while others require modification within the program. Examples of some of the most common applications are conjunctive use and long term water management, reservoir draft and cloud seeding studies. Similarly, the effects of human inhabitance 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 versions of the model currently exist for some of the above applications.

The study of draft reduction 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 for different "start shortage" volumes. The chosen draft and "start shortage" volume are entered in the menu. The model is run, repeatedly, each time adjusting the "May1Delv%" upward or downward until the desired base period "Minimum Volume" for the reservoir is reached.

Selection of a steep ramp allows for a high yield for a long period of time, but the yield 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. This may be desirable provided alternative supplies are available for short periods of time. Incidental effects



CACHUMA RESERVOIR RANKED INFLOW: (Y Scale = KAF/Yr)
1000
100
10
1
10%
20%
30%
40%
50%
60%
70%
80%
90%
% Time Annual River Flow Is Equal or Greater than Y Axis Amount.

Figure 4-5

include reduced overall losses due to evaporation and increased storage capacity for periods of high precipitation.

A more conservative approach may utilize a gradual ramp, thereby allowing more time for imposition of temporary conservation programs and emergency water supply planning. The summary printout then provides the worst case reduction, average annual yield, percentage of short years, and worst year percent of safe yield. Figure 4-6 is a graph for Cachuma Reservoir depicting many such runs at different "start shortage" and draft values with a 20,000 acre foot 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, 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 10,000 acre feet. The safe yield, for this scenario, turns out to be 26,049 acre feet per year (with 75 percent effective cloud seeding).

The effects of increased human inhabitance near the Riparian Strip may be investigated simply by increasing the M&I and agricultural consumptive use. In order to investigate the effect of an enlarged reservoir, the maximum water surface elevation is raised within the menu. This causes an increase in the reservoir volume.

Similarly, the effect of removing all three of the surface reservoirs and all of the Above Narrows alluvial and upland pumpers may be studied by entering data in the menu as shown in figure 4-7. In this case, all 3 surface reservoirs have been essentially removed from the system (by setting the maximum water surface elevation for each reservoir at one foot above the lake bottom). The project draft level has been set to 1 AFY (zero would cause an error condition when displaying certain graphs). The draft is placed upon the lake and tunnel and will be more than met by tunnel infiltration. The agricultural type deliveries to ID#1 are zero as is all riparian alluvial

NO. 341-10 DIETZGEN GRAPH PAPER 10 X 10 PER INCH

DIETZGEN CORPORATION MADE IN U.S.A.

Figure 4-6

Cachuma Yield Graph

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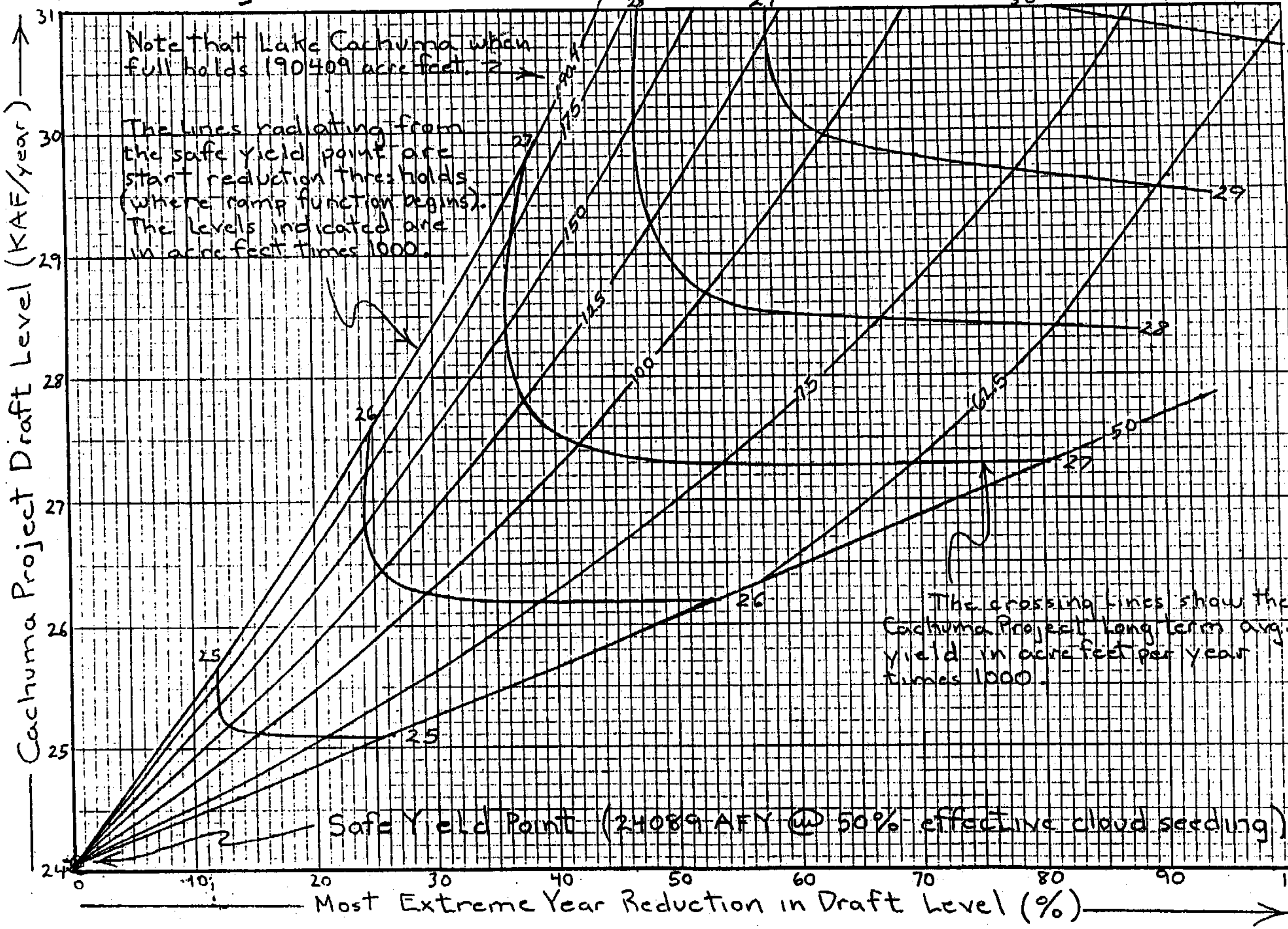


Column

Row		1	2	3	4	5	6
	RESERVOIR	BegWSElev	MaxWSElev	ProjDraft	1=Lk2=L+T	StrtShort	May1Delv%
1	ResJUNCAL	2138.00	2138.00	1	Lk + Tunl	0	100.000%
2	GIBRALTAR	1341.00	1341.00	1	Lk + Tunl	0	100.000%
3	RsCACHUMA	592.00	592.00	1	Lk + Tunl	0	100.000%
	PIPE & CU	ID#1 Pipe	LompcPipe	M&ICnsUse	AgConsUse	CSeedFlag	SeedEfcny
4	&Cld SEED	0	0	0	0	0	0.75
	Acnts&Etc	ShwDetYrs	BegRipStr	BegnngANA	ANAStrtRl	BegnngBNA	BNAStrtRl
5	RipACCNTS	1918.62	85000	0	25000	0	25000
	RUN TYPES	RunDETAIL	RunOUTPUT	TableTYPE	TabOUTPUT	GraphTYPE	DrouthADD
6	andOUTPUT	SUMMARY	To CRT	No Table!	To CRT	No Graph!	NONE!!!

PUT Caps Lock ON!!! OUTPUTS: 1=CRT; 2=Laser. RunDETAIL (1 thru 7): Junc, Base, Gibr, Cach, AbvN, BlwN, Sumry. TableTYPES: see Tab list. GraphTYPES: see Gph list. Use ARROWS to move. Press R to make RUN. After RUN, S displays selected table &/or graph for viewing & output..

Figure 4-7

Special Case Menu

basin pumpage between Cachuma Reservoir and Lompoc. The Above and Below Narrows Accounts are set to be inoperative. The riparian pumpage having been made zero causes the upland depletions (depletions of inflow to the riparian subareas) to be zero also.

The purpose of the menu displayed in Figure 4-7 is to give a model run which will show model estimated flows (tabular and graphical) at points along the Santa Ynez river which portray completely unimpaired conditions. This use of the model may be for academic purposes only, but it has been illustrated as an extreme case of menu parameter manipulation worth showing as it illustrates both the flexibility of the "Menu" subprogram and the proper way to achieve this particular unimpaired condition.

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 <u>noting that the error was almost certainly caused by an improper menu entry.</u>
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 Ctrl + Break (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!

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 principle satellite procedures, with nine additional auxiliary procedures required to provide the various model outputs. The subprogram field comprises satellite and auxiliary procedures which are arranged in three tiers. The overall model diagram is shown in Figure 5-1.

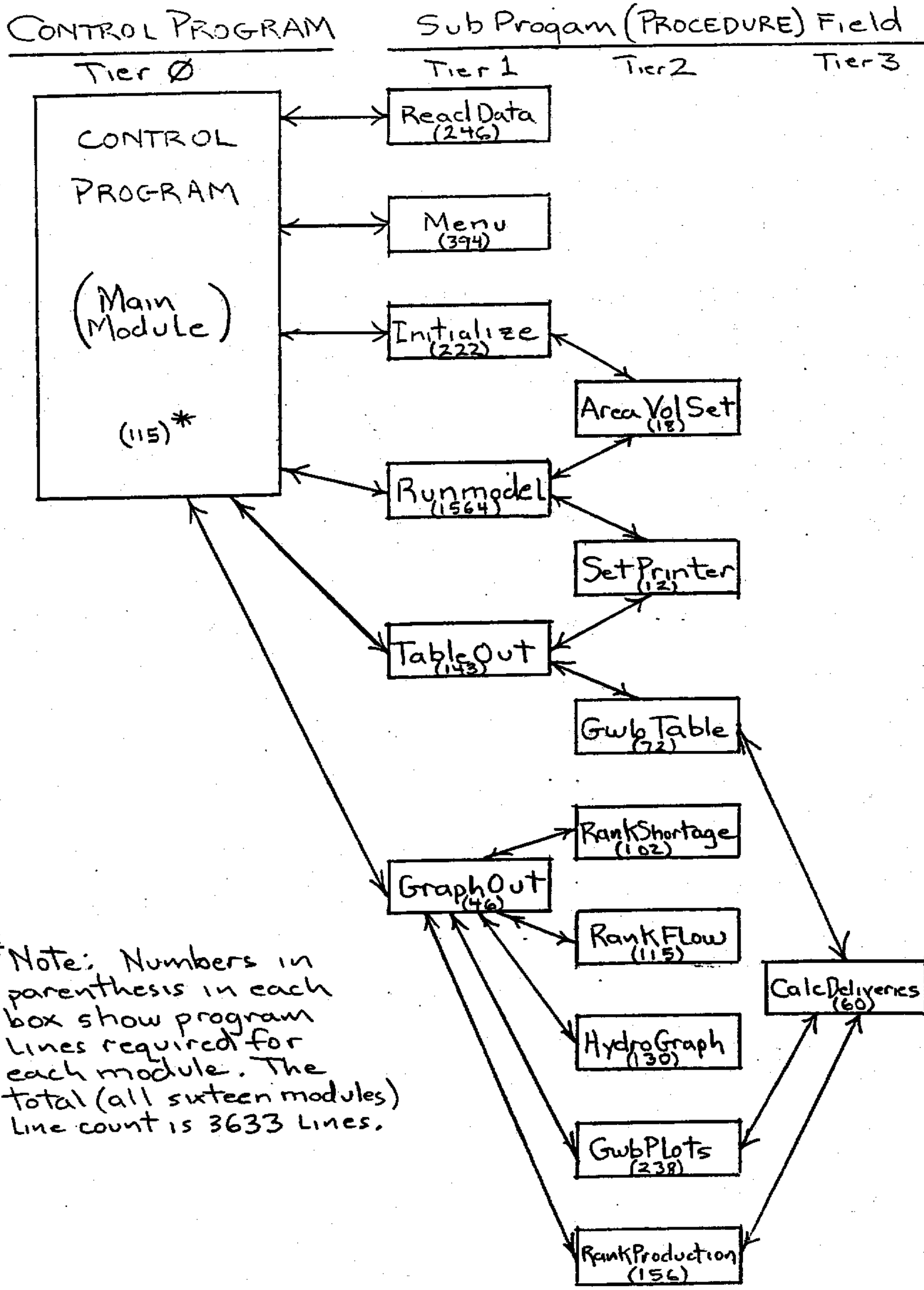
In the SubProgram field, Tier 1 procedures are the six principle procedures noted above. Tiers 2 and 3 show the remaining procedures. The arrows show the relationship between the subprograms (procedures). The control program (Tier 0) calls subprograms in Tier 1. When each Tier 1 subprogram has completed 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.

The Santa Ynez River Model is written in both Microsoft QuickBASIC 4.0 and 4.5. Both versions perform identical analyses in the manner diagrammed in Figure 5.1. The QuickBASIC 4.0 version is entitled "SYRM0193.BAS". The 4.5 version is entitled "SYRMQB45.BAS. Both

Santa Ynez River Model
SYRM0193

Figure 5-1

SBCWA 1/24/93



*Note: Numbers in parenthesis in each box show program lines required for each module. The total (all sixteen modules) line count is 3633 lines.

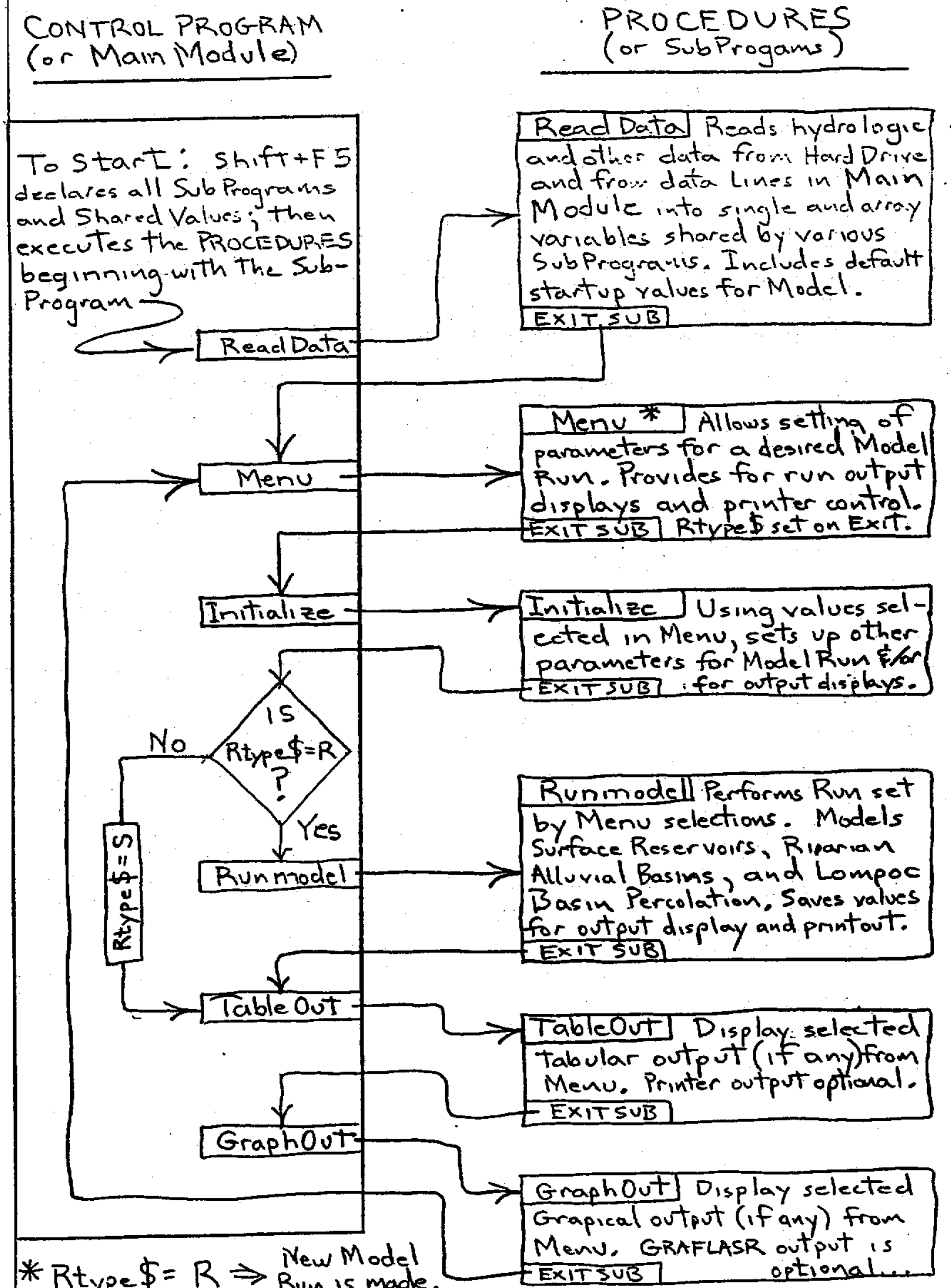
versions (along with all required data files) are available to authorized users of the Santa Ynez River Model. The model date is January 24th, 1993. The model program listing is displayed in Appendix A, on a module by module basis in the Tier and vertical order of Figure 5.1.

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 seven modules displayed on Figure 5-2 is contained in Sections 5.1 and 5.2. Section 5.3 provides a discussion of the 9 modules in Tiers 2 and 3.

5.1 TIER 0: CONTROL PROGRAM

As shown on Figure 5-2, "Main Module" has four main functions. It 1) specifies all subprograms to be used; 2) dimensions and declares all numeric and string variables to be shared 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) lists all data lines to be read into single or array variables (numeric and string) which have been dimensioned as shared variables (noted above); and 4) sets out the order and logic of the model procedures as depicted in Figure 5-2.

Santa Ynez River Model | SYRMØ193 | Figure 5-2 | SBCWA: 1/21/93



* Rtype$ = R ⇒ New Model Run is made.

Rtype$ = S ⇒ Display &/or print selected Tabular or Graphical output.

5.2 TIER 1 SUBPROGRAMS

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

5.2.1 "ReadData" SUBPROGRAM

The "ReadData" procedure fills many of the shared variable locations dimensioned in "Main Module" with numeric and string data read off the computer hard disc 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 15,836 values as shown in the INPUT instructions on Page 3 and 4 of the Model Code listing ("ReadData" Subprogram) and is described in detail in Appendix "F" (Hydrologic Data Base). After data from the hard drive is read, the data lines listed in "Main Module" are read (see Page 1 and 2 of Model Code listing). The data from the "Main Module" fills small arrays and single variables (numeric and string) required 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

The "Menu" subprogram (see pp. 7-12 of Model Code Listing) specifies reservoir, riparian alluvial basin, cloud seeding, and drought length 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

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 (See pages 13-15 of Model Code listing). "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 (see Figure 5-1).

5.2.4 "Runmodel" SUBPROGRAM

The subprogram "Runmodel" is the principal element of the Santa Ynez River model version SYRM0193; 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 changes 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.

The "Runmodel" subprogram code is listed on pages 16 through 36 of the model listing in Appendix A. 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 modelling 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 19 through 32). 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 months 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 the month's groundwater pumpage is set for the below Cachuma riparian alluvial basins. Then calculation of all hydrologic factors is performed for the month starting with the upper watershed (Juncal Dam) and working down river to Lompoc. Six basic elements of the system are modelled:

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

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 totalled, the bottom of the annual loop is entered. Here, modelling period numeric accumulators tally the annual values required to calculate modelling 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 modelling period are completed (62 cycles through the annual loop; 744 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 5 listed above (the Riparian alluvial Basins) is actually divided into 4 distinct reservoirs (groundwater basins) in the model, the number of model elements calculated out with each pass through the monthly loop is 9. Therefore each "run" of the model entails 6696 (62 years x 12 months x 9 days) 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

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 (Section 4, Table 4-1). This list is summarized here.

1. Delivery shortages from Juncal (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 - 1979.
7. Lompoc Narrows monthly & water year runoff, 1918 - 1979
8. Santa Barbara Groundwater Basin Budget Table.
9. No Table

Tables 1,3, and 4 show associated mountain tunnel names in parentheses. This is to indicae 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. The subprogram code of "TableOut" is used to print out Tables 1 through 7. If Table 8 is the menu selection, "TableOut" calls the subprogram "GwbTable" which performs the actual calculation and output of the table. 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 9 then no table is output, and an exit is made from "TableOut" back to "MainModule". See Model Code listing pp. 37 and 38.

5.2.6 "GraphOut" SUBPROGRAM

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 twelve of which allow selection of individual graphic printouts while the 13th 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 12, "GraphOut" calls one of 5 tier 2 subprograms (see Figure 5-l) which then produce the selected graph on the CRT for display. Inclusion of the "GRAFLASR" software into the computer before loading Microsoft QucikBASIC 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

Only two of the Tier 2 subprograms (AreaVolSet and SetPrinter) are required by the model to make and printout runs and to display and print out 7 of the 8 possible table selections of the Model menu. The remaining 6 Tier 2 procedures are required for the output of the special groundwater basin Table #8, and the 12 menu selectable graphs displaying reservoir shortages (5 selections), reservoir and alluvial basin hydrographs (1 selection), Santa Ynez River flow ranking graphs (4 selections), and finally, special groundwater basin display graphs (2 selections, the first of which actually displays 2 graphs).

5.3.1 "AreaVolSet" SUBPROGRAM

"AreaVolSet" (Model Code listing, Page 40) 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 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 to be evaluated.

5.3.2 "SetPrinter" SUBPROGRAM

This subprogram is called by "Runmodel" and by "TableOut" if the user has selected external printer output for either or both of the menu positions in Row 6, Columns 2 & 4 (Column 2 is for Run output; column 4 is for selected tabular output). "SetPrinter" (Model Code listing page 41) is presently set for a laserjet printer. Appropriate adjustment of the escape sequences used in this subprogram can allow another type of printer to be used.

5.3.3 "GwbTable" SUBPROGRAM

This is a special Model output module developed to illustrate the usefulness of the model in conducting conjunctive use studies. The Santa Barbara City groundwater basin (and service area was selected because of the multitude of water supply sources. This subprogram (see Model Code listing page 41) is based on a 62 water year groundwater basin budget modelling of storage units I and III and the Foothill Basin in the Santa Barbara City service area. All known elements of Basin inflow and outflow are utilized. Rainfall, stream seepage, and other groundwater basin parameters as well as overall service area production and surface water and other source parameters are established in the Control Module and "ReadData" subprograms.

Monthly groundwater basin pumpage is calculated as a residual of monthly service area production (or demand) less monthly water supplies from all sources (other than groundwater and ocean desal). The pumpage amounts are determined in "Runmodel" during model calculations. The "GwbTable" procedure uses data produced from the "CalcDeliveries" (Tier 3) subprogram which, in turn, calculates the water year totals for all sources of water produced in the Santa Barbara City service area. Table 4-6 shows an example "GwbTable" printout based upon a model run with the default menu settings.

5.3.4 "RankShortage" SUBPROGRAM

The "RankShortage" subprogram (Model Code listing page 43 & 44) is used to display the frequency of surface reservoir delivery shortages which may 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 1 through 5. "RankShortage" creates any of 5 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 4.3.7 describes the "RankShortage" graphs and Figure 4-3 is an example graph (menu selection #3 of 5 graphs).

5.3.5 "RankFlow" SUBPROGRAM

Like the "RankShortage" subprogram, "RankFlow" (Model Code listing pp. 45 & 46) 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 flow volume totals of the Santa Ynez River at selected points. The presently selected points are four: inflow to each of the 3 modelled 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 7 through 10 for GraphTYPE in the menu. Figure 4-5 is an example of this graphical output (GraphTYPE menu value = 9; default menu used). Note that the annual values are displayed on a logarithmic scale (Y-axis) plotted against percent of time (X-axis).

5.3.6 "HydroGraph" SUBPROGRAM

The "HydroGraph" subprogram (see Model Code listing pp. 47 & 48) produces hydrographs based on model calculated values representing end of month storage for the entire modelling 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 subprograms described above (Sections 5.3.4 and 5.3.5) "HydroGraph" is called by the Tier I subprogram "GraphOut" (see Figure 5-1). The menu selection (GraphTYPE) is number 6 to produce the hydrograph display. Section 4.3.8 describes the hydrograph output and Figure 4-4 displays results from the Model run with default menu.

5.3.7 "GwbPlots" SUBPROGRAM

This subprogram (Model Code Listing , pp. 49 through 52) produces two special conjunctive use graphs depicting total water production and shortages, and groundwater basin recharge and storage response for the Santa Barbara City service area. Calculation of the Data is discussed in Section 5.3.3. These displays illustrate a model application for evaluation of multiple source conjunctive use by the City of Santa Barbara.

The first graph displays all sources of annual water production to the City of Santa Barbara (Cachuma water, Gibraltar water, Juncal allotment, reclaimed waste water, State water, ocean desal water and groundwater basin pumpage). Shortages, if any, appear at the top of the graph as downward protruding bars. If injection of Cachuma spill water into the ground water basin is activated (by setting the InjectRate! parameter in Line 224 of the "ReadData" procedure to a non zero value) the injected amounts will appear at the bottom of the bar graph overlapping the Cachuma deliveries (see Figure 5-3).

The second available graph displays groundwater basin recharge and storage conditions of the model base period. The uppermost portion of the graph shows an annual bar chart of all elements of basin recharge (from top-down these are stream seepage, all forms of return flows plus net underflow, areal percolation of rainfall, and injected water). The bottom portion of the graph displays the storage hydrograph of the Santa Barbara area groundwater basins. This second graph displays the values tabulated in the menu TableTYPE selection 8 see section 5.3.3, "GwbTable" (Figure 5-4).

5.3.8 "Rank Productions" SUBPROGRAM

This subprogram simply ranks the Santa Barbara City total annual production (minus all ground water pumpage) displayed in the first graph of the "GwbPlots" subprogram. The "RankProduction" procedure (model code listing pp. 53 through 55) is activated by setting the menu GraphTYPE selection to number 12.

5.4 Tier 3: "CalcDeliveries" SUBPROGRAM

The "CalcDeliveries" (tier 3) procedure is used by the "GwbTable", "GwbPlots", and "RankProduction" subprograms to calculate the total annual deliveries (production) of various

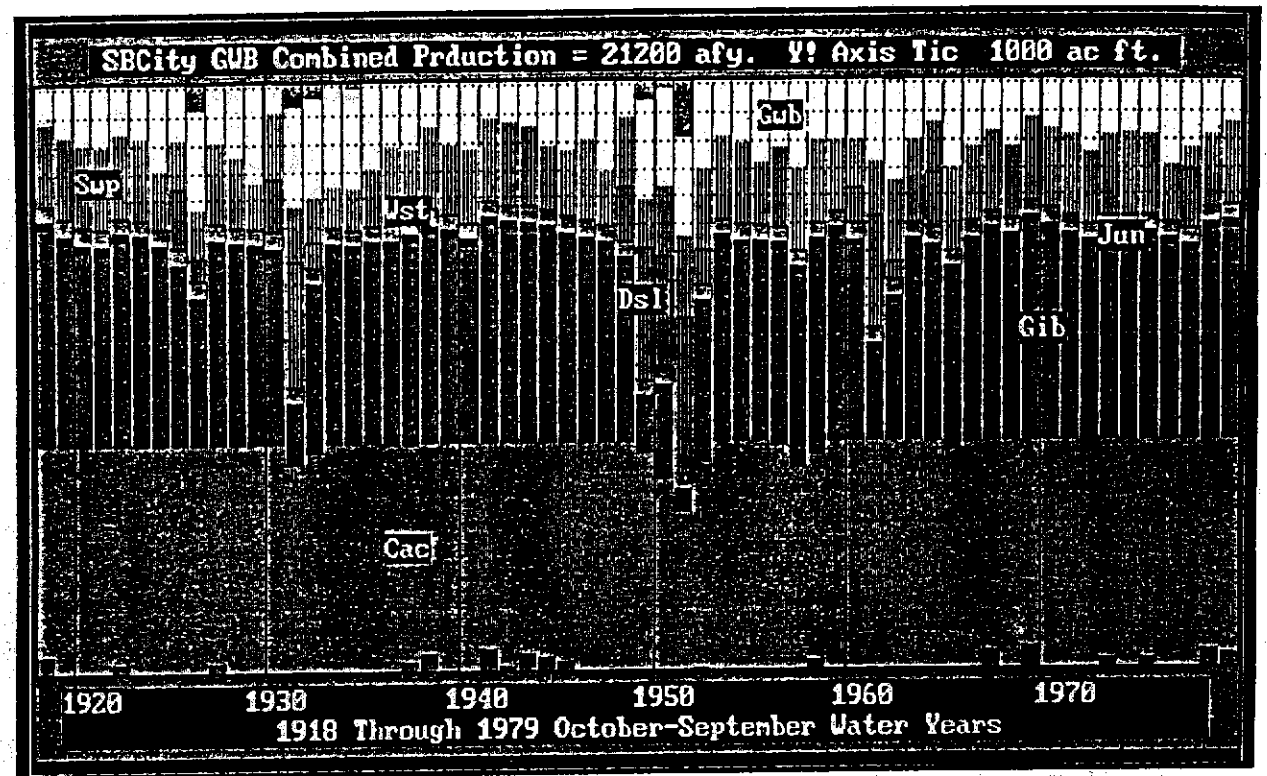


Figure 5-3
Modelling Period Water Production
Bar Chart

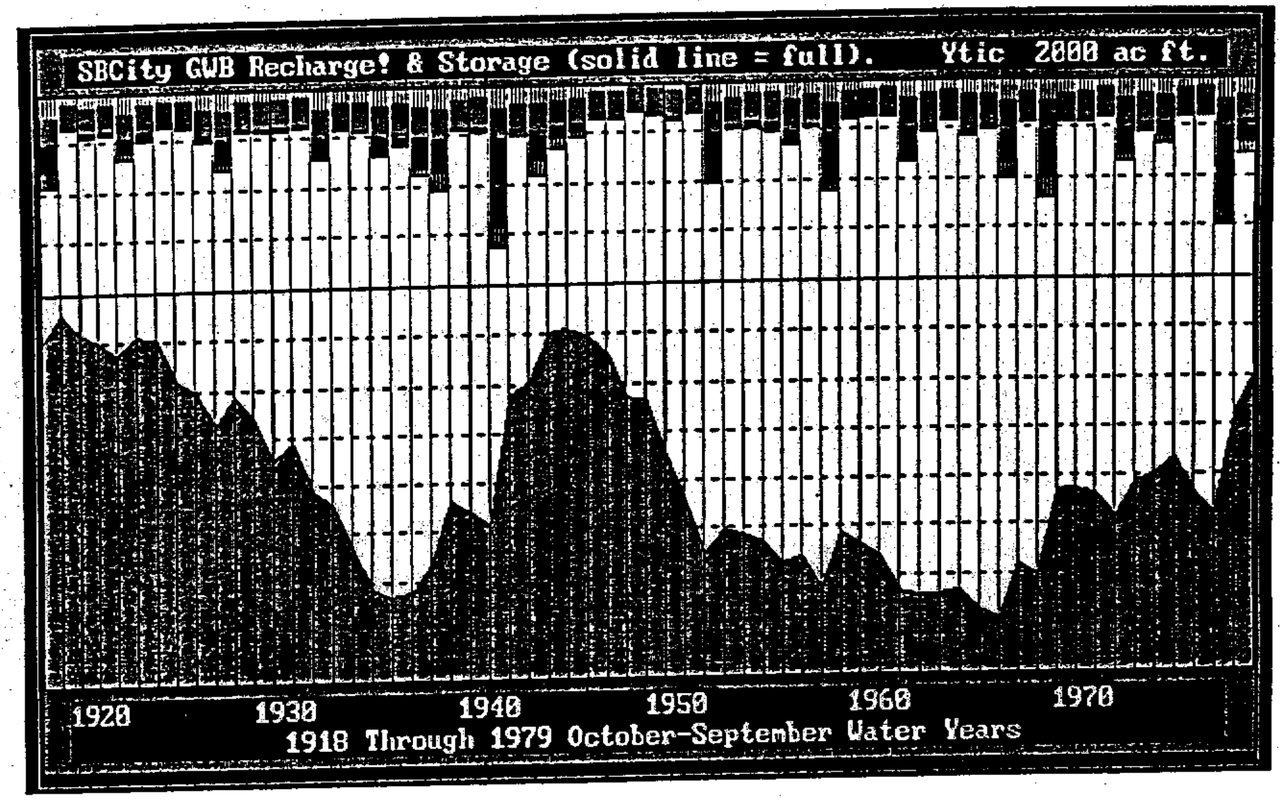


Figure 5-4

Groundwater Basin Recharge and Storage Graph sources of water available to Santa Barbara City. The "CalcDeliveries" subprogram also calculates the annual elements of recharge to and discharge from the Santa Barbara City service area ground water basins. This latter function of the subprogram is based on ground water basin budget models developed for the Santa Barbara area basins and for other areas by the Santa Barbara County Water Agency during the 1980's.

The parameters used to establish the various sources of water to Santa Barbara City, the annual production level to be met by the City, and the characteristics of the service area groundwater basins, are set in the "ReadData" subprogram. The sources of water are defined in terms of annual delivery volumes or fractions of monthly reservoir deliveries in the "ReadData" subprogram. Maximum and minimum annual ground water pumpage rates and maximum daily seawater desal production rates are also defined in the "ReadData" procedure. If any of these values are changed by the model user, the user must restart the model (Shift + F5) as noted in Section 4 and in the CONTROL PROGRAM box on Figure 5-2.

The "CalcDeliveries" subprogram talleys up the annual sources of water available to Santa Barbara City using monthly water source data calculated in the monthly time loop of the "Runmodel" subprogram. The parameters set in "ReadData" are used in "Runmodel" to calculate the monthly water source values. In the monthly loop of "Runmodel", if the monthly production level cannot be met by surface and other water sources (wastewater, State Water, groundwater, etc.), then seawater desal is activated to make up the deficit. However, the desal volume is limited to the maximum daily desal rate times the number of days of the particular calculation month. Seawater desal is activated in any given month only after groundwater pumpage at the maximum rate set in "ReadData" plus all other water sources available that month falls short of meeting that month's total production (demand) figure for Santa Barbara City. If, in the "Runmodel" monthly loop, desal plus groundwater plus all other sources falls short of meeting that month's total water production, then a monthly shortage is calculated.

All of the above monthly tabulations are saved during a model run, and are used by "CalcDeliveries" to talley up the annual totals for each water source. These annual values are used with the ground water basin parameters set in "ReadData" to calculate end of year ground water basin storage. The annual values calculated by the "CalcDeliveries" subprogram are needed by the Tier 2 subprograms "GwbTable", "GwbPlots", and "RankProduction" (see Sections 5.3.3, 5.3.7, and 5.3.8) to produce those procedures various outputs.

APPENDIX A:

PROGRAM LISTING

SYRMØ193.BAS
"Main Module"
1/24/93

```
'THIS IS MAIN PROGRAM MODULE FOR SYRM0193.BAS .......
DEFINT A-Z
DECLARE SUB ReadData ()
DECLARE SUB Menu ()
DECLARE SUB AreaVolSet ()
DECLARE SUB Initialize ()
DECLARE SUB Runmodel ()
DECLARE SUB SetPrinter ()
DECLARE SUB TableOut ()
DECLARE SUB GraphOut ()
DECLARE SUB RankShortage ()
DECLARE SUB RankFlow ()
DECLARE SUB HydroGraph ()
DECLARE SUB GwbPlots ()
DECLARE SUB GwbTable ()
DECLARE SUB CalcDeliveries ()
DECLARE SUB RankProduction ()
' - - - - - - - - - - - - Dimension Arrays - - - - - - - - - -
OPTION BASE 1
DIM SHARED Accret%(4, 744), Rain%(3, 744), Evap%(3, 744), Tunnel%(3, 744)
DIM SHARED Salsi%(744), CsInc%(3, 744), CachET%(744), JunPar!(2, 62)
DIM SHARED GibPar!(2, 62), CacPar!(2, 62), SalPar!(2, 62), LomPar!(2, 62)
DIM SHARED ResvCap!(3, 260), Pcnt%(6, 12), Leakage!(61), GinChowRelFlag%(12)
DIM SHARED DwnStrRelFlag%(12), AgDist!(12), MoDays%(12), PanFac!(3, 12)
DIM SHARED Datum%(3), Scale!(4), Ytic!(4), Eavg%(12), Ranker!(9, 62), 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$(3), Pointer%(3)
DIM SHARED VolGrph!(4, 744), TabValue!(7, 744), EndMoVol!(4), TotalDraft!(4)
DIM SHARED Draft!(5), StartElev!(3), MaxVol!(4), MaxElev!(3), NarrowsQ!(36)
DIM SHARED ScrnType%, InitYr%, NumYears%, Resv%, Elev7!, Area7!, Volume7!
DIM SHARED JunStartShortage%, JunMinDelv!, JunLowVol%, JunRedFac!, Vjun!
DIM SHARED GibStartShortage%, GibMinDelv!, GibLowVol%, GibRedFac!, Vgib!
DIM SHARED CacStartShortage!, CacMinDelv!, CacLowVol%, CacRedFac!, Vcac!
DIM SHARED TotMI%, AgrCU%, SyMI!, BuMI!, SyRed!, BuRed!, SeRed!, SwRed!
DIM SHARED UplandDepl%, UnderflowOut%, Vrip!, AboveNarrwAcct!, StartRelease%
DIM SHARED BelowNarrwAcct!, StartRelBlw%, Seed%, CsEff!, TabVal%, ResvDet%
DIM SHARED Esc$, BeginDetPrint%, EndHardCopy%, RunType$, RunOut$, TabType$
DIM SHARED TabOut$, GphType$, DAdd%, PrinterType$, NumDetYrs%, MitigationFlag%
DIM SHARED SeasonalDistrib!(12), SBprecip!(62), Seepage%(62), Swp!(62)
DIM SHARED Gwb$, MaxProdLevel%, Buildtic%, JunFactor!, GibFactor!, CacFactor!
DIM SHARED DesalMaxAfd!, SwpDel%, WasteWater%, InjectRate!, SpillInjectThresh%
DIM SHARED GwbYmin%, GwbYmax%, GwbYtic%, MaxPump%, MinPump%, TSacres%
DIM SHARED GWacres%, UfO!, Kuf!, Kpr!, Kir!, Snum!, StartVol%, LossZone%
DIM SHARED JunSource!(744), GibSource!(744), CacSource!(744), DslSource!(744)
DIM SHARED SwpSource!(744), WstSource!(744), GwbSource!(744), Inject!(744)
DIM SHARED YearsJun!(62), YearsGib!(62), YearsCac!(62), YearsDsl!(62), Xpos%
DIM SHARED YearsSwp!(62), YearsWst!(62), Pumpage!(62), Injection!(62), Ypos%
DIM SHARED Import!(62), Shortage!(62), Loss!(62), RainPerc!(62), PumpRet!(62)
DIM SHARED ImptRet!(62), UndrFlow!(62), StrmSeep!(62), Recharge!(62), Rtype$
' -- - - - - - - - - - - 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 2137,1339,591
    DATA 3600,10000,40000,50000
    DATA 200,500,2000,2000
    DATA 559,365,273,266,131,453,591,746,861,964,911,715
    DATA 0,400,500,600,700,800,1000,1200,1500,1700,2000,2500,3000,4000,5000,6000,7000,8000,10000,12000,15000
```

```
DATA 20000,25000,30000,35000,40000,45000,50000,60000,70000,90000,100000,200000,300000,400000,500000
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 2217.6,2224,1600,1,2500,22.27
DATA 1393.8,1400,6000,1,50,0
DATA 743.3,750,25715,2,100000,56.764
DATA 3000,0,2500,9000,0,.5
DATA 1918.62,77972,25,10600,362,200
DATA 7,1,9,1,13,0
DATA "|ResJUNCAL|","|GIBRALTAR|","|RsCACHUMA|","|&Cld SEED|","|RipACCNTS|","|andOUTPUT|"
DATA 1,1
DATA  83,58,56,53,50,67,83,100,108,125,117,100
DATA  2443,1033,1384,1455,1901,1740,620,1231,1693,2284,1332,1454,1392,1522,2200,853,1347,2139,1861,2480,2629
DATA  1343,1468,4525,1286,2434,1795,1523,1133,1341,928,1043,1439,1011,3122,1291,1533,1706,1958,1389,3221,880
DATA  1081,1004,2617,1671,922,1852,1439,2514,1346,3052,1198,1400,866,2355,1734,1885,1283,1196,4243,2159
DATA  424,187,267,217,372,237,170,180,328,378,237,204,190,140,388,250,240,327,320,386,435
DATA  260,230,448,326,354,310,262,151,132,19,96,120,63,394,294,205,236,350,244,433,200
DATA  162,138,334,277,196,291,309,435,249,433,288,252,190,405,315,345,197,193,439,330
DATA  0,0,0,0,0,1,30,38,38,0,14,41,18,32,44,47,47,30,4,15,0,14,9,0,0,1,21,17,0,32,16,38
DATA  15,0,0,0,0,21,0,0,0,11,38,31,2,0,38,0,8,0,10,0,2,0,12,0,0,0,30,71,10,0

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

1/24/93
SYRMØ193 SubProgram
"Read Data"

```
'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 SYRM0193 by Jon Ahlroth, 01/93": COLOR 7, 0
   LOCATE 4, 20: PRINT "Translated to QuickBASIC 4.0 by Jim Stubchaer"
   Esc$ = CHR$(27)
   ScrnType% = 9
   PrinterType$ = "Laser"
   OPEN "CSACCR4.HPA" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 3, 0:  PRINT "        Reading CSACCR4 files"
           FOR ResvX = 1 TO 4
             FOR Mo% = 1 TO 744
               INPUT #1, Accret%(ResvX, Mo%)
             NEXT Mo%
           NEXT ResvX
   CLOSE #1
   OPEN "CSRAIN3.HPA" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 1, 0:  PRINT "        Reading CSRAIN3 files"
           FOR ResvX = 1 TO 3
             FOR Mo% = 1 TO 744
               INPUT #1, Rain%(ResvX, Mo%)
             NEXT Mo%
           NEXT ResvX
   CLOSE #1
   OPEN "EVAP3.HPA" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 5, 0:  PRINT "        Reading EVAP3 files"
           FOR ResvX = 1 TO 3
             FOR Mo% = 1 TO 744
               INPUT #1, Evap%(ResvX, Mo%)
             NEXT Mo%
           NEXT ResvX
   CLOSE #1
   OPEN "TUNL3.HPA" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 6, 0:  PRINT "        Reading TUNL3 files"
           FOR ResvX = 1 TO 3
             FOR Mo% = 1 TO 744
               INPUT #1, Tunnel%(ResvX, Mo%)
             NEXT Mo%
           NEXT ResvX
   CLOSE #1
   OPEN "CSSAL.HPA" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 2, 0:  PRINT "        Reading CSSAL file"
             FOR Mo% = 1 TO 744
               INPUT #1, Salsi%(Mo%)
             NEXT Mo%
   CLOSE #1
   OPEN "CACHET.HPA" FOR INPUT AS #1
    LOCATE 12, 25: COLOR 4, 0:  PRINT "        Reading CachET file"
             FOR Mo% = 1 TO 744
               INPUT #1, CachET%(Mo%)
             NEXT Mo%
   CLOSE #1
   LOCATE 12, 25: COLOR 2, 0:   PRINT "        Reading CS_INC files"
   OPEN "CS_INC.HPA" FOR INPUT AS #1
           FOR ResvX = 1 TO 3
             FOR Mo% = 1 TO 744
               INPUT #1, CsInc%(ResvX, Mo%)
             NEXT Mo%
           NEXT ResvX
   CLOSE #1
   OPEN "JUNPAR.HPA" FOR INPUT AS #1
   LOCATE 12, 25: COLOR 3, 0:   PRINT "        Reading Parabola files"
           FOR I% = 1 TO 2
             FOR Year% = 1 TO 62
               INPUT #1, JunParl(I%, Year%)
             NEXT Year%
           NEXT I%
   CLOSE #1
   OPEN "GIBPAR.HPA" FOR INPUT AS #1
           FOR I% = 1 TO 2
             FOR Year% = 1 TO 62
               INPUT #1, GibParl(I%, Year%)
             NEXT Year%
           NEXT I%
   CLOSE #1
```

```
OPEN "CACPAR.HPA" FOR INPUT AS #1
        FOR I% = 1 TO 2
          FOR Year% = 1 TO 62
            INPUT #1, CacPar!(I%, Year%)
          NEXT Year%
        NEXT I%
CLOSE #1
OPEN "LOMPAR.HPA" FOR INPUT AS #1
        FOR I% = 1 TO 2
          FOR Year% = 1 TO 62
            INPUT #1, LomPar!(I%, Year%)
          NEXT Year%
        NEXT I%
CLOSE #1
OPEN "SALPAR.HPA" FOR INPUT AS #1
        FOR I% = 1 TO 2
          FOR Year% = 1 TO 62
            INPUT #1, SalPar!(I%, Year%)
          NEXT Year%
        NEXT I%
CLOSE #1
'============== Read Dam Storage Data  =====================
 OPEN "RESVCAP2.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
' - - 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 GlnChowRelFlag%(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 NarrowsO!(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) = "|\    \|######|#####|#####|####|#####|#####|####|######|#####|###.###%|##### af|"
 Image$(3) = "|##### af|###.###%|#### af|##### af|###.###%|#### af|######af|###.###%|##### af|"
 Image$(4) = "|\          \|####.#|####|######|####.#|####|######|\        \|\          \|####,### |"
 Image$(5) = "\                              \####!##\                                              \"
 Image$(6) = "|\          \|######|####|####|#####|#####|#####|#####|####|######|####|#####|#####|"
 Image$(7) = "|\ \####|#######|######|######|#######|######|#####|#######|#####  |#####  |  ####|"
 Image$(8) = "\                              \####!##\                                              \"
 Image$(9) = "|\        \|#######|######|######|#######|######|#####|#######|#####  |#####  |  ####|"
Image$(10) = "|\ \##|######|#####|#####|####|#####|#####|####|######|#####|####.#|####|######|"
Image$(11) = "|\    \|######|####|####|####|#####|#####|#####|####|######|    |#####|#####|#####|"
Image$(12) = "\            \###,###,### af   |###,###,### af   |###,###,### af   |              |"
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$(Row)
    NEXT Row
    READ Xpos%, Ypos%
 ' SERVICE AREA PARAMETERS
    FOR I% = 1 TO 12
      READ SeasonalDistrib!(I%)
      SeasonalDistrib!(I%) = SeasonalDistrib!(I%) / 1000
    NEXT I%
    FOR I% = 1 TO 62
      READ SBprecip!(I%)
      SBprecip!(I%) = SBprecip!(I%) / 100
    NEXT I%
    FOR I% = 1 TO 62
      READ Seepage%(I%)
    NEXT I%
    FOR I% = 1 TO 62
      READ Swp!(I%)
      Swp!(I%) = (100 - Swp!(I%)) / 100
    NEXT I%
    Gwb$ = "SBCity GWB"
    MaxProdLevel% = 21200
    Buildtic% = 1000
    JunFactor! = 25
    GibFactor! = 1
    CacFactor! = .32188        ' Seventh period portion to City
    DesalMaxCfs! = 10.359      ' Corresponds to 7500 AFY
```

```
    DesalMaxAfd! = 1.98347 * DesalMaxCfs!
    SwpDel% = 3000
    WasteWater% = 500
    GwbYmin% = -16000          'Y scale minimum
    GwbYmax% = 8000            'Y scale maximum
    GwbYtic% = 2000            'Y scale tic marks
    MaxPump% = 3500            'Maximum annual pumpage
    MinPump% = 500             'Minimum annual pumpage
    TSacres% = 1000            'Acreage in trees & shrubs (recharge zone)
    GWacres% = 1000            'Acreage in grass & weeds (recharge zone)
    Uf0! = -88.2               'Base underflow (AFY, net inflow - outflow)
    Kuf! = .015                'Variable underflow factor (Uf = Uf0 + Kuf * Vdw)
    Kpr! = .05                 'Pumpage returns (% of total pumpage)
    Kir! = .05                 'Import returns (% of total imports)
    Snum! = 2.1                'Stream seepage multiplier
    StartVol% = -2000          'Beginning Fall, 1917 GW storage level
    LossZone% = -2000          'Above this GW storage level losses occur
    SpillInjectThresh% = 2000 'No injection below this spill level!!!
    InjectRate! = 0            'Average Monthly GW injection rate (cfs)
    InjectRate! = 1.98347 * InjectRate!
END SUB
```

1/24/93
SYRMØ193 Sub Progam
"Menu"

```
'THIS IS THE MENU SUBPROGRAM...
SUB Menu STATIC
   SCREEN 0
   CLS
   SCREEN ScrnType%
20 COLOR 15, 11
30 VIEW (8, 4)-(632, 346), 15, 1
   MenuVal!(5, 1) = 1918.62
   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 15
   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$, MenuVal!(Row, 5); MenuVal!(Row, 6)
   NEXT Row
   COLOR 14
   LOCATE 8, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   LOCATE 9, 5
   PRINT "│PIPE & CU│ID#1 Pipe│LompcPipe│M&ICnsUse│AgConsUse│CSeedFlag│SeedEfcny│"
   LOCATE 10, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   LOCATE 11, 5
   Row = 4
   COLOR 15
   PRINT USING Image2$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), MenuVal!(Row, 4), MenuVal!(Row, 5); MenuVal!
   COLOR 4
   LOCATE 12, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   LOCATE 13, 5
   PRINT "│Acnts&Etc│ShwDetYrs│BegRipStr│BegnngANA│ANAStrtRl│BegnngBNA│BNAStrtRl│"
   LOCATE 14, 5
   PRINT "├─────────┼─────────┼─────────┼─────────┼─────────┼─────────┼─────────┤"
   LOCATE 15, 5
   Row = 5
   COLOR 15
   PRINT USING Image3$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), MenuVal!(Row, 4), MenuVal!(Row, 5); MenuVal!
   SELECT CASE MenuVal!(6, 1)
   CASE 1
     Pout1$ = "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-Low"
     GOTO Nxt
   CASE 6
     Pout1$ = "Det=BlwNr"
     GOTO Nxt
   CASE 7
```

```
    Pout1$ = " SUMMARY "
    GOTO Nxt
  CASE ELSE
    Pout1$ = "WRONG ##!"
  END SELECT
Nxt: 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 Narrows"
    GOTO Typ
  CASE 8
    Pout2$ = "GWBasnTab"
    GOTO Typ
  CASE 9
    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$ = "RankQJunc"
    GOTO Zyp
  CASE 8
    Pout3$ = "RankQGibr"
    GOTO Zyp
  CASE 9
    Pout3$ = "RankQCach"
    GOTO Zyp
  CASE 10
    Pout3$ = "RankQLomp"
    GOTO Zyp
  CASE 11
    Pout3$ = "GWB Plots"
    GOTO Zyp
  CASE 12
    Pout3$ = "RankDeliv"
    GOTO Zyp
  CASE 13
    Pout3$ = "No Graph!"
```

```
      GOTO Zyp
    CASE ELSE
      Pout3$ = "WRONG ##!"
    END SELECT
Zyp: COLOR 10
    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 15
    PRINT USING Image4$; Res$(Row); Pout1$; Out1$; Pout2$; Out2$; Pout3$; Out3$
    COLOR 10
    LOCATE 20, 5
    PRINT "└─────────┴─────────┴─────────┴─────────┴─────────┴─────────┴─────────┘"
    LOCATE 21, 5
    COLOR 8
    PRINT " PUT Caps Lock ON!!!   OUTPUTS: 1=CRT; 2=Laser.   RunDETAIL (1 thru 7):"
    LOCATE 22, 5
    PRINT " Junc, Base, Gibr, Cach, AbvN, BlwN, Sumry.   TableTYPES: see Tab list."
    LOCATE 23, 5
    PRINT " GraphTYPES: see Gph list.   Use ARROWS to move.   Press R to make RUN."
    LOCATE 24, 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$(82) THEN
      Rtype$ = "R"
      Xpos% = X
      Ypos% = Y
      SOUND 440, 2: EXIT SUB
    END IF
    IF A$ = CHR$(83) THEN
      Rtype$ = "S"
      Xpos% = X
      Ypos% = Y
      SOUND 660, 2: 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 15
          PRINT USING Image1$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), Mode$, MenuVal!(Row, 5); MenuVal!(Row,
          RETURN
        END IF
        IF Row = 4 THEN
          LOCATE 11, 5
          COLOR 15
          PRINT USING Image2$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), MenuVal!(Row, 4), MenuVal!(Row, 5); Me
          RETURN
        END IF
        IF Row = 5 THEN
          LOCATE 15, 5
          COLOR 15
          PRINT USING Image3$; Res$(Row); MenuVal!(Row, 1); MenuVal!(Row, 2); MenuVal!(Row, 3), MenuVal!(Row, 4), MenuVal!(Row, 5); Me
          RETURN
        END IF
        IF Row = 6 THEN
          Out1$ = " 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
Tip:  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 Narrows"
        GOTO Tsip
      CASE 8
        Pout2$ = "GWBasnTab"
        GOTO Tsip
      CASE 9
        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$ = "RankQJunc"
        GOTO Pyp
      CASE 8
        Pout3$ = "RankQGibr"
        GOTO Pyp
      CASE 9
        Pout3$ = "RankQCach"
        GOTO Pyp
      CASE 10
        Pout3$ = "RankQLomp"
        GOTO Pyp
      CASE 11
        Pout3$ = "GWB Plots"
        GOTO Pyp
      CASE 12
        Pout3$ = "RankDeliv"
        GOTO Pyp
      CASE 13
        Pout3$ = "No Graph!"
        GOTO Pyp
      CASE ELSE
        Pout3$ = "WRONG ##!"
```

```
        END SELECT
Pyp:    LOCATE 19, 5
        COLOR 15
        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
```

1/24/93
SYRMØ193 SubProgram
"Initialize"

```
'INITIALIZE WITH MENU & OTHER VALUES...
DEFINT A-Z
SUB Initialize STATIC
    InitYr% = 1917
    NumYears% = 62
' 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)
    AgrCU% = MenuVal!(4, 4)
    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% + AgrCU% < 360 THEN
      TotMI% = 0
      AgrCU% = 0
      SyMI! = 0
      BuMI! = 0
      SyRed! = 1
      BuRed! = 1
      SeRed! = 1
      SwRed! = 1
      GOTO Rc
    END IF
    SyMI! = 1000 + 748! * (TotMI% - 2500) / 1683   'annual SY Subarea M&IDivs.
    BuMI! = 1500 + 935! * (TotMI% - 2500) / 1683 'annual Buel Subarea M&IDivs.
    SyRed! = 2620 / (.18 * AgrCU% + SyMI!) 'added 3/15/88
    IF SyRed! > 1 THEN SyRed! = 1
    BuRed! = 4560 / (.34 * AgrCU% + BuMI!)
    IF BuRed! > 1 THEN BuRed! = 1
    SeRed! = 4050 / (.45 * AgrCU%)
    IF SeRed! > 1 THEN SeRed! = 1
    SwRed! = 270 / (.03 * AgrCU%)
    IF SwRed! > 1 THEN SwRed! = 1
Rc: UplandDepl% = 100    'monthly
    IF TotMI% + AgrCU% = 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 Narrows"
      GOTO Ty
    CASE 8
      TabType$ = "GWBasnTab"
      GOTO Ty
    CASE 9
      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$ = "JunQRank"
      GOTO Zy
    CASE 8
      GphType$ = "GibQRank"
      GOTO Zy
    CASE 9
      GphType$ = "CacQRank"
      GOTO Zy
    CASE 10
      GphType$ = "LomQRank"
      GOTO Zy
    CASE 11
      GphType$ = "GWB Plots"
      GOTO Zy
    CASE 12
      GphType$ = "RankDeliv"
      GOTO Zy
    CASE 13
      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
```

1/24/93
SYRMØ193 SubProgram
"Runmodel"

```
'SYRM0193.BAS Main Yearly & Monthly Model
DEFINT A-Z
SUB Runmodel STATIC
DIM SYRSeep!(4), MinMo$(4), Vavg!(4), GibOrdDiv!(12), AgUseFactor!(12)
DIM JunDiv!(12), GibDiv!(12), CacDiv!(3, 12), CacDemand!(12), MinVol!(4)
DIM AnnRunoff!(3), Area!(3), YrRainOnLake!(3), YrSpil!(3)
DIM AnnShort!(3), Sworst!(3), YrLeak!(3), GibFldDiv!(12), PShortMinYr!(3)
DIM MinMo%(4), MinYr%(4), YrTun!(3), YrDivs!(3), YrRels!(3), YrSysYld!(3)
DIM YrEvpo!(3), SumRunoff!(3), SumPrecip!(3), SumEvap!(3), SumDiv!(3)
DIM SumRel!(3), SumTun!(3), SumSpill!(3), SumLeak!(3)
DIM ShortMon%(3), SumYld!(4), SumVol!(4), SyDiv!(12), BuDiv!(12)
  SCREEN 0
  CLS
  SCREEN ScrnType%
  COLOR 15, 14
  VIEW (8, 4)-(632, 346), 15, 1
  IF RunOut$ = "EXT" THEN
    SetPrinter
  END IF
  COLOR 1
  LOCATE 2, 3
  PRINT " SANTA YNEZ RIVER MODEL SYRM0193 (01/93) "; TIME$; ", "; DATE$; "                    "
  RipFullSyn% = 20600 'Full Riparian Storages
  RipFullBuel% = 28300
  RipFullSRitaE& = 33900
  RipFullSRitaW% = 7200
    EndRipStorSYn! = EndMoVol!(4) * .23 'Beginning Riparian Storages
    EndRipStorBuel! = EndMoVol!(4) * .28
    EndRipStorSRitaE! = EndMoVol!(4) * .4
    EndRipStorSRitaW! = EndMoVol!(4) * .09
    TunFac! = Tunnel%(3, 1) / 2500
  SyLast! = TunFac! * (RipFullSyn% - EndRipStorSYn! - 2928)
  BuLast! = TunFac! * (RipFullBuel% - EndRipStorBuel! - 5480)
  SeLast! = TunFac! * (RipFullSRitaE& - EndRipStorSRitaE! - 32)
  SwLast! = TunFac! * (RipFullSRitaW% - EndRipStorSRitaW! - 344)
    Beta! = .66
    Alpha! = 1 / Beta!
  SYnPerc! = 32
  SYnStr! = 9100
  SYnSpMx! = 3933
    BuePerc! = 32
    BueStr! = 11950
    BueSpMx! = 4647
  SRitaEPerc! = 32
  SRitaEStr! = 13450
  SRitaESpMx! = 3082
    SRitaWPerc! = 32
    SRitaWStr! = 2450
    SRitaWSpMx! = 708
  TotDewatStor! = MaxVol!(4) - EndMoVol!(4)
  OperDewatStor% = 10000
  AccumRelease! = 0
  CumPhanRel! = 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$; " Reduced Cachuma, with "; 750 - MaxElev!(3); " foot reduction in height.            "
      GOTO 21
    END IF
    PRINT USING Image$; " Enlarged Cachuma, with"; MaxElev!(3) - 750; " foot raise.                            "
  END IF
21 LOCATE 4, 3
  IF Seed% = 1 THEN
    PRINT USING "\                     \#.##\                                    \"; " With Cloudseeding at "; CsEff!; " e
   ELSE
    PRINT " No cloudseeding                                                        "
  END IF
  PRINT "┌──────────────────────────────────┬──────────────────────┬────────────────────────────────┐"
  PRINT "│INITIAL RESV/BASN CONDITIONS│MAXIMUM CONDITIONS│      DIVERSION INFORMATION     │"
  PRINT "│Reservoir│WSElev│Area│Volume│WSElev│Area│Volume│Divert To│   Mode    │SysDemand│"
```

```
                                                                                               ┤"
PRINT "├─────────┼─────┼───┼──────┼─────┼───┼──────┼────────┼─────────┼
COLOR 8
IF RunOut$ = "EXT" THEN
  LPRINT " SANTA YNEZ RIVER MODEL SYRM0193 (01/93) "; TIME$; ", "; DATE$
  IF MaxElev!(3) = 750 THEN                                                                  "
    LPRINT " Existing Cachuma Reservoir
   ELSE                                                                                                                     "
    IF MaxElev!(3) < 750 THEN
      LPRINT USING Image$; " Reduced Cachuma, with "; 750 - MaxElev!(3); " foot reduction in height.
      GOTO 41                                                                                                              "
    END IF
    LPRINT USING Image$; " Enlarged Cachuma, with"; MaxElev!(3) - 750; " foot raise.
  END IF
41  IF Seed% = 1 THEN                                                                          \"; " With Cloudseeding at "; CsEff!;
    LPRINT USING "\                         \#.##\
   ELSE                                                                                       "
    LPRINT " No cloudseeding
  END IF                                                                                                                 "
  LPRINT "┌──────────────────────────────┬──────────────────────┬──────────────────────────────┐"
  LPRINT "│INITIAL RESV/BASN CONDITIONS│MAXIMUM CONDITIONS│      DIVERSION INFORMATION      │"
  LPRINT "│Reservoir│WSElev│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
  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
    PhanDatum% = 1345
    PhanPointer% = 52
    PhanElev! = 1400
    GOSUB PhanAVSet
    Em! = PhanElev!
    Am! = PhanArea!
    Vm! = PhanVol!
    PhanElev! = 1395.4
    GOSUB PhanAVSet
    LastVol! = PhanVol!
    LastArea! = PhanArea!                                                                                   7278
    PRINT USING Image$(4); "BaseGibrl"; PhanElev!; PhanArea!; PhanVol!; Em!; Am!; Vm!; "PhantCity"; "LakeDraft"; 7278
    IF RunOut$ = "EXT" THEN LPRINT USING Image$(4); "BaseGibrl"; PhanElev!; PhanArea!; PhanVol!; Em!; Am!; Vm!; "PhantCity"; "LakeDr
  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$(Resv%); Mode$(Resv%); Draft!(Res
  IF RunOut$ = "EXT" THEN LPRINT USING Image$(4); Name$(Resv%); Elev7!; Area!(Resv%); EndMoVol!(Resv%); Em!; Am!; Vm!; User$(Resv%);
NEXT Resv%
LastEl! = StartElev!(3)
MinVol!(4) = 10000000
SumUnimpRunoff! = 0
SumRunoffDepl! = 0
SumBankDepl! = 0
SumMICU! = 0
SumAgCU! = 0
SumRivPerc! = 0
SumBank! = 0
SumUndrFlow! = 0
SumNarrowsQ! = 0
SumAbvNrwsAcct! = 0
SumDewatStor! = 0
SumVol!(4) = 0
SumCalcPerc! = 0
SumCalcQIncr! = 0
SumConstNarwQ! = 0
SumConstPerc! = 0
SumBelowNarwRel! = 0
SumOFlor! = 0
SumBelowNarwCred! = 0
SumBnRedu! = 0
SumBelowNarwAcct! = 0
LastMonthsSpill! = 0
LastMoLivel = 0
SwitchThresh! = 20000
MaxPThresh! = 100000
CurveSpan! = LOG(500000) - LOG(1000)
Aspan! = -402.581
Bspan! = .03807
Kspan! = -226.68
A1K! = 324.32
B1K! = -.19459
K1K! = 520.67
Aon! = 547.05
Bon! = .003166
Kon! = 679.66
LOG1000! = LOG(1000)
Ordvol! = PhanVol! - 2500
Fldvol! = 2500
COLOR 4
PRINT "┌─────────┬─────────────────────────────────────────────────────┬──────┬────────────────┐"
PRINT "│Begining│    A b o v e   N a r r o w s   R i p a r i a n     │Lompoc│BelowNarrows│"
PRINT "│Cachuma-│  Storage │FullVolume│ Ag CU│M&I CU│   Strel│Accnt│  Pipe│   Strel│Acct│"
COLOR 8
PRINT USING Image$(1); EndMoVol!(4); MaxVol!(4); AgrCU; TotMI; StartRelease%; AboveNarrwAcct!; Draft!(5); StartRelBlw%; BelowNarrwA
COLOR 6
PRINT "┌────────┬────────┬───────┬────────┬────────┬───────┬────────┬────────┬────────┐"
PRINT "│JunRedPt│%YrsDel@│LowPtAF│GibRedPt│%YrsDel@│LowPtAF│CacRedPt│%YrsDel@│LowPt AF│"
COLOR 8
PRINT USING Image$(3); JunStartShortage%; JunMinDelv! * 100; JunLowVol%; GibStartShortage%; GibMinDelv! * 100; GibLowVol%; CacStart
COLOR 6
PRINT "└────────┴────────┴───────┴────────┴────────┴───────┴────────┴────────┴────────┘"
IF RunOut$ = "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$(1); EndMoVol!(4); MaxVol!(4); AgrCU; TotMI; StartRelease%; AboveNarrwAcct!; Draft!(5); StartRelBlw%; BelowNar
  LPRINT "┌────────┬────────┬───────┬────────┬────────┬───────┬────────┬────────┬────────┐"
  LPRINT "│JunRedPt│%YrsDel@│LowPtAF│GibRedPt│%YrsDel@│LowPtAF│CacRedPt│%YrsDel@│LowPt AF│"
  LPRINT USING Image$(3); JunStartShortage%; JunMinDelv! * 100; JunLowVol%; GibStartShortage%; GibMinDelv! * 100; GibLowVol%; CacSt
  LPRINT "└────────┴────────┴───────┴────────┴────────┴───────┴────────┴────────┴────────┘"
END IF
IF RunType$ = "Summary" THEN LOCATE 11, 35: COLOR 15: 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%) = SyM!! * Pcnt%(6, WtrYrMo%) / 1000
    BuDiv!(WtrYrMo%) = BuM!! * Pcnt%(6, WtrYrMo%) / 1000
    AgUseFactor!(WtrYrMo%) = AgrCU * AgDist!(WtrYrMo%) / Eavg%(WtrYrMo%)
  NEXT WtrYrMo%
  SYRSeep!(1) = 0
  SYRSeep!(2) = 0
  SYRSeep!(3) = 0
  SYRSeep!(4) = 0
  DAdder% = 0
  Lastflddiv! = 0
  LOCATE 20, 1
'==================== BEGIN ANNUAL LOOP ====================
  FOR Yr% = 1918 TO 1979
    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$(5); " Oct-Sep Water Year = "; Yr% - 1; "-"; Yr% - 1900; "    (flagged for monthly detail)"
    IF RunOut$ = "EXT" THEN LPRINT USING Image$(5); " Oct-Sep Water Year = "; Yr% - 1; "-"; Yr% - 1900; "    (flagged for monthly det
    SELECT CASE RunType$
    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│Runoff@│Calc'd │Calc'd│Cnstrcv│Cnstrc│BlwNr│ Calc'd│BlwNar│Redctn│ BNA  │"
      PRINT "│Subarea│Narrows│Percol │ Qinc │NarrwsQ│Percol│Reles│QFlorAv│Credit│In BNA│Accnt │"
      PRINT "├───────┼───────┼───────┼──────┼───────┼──────┼─────┼───────┼──────┼──────┼──────┤"
      IF RunOut$ = "EXT" THEN
        LPRINT "┌───────┬───────┬───────┬──────┬───────┬──────┬─────┬───────┬──────┬──────┬──────┐"
        LPRINT "│BelwNar│Runoff@│Calc'd │Calc'd│Cnstrcv│Cnstrc│BlwNr│ Calc'd│BlwNar│Redctn│ BNA  │"
        LPRINT "│Subarea│Narrows│Percol │ Qinc │NarrwsQ│Percol│Reles│QFlorAv│Credit│In BNA│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$(ResvDet%) + "│runoff│precp│evapo│-age│divrt│reles│infl│spills│yield│ USEL │area│storag│"
      PRINT "├─────┼────────┼───────┼────┼─────┼─────┼─────┼──────┼─────┼─────┼─────┼─────┼──────┤"
      IF RunOut$ = "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│ USEL │area│storag│"
        LPRINT "├─────┼────────┼───────┼────┼─────┼─────┼─────┼──────┼─────┼─────┼─────┼─────┼──────┤"
      END IF
    END SELECT
2970 FOR Resv% = 1 TO 3
      AnnRunoff!(Resv%) = 0
      YrLeak!(Resv%) = 0
      Vavg!(Resv%) = 0
      YrTunl!(Resv%) = 0
      YrDivs!(Resv%) = 0
      YrRels!(Resv%) = 0
      YrSysYld!(Resv%) = 0
```

```
    YrSpill(ResvX) = 0
    YrRainOnLake!(ResvX) = 0
    YrEvpo!(ResvX) = 0
    AnnShort!(ResvX) = 0
  NEXT ResvX
  YrPhanRol! = 0
  YrPhanEvp! = 0
  YrPhanDiv! = 0
  YrPhanRel! = 0
  YrPhanSpl! = 0
  YrPhanYld! = 0
  YrPhanShort! = 0
  PhanAvgVol! = 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
  YrQFlor! = 0
  CumlNarrowsQ! = 0
  CumlConstNrwsQ! = 0
  YrBelowNrwsCred! = 0
  YrBnRedu! = 0
  YrBelowNrwsAcct! = 0
  CsFac! = CsEff!
  JpSum! = 0
  Gpsum! = 0
  CpSum! = 0
  LpSum! = 0
  SpSum! = 0
  YnX = YrX - 1917
'------------------ THIS BEGINS MONTHLY LOOP -----------------
 FOR WtrYrMoX = 1 TO 12
   MoX = 12 * (YrX - 1918) + WtrYrMoX - DAdderX
   Leakg! = 0
   BelowNrwsRel! = 0
   CsFlagX = SeedX
   IF CsFac! < CsEff! - .01 THEN CsFlagX = 0
   IF WtrYrMoX = 1 THEN CsFlagX = 0
   IF WtrYrMoX > 7 THEN CsFlagX = 0
   IF WtrYrMoX = 8 THEN
     IF EndMoVol!(1) < JunStartShortageX THEN
       JunRedFac! = (EndMoVol!(1) - JunLowVolX + JunMinDelv! * (JunStartShortageX - EndMoVol!(1))) / (JunStartShortageX - JunLowVol
       IF JunRedFac! < 0 THEN JunRedFac! = 0
       IF JunRedFac! < PShortMinYr!(1) THEN PShortMinYr!(1) = JunRedFac!
     END IF
     IF EndMoVol!(2) < GibStartShortageX THEN
       GibRedFac! = (EndMoVol!(2) - GibLowVolX + GibMinDelv! * (GibStartShortageX - EndMoVol!(2))) / (GibStartShortageX - GibLowVol
       IF GibRedFac! < 0 THEN GibRedFac! = 0
       IF GibRedFac! < PShortMinYr!(2) THEN PShortMinYr!(2) = GibRedFac!
     END IF
     IF EndMoVol!(3) < CacStartShortage! THEN
       CacRedFac! = (EndMoVol!(3) - CacLowVolX + CacMinDelv! * (CacStartShortage! - EndMoVol!(3))) / (CacStartShortage! - CacLowVolX
       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) > JunStartShortageX 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%) / JunRedFac!)
      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$(2)
    CASE "LakeSfYld"
Dg:   GDiv! = GibDiv!(WtrYrMo%)
      GOTO Ca
    CASE "LakeDraft"
      GDiv! = GibRedFac! * GibDiv!(WtrYrMo%)
      GOTO Ca
    CASE "L+T SfYld"
      GDiv! = GibDiv!(WtrYrMo%) - Tunnel%(2, Mo%)
      GOTO Ca
    CASE "L+T Draft"
      GDiv! = GibRedFac! * (GibDiv(WtrYrMo%) - Tunnel%(2, Mo%) / GibRedFac!)
      GOTO Ca
    CASE ELSE
      GOTO Dg
    END SELECT
Ca: IF CacRedFac! < 1 THEN
      IF EndMoVol!(3) > CacStartShortage! THEN CacRedFac! = 1
    END IF
    SELECT CASE Mode$(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%) / CacRedFac!)
      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)) - (MaxVol!(2) - EndMoVol!(2))
      IF V7! > MaxVol!(3) THEN
Zap:    CsFlag% = 0
        GOTO Jbps
      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!
```

```
Nrj:  JpSum! = JpSum! + (Rain%(1, Mo%) + RainInc!) / 100
    END IF
Jbps: Accr! = 100! * Accret%(Resv%, Mo%) + RunoffInc!
    Rainer! = Rain%(1, Mo%) + RainInc!
    AnnRunoff!(Resv%) = AnnRunoff!(Resv%) + Accr!
    Inflow! = Accr!
    Tunnl% = Tunnel%(Resv%, Mo%)
    LakeDiv! = JDiv!
Junset: GOSUB Reservoir
    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
    JunSource!(Mo%) = JunFactor! * (LakeDiv! + Tunnl%)
    IF JunFactor! > 1 THEN JunSource!(Mo%) = JunFactor!
    UpStrmSpill! = Spill!
' - - - - - - - - - - - Gibraltar Lake Section - - - - - - - -
Gibraltar: Resv% = 2
    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!
    AnnRunoff!(Resv%) = AnnRunoff!(Resv%) + Inflow!
    Tunnl% = Tunnel%(Resv%, Mo%)
' - - - - - - - - - - - Phantom ops start here - - - - - - - -
    Qfld! = 0
    A! = 0
    Prc! = Rainer! / 100
    Evp! = .8 * Evap%(Resv%, Mo%) * PhanArea! / 1200
    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
  Ofld! = Inflow! * .988
  IF Ofld! < 50000 THEN
    Ofld! = Ofld! * (.26 + .74 * Ofld! / 50000)
    IF Ofld! < 1587 THEN Ofld! = 1587
  END IF
Nf: Gpsum! = Gpsum! + Prc!
  Oord! = Inflow! - Ofld!
  Del! = 8567 - LastVol!
  IF Del! > Inflow! THEN Del! = Inflow!
  OrdRatio! = 1
  FldRatio! = 0
  IF Ofld! > 0 THEN
    FldRatio! = (Ofld! / Inflow!) ^ 2.46
    IF FldRatio! > .997 THEN FldRatio! = .997
    OrdRatio! = 1 - FldRatio!
  END IF
  Orddiv! = GibOrdDiv!(WtrYrMo%)
  Flddiv! = GibFldDiv!(WtrYrMo%)
  IF Lastflddiv! = 0 THEN Flddiv! = Flddiv! / 2
  IF Oord! > 0 THEN
    Amt! = Oord!
    IF Amt! > OrdRatio! * Del! THEN Amt! = OrdRatio! * Del!
    IF Orddiv! > Amt! + Ordvol! THEN Orddiv! = Amt! + Ordvol!
    GOTO 546
  END IF
  IF Orddiv! > Ordvol! THEN Orddiv! = Ordvol!
546 IF Ofld! > 0 THEN
    Amt! = Ofld!
    IF Amt! > FldRatio! * Del! THEN Amt! = FldRatio! * Del!
    IF Flddiv! > Amt! + Fldvol! THEN Flddiv! = Amt! + Fldvol!
    GOTO 553
  END IF
  IF Flddiv! > Fldvol! THEN Flddiv! = Fldvol!
553 PhanDiv! = Flddiv! + Orddiv!
  Phanrel! = 0
  Prc! = Prc! * PhanArea! / 12
  VolEst! = PhanVol! + Inflow! + Prc! - Evp! - PhanDiv!
  IF GinChouRelFlag%(WtrYrMo%) = 1 THEN
    IF PhanVol! > 8500 THEN
      IF VolEst! > 8500 THEN GOTO NPRel
    END IF
    Phanrel! = Inflow!
    CumPhanRel! = CumPhanRel! + Phanrel!
    IF CumPhanRel! > 616 THEN
      Phanrel! = Phanrel! - (CumPhanRel! - 616)
      CumPhanRel! = 616
    END IF
    VolEst! = VolEst! - Phanrel!
  END IF
NPRel: IF WtrYrMo% = 2 THEN CumPhanRel! = 0
  PhanSpl! = 0
  PhanVol! = VolEst!
  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%
    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
    Eord! = PhanEvp! * Ordvol! / PhanVol!
    Efld! = PhanEvp! * Fldvol! / PhanVol!
    IF PhanVol! = 8567 THEN
      IF Qfld! = 0 THEN
        Ordvol! = Ordvol! + Del! + Flddiv! + Efld!
        Fldvol! = Fldvol! - Flddiv! - Efld!
        IF Fldvol! <= 0 THEN
          Ordvol! = PhanVol!
          Fldvol! = 0
          GOTO Phanset
        END IF
Balance: IF Ordvol! + Fldvol! <> PhanVol! THEN
          Diff! = Ordvol! + Fldvol! - PhanVol!
          Ordvol! = Ordvol! - (Ordvol! / PhanVol!) * Diff!
          Fldvol! = Fldvol! - (1 - Ordvol! / PhanVol!) * Diff!
          GOTO Phanset
        END IF
        GOTO Phanset
      END IF
      Fldvol! = Fldvol! + FldRatio! * Del! + .077 * Orddiv!
      Ordvol! = PhanVol! - Fldvol!
      GOTO Phanset
    END IF
    Rord! = OrdRatio! * PhanRol!
    Rfld! = FldRatio! * PhanRol!
    Ordvol! = Ordvol! + Qord! + Rord! - Eord! - Orddiv! - Phanrel!
    Fldvol! = Fldvol! + Qfld! + Rfld! - Efld! - Flddiv!
    IF Fldvol! <= 0 THEN
      Ordvol! = PhanVol!
      Fldvol! = 0
      GOTO Phanset
    END IF
    IF Ordvol! <= 0 THEN
      Fldvol! = PhanVol!
      Ordvol! = 0
      GOTO Phanset
    END IF
    GOTO Balance
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!
    IF PhanMinVol! > PhanVol! THEN
      PhanMinVol! = PhanVol!
      PhanMinMo% = WtrYrMo%
      PhanMinYr% = Yr%
      IF WtrYrMo% < 4 THEN PhanMinYr% = PhanMinYr% - 1
    END IF
    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 VolEst! < 0 THEN LakeDiv! = LakeDiv! + VolEst!
    IF GinChowRelFlag%(WtrYrMo%) = 1 THEN
      IF EndMoVol!(Resv%) > 8554 THEN
        IF VolEst! > 8554 THEN GOTO Nr
      END IF
      RegulRelease! = Inflow!
      AccumRelease! = AccumRelease! + RegulRelease!
      IF AccumRelease! > 616 THEN
        RegulRelease! = RegulRelease! - (AccumRelease! - 616)
        AccumRelease! = 616
      END IF
    END IF
Nr: IF WtrYrMo% = 2 THEN AccumRelease! = 0
Gibset: GOSUB Reservoir
    VolGrph!(Resv%, Mo% + DAdder%) = Volume7!
    SELECT CASE Mode$(2)
    CASE "LakeSfYld"
G1:   GibShort! = GibDiv!(WtrYrMo%) - LakeDiv!
      GOTO Fg
    CASE "LakeDraft"
      GOTO G1
    CASE "L+T SfYld"
G2:   GibShort! = GibDiv!(WtrYrMo%) - (LakeDiv! + Tunnl%)
      GOTO Fg
    CASE "L+T Draft"
      GOTO G2
    CASE ELSE
      GOTO G1
    END SELECT
Fg: IF GibShort! > .001 THEN ShortMon%(2) = ShortMon%(2) + 1
    AnnShort!(Resv%) = AnnShort!(Resv%) + GibShort!
    TabValue!(3, Mo% + DAdder%) = GibShort!
    IF Yr% >= BeginDetPrint% THEN
      IF Yr% < BeginDetPrint% + NumDetYrs% THEN
        IF RunType$ = "Gibraltar" THEN GOSUB DetailPrint
      END IF
    END IF
    GibSource!(Mo%) = GibFactor! * (LakeDiv! + Tunnl%)
    Correction! = PhanSpl! - Spill!
    IF MitigationFlag% = 1 THEN
      IF Correction! < 0 THEN Correction! = 0
    END IF
    UpStrmSpill! = Spill!
' - - - - - - - - - - - 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, Yr%) * X! + CacPar!(2, Yr%)
      IF Slope! <= 0 THEN GOTO Nrc
      RunoffInc! = 107.2 * RainInc! * Slope!
Nrc:  CpSum! = CpSum! + (Rain%(2, Mo%) + Rain%(3, Mo%)) / 200 + RainInc! / 100
      RainInc! = CsFac! * CsInc%(3, Mo%)
    END IF
    Et! = Area!(Resv%) * CachET%(Mo%) / 1200
    Accr! = 100! * Accret%(Resv%, Mo%) + Et! + RunoffInc!
    Inflow! = UpStrmSpill! + Accr!
    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 TotDewatStor! > StartRelease% THEN RegulRelease! = (TotDewatStor! - OperDewatStor%)
        IF RegulRelease! > AboveNarrwAcct! THEN RegulRelease! = AboveNarrwAcct!
        IF RegulRelease! > 4000 THEN RegulRelease! = 4000
        IF BelowNarrwAcct! > StartRelBlw% THEN BelowNrwsRel! = BelowNarrwAcct!
        IF BelowNrwsRel! > 500 THEN BelowNrwsRel! = 500
        IF OFlor! > 120 THEN BelowNrwsRel! = 0
        IF RegulRelease! > 1000 THEN Pfac! = 1.4
      END IF
    END IF
Nrel: AnnRunoff!(ResV%) = AnnRunoff!(ResV%) + Inflow!
    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
    VolGrph!(ResV%, Mo% + DAdder%) = Volume7!
    SELECT CASE Mode$(3)
    CASE "LakeSfYld"
C1:   CacShort! = CacDemand!(WtrYrMo%) - LakeDiv!
      GOTO Fc
    CASE "LakeDraft"
      GOTO C1
    CASE "L+T SfYld"
C2:   CacShort! = CacDemand!(WtrYrMo%) - (LakeDiv! + Tunnl%)
      GOTO Fc
    CASE "L+T Draft"
      GOTO C2
    CASE ELSE
      GOTO C1
    END SELECT
Fc: IF CacShort! > .001 THEN ShortMon%(3) = ShortMon%(3) + 1
    AnnShort!(ResV%) = AnnShort!(ResV%) + CacShort!
    TabValue!(4, Mo% + DAdder%) = CacShort!
    TabValue!(5, Mo% + DAdder%) = JunShort! + GibShort! + CacShort!
    TabValue!(6, Mo% + DAdder%) = Inflow!
    Inject!(Mo%) = 0
    IF Spill! > SpillInjectThresh% THEN
      Inject!(Mo%) = InjectRate! * MoDays%(WtrYrMo%)
      IF LastMonthsSpill! = 0 THEN Inject!(Mo%) = Inject!(Mo%) / 2
    END IF
    Spill! = Spill! - Inject!(Mo%)
    CacSource!(Mo%) = CacFactor! * (LakeDiv! + Tunnl%)
    WstSource!(Mo%) = WasteWater% / 12!
    SwpSource!(Mo%) = SwpDel% * Swp!(Yr%) / 12!
    DslSource!(Mo%) = 0
    IF EndMoVol!(3) < 120000 THEN
      IF EndMoVol!(2) < 3000 THEN
        Delta! = SeasonalDistrib!(WtrYrMo%) * MaxProdLevel% - (JunSource!(Mo%) + GibSource!(Mo%) + CacSource!(Mo%) + SwpSource!(Mo%)
        IF Delta! > MaxPump% / 12! THEN DslSource!(Mo%) = Delta! - MaxPump% / 12!
        IF DslSource!(Mo%) > DesalMaxAfd! * MoDays%(WtrYrMo%) THEN DslSource!(Mo%) = DesalMaxAfd! * MoDays%(WtrYrMo%)
      END IF
    END IF
    GwbSource!(Mo%) = SeasonalDistrib!(WtrYrMo%) * MaxProdLevel% - (JunSource!(Mo%) + GibSource!(Mo%) + CacSource!(Mo%) + SwpSource!(
    IF Yr% >= BeginDetPrint% THEN
      IF Yr% < BeginDetPrint% + NumDetYrs% THEN
        IF RunType$ = "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!
  '- - - - - - - - - - - Start Riparian Section - - - - - - - -
    IF Spill! > 0 THEN LivStrmFlgO% = 1
    IF Accret%(4, Mo%) >= 10 THEN LivStrmFlgO% = 1
    IF (RegulRelease! + Leakg!) > 120 THEN LivStrmFlgO% = 1
    LroInc! = 0
```

```
    LrnIncl = 0
    SroIncl = 0
    SrnIncl = 0
    IF CsFlag% = 1 THEN
     Lx! = LpSum! + .003 * Rain%(3, Mo%)
     Sx! = SpSum! + .00367 * Rain%(3, Mo%)
     LrnIncl = CsFac! * .9 * CsInc%(3, Mo%)
     SrnIncl = 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
     LroIncl = 198.4 * LrnIncl * 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
     SroIncl = 25.12 * SrnIncl * Sslope!
Nrl:  LpSum! = LpSum! + (.9 * Rain%(3, Mo%) + LrnIncl) / 100
      SpSum! = SpSum! + (1.1 * Rain%(3, Mo%) + SrnIncl) / 100
    END IF
    Accr! = 100! * Accret%(4, Mo%) + LroIncl - UplandDepl%
    Salsipuedes! = 100! * Salsi%(Mo%) + SroIncl
    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
    UnimpRunoff! = Spill! + RegulRelease! + Leakg! + 100! * Accret%(4, Mo%) + LroIncl
    YrUnimpRunoff! = YrUnimpRunoff! + UnimpRunoff!
    YrRunoffDepl! = YrRunoffDepl! + UplandDepl% - BankDepl!
    YrBankDepl! = YrBankDepl! + BankDepl!
    TunFac! = Tunnl% / 2500   '=.1*Tunnl%/250, where .1 is bank multiplier
    AgUseMo! = AgUseFactor!(WtrYrMo%) * Evap%(3, Mo%)
'- - - - - - - - - - - - - - - - - - - - - - - - -
SantaYnez:
    TempDewatStor! = RipFullSyn% - EndRipStorSYn!
    PercRate! = SYnPerc! * TempDewatStor! / SYnStr!
    IF PercRate! > SYnPerc! THEN PercRate! = SYnPerc!
    PercRate! = PercRate! * Pfac!
    Qin! = .316 * Accr! + Spill! + RegulRelease! + 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! > 4900 THEN
     Bank! = .9 * SyLast!
     GOTO SySet
    END IF
    Bank! = TunFac! * (TempDewatStor! - 2928)
    IF Bank! > 0 THEN Bank! = SyRed! * Bank!
SySet:
    SyLast! = Bank!
    Bank7! = Bank!
    EndRipStorSYn! = EndRipStorSYn! + Seep! + Bank! - 75 - SyDiv!(WtrYrMo%) - .18 * AgUseMo! - .78 * BankDepl!
    IF EndRipStorSYn! <= RipFullSyn% THEN GOTO Buellton
    Delta! = EndRipStorSYn! - RipFullSyn%
    Seep! = Seep! - Delta!
    QAlisal! = QAlisal! + Delta!
    EndRipStorSYn! = RipFullSyn%
'- - - - - - - - - - - - - - - - - - - - - - - - -
Buellton:
    Sp7! = Seep!
    SYRSeep!(1) = SYRSeep!(1) + Seep!
    IF QAlisal! > 120 THEN LivStrmFlg1% = 2
    TempDewatStor! = RipFullBuel% - EndRipStorBuel!
    PercRate! = BuePerc! * TempDewatStor! / BueStr!
```

```
    IF PercRate! > BuePerc! THEN PercRate! = BuePerc!
    PercRate! = PercRate! * Pfac!
    Qin! = .459 * 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! > 6200 THEN
     Bank! = .9 * BuLast!
     GOTO BuSet
    END IF
    Bank! = TunFac! * (TempDewatStor! - 5480)
    IF Bank! > 0 THEN Bank! = BuRed! * Bank!
BuSet:
    BuLast! = Bank!
    Bank7! = Bank7! + Bank!
    EndRipStorBuel! = EndRipStorBuel! + Seep! + Bank! - BuDiv!(WtrYrMo%) - .34 * AgUseMo! - .1 * BankDep!!
     IF EndRipStorBuel! <= RipFullBuel% THEN GOTO EastSantaRita
    Delta! = EndRipStorBuel! - RipFullBuel%
    Seep! = Seep! - Delta!
    QBend! = QBend! + Delta!
    EndRipStorBuel! = RipFullBuel%
' - - - - - - - - - - - - - - - - - - - - - - - - -
EastSantaRita:
    Sp7! = Sp7! + Seep!
    SYRSeep!(2) = SYRSeep!(2) + Seep!
    IF QBend! > 120 THEN LivStrmFlg2% = 4
    TempDewatStor! = RipFullSRitaE& - EndRipStorSRitaE!
    PercRate! = SRitaEPerc! * TempDewatStor! / SRitaEStr!
    IF PercRate! > SRitaEPerc! THEN PercRate! = SRitaEPerc!
    PercRate! = PercRate! * Pfac!
    Qin! = .169 * 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! > 6900 THEN
     Bank! = .9 * SeLast!
     GOTO SRitaESet
    END IF
    Bank! = TunFac! * (TempDewatStor! - 32)
    IF Bank! > 0 THEN Bank! = SeRed! * Bank!
SRitaESet:
    SeLast! = Bank!
    Bank7! = Bank7! + Bank!
    EndRipStorSRitaE! = EndRipStorSRitaE! + Seep! + Bank! - 15 - .45 * AgUseMo! - .02 * BankDep!!
    IF EndRipStorSRitaE! <= RipFullSRitaE& THEN GOTO WestSantaRita
    Delta! = EndRipStorSRitaE! - RipFullSRitaE&
    Seep! = Seep! - Delta!
    QabvSalsi! = QabvSalsi! + Delta!
    EndRipStorSRitaE! = RipFullSRitaE&
' - - - - - - - - - - - - - - - - - - - - - - - - -
WestSantaRita:
    Sp7! = Sp7! + Seep!
    SYRSeep!(3) = SYRSeep!(3) + Seep!
    IF QabvSalsi! > 120 THEN LivStrmFlg3% = 8
    TempDewatStor! = RipFullSRitaW% - EndRipStorSRitaW!
    PercRate! = SRitaWPerc! * TempDewatStor! / SRitaWStr!
    IF PercRate! > SRitaWPerc! THEN PercRate! = SRitaWPerc!
    PercRate! = PercRate! * Pfac!
    Qin! = .056 * 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! > 1300 THEN
```

```
    Bank! = .9 * SwLast!
    GOTO SRitaWSet
   END IF
   Bank! = TunFac! * (TempDewatStor! - 344)
   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:
    TabValue!(7, Mo% + DAdder%) = QNarrows!
    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& - EndRipStorSRitaE! + RipFullSRit
    Live! = LivStrmFlg0% + LivStrmFlg1% + LivStrmFlg2% + LivStrmFlg3%
    Qin! = QNarrows!
    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! - [redacted] - 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!
```

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      BelowNarrwAcct! = BelowNarrwAcct! - BelowNrwsRel! + 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!
    IF BelowNarrwAcct! < 0 THEN BelowNarrwAcct! = 0
    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!
    YrQFlor! = YrQFlor! + 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 - YrPhanDiv! > 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! / 12
    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%) + YrSpill!(Resv%)
```

```
    SumYld!(ResvX) = SumYld!(ResvX) + YrSysYld!(ResvX)
    SumVol!(ResvX) = SumVol!(ResvX) + Vavg!(ResvX) / 12
NEXT ResvX
    Ranker!(1, YnX) = AnnShort!(1)
    Ranker!(2, YnX) = YrPhanShort!
    Ranker!(3, YnX) = AnnShort!(2)
    Ranker!(4, YnX) = AnnShort!(3)
    Ranker!(5, YnX) = AnnShort!(1) + AnnShort!(2) + AnnShort!(3)
    Ranker!(6, YnX) = AnnRunoff!(1)
    Ranker!(7, YnX) = AnnRunoff!(2)
    Ranker!(8, YnX) = AnnRunoff!(3)
    Ranker!(9, YnX) = YrNarrowsQ!
' - - - - - - - - - - - - - - - - - - - - - - - - - - - -
RiparianPrint:
    YrAbvNrwsAcct! = YrAbvNrwsAcct! / 12
    YrTotDewatStor! = YrTotDewatStor! / 12
    Vavg!(4) = Vavg!(4) / 12
    YrBelowNrwsAcct! = YrBelowNrwsAcct! / 12
    IF YrX < BeginDetPrintX THEN GOTO Py
    IF YrX >= BeginDetPrintX + NumDetYrsX THEN GOTO Py
    SELECT CASE ResvDetX
    CASE 7
      GOTO Py
    CASE 1
      ResvX = 1
Rg:   Volume7! = Vavg!(ResvX) / 12
      GOSUB AreaElevSet
      COLOR 6
      PRINT "├────┼─────┼────┼────┼───┼────┼──────┼──────┼────┼─────┼───┼──────┤"
      COLOR 8
      PRINT USING Image$(2); ShortName$(ResvDetX); AnnRunoff!(ResvX); YrRainOnLake!(ResvX); YrEvpo!(ResvX); YrLeak!(ResvX); YrDivs!(R
      COLOR 6
      PRINT "└────┴─────┴────┴────┴───┴────┴──────┴──────┴────┴─────┴───┴──────┘"
      IF RunOut$ = "EXT" THEN
        LPRINT "├────┼─────┼────┼────┼───┼────┼──────┼──────┼────┼─────┼───┼──────┤"
        LPRINT USING Image$(2); ShortName$(ResvDetX); AnnRunoff!(ResvX); YrRainOnLake!(ResvX); YrEvpo!(ResvX); YrLeak!(ResvX); YrDivs
        LPRINT "└────┴─────┴────┴────┴───┴────┴──────┴──────┴────┴─────┴───┴──────┘"
      END IF
      GOTO Py
    CASE 2
      ResvX = 2
      PhanVol! = PhanAvgVol! / 12
      GOSUB PhanAESet
      COLOR 6
      PRINT "├────┼─────┼────┼────┼───┼────┼──────┼──────┼────┼─────┼───┼──────┤"
      COLOR 8
      PRINT USING Image$(2); ShortName$(ResvDetX); AnnRunoff!(ResvX); YrPhanRo!; YrPhanEvp!; YrLeak!(ResvX); YrPhanDiv!; YrPhanRel!;
      COLOR 6
      PRINT "└────┴─────┴────┴────┴───┴────┴──────┴──────┴────┴─────┴───┴──────┘"
      IF RunOut$ = "EXT" THEN
        LPRINT "├────┼─────┼────┼────┼───┼────┼──────┼──────┼────┼─────┼───┼──────┤"
        LPRINT USING Image$(2); ShortName$(ResvDetX); AnnRunoff!(ResvX); YrPhanRo!; YrPhanEvp!; YrLeak!(ResvX); YrPhanDiv!; YrPhanRe
        LPRINT "└────┴─────┴────┴────┴───┴────┴──────┴──────┴────┴─────┴───┴──────┘"
      END IF
      GOTO Py
    CASE 3
      ResvX = 2
      GOTO Rg
    CASE 4
      ResvX = 3
      GOTO Rg
    CASE 5
      COLOR 4
      PRINT "├────┼─────┼────┼────┼───┼────┼──────┼──────┼────┼─────┼───┼──────┤"
      COLOR 8
      PRINT USING Image$(11); "C_Lom|"; YrUnimpRunoff!; YrRunoffDepl!; YrBankDepl!; YrMICU!; YrAgCU!; YrRivPerc!; YrBank!; YrUnderFlo
      COLOR 4
      PRINT "└────┴─────┴────┴────┴───┴────┴──────┴──────┴────┴─────┴───┴──────┘"
      IF RunOut$ = "EXT" THEN
        LPRINT "├────┼─────┼────┼────┼───┼────┼──────┼──────┼────┼─────┼───┼──────┤"
        LPRINT USING Image$(11); "C_Lom|"; YrUnimpRunoff!; YrRunoffDepl!; YrBankDepl!; YrMICU!; YrAgCU!; YrRivPerc!; YrBank!; YrUnder
        LPRINT "└────┴─────┴────┴────┴───┴────┴──────┴──────┴────┴─────┴───┴──────┘"
      END IF
      GOTO Py
    CASE 6
```

```
    COLOR 5
    PRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
    COLOR 8
    COLOR 4: PRINT USING Image$(9); "BelwNar"; YrNarrowsQ!; YrCalcPerc!; YrCalcQincr!; YrConstNrwsQ!; YrConstPerc!; YrBelowNrwsRel!
    COLOR 5
    PRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    IF RunOut$ = "EXT" THEN
      LPRINT "├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
      LPRINT USING Image$(9); "BelowNar│"; YrNarrowsQ!; YrCalcPerc!; YrCalcQincr!; YrConstNrwsQ!; YrConstPerc!; YrBelowNrwsRel!; Yr
      LPRINT "└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
    END IF
   END SELECT
Py: SumUnimpRunoff! = SumUnimpRunoff! + YrUnimpRunoff!   'Period Accumulators [62 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!
   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%) / 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! / 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%
  SumQFlor! = SumQFlor! / NumYears%
  SumBelowNarwCred! = SumBelowNarwCred! / NumYears%
```

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  SumBnRedu! = SumBnRedu! / NumYears%
  SumBelowNarwAcct! = SumBelowNarwAcct! / NumYears%
' - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
PrintFinal: SOUND 345, 7
  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: 1918-1979 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!
      GOSUB PhanAESet
      PRINT USING Image$(13); "BaseG"; SumPhanRnf!; SumPhanROL!; SumPhanEvp!; 0; SumPhanDiv!; SumPhanRel!; SumTunl!(2); SumPhanSpl!;
    END IF
    Volume7! = SumVol!(Resv%)
    GOSUB AreaElevSet
    PRINT USING Image$(13); ShortName$(Resv% + Del%); SumRunoff!(Resv%); SumPrecip!(Resv%); SumEvap!(Resv%); SumLeak!(Resv%); SumDiv!
  NEXT Resv%
  COLOR 4
  PRINT "├────────┬──────┬────┬────┬─────┬─────┬─────┬─────┬────┬──────┬────┬────┬─────┤"
  PRINT "│CACH-LOM│Runoff│RDep│BDep│M&ICU│Ag CU│Percl│Bnk&P│UFlw│QNarrw│ ANA│ Tds│Volum│"
  PRINT "├────────┼──────┼────┼────┼─────┼─────┼─────┼─────┼────┼──────┼────┼────┼─────┤"
  COLOR 8
  PRINT USING Image$(6); "Riparian"; SumUnimpRunoff!; SumRunoffDepl!; SumBankDepl!; SumMICU!; SumAgCU!; SumRivPerc!; SumBank!; SumUnd
  PRINT "├────────┴──────┴────┴────┴─────┴─────┴─────┴─────┴────┴──────┴────┴────┴─────┤"
  PRINT USING Image0$; SYS1!; SYS2!; SYS3!; SYS4!
  COLOR 5
  PRINT "├────────┬───────┬──────┬──────┬───────┬──────┬─────┬───────┬─────┬──────┬────┤"
  PRINT "│BELOWNAR│QNarrws│ActPrc│Qincrm│ConstrQ│ConstP│BNRel│QFlorAv│BNCred│BNRedu│ BNA│"
  COLOR 8
  PRINT USING Image$(14); "Averages|"; SumNarrowsQ!; SumCalcPerc!; SumCalcQIncr!; SumConstNarwQ!; SumConstPerc!; SumBelowNarwRel!; Su
  COLOR 6
  PRINT "├────────┬────────────┬────────────┬────────────┬────────────┬────────────┤"
  PRINT "│ PERIOD │ Jameson Lake│BaseGibraltar│GibraltarLake│ Lake Cachuma│Riparian Volm│"
  COLOR 8
  PRINT USING Image$(21); "│End Vols│"; EndMoVol!(1); LastVol!; EndMoVol!(2); EndMoVol!(3); EndMoVol!(4)
  PRINT USING Image$(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%(2); MinMo$(3); MinYr%(3); MinMo$
  PRINT USING Image$(16); "│ShortMos│"; ShortMon%(1) / 7.44; PhanShortCtr% / 7.44; ShortMon%(2) / 7.44; ShortMon%(3) / 7.44
  PRINT USING Image$(22); "│MxyrShrt│"; Sworst!(1); PhanWorst!; Sworst!(2); Sworst!(3)
  PRINT USING Image$(27); "│Wors%Sht│"; 100 * (1 - PShortMinYr!(1)); 100 * (1 - PhanMinPcnt!); 100 * (1 - PShortMinYr!(2)); 100 * (1
  PRINT "└────────┴────────────┴────────────┴────────────┴────────────┴────────────┘";
  IF RunOut$ = "EXT" THEN
    LPRINT
    LPRINT " SUMMARY: 1918-1979 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!
        GOSUB PhanAESet
        LPRINT USING Image$(13); "BaseG"; SumPhanRnf!; SumPhanROL!; SumPhanEvp!; 0; SumPhanDiv!; SumPhanRel!; SumTunl!(2); SumPhanSpl
      END IF
      Volume7! = SumVol!(Resv%)
      GOSUB AreaElevSet
      LPRINT USING Image$(13); ShortName$(Resv% + Del%); SumRunoff!(Resv%); SumPrecip!(Resv%); SumEvap!(Resv%); SumLeak!(Resv%); SumD
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    NEXT Resv%
    LPRINT "┌─────────┬───────┬────┬────┬─────┬─────┬─────┬─────┬────┬──────┬────┬────┬─────┐"
    LPRINT "│GWB-Avgs │Unimpr │Runf│Bank│Ripar│Agric│River│Bank&│Undr│Narrow│ PERIOD AVERAGE │"
    LPRINT "│CachLomp │runoff │depl│depl│divrs│ C.U.│perc.│Phrea│flow│outflw│ ANA│ Tds│Volum│"
    LPRINT "├─────────┼───────┼────┼────┼─────┼─────┼─────┼─────┼────┼──────┼────┼────┼─────┤"
    LPRINT USING Image$(6); "Riparian"; SumUnimpRunoff!; SumRunoffDepl!; SumBankDepl!; SumMICU!; SumAgCU!; SumRivPerc!; SumBank!; Sum
    LPRINT "├─────────┼───────┼────┼────┼─────┼─────┼─────┼─────┼────┼──────┼────┼────┼─────┤"
    LPRINT USING Image0$; SYS1!; SYS2!; SYS3!; SYS4!
    LPRINT "├─────────┬───────┬──────┬──────┬───────┬──────┬─────┬───────┬──────┬──────┬────┤"
    LPRINT "│BelowNar │Runoff@│Calc'd│Calc'd│Cnstrcv│Cnstrc│BlwNr│ Calc'd│BlwNar│Redctn│ BNA│"
    LPRINT "│rowsPeri │Narrows│Percol│ Qinc │NarrwsQ│Percol│Reles│QflorAv│Credit│In BNA│Acct│"
    LPRINT USING Image$(14); "odAvergs│"; SumNarrowsQ!; SumCalcPerc!; SumCalcQIncr!; SumConstNarwQ!; SumConstPerc!; SumBelowNarwRel!
    LPRINT "├─────────┬──────────────┬────────────┬─────────────┬─────────────┬─────────────┤"
    LPRINT "│PeriodEn │ Jameson Lake │BaseGibraltar│GibraltarLake│ Lake Cachuma│Riparian Volm│"
    LPRINT USING Image$(21); "│dingVols│"; EndMoVol!(1); LastVol!; EndMoVol!(2); EndMoVol!(3); EndMoVol!(4)
    LPRINT USING Image$(21); "│Min Vols│"; MinVol!(1); PhanMinVol!; MinVol!(2); MinVol!(3); MinVol!(4)
    LPRINT USING Image$(15); "│Min Date│"; MinMo$(1); MinYr%(1); PMinMo$; PhanMinYr%; MinMo$(2); MinYr%(2); MinMo$(3); MinYr%(3); Mi
    LPRINT USING Image$(16); "│ShortMos│"; ShortMon%(1) / 7.44; PhanShortCtr% / 7.44; ShortMon%(2) / 7.44; ShortMon%(3) / 7.44
    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!); 100 * (1 - PShortMinYr!(2)); 100 *
    LPRINT "└─────────┴──────────────┴────────────┴─────────────┴─────────────┴─────────────┘";
    LPRINT CHR$(12) 'form feed
  END IF
  DO
  A$ = INKEY$
  LOOP WHILE A$ = ""
  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! > 0 THEN Part! = (Vsave! + Inflow! + Prcl! - Evpr!) / (LakeDiv! + RegulRelease! + BelowNrwsRel!)
      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
    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
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 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!
 YrSpill!(Resv%) = YrSpill!(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!
 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%, Depth%))
 Area7! = (ResvCap!(Resv%, Depth% + 1) - ResvCap!(Resv%, Depth% - 1) + Diff! * (ResvCap!(Resv%, Depth% + 2) - ResvCap!(Resv%, Depth%
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!(PhanPointer% + 2) - PhanCap!(PhanPointer
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!(PhanPointer% + 2) - PhanCap!(PhanPointer
  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!; Tunnl%; PhanSpl!; PhanDiv! + Tunn
      IF RunOut$ = "EXT" THEN LPRINT USING Image$(10); M$; Y% - 1900; Rnff!; PhanRol!; PhanEvp!; Leakg!; PhanDiv!; Phanrel!; Tunnl%;
      RETURN
    END IF
    SysYld! = LakeDiv! + Tunnl%
    IF ResvDet% = 4 THEN
      COLOR 8
      PRINT USING Image$(10); M$; Y% - 1900; Rnff!; Prcl; Evpl; Leakg!; LakeDiv!; RegulRelease! + BelowNrwsRel!; Tunnl%; Spill!; SysY
      IF RunOut$ = "EXT" THEN LPRINT USING Image$(10); M$; Y% - 1900; Rnff!; Prcl; Evpl; Leakg!; LakeDiv!; RegulRelease! + BelowNrwsR
      RETURN
    END IF
    COLOR 8
    PRINT USING Image$(10); M$; Y% - 1900; Rnff!; Prcl; Evpl; Leakg!; LakeDiv!; RegulRelease!; Tunnl%; Spill!; SysYld!; Elev7!; Area7
    IF RunOut$ = "EXT" THEN LPRINT USING Image$(10); M$; Y% - 1900; Rnff!; Prcl; Evpl; Leakg!; LakeDiv!; RegulRelease!; Tunnl%; Spill
    RETURN
  CASE 5
    MiCU! = SyDiv!(WtrYrMo%) + BuDiv!(WtrYrMo%)
    COLOR 8
    PRINT USING Image$(20); M$; Y% - 1900; UnimpRunoff!; UplandDepl% - BankDepl!; BankDepl!; MiCU!; AgUseMo!; Sp7!; Bank7!; Underflow
    IF RunOut$ = "EXT" THEN LPRINT USING Image$(20); M$; Y% - 1900; UnimpRunoff!; UplandDepl% - BankDepl!; BankDepl!; MiCU!; AgUseMo!
    RETURN
  CASE 6
    COLOR 8
    PRINT USING Image$(7); M$; Y%; QNarrows!; Percl1!; Qincr!; ConstNrwsQ!; Percl2!; BelowNrwsRel!; QFlor!; BnCred!; BnRedu!; BelowNa
    IF RunOut$ = "EXT" THEN LPRINT USING Image$(7); M$; Y%; QNarrows!; Percl1!; Qincr!; ConstNrwsQ!; Percl2!; BelowNrwsRel!; QFlor!;
    RETURN
END SELECT
'- - - - - - - - - - - - - - - - - - - - - - - - -
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
ChkHigher: 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))
      RETURN
    END IF
    P1! = HighNarP%(I% - 1) + Ratio! * (HighNarP%(I%) - HighNarP%(I% - 1))
    P2! = LowNarP%(I% - 1) + Ratio! * (LowNarP%(I%) - LowNarP%(I% - 1))
    Prop! = (CumlQ! - SwitchThresh!) / (MaxPThresh! - SwitchThresh!)
    IF Prop! > 1 THEN Prop! = 1
    Percl! = P2! + (1 - Prop!) * (P1! - P2!)
 RETURN
 END SUB
```

1/24/93
SYRMØ193 SubProgram
"TableOut"

```
' 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!(62)
  SCREEN 0
  CLS
  SCREEN ScrnType%
  COLOR 15, 10
  VIEW (8, 4)-(632, 346), 15, 1
  Resv% = ShortDet%
  CumAnnVal! = 0
  FOR WtrYrMo% = 1 TO 12
     MonthCuml!(WtrYrMo%) = 0
  NEXT WtrYrMo%
  IF TabOut$ = "EXT" THEN SetPrinter
  LOCATE 1, 10
  COLOR 8
  SELECT CASE TabType$
  CASE "JuncShort"
    PRINT "  Jameson Lake Shortages:            Run of "; TIME$; "  "; DATE$; " "
    IF TabOut$ = "EXT" THEN LPRINT "  Jameson Lake Shortages:            Run of "; TIME$; "  "; DATE$;
    Ptr% = 1
 Gi: Format% = 1
    GOTO Ch
  CASE "BaseShort"
    PRINT "  Base Gibraltar Lake Shortages:  Run of "; TIME$; "  "; DATE$; " "
    IF TabOut$ = "EXT" THEN LPRINT "  Base Gibraltar Lake Shortages:  Run of "; TIME$; "  "; DATE$;
    Ptr% = 2
    GOTO Gi
  CASE "GibrShort"
    PRINT "  Actual Gibraltr Lake Shortages: Run of "; TIME$; "  "; DATE$; " "
    IF TabOut$ = "EXT" THEN LPRINT "  Actual Gibraltr Lake Shortages: Run of "; TIME$; "  "; DATE$;
    Ptr% = 3
    GOTO Gi
  CASE "CachShort"
    PRINT "  Lake Cachuma Shortages:            Run of "; TIME$; "  "; DATE$; " "
    IF TabOut$ = "EXT" THEN LPRINT "  Lake Cachuma Shortages:            Run of "; TIME$; "  "; DATE$;
    Ptr% = 4
    GOTO Gi
  CASE "CombinedS"
    PRINT "  Junc + Gibr + Cach Shortages:   Run of "; TIME$; "  "; DATE$; " "
    IF TabOut$ = "EXT" THEN LPRINT "  Junc + Gibr + Cach Shortages:   Run of "; TIME$; "  "; DATE$;
    Ptr% = 5
    GOTO Gi
  CASE "CacInflow"
    PRINT "  Lake Cachuma Inflow (acrefeet): Run of "; TIME$; "  "; DATE$; " "
    IF TabOut$ = "EXT" THEN LPRINT "  Lake Cachuma Inflow (acrefeet): Run of "; TIME$; "  "; DATE$;
    Ptr% = 6
 Gt: Format% = 2
    GOTO Ch
  CASE "@ Narrows"
    PRINT "  SantaYnez River @ Narrows (AF): Run of "; TIME$; "  "; DATE$; " "
    IF TabOut$ = "EXT" THEN LPRINT "  SantaYnez River @ Narrows (AF): Run of "; TIME$; "  "; DATE$;
    Ptr% = 7
    GOTO Gt
  CASE "GWBasnTab"
    GwbTable
    GOTO Fi
  CASE ELSE
    EXIT SUB
  END SELECT
Ch: IF TabOut$ = "EXT" THEN LPRINT "  October thru September water years 1918 - 1979  (average values on last line) "
  LOCATE 2, 1
  PRINT "  October thru September water years 1918 - 1979  (average values on last line) "
  Image1$ = "|##|#####|#####|#####|####|####|####|#####|#####|#####|#####|#####|#####|######|"
  Image2$ = "\  \#####|#####|#####|####|####|####|#####|######|#####|####|####|####|###|######|"
  Image3$ = "|##|###|#####|#####|######|######|######|######|#####|####|####|####|###|######|"
  Image4$ = "\  \###|#####|#####|######|######|######|######|#####|####|####|####|####|######|"
  Image5$ = "||####|#####|#####|######|######|######|######|#####|####|####|####|####|######|"
    IF Format% = 2 THEN
      PRINT "┌──┬───┬────┬────┬─────┬─────┬─────┬─────┬────┬───┬───┬───┬───┬──────┐"
      PRINT "│YR│OCT│NOV │DEC │ JAN │ FEB │ MAR │ APR │MAY │JUN│JUL│AUG│SEP│TOTALS│"
      PRINT "├──┼───┼────┼────┼─────┼─────┼─────┼─────┼────┼───┼───┼───┼───┼──────┤"
      IF TabOut$ = "EXT" THEN
        LPRINT "┌──┬───┬────┬────┬─────┬─────┬─────┬─────┬────┬───┬───┬───┬───┬──────┐"
```

```
      LPRINT "│YR│OCT│ NOV │ DEC │  JAN │  FEB │  MAR │  APR │ MAY │ JUN│ JUL│ AUG│SEP│TOTALS│"
      LPRINT "├──┼───┼─────┼─────┼──────┼──────┼──────┼──────┼─────┼────┼────┼────┼───┼──────┤"
    END IF
    GOTO Vw
  END IF
  PRINT "┌──┬─────┬─────┬─────┬────┬────┬────┬─────┬─────┬─────┬─────┬─────┬─────┬──────┐"
  PRINT "│YR│ OCT │ NOV │ DEC │ JAN│ FEB│ MAR│ APR │ MAY │ JUN │ JUL │ AUG │ SEP │TOTALS│"
  PRINT "├──┼─────┼─────┼─────┼────┼────┼────┼─────┼─────┼─────┼─────┼─────┼─────┼──────┤"
  IF TabOut$ = "EXT" THEN
    LPRINT "┌──┬─────┬─────┬─────┬────┬────┬────┬─────┬─────┬─────┬─────┬─────┬─────┬──────┐"
    LPRINT "│YR│ OCT │ NOV │ DEC │ JAN│ FEB│ MAR│ APR │ MAY │ JUN │ JUL │ AUG │ SEP │TOTALS│"
    LPRINT "├──┼─────┼─────┼─────┼────┼────┼────┼─────┼─────┼─────┼─────┼─────┼─────┼──────┤"
  END IF
Vw: VIEW PRINT 6 TO 25
 FOR Yr% = 1 TO NumYears%
  AnnualVal!(Yr%) = 0
  Y% = Yr% + 17
  FOR WtrYrMo% = 1 TO 12
    Mo% = 12 * (Yr% - 1) + WtrYrMo%
    MonthVal!(WtrYrMo%) = TabValue!(Ptr%, Mo%)
    MonthCum!(WtrYrMo%) = MonthCum!(WtrYrMo%) + MonthVal!(WtrYrMo%)
    AnnualVal!(Yr%) = AnnualVal!(Yr%) + MonthVal!(WtrYrMo%)
  NEXT WtrYrMo%
  IF Format% = 2 THEN
    IF MonthVal!(1) >= 1000 THEN GOTO Cram
    IF MonthVal!(12) >= 1000 THEN
Cram:   PRINT USING Image5$; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal!(5); MonthVal!(6); MonthVal!(7); MonthV
      IF TabOut$ = "EXT" THEN LPRINT USING Image5$; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal!(5); MonthVal!
      GOTO Ed
    END IF
    PRINT USING Image3$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal!(5); MonthVal!(6); MonthVal!(7); Mont
    IF TabOut$ = "EXT" THEN LPRINT USING Image3$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal!(5); MonthVa
    GOTO Ed
  END IF
  PRINT USING Image1$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal!(5); MonthVal!(6); MonthVal!(7); MonthV
  IF TabOut$ = "EXT" THEN LPRINT USING Image1$; Y%; MonthVal!(1); MonthVal!(2); MonthVal!(3); MonthVal!(4); MonthVal!(5); MonthVal!
Ed: CumAnnVal! = CumAnnVal! + AnnualVal!(Yr%)
 NEXT Yr%
 AvgAnnVal! = CumAnnVal! / NumYears%
 FOR WtrYrMo% = 1 TO 12
  AvgMoVal!(WtrYrMo%) = MonthCum!(WtrYrMo%) / NumYears%
 NEXT WtrYrMo%
 IF Format% = 2 THEN
  PRINT "├──┼──┼───┼───┼───┼───┼───┼───┼───┼───┼───┼───┼───┼───┤"
  PRINT USING Image4$; "│Av│"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3); AvgMoVal!(4); AvgMoVal!(5); AvgMoVal!(6); AvgMoVal!(7); Av
  PRINT "└──┴──┴───┴───┴───┴───┴───┴───┴───┴───┴───┴───┴───┴───┘"
  IF TabOut$ = "EXT" THEN
   LPRINT "├──┼──┼───┼───┼───┼───┼───┼───┼───┼───┼───┼───┼───┼───┤"
   LPRINT USING Image4$; "│Av│"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3); AvgMoVal!(4); AvgMoVal!(5); AvgMoVal!(6); AvgMoVal!(7);
   LPRINT "└──┴──┴───┴───┴───┴───┴───┴───┴───┴───┴───┴───┴───┴───┘"
  END IF
  GOTO Fi
 END IF
 PRINT "├──┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
 PRINT USING Image2$; "│Av│"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3); AvgMoVal!(4); AvgMoVal!(5); AvgMoVal!(6); AvgMoVal!(7); AvgM
 PRINT "└──┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
 IF TabOut$ = "EXT" THEN
  LPRINT "├──┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤"
  LPRINT USING Image2$; "│Av│"; AvgMoVal!(1); AvgMoVal!(2); AvgMoVal!(3); AvgMoVal!(4); AvgMoVal!(5); AvgMoVal!(6); AvgMoVal!(7); A
  LPRINT "└──┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘"
 END IF
Fi:
 VIEW PRINT
 DO
 A$ = INKEY$
 LOOP WHILE A$ = ""
 EXIT SUB
END SUB
```

1/24/93

SYRMØ193 SubProgram

"GraphOut"

```
'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 "JunQRank"
      RankFlow
      GOTO Back
    CASE "GibQRank"
      RankFlow
      GOTO Back
    CASE "CacQRank"
      RankFlow
      GOTO Back
    CASE "LomQRank"
      RankFlow
      GOTO Back
    CASE "GWB Plots"
      GwbPlots
      GOTO Back
    CASE "RankDeliv"
      RankProduction
      GOTO Back
    CASE "No Graph!"
      GOTO Back
    CASE ELSE
  Back: EXIT SUB
    END SELECT
  END SUB
```

1/24/93
SYRMØ193 SubProgram
"AreaVolSet"

```
'GOTO THIS PROCEDURE WITH Elev7! SET....
DEFINT A-Z
SUB AreaVolSet STATIC
  Depth% = Pointer%(Resv%)
  Del! = Elev7! - Datum%(Resv%) + 1
Upr:
  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%, Depth% + 2) - ResvCap!(Resv%, Depth%
  Pointer%(Resv%) = Depth%
END SUB
```

1/24/93
SYRMØ193 SubProgram
"SetPrinter"

```
'THIS SUBROUTINE SELECTS LASER PRINTER OUTPUT FONT...
DEFINT A-Z
SUB SetPrinter
    WIDTH LPRINT 81
    LPRINT Esc$ + "&l0O" + Esc$ + "(11U" + Esc$ + "(s0p10h12v0s0b3T";
    LPRINT Esc$ + "&l7C";        ' SETS VERTICAL MOTION INDEX.
    LPRINT Esc$ + "&l75F"        ' NUMBER OF LINES PER PAGE.
    LPRINT Esc$ + "&k11.14H";    ' SETS HORIZONTAL CURSOR SPACING AS DESIRED.
    LPRINT Esc$ + "&a4L";        ' LEFT MARGIN SET (2 cols. from left default).
    LPRINT Esc$ + "&l2E";        ' SETS TOP MARGIN (@ 2 lines down from top).
    LPRINT Esc$ + "&a0R";        ' SETS CURSOR TO TOP MARGIN (must have this).
END SUB
```

1/24/93
SYRMØ193 SubProgram
"GwbTable"

```
' ======== Special Table printout for Gwb Studies =========
  DEFINT A-Z
SUB GwbTable
  Image25$ = "|####|#####  |#####  |#####  |#####  |#####  |#####  |######  |#####  |######  |#######  |"
  Image26$ = "\       \#####  |#####  |#####  |#####  |#####  |#####  |######  |#####  |######  |#######  |"
  LOCATE 1, 1
  PRINT " GWB ELEMENTS OF RECHARGE: "; Gwb$; "   Time = "; TIME$; ".   Date = "; DATE$; "      "
  PRINT "┌────┬───────┬──────┬──────┬──────┬──────┬──────┬───────┬──────┬───────┬─────────┐"
  PRINT "│YEAR│RAINPC │STRMSP│UNDRFL│INJECT│PUMPIN│IMPTIN│RECHARG│LOSSES│PUMPAGE│ EOY VOL │"
  PRINT "├────┼───────┼──────┼──────┼──────┼──────┼──────┼───────┼──────┼───────┼─────────┤"
  VIEW PRINT 5 TO 25
  IF TabOut$ = "EXT" THEN
    LPRINT " BASIN: "; Gwb$; "   Time = "; TIME$; ".   Date = "; DATE$;
    LPRINT "┌────┬───────┬──────┬──────┬──────┬──────┬──────┬───────┬──────┬───────┬─────────┐"
    LPRINT "│YEAR│RAINPC │STRMSP│UNDRFL│INJECT│PUMPIN│IMPTIN│RECHARG│LOSSES│PUMPAGE│ EOY VOL │"
    LPRINT "├────┼───────┼──────┼──────┼──────┼──────┼──────┼───────┼──────┼───────┼─────────┤"
  END IF
  CumRainPerc! = 0
  CumStrmSeep! = 0
  CumUndrFlow! = 0
  CumInjecton! = 0
  CumPmpRetrn! = 0
  CumImpRetrn! = 0
  CumRecharge! = 0
  CumultvLoss! = 0
  CumlPumpage! = 0
  CumulEoyVol! = 0
  CumDesal! = 0
  CumSwp! = 0
  CalcDeliveries
  EoyVol! = StartVol%
  FOR Yr% = 1 TO NumYears%
    Y% = Yr% + 1917
    CumRainPerc! = CumRainPerc! + RainPerc!(Yr%)
    CumStrmSeep! = CumStrmSeep! + StrmSeep!(Yr%)
    CumUndrFlow! = CumUndrFlow! + UndrFlow!(Yr%)
    CumInjecton! = CumInjecton! + Injection!(Yr%)
    CumPmpRetrn! = CumPmpRetrn! + PumpRet!(Yr%)
    CumImpRetrn! = CumImpRetrn! + ImptRet!(Yr%)
    CumRecharge! = CumRecharge! + Recharge!(Yr%)
    CumultvLoss! = CumultvLoss! + Loss!(Yr%)
    CumlPumpage! = CumlPumpage! + Pumpage!(Yr%)
    CumDesal! = CumDesal! + YearsDsl!(Yr%)
    CumSwp! = CumSwp! + YearsSwp!(Yr%)
    EoyVol! = EoyVol! + Recharge!(Yr%) - Pumpage!(Yr%) - Loss!(Yr%)
    CumulEoyVol! = CumulEoyVol! + EoyVol!
    PRINT USING Image25$; Y%; RainPerc!(Yr%); StrmSeep!(Yr%); UndrFlow!(Yr%); Injection!(Yr%); PumpRet!(Yr%); ImptRet!(Yr%); Recha
    IF TabOut$ = "EXT" THEN LPRINT USING Image25$; Y%; RainPerc!(Yr%); StrmSeep!(Yr%); UndrFlow!(Yr%); Injection!(Yr%); PumpRet!(Y
  NEXT Yr%
  AvgRainPerc! = CumRainPerc! / NumYears%
  AvgStrmSeep! = CumStrmSeep! / NumYears%
  AvgUndrFlow! = CumUndrFlow! / NumYears%
  AvgInjecton! = CumInjecton! / NumYears%
  AvgPmpRetrn! = CumPmpRetrn! / NumYears%
  AvgImpRetrn! = CumImpRetrn! / NumYears%
  AvgRecharge! = CumRecharge! / NumYears%
  AverageLoss! = CumultvLoss! / NumYears%
  AvrgPumpage! = CumlPumpage! / NumYears%
  AvergEoyVol! = CumulEoyVol! / NumYears%
  AverageSwp! = CumSwp! / NumYears%
  AvergDesal! = CumDesal! / NumYears%
  PRINT "├─────────┼──────┼──────┼──────┼──────┼──────┼──────┼───────┼──────┼───────┼─────────┤"
  PRINT USING Image26$; "|Avgs|"; AvgRainPerc!; AvgStrmSeep!; AvgUndrFlow!; AvgInjecton!; AvgPmpRetrn!; AvgImpRetrn!; AvgRecharge!;
  PRINT "└─────────┴──────┴──────┴──────┴──────┴──────┴──────┴───────┴──────┴───────┴─────────┘"
  IF TabOut$ = "EXT" THEN
    LPRINT "├─────────┼──────┼──────┼──────┼──────┼──────┼──────┼───────┼──────┼───────┼─────────┤"
    LPRINT USING Image26$; "|Avgs|"; AvgRainPerc!; AvgStrmSeep!; AvgUndrFlow!; AvgInjecton!; AvgPmpRetrn!; AvgImpRetrn!; AvgRechar
    LPRINT "└─────────┴──────┴──────┴──────┴──────┴──────┴──────┴───────┴──────┴───────┴─────────┘"
  END IF
  PRINT USING "\                    \####\                    \#####"; "Averages for: Ocean Desal ="; AvergDesal!; "; Swp Imports
  IF TabOut$ = "EXT" THEN LPRINT USING "\                    \####\                    \#####"; "Averages for: Ocean Desal ="; Av
END SUB
```

1/24/93
SYRM0193 SubProgram
"RankShortage"

```
' This SUB displays selected SYR Reservoir shortages...
DEFINT A-Z
SUB RankShortage STATIC
DIM Sort!(62)
    SCREEN 0
    CLS
    SCREEN ScrnType%
    COLOR 15, 1
    VIEW
    Xmin = 0
    Xmax = 100
    Ymin = 0
    Ymax = 100
    Image1$ = "\                        \########\                                        \"
    VIEW (10, 10)-(630, 340), 15
    WINDOW (Xmin, Ymin - 14.1)-(Xmax, Ymax + 8.1)
    LINE (Xmin, Ymax)-(Xmax, Ymax + 8.1), 10, BF
    LINE (Xmin, Ymin - 14.1)-(Xmax, Ymin), 10, BF
    LOCATE 24, 7: PRINT "     % Time Annual Delivery Is Equal or Less than Y Axis Amount          ";
    LOCATE 23, 7: PRINT " 10%     20%     30%     40%     50%     60%     70%     80%     90% ";
    LINE (Xmin, Ymin)-(Xmax, Ymax), 4, 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), 8
    NEXT X!
    SELECT CASE GphType$
    CASE "JuncShort"
      LOCATE 2, 9: PRINT USING Image1$; " JAMESON LAKE Totl Draft ="; TotalDraft!(1); " afy.    Y Axis Spacing = 10%. "
      FullD! = TotalDraft!(1)
      Ptr% = 1
      GOTO Sel
    CASE "BaseShort"
      LOCATE 2, 9: PRINT USING Image1$; " PHANTOM Gibraltar Draft ="; 7278; " afy.   Y Axis Spacing = 10% "
      FullD! = 7278
      Ptr% = 2
      GOTO Sel
    CASE "GibrShort"
      LOCATE 2, 9: PRINT USING Image1$; " GIBRALTAR RES Tot Draft ="; TotalDraft!(2); " afy.   Y Axis Spacing = 10%. "
      FullD! = TotalDraft!(2)
      Ptr% = 3
      GOTO Sel
    CASE "CachShort"
      LOCATE 2, 9: PRINT USING Image1$; " CACHUMA PROJ Totl Draft ="; TotalDraft!(3); " afy.   Y Axis Spacing = 10%. "
      FullD! = TotalDraft!(3)
      Ptr% = 4
      GOTO Sel
    CASE "CombinedS"
      LOCATE 2, 9: PRINT USING Image1$; " JUN+GIB+CACH Totl Draft ="; TotalDraft!(4); " afy.   Y Axis Spacing = 10%. "
      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:  DO
    A$ = INKEY$
    LOOP WHILE A$ = ""
    EXIT SUB
END SUB
```

1/24/93
SYRMØ193 Sub Program
"Rank Flow"

```
' SUBROUTINE TO RANK FLOWS @ POINTS ALONG THE SANTA YNEZ RIVER.....
DEFINT A-Z
SUB RankFlow
DIM Sort!(62), Rnker!(4, 62)
    SCREEN 0
    CLS
    SCREEN ScrnType%
    COLOR 15, 1
    VIEW
    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! = .01 * (Ymx! - Ymn!)
    VIEW (10, 6)-(630, 344), 15
    WINDOW (Xmin, Ymn! - 16 * Delta!)-(Xmax, Ymx! + 10 * Delta!)
    LINE (Xmin, Ymx!)-(Xmax, Ymx! + 10 * Delta!), 10, BF
    LINE (Xmin, Ymn! - 16 * Delta!)-(Xmax, Ymn!), 10, BF
    LOCATE 2, 15: PRINT Title$
    LOCATE 24, 7: PRINT "   % Time Annual River Flow Is Equal or Greater than Y Axis Amount.  ";
    LOCATE 23, 7: PRINT " 10%     20%     30%     40%     50%     60%     70%     80%     90% ";
    COLOR 8
    LINE (Xmin, Ymn!)-(Xmax, Ymx!), 4, B
    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!)
    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%
    COLOR 14
    LOCATE 22, 76: PRINT Y1$
    LOCATE 16, 74: PRINT Y2$
    LOCATE 9, 74: PRINT Y3$
    LOCATE 3, 74: PRINT Y4$
    DO
    A$ = INKEY$
    LOOP WHILE A$ = ""
    EXIT SUB
END SUB
```

1/24/93
SYRMØ193 SubProgram
"HydroGraph"

```
' This SUB Displays the Reservoir & Riparian GWB hydrographs...
DEFINT A-Z
SUB HydroGraph
   SCREEN 0
   CLS
   SCREEN ScrnType%
   COLOR 15, 1
   VIEW
   Xmn% = 0
   Xmx% = 744
   Ymn4% = 0
   Ymx4% = 131
   Ymn3% = 177
   Ymx3% = 522
   Ymn2% = 568
   Ymx2% = 739
   Ymn1% = 786
   Ymx1% = 914
   TopLine% = 958
   BotLine% = -42
   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, 349), 15
   WINDOW (Xmn%, -85)-(Xmx%, 1000)
   LINE (Xmn%, -85)-(Xmx%, 0), 10, BF
   LINE (Xmn%, 131)-(Xmx%, 177), 10, BF
   LINE (Xmn%, 522)-(Xmx%, 568), 10, BF
   LINE (Xmn%, 739)-(Xmx%, 786), 10, BF
   LINE (Xmn%, 914)-(Xmx%, 1000), 10, BF
   LOCATE 1, 15: PRINT " STORAGE HYDROGRAPHS:                    Run of "; DATE$ + " "
   LOCATE 2, 3
   IF JunMinDelv! = 1 THEN
     PRINT USING Gim1$; " Juncal reservoir max volume ="; MaxVol!(1); " ac ft.;    Safe Yield = "; Draft!(1); " ac ft. "
     GOTO 6591
   END IF
   PRINT USING Gim1$; " Juncal reservoir max volume ="; MaxVol!(1); " ac ft.;   Draft level = "; Draft!(1); " ac ft. "
 6591 : LOCATE 6, 3
   IF GibMinDelv! = 1 THEN
     PRINT USING Gim1$; " Gibraltar resrvr max volume ="; MaxVol!(2); " ac ft.;    Safe Yield = "; Draft!(2); " ac ft. "
     GOTO 6592
   END IF
   PRINT USING Gim1$; " Gibraltar resrvr max volume ="; MaxVol!(2); " ac ft.;   Draft level = "; Draft!(2); " ac ft. "
 6592 : LOCATE 11, 3
   IF CacMinDelv! = 1 THEN
     PRINT USING Gim1$; " Cachuma reservor max volume ="; MaxVol!(3); " ac ft.;    Safe Yield = "; Draft!(3) + Draft!(4) + Draft!(5);
     GOTO 6593
   END IF
   PRINT USING Gim1$; " Cachuma reservor max volume ="; MaxVol!(3); " ac ft.;   Draft level = "; Draft!(3) + Draft!(4) + Draft!(5); "
 6593 : LOCATE 20, 3
   PRINT USING Gim2$; " Riparian storage (50 to 90 KAF);   M&I CU ="; SyMI! + BuMI!; ";   Ag CU ="; AgrCU%; " ac ft. "
   LOCATE 24, 3: PRINT " 20    25    30    35    40    45    50    55    60    65    70    75 ";
   LOCATE 25, 7: PRINT " Graphs from Oct, 1917 thru Sep, 1979 (vertical lines set @ Jan 1) ";
   LINE (Xmn%, RipFac! * (MaxVol!(4) / 1000 - 50))-(Xmx%, RipFac! * (MaxVol!(4) / 1000 - 50)), 5
   LINE (Xmn%, Ymn3%)-(Xmx%, Ymn3%), 2
   LINE (Xmn%, CacFac! * MaxVol!(3) / 1000 + Ymn3%)-(Xmx%, CacFac! * MaxVol!(3) / 1000 + Ymn3%), 5
   LINE (Xmn%, Ymn2%)-(Xmx%, Ymn2%), 2
   LINE (Xmn%, GibFac! * MaxVol!(2) / 1000 + Ymn2%)-(Xmx%, GibFac! * MaxVol!(2) / 1000 + Ymn2%), 5
   LINE (Xmn%, Ymn1%)-(Xmx%, Ymn1%), 2
   LINE (Xmn%, JunFac! * MaxVol!(1) / 1000 + Ymn1%)-(Xmx%, JunFac! * MaxVol!(1) / 1000 + Ymn1%), 5
   FOR X! = 27 TO 687 STEP 60
     LINE (X!, Ymn4%)-(X!, Ymx4%), 2
     LINE (X!, Ymn3%)-(X!, Ymx3%), 2
     LINE (X!, Ymn2%)-(X!, Ymx2%), 2
     LINE (X!, Ymn1%)-(X!, Ymx1%), 2
   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%, 0)-(Xmx%, 0), 6
 LINE (Xmn%, TopLine% + 3)-(Xmx%, TopLine% + 3), 10
 LINE (Xmn%, TopLine%)-(Xmx%, TopLine%), 10
 LINE (Xmn%, BotLine%)-(Xmx%, BotLine%), 10
 LINE (Xmn%, BotLine% - 3)-(Xmx%, BotLine% - 3), 10
 LINE (Xmn%, -85)-(Xmx%, 1000), 6, B
 LINE (Xmn% + 1.2, -82)-(Xmx% - 1.2, 997), 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!), 1
 NEXT J0%
 PSET (Xmn%, Ymn3% + Vc! * CacFac!), 1
 FOR J0% = 1 TO Xmx%
  IF VolGrph!(3, J0%) < CacStartShortage! THEN Colr% = 6 ELSE Colr% = 1
  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% = 6 ELSE Colr% = 1
  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% = 6 ELSE Colr% = 1
  LINE -(J0%, Ymn1% + VolGrph!(1, J0%) * JunFac! / 1000), Colr%
 NEXT J0%
 DO
 A$ = INKEY$
 LOOP WHILE A$ = ""
 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
```

1/24/93
SYRMO193 SubProgram
"GwbPlots"

```
' ======== Screen Plot Section for Gwb Studies =========
DEFINT A-Z
SUB GwbPlots
GwbPlot1:
    DIM Row$(4)
    CLS
    SCREEN ScrnType%
    COLOR 15, 1
    VIEW
    Xmin% = 0
    Xmax% = 62
    Ymin% = 0
    Ymax% = MaxProdLevel%
    Ytc% = Buildtic%
    Del! = (Ymax% - Ymin%) / 100
    Row$(1) = CHR$(&HFF) + CHR$(&H55) + CHR$(&H55) + CHR$(&HAA)
    Row$(2) = CHR$(&HFF) + CHR$(&H55) + CHR$(&H55) + CHR$(&HAA)
    Row$(3) = CHR$(&HFF) + CHR$(&H55) + CHR$(&H55) + CHR$(&HAA)
    Row$(4) = CHR$(&HFF) + CHR$(&H55) + CHR$(&H55) + CHR$(&HAA)
    Tile1$ = ""
    FOR I% = 1 TO 4
      Tile1$ = Tile1$ + Row$(I%)
    NEXT I%
    Row$(1) = CHR$(&HAA) + CHR$(&H55) + CHR$(&HFF) + CHR$(&H55)
    Row$(2) = CHR$(&HAA) + CHR$(&H55) + CHR$(&HFF) + CHR$(&H55)
    Row$(3) = CHR$(&HAA) + CHR$(&H55) + CHR$(&HFF) + CHR$(&H55)
    Row$(4) = CHR$(&HAA) + CHR$(&H55) + CHR$(&HFF) + CHR$(&H55)
    Tile2$ = ""
    FOR I% = 1 TO 4
      Tile2$ = Tile2$ + Row$(I%)
    NEXT I%
    VIEW (10, 10)-(630, 340), 15
    WINDOW (Xmin%, Ymin% - 14.1 * Del!)-(Xmax%, Ymax% + 8.1 * Del!)
    LINE (Xmin%, Ymax%)-(Xmax%, Ymax% + 8.1 * Del!), 10, BF
    LINE (Xmin%, Ymin% - 14.1 * Del!)-(Xmax%, Ymin%), 10, BF
    LOCATE 24, 4: PRINT "           1918 Through 1979 October-September Water Years           ";
    LOCATE 23, 4: PRINT "1920          1930          1940          1950          1960          1970      "
    LINE (Xmin%, Ymin%)-(Xmax%, Ymax%), 4, B
    LOCATE 2, 6: PRINT USING Image$(23); Gwb$, " Combined Prduction =", MaxProdLevel%, " afy.  Y! Axis Tic =", Ytc%, " ac ft. "
    CalcDeliveries
    FOR Yr% = 1 TO 62
      X! = Yr%
      Y1! = 0
      Y2! = YearsCac!(Yr%)
      PSET (X! - 1, Y1!), 11
      LINE (X! - 1, Y1!)-(X!, Y2!), 14, BF
      Y1! = Y2!
      Y2! = Y2! + YearsGibl(Yr%)
      IF YearsGibl(Yr%) > 0 THEN
        PSET (X! - 1, Y1!), 7
        LINE (X! - 1, Y1!)-(X!, Y2!), 10, BF
      END IF
      Y1! = Y2!
      Y2! = Y2! + YearsJun!(Yr%)
      IF YearsJun!(Yr%) > 0 THEN
        PSET (X! - 1, Y1!), 8
        LINE (X! - 1, Y1!)-(X!, Y2!), 8, BF
      END IF
      Y1! = Y2!
      Y2! = Y2! + YearsWst!(Yr%)
      IF YearsWst!(Yr%) > 0 THEN
        PSET (X! - 1, Y1!), 12
        LINE (X! - 1, Y1!)-(X!, Y2!), 11, BF
      END IF
      Y1! = Y2!
      Y2! = Y2! + YearsDsl!(Yr%)
      IF YearsDsl!(Yr%) > 0 THEN
        PSET (X! - 1, Y1!), 14
        LINE (X! - .999, Y1! + .001)-(X! - .001, Y2! - .001), 4, B
        PAINT (X! - .5, (Y1! + Y2!) / 2), Tile2$, 4
      END IF
      Y1! = Y2!
      Y2! = Y2! + YearsSwp!(Yr%)
      IF YearsSwp!(Yr%) > 0 THEN
        PSET (X! - 1, Y1!), 10
```

```
      LINE (X! - .999, Y1! + .001)-(X! - .001, Y2! - .001), 9, B
      PAINT (X! - .5, (Y1! + Y2!) / 2), Title1$, 9
    END IF
    Y1! = Y2!
    Y2! = Y2! + Pumpage!(Yr%)
    IF Pumpage!(Yr%) > 0 THEN
      PSET (X! - 1, Y1!), 15
      LINE (X! - 1, Y1!)-(X!, Y2!), 15, BF
    END IF
    IF Shortage!(Yr%) > 0 THEN
      Y1! = Y2!
      Y2! = Y2! + Shortage!(Yr%)
      PSET (X! - 1, Y1!), 13
      LINE (X! - 1, Y1!)-(X!, Y2!), 13, BF
    END IF
    Y1! = 0
    Y2! = Injection!(Yr%)
    IF Injection!(Yr%) > 0 THEN
      PSET (X! - 1, Y1!), 4
      LINE (X! - 1, Y1!)-(X!, Y2!), 4, BF
    END IF
  NEXT Yr%
  FOR X! = 1 TO 61
    LINE (X!, 0)-(X!, MaxProdLevel%), 15
  NEXT X!
  FOR X! = 2 TO 52 STEP 10
    LINE (X!, 0)-(X!, MaxProdLevel%), 0
  NEXT X!
  FOR Y! = Ytc% TO Ymax% - 10 STEP Ytc%
    LINE (Xmin%, Y!)-(Xmax%, Y!), 4, , &H1111
  NEXT Y!
  IF MaxPump% = 0 THEN GOTO NL1
  Y! = Shortage!(37) + Pumpage!(37) / 2
  X! = 49
  Source$ = "Gwb"
  GOSUB LabelSource
NL1: IF SwpDel% = 0 THEN GOTO NL2
  Y! = Shortage!(3) + Pumpage!(3) + YearsSwp!(3) / 2
  X! = 5
  Source$ = "Swp"
  GOSUB LabelSource
NL2: IF DesalMaxAfd! = 0 THEN GOTO NL3
  Source$ = "Dsl"
  Y! = Shortage!(32) + Pumpage!(32) + YearsSwp!(32) + YearsDsl!(32) / 2
  X! = 40
  GOSUB LabelSource
NL3: IF WasteWater% = 0 THEN GOTO NL4
  Y! = Shortage!(26) + Pumpage!(26) + YearsSwp!(26) + YearsDsl!(26) + YearsWst!(26) / 2
  X! = 25
  Source$ = "Wst"
  GOSUB LabelSource
NL4: IF JunFactor! = 0 THEN GOTO NL5
  Y! = Shortage!(56) + Pumpage!(56) + YearsWst!(56) + YearsSwp!(56) + YearsDsl!(56) + YearsJun!(56) / 2
  X! = 71
  Source$ = "Jun"
  GOSUB LabelSource
NL5: IF GibFactor! = 0 THEN GOTO NL6
  Y! = Shortage!(62) + Pumpage!(62) + YearsWst!(34) + YearsSwp!(62) + YearsDsl!(62) + YearsJun!(62) + YearsGib!(62) / 2
  X! = 66
  Source$ = "Gib"
  GOSUB LabelSource
NL6: Y! = Shortage!(62) + Pumpage!(62) + YearsWst!(34) + YearsSwp!(62) + YearsDsl!(62) + YearsJun!(62) + YearsGib!(62) + YearsCac!(62
  X! = 25
  Source$ = "Cac"
  GOSUB LabelSource
  LINE (Xmin%, Ymin%)-(Xmax%, Ymax%), 8, B
  GOTO ByPassSave
SaveFiles: OPEN "CACDEL.DAT" FOR OUTPUT AS #1
  OPEN "GIBDEL.DAT" FOR OUTPUT AS #2
  OPEN "DSLDEL.DAT" FOR OUTPUT AS #3
  OPEN "SWPDEL.DAT" FOR OUTPUT AS #4
  OPEN "PMPDEL.DAT" FOR OUTPUT AS #5
  FOR Yr% = 1 TO 62
    WRITE #1, YearsCac!(Yr%)
    WRITE #2, YearsGib!(Yr%)
```

```
      WRITE #3, YearsDsl!(Yr%)
      WRITE #4, YearsSwp!(Yr%)
      WRITE #5, Pumpage!(Yr%)
    NEXT Yr%
    CLOSE #1, #2, #3, #4, #5
ByPassSave:  DO
  A$ = INKEY$
  LOOP WHILE A$ = ""
  CLS
'- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
GwbPlot2:
    SCREEN ScrnType%
    COLOR 15, 1
    VIEW
    Xmin% = 0
    Xmax% = 62
    Ymin% = GwbYmin%
    Ymax% = GwbYmax%
    Ytc% = GwbYtic%
    Del! = (Ymax% - Ymin%) / 100
    VIEW (10, 10)-(630, 340), 15
    WINDOW (Xmin%, Ymin% - 14.1 * Del!)-(Xmax%, Ymax% + 8.1 * Del!)
    LINE (Xmin%, Ymax%)-(Xmax%, Ymax% + 8.1 * Del!), 10, BF
    LINE (Xmin%, Ymin% - 14.1 * Del!)-(Xmax%, Ymin%), 10, BF
    LOCATE 24, 4: PRINT "              1918 Through 1979 October-September Water Years          ";
    LOCATE 23, 4: PRINT "1920       1930       1940       1950       1960       1970       "
    LOCATE 2, 4: PRINT USING Image$(24); Gwb$, " Recharge & Storage (solid line = full).     Ytic =", Ytc%, " ac ft. "
    CalcDeliveries
    FOR Yr% = 1 TO 62
      X! = Yr%
      Y1! = Ymax%
      Y2! = Ymax% - StrmSeep!(Yr%)
      PSET (X! - 1, Y1!), 7
      LINE (X! - .999, Y1! + .001)-(X! - .001, Y2! - .001), 9, B
      PAINT (X! - .5, (Y1! + Y2!) / 2), Tile1$, 9
      Y1! = Y2!
      Y2! = Y2! - UndrFlow!(Yr%) - PumpRet!(Yr%) - ImptRet!(Yr%)
      PSET (X! - 1, Y1!), 11
      LINE (X! - 1, Y1!)-(X!, Y2!), 10, BF
      Y1! = Y2!
      Y2! = Y2! - RainPerc!(Yr%)
      IF RainPerc!(Yr%) > 0 THEN
        PSET (X! - 1, Y1!), 8
        LINE (X! - 1, Y1!)-(X!, Y2!), 8, BF
      END IF
      Y1! = Y2!
      Y2! = Y2! - Injection!(Yr%)
      IF Injection!(Yr%) > 0 THEN
        PSET (X! - 1, Y1!), 14
        LINE (X! - .999, Y1! + .001)-(X! - .001, Y2! - .001), 4, B
        PAINT (X! - .5, (Y1! + Y2!) / 2), Tile2$, 4
      END IF
    NEXT Yr%
    FOR X! = 1 TO 61
      LINE (X!, Ymin%)-(X!, Ymax%), 15
    NEXT X!
    FOR Y! = Ymin% + Ytc% TO Ymax% - 10 STEP Ytc%
      LINE (Xmin%, Y!)-(Xmax%, Y!), 4, , &HF0F0
    NEXT Y!
    LastVol! = StartVol%
    PSET (0, StartVol%)
    FOR Yr% = 1 TO 62
      EoyVol! = LastVol! + Recharge!(Yr%) - Pumpage!(Yr%) - Loss!(Yr%)
      PSET (Yr% - 1, Ymin%), 8
      LINE -(Yr% - 1, LastVol!), 8
      LINE -(Yr%, EoyVol!), 8
      LINE -(Yr%, Ymin%), 8
      LINE -(Yr% - 1, Ymin%), 8
      PAINT (Yr% - .5, (2 * Ymin% + LastVol! + EoyVol!) / 4), 11, 8
      LastVol! = EoyVol!
    NEXT Yr%
    FOR X! = 2 TO 52 STEP 10
      LINE (X!, Ymin%)-(X!, Ymax%), 0
    NEXT X!
    PSET (0, 0), 0
```

```
    LINE (0, 0)-(Xmax%, 0), 0
    LINE (Xmin%, Ymin%)-(Xmax%, Ymax%), 8, B
    DO
    A$ = INKEY$
    LOOP WHILE A$ = ""
    EXIT SUB
LabelSource:
      Dat! = 2.8 + 19.3 * Y! / MaxProdLevel%
      IF Dat! - INT(Dat!) >= .5 THEN Dat! = Dat! + 1
      Dat! = INT(Dat!)
      LOCATE Dat!, X!: PRINT Source$;
    RETURN
END SUB
```

1/24/93
SYRMØ193 SubProgram
"RankProduction"

```
'============== This SubProgram ranks District production.....
DEFINT A-Z
SUB RankProduction
DIM Sort%(62), Row$(4)
Bk: CLS
    SCREEN ScrnType%
    COLOR 15, 1
    VIEW
    Xmin% = 0
    Xmax% = 100
    Ymin% = 0
    Ymax% = MaxProdLevel%
    Ytc% = Buildtic%
    Del! = (Ymax% - Ymin%) / 100
    Row$(1) = CHR$(&HFF) + CHR$(&H55) + CHR$(&H55) + CHR$(&HAA)
    Row$(2) = CHR$(&HFF) + CHR$(&H55) + CHR$(&H55) + CHR$(&HAA)
    Row$(3) = CHR$(&HFF) + CHR$(&H55) + CHR$(&H55) + CHR$(&HAA)
    Row$(4) = CHR$(&HFF) + CHR$(&H55) + CHR$(&H55) + CHR$(&HAA)
    Tile1$ = ""
    FOR I% = 1 TO 4
      Tile1$ = Tile1$ + Row$(I%)
    NEXT I%
    Row$(1) = CHR$(&HAA) + CHR$(&H55) + CHR$(&HFF) + CHR$(&H55)
    Row$(2) = CHR$(&HAA) + CHR$(&H55) + CHR$(&HFF) + CHR$(&H55)
    Row$(3) = CHR$(&HAA) + CHR$(&H55) + CHR$(&HFF) + CHR$(&H55)
    Row$(4) = CHR$(&HAA) + CHR$(&H55) + CHR$(&HFF) + CHR$(&H55)
    Tile2$ = ""
    FOR I% = 1 TO 4
      Tile2$ = Tile2$ + Row$(I%)
    NEXT I%
    VIEW (10, 10)-(630, 340), 15
    WINDOW (Xmin%, Ymin% - 14.1 * Del!)-(Xmax%, Ymax% + 8.1 * Del!)
    LINE (Xmin%, Ymax%)-(Xmax%, Ymax% + 8.1 * Del!), 10, BF
    LINE (Xmin%, Ymin% - 14.1 * Del!)-(Xmax%, Ymin%), 10, BF
    LOCATE 24, 7: PRINT "   % Time Annual Production Is Equal or Less than Y! Axis Amount     ";
    LOCATE 23, 7: PRINT " 10%     20%     30%     40%     50%     60%     70%     80%     90%  ";
    LOCATE 2, 6: PRINT USING Image$(23); Gwb$, " Combined Prduction =", MaxProdLevel%, " afy.  Y! Axis Tic =", Ytc%, " ac ft. "
    CalcDeliveries
    Dx! = 100 / NumYears%
    Ctr% = 0
    FOR Yr% = 1 TO NumYears%
      Min! = 1000000
      FOR I% = 1 TO NumYears%
        FOR K% = 1 TO Ctr%
          IF I% = Sort%(K%) THEN GOTO Nwl
        NEXT K%
        IF Import!(I%) < Min! THEN
          Min! = Import!(I%)
          P% = I%
        END IF
 Nwl:  NEXT I%
      Ctr% = Ctr% + 1
      Sort%(Ctr%) = P%
    NEXT Yr%
    FOR Yr% = 1 TO NumYears%
      P% = Sort%(Yr%)
      X! = Yr% * 100 / NumYears%
      Y1! = 0
      Y2! = YearsCacl!(P%)
      PSET (X! - Dx!, Y1!), 14
      LINE (X! - Dx!, Y1!)-(X!, Y2!), 14, BF
      Y1! = Y2!
      Y2! = Y2! + YearsGib!(P%)
      IF YearsGib!(P%) > 0 THEN
        PSET (X! - Dx!, Y1!), 10
        LINE (X! - Dx!, Y1!)-(X!, Y2!), 10, BF
      END IF
      Y1! = Y2!
      Y2! = Y2! + YearsJun!(P%)
      IF YearsJun!(P%) > 0 THEN
        PSET (X! - Dx!, Y1!), 8
        LINE (X! - Dx!, Y1!)-(X!, Y2!), 8, BF
      END IF
      Y1! = Y2!
      Y2! = Y2! + YearsWst!(P%)
```

```
IF
  F
  L
END
Y1!
Y2!
IF
  P
  L
  P
END
Y1!
Y2!
IF
  P
  L
  P.
END
Y1!
Y2!
IF I
  P:
  L:
END
IF :
  Y'
  Y:
  P:
  L!
END
NEXT Y
FOR I:
  LINE
NEXT I
X! = 1
FOR Y!
  LINE
NEXT Y
FOR X!
  LINE
NEXT X
LINE (
Source
Y! = S
X! = 3
GOSUB
Source:
Y! = S:
X! = 3.
GOSUB I
Source:
Y! = S!
X! = 5:
GOSUB I
Source!
Y! = S!
X! = 6(
GOSUB L
Source!
Y! = S!
X! = 2
GOSUB L
Source$
Y! = Sh
X! = 43
GOSUB L
Source$
Y! = Sh
X! = 21
GOSUB L
DO
A$ = IN
LOOP WH
EXIT SU
LabelS:
```

```
    IF YearsWst!(P%) > 0 THEN
      PSET (X! - Dx!, Y1!), 11
      LINE (X! - Dx!, Y1!)-(X!, Y2!), 11, BF
    END IF
    Y1! = Y2!
    Y2! = Y2! + YearsDsl!(P%)
    IF YearsDsl!(P%) > 0 THEN
      PSET (X! - Dx!, Y1!), 4
      LINE (X! - .999 * Dx!, Y1! + .001)-(X! - .001, Y2! - .001), 4, B
      PAINT (X! - .5 * Dx!, (Y1! + Y2!) / 2), Tile2$, 4
    END IF
    Y1! = Y2!
    Y2! = Y2! + YearsSwp!(P%)
    IF YearsSwp!(P%) > 0 THEN
      PSET (X! - Dx!, Y1!), 9
      LINE (X! - .999 * Dx!, Y1! + .001)-(X! - .001, Y2! - .001), 9, B
      PAINT (X! - .5 * Dx!, (Y1! + Y2!) / 2), Tile1$, 9
    END IF
    Y1! = Y2!
    Y2! = Y2! + Pumpage!(P%)
    IF Pumpage!(P%) > 0 THEN
      PSET (X! - Dx!, Y1!), 15
      LINE (X! - Dx!, Y1!)-(X!, Y2!), 15, BF
    END IF
    IF Shortage!(P%) > 0 THEN
      Y1! = Y2!
      Y2! = Y2! + Shortage!(P%)
      PSET (X! - Dx!, Y1!), 13
      LINE (X! - Dx!, Y1!)-(X!, Y2!), 13, BF
    END IF
  NEXT Yr%
  FOR I% = 1 TO 61
    LINE (Dx! * I%, Ymin%)-(Dx! * I%, Ymax%), 15
  NEXT I%
  X! = 10
  FOR Y! = Ytc% TO Ymax% - 10 STEP Ytc%
    LINE (Xmin%, Y!)-(Xmax%, Y!), 8, , &H8888
  NEXT Y!
  FOR X! = 10 TO 90 STEP 10
    LINE (X!, Ymin%)-(X!, Ymax% - 10), 8
  NEXT X!
  LINE (Xmin%, Ymin%)-(Xmax%, Ymax%), 8, B
  Source$ = "Cac"
  Y! = Shortage!(30) + Pumpage!(30) + YearsWst!(30) + YearsSwp!(30) + YearsDsl!(30) + YearsJun!(30) + YearsGib!(30) + YearsCac!(30)
  X! = 36
  GOSUB LabelS
  Source$ = "Gib"
  Y! = Shortage!(30) + Pumpage!(30) + YearsWst!(30) + YearsSwp!(30) + YearsDsl!(30) + YearsJun!(30) + YearsGib!(30) / 2
  X! = 36
  GOSUB LabelS
  Source$ = "Jun"
  Y! = Shortage!(37) + Pumpage!(37) + YearsWst!(37) + YearsSwp!(37) + YearsDsl!(37) + YearsJun!(37) / 2
  X! = 52
  GOSUB LabelS
  Source$ = "Wst"
  Y! = Shortage!(52) + Pumpage!(52) + YearsSwp!(52) + YearsDsl!(52) + YearsWst!(52) / 2
  X! = 66
  GOSUB LabelS
  Source$ = "Dsl"
  Y! = Shortage!(34) + Pumpage!(34) + YearsSwp!(34) + YearsDsl!(34) / 2
  X! = 2
  GOSUB LabelS
  Source$ = "Swp"
  Y! = Shortage!(36) + Pumpage!(36) + YearsSwp!(36) / 2
  X! = 43
  GOSUB LabelS
  Source$ = "Gwb"
  Y! = Shortage!(7) + Pumpage!(7) / 2
  X! = 21
  GOSUB LabelS
  DO
  A$ = INKEY$
  LOOP WHILE A$ = ""
  EXIT SUB
LabelS:
```

```
        Dat! = 2.8 + 19.3 * Y! / MaxProdLevel%
        IF Dat! - INT(Dat!) >= .5 THEN Dat! = Dat! + 1
        Dat! = INT(Dat!)
        LOCATE Dat!, X!: PRINT Source$;
      RETURN
END SUB
```

1/24/93
SYRMØ193 SubProgram
"CalcDeliveries"

```
DEFINT A-Z
SUB CalcDeliveries
    EoyVol! = StartVol%
    LastUndr! = UfO! - Kuf! * StartVol%
    FOR Yr% = 1 TO 62
      YearsJun!(Yr%) = 0
      YearsGib!(Yr%) = 0
      YearsCac!(Yr%) = 0
      YearsDsl!(Yr%) = 0
      YearsSwp!(Yr%) = 0
      YearsWst!(Yr%) = 0
      Pumpage!(Yr%) = 0
      Injection!(Yr%) = 0
      Shortage!(Yr%) = 0
      FOR I% = 1 TO 12
        Mo% = 12 * (Yr% - 1) + I%
        YearsJun!(Yr%) = YearsJun!(Yr%) + JunSource!(Mo%)
        YearsGib!(Yr%) = YearsGib!(Yr%) + GibSource!(Mo%)
        YearsCac!(Yr%) = YearsCac!(Yr%) + CacSource!(Mo%)
        YearsDsl!(Yr%) = YearsDsl!(Yr%) + DslSource!(Mo%)
        YearsSwp!(Yr%) = YearsSwp!(Yr%) + SwpSource!(Mo%)
        YearsWst!(Yr%) = YearsWst!(Yr%) + WstSource!(Mo%)
        Pumpage!(Yr%) = Pumpage!(Yr%) + GwbSource!(Mo%)
        Injection!(Yr%) = Injection!(Yr%) + Inject!(Mo%)
      NEXT I%
      IF Pumpage!(Yr%) > MaxPump% THEN
        Shortage!(Yr%) = Pumpage!(Yr%) - MaxPump%
        Pumpage!(Yr%) = MaxPump%
      END IF
      IF Pumpage!(Yr%) < MinPump% THEN Pumpage!(Yr%) = MinPump%
      Import!(Yr%) = YearsJun!(Yr%) + YearsGib!(Yr%) + YearsCac!(Yr%) + YearsWst!(Yr%) + YearsDsl!(Yr%) + YearsSwp!(Yr%)
      IF MaxProdLevel% - Pumpage!(Yr%) - Import!(Yr%) > 0 THEN Shortage!(Yr%) = MaxProdLevel% - Pumpage!(Yr%) - Import!(Yr%)
      TSPerc! = 0
      GWPerc! = 0
      IF SBprecip!(Yr%) > 17.2 THEN
        GWPerc! = GWacres% * .572 * (SBprecip!(Yr%) - 17.2) / 12
        TSPerc! = TSacres% * .827 * (SBprecip!(Yr%) - 12.4) / 12
        GOTO Fisk
      END IF
      IF SBprecip!(Yr%) > 12.4 THEN
        TSPerc! = TSacres% * .827 * (SBprecip!(Yr%) - 12.4) / 12
      END IF
Fisk: RainPerc!(Yr%) = TSPerc! + GWPerc!
      PumpRet!(Yr%) = Kpr! * Pumpage!(Yr%)
      ImptRet!(Yr%) = Kir! * Import!(Yr%)
      StrmSeep!(Yr%) = Snum! * Seepage%(Yr%)
      Loss!(Yr%) = 0
      VolEst! = EoyVol! - Pumpage!(Yr%) + Injection!(Yr%) + RainPerc!(Yr%) + StrmSeep!(Yr%) + LastUndr! + PumpRet!(Yr%) + ImptRet!(Yr
      IF VolEst! > LossZone THEN Loss!(Yr%) = (VolEst! - LossZone) / 2
      VolEst! = VolEst! - Loss!(Yr%)
      IF VolEst! > 0 THEN
        Loss!(Yr%) = Loss!(Yr%) + VolEst!
        VolEst! = 0
      END IF
      UndrFlow!(Yr%) = UfO! - Kuf! * (EoyVol! + VolEst!) / 2
      Recharge!(Yr%) = Injection!(Yr%) + RainPerc!(Yr%) + StrmSeep!(Yr%) + UndrFlow!(Yr%) + PumpRet!(Yr%) + ImptRet!(Yr%)
      EoyVol! = EoyVol! + Recharge!(Yr%) - Pumpage!(Yr%) - Loss!(Yr%)
      LastUndr! = UfO! - Kuf! * EoyVol!
    NEXT Yr%
END SUB
```

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, B-2, B-3, B-4, and B-5. Terms used in the program to represent hydrologic quantities are printed in bold letters throughout this section. These terms and 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 of the Santa Ynez River Hydrology committee before being incorporated into the model. Justification for many of the constants may be found in Appendix F, the Data Base.

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 uses a water year from the beginning of October to the end of September in order to conform to historic practices. It is assumed, in the model, that cloud seeding is conducted between the beginning of October and the end of April, only. Therefore, the model checks if the current month falls within the

Figure B-1

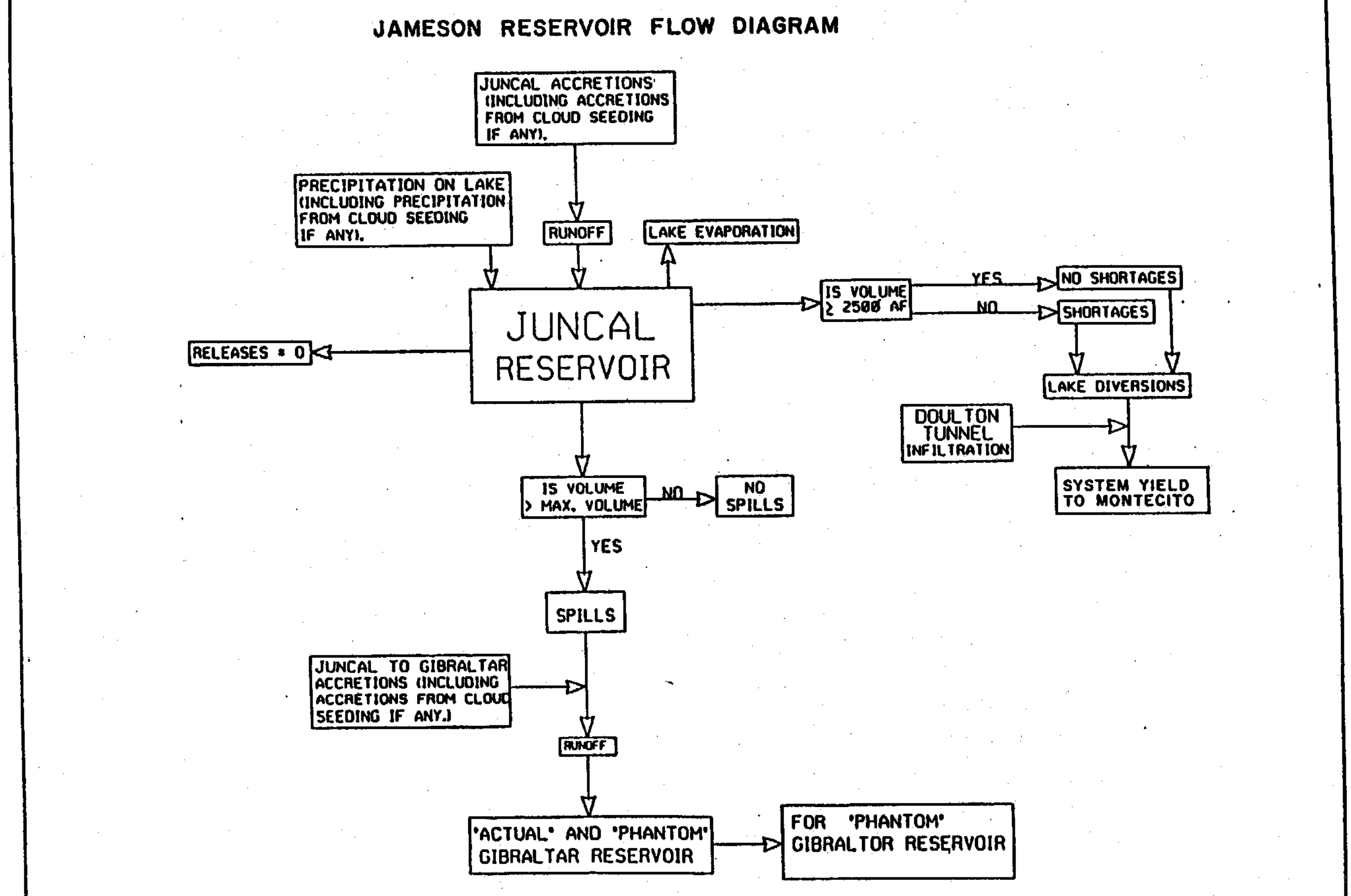

JAMESON RESERVOIR FLOW DIAGRAM
JUNCAL ACCRETIONS (INCLUDING ACCRETIONS FROM CLOUD SEEDING IF ANY).
PRECIPITATION ON LAKE (INCLUDING PRECIPITATION FROM CLOUD SEEDING IF ANY).
RUNOFF
LAKE EVAPORATION
JUNCAL RESERVOIR
RELEASES = 0
IS VOLUME ≥ 2500 AF
YES
NO
NO SHORTAGES
SHORTAGES
LAKE DIVERSIONS
DOULTON TUNNEL INFILTRATION
SYSTEM YIELD TO MONTECITO
IS VOLUME > MAX. VOLUME
NO
NO SPILLS
YES
SPILLS
JUNCAL TO GIBRALTAR ACCRETIONS (INCLUDING ACCRETIONS FROM CLOUD SEEDING IF ANY.)
RUNOFF
'ACTUAL' AND 'PHANTOM' GIBRALTAR RESERVOIR
FOR 'PHANTOM' GIBRALTOR RESERVOIR

Figure B-2

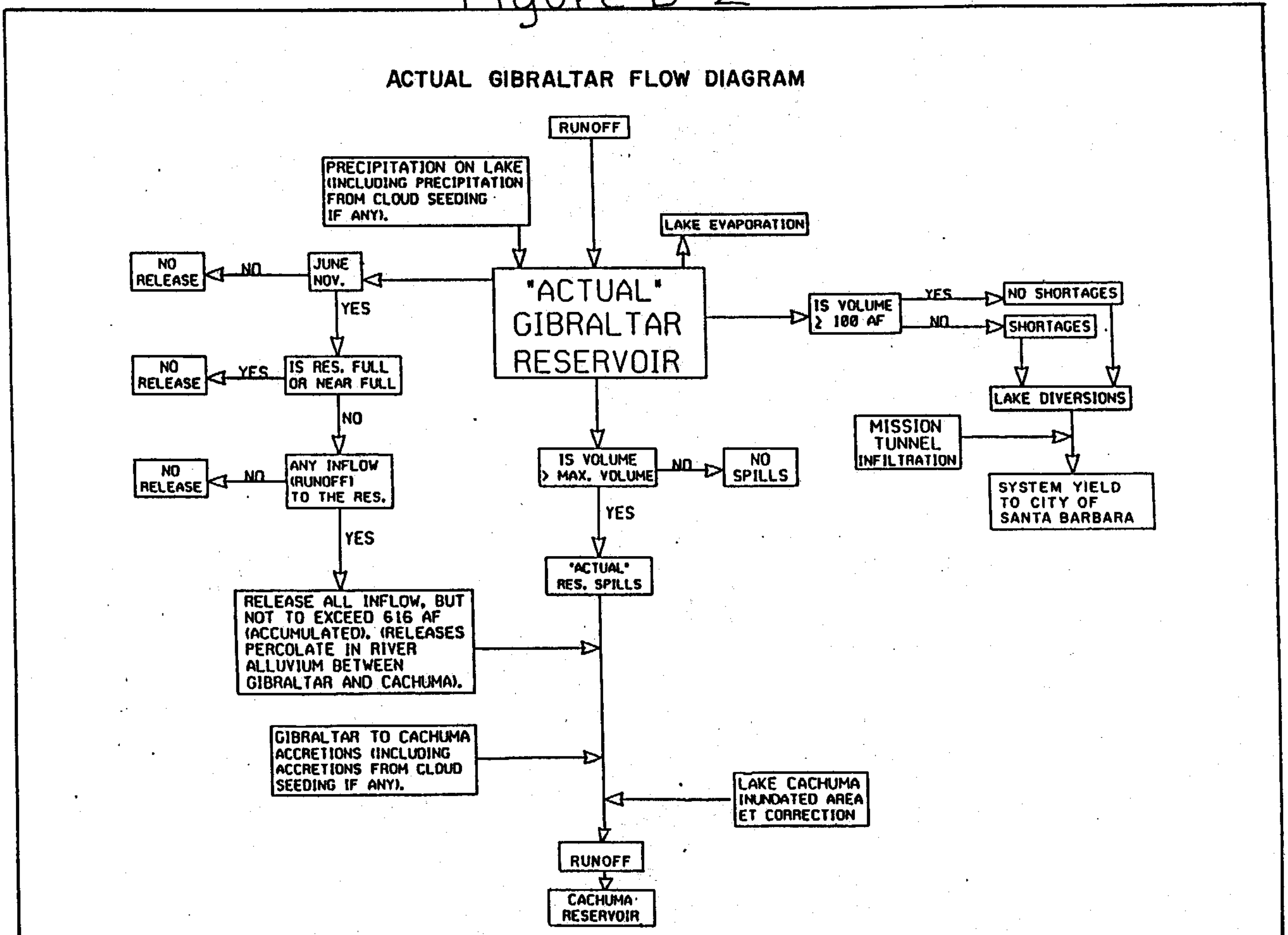

ACTUAL GIBRALTAR FLOW DIAGRAM
RUNOFF
PRECIPITATION ON LAKE (INCLUDING PRECIPITATION FROM CLOUD SEEDING IF ANY).
LAKE EVAPORATION
"ACTUAL" GIBRALTAR RESERVOIR
JUNE NOV.
NO
NO RELEASE
YES
IS RES. FULL OR NEAR FULL
YES
NO RELEASE
NO
ANY INFLOW (RUNOFF) TO THE RES.
NO
NO RELEASE
YES
RELEASE ALL INFLOW, BUT NOT TO EXCEED 616 AF (ACCUMULATED). (RELEASES PERCOLATE IN RIVER ALLUVIUM BETWEEN GIBRALTAR AND CACHUMA).
GIBRALTAR TO CACHUMA ACCRETIONS (INCLUDING ACCRETIONS FROM CLOUD SEEDING IF ANY).
IS VOLUME > MAX. VOLUME
NO
NO SPILLS
YES
"ACTUAL" RES. SPILLS
LAKE CACHUMA INUNDATED AREA ET CORRECTION
RUNOFF
CACHUMA RESERVOIR
IS VOLUME ≥ 100 AF
YES
NO SHORTAGES
NO
SHORTAGES
LAKE DIVERSIONS
MISSION TUNNEL INFILTRATION
SYSTEM YIELD TO CITY OF SANTA BARBARA

Figure B-3

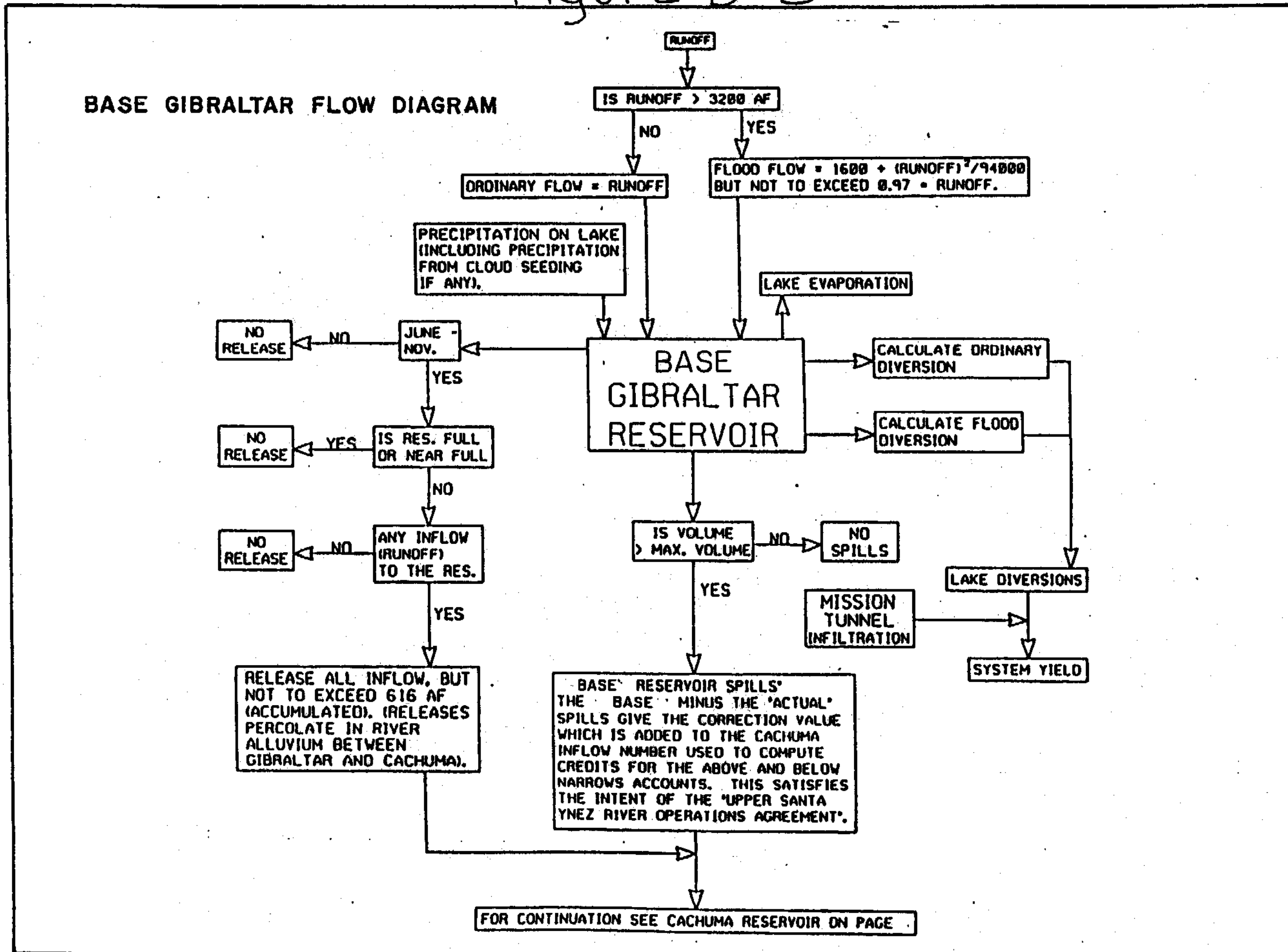
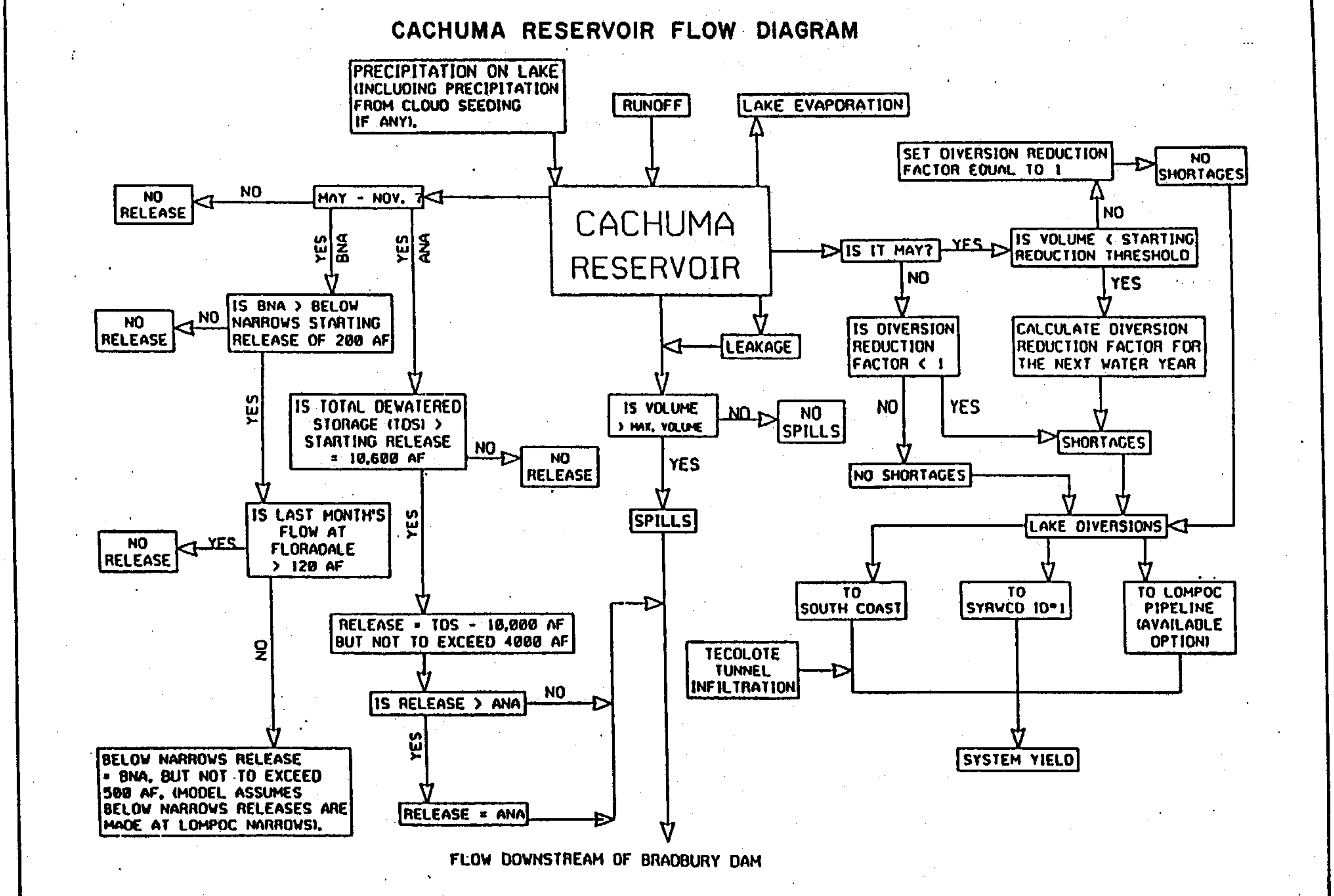
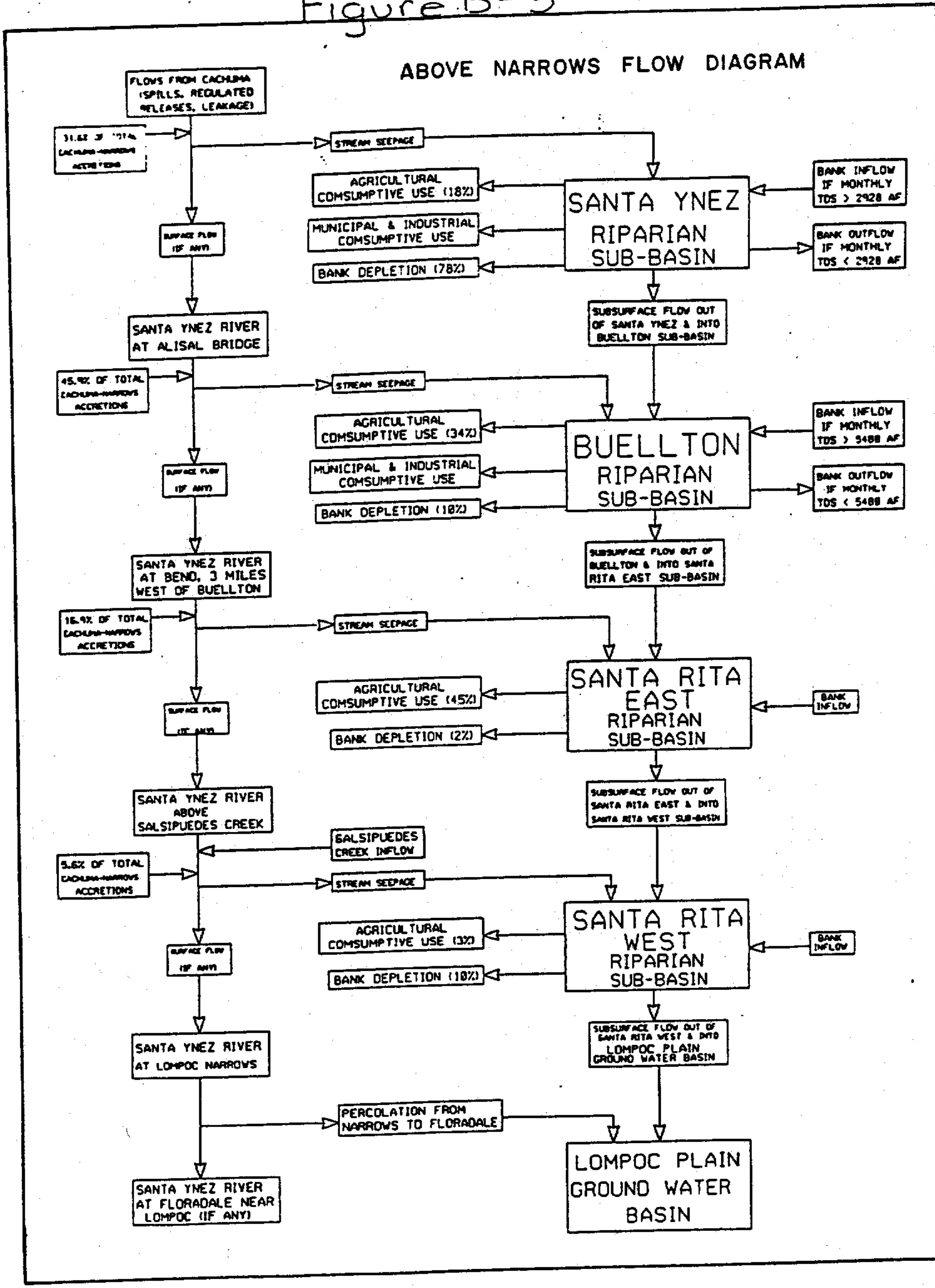

BASE GIBRALTAR FLOW DIAGRAM
RUNOFF
IS RUNOFF > 3200 AF
NO
YES
ORDINARY FLOW = RUNOFF
FLOOD FLOW = 1600 + (RUNOFF)²/94000 BUT NOT TO EXCEED 0.97 * RUNOFF.
PRECIPITATION ON LAKE (INCLUDING PRECIPITATION FROM CLOUD SEEDING IF ANY).
LAKE EVAPORATION
BASE GIBRALTAR RESERVOIR
CALCULATE ORDINARY DIVERSION
CALCULATE FLOOD DIVERSION
JUNE - NOV.
NO
NO RELEASE
YES
IS RES. FULL OR NEAR FULL
YES
NO RELEASE
NO
ANY INFLOW (RUNOFF) TO THE RES.
NO
NO RELEASE
YES
RELEASE ALL INFLOW, BUT NOT TO EXCEED 616 AF (ACCUMULATED). (RELEASES PERCOLATE IN RIVER ALLUVIUM BETWEEN GIBRALTAR AND CACHUMA).
IS VOLUME > MAX. VOLUME
NO
NO SPILLS
YES
BASE' RESERVOIR SPILLS' THE BASE MINUS THE 'ACTUAL' SPILLS GIVE THE CORRECTION VALUE WHICH IS ADDED TO THE CACHUMA INFLOW NUMBER USED TO COMPUTE CREDITS FOR THE ABOVE AND BELOW NARROWS ACCOUNTS. THIS SATISFIES THE INTENT OF THE 'UPPER SANTA YNEZ RIVER OPERATIONS AGREEMENT'.
LAKE DIVERSIONS
MISSION TUNNEL INFILTRATION
SYSTEM YIELD
FOR CONTINUATION SEE CACHUMA RESERVOIR ON PAGE

Figure B-4



CACHUMA RESERVOIR FLOW DIAGRAM
PRECIPITATION ON LAKE (INCLUDING PRECIPITATION FROM CLOUD SEEDING IF ANY).
RUNOFF
LAKE EVAPORATION
CACHUMA RESERVOIR
LEAKAGE
MAY - NOV. ?
NO
NO RELEASE
YES BNA
YES ANA
IS BNA > BELOW NARROWS STARTING RELEASE OF 200 AF
NO RELEASE
IS TOTAL DEWATERED STORAGE (TDS) > STARTING RELEASE = 10,600 AF
NO RELEASE
IS LAST MONTH'S FLOW AT FLORADALE > 120 AF
NO RELEASE
BELOW NARROWS RELEASE = BNA, BUT NOT TO EXCEED 500 AF. (MODEL ASSUMES BELOW NARROWS RELEASES ARE MADE AT LOMPOC NARROWS).
RELEASE = TDS - 10,000 AF BUT NOT TO EXCEED 4000 AF
IS RELEASE > ANA
RELEASE = ANA
IS VOLUME > MAX. VOLUME
NO SPILLS
SPILLS
FLOW DOWNSTREAM OF BRADBURY DAM
IS IT MAY?
IS VOLUME < STARTING REDUCTION THRESHOLD
SET DIVERSION REDUCTION FACTOR EQUAL TO 1
NO SHORTAGES
CALCULATE DIVERSION REDUCTION FACTOR FOR THE NEXT WATER YEAR
IS DIVERSION REDUCTION FACTOR < 1
NO SHORTAGES
SHORTAGES
LAKE DIVERSIONS
TO SOUTH COAST
TO SYRWCD ID*1
TO LOMPOC PIPELINE (AVAILABLE OPTION)
TECOLOTE TUNNEL INFILTRATION
SYSTEM YIELD
YES
NO

Figure B-5

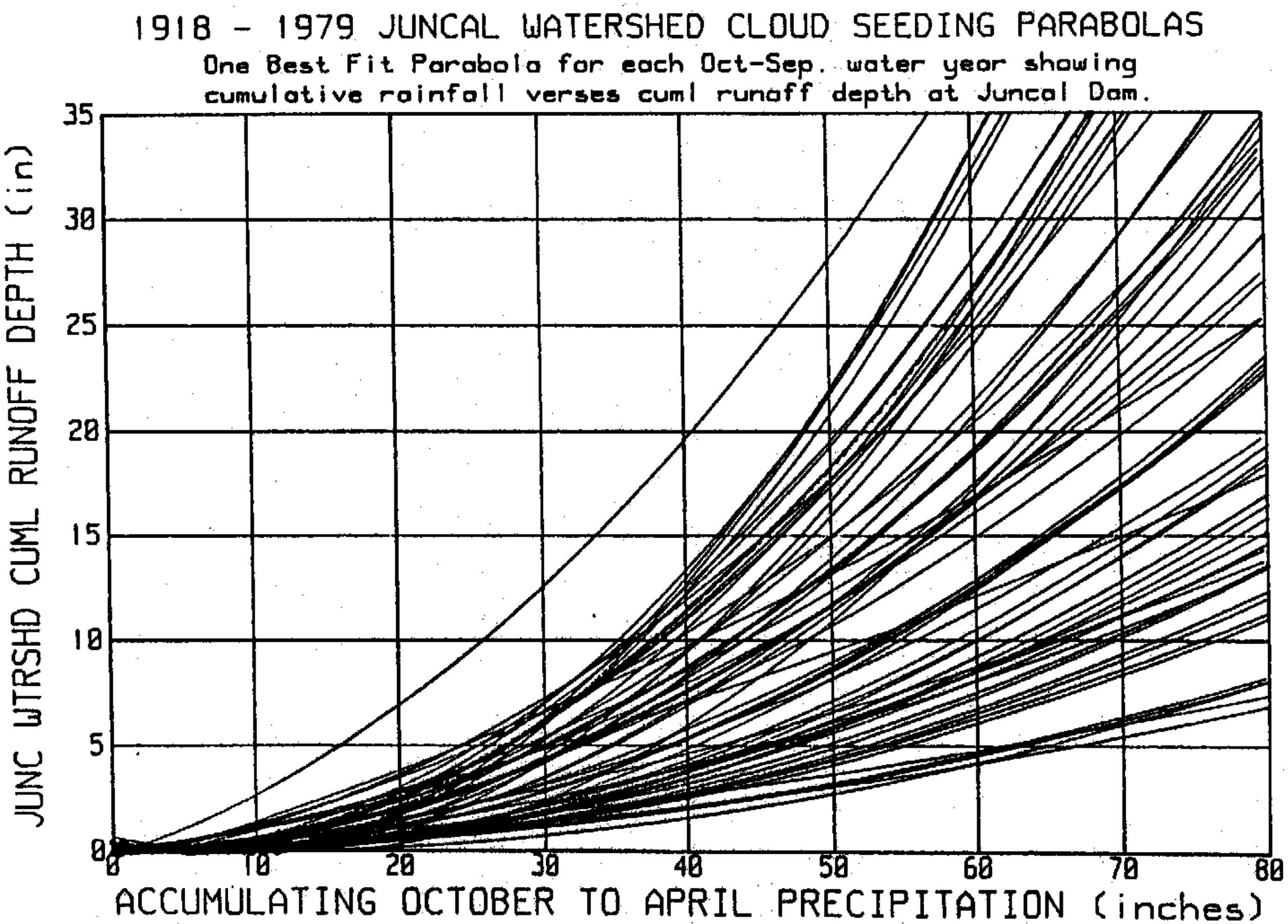

ABOVE NARROWS FLOW DIAGRAM
FLOWS FROM CACHUMA (SPILLS, REGULATED RELEASES, LEAKAGE)
STREAM SEEPAGE
AGRICULTURAL COMSUMPTIVE USE (18%)
MUNICIPAL & INDUSTRIAL COMSUMPTIVE USE
BANK DEPLETION (78%)
SANTA YNEZ RIPARIAN SUB-BASIN
BANK INFLOW IF MONTHLY TDS > 2928 AF
BANK OUTFLOW IF MONTHLY TDS < 2928 AF
SURFACE FLOW (IF ANY)
SUBSURFACE FLOW OUT OF SANTA YNEZ & INTO BUELLTON SUB-BASIN
SANTA YNEZ RIVER AT ALISAL BRIDGE
45.9% OF TOTAL CACHUMA-NARROWS ACCRETIONS
STREAM SEEPAGE
AGRICULTURAL COMSUMPTIVE USE (34%)
MUNICIPAL & INDUSTRIAL COMSUMPTIVE USE
BANK DEPLETION (10%)
BUELLTON RIPARIAN SUB-BASIN
BANK INFLOW IF MONTHLY TDS > 5480 AF
BANK OUTFLOW IF MONTHLY TDS < 5480 AF
SURFACE FLOW (IF ANY)
SUBSURFACE FLOW OUT OF BUELLTON & INTO SANTA RITA EAST SUB-BASIN
SANTA YNEZ RIVER AT BEND, 3 MILES WEST OF BUELLTON
16.9% OF TOTAL CACHUMA-NARROWS ACCRETIONS
STREAM SEEPAGE
AGRICULTURAL COMSUMPTIVE USE (45%)
BANK DEPLETION (2%)
SANTA RITA EAST RIPARIAN SUB-BASIN
BANK INFLOW
SURFACE FLOW (IF ANY)
SUBSURFACE FLOW OUT OF SANTA RITA EAST & INTO SANTA RITA WEST SUB-BASIN
SANTA YNEZ RIVER ABOVE SALSIPUEDES CREEK
SALSIPUEDES CREEK INFLOW
5.6% OF TOTAL CACHUMA-NARROWS ACCRETIONS
STREAM SEEPAGE
AGRICULTURAL COMSUMPTIVE USE (3%)
BANK DEPLETION (10%)
SANTA RITA WEST RIPARIAN SUB-BASIN
BANK INFLOW
SURFACE FLOW (IF ANY)
SUBSURFACE FLOW OUT OF SANTA RITA WEST & INTO LOMPOC PLAIN GROUND WATER BASIN
SANTA YNEZ RIVER AT LOMPOC NARROWS
PERCOLATION FROM NARROWS TO FLORADALE
SANTA YNEZ RIVER AT FLORADALE NEAR LOMPOC (IF ANY)
LOMPOC PLAIN GROUND WATER BASIN

permissible cloud seeding time period. If not, the model turns off the "cloud seeding flag" CsFlag) that it uses to initiate calculation of augmented rain conditions. **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 at the beginning of the current month, the model makes a preliminary calculation of the month's ending storage volume at Cachuma Reservoir. In making that calculation, the sources of inflow (accretions) to the reservoir must be evaluated. The accretions (**Accret**) are separated into five areas or files. **Accret (1)**, **Accret (2)**, **Accret (3)**, **Accret (4)**, and **Salsi (5)** refer to accretions to Jameson Reservoir, from Juncal Dam to Gibraltar Reservoir, from Gibraltar Dam to Cachuma Reservoir, from Cachuma Dam to Lompoc, and at Salsipuedes near Lompoc, respectively. Within the model, if cloud seeding is activated, the decision of whether to cloud seed is based on storage 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, 1,700 acre feet is subtracted from the total in order to allow for losses due to diversions. If that volume is greater than the maximum capacity of Cachuma Reservoir, **CsFlag** is set to zero (inactive) for current month 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.

Figure ~~B~~ B-6

JUNCAL CLOUD SEEDING PARABOLAS



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%(n)**) and precipitation data were used to produce a family of sixty two, 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 to account for differences in the precipitation-stream flow relationship.

Year to year variations occur as a result of changes in watershed vegetation, temperature and time of occurrence of precipitation all of which affect 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 surface, needed to produce a specific amount of runoff to a reservoir. 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:

$$Y = AX^2 + BX + C$$

Where Y is the total runoff depth in inches (Y - axis) at the cumulative seasonal precipitation point X (X - axis). A, B, and C are constants that refer parameters for the specific parabola for a given year. **X** is equal to the accumulated augmented rainfall for the year (including the 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, 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 (**Fj**), **RainInc**, and **Slope** as determined above. **Fj** is 741.3, a constant equal to the area of the Juncal Watershed expressed in acre feet per inch. 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 rain fall for Cachuma Reservoir (**Cpsum**) utilize the average rainfall and cloud seeding increment values from Gibraltar and Cachuma Reservoirs.

effects of cloud seeding) plus the current month's un-augmented precipitation (**Rain**) divided by three. For Jameson Reservoir:

$$\textbf{X} = \textbf{Jpsum} + \textbf{Rain/3}$$

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 of the general equation for the parabola is:

$$dY/dX = 2AX + B$$

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

$$dY = (2AX + B) * dX$$

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

$$\textbf{Slope} = \textbf{2(JunPar A)X} + \textbf{JunPar B}$$

At the beginning of the program, **RedFac** for each reservoir is set to one (100 percent of requested draft) and no ramp is implemented. 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 - LowVol + MinDelv * (StartShortage - EndMoVol)) / (StartShortage - LowVol)

In the accounting section of the program for each reservoir (See Section B1.3), the program restores **RedFac** to one if **EndMoVol** exceeds **StartShortage**, thereby eliminating the ramp effect for the subsequent month.

The model output provides, in tabular form, the system yield over the 62 year base period and indicates what percentage of months in those years result in water yields below the desired draft amount (Table 4-2). The actual storage distribution for each reservoir and basin is also output in the form of a hydrograph (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 Table 4-2 under "Initial Conditions".

B2 DRAFT REDUCTION

The ramp function or draft reduction factor (**RedFac**) executes a reduction in reservoir draft which is proportional to each years May 1st storage volume of the reservoir (See Section 4.2.2). 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 draft 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 the adjustment of four variables. Three of these, the storage volume at which shortages are to be initiated (**StartShortage**), the initial system demand or draft, which is employed when storage is at or above **StartShortage**, and the smaller draft expressed as a percent of the initial draft (called "**MinDelv**" in the program, "**Delivery Factor**" in the menu, and "**%YrsDel@**" in the printout) can be set in the menu. The fourth variable is the storage volume at which **MinDelv** is applied (**LowPt** or **LowVol**) and is fixed within the program (Appendix A).

The relationship between these variables is illustrated in Figure 4-2. Note that the ramp is determined by the position of **StartShortage**, **MinDelv**, and **LowPt**. Below the **StartShortage** point, the annual draft (as determined on the 1st of each May) decreases as the May 1st reservoir volume decreases. The 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.

diversion shortages. This quantity is stored as "**Deficit**". "**AnnShort**" is equal to the current year accumulated shortage plus the current month shortage. **AnnShort** is compared to earlier year's greatest deficit within the annual loop of the model and the maximum shortage during the 62 year base period is listed in the printout as "**Maxyr Short**" (Table 4-2).

The Reservoir Subroutine establishes an end of the month area 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. Rainfall directly on the lake (**Prc**) is equal to the current month's total rain (**Rainer**) multiplied by reservoir area (**Area7**).

Monthly evaporation is multiplied by a pan factor (**PanFac**) and the reservoir area to determine evaporation. The pan factor compensates for differences in physical conditions between the pan and reservoir such as temperature variations. 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).

B3 WATER ACCOUNTING

A key function of the model is to keep track of all of the sources of reservoir inflow and depletion for each month and each year of the base 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. 16-19), 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 base 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 B1.1 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). "**Short**" when preceded by **Jun, Gib,** or **Cac** to indicate the specific reservoir, is equal to the current month's

The second iteration for the volume then becomes:

```
Volume7 = Vsave + Inflow + RainOnLake - LakeDiv -
RegulRelease - Evapr - Leakage - 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. The loop multiplies **LakeDiv, RegulRelease, BelowNrwsRel, RainOnLake,** and **Evapr** by a fraction (**Part**) which is:

Part = (Vsave + Inflow)/(Vsave + Inflow - Volume7)

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**). If **Volume7** is greater than **MaxVol**, then **Spill** is equal to the difference between **MaxVol** and **Volume7** plus leakage. **Leakg** is then set to zero and **Volume7** is set equal to **MaxVol**.

JAMESON RESERVOIR

Water accounting for Jameson Reservoir deviates little from the general description above. The model menu allows the monthly diversion value to include or exclude tunnel infiltration in the lake diversion value. The present default menu selection places the monthly diversion value

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

Volume7 = Volume7 + UpStrmSpill + Accr + Prc - LakeDiv - RegulRelease - Evp - Leakage - BelowNrwsRel

"**RegulRelease**" and "**BelowNrwsRel**" are releases made to satisfy the Above Narrows and Below Narrows Accounts, respectively. **Leakage** 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 incrementaly 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 **Leakage** 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:

RainOnLake = (Prc + Rainer * Area7)/2

Evapr = (Evp + PanFac * Evap * Area7)/2

be algebraically added 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.

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. If the flag has a value of one and the end of last month's reservoir volume **(EndMoVol)** exceeds the maximum capacity of Gibraltar Reservoir **(MaxVol)** minus one acre foot, then the model performs a rough end of month reservoir volume estimate **(VolEst)** via the following equation:

$$\mathbf{VolEst = EndMoVol + (Inflow - LakeDiv) / 2}$$

If this equation yields a volume greater than **MaxVol** minus one, then the reservoir is considered full, no release is made and the program is directed to the section entitled, **"NRRel"** or No Regulated Release. Otherwise, the inflow to the reservoir is released until the Gin Chow requirement has been fulfilled. Water released in accordance with the Gin Chow Settlement **(RegulRelease)** is set equal to **Inflow** and the volume of release water for the year, up to the current month **(AccumRelease)**, is equal to the previous month's **AccumRelease** plus upon the reservoir alone.

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 2.4. 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 will generally exceed the "Base" Reservoir spills. 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 differential between the Actual and "Base" operations is transmitted to Cachuma Reservoir to

VolEst = EndMoVol + Inflow - LakeDiv - RegulRelease + NetEvap

If **VolEst** yields a volume less than one hundred acre feet, than **LakeDiv** is reduced according to the following equation:

LakeDiv = LakeDiv - (100 - VolEst)

If this equation yields a negative number than **LakeDiv** is set equal to zero. The program is directed to the Reservoir Subroutine in which the end of the current month area and volume are determined.

The final task of the Gibraltar Reservoir section is to calculate the Cachuma Reservoir inflow correction (**Correction**) so as to keep "whole" the below Cachuma Reservoir accounts. **Correction** is equal to the difference between the amount of water that spilled from the "Base" Gibraltar Reservoir (**PhanSpill**) minus the amount that spilled from the actual reservoir (**Spill**). This quantity is incorporated into the Cachuma Reservoir section in the calculation of net inflow.

THE "BASE" GIBRALTAR

As noted above, the primary 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

RegulRelease. When **AccumRelease** exceeds 616 acre feet, the Gin Chow requirement has been fulfilled. Therefore, the current month's **RegulRelease** is revised to equal the exact amount of release water needed to equal 616 acre feet according to the equation:

RegulRelease = RegulRelease - (AccumRelease - 616)

and **AccumRelease** is set equal to 616 acre feet.

In the **NRRel** section of the model monthly loop, **LakeDiv** is calculated so as to leave one hundred acre feet of water in the reservoir. As it happens, the reservoir dries up completely during the worst year drought of the base period due to evaporation. The model uses an estimate of net evaporation (rain on the reservoir minus evaporation off of the reservoir) to determine an approximate end of month volume based on the beginning of the month surface area to determine when a reduction in **LakeDiv** is appropriate. The beginning of the month net evaporation from the reservoir (**NetEvap**) is:

NetEvap = Area(2) * (Rainer -.8 * Evap(2))

In this equation, **Rainer** is equal to the month's total rainfall at the reservoir. The evaporation calculation is identical to those for the other reservoirs (See Pg.). The estimated beginning of the current month volume (**VolEst**) is then:

and flood volume diversion are constants equal to 4,189 acre feet and 3,089 acre feet, respectively. **OrdDiv** and **FldDiv** are equal to pre-established monthly percentages of this yearly draft. If the volume of ordinary water in the lake (**OrdVol**) plus **Qord** minus **OrdDiv** is less than fifty acre feet, then **OrdDiv** is set equal to zero. This also applies to **FldDiv**. The total "Base" operation diversion (**PhanDiv**) is equal to **FldDiv** plus **OrdDiv**.

Releases from the "Base" Gibraltar Reservoir (**PhanRel**) are essentially identical to those for the actual Gibraltar Reservoir except that the "Base" Reservoir has an established volume. Therefore, actual numbers are used for quantities such as **MaxVol** in the place of variables (See Gibraltar Variations). As with the actual Gibraltar Reservoir, if the **GinChowRelFlag** is equal to one and the reservoir volume exceeds 8,566 acre feet (one foot under capacity), then the model performs a rough end-of-month volume estimate (**VolEst**) via the following equation:

VolEst = PhanVol + (Inflow - PhanDiv) / 2

If this equation yields a value which is greater than 8,566 acre feet no release is made and the program is directed to the section entitled, "**NPRel**" or No "**Phantom**" Release. Otherwise, the inflow is released until the Gin Chow requirements have been fulfilled. **PhanRel** is set equal to **Inflow** and the volume of release water for the year, up to the current month (**CumPhanRel**), is then equal to the previous month's **CumPhanRel** plus **PhanRel**. When **CumPhanRel** exceeds 616 acre feet, the current month's **PhanRel** is revised to equal the volume of release water needed to equal 616 acre feet and **CumPhanRel** is set equal to 616 acre feet.

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" flow and 3,089 acre feet per year of "flood" flow. Ordinary flow is defined to be average daily inflow to the reservoir of less than 800 cubic feet per second (cfsdays). 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.

Initially, **Qord** and **Qfld** are set to zero and the last month's "Base" Gibraltar Reservoir storage volume is saved as **(LastVol)**. If the inflow **(Inflow)** for the month is greater than or equal to 3,200 acre feet then **Qfld** is:

$$\mathbf{Qfld} = 1{,}600 + \mathbf{Inflow} * (\mathbf{Inflow} / 94{,}000)$$

1,600 acre feet is approximately equal to one day of 800 cubic feet per second (cfs) inflow. This equation effectively reduces **Qfld** in order to correlate with existing data (Appendix F). **Qfld** is limited to ninety seven percent of the inflow. **Qord** is then **Inflow** minus **Qfld**. If **Inflow** is greater than zero, than **"Ratio"** is set equal to **Qfld** divided by **Inflow**. **Ratio** is later used in the **"Phanset"** subroutine to calculate the current month's volume of flood flows **(FldVol)**. Reservoir diversions are divided into diversions from ordinary **(OrdDiv)** and diversions from the flood volumes **(FldDiv)**. The maximum annual ordinary volume diversion

Each month in the Gibraltar Base Operations part of the monthly time loop the end of last month's volume (**PhanVol**) is saved as **Vsave** and **PhanSpl** is set equal to zero. The model then conducts two iteration calculations of the "Base" operations current month's volume (**PhanVol**), similar to those conducted for the actual reservoirs in the Reservoir Subroutine. The first iteration of **PhanVol** is:

PhanVol = PhanVol + Inflow + Prc - PhanDiv - PhanRel - Evp

Evp and **Prc**, in this equation are based on the end of last month's area. The model uses the first iteration volume calculation to determine an approximate end of month reservoir area from which the final values of rain on, and evaporation from, the reservoir are determined as per the following equations:

PhanRol = (Prc + Rainer * PhanArea) / 2

PhanEvp = (Evp + PanFac * Evap * PhanArea) / 2

The effect of these equations is to provide averaged values for **PhanRol** and **PhanEvp** based on the beginning of the month values and the end of the month values divided by two. The final volume iteration is then:

PhanVol = Vsave + UpstrmSpill + Accr + PhanRol - PhanDiv - PhanRel - PhanEvp

As with the actual Gibraltar Reservoir, the "Base" operation calculations reduce **PhanDiv** so as to leave one hundred acre feet of water in the reservoir. The estimated beginning of the month net evaporation from the reservoir (**NetEvap**) is:

NetEvap = PhanArea * (Rainer -.8 * Evap(2))

The estimated beginning of the current month volume (**VolEst**) is then:

VolEst = Phanvol + Inflow - PhanDiv - PhanRel + NetEvap

If **VolEst** yields a volume less than one hundred acre feet, then the equation to reduce **PhanDiv** is:

PhanDiv = PhanDiv - (100 - **VolEst**)

If **PhanDiv** is negative, then it is set equal to zero. If a reduction in **PhanDiv** is necessary, then **OrdDiv** and **FldDiv** must be proportionally reduced since **OrdDiv** plus **FldDiv** is equal to **PhanDiv**. The model achieves this by multiplying each by a ratio (**Rto**) which is equal to **PhanDiv** divided by the quantity **OrdDiv** plus **FldDiv**. **Rto** will always yield a fraction because **PhanDiv** has been previously reduced.

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 2.4.3). 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 evaporative effects of plant loss due to inundation of land by Cachuma Reservoir.

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( )**), and the two values are averaged to give the month's leakage (**Leakg**). See Cachuma Reservoir Leakage Table B-0.

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

In the above equation, **UpstrmSpill** plus **Accr** is equal to **Inflow**. If the equation yields a volume which is greater than the "Base" Gibraltar capacity of 8,567 acre feet, then the difference between **PhanVol** and 8,567 acre feet is spill water (**PhanSpl**) and **PhanVol** is set equal to 8,567 acre feet. The program is directed to the **PhanAEset** subroutine a final time to make the final adjustment of reservoir area and elevation based upon the second iteration's calculated volume.

In the event that these iterations yield a volume less than zero, the model provides a method of emptying the reservoir in proportion to all of the reservoir inflows and outflows (identical to the handling of the actual reservoirs).

In the "**PhanSet**" portion of the model, the yearly accumulated values of **PhanRel, PhanRol, PhanEvp, PhanSpl**, and average Volume (**AvgVol**) are calculated. The yearly accumulated "Base" operation yield (**YrPhanYld**) is equal to last month's value plus **PhanDiv** plus **Tunnl**. The volume of flood flows (**FldVol**) is:

FldVol = FldVol + Ratio * (Inflow - PhanSpl) - FldDiv

If **FldVol** is greater than the "Base" Gibraltar storage capacity, it is set equal to the full capacity and if **FldVol** is less than zero, it is set equal to zero. **OrdVol** is then equal to **PhanVol** minus **FldVol**.

of the month's value (also **Leakg**) plus the end of the month value (**Lek**) divided by two.

EVAPOTRANSPIRATION CORRECTION

Within the Cachuma Reservoir Section of the monthly loop there is an evaporation correction (**CachEt**) which corrects for the change in evaporation due to the inundation of land and the resulting loss of vegetation and/or exposed land surface 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 reservoir. As the area of the lake increases, the evapotranspiration and water loss from plants and direct evaporation decreases. Therefore, the total amount of water available to the reservoir increases. The monthly evapotranspiration value **CachEt** is from the hydrologic data items discussed in Chapter 3 and Appendix F. Evapotranspiration (**Et**) is equal to the last month ending reservoir area multiplied by **CachEt** for the current month. This value is added to the **Accr** equation to account for the available water due to the loss of vegetation and exposed land surface. Water evaporated from the surface of the reservoir is accounted for separately (See Section B1.3).

DOWNSTREAM RELEASES

In the accounting for Cachuma Reservoir the model must determine under which circumstances to make releases. The **"DwnStrRelFlag"** functions similar to **GinChowRelFlag** (see Section B1.3, Gin Chow Releases) and has allowable values of zero (non-activated) and one (activated). It is used to indicate months in which downstream releases from Cachuma Reservoir can be made. **DwnStrRelFlag** has a value of one for May through November only.

TABLE [illegible] 5-6

USBR LEAKAGE/WATER ELEVATION TABLE

CACHUMA PROJECT LAKE LEAKAGE LOOKUP TABLE

ELEVATION RANGE From (ft, MSL)	ELEVATION RANGE To (ft, MSL)	LEAKAGE (acre_feet per day)	ELEVATION RANGE From (ft, MSL)	ELEVATION 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	746.0	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	739.0	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

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.

As of February, 1992 the model still makes Below Narrows Releases as if there were a Cachuma Reservoir to Lompoc pipeline through which the releases could be made. A future version of the model is planned in which these simulated Below Narrows Releases will be made from Cachuma Reservoir down the Santa Ynez River Channel (See Section 1.3). If the Below Narrows Account (**BelowNarrwAcct**) is greater than the Below Narrows start release volume (**StrtRelVol**) than **BelowNrwsRel** is set equal to **BelowNarrwAcct**, except that **BelowNrwsRel** is limited to 500 acre feet in any one month in order to prevent water from escaping to the ocean. Similarly, if last month's flow at Floradale Bridge exceeded 120 acre feet then **BelowNrwsRel** is set equal to zero.

B4 Above Narrows Alluvial Groundwater Basin

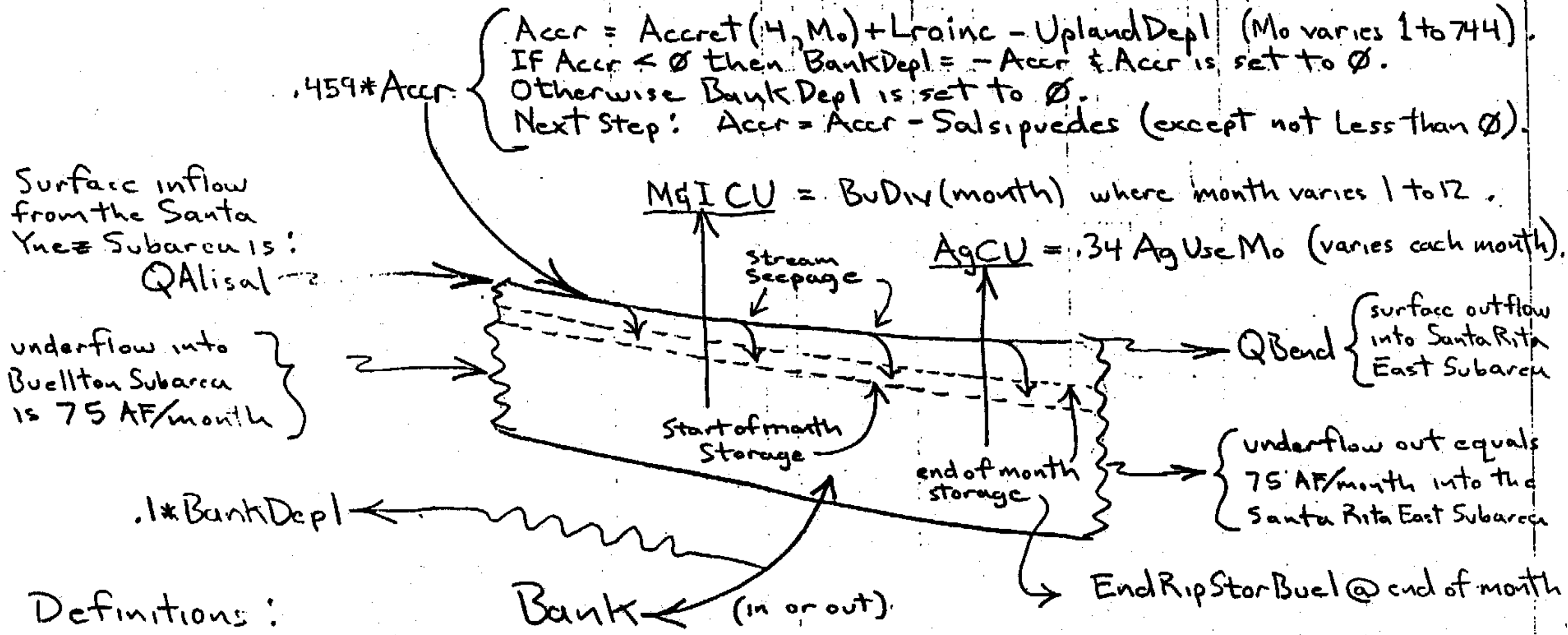
The Above Narrows Alluvial Groundwater Basin or Riparian Strip extends from Bradbury Dam to Lompoc along the Santa Ynez River. For the purpose of the model this section is divided into four subareas (See Section 2.2). The sections of the program addressing the Above Narrows Alluvial Groundwater Basin calculations are entitled "Start Riparian Section", "Santa Ynez", "Buellton", "East Santa Rita", and "West Santa Rita". Each subarea is similar to a reservoir

"**RegulRelease**" and "**BelowNrwsRel**" refer to releases to satisfy the Above and Below Narrows Accounts, respectively. 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, that is **DwnStrRelFlag** is equal to one, 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. These criteria simulate approximate guidelines for determining when, in reality, releases may be requested. If conditions are too wet, the program is directed to "**Nrel**", the section in which much of the water accounting is conducted.

If the previous month was sufficiently dry, the model makes releases based on the SWRCB Order No. WR 89-18 and the existing credits in the Above and Below Narrows Accounts (See Section 2.4.3). If the total dewatered storage in the Above Narrows Account (**TotDewatStor**) is more than the start release volume (**StartRelease**), than **RegulRelease** is equal to the **TotDewatStor** minus the operational dewatered storage (**OperDewatStor**). **OperDewatStor** is 10,000 acre feet and represents the dewatered storage volume that is normally maintained in 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

EXAMPLE RIPARIAN SUBAREA FLOW DIAGRAM

(For the Buellton Subarea)



Definitions:

1) Accret(4,Mo) is the Cachuma to Lompoc accretions for this month.

2) Lroinc is the Cachuma to Lompoc runoff increment due to cloudseeding (if any) for this month.

3) UplandDepl (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 + .459 * Accr - QBend.

6) EndRipStorBuel = EndRipStorBuel + Seep + Bank - BuDiv(month) - .34*AgUseMo - .1* BankDepl.

Figure B-7

system in that it has a specific storage capacity to which accretions and diversions are added or subtracted. Therefore, many of the model components of the Above Narrows Alluvial Groundwater Basin are similar to those of the Santa Ynez River surface reservoirs. Hydrologic components that are unique to the Above Narrows Alluvial Groundwater Basin include underflow, percolation, upland depletions and ground water pumping. Figure B-7 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 Above Narrows Alluvial Groundwater Basin 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 subareas of the Above Narrows Alluvial Groundwater Basin and providing there is not a live stream below Cachuma Reservoir (See Section 2.4.3). This Order necessitates a method of determining when and where the Santa Ynez River is flowing and to initiate the appropriate action in accordance with the agreements. This is done through the use of live stream flags (**LivStrmFlg**) 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 Salsipuedes, respectively. Except for San Lucas Bridge, these locations correspond to the Above Narrows subarea boundaries. The model assigns the flags values of 1, 2, 4, and 8 for Flag 0, 1, 2, and 3 if the

"**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 benefits 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**). Again, ninety percent is a reduction factor used to account for the decrease in average precipitation westward downstream Cachuma Reservoir.

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

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

stream is live during the current month at these locations. Otherwise the flags are assigned a value of zero. 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, **LiveStrmFlg0** = 1. Furthermore, if releases to the Above Narrows Account (**RegulRelease**) plus any leakage from Bradbury Dam total 120 acre feet, **LiveStrmFlg0** = 1. This information is later used in the program section entitled **"Fin"** to determine the amount of credit to be applied to the Above Narrows Account.

B4.2 CLOUD SEEDING

As with the County 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 has lowered the water levels in aquifers adjacent to the Above Narrows Alluvial Groundwater Basin, resulting in a reduction in the amount of water which historically has leaked 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 (**Salsipuedes**) 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 (**Qin**); Santa Ynez receiving 31.6 percent, Buellton receiving 45.9 percent, East Santa Rita receiving 16.9 percent, and West Santa Rita receiving 5.6 percent of the total. 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

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 (19,840), **LrnInc**, and **Lslope**. The Cachuma Reservoir to Lompoc Watershed factor is a constant equal to the area of the Watershed in acres divided by twelve inches and expressed in acre feet per inch. 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** 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 human inhabitance and development along the banks north and south of the Santa Ynez River. Increased pumping of groundwater for agriculture and residential use in these areas storage is set to a percentage of the total Above Narrows Alluvial Groundwater Basin storage which is proportional to the subarea's size. Therefore, at the beginning of the modelling period **EndRipStorSYn** is set equal to twenty three percent of the total Above Narrows aquifer September, 1917 storage.

The maximum percolation rate (**SynPerc**) is a constant equal to 32 feet per month. **SynStr** is a calibration constant equal to 9,100 acre feet. As **TempDewatStor** becomes large, the percolation rate becomes very large. As TempDewatStor becomes small, the percolation rate becomes small. The **PercRate** equation simulates the reduction in percolation with decreased aquifer storage. The value of **PercRate** is restricted so that it cannot exceed SynPerc.

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 percentages vary according to the size of the subarea. Table B-1 lists the four subareas and the associated values.

Table B-1

Percolation Rate Constants

Percolation		Calibration Constant		Start Storage%	
SynPerc	32	SynStr	9,100	Santa Ynez	23
BuePerc	32	BueStr	11,950	Buellton	28
SRitaEPerc	32	SRitaEStr	13,450	E. Santa Rita	40
SRitaWPerc	32	SRitaWStr	2,450	W. Santa Rita	09

for West Santa Rita in order to make the Cachuma to Lompoc incremental flow balance with the original value of **Accr**.

Within each subarea section of the program, the end of month Riparian storage (**EndRipStorSy, EndRipStorBu, 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 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.

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 (**Q**) 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 Santa Ynez subarea storage volume is set to 20,600 acre feet. At the beginning of the modeling period each subarea's

BANK FLOW

"**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 4,900 acre feet, **Bank** is set equal to ninety percent of the last month's **Bank** value (**SyLast**). This allows for a reduction in bank infiltration with an increase 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 limiting factor: **Bank = .9 * SyLast** provides for monthly recession of bank infiltration in the latter case.

In the event that **TempDewatStor** is less than 4,900 acre feet, **Bank** is:

Bank = TunFac * (TempDewatStor - 2928)

"**TunFac**" is equal to the last month's Tecolote tunnel infiltration (**Tunnl**) divided by 2,500. 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). If **TempDewatStor** is less than 2,928, that is the aquifer has considerable water in storage, **Bank** is a negative number indicating a loss of to the adjacent aquifer.

If **TempDewatStor** is greater than 2,928 but less than 4,900, then **Bank** is equal to the Santa Ynez reduction factor (**SyRed**) multiplied by the former **Bank** value. The equation for **SyRed** is:

SyRed = 2620 / (.18 * **AgrCU** + **SyMI**)

In the above equation, **AgrCU** and **SyMI** are the agricultural consumptive use and the Santa Ynez municipal and industrial use, respectively (see Diversions). An increase in agricultural, Inflow to the Santa Ynez subarea (**Qin**) is equal to 31.6 percent of the Cachuma Reservoir to Lompoc accretions plus Cachuma Reservoir spills, releases and leakage from Bradbury dam or:

Qin = .316 * Accr + Spill + RegulRelease + Leakg

Each Month, the flow out of the Santa Ynez subarea at Alisal Bridge (**QAlisal**) is initially set to zero. Based on 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 Appendix E). The model equivalent of the 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. **Qin** for the other subareas varies according to the size of the subarea and the water sources available to it. **Qin** at Buellton is equal to 45.9 percent of **Accr** plus any inflow from the Santa Ynez subarea (**QAlisal**) and **Qin** at East Santa Rita is 19.9 percent of **Accr** plus inflow from Buellton (**QBend**). West Santa Rita subarea flows include Salisipuedes Creek inflow. Therefore, **Qin** at West Santa Rita is equal to 5.6 percent of **Accr** 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 3,993 acre feet a calibration value). If **Seep** exceeds that value, **QAlisal** is set equal to the previous **QAlisal** plus **Seep** minus **SYnSpMx** and **Seep** is set equal to **SYnSpMx**.

Notice that at the **TotMI** default value, **SyMI** and **BuMI** equal 1,000 and 1,500 acre feet, respectively. Given a **TotMI** value of 4,183 acre feet the right side of the equation is equal to one and **SyMI** and **BuMI** become 1,748 and 2,435 acre feet. The 4,183 acre foot value was selected as a reasonable projection of municipal and industrial diversions in the future. Diversions of more than 4,183 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 equation:

SyDiv = SyMI * (Pcnt(6)) / 1000
BuDiv = BuMI * (Pcnt(6)) / 1000

(Pcnt(6)) is an array of twelve monthly values representing the annual distribution of municipal and industrial drafts. The above equations convert the values to monthly fractions by dividing them by 1,000. Municipal and industrial diversions are considered to be constant from year to year but to vary monthly.

Agricultural diversions are handled in much the same way as municipal and industrial diversions except that agricultural consumptive use **(AgrCU)** fluctuates with the monthly deviations of the Cachuma evaporation pan from the average monthly values for that pan. Thus, agricultural diversions vary yearly as well as monthly. In the "BeginModel" section of the program, a multiplier is calculated **(AgUseFactor)** which is later used to determine the total agricultural diversion for the Above Narrows Alluvial Groundwater Basin each month **(AgUseMo)**.

AgUseFactor = AgrCU * AgDist / Eavg

(AgrCu) is the 1976 to 1986 average annual agricultural net diversion from the Above Narrows Alluvial Basin as determined by a private consultant (see Appendix D). It is equal to 9,000 acre feet. "**AgDist**" is an array of twelve values representing the monthly percentages of the total municipal and industrial pumpage causes **SyRed** to decrease. Therefore, the value of **Bank** multiplied by **SyRed** decreases. The result is that the increase in bank infiltration, as the storage in the aquifer is decreased, is reduced as consumptive use of water from the subarea is raised.

SUBAREA UNDERFLOW

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. These 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.

GROUNDWATER DIVERSIONS

Communities located adjacent to both the Santa Ynez and Buellton subareas of the Above Narrows Alluvial Groundwater Basin divert water from the Santa Ynez River for municipal and industrial use. (**SyMI**) and (**BuDiv**) refer to municipal and industrial net diversions from the Santa Ynez and Buellton subareas, respectively. The default value for the total Above Narrows Alluvial Groundwater Basin municipal and industrial diversions (**TotMI**) is 2,500 acre feet; 1,000 acre feet of this is removed from the Santa Ynez subarea and 1,500 acre feet from the Buellton subarea. This was the areas estimated municipal and industrial diversions, minus return flows, in the early 1980's. There are no substantial communities located along the East and West Santa Rita subareas and therefore, no municipal and industrial diversions. The model allows for adjustment of **TotMI** upward from 2,500 acre feet via the following equations:

$$\mathbf{SyMI} = 1000 + 748 * (\mathbf{TotMI} - 2500) / 1683$$

$$\mathbf{BuMI} = 1500 + 935 * (\mathbf{TotMI} - 2500) / 1683$$

B5 Below Narrows Groundwater Basin

Credits to the Below Narrows Account are based on the difference between the actual and "constructive" percolation. "Constructive" percolation is the percolation that would have occurred if the Cachuma Reservoir project did not exist. Calculations of the Below Narrows Account 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 at the end of the program (See Appendix A). The actual flow at the Narrows is that flow generated for 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 within 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 LOMPOC SUBROUTINE

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 20,000 acre feet (**SwitchThresh**) then percolation is determined by the upper curve. If the flow is equal to or greater than 100,000 acre feet (**MaxThresh**) 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.

annual agricultural diversion. "**Eavg**" is the current month's evaporation value averaged over the base period (See Section B1.3). **AgUseMo** is then determined within the monthly loop and is equal to **AgUseFactor** multiplied by the current month's evaporation from the Cachuma Reservoir evaporation pan.

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 is subjected to. Similarly, **BankDepl** is subtracted from each subarea in proportion to the amount of human development within them. The net underflow into and out of each subarea is included as a constant. The **EndRipStor** equation for each subarea is listed below.

EndRipStorSYn = EndRipStorSYn + Seep + Bank - 75 - SyDiv - (.18 * AgUseMo) - (.78 * BankDepl)

EndRipStorBuel = EndripStorBuel + Seep + Bank - BuDiv - (.34 * AgUseMo) - (.1 * BankDepl)

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

EndRipStorSRitaW = EndRipStorSRitaW + Seep + Bank - 35 - (.03 * AgUseMo) - (.1 * BankDepl)

Notice that if **Prop** is equal to one (**CumlQ** is equal or greater than 100,000), **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 - RegulReleases

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. Therefore, if **Qincr** is less than zero the model sets it equal to zero.

The "constructive" flow (**Qin**) is 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 minus any releases to the Below Narrows Account from Cachuma Reservoir plus this month's **Bncred**.

The first table consists of thirty six monthly flow values at the Narrows (**NarrowsQ**) ranging from zero to 500,000 acre feet. "**HighNarP**" is the table of values defining the upper curve and "**LowNarP**" is the table of values defining the lower curve. The flow at the Narrows (**Qin**) is calculated in the West Santa Rita subarea section of the program (See Section B4.3). 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) $\leq$ **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 20,000 acre feet, the equation for **Percl** is:

Percl = HighNarP(I-1) + (Ratio * ((HighNarP(I) - HighNarP(I-1)))

If **CumlQ** lies somewhere between 20,000 and 100,000 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)/(MaxThresh - SwitchThresh)

Where **SwitchThresh** equals 20,000 acre feet and **MaxThresh** equals 100,000 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))

APPENDIX C:

GLOSSARY OF MODEL ACRONYMS

Note: The symbol (*) following the term indicates an array variable. Otherwise, the term is an individual variable.

%YrsDel@	-	"Percent Year's Delivery at...". See **MinDelv.** Pg.
AboveNarrwAcct	-	"Above Narrows Account". Last month's Above Narrows Account. Pg.
Accr	-	"Accretions". All of the runoff into a reservoir including runoff resulting from cloud seeding and excluding spills from reservoirs upstream and rainfall directly on the reservoir. Pg.
Accret(*)	-	"Accretions". Basic runoff data file used in model. Pg.
AccumRelease	-	"Accumulated Releases". The total Gin Chow releases from Gibraltar Reservoir for the current year up to and including the current month. Pg.
AgDist(*)	-	"Agricultural Distribution". Twelve values representing each month's percentage of the yearly agricultural use. Pg.
AgrCU	-	"Agricultural Consumptive Use". The Above Narrows ground water pumpage for agricultural purposes. Pg.
AgUseFactor(*)	-	"Agricultural Use Factor". A multiplier used to determine total agricultural diversions. Pg.
AgUseMo(*)	-	"Agricultural Use Month". The monthly agricultural pumpage from the Riparian strip. Pg.
AnnRunoff(*)	-	"Annual Runoff". The annual runoff into a reservoir up to, and including, the current month's inflow. Pg

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**). **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 again reduced by **BnRedu**.

ChkLower	-	
Correction	-	The difference between the amount of water that spilled from the "Base" Gibraltar and the actual Gibraltar Reservoir. This quantity is applied to the Cachuma Reservoir net inflow. Pg.
Correction	-	The difference between the Actual and "Base" Gibraltar Reservoir spills applied to the total inflow at Cachuma Reservoir. Pg.
Cpsum	-	
CsEff	-	"Cloud Seeding Efficiency." The effectiveness of cloud seeding expressed as a percentage of the maximum possible precipitation due to cloud seeding. Pg.
CsFac	-	"Cloud Seeding Factor".
CsFlag	-	"Cloud Seeding Flag". The device used by the Model to initiate cloud seeding calculations. Pg.
CsInc(*)	-	"Cloud Seeding Increment". The maximum incremental precipitation resulting from cloud seeding for each month of the base period. Pg.
Cum1Q	-	
CumPhanRel	-	"Cumulative Phantom Release". The volume of water released from the "Base" Gibraltar Reservoir for the current year up to, and including, the current month. Pg.
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.
Base Period	-	The historic time period used by the Model to predict current or future responses. Pg.

AnnShort(*)	-	"Annual Shortage". The current year's accumulated shorted up to, and including the current month. Pg.
Area7	-	The total current area of a reservoir. Pg.
AvgVol	-	
BankDepl	-	"Bank Depletions". The loss of inflow to the Riparian Basin through the surrounding geologic units due to human development in the surrounding areas. Pg.
Bank	-	"Bank Infiltration". Water that infiltrates the Riparian Strip from the aquifer banks. Pg.
BelowNarrwAcct	-	"Below Narrows Account".
BelowNrwsRel	-	"Below Narrows Release". Releases from Cachuma Reservoir to satisfy the Below Narrows Account. Pg.
Bncred	-	"Below Narrows Credit". The credit to be applied to the Below Narrows Account for the current month. Pg.
BnRedu	-	"Below Narrows Reduction". The amount of Cachuma Reservoir spill water that percolated into the Lompoc Forebay. Pg.
BufPtr	-	"Buff Pointer". The pointer that selects the elevation to be used to determine leakage from Cachuma Reservoir. Pg.
BuDiv	-	
BuMI	-	
CachEt(*)	-	"Cachuma Evapotranspiration". The factor which corrects for inundation of vegetation at Cachuma Reservoir. Pg.
CachNetIn	-	"Cachuma Net Inflow". The monthly net inflow to Cachuma Reservoir. Pg.
ChkHigher	-	

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 -

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 base 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

APPENDIX E:

STREAM SEEPAGE FORMULA

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

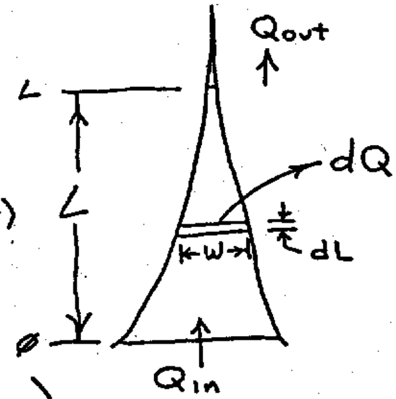
5) Groundwater and Percolation Data For Use in Determining Downstream Releases, Santa Ynez River, Cachuma Project, CA, United States Department of the Interior, Bureau of Reclamation, March 1973 pp. 3-15.

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

This formula, as shown, is developed for use with average daily flow (cfs-days) type data.

The use of other time periods requires appropriate conversion factors.



a) Assume seepage is proportional to wetted surface area.

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

& differential area $= dA = W \times dL$

& perc rate (ft./day) $= P$

& Let percolation $= dQ$ (a-number)

b): Derive W (i.e. α & β) from air photos & dates & records plotting stream widths against Qs on LOG-LOG paper.

then, $-dQ = dA \times \frac{P}{86400} = \frac{P}{86400} \times \alpha \times Q^{\beta} \times dL$

so, $-\frac{dQ}{Q^{\beta}} = \frac{P}{86400} \times \alpha \times dL$

c) As dL slides from ∅ to L, Q varies from Q_{in} to Q_{out}.*

$$-\int_{Q_{in}}^{Q_{out}} \frac{dQ}{Q^{\beta}} = \int_{0}^{L} \frac{\alpha \times P}{86400} dL = \frac{\alpha \times P \times L}{86400} = \frac{1}{1-\beta} \times Q^{1-\beta} \Big|_{Q_{out}}^{Q_{in}}$$

note: order switch makes positive

so, $$Q_{in}^{1-\beta} - Q_{out}^{1-\beta} = \frac{(1-\beta) \times \alpha \times P \times L}{86400}$$

or, $$Q_{out} = \left[Q_{in}^{1-\beta} - \frac{(1-\beta) \times \alpha \times P \times L}{86400} \right]^{\frac{1}{1-\beta}}$$

and, seepage equals Q_{in} minus Q_{out}.

* Note: Q_{in} and Q_{out} are in cfs-days.