CALIFORNIA PUBLIC UTILITIES COMMISSION
Utilities Division
Hydraulic Branch

GUIDE TO THE USE OF COMPUTER PROGRAMS FOR ESTIMATING WATER CONSUMPTION AND REVENUES

Supplement to

Standard Practice No. U-25
April 1, 1977

ACKNOWLEDGEMENT

This standard practice supplement was prepared by Associate Engineer D. H. Weiss. Under his general direction, the basic weather adjustment routine WEATHER of CLIMATE was developed by the California Department of Water Resources (Mr. C. Landon) and incorporated in the overall CLIMATE Program by the Data Processing Branch (Mr. G. Parras). Mr. J. Duggan of that branch has combined and improved the ESTREVS Program (originally developed by his associate, Mr. J. Millington) and has developed LINKUP. Mr. J. Panella (now of the Transportation Division) provided significant assistance in evaluation of statistical parameters developed by MUREG.

The writer also appreciates the assistance of many members of the Hydraulic Branch in developing the techniques discussed in this report. Of special value was the careful and critical review of this work by Messrs. A. Tokmakoff, W. L. Hancock and B.Y.B. Tan.

Finally much credit must be given to Dr. George Kuznets, of the University of California at Berkeley, Professor of Agricultural and Resource Economics, as well as Statistics, who spent much time explaining to us the strengths and weaknesses of statistical analysis.

For a historical development of the basic multiple regression approach, see Modified Bean Method for Normalizing Water Sales, A. Tokmakoff, California Water Conservation, Yosemite, California, November 14, 1974.

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ABSTRACT

This guide has been prepared to supplement Standard Practice No. U-25, Guide to Ad,justing and Estimating Operating Revenues for Water Utilities, April 30, 1968. It makes available a description of the existing Hydraulic Branch computer programs and procedures that may be used to estimate such revenues and provides detailed-instruction as to their use.

The recommended method of water consumption estimating for the commercial class as developed by the FUC-CWA Consumption-Revenue Committee (hereinafter referred to as "Committee")is described in terms of the existing computer programs.

One of the procedures (ONESHOT)ensbles.the Engineer by simply entering on data sheets such information as recorded water consumption, weather station identification, and revenue structure data to determine in one step, normalized and forecast revenues.

The CLIMATE program also is of special interest as it allows a series of runs with different time spans to be run with only one set of input data which is often of particular'value in carrying out the Committee's recommended procedure.

NOTATIQ!I

Term	Definition	Units
Q,(R)	*Recorded Hater Consumption (Unit Consumption)	ccf/meter - year
Q(N)	Computed or Engineer Furnished Normalized Water Consumption Forecast (Unit Consumption)	ccf/meter - year
Q(A)	Computed or Engineer Furnished Test Year A Water Consumption Forecast (Unit Consumption)	ccf/meter - year
Q(B)	Computed or Engineer Furnished Test Year B Water Consumption Forecast (Unit Consumption)	ccf/meter - year
Q(C)	Computed Water Consumption for the Recorded Year R (Unit Consumption)	ccf/meter - year
B(R)	*Recorded Bills (Total)	Bills/year
B(N)	Normalized Bills (Total)Forecast	Bills/year
B(A)	*Test Year A Bills (Total)Forecast	Bills/year
B(B)	*Test Year B Bills (Total)Forecast	Bills/year
,,; Q(R)	Computed Recorded Water Consumption (Total)	ecf/year
::sQ(N)	Computed Normalized Water Consumption {Total)	ccfjyear
::s Q(A)	Computed Test Year A Water Consumption (Total)	ccf/year
::SQ(B)	Computed Test Year B Water Consumption (Total)	ccf/year
Q(RN)	Computed Consumption Growth Ratio based upon Recorded and Normalized Year Values	**Dimensionl-ess**
Q(RC)	Computed Consumption Growth Ratio based upon Recorded and Computed Values for Year R. Always Equal to 1.0.	Dimensionless
Q(RA)	Computed Consumption Growth Ratio based upon Recorded and Test Year A Values	DimensionLess
Q(RB)	Computed Consumption Growth Ratio based upon Recorded and Test Year B Values	**Dimensionless**
B(RN)	Computed Bill Growth Ratio based upon Recorded and Normalized Year Values	Dimensionless
B(RA)	Computed Bill Growth Ratio based upon Recorded and Test Year A values	Dimensionless
B(RB)	Computed Bill Growth Ratio "based upon Recorded and Test Year B Values	Dimensionless

* Engineer furnished data.

NOTATION

	Definition	Units
BXS(R)	*Recorded Bills (except smallest meter) Forecast	Bills/year
BXS(N)	Normalized Bills (except smallest meter} Forecast	Bills/year
BXS(A)	*Test Year A Bills (except smallest meter) Forecast	Bills/year
BXS(B)	*Test Year B Bills (except smallest meter) Forecast	Bills/year
BXS(RN)	Computed Bill Growth Ratio based upon Recorded and Normalized Year Values except for Smallest Meters	Dimensionless
BXS(RA)	Computed Bill Growth Ratio based upon Recorded and Test Year A Values except for Smallest Meters	Dimensionless
BXS(RB)	Computed Bill Growth Ratio based upon Recorded and Test Year B Values except for Smallest'Meters	Dimensionless
R(R)	*Recorded Revenue	Dcllars
Q_t	Unithconsumption as a function of time and normalized west er	ccf/meter - year
k	Number of Independent Variables	Dimensionless
n	Number of Observations	Dimensionless
t	Year	¥ear
RJ_x	Monthly Recorded Rain:fall, January, Year X {typical)	Inches
TJ_x	Montncy Recorded Avg.Temperatur.q January.Year X (typ)	°F
R_{adj}.	Annual Rainfall Adjusted for Meter Reading Cycle	Inches
T_{adj}.	Annual Temperature Adjusted for Meter Reading Cycle	°F
Ravg	Average of Adjusted Annual Rainfall over a Nominal 30-year Period (Printout: SUM R ADJ)	Inches
Tavg	Average or Adjusted Annual Temperature over a Nominal 30-year Period (Printout: SUM T ADJ)	°F
	Constant	ccf/meter - year
Q(r)	Recorded unit water consumption for each or the span years. Called Y-OBSERVED on printout.	ccf/meter - year
Q(c)	Calculated unit water consumption ror each of the span years. Called Y-CALCULATED on printout.	ccf/meter - year
Q(m)	Mean of recorded unit waterconsumption for the span years	ccf/meter - year

* Engineer furnished data.

CHAPTER 1

INTRODUCTION

The main body of this report describes individually, and then in integr-ated form, three progr-ams/procedureJ/used by the Hydraulic Branch primarily in commercial class revenue estimating, i.e., \>lEATHER, MUREG, and ESTREVS. The integr-ated overall progr-am (ONESHOT) is achieved via the use of a fourth progr-am entitled LINKUP.

When ONESHOT is used, it carries out the following six operations in sequence.

\>lEATHER (Temoerature and Precinitation)Y

1. Obtains weather data for a particular weather station from a PUC modified U.S. Weather Bureau magnetic tape which contains essentially all weather information of record (but at least from 1931) for all California weather stations.2/
2. Interpolates for a missing month's temperature and/or precipitation. When two or more consecutive months' data is missing, it alerts user that such is missing and deletes that year's records from subsequent calculations.
3. Makes other engineer-desired adjustments to the raw data, i.e., adjusts recorded rainfall and temperatures for billing cycle procedures and engineer-specified maximum

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We have taken the liberty of using program identification not used by the Data Processi."lg Branch in order to simplify understanding.

\<lEATHER is only used in conjunction with MUREG (steps 1 through 5 above). The joint program is entitled CLIMATE.

While the Hydraulic Branch obtains temperature and precipitation only from the tape, other weather information is available from it whi.ch can be accessed independently of the procedures described here. A complete new tape or an annual supplement is purchesed each year by the Commission from the Environmental Data Service, NOAA, Asheville, N.C. 28801.

allowable monthly rainfall limits. Prints out the data from steps 1 and 2, plus the annual adjusted averages a multi-year annual adjusted average as specified by the engineer.

MUREG

4. Automatically combines above information with engineer-furnished recorded water consumption data and uses it in a multiple regression program where complex mathematical calculations are made. Provides valuable statistical information for judging validity of results.iJ

5. Estimates normal year and forecasts future year(s) water consumption assuming a time trend.

ESTREVS

6. Receives above estimates and calculates revenue as a function of tariff and billing procedure, rates (present/proposed), customers, and customer growth projection assuming either a time trend or no trend with time after the establishment of the recorded year normalized consumption.

The basic program CLIMATE is described in Chapter 2. It requ4 es 1 the use of only two forms, CI and CD.2/

Chapter 3 illustrates hoJ basic information from CLIMATE may be used in conjunction with changing weather data and adding or omitting variables prior to using separately the multiple regression program MUREG. Only forms MI and MD are required.

.iJ In simplified analysis, the standard error of the equation divided by the mean of the recorded consumption over the regression time soan considered is the fundamental measure of equation fit. See Chapter 6, Committee Method.

5/ T"ne Hydraulic Branch request for arry EDP services form not shown in this

1 - INTRODUCTION

The program to calculate revenue, ESTREVS, is described in Chapter 4, along with its single form ESTREVS (492.12B), The obtaining of b:illing and consumption data for either a monthly or bimonthly b:illing is shown,

Chapter 5 shows how CLIMATE and ESTREVS may be combined (ONESHOT) to get revenue directly using forms CI, CD, and ESTREVS,

Chapter 6 discusses the report of the Committee and describes two alternate approaches to carrying out the recommended procedure using the existing programs and forms referred to above.

All programming is in general accordance with Standard Practice U-25 and the modified Bean Theory (a description of the graphical approach to that theory is given on pages 5-3 through 5-7 of that document) fi./

Approximate average out-of-pocket cost, including Engineer's preparation time and analysis for a typical case of ONESHOT, is $170, compared to about $700 when hand calculations a.reference books are used, Tima saving is about one and a half weeks for San Francisco work. The branch has about 30 such cases per year.

As noted above, the three basic programs can also be used separately. A typical application would be the use of ESTREVS to make .res rapid multiple studies of changes in rates once overall consumption characteristics have been estimated.

The report includes as Exhibit N, a description of how the MUREG portion of the existing ONESHOT program may be modified in the future EG. so that we will be able essentielly to perform automatically the complete revenue estimating process according to the {Jommittee method.

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6,

thiS

/ Only linear multiple regression is used with the computer as compared to linear and curvilinear techniques shown in U-25.

To sum up, the entire practice is based upon the assumption that past is prologue and thus by fitting a linear equation to past water sales results and, using a mean of past weather data, future water sales can be projected on a "normalized" basis. No accounting for weather or economic changes is considered as, in both those areas, no generally accepted procedures for predicting the future are currently available. That does not mean that the Engineer is not encouraged to research out other weather factors, etc., that may in the future improve the techniques described here.

CHAPTER 2

CLIMATE PROGRAM

A. Program Description

The program consists of the WEATHER and MUREG programs in one package, Thus, it combines the U.S. Weather Bureau library of historical weather infer-

ures mation for California (on tape) with the Control Data Corporation library MUREG (Multiple Regression) Program and, in addition, estimates normalized water consumption for the last recorded and for the two following years. The program specifically does the following:

1. Input parameter records (Data obtained frcm Engineer furnished forms CI and CD shown as Exhibits A.1 and A.2 and calculated per pg. 5-6).
   a. Date, Run Identification and Weather Station Identification Number (latter available in U.S. Climatological Data Books).
   b. Lists whether card or tape input data is to be used; i.e., the Engineer must indicate whether he wishes to use weather information frcm the Weather Bureau tape or whether he wishes to insert his own rainfall or temperature data via cards.
   c. Maximum rainfall to be considered in a:rry one month as specified by Engineer (Standard value is 4.0).
   d. Billing type by Engineer monthly or bimonthly).
   e. Data grouping (annual or quarterly); ;V

;V Based upon the Committee's procedure, only annual data is to be used in analysis and CLIMATE is designed on that basis. The WEATHER portion however iJ1 provide quarterly adjusted data f r separate MID!EG analysis if required.

:f. Time spans to be used in the development of adjusted rainfeJJ. and temperature averages (Rain/Temperature Mean Period) and MUBEG analysis (Water Consumption Period) ,*Sf* note, the MUREG analysis is not restricted to end on the last year of the tape. Note also, if 30-year mean rainfall and temperature va.J..ues are to be used as the normalized values, 3l years of rainfall and temperature data must be available on the tape. A reference is available upon request from the Weather Bureau listing all tape weather data.

g. Starting year for spans referred to in Item f., above (computer calc.)•

h. Number of times to drop a year in order to get different MUREG time span runs. Years are dropped only from the beginning of the span)./

i. \-later ales (consumption) are a function of tims.

2. WEATHER Computations - The program retrieves data and computes as follO>lS:

a. Obtai.t1S "raw" historical' weather data. from the tape and prints it out. Alternately, it is possible to use cards to insert weather data so that the Engineer, upon special occasions, can

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Sf Up to thirty years of observation of recorded meter water consumption on ant1ual or quarterly basis can be furnished by the Er,.gineer.

This is an optional procedure and is only usable with CLJMATE. Leave inuu data sheet line blank when ONESHOT is celled for (Exhibit A.l, line 10).-

add monthly data in cases where. data is missing from the tape or substitute his own weather inforwAtion for all or part of that furnished by the Weather Bureau.

b. In preparing the above raw data, the program interpolates between monthly records if one month is missing from the rainfall. and temperature data. It indicates that procedure by printing out symbol "777" and a flag on the raw data sheets. If more than one month of data is missing, it omits the entire year from weather averaging and MUREG calculations. That is, it does not print out that year's or quarter's adjusted weather data. Ho;1ever, the program will complete the MUREG analysis and extrapolation after taking into account the missing data.

c. It adjusts the recorded monthly rainfal1.2/ to any specified maximum level bet>Teen 1 and 9 inches per month,

d. It adjusts that data for continuous meter reading cycles, either monthly or bimonthly, per Standard Practice U-25,§/

.s

':} The computer will also "dump" the weather records contained in the library weather station. The Engineer .can thus determine how many years of useful data is available from the Weather Bureau re.cords, For example, he may find only 16 years' information is available for developing 30-year mean rainfall and temperature figures and thus may wish to use another station for the other 15 years' data. This combining operation may be done after dumping through the use of card input. "Dump" refers to a complete storage printout.

can

Note that the program;.'ill "dump out" if you direct the computer to use 30 years of weather data associated with a station >Then less than 30 years data is on the tape. The raw and adjusted data printed out, ho>Tever, >Till be useful ,.,hen going back to the regular 14\JREG program >Then using card input.

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e inpu
10).

Time and money will be saved hm1ever if the previously referred to weather reference book is consulted prior to computer use.

The figures 999.99 under precipitation indicate a trace of rainfall which >Te define as zero rainfall.

§/ See Exhibit A.3 for procedure applying to both annual and quartel'ly data.

e. It summarizes "adjusted" weather data for MUREG analysis on an annual or quarterly basis. It calculates an average of adjusted rainfall and temperature for the specified historical period wnDsea last year corresponds to the last year of the MUREG analysis and prints it out. That average is called the normalized rain€al1 and temperature, and is listed on the printout as SUM R ADJ and SUM T AnJ.

Computations for J{UREG – The program performs multiple regres£ion and 1 determines normalized consumption as follows:

a. The MUREG program takes the recorded water consmnption data and the a.nnual adjusted rainfall and temperature data and carri s out ordinary stepwisei/ multiple regression analysis (using consumption as the dependent variable). The result is a forecast of water consmnption based upon the equation:

$$Q = K + at + bR_{avg} + cT_{avg}$$ §./

;;here the adjusted average values of R and T are to be inserted into the equation along vrith appropriate values of timet f:or the last recorded and the two forecast years Aand B, in order to obtain normalized and forecast year consmnptions. K, a, b, and c are constants determined by the analysis. In the printouts, K is called the CDNSTA.t"fr TEand a, b, and c, BETA.

b. The program currently calculates and prints out water consumption, based upon the normalized rainfall and temperature f:or the last

1/ The order in which the independent variables are printed out is a me of the contribution of that variable in explaining the correlation.

§./ Signs of the coefficients are determined by the regression analysis are automatically printed out as well as utilized by the computer in making **forecasts¢**

recorded consu.m;ption year. It also calculates and prints out water consumption for two years following the last recorded year using the time trend coefficient developed in MUREG.

c. After the development of the existing program, the Committee concluded that BETA coefficients for R and T with illogical signs should be eliminated from the basic formula when they occur. Until MUREG is modified it is necessary to perform that step by hand as discussed in Chapter 6 so that the values of "c" and "d" coefficients of the fundamental equation must always be restricted to:

$$c \geq 0 \text{ and } d \geq 0$$

Normalized and forecast consumption values therefore will be slightly different from that given in the printout under those circumstances.

4. Computations of Statistical Data

The program computes Adjusted R^2 (Adjusted Coefficient of Determination - Squared) which is useful in comparing runs where a different number of years are used as well as the ratio of Standard rror of the Equation di\ ded by the Mean Consumption over the time span considered. (Hater Consumption Period)

5. Typical Printouts

Ex:hibit A.4 illustrates the operation of some features of WEATHER referred to above. For example, pages A.4- 1, 2, 3, and 4 show data 11as missing from the \-leather Bureau tape. Pages A. and A.4-2 shm; t11o or more consecutive missing items in 1946 and 1957, as indicated by "777" and a flag message. As a result, those years plus two others not sho-wn on the printout were dropped from

the data used to develop mean rainfall and temperature as noted on page A.4-3. The mean shown in this case on page A.4-4 is only 26 years, compared to our standard 30-year mean.

Note also that while one month's temperature data was missing on page A.4-3, year 1970 was not dropped. Instead, the computer interpolated the missing temperature value from the preceding and following temperatures and used that value to caJ.culate the annual average adjusted temperature for 1970, as shown on page A.4-4, i.e., 62.5° Fahrenheit. See also Exhibit L.l :for additiO!lal examples of the computer performed adjustments of WEATHER.

A typical CLIMATE printout consists of pages L.l-1 through L.l-7 of Exhibit L (pages 5-6 through 5-12).

B. Time Spans

As analysis is generally made by reviewing time spans ranging from 5 to 13 years, alwayusing when possible, the last recorded year as one of th observations. At least five observations are required to use the program, thu cases may arise where spans of at least six y ars or more are needed to provid the required input data. Whether or not weather data is to be substituted for missing data to obtaLa complete set of spans is left to the judgment of the Engineer.

\'/hen a suitable value for cropping is inserted adjacent to columns 43-44 of Form CI, e.g. 8, the computer will carry out the WEAT!iER program one after which it will utilize that basic input and its computed adjusted data t perform a series of MtJRBJ runs covering tine spans from the maximum of 13 yea dto 5 years.

To aid in span run selection, the standard error ratio will be prin out (see Chapter 6) after each span run, just bel<Yw the Adjusted R square val

C, Data Forms Required

The forms to be used in CLJJ-1.1\TE consist of Forms CI and CD. These provide the instructions and input data to the computer. A self-explanatory example is provided in Exhibits A.l and A.2. Note that Unit Consumption (Sales) must always be determined in the srune way as Hater Use Analysis calculated values and is calculated for each year by dividing the total consumption by the total p.umber of bills, irrespective of whether they are partiaJ. or compJ.ete bills. See Q(R) calculation in Exhibits D.l and F.l (pages 4-22 and 4-4o) •

The results of the use of Exhibits A.l and A.2, are as noted above, are shown in Exhibit L.l, pages L.l-1 through L.l-7. (starling page 5..:6).

C!

EXHIBIT A.l

Control Card for CPUC llydraul.ic Branch CLIMATE Program
CLIMATE Instructions

	DescriPtion of Field	Columns	Min:Sample
1.	Identification	Ol.-16	
2.	If Rain/Temp Data Come From Tape, Code (T) If Rain/Temp Data Come From Cards, Code (C)	18-1.8	
3.	Maximum Ra.infal.l. (All.owable Range is l.-9 inches)	20-20	*4*
4.	If Billing Cycle is Monthly, Code (M) If Billing Cycle is Bimonthly, Code (B)	22-22	*M*
5.	If Deta Grouping is Quarterly, Code .(Q) If Data Grouping is Annual, Code (A)	24-24	*A*
6.	Rain/Temp Mean Period (Years)	29-30	*Q*
7.	Last We.t<:'r Consumption Year (Last Tlio Digits of Year)	32-33	*71-*
8.	Number of Years of Watsr Consumption Deta {Span)	35-36	*-'?.*
9.	Station Number	38-41.	*Bi*
10.	Number of Times to Drop e Year starting with Initia.l Year (Optional)	43-44	*-{1*

Use this sheet with sheet CD
All values lobe righl- Justified

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CPUC Hydraulic Branch CLIMATE Program - CLIMATE Data
If ANNUAL: One line Per Year
If QUARTERLY: Four lines Per Year

IDENTIFICATION	YR	WATER CONSUMPTION	Station NUMBER
MIN SAMPLE	66	4042	5738
	67	4261	
	68	4140	
	69	3921	
	70	4157	
	71	4129	
	72	4332	
	73	4205	
	74	4201	

9/76

EXHIBIT A2

C3

EXHIBIT A.3
Sheet 1 of 3

BILLING CYCLES AND RAINFALL ADJUSTMENTS

Standard Practice U-25, page 5-3, paragraph 10 describes how monthly rainfall and temperature readings are to be adjusted to better correlate them with annual water sales data. The adjustments which are a function of meter reading cycle (also called billing cycle) may be written as follows for continuous meter reading:

Monthly Meter Reading

$$R_{adj.\ x} = \frac{x-1}{2} + \sum\left(R_{J_x} \longrightarrow R_{D_x}\right) \qquad \frac{R_{D_x}}{2}$$

$$T_{adj.\ x} = \frac{1}{12}\left[\frac{T_{D_{x-1}}}{2} + \sum\left(T_{J_x} \longrightarrow T_{D_x}\right) \qquad \frac{T_{D_x}}{2}\right]$$

Bimonthly Meter Reading

$$\sum_{x-1} + \frac{3}{4} R_{D_{x-1}} + \sum\left(R_{J_x} \longrightarrow R_{D_x}\right) - \frac{R_{N_x}}{4} \qquad \frac{3R_{D_x}}{4}$$

$$= \frac{1}{12}\left[TN_{x-1} + \sum TD_{x-1} + \sum\left(T_{J_x} \longrightarrow T_{D_x}\right) \qquad \frac{TN_x}{4} \qquad \frac{3}{4}\right]$$

BILLING CYCLES AND RAINFALL ADJUSTMENTS

Where $R_{adj.x}$ $T_{adj.x}$ = Annual Adjusted Values required for Year X. Printed out by computer as Adjusted Values.

$R_{D_{x-1}}$ $T_{D_{x-1}}$ = Typical monthly values such as December for year preceding Year X. Obtained from Weather. Bureau tape as raw data. The monthly R values then are adjusted by computer so as never to exceed the ngineer specified monthly maximum and are used by the computer to calculate the annual Adjusted Values.

As the Engineer may be required to anlyze sales on a quarter1y rather than annual basis, WEATHER includes the capability o'f adjusting the Weather Bureau raw data on that basis (CLIMATE at this time is not able to handle quarterly data and thus MUR:&Z must be used in conjunction With that type of analysis The adjustments may be written as follows where $Rd._{a\ J.1Q}$ and $T\ d._{a\ J\bullet 1Q}$ refer typically to 'first quarter data. R input is again limited to the Engineer specified maximum monthly value.

Monthly Meter Reading

$$Rd._{a\ J.1Q} = x\frac{-1}{2} + RJ_x + \frac{RJ_x + 1)._x}{2} + \frac{1)._x + x}{2}$$

$$= \frac{x-1}{2} + RJ_x + p'F_x + \frac{x}{2}$$

$$T_{adj.1Q} = \frac{1}{3}\left[TD_{\frac{x-1}{2}} + TJ_x + TF_x + T{:}X\right]$$

BILLING CYCLES AND RAINFALL ADJUSTMENTS

Bimonthly Meter Reading

$$R_{adj.1Q} = \frac{1}{2}\left(R_{x-1} + R_{D_{x-1}} + \frac{R_{J_x}}{2}\right) + \frac{1}{2}\left(\frac{R_{D_{x-1}}}{2} + R_{J_x} + \frac{R_{F_x}}{2}\right) + \frac{1}{2}\left(\frac{R_{J_x}}{2} + R_{F_x} + \frac{R_{M_x}}{2}\right)$$

$$= \frac{R_{x-1}}{4} + R_{D_{x-1}} + R_{J_x} + \frac{R_x}{4}$$

$$T_{adj.1Q} = \frac{1}{4}\left[T_{N_{x-1}} + T_{D_{x-1}} + \frac{3}{4}T_{J_x} + \frac{3}{4}T_{F_x} + T_{M_x}\right]$$

While the basis of these equations is continuous meter reading, their application to non-continuous meter reading is believed satisfactory although it should theoretically result in a decrease of the standard error ratio.

r.< PF" tNPUT m RA 04TA

					SfAH	D!V	STATION	VEAl:?	Mf.i	TEMP	P ECIP
Otl06	JI9Q7.391d3fHl	059C	00 1fJ3	oa		0	8Q73			SQ,C	t O3
OMOb	,SQ739U30'5	062A	QqqqQ	O•			8971		5	b2,6qqq	eyq
0406	89739430b	062C	00000	O•		6	eon	003	6	b2,C	,00
0006	69739U307	ObbF	OOOOn	O•			R013	943	7	bboF	•00
0406	691394308	0670	00000	O•		6	8973		8	b7,0	,00
()ltOb	897394300	065F	OOnOO	O•		b	O•n			bS,F	,00
0006	eono•l!O	063<	00031	O•		b	eon	003	I0	bl,<	•
O•O•	Mn9all 1	0590	OOOO•	O•		6	8973		I I	t;Q,0	,OO
0006	8071941 I 2	055C	00550	O•		b	eon	OOJ	\2	S'5,C	5 0 5q
0406	s•n•••O1	051G	00065	O•		b	8OB	Ouu	I	53,G	,65
OIJ06	80710U402	052F	00725	O•			e•n		2	S2,F	1,25
0006	89i' QIHI03	057A	00?23	O•			eon			57 1A	2,2
Ol!Ob	sq719cuoa	0560	00038	O•		b	8073			SO,O	,Ja
0406	s•n•••os	060M	0000\	O•			eon		5	bO,	,0I
O•O•	807!04406	Ob2G	00000	00			eon			&2eG	,00
0406	sq7JQuuo7	()b(d	00000	O•		6	eon		7	biJtN	,00
OIJ()h	OOnOOOOO	Obb!	001'00	O•	0	b	8073		8	bb t	,00
/)406	B91V'H!ll0q	OObH	OOOO/'1	0	0		8073			bb,H	,00
,)406	8971044!0	062F	00002	O•			RQ73		I0	629F	,02
()06	son••• 11	0560	OOUQ/.1.	OO		b	8073		I I	5b 1D	u,QI.I
0406	B•n•••t?	OSSF	00050	OU		6	BQH		I<	SS,F	,SQ
		052!	00005	O•	4						
01.106	80730450 I						8Q1!			52,Y	,OS
	807HOS02	OSH	OO'SO	0		6	8073			53 t	3g80
0406 (!1.106	s•n••>o;	053C	00383	O•		6	8Q7l	QOS	2 3	53,C	3,83 ,00
0006	a•n••s 11	0571	00048	O•		b	oon	ous	I I	57,!	,•8
0«06	8073Q0500	OSYF	00000	O•	0	6	8Q1l				
Oli06	a•n••sos	0608	0000\	00		6	8Q73		5	57.E &O,R	•0!
1\) Ot. Ob	M719450h	0600	0000?.	00		6	8013		b	blJ,O	,02
0006	8Q7300507	0680	00000	O•	0	6	eon		1	ea,o	,00
0J 0006	a•n•osos	071C	00000	00		6	8073	•OS	8	1!.C	.00

CLIMATE PRINTOUT

EXHIBIT AA-1

WEATHER BUREAU SYMBOLOGY

Symbol	Value
<	O
A	I
B	2
C	3
D	4
E	5
F	6
G	7
H	8
I	9

Ot.!Of:l	897Ho<;OO	0708	•••••	o•	•	b	eon					
OUOb	MH40SIO	OoSE	00002	o•	•	•	eon	••S'	•	10	b'S,E	,02
0006	8073905!2	056A	OOHZ	o•	•	b	8013	00'5	12		5b,A	3,72
0006	*601* ··1>0!	OSS	0002'i	00	0	•	son	•••	1		SS,B	,25
0ʟI(\b	897394&02	OS2B	QOOBLI	o•	0	•	807:3	•••	2		52,8	,au
0006	89)390603	05H	00300	o•	"	6	eon	006	3		SEJ,E	:S,0q
OliO&	807!94600	0500	OOO'iO	00	•	b	8973	••,	0		SQ,O	,su
0006	897:l9460S	1)60H	00000	o•	•	•	BQB	•••	5		60tH	,00
0406	807394Mb	065F	00000	o•	•	6	eon	OOb			65pF	,00
(\IJ06	09139«607	068'	00000	o«	•	6	8911	•••			68,A	,00
OIJ06	89739UoOA	*ObBM*	00000	••	"	•	son	q -			8 H	0
0006	son•••n•	777	177	*ou*	•	•	8973				17, 777,00	
OIJ06	007JO«b!O	*177*	777	00	•	b	8013		!		*171*, 777,00	
040h	807"!946!1	177	777	o•	•	b	8073		I		777. 777,00	
OIJ06	807H0612	717	777	o•	•	b	son		I		777, 777,00	
0406	097304701	Q5jH	0001«	O•	0	6	BOB			I	I, H	•
	o•n•oroz	058.	00058	n0	0	6	nnJ			2	58,A	,58
0406	807!04703		00064	04	0	6				3		•••
oUO&		05Q<					son				SQ,<	
0401>	897390700	060H	00023	04	•	b	8973		•		$b0_0$H	,23
0406	807\Q0705	Ob3C	n0000	o•	•	6	8073				$o5_9$C	,no
040&	s•n••roo	OoH	0000!	04	•	6	8073		b		bh$1::	,0I

MISSING TEMPERATURE 8 PREC PITATION
2 OR MORE MISSING MONTHS
.. DELETE YEAR 1946

MSSNG T(;'MP"SSNG POE(
MSSNG TE"'PMSSNG PREC
•SSNG TfMPJ. SSNG PREC
MSSNG TEMPM55Nt;

POEC'

FLAG

					STAT[	OIV	5f. T{QN	VEAR	MO	TE P4P	PRfCIP
fltJQ6	8Q7}Q5bfll	0520	tl043q	00	•	•	8Q73	95b	▮	f52',0	.3Q
(}.006	AQ7.JQ5b02r-t0fJOq	0005	00		•	•	AQ7]	0S0	Z	4Q•A	,53
OlJOl""	601!05&03	055A	00000	00	•	•	6015	05&	3	SS,A	,00
O•O•	8Q7'3Q'5bOUM015'lE		00178	00	•	•	a.n	05&	•	'S'S,E	1c78
0006	807J95h05MOoO!		00001	O•	•	•	a•n	05&	5	bO,l	,03
0000	897195&07	Obb<	n0000	00	•	•	8073	0%	1	6b,<	,00
000&	807105b08MO&H.		00000	O•	•	b	6073	05&	8	o7,E	,00
I)!H}6	09730%00M0&8E		00000	O•	0	•	8973	05b	0	be.E	,00
0000	eon•s•t o	Ob3A	qqqqQ	o•	II	6	son	•S•	10	b3 0 A()Q	,qq
fllIOb	897!95&11	Ob2E	ooooo	o•	II	6	6015	•S•	11	b2 0 E	,oo
0406	89739 1>12	OSbG	00000	04	•	b	8973	056	12	s&.G	,oo
OLl06	89B95701	052<	00420	04	0	0	8973	05?	1	S2.<	llu20
IHJO	897305702	0578	001!7	••	•	•	eon	957	2	SY,B	i 1 3'1
oaott	647305703	056E	00126	04	•	•	aon	957	▮	5b,(	t.co
0406	897.!05704M057		00063	O•	•	II	6973			8	,63
0400	80H95705M777		00046	••	•	•	8973		5777.		•••
O•O•	B0739570bM777		qq qq	O•	0	II	eon		b777,	qqq,qq	
0«06-	897305707	071B	qqqqq	O•	4	b	8073	1		,aqqq,qq	
OIJ()A	807305708	OY!F	00000	O•	•	•	son	057	8	11 a F	,oo
OLl06	eqnos1oo	o•a•	00000	O•	0	b	son	•57	q	8,<	,oo
0006	M7l057!0	Ob5A	00100	04	0	b	eon	057	10	es.A	1 t 00
0 /j 06	0130 7\1M0	8H	00060	O•	•	b	eon	057	11	sa.H	•••
0006	80730'5712	050<	00268	00	4	b	son	057	12	sq.<	Z.M
0006	807!05801	OS1A	00107	00	•	•	e,q·n	058	▮	57••	1.-Q7
0U06	eonosaoz	os•c	00678	04	•	•	son	•S•	2	sq.e	o.le
0406	BOH05M3	OS&G	oo•n	04	•	b	BOB	· 8	1	'5boG	•·n
O«i'h!l	eonoseou	062!	00288	O•	•	•	an;	058	•	62,!	2.Ae
0401>	807305805M0600		00003	o•	•	•	an;	058	5	b t 0	•01
040il	8HH5801>	Obi>!	00000	o•	•	•	80 7l	058	•	bb,I	,oo
O•O•	eono5807	008!	00000	O•	•	•	8073	9SR	7	M.I	,00
O•O•	807305808	0728	00000	o•	•	•	MB	058	8	72,8	,00
0006	07!05800	071H	00000	M	•	•	8073	058	•	71 •;4	,o•
o«oo	aonose1 o	070E	00000	00	0	&	son	0SS	10	70,Eqqq,t:;tt/	
0006	8073Q5811	Ob1C	Qqqqq	O•	•	•	eon	•sa	11	ot,eqqq,qq	
O•O•	aonosa12	osoa	00000	o•	•	•	8073	0;a	12	I§Q.A	,00
0006	s•n•s•ot	056H	001&0	o•	•	6	8073	0 ·	1	5&,).4	t.0q
000&	S07105ooz	o53n	00069	o•	•	•	eon	O'iO	2	5J,D	u.&Q
oaoe	8073050/)3	ObOF	Qqqqq	O•	•	b	8073	▪ ,▮	▮	&o,Fqqq,Qq	
000&	807305004	062A	00020	o•	•	•	8073	•so	•	b2,A	,20
O•O•	807305005	0&2!	00000	00	•	b	son	os•	5	62,!	,oo
0006	80730500&	001<	00000	O•	•	b	8973	•S•	•	61.<	,oo
0406	eonoSQ07	o72G	qqqqq	O•		b	s•n	•so	7	12,Gqqq,qq	
0406	BQ7JQ5Q08	01!<	oo on	Oa	a	6	eon	•so	8	71 t c	,00
040!>	•nosooo	o7o<	•••••	04	•	b	eon	OS0	•	1o,cqqq.qq	
0406	07HS010	ObbG	o••••	oo	•	6	8973	▮▮▮	\0	bb,GQ'?9sQ	
0406	OB0501!	063F	qqqqq	oo	•	b	son	•S•	t1	&:S.FQqq.eyq	
0006	80H05Q12	057G	00182	O•	•	▼	son	· 0	12	57,G	t,82
0406	8Q73Qb001	051G	00020	O•	•	6	8973	•0	1	St,G	a,20
0406	AOHOb002	0500	002'lA	O•	•	0	8073	•0	2	Su,O	2,58
000&	AOHObOOl	0578	00005	O•	•	6	e•n	••o		57,8	▮▮

A.42.

MSSNG T["1P
MSSNG Tf.MP

DELETE YEAR 1957

hiiiiP fiVi!iiO'P ..,. Ihb bA ¥A

				STAH	nrv	STATION	YEA	MQ	TEr>P	PRI!CYP
Oll06	6q73qbBfO	0btJG	OOOH	o•	●	aq;3	●●§	I 0	ott,G	•38
040b	8 7396621	ObON	OOQLI1	●●	▮	RQ7:S	●●§	▮▮	bO,	•0 I
Ol.IOb	89730M12	053B	00190	o•	4	b	eon	9&8	12	53,6	1&qey
0406	897396901	M05&F	01326	04	●	●	8913	●●●	I	Sb,F	13,2&
040&	897Hb90Z	O 1G	00585	04	●	b		● ● ●	2	53,G	5.8'5
											,SS
								● ● ●	●		
040&	80730&00b	MOo5<	00000	o•	●	b	son	● ● ●	▮▮	b5,<	,00
							son				
0«06	897396003	050A	00026	04	●	b	8973	● ● ●	3	5b,A	,2A
0406	eonoo904	o&o•	00055	o•	●	b	8973			eO,F	
0406	89739&905	O&ln	00002	00	●	b	8073	9!.9	5	b3,0	,02
0406	807396907	Obt3D	00002	o•	4	▮▮	8073	OoO	1	GQ,C)	,02
o•o•	8Q7J0&008	071H	00000	oo	4	b	eon	● ● ●	8	7!,M	,00
o•o•	son•••••	007<	qqqqq	o•	●	●	8073	●●●	●	b'fe<qqqoqq	
OOOo	897Hb010	O&SA	00000	o•	●	●	son	● ● ●	10	S,A	•00
OliOb	eon•••I 1	0l>lB	00110	00	●	●	son	●●	I1	63,6	1•tq
0006	A073Qb0120	76	000!2	o•	●	&	son	%9	12	S7,8	't2
● ● ● ●	807397001	055!	00223	o•	●	●	son	070	1	.!	?.u23
0006	aono1oo2	os••	00230	04	●	b	8073	070	2	5(),<	2,39
ooo•	s•nnool	o5BD	OOibt	o•	●	b	8973	070	▮	se.O	1•bt
0406	807H7000	0508	00000	no	●	●	8075	970	●	S .e	,00
Ol.!Ob	89B07005	OblF	00000	00	q	6	8Q7J	070	5	b3,F	,00
0406	807H7006	065!	00000	04	4	●	8973	970	b	b5 ▪▮	,00
OOO;	897307007	MObqG	00000	o•	●	●	8973	070	7	6Q,G	,00
0406	807507008	717	EOOQQQ	04	●	b	eon	070	8111,	QQ,QQ	
000&	M7397ooo	Oo6H	00000	04	●	▮▮	son	970	()	b8 ▮▮ H	,00
0406	89730701 0	0658	00002	04	●	b	8473	070	tO	65,8	,oz
0006	aonorott	OSOH	00 80	04	●	●	8473	470	I I	SQ$K	5,80
0U06	897397012	050E	00030	00	●	▮▮	8073	070	12	50,f	a;3o
0406	s•nntot	os•G	noo«4	00	●	6	8973	97!	1	Sl.!,G	● ● ●
o•o•	80B47t02	055E	00076	o•	4	●	8973	47!	2	SS,f	,1b
0000	607397!03	056[	00022	o•	●	●	8913	971	J	5o,E	e22
0406	B4H07to•	058E	00070	00	4	●	8913	97j	●	56.!!	,10
0406	897307\05	OoOF	00035	o•	●	&	an3	n1	5	bO,F	,35
0406	807$97!06	OoSD	00000	o•	●	●	8973	97!	b	OS.O	,oo
0406	897307!07	0700	00000	oo	●	●	897:1	07!	7	70,f)	,00
0406	89BH!08	070[	00000	o•	●	b	BOH	971	8	74.£	,oo
o•o•	897397!09	071<	00000	oo	●	b	son	071	●	yJ ч<	,oo
o•o•	897397to•o••c		000!1	o•	●	b	8073	971	10	eu,C	,I7
0006	8973971t1	0580	nooz•	Ou	●	b	8973	•n	11	580	,20
o•oo	897347!12	05!F	00720	o•	0	●	son	•rt	!2	St 0,	1o2ll
0006	897397201	053A	00000	00	●	●	son	972	▮	Sl,A	,00
0006	07197202	M05bD	00021	04	●	6	·73	072	2	5b,D	,21
000	eor3•7<o3	osoF	ooooo	o•	●	▮▮	MH	072	3	SO,r	,oo
•o	601307204	oooF	oooon	o•	●	●	son	072	4	bOeF	,00
Ot!Oh	807H7205	Ob3B	qqqqq	o•	●	▮▮	8973	072	5	b3,8Qqq,Qq	
o•o•	897307206•	067<	OOO!b	o•	▮▮	●	eon	•rz	●	&1.<	,!b
o•o•	807307207	0701!	00000	o•	●	●	8913	•n	7	70.E	,00
0 i)6	807107208	073A	00003	o•	●	●	•n	072		73,A	,03
0006	807307200	MOOH	00007	o•	●	●	M73	472	●	b9 ₉A	,07
0006	807397210	Ob5G	00010	o•	0	●	8073	072	I 0	b5,G	,I0
01.106	80H072 I	O OE	000!9	o•	0	▷	son	072	11	51.) r	Q,1q
0006	807307212	OS5E	00!51	04	●	●	807)	072	12	ss,E	t•1

MSSNG TEMP — 1970 YEAR NOT DELETED

t••• DfLFTFO • M!SS!"G RA!" DATA 2 OR MORE CONSECUT!Vf '-'ONTHS

1QOo DiLPIIr • •ISII•G TE•P OATA 2 OR MQRE CO IICUT!VF •0>.r•S
jQq1 OELEifn • "!ISING RAIN DATI 2 (1P Mf)Rf. CONSECUI!VE MI)NIHS
IQ07 DELFI!O • MISSING TE•P OA fA 2 R MORE CO,SFCUT I Vf Mf1NTf45
!QS'i OfL!TEO • •!ISING !E"P OA1A 2 n0 •ORE WNSECUT IV! MONT MS
IQ57 nELITEO • •!SliNG fE'MP ('iATA ? ;1R •ORE cn•s•r•<TlVI ,'1()NTHS

4&

SUMMARY OF DELETIONS

4 YEARS DELETED

NO. OF YEARS USED FOR MEAN = 30- 4 = 26 YEARS

A ADJUSTED VALUES

y [fff	RAJN	n: P	WATER
60,	11,15/J	61,8	tG S,eo
bl'	Q,tJl	61,1	210ub0
63,	15.14	b 1,8	tQS,qo
	ɯ•b1	b t •ij	zoq,oo
62,	q,0'$	&0,4	iQ5,00
	13.7h	61,8	1 8,50
06,	8,69	&21)'5	20l,\0
ol,	10.!0	b2₉e	200,30
bf.l,	*'•q_3	1>2 1	20tl,30
	Udt	&2 1	200,60
70,	t2dd	b2,S	21b ₉tlQ
71	&,en	o!,?	2!8,!0
12,	1₀3.2	62₀&	uo' 50

YEAR 1970 NOT DELETED

"VMSE OF OBBUVAT!ONS	•	!3
SU14 R ADJ	•	Q,72t
SliM T AOJ	•	I>¦612
\JO VRSn •8 DATA USED	•	20

NO. OF YEARS USED TO OBTAIN SUM R ADJ.
SUM T ADJ.

1\)
I
Cil

CHAPTER 3

MUREG PROGRAM

The CLIMATE Program discussed in Chapter 2 is based upon always using time, rainfall, and temperature as independent variables and utilizes forms CI and CD (Exhibit A) which refer to CLIMATE information and data, respectively.

If one wishes to perform a multiple regression analysis only and eliminate or add variables, Forms MI and MD should be used, as discussed below and illustrated in Exhibit B.1/

A. Standard Run identical to MURJ!XJ portion of CUMATE

For three independent variables and one dependent variable, enter data as shown in Exhibits B.1 and B.2. The order of variables t, R, T and Q always must remain in the same location as shown in B.2.

Note that if the Engineer wishes to substitute different annual adjusted rainfall and temperature values than those produced by the CLIMATE then this procedure may be used in place of the use of cards as discussed in Chapter 2. Substitution of alternative or missing weather data i.n the formulas of Exhibit A.3 will provide the required adjusted values for use in MUREG.

B. Run vith One or More Independent Variables Eliminated

For example, to eliminate variable T, remove the term (4Fl0) as shown in Exhibit B.3 Card *2,* Columns 01-o6 end replace it with (FlO, FlO, lOX, FlO) which uses 17 columns. Therefore, change the column limits as shown. The right-most FlO refers to the dependent variable Q, and thus never should be changed in location. Also change in two places, the total number of variables considered per columns 04-05 of Card 1 and the Regression Control Card. Do not change sheet MD (Exhibit B.2) for which cards may have already been punched.

Pri..'"!touts are not provided as they are similar to the M!JREG portion of CLIMATE re Exhibit L.1, pages 5-9 through 5-12.

C. Run with more than three independent variables

To explore the use of more variables, see Exhibits B.4 and B.5 w1' a five variable example. Note the dependent variable must al'W'!iys be listed in righthand end of array, as shown in Form MD, Exhibit B.5. Insert on Variable Control Card, Columns 24-25 the value "5". Modif'y Card 2, beginnning in Column as shown; and indicate proper number of variables on Card 1 and the Regression Control card.

D. Omitting a Year's Data

Note also if unreliable or incomplete data exists for a year{s), the associated input may be omitted from the MD sheet. For example, in the cast of Exhibits B.4 and B.5, 1971 data vas omitted from the MD sheet and the number of observations on the MI sheet reduced to 9. This same procedure is automaticl used in the CLIMATE program and can be observed by comparing the Input Data witt the Adjusted Data Printouts.

E. Change Of Meter Reading Procedure during Time Span

If for example, the procedure changes during a 13-year span from say that associated with monthly to bimonthly billing, then CLIMATE should be m to obtain the required annual R adj and T adj values as a f'unction of billing f• each sub-span. The R avg and T avg may bs based upon either assumed billing procedure as they are relatively insensitive to that factor. The R adj and T IM values may then be used with the MUREG program to obtain a 'Correlation after which the R avg and T avg values are used to estimate consumption.

F. Statistical Ind:icawrs in the Printouts

The following are brief definitions of some of the terms that a e printed out by the computer particularly in the MUREG section: Y refers to unit consumption Qt •

1. Standard Error of Y Is the standard deviation of the .dependent variable (unit water consumption). It is a measure of the spread between the calculated and recorded values. The smallest spread is desirable.

2. Multiple Correlation Is a measure of the direct relationship of Y with other variables. The ideal number is plus or minus one. Due to a small amount of data, high correlation coefficients do not necessarily mean perfect results. It is also a measure of slope of the regression line and therefore can be misleading when using this standard practice.

3. R-.sguared -Multiple correlation squared.

4. F-Level – Measures the effect of introducing new :independent variables into the analysis. In some oases, statisticians limit introduction of data by setting F-Level at a specific amount. Our standard practice does not consider the question of adding other independent variables.

5. Residual Degrees of Freedom The number equals the sets of data available minus the number of coefficients minus one. The better the degree of freedom, the better the answer, statistically. Obviously, with the degrees of freedom of one (5-year data) very little choice is available.

6. Student T – Measures the confidence we may have of coef.fi,ciJmi;!is determined for the regression equation. The higher the better. ±1 or more is preferred.

7. Durbin-Watson Statistic – Is a measure of the randomness of the residuals (i.e., Q(c) – Q(r)). The most reliable colrrela1;ioJ have the most randomness.

EXHIBIT B.!

Control Cards for CPUC It:r:J.rauJ.:!.e Branch Hl.Jl\EG Prog:rm.
L struct:!.ons

Card One: Primary ll;1'\SG Control Card (Righi Justified)

Description of Field	Colunms	
Number of Variables (including' dependent variable)	o4-05	4
Number of Observations	08-10	9
Columns 15, 20, and 25 ...		...Punch_ _ _...
Columns 30, 35, 40, !ll'ld 45 ...		..... Punch.....
	55	"1"
Job Identification	56-n	CAL WATER AS4/1G

Card Two: Input Formal Specification Card Ol-o6 "(4no)"

Data Cards: One for Each Observation - Use Special Coding Sheet MD

Card Following Observation C ds: Regression Control C:u-d

Number of Variables (same as on Card 1)	o4-05	
	10	"1n
	25	
	25	

Variable Control Card:

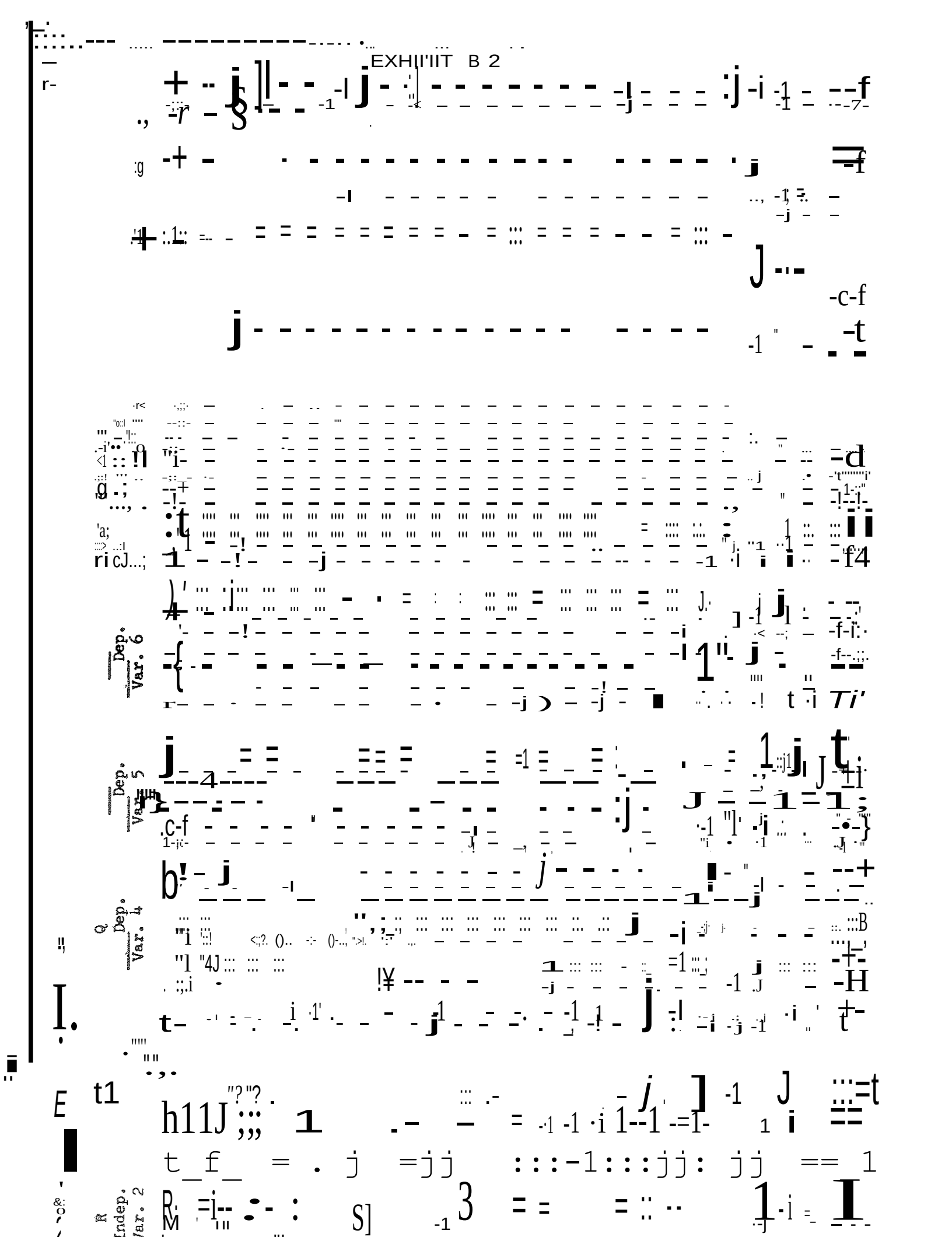
= Dependent Vari,.ble :nust al,;u:t-s be last

o4-05	"1"
{)9-10	"2"
14-15	"3"
19-20	"4"

and so on for as :r.any "ar!ab1o as &re UBed {max.: <light per eard)

End of Job Card: Columns 01-10 "End of Job"

:End, of **Regressions Card:** Columns 01-18 **"End of Reg.ressionsn**


Dep. Var. 6
Dep. Var. 5
Dep. Var. 4
Indep. Var. 2

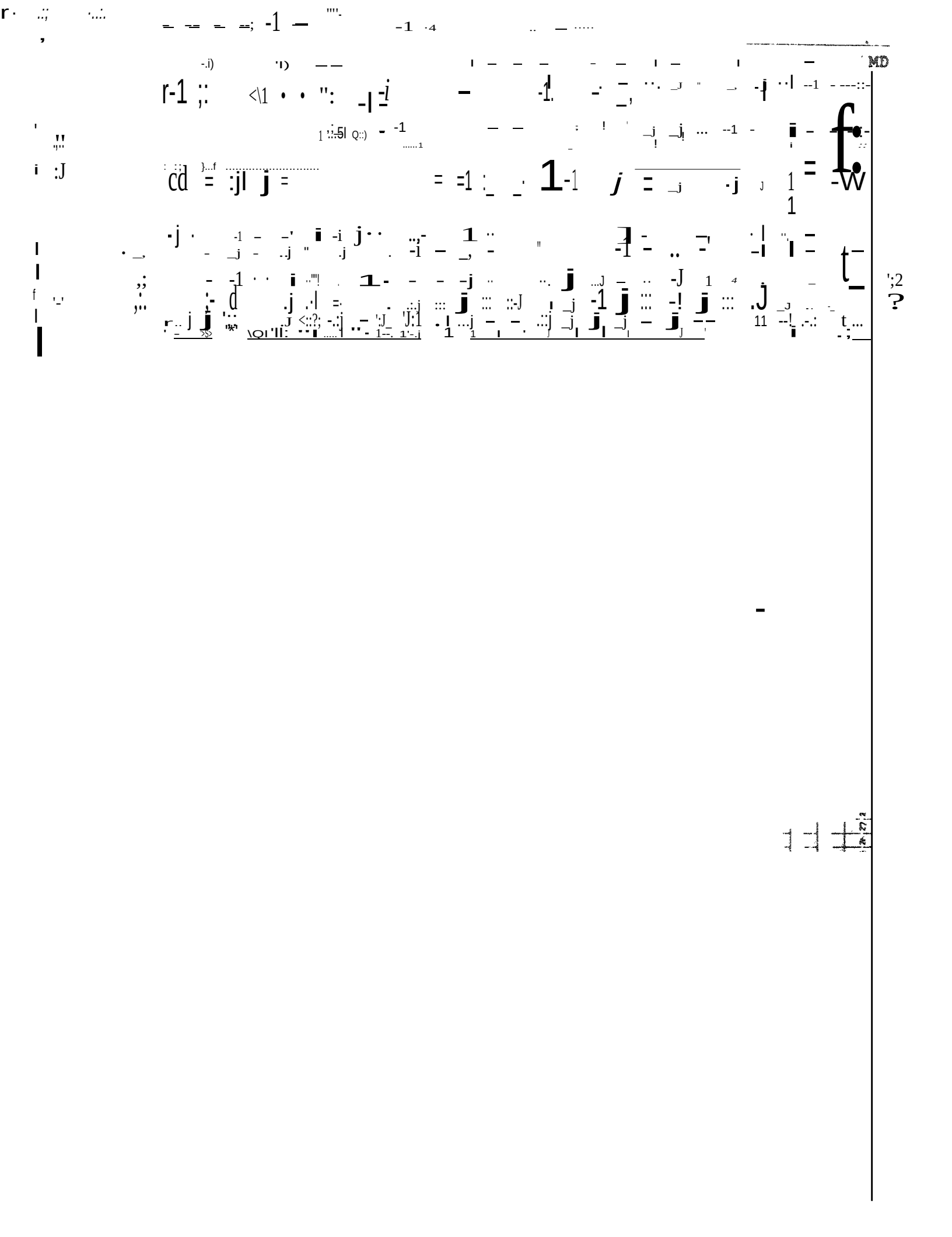


EXHIBIT B .3

Control Cards for CP!.K:: Hydraulic Branch MUREJG Program
MUREIG Instructions

card One: Primary MUREG Conl.roCard (Right Justified)

Description of Field	Columns
Number of Variables (including dependent variable)	o4-05
Number of Observations	o8-10
Coltnnns 15, 20, and 25 ..... Punch..... Columns 30, 35, 4o, a.nd 45 ... Punch.....	ulu ' Oil
	55
Job Identification	56-71

<:.4t..l!Y&f. _4$':1.!.!

....''''''--''''''-------·---''''-·''';-Z- {FIO, FIO, lOX, FIO]

Card Two: Input Formal Sp€cificatlon Card 01-%

Data Cards: One for Bach Observation - Use Special Coding Sheet MD

Card r'ollo>ring Observation Cards: Regression Control CSJ"d

Nurr.ber of Variables (sa:me as on Card 1)	04-05	
	10	rllH
	25	
	25	

Variable Control Card:

Note: Dependent Variable must always be last

	oll-05	.,1,.
	09-10	!12tf
	14-15	H?n
	19-20	"it it

e.nd r,o on for as many vnriable as are used {max.: eight per card)

F',nd of ,Job -Ca.rJ: Columns 01-10 "E:nd of ,J-ob"

-End of :Regressions Card: Columns Ol-J..8 "End of Regressions"

EXHIBIT 8.4

Contro<:ards for CPUC Hydraulic Branch MUREG Program
MUREG Instructions

Card One: Pr:!.mary MUREG ControCard(Righl Justified)

Description of Fie d	Columns	
Number of Variables (including dependent variable)	04-05	S
Number of Observations	o8- 0	9
Colurrl*l.S 15, 20, and 25 o ....Punch., ... o		"1"
Columns 30, 35, 4o, and 45 ....Punch........		"0"
	55	"1"
Job Identification	56-n	CAL WATER A54-116

Card Two: Input Formal Spedfication Card Ol-o6 "(5 F10)" ~~"(4F10)"~~

Data Cards: One for Each Observation – Use Special Coding Sheet liJ)

Card Following Observation Cards: Regression Control Card

NUJr.ber of Variab es (sa'!le as on Card 1)	o4-05	
	O	
	25	t10U
	25	

1

Var:i.able Control Card:

Note: Dependent Variable must alwa:;,rs be last

	o4-05	!!IH
	09-10	"2"
	llr-15	H.-, !! .5
	19-20	"h"
	24-25	

and o on for as many vnriable as are used (max.: eight per card)

F.nd of Job Card:	Colu:mns 01-10	"End of Job"
End of Regr€ss:i.ons Card:	Columns 01-18	"End of Regressions"

CPUC Hydraulic Branch - *MURFG* Program - MUREG Data

(DUMMY)

t Indep. Var. 1	R Indep. Var. 2	1' Indep. Var. 3	Dep, Vir. 4	Q ---riep. -vir. 5	-riep. --vir. 6

1, Use Decimals
2. Left Justified
3. Dep. Variable Rightmos

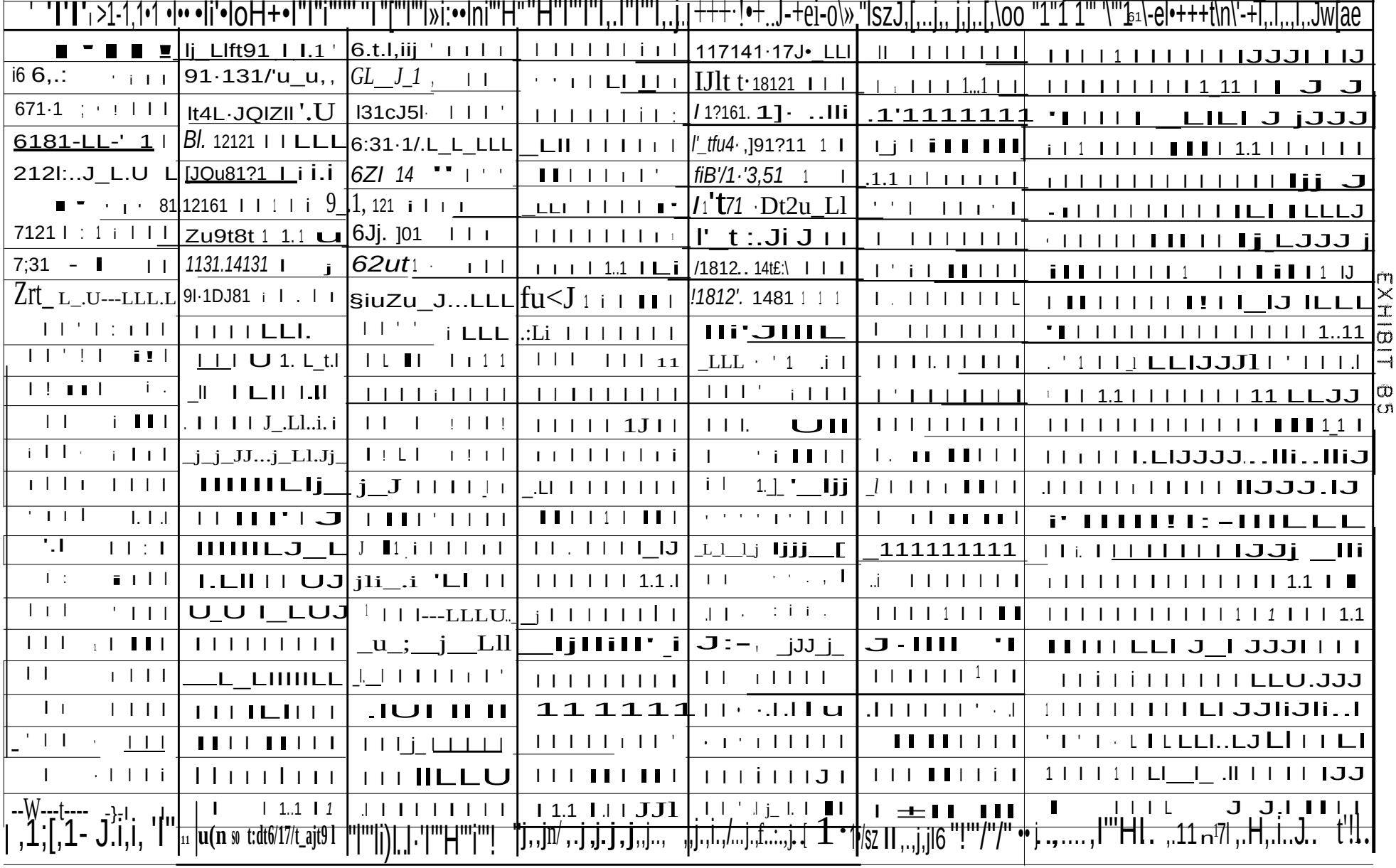


EXHIBIT B5

CHA.PrER 4

E.STREVS PROOliJIJ,f

As noted in Chapter 1, the ESTREVS Program .estimates and calculates revenue as a :function of tariff t;ype, b.H!ing procedure, rates, and existing and projected consumption and customers; all in general accordance with Standard Pr!l.ctice U-25. As described in Chapter 5, ESTREVS is automatically connected to CLIMATE when the Engineer .submits an ESTREVS data input form (El<hibit ,C) along with forms CI and CD (Exhibit A)• Much of what is discussed here is of backgro d nature as the Engineer norm.al.ly need know only how to fill in the l:STREVS form•

·Basically, the program uses Engineer furnished billing growth data estimates along with Engineer or computer determined values of Q{R), (N), Q(A) and Q(B) to develop the following ratios which areused to project an applicant's Water Use Analysis Table from its recorded values to that which would approximately exist in the normalized and test years.±/

Q(RN) = NR = ; ═══ R.

B(R) = B(N) Thus B(RN) = l.O

B(RA) ııı 1

Q(RA) = Q R = f 5

B(RB) = :?

Q(RB) = QfB R = QtB) B Q R)BR

In conjunction with the above equations, the following relationships are used to project growth of billings corresponding to those meters that are larger than the smallest size:

BXS(RA) ═══

BXS{RB) = BXS(B) BXS(R)

Y The ratios shown here apply to the service charge t;ype of tari!'f. A slightly more compl.ex version of these ratios is used for minimum cherge tariff per Exhibits H and L

A. Required Input Data for ESTREVS

Three types of input data are required:

--a Water Use Analysis Table preferably based upon the latest recorded year.data,

--Growth data to be used by the computer to establish ratios required to project customer and consumption changes,

--Pricing data for minimum or servie charges and unit consuunption as a function of time, rate block location, and billing period •

.The Water Use Analysis discussed in Part 1 that 'follows is required to est blish a reference listing of bills as a 'function of meter size and consumption rate block. This basic customer reference is then expanded as a function of' growth of customers end consumption by the use of growth ratios as discussed in Part 2• starting on page 4- 7.Y

In Part 3 (page 4-12) the basic pricing data is collected to record present and proposed tariff rates. All this in:f.ormstion is then inserted in the computer's memory per use of the l!ETREVS Form (492.12B).

The preparation of data input is not difficult sf'ter the Engneer has tried it one or two times. The only place problems may arise is in the choice of data for Cards 3 {Bills p.er Rete Block), 5 (Bills by met.er size), and 10 (Consumption per Rate Block). Cards are used for feeding the computer and are made from date on the l!ETJL""""S Form. Spaces 79 and .SO are used to identify the cards. That selection process requires ·study of the Water Use Analysis Table as it is a function of tariff type.

To simplify understanding, Water Use Analysis Tables based upon monthly billing cycles are discussed f'irst, after whioh bimonthly billing

Note that overall consumption is based upon the last recorded oonsumotion value of MURID. As .ctiscussed in Chapter 2, unit consumption equals the \'later Use Analysis calculated value and is determined by dividing the total sales consumption by the total number of bills, irresp.ective <: f whether they were partial or complete bills. See Exhibits D.l and F.1.

cycles are reviewed. Part 4 (starting on page lrlJ) provides details as to how to generally prepare data, while Part 5 (starting on page 4-17) describes how basic data is to be modified when bimonthly billing exists.

1. Water Use Analysis Tables

When using the program, the Water Use Analysis Tabl;;J lllUSt be in the format similar to that furnished by Cal-American•.!t/ That company and the smaller Santa Clarita Water Company now have this type of table directly printed out via computer. In addition, Santa Clarita has a monthly printout, as well as an annual printout, which may be useful for more sophisticated analysis.

Exhibit D.l (and related Exhibit D.4) were developed by Cal-American to estimate min.imum tariff revenue. We have modified them to obtain Exhibits E.l and E.4, which are in the format to be used in a Service Charge Tariff estimate.

With respect to the Minimum Charge Water Use Analysis Table, it should be noted that the average consumption in each of the blocks, i.e., column entitled, "Average Consumption in Block," is a calculated one based upon

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:J The Water Use Analysis (WUA) Tables shown list the total number of bills issued per year. Note that the horizontal lines such as shown on Exhibits D.l .and E.l split the table in accordance with a tariff defined on a monthly basis. I.f billing is on a bimonthly basis, some input to the ESTREVS Fol'!ll is modified as diS{:ussed in Part 5 of this chapter and as illustrated in Exhibits F.l and G.l•

.!t/ The Cal-American table is the basic one from which a typical single meter table such as shown in Standard Practice U-25, page 6-2, is derived and therefore a method for combining the single meter tables is not described in this report. The case of small utilities failing to report meter sizes greater than the smallest is discussed on page 4-20,

rounded vaJ.ues,2/ thus the three columns on the extreme right of Exhibit D.l are not exactly correct. The small error resulting from that assumption is eventually corrected through the use of the overaJ.l revenue adjustment factor ratio (caJ.led RRCR)$_1$ which relates recorded revenue to computed revenue for the recorded.year R.

a. Minimum Charge Tariff

Let us consider first a tariff format as shown on Exhibit D.l with associated manual calculations on Exhibit D,4. This exhibit illustrates the estimated CCF sold as a function of rate blocks. It also shows the bills associated with those sales. The solid stepped line on the left side o:f Exhibit D.l separates the bills for which consumption was less than the respective minimum (which is a function of meter size) from those which exceeded that minimum. Consumption was less than the minimum for bills listed above the stepped line, while it exceeded the minimum if it occurred below the line {except for smaJ.lest size meter in smaJ.lest block). Note illustration in upper right of Exhibit D.l.

For example, it is estimated that in the 6-30 CCF rate block 125,285 bills were associated with collecting revenues due on 1,908,995 CCF. Each of these bills

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For example, the "average consumption in block" of 2 CCF is based upon meter readinge which could have actuaJ.ly varied from 1.50 to 2.49 CCF but which have all been rounded off to 2 CCF by the meter reeder. (See Standazod Practice U-25, page 2-3,) For consumption in 1ar.ger ranges such as 31-35 CCF, an average va.lue should be calculated from the act-ual bills as is indicated in the exhibit where avera§e consumption in Bleck is listed as 32.7 CCF rather than :n.0 CCF.

was based upon usage of water beyond the respective meter size minimum consumption, Also in the example shown here, the minimum consumption :for the 5/8-inch meter is 5 CCF while for the l-inch meter, it is 10.6 CCF. This pricing is based upon charging customers with the l-inch meter $2.55 plus the consumption cost for (10.6 – 5,0) CCF at $0.40 per CCF or $4.00 per month. other meter minimum charges are based upon the same principle as shown in Exhibit D.l

Exhibit D.4 also shows how the above Exhibit D.l type information is used to spread consumption to take into account proper rate block billing charge/2/ {Exhibits F.1 and F.4 provide similar information for bimonthly billing cycles).

b. Service Charge Tariff

Exhibit E.l is almost identical to Exhibit D.l except that only the data required :for a Ssrvice Charge is shown. Exhibit E.4 is similar to Exhibit 0.4 and 1"ulfills the same purpose. (Exlri.bits G.l and G.4 illustrate the bimonthly cycle application,)

c. Data Input Form ESTREVS (492.12B) Details

Exhibits D.2 and E.2 illustrate filled-in forms with data provided from Exhibits D.l and E.l, respectively, plus information as developed by methods desorihed later i.."l. this practice. Units for esoh quantity are shown at the of

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§/ See Standard Practice U-25 for details, Note thet the computer takes all this data and carries out the procedures shown for each y<3ar.

the form. Exhibits D.3 and E.3 provide typical ES'i'REII'S printouts for both tariff types. Data from the form is used to make up 11 cards labeled 1, lA and 2 through 10. Card numbers are used for identification of the data form location throughout the following discussion.

The sources of data from the Water Use Analysis Table for use in ESTREVS are shown typically in Exhibits D.l and E.l for monthly billing cycles. Examples with bimonthly billing follow.

1. Minimum Charge Tariff

   Exhibit D.l illustrates a water table with the source of much of the card data identified.

   Card 3 (bills by rate blocks) values are to be obtained from above the heavy stepped line for the smallest size meter and below the line for all other meters. Apart from the bills in the first block, the number of bills in each rate block is the total bills that used more than the minimum amount for each meter size. For example, in Exhibit D.l for the 6 – 30 CCF rate block, the number of bills for that block will be the total number of bills in the shaded area.

   For the first block, however, the number of bills will be total number of bills for the smallest meter size in the first block.

Card 10 data is obtained from the right hand side of Exhibit D.land represents the consumption p.er rate blocki/ associated with Card 3· Note that color/shade coding is used in the fields to further aid in choi e of the number required to be filled in. Compare also Exhibit D.2 to Exhibit D.3.

Card 5 data consists of the number of bills that used less than the minimum for each meter size excluding the smallest meter size. It is obtained from the bottom of Exhibit D.l.

2. Service Charge TarU'f

For a Service Charge Tariff the figure to be used are those from Exhibit E.l as tabulated in Exhibit E.4. There is no stepped line required in analyzing such a tariff because no fixed amounts of consumption are available for specific meter sizes for a minimum charge. Compare Exhibit E.3 to Exhibit E.4.

Data for Card 3, therefore, comes directly from the right halld side of Exhibit E.l. Card 5 data comes from the bottom of the Exhibit, with Card 10 data :!'rom the extreme right-hand edge.

2. Growth Data

The following input data is to be provided by the Engineer and entered in Cards 1 and lA. It is used by the computer to calculate the appropriate ratios listed in the right-hand column as follows:

With the exception of the first block, the consumption is that associated with bills gre111ter than the respective minimums.

In-out Data	Symbol	Computed Rat£
Recorded water consumption (CCF/meter-year:		
Normalized water consumption CCF/meter year	Q(N)	Q{RN)
Test Year A forecast consumption CCF/meter year	Q{A)	Q(RA)
Test Year B forecast consumption CCF/meter year	Q(B)	Q(RB)
Recorded bills (total) per Year/1/	B(R)	
Test Year A forecast bills for the year	B(A)	B(RA)
Test Year B forecast bills for the year	B(B)	B(RB)
Recorded bills (except eme.llest meter) per year/1/	BXS(R)	
Teet Year A forecast bills for the year	BXS(A}	:B:XS(RA)
Test Year B forecast bills for the year	BSX(B)	BSX(RB)
Revenue adjustment factor determined by dividing recorded revenue (RR) by computed revenue (CR) as determined by Water Use Table for Year R 2/		RRCR

Note that when the combined CLIMATE - ESTRE'I'S Program {ONESHOT) is used, the above Q-labeled data on consumption is not to be inserted by the Engineer as it will be calculated by the computer and autoll!Sti<::ally delivered to the ESTREVS subroutine.

a. Ratio Q(RN) used to convert the water consumption in rate blocks and in <u>total</u> from that Which existed during the recorded year to that Which woul.d e:d.st during a normali zed year. It is identical to the Usege Factor of Standard Practice U-25, pege 6-3, paragt'a Normalized year consumption refers to the water consumption that 'IWul.d be forecast for the recorded year by the Modifi.ed Bean MuJ." Regression Method. In considering the normali.zed year, no change

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[/ Actual number of bille, irreepective of monthly or bimonthly billing cycl.e• M:i..nimum value hcwever for any (R) value must be 1.0 and it must be entere

9..1 Computed Revenue (CR) calculated by computer ueing , B(R), and BXS(R) as 'found in recorded year Water Use Analysis 'I'able.

10,1 We have ignored the .PJ:'9£edure discussed in Standard Practi4:!e U-25 on page 1 paragraphs 10 through u:.

the number of bills is assumed between it and the recorded year.

The general expression is:

$$\text{Ratio } Q(RN) = \frac{\text{Totlll Forecast Water Consumption (Normalized) for Recorded Year R}}{\text{Totlll Recorded Water Consumption for Recorded Year R}}$$

$$\frac{Q(N)}{Q(R)} = \frac{Q(N)}{Q(R)}$$

For a minimum charge tariff the ratio applies only to consumption greater than the meter minimums as discussed in Exhibit J.

b. Retios Q(RA) and Q(RB) are used to account for the estimated change in the water consumption by rate bl.ocks and in totlll from a recorded year to the vlllues the ll'taff' estimates for the two foll.owing test years A and B. It is identiclll in definition to the Usage Factor above, except for reference to projected years.

$$\text{Ratio } Q(RA) = \frac{\text{Total Forecast Water consumption for Year A}}{\text{Totlll Recorded Water Consumption for Recorded Year}} = \frac{\Sigma Q(A)}{\Sigma Q(R)}$$

$$\text{Ratio } Q(RB) = \frac{\text{Total Forecast Water Consumption for Year B}}{\text{Total Recorded Water Consumption for Recorded Year}} = \frac{\Sigma Q(B)}{\Sigma Q(R)}$$

As noted previously, this information can be furnished directl.y by the CLIMATE Program, to ESTREVS vis. LINKUP. For a minimum charge tariff the ratio applies only to consumption greater than the meter minimums as discussed in Exhibit J.

c. Ratios B(RA) and B(RB) account for the Engineer's estimated change in the total number of bills. These ratios are identical to the Growth Factor of Standard Practice U-25, page 6-3, :paragraph 7.

As noted previously, by definition, that the number of bills in the recorded year equals that of the normalized year, and that

$$B(R) = B(N)$$

and

$$\text{Year A} = \text{Year R} + 1$$

$$\text{Year B} = \text{Year A} + 1 = \text{Year R} + 2$$

$$\text{Ratio B(RA)} = \frac{\text{Total Bills for Year A}}{\text{Total Bills for Year R}} =$$

$$\text{Ratio B(RB)} = \frac{\text{Total Bills for Year B}}{\text{Total Bills for Year R}} = \quad R$$

d. The Engineer's estimated changes in the number of bills (ex t for those associated with the smallest meter) is designated by the terms BXS(RA) and BXS(RB). By use of these ratios, the Engineer can account for different growth rates between the total group of meters and those of a size greater than the smallest size. The slight error occurring in revenue estimet:i.ng due to lumping meter growth together rather than estimeting growth by individual sizes is ignored. Different growth rates are typical in most rate cases. For cases where utilities lump all meters together irrespsctive or size, see page 4-20.

$$\text{Ratio BXS(RA)} = \frac{\text{Bills (Except Smallest Meter for Year A}}{\text{Bills (Except Smallest Meter for Year R}} = \text{BXS(A}$$

$$\text{Ratio Bxs(RB)} \quad \frac{\text{Bills (Except Smallest Meter for Year B}}{\text{Bills (Except Smallest Meter for Year R}} = \text{BXS(B}$$

The computer uses these ratios in slightly different ways depeJ:ii:iJI being upcn whether a min:iJllum charge or a service charge tar:U::f is calculated. Sse Exhibit J.

e. Ratio RRCR is used to adjust revenue figure from that which we theoretically computed from the number of bills and the consumption to that which was actually collected in the recorded year, i.e., the Revenue Adjustment Factor as discussed in Standard Practi-ce U-25, page 6-3, paragraph 5. It accounts for a number of errors that creep into these practiceal ealculations.

$$\text{Ratio RRCR} = \frac{\text{Recorded Revenue Year R}}{\text{Computed Revenue Year R}} = \frac{\text{l'li.ru}}{\text{R(CJ}}$$

f. Miscellaneous

1. The use of this program doss not depend upon the methods used in estimating the values listed on Cards 1 and IA.
2. Note also that the computer internally uses a lar number of decimals but generally prints out results of calculations only to a small number of pla-ces. Therefore the arithmetic sometimes appears to be slightly incorrect.
3. In the illustrative examples (Exhibits D.2, E.2, F.2 and G.2), the total bills (B) are assumed to increase by 2 percent a year and tbe bills except for the smallest size (BXS) by 1 percent a year (See Card 1). Water consumption grows on the average as shown. For demonstration purposes, we have generally assumed Q(R) = Q{N).

:3· Rate or Pricing Data

Present and proposed meter char,ge pricing data is to be entered on Cards 6 and 7 while consumption pricing is to be similarly entered on Cards 8 and 9. The number of entries correspond to 'Card 2, Items RB and MS, respectively. Remember color coding%

Note, however, that with a minimum charge tariff, ,the unit consumption charge for the first block: (Cards 8 and 9, spaces 1 through 7) is to be t.he minimum charge, net the equivalent unit consumption charge. For example, :in Exhibit D.2, the minimum charge at present rates is $2.55 per month, while the unit consumption charge for 5 CCF is $0.51 (as shown on the servie charge input data sheet, Exhibit E.2).

4. Data Inout Form ESTREVS (4Q2.l2B) Details – Monthly Billing

a. General

1. All values to be right justified exoopt when triangle is indicated.

2. The triangle indicates the location of the decimal point. If a value is less than 1, fill in spaces to the right of the triangle. If a value does not exist, or is zero, nothing need be filled in•

.3· Fields – This term refers to the place in which the values of ratios, rate blocks, etc., are inserted. Fislds are to be generally filled in starting at the left side and in rising sequenoe, but data within each field must be right justified unless specifically prohibY...ed.

4. Each set of data must consist of eleven cards, that is, the 492.12B form must be completely filled out except for a ONESHOT run where Card lA is ignored. Card identification is in spaces 79-f!lJ.

5. Remember the colors of this form are to assist the Engineer by alerting him as to the number of entries required, as ir..dicated on Card 2, Items RB and MS. RB (medium green) refers to the number of rate blocks while MS (white) refers to the number of meter sizes. They indicate respectively the number of fields to be filled in, per card, i.e., 2, 3, 8, 9 and and 5, 6 and 7.

6. The form may be modified :in the future, and such will be :indicated by changing the last letter of the identification 492.128.

b. Card Input

Note basic units listed :in upper right portion of ESTREVS Form.

1. Card 1 is to contain the basic billing and revenue information as recorded. In addition, the word "ONESHOT" is to be :insert.ed in spaces 1 through 7 to conmand the computer to perform a "one-shot run" if thet is so desir d. If time trend is not desired :in ONESHOT• then the word HORIZONTAL is to be placed :in spaces 66 through 75 (labeled TREND).

Card lA is to be filled in only when a revenue estimate wi.thout a consumption estimate (ONESHOT) is required. Note units are OCF/meter-year.

Cerd values must lie between 0 and 9999999.9 except for letter :input.

2. Cerd 2 contains the rate block upper limits and is also to be used to :indicate a minimum or service type tariff through use of "1" or "0". In addition it is used to indicate whether billing is monthly or bimonthly by entering in white space 75, symbol M or B as appropriste,

Cerd 2 also contains an identification field and plus a listing of number of rate blocks and meter sizes.

Item RB: This is the count of rate block upper limit values. The values can run from 1 through 9.

It-em MS: This is the count of met-er sizes whi<:h ere to be entered on <:erct 4. Values start at 1..

Rate Block Upper Limits: These are int-eger numbers running in value .from *1.* to 9999999. The number of' entries must agree with Item RB. The right-most field is used to represent "infinity," and may be any integer number lerger than the highest rat-e block limit actually used. For example: 999, or larger, if' the great-est actual rate block upper limit was 650•

.3. Card .3 is to contain Recorded Bills by Rate Block, as discussed on pages 4-6 and 4-7, plue job request date.

Cerd Values: Int-eger numbers with the number of :fields used corresponding to Card 2, Item RB.

4. Card 4, Met-er Sizes: List all meters in the system. Examples: 5/8-inch entered as .625; .3-inch en'"vered as _3.000, or *3;* 14 mch entered as 14.500, or 14 •5 (zeros to the riP.,ht of the decimal point need not be entered). As many entri.es as Card 2, Item MS ere to be used.

5. Card 5 is for Recorded Bills by Meter Size: Integer numbers as discussed on page 4-7. Entries correspond to Cerd 2, Item MS and Cerd 4.

6. Cards 6 and 7, Present Rates – Meters, and Proposed Rates – Meters:

Values from .001 to 9999.999. Zeros preceding the decimal. may be left blank as in other deoisal. .entries. Entries to correspond to Card 2, Item MS, and Cerd 4.

7. Cards 8 and 9, Present and Proposed Rates -Consumption:

   Decimal numbers ranging in value from .00001 to 99.99999, with as many entries as Card 2, Item RB.

8. Card 10, Recorded Consumption by Rate Blocks, as discussed on page 4

   Integer numbers. As many entries as Card 2, Item RB are required.

5. Data Irrout Form (492.12B) Details – Bimonthly Billiqg

While tariffs are usually defined in monthly terms, the billing cycle may be bimonthly, If that is the case, the pull-out of data !'rom the WUA must be in accordance with the actual pricing out of the bills, e.g., a bimonthly minimum charge is twice that of a monthly minimum charge.

Exhibits F and G illustrate minimum and service charges on the assU!l!ption that the bills and total consumption shown on the WUA represent the bimonthly billing cycle ,case. You will note the break-lines between the rate blocks have changed from the monthly billing exhibits, and, in addition, the line separating the minimum bills from those reporting consumption greatel' than the respective minimums has also shifted up to hig.'ler values, thus :re.fl.ectr-ing allowable consumptions in the bimonthly case. 'i'hese changes must be reflected in the data input form as follows:

1, Minimum Cr.a.rge Tariff (Exhibits F.1 through F,4)

Card 2: Double Meter Monthly Rate Block Upper 'Limits ('CCF)

Cards 6 & 7: Double Meter Monthly Tariff Rates ($/month)

Cards 8 & 9: Double Meter Monthly Tariff Rates for 1st block only, which is the basic monthly minimum charge (spaces 1 – 7). Do not change consumption charges ($/CCF).

Other Cards: Read Bills and consumption f'igures as defined on WUA Table and beginning on page 4-18.

2. Serviee Charge Tariff (Exhibits G.l through G.4)

Card 2: Same as Card 2 above

Cards 6 & 7: Same as Cards b and 7 above

Other Cards: Same as 'Other Cards above

3. Billing Type

Per Part A.4.b.2 (page 4-14) always insert M orB in space 75 of Card 2. If nothing is entered, the computer will assume a monthly billing cycle exists.

B. Examples of Each Type of Tariff Computation

1. Minimum Charge Tari:ff – Monthly (See Exhibit D.3)

Preface page (The first page of the printout set--note each page is numbered in sequence) lists the input data. The recorded appropriate bills consumption data are repeated on pages 1 and 2. On page 2, the recorded data is ratioed up or down via Ratio Q(RN) in order to develop data for the normali year, after which the consumption is "spread." Q{RC) 1s used to determine RBC {Exhibit L however provides a better demonstration of the determination and use of the computed year to determine the *RRCR* value as recorded and normali ed consumption were not equal as was assumed here.)

On page 3, the same operation is repeated for test year A. In this case, the computer also ratios the bills by block by taking r.e.corded informati and multiplying it by Ratio B\RA). The ratioed rate block consumption is obtained by taking recorded information and multiplying it by Ratio Q(RA).

Test year B is shown on page 4.

On page 5, the cons=tion revenue sub-routine is begun. The normalized consumption quantities are multiplied by the two <li:ffer nt consump· tion charge rates (present and proposed rates in dollars per CCF) to get reven based on co'lsumption. {)n pages 6, 7 and 8, the operation is repeated• The t <!onsuinption in the s ond colu..rrL.'1 fran the **I-eft** is not summed up f'or th"e minimum charge tariff as the first (lowest) block quantity re:fers to bills and not cef

On page 9, the meter revenue sub-routine is begun. The revenue due to meters is calculated. Note, for example, that in test year A the number of bills is equal to the recorded information times Ratio BXS{RA). Finally, page lO,the revenue based on both sub-routines are summed up and then multiplied by Ratio RRCR to calculate the final r venues entitled "Adjusted Totals."

The RRCR value is determined by computing revenues based upon recorded year values of consumption, etc. and cemparing it with the recorded value of revenue. That factor is used throughout :the rest of the computations (for normalized and test years). The Summary Page lists the computed RRCR.

2. Service Char{'{ Tariff- Monthly (See Exhibit E.3

Procedure is generally the same as shown above. Input data, however, is slightly different, as discussed above. You will also notice throughout the printout that there are slight differences between the service and minimum tariff calculations, which are all in line with the standard procedure.

Of spacial interest is that the meter sub-routine is such that the overall sum of meter bills is projected by Ratios B{RA) and B{RB), but the bills derived from all meters larger than the smallest is projected by Ratios BXS(RA) and BXS(RB). As a resul !...e _growth of the smallest sized meters is developed by differences as -s mentioned on page 4-10 and Exhibit J.

3· Minimum and Service Charge Tarif'.fs - Bimonthly

Exhibits F.2 and G.2 illustrate eompl<!ted ESTREVS input sheets .for bimonthly billing. See typi<:al printouts pages F.3 and G.3.

C. Rate Changes During a Recorded Year

The program has been developed on the basis of no recorded or proposed rate changes during a year.

To handle a rate change during a recorded year, the i.'ollowing alternatives should be considered (ignore RRCR factor):

1. Obtain Water Use Analyeis Tables for each part of the year and perform two separate revenue analyses.
2. Assume present rates held throughout the year and make an independent computation of the additional revenues.
3. Calculate an average annual pricing schedule and apply to the Water Use Analyeis Table.
4. Using same Water Use Analyeis Table, determine revenues at the different rates and interpolate the annual results.

D. Small Utilities

Small utilities often omit reporting on their Water Use Analysis Tables the existence of meter sizes greater than the smallest size. When that occurs and is acceptable to the Engineer, the approximation to be used is to assign BXS(R) = 1.0 and BXs(A) = BXS(B) = Proceed from that point assurning no meters exist that are larger than the smallest and therefore all meters are equal to the smallest in size (usually 5/8" x 3/4"), The RRCR factor w:l.ll tend to compensate for the erroneous meter <:ount,

ONE SHOT OR ESTREVS DATA INPUT SHEET

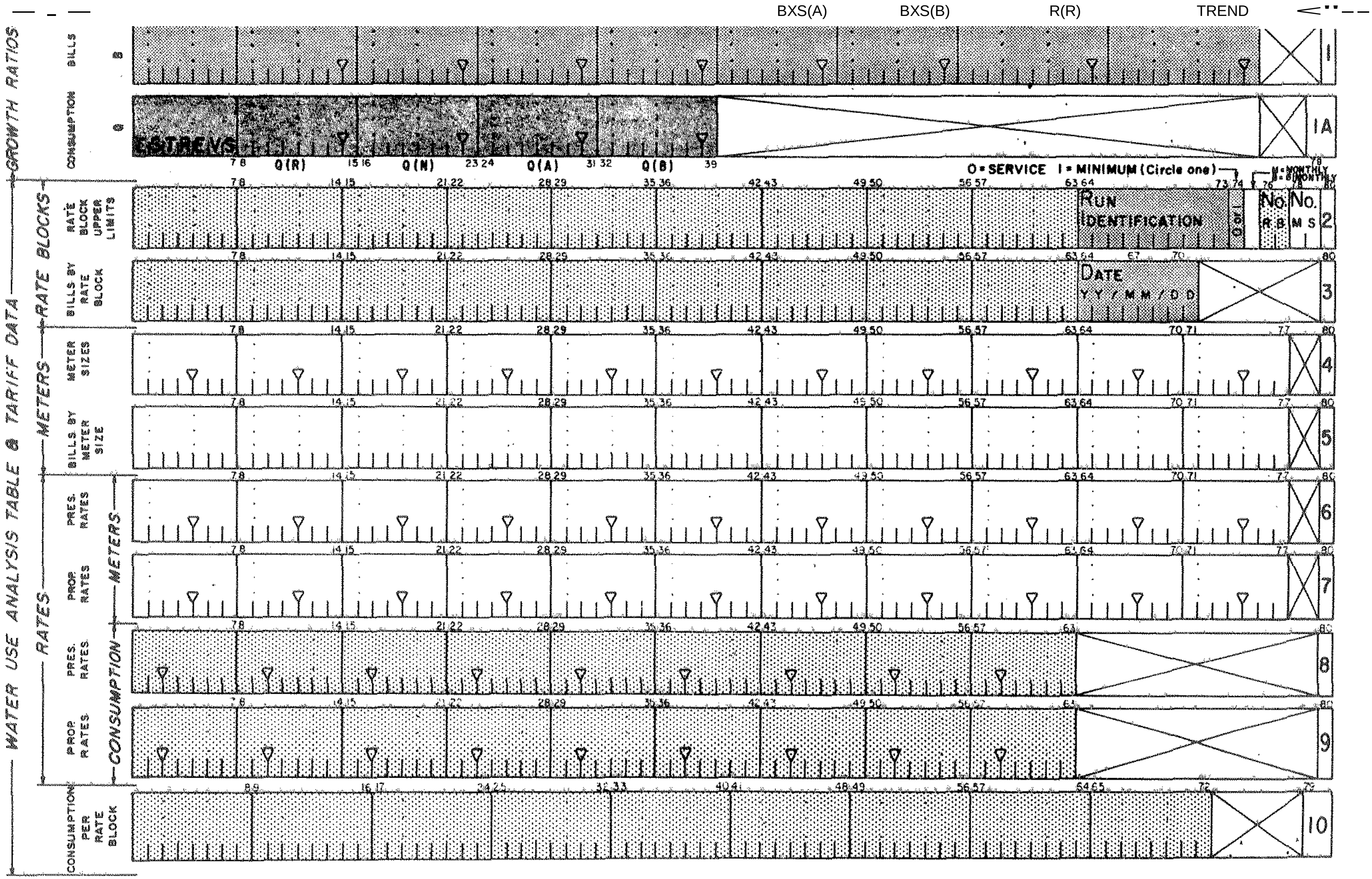
CALIFORNIA PUBLIC UTILITIES COMMISSION
[illegible]

492.128

NOTES*

1. [illegible]
2. [illegible]
3. [illegible]

CARD	ITEM	UNITS	CARD	ITEM	UNITS
1	BILLS	BILLS/YEAR	4	METER SIZES	INCHES
1	[illegible]	/YEAR	5	BILLS BY METER SIZES	BILLS/YEAR
1A	[illegible]	CCF/WATER YEAR	6	METER CHARGES	[illegible]
2	RATE BLOCK UPPER LIMITS	CCF	8, 9	CONSUMPTION CHARGES	/CCF
3	BILLS BY RATE BLOCK	BILLS/YEAR	10	CONSUMPTION PER RATE BLOCK	CCF/YEAR



\11\.'!'ER USE ANALYSIS TABLE

Unimum Charf!;e Tariff

11onthly 01111nr:

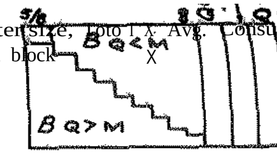
		19			377	7	46,340	2,639	
		17	1		495	8	59,568	3,960	
		II	1		472	9	67,743	4,248	
		11			527	1Q	81,100	5,270	
		14			353	II	84,502	3,883	
		6			42	12	95.724	504	
		8			30	I.I	97,8)8	390	
		11	2		31	14	105,238	434	
		21			43	15	103,050	645	
		9	1		47	16	104,352	752	
		I4			39	17	105,536	663	
					47	1	105,S76	846	
					21	to		420	
					38	.19	'I?	722	
					22	21.5		473	
					15	23.5		353	
					lO	25.5		255	
					14	27			
	972	189				37.8	,395		
41 – 50	1,192	308	4		7	44.9		314	
51 – 60	556	2:¥9	1		5	54.9		275	73,
71 – S0	198	105	2	::1	6	75.0	)4,221	4SO	33,771
61 – 70	336	197	1		1	65.1	49,01.9	65	48,964
	121	119	2	ill					
					2	85.1	29,3H	170	29,183
Sl – 90	'/0	73							
91 – 100						95.5	24,b62		24J062
101 – 125	120	w.	2		2	112.6	53,812	225	53,587
126 – 150	43	101,				137.6	39,893		39,893
151 – 200	47	121			J	173.7	64,452	521	63,931
to1 – JOO	23	114			6	244.7	110,841	1,468	109,373
301 – 400	2	27			1	347.2	72,571	341	72.,224
401 –		n.				446.1	53'9l!4		
501 –	6	32				692.2	20t..,202		
Tota.la					3,858		J,843,022	35,755	J,W/,267
BHls w/Q Hespec.tive t!Jinimum Q					Cort:I' .S		100.00;:	o93	99.07%

*8

Min. wfo 5/8" ... Meter Year
162,968 / 12 Meters
BXS(R) 0

Card

(1) No. of bills by meter size, Toto l x Avg. Consumption Block
(2) Min. No. of bills in block
(3) = (1) - (2)



Card #3
Card #4
Card #10
Card #2

Rate Block Limits (CCF) and Charges	Consumption Block 100 cu. ft.	5/8"	1"	1½"	2"	3"	4"	6"	8"	Total	Minimum Bills in Block	Average Consumption	Q(R) Consumption	$Q_{MB}(R)$ In Min.	$Q_{Q>M}(R)$
0-5 2.55$ Month	0	1,332								1,332					
	1	1,710	95	30	17		2			1,854	144	1	1,854	144	1,710
	2	2,248	107	20	9					2,384	136	2	4,768	272	4,496
	3	3,013	162	8	10					3,193	180	3	9,579	540	9,039
	4	4,001	151	16	20					4,188	187	4	16,752	748	16,004
	5	4,917	239	14	21					5,191	274	5	25,955	1,370	24,585
6-20 .40$	6	5,570	243	12	13					5,838	268	6	35,028	1,608	33,420
	7	6,343	344	19	14					6,620					43,701
	8	6,951	450	25											55,608
	9	7,055	441	12											63,495
	10	7,583	483	32											75,830
	11	7,115	321 214	21											80,619
	12	7,350	579	28											95,220
	13	6,94[illegible]	553	24											97,448
	14	6,899	587	23											
	15	6,293	536	30											
	16	[illegible]	[illegible]	[illegible]											
	20	3,977	522	36	19										
	21 - 22	6,920	1,079	65	22										
	23 - 24	5,370	1,007	57	15					6,449					
	25 - 26	4,152	887	69	10					5,118					
	27 - 28	3,176	820	64	14					4,074					
	29 - 30	2,240	751	57			2			3,058	9	29.5	90,080	265	89,815
31-9999 .38$ CCF	31 - 35	3,530	1,353	154	56	2	2			5,097	4	32.7	166,765	131	166,634
	36 - 40	1,809													

17,221 Bills
18,142 Bills
921 Bills
58,902 CCF
55,834 CCF
789
842,438 CCF

Card

EXHIBIT D.2

ONE SHOT OR ESTREVS DATA INPUT SHEET

CALIFORNIA PUBLIC UTILITIES COMMISSION
Utilities Division, Hydraulic Branch

492.12B
9/76

NOTES:
1. For Climate - Mareg - Revenue run, insert word ONESHOT on card 1, spaces 1 to 7 and leave card 1A, spaces 8 though 39 blank. Fill in rest of card 1.
2. For revenue estimate only, leave card 1, spaces 1 to 7 blank, but fill in remainder of cards 1 and 1A.
3. Fill in fields from left to right. Essentially all values right justified except when decimal indicated ∇.

CARD	ITEM	UNITS	CARD	ITEM	UNITS
1	B, BXS	BILLS / YEAR	4	METER SIZES	INCHES
1	R	$ / YEAR	5	BILLS BY METER SIZES	BILLS / YEAR
1A	Q	CCF/METER-YEAR	6,7	METER CHARGES	$ / MONTH
2	RATE BLOCK UPPER LIMITS	CCF	8,9	CONSUMPTION CHARGES	$ / CCF
3	BILLS BY RATE BLOCK	BILLS / YEAR	10	CONSUMPTION PER RATE BLOCK	CCF / YEAR

WATER USE ANALYSIS TABLE & TARIFF DATA

GROWTH RATIOS

Card 1 — BILLS (B)

1–7	B(R) [B(N)] 8–15	B(A) 16–23	B(B) 24–31	BXS(R) [BXS(N)] 32–39	BXS(A) 40–47	BXS(B) 48–55	R(R) 56–65	TREND 66–75
	1629680	1662274	1695519	232460	234785	237132	1160117070	

Card 1A — CONSUMPTION (Q)

1–7	Q(R) 8–15	Q(N) 16–23	Q(A) 24–31	Q(B) 32–39
ESTREVS	2830	2830	2910	3060

RATE BLOCKS

Card 2 — RATE BLOCK UPPER LIMITS

0 = SERVICE 1 = MINIMUM (Circle one); M = MONTHLY, B = BIMONTHLY

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	RUN IDENTIFICATION 64–73	74	75	No. RB	No. MS
5	30	9999							CACORM M/M	0	M	3	8

Card 3 — BILLS BY RATE BLOCK

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	DATE YY/MM/DD 64–70
177221	1125285	116604							75 9 18

METERS

Card	1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	64–70	71–77
4 METER SIZES	.625	1.000	1.500	2.000	3.000	4.000	6.000	8.000			
5 BILLS BY METER SIZE	177221	30316	4217	3145	14	12	4	20			

RATES

METERS

Card	1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	64–70	71–77
6 PRES. RATES	2.55	4.80	8.00	12.50	23.00	40.00	80.00	125.00			
7 PROP. RATES	2.95	5.50	9.20	14.50	26.00	46.00	92.00	145.00			

CONSUMPTION

Card	1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63
8 PRES. RATES	.255	.410	.38						
9 PROP. RATES	.295	.46	.44						

Card 10 — CONSUMPTION PER RATE BLOCK

1–8	9–16	17–24	25–32	33–40	41–48	49–56	57–64	65–72
558314	11908995	1842438						

EXHIBIT D.3

TiHHFf fVPE t f"'l ll'!UM tHARGI:. MONTHLY BILLING CYCLE USED IN THIS RUN

LISTING 0F OATA • AATIOS

!NPU! DATA

	IOEN f	VALUES	
HtCOWUEO *CONSUMPii* CC PER MeTtR VEAH	(RJ	aa3,o	
NQRMA!.llEO	Q(Nl	u.O	"'lA
TEST YEAR A FORECAST	Q(A)	i!91,0	
TEll Y[IR ■ fORtCASJ	Q(6)	lOO,O	
"HORDlb AVG 'O Of BILLS PER YeAR	B(RJ	1 29b6,0	*Card *I*
HIT HAR A FORECAS 1	B!Al	!&&227,	
H.Sl YEAR I FORECAST	8(8)	1..955!,9	
RECORDtD AVG NO OF BIL!.S PER VtAR (EXCEPT SMALLEST METER)	ijXS(R)	uzq&,O	
TEST YEAR A FORHAST	HXS(A)	i!3476,S	
TEST YE.AR o FORECAST	BXS(BJ	23113,2	
RECORDED REVENUE	R(Rl	lb01707,o	

CILCULITtD OIT!OI FROM INPUT Ill

RIT!U O(RCl	1,0000000	TO (.I-IANGE · C	YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS $1_0$0000000)
"AT!O {J(KN)	leO!lOOOOO	TO CNANGE REC	VR CONSUMPTION TO NORMALIZED YR CONSUMPTION
••ro W(RA)	l.Ot Q2020	TO CHANGE R<c	VR CONSUMPTION TO TF.ST YR •A• CONSUMPT!O
••no <HR"')	l,103b817	TO CHAIIGE REC	TN CONSUM TION TO TEST YR •8• CONSU PT!ON
i ATIO !!(RA)	!,020.!!13	TO CHANGE ALL	THE R C VR BILLS TO ALL THE lEST VR •A• SILLS
-!> RAT !O 8(RU)	$l_0$01408t!V7	TO (;MANGE ALL	1ME REC VR ILLS TO ALL THl !lsi VR •B• BILLS
! RIT!O 8XS(RA)	!,0100017	TO CHANGE THE	REC VR BILLS (lXCEPT SMALLEST METER) 10 TEST VR •A• ILLS (EXCEPT SMALLEST METER)
[-> RA ltU BXS(Rh)	l,Oi!OOQ8l	10 CHANGf THE	REC VR 8!LLS !EXCEPT SMALLEST MlTEkl TO TEST YR •B• B!LLS (EXCfPT SMALLEST METER)
-!>			

UMBER OF Rl TIC LOCKS • ▮

NUMBER 0F METER S!H.S • 8

RECORDED OATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	RfC NO U SILLS PER RITE 8L0CK	wEC CONSUMPTION PER RATE 8LOCK CCF	ION CK R	CONSUMPTION CHARGES PRESENT	PROPOSED
5	172217	55854		2,55000	2,95000
30	125285	1903995		.40000	.46000
9999	16604	1842438		.38000	.44000

Card #2 WUA — *Card "3 WVA* — *Card #9 WUA*

Card #10 WUA — *Card #8 WUA*

NfH:.k SI ns (!NCHfSJ	AVG NO 0F tl!LLS HT Mt HR SllE	Mf:.fcR ● PER PRESENT	CHARGES MONTM PROPOSED
,ocr;	17 2£1$_0$	.5 0	2o'9'>U
1,000	30 lb.	Uu€100	S,>OO
1.)00	4t!/•	",OOO	'- tlOO
2 000	jiJij,	te,soo	1ll,501,)
3,000	l4.	n.OOO	,:ooOOO
IJ O(JO	12.	IJO.ooo	tJo.ooo
1),000	ll.	OO.VOO	91!,000
6,000	20	12'>,0011	105,000

*Card *4* *Card "S* *Card #6* *Card #7*

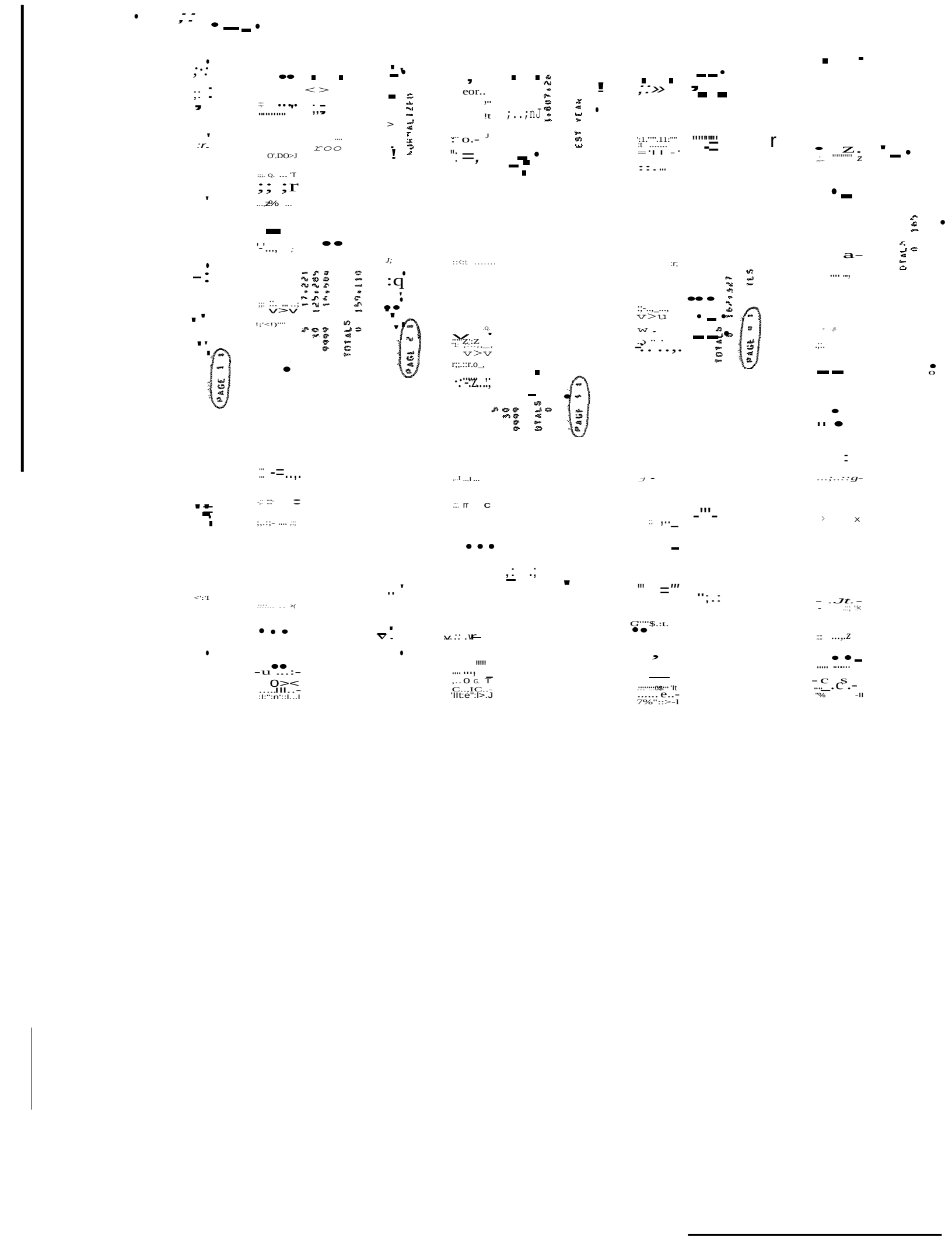
ZERO
TO
A

55,830
620,025
83,020

3,807,25

[illegible] [illegible]
TO TO
[illegible] INFINITY

3,444,592



PAGE 5. CP/tPtJTi-p ""_""

• ll.t..S

HA H tl[()(1\ UFPf L 11-1 IT 3	col\;!hiMP r 1o J LUCK yl;t.t ilTlfS tCl- ..Ff.R... vfAI.f	CUNStJMPT !0."4 Crl.?d-'GtS PRf:.St.Nf • Pf:R ccr	CONSIJMP1 HIN »t VU US PR!:.StNT U	Cfs JSUH l10 CI-IAI(b S PROPIJSED $ PER CCf	CONSU,..Pf!ON ftEYEt IJES PHOPOSED U
;	t "Jd lf) •	t!ti 5000	40!:n 730	2.<15000	Ubqt37
30	1,6'l'lo6/u	l.!{Il)Q\)	b/9oOQ8	o/J OOO	7eo,q<s
!.)999	lt.'SIH1t318	,§11000	';)t0 841	.44000	Sqi•SOO
rOYAL					
0		,000uo	l• qSobjq	.00000	1t8tJ1,803

PAGE 6. ,d!f..: IA!. j ZUl Y(IU.t

• tilLLS

w,\ſ t Ht 0(11. UPPfW t l" 1l5	cor,su,.,PT ro HLOC"- ,JliANl J f HS (,Cf'... Pl:W""!'EAkl	CrlNSUMPTlfJN CH kGES PRESENT > Pf. W CC>	(;ONSUMPTltJN •nt NUES Pk[5!N1 U	CONSU!'>IPT!ON CHARGES PROPOS!.O $ P N CC;	CONSU PTIDN HEvE•UES P OPOSED U
'>	1 9tJ1{J •	.c.S!JOOO	!l05J730	z.q'3000	1Jb'h31
!O	l b'17,b70	oi.lOOOO	f>1r/it0D8	.«&000	7Bo,qza
999Q	1,Jq4dte	, H1000	5!0•8«!	ot.I OOO	SQ!, OO
TOTALS					
0		,00000	1.sqs ttd9	,00000	1•8•1•803

-11.

PAGE 7. 1l::il YtA •••

• BILLS

PAT f. HLiJtK IIPPE) L!<lJTS	(:{H,d)UMPT IJI\. tll.UC t lJAf>,f!Tl ;S CCf-.,.PEI<i... 'ilAK	COII.:iUMPTJOII; CHARGES PRE SC.T " P£N CCf	CfJN UMPT!ON REVfNUIS PRESfN1	CONSOMPTl0' CHARGIS PROPOSEO	CONStiMPl!ON REHNU S PROPOSED
.,	)nt!d27 *	.'.:1 000	413t 33	c.q ;,000	AJl8•ab4
lv	1d!:'l7t3C4	oi.IOOOO	114•9.10	,4b000	au.toq
1f91/9	1 ,t!24t0119	e HHiUO	l::tltt.«b2	e414000	&Zb•qS&
rorAt.S					
0		,00000	1tb70t.iCLI	.00u00	1t927t981'1

PAGE 8. Tf 0T \'fA"' ...t....

• HILLS

Wt:li (: eLOt'\ L'H'tfr L l rl I r.:;	COr>.SoJMPT IUr h .0C ı(uAt>.fltH.S CCl- ..Fl_r-i... HAR	CUNSU IPf!O tHA l-i(S PRtotNI .' PlR ccr	t:LtNSUM llO Nt VENvES PR!S!,NT	CONSU•PT!ON CHA G S PNOPOHD • PlR tCf	CONSUMPTION REVENUES PROPOSED U
5	lhStoOb ▾	<.;;uoo	Lild• Hlt	2,9!>000	UB8•o0o
0	! d'H6t967	,00000	754.181	,0b000	868!005
'TY99	1 '!)1 '0 l)t!	.311000	''''''''''!	,00000	bbb•bOI
T(11AL					
		ouooo	1•f')C,7ry	,00000	2•0231!50

8 • 2 REVl Ut CALCULATION • METER SUB=ROUTINE

PAGE 9) METER SIZES, RATES, AND REVENUES

METER S!ZES	RECORDED NUM ER OF BILlS	MEHR CHARGES PRESt'T	R!.V!.NUES PRESNT	METER CHARGES PROPOSED	REVENUES PROPOHO	TEST YEAR NUMBlR OF BILLS	METER CHARG S PRESENT	REVENUES PRESENT	METER tHARG£5 PROPOSED	REVENUES PROPOSED
CO PUTED A D QRMALlZEO YtARS						**f ST YEAR •A• 8(RA) AND BXS(RA)**				
t 000	1Olb	4e800	!Oo5H	5,500	loooqa	30&&,	4,600	14>71•	5,'500	hohS
lo>OO	427u	a,000	loOlo	q,ZOO	.lt928	Ul,	8,000	lo•so	•,Z00	$oQ&6
l,000	lt.15,	ll,SOO	Odll	14. 00	S,003	lU,	1Zo500	4ol5•	14,500	StOH
l.000	l O'	3.000	322	2&,000	36M	14.	Zl,OOO	3i!S	2&,000	3&8
-4.000	u.	l.IO,OOO	60	Ub,OOO	552	12,	40,000	QSS	4&,000	556
0,000	4,	60,000	!i!0	•2,000	3&8	4,	80,000	lU	•Z,000	Hi!
e,000	eo,	!2S,000	z.SOO	1•5,000	•••00	zO,	uS,OOO	2o525	145,000	z,qzq
TilT ALB										
aOOO	JSS8,	,000	i!So•23	.000	•••au	*38.1,*	,000	2bo!8J	,000	30!It!
•••••••••••••••••••••						**lUT YEAR •8• 8!RBl AND BXS(RB)**				**••••••••••••••••••**
l'O00						]0.1,	4,800	14o8bb	5,500	!7o03
1a50Q						l.l!b,	8,000	lo485	q,ZOO	4t007
2a000						}5i!,	u,SOO	4oJ9q	14,500	5o!Ol
!,OOO						14.	ll,OOO	ll8	Z ,000	HI
4,000						U,	40,000	nO	4b,000	S l
6,000						4,	80,000	*3lb*	qii,000	3H
81'1000						i!0,	uS,OOO	ilo550	!45,000	2oqss
TOTALS										
,000						3q3b,	,000	a,•••	,000	30o4U

C 1 GRAND TOTALS = REVENUE IN DOLLARS PER YEAR

TARIFF TYPE 1 MINIMUM CHARGE

D.5-5

PAGE 10

HOUI!Nf	COMPUTED VfAF PR<SENT	COMPUTED VfAF PROPOSED	NORMALIZED YEAR PRESENT	NORMALIZED YEAR PROPOSED	ren YUH PRESENT	ren YUH PROPOSED	IUT VUR •B• PRt$[NT	IUT VUR •B• PROPOS£0
-1	!tSQS, H i!5t923	11sq1•su	lt595tb39	!o64S.803	lt070tl24	I• <71989		
B•2 TOTAlS	loo2!o31>3	<!9.813 ioB71oo!o	i!5t9i!j lol>21o51>3	29o811 !o87t.olo	.18l ltUbt$07	lOti II ona.aoo	lt752t?88 26• 4Q4 1•71••233	2t023tl50 J0 0412 2oOS3ttU
RRCR ADJUSTED TOTALS	1t601t707	!9 648th'H	i•i>Oio107	1•848tb98	!oors•n•	lt914tl21	1•157•••	Zo0i!8o4!b

4-28

'f(J1V '1'lJ mrfu?i[,grc'7)1tN /;'" ·oau·---- "C:y":>-;/-;:9-;/"71":.---;;,:.:-;;;:-, -:M:-1:.;.;:.U:-M-::-C;M::. R:G;:. --MONt t-4\, V tH\.\.1NG t.'t 't\,E.

UM A AG OATA AND UAT105 FROM P"EFAC[PAGE PLUS R(C) AND HRCM

!INPUT DATA	IDENf	VALUES
RECORDED CONIU•PT!ON CCF PEA METER YEAR	Q(R)	18J,o
NORMALIZED	Q(N)	281,0
TEST VEAA A FORECAST	Q(Al	2q1,0
!E11 YEAR B FORECAST	Q(Bl	1OO,O
Ar.CORDED AVG NO OF H11.LI PfA YEAR	S(RJ	16Zqb6,0
HST Vf;.AR ● FORECAST	B(A)	1&b217,q
TEST VEAR H FORECAST	8(8)	!&qss!,,
RECMOEI) AVG NO OP HILLS PER YEAR <EXCEPT SMA1.1.EST MU R)	BXS(A)	ZJ2Q&,o
H31 YEAR A FORECAST	BXS(A)	UQ78,5
jf$1 YeAR B FORECAST	BX8( )	urn,z
RECORDED REVENuE	R(R)	lb0!707,0
REVENUE VIA •ATER USE TAOLE BY COMPUTER	R(Cl	IU!5U,o

CALCULATED RATIOS FROM INPUT DATI

RATIO Q(RC)	t,oou0000	TO CHANGE R1C VR CONSUMPTION TO COMPUTED VR CONSUMPTION (A-wAYS !,0000000)
RATIO Q(RN)	!,0000000	TO (MANGE REC VR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RoT!D Q(RA)	t.ouqcozo	TO CHANG NfC VA CONSUMPTION TO TEST YR •A• CONSUMPTION
RA!JO Q(RBJ	1.101e817	TO CHANGE HEC VR CONSUMPTION TO 1EST VR •S• CONSUMPTION
RATIO B(RA)	1,0202173	TO CHANGE ALL THE REC YR ILLS TO ALL THE TEST VR •A• BILLS
RAT!O B(kB)	1,0«08407	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST VA •8• BILLS
RATIO 6XS(RAJ	1,0100017	TO CHA,Gt THE REC VA BILLS (EXCEPT SMALLEST HEIER) TO TEST YR •A• BILLS (EXCEPT SMALLEST METER)
RATiO BXS(RBJ	t,o.:ooqe!	TO CHANGE THE REC VR MILLS !EXCEPT SMALLEST METER) TO TEST YR •M• BILLS (EXCEPT SMALLEST METER)
RA1!D RRCR	,qon sz	REVENUE ADJUSTMENT fACTOR (REC YR R / COMPUTED VR R)

4-29

UMBER OF AATE OCKS w !
'UMBER OF METER SIZES •

IYcf on Pr<floce /)qge

RECORDED DATA Y AR R

RATE flLOC< UPPER \.IN!1 (CCF l	RtC NO OF tl!LLS PlR RAT!. BLOCK	REC CONSUMPTION P!:R RATE BLOC< CCf PER YEAR	CONSUMPTION CHAkGES PRESfNT	PROPOSlO
5	l 7221	5 8 4	<,5!>000	2,qsooo
30	12 26>	t•osqqs	••0000	,4&000
q qq	!bOOR	18424.!8	,38000	-"14000

ME. fEN S1ns (!RCKIS)	AVG tO OF ⊳1LLS BY ME!tR Silt	METER (MANGES 1 PER MONTH PHESEN!	PRQPOSEU
,62?	172<?\.	2,550	i,qt;t)
t,000	303o,	4.800	5,500
1 00	tJtn.	8,000	q.eoo
2$000	3U5,	!2,500	!U,500
;,000	IR,	23,000	2o,000
u,000	!2.	U0,000	Rb,000
o,OVO	••	110.·.)00	92,000
S uoo	dO,	t 2') t J 0 (l	i«'.:i0000

EIHIBIT D.4

WA'l'm llSE Am.Ll'SIS CAWUIATIOi

M:lnimum Charge Tariff

Monthly Billing

Block	Number of Bills	Minimum Q	0 - 5 Ccf	6 - 30 Ccf	Over 30 Ccf
0 - 5	17,221!:1	55,834	55,834		
6 - 30	125,285	1,908,995	626,425	1,282,570	
Over 30 a!	16,6o4	1,842,438	83 020	415,100	1,344,318
Total!!:!	159,110	3,80	765,279d/	1,697,670	1,344,318
Minimums£/	3,858				
Total Bills	162,968				

	Quantity	Present Rates	Revenues
Minimum	159,110	$ 2.55	$ 405,731
6 - 30	1,697,670	.4o	679,{)68
Over 30	1,344,318	.38	510,841
Subtotal			155'64o
Minimum Charges:			
1" Meter	3,036	$ 4.80	$ 14,573
1 " "	427	8.00	3,416
2" "	345	12.50	4,312
3" "	14	23.00	322
4" "	12	40.00	48o
6" "	4	8o.oo	320
8" "	20	125.00	2500
Subtotal	3,1l5t!		$ 25:923
Total Revenues per Water Use Analysis			$],621,563

!972 Recorded Revenues	
Residential	1,133,2 7
Commercial	76,133
Industrial	2,680
Public Authority	l8Q,647
'.rotal Revenues	1,'601,707
Correction Factor HRCR	96.78

!/ Bills with Q} W.nimum Q, .except for smallest size meter in ;smallest bl.ock where they are all those referr.ed to in EJ below.

pJ Bills with Q A Minimum Q, exe.ept for smal.lest si'Ze meter.

sJ 1Smallsst size meter billi with associated Ccf for Q l>'.inimum Q. Igno;re this sum as Q charge is in 159,1.10 bill quantity charge.

EXHIBIT E.1

#A'rER USE ANALYSIS TABLE

Service Charge Tar>iff
r onthly Billing

Rate Block Limits (CCF)	Consumption 100 cu.									Total	Consumption Total
	0									1,332	
	[redacted]									1,854	1,854
	2									2,384	4,768
	3									3,193	9,579
	4									4,188	16,752
										5,191	25,955
										5,838	35,028
	7									6,620	46,340
	8						1			7,446	59,568
	9					[redacted]	1			7,527	67,743
	10					1				8,110	81,100
	11									7,682	84,502
	1.2									7,977	95,724
	13									7,526	97,838
	11<									7,517	105,238
	15					I!				6,870	103,050
	16									6,522	104,352
	17					1				6,208	105,536
	18									5,882	105,876
	19									5,123	97,337
	:r0									4,556	91,120
	21 - 22									8,082	173,604
	23- 24									6,449	151,366
	25.26									5,118	130,361
	27 - 28									4,074	111,947
	29 - 3!)									3,058	90,080
	31 -									5,097	166,765
	36 -									3,053	115,395
	41 • 51)					3				2,905	130,467
	51 • 6o	469	556	229	89	6			1	1,350	74,064
	61.70	149	336	197	70				1	753	49,049
	71 • 110	56	198	105	87	4	4		2	456	34,221
31-9999	81.90	48	121	119	53	2			2	345	29,353
	91 • 100	43	70	73	65	1				252	24,062
	101 • 125	52	120	154	127	15	8	2		478	53,812
	1.26 • 150	13	43	1o4	117	10	3			290	39,893
	15'1 - 200	15	47	1.21	157	22	6	1	2	371	64,452
	1!01 • 300	8	23	nlo	233	52	8	10	5	453	110,841
	301. 400	4	2	27	113	28	26	6	3	209	72,571
	It¢1- 500	1		21	64	16	10	8	1	121	53,964
	51)1 • 1,000		6	32	116	68	65	8		295	204,202
	O?illl' 1,000				32	42	48	90	1	213	623,273
	Total	139,722	17,975	2,738	1,922	276	186	125	24	162,968	3,843,022
	(R)	0	17,975	2,738	1,922	276	186	125	24	23,246	

Card
Card#10
Q(R)
18,142 Bills
98,908 CCF
128,185 Bills
1,937,710 CCF
16,641 Bills
1,846,404 CCF
Card:tts

ONE SHOT OR ESTREVS DATA INPUT SHEET

CALIFORNIA PUBLIC UTILITIES COMMISSION

492 1213

CUD	ITDI	UNITS	UAO	IT'I:M	11'8
	IJXS	IJIL $ YEAII		M!!:If__SIZES	INCH£$
1	11	/Y£.q	$	1/LSIYMCTtlfS/ZI'$	8/L /-_'All
,..	C ,__	wrEit·YEAII	- -	1/Ert:It CHAitiE$	1 /!!!!!fl."----- rN
/	RATE IJLIJCK 1!,.11£/f LIMIT$	CCF	I.	CONSUMPTION CHAIIU8	/ f;F
J	11/,.L$ IIY IIAf'E ILOCK ·	IILLI /YEA/I	10	CONStJMPrt<JIII ,,.Eft IIAT'£ 1/.DCK	CCF/t'EA

TREND

WATER USE ANALYSIS TABLE & TARIFF RATIOS

CONSUMPTION — METERS

CONSUMPTION BILLS

ESTREVS

Q(R) Q(N) Q(A) Q(B)

O = SERVICE I = MINIMUM (Circle one)

M = MONTHLY B = BIMONTHLY

RUN IDENTIFICATION

No. No. R B M S

DATE Y Y / M M / D D

METER SIZE

BILLS BY METER SIZE

PRES. RATES

PROP. RATES

PRES. RATES

PROP. RATES

CONSUMPTION PER RATE BLOCK

INPUT OATA	!OENI	VA UU
RECORDED COOSUMPT!ON CCF PER MEIER TiiR	Q(R)	281,0
NORMAl.,!ZED	Q(N)	lei!.0
TEST VEIR A FORECAST	Q(Al	HI,O
TEST V[A 8 FORECAST	Q(8)	100,0
RI:COR0EO IVG NO OF 6!LLS PER	8(Rl	1Uq&8,0
TEST YEAR A FORECAST	B(A)	looZ27,4
TEST VEAR 8 FORECAST	8(8)	toqS51,q
RtcOR0EO AVG NO OF 8!1.1.5 PER YEAR (EXCEPT SMALLEST METER)	SXS(R)	ZHQo,O
TEST VUR A FORECAST	BXS(A)	2}478,5
TEST YEAR 6 FORECAST	8XS(8)	23713,2
RECORDED REVENUE	R(R)	zonqu,o

CALCULATED RATIOS FROM INPUT DATA

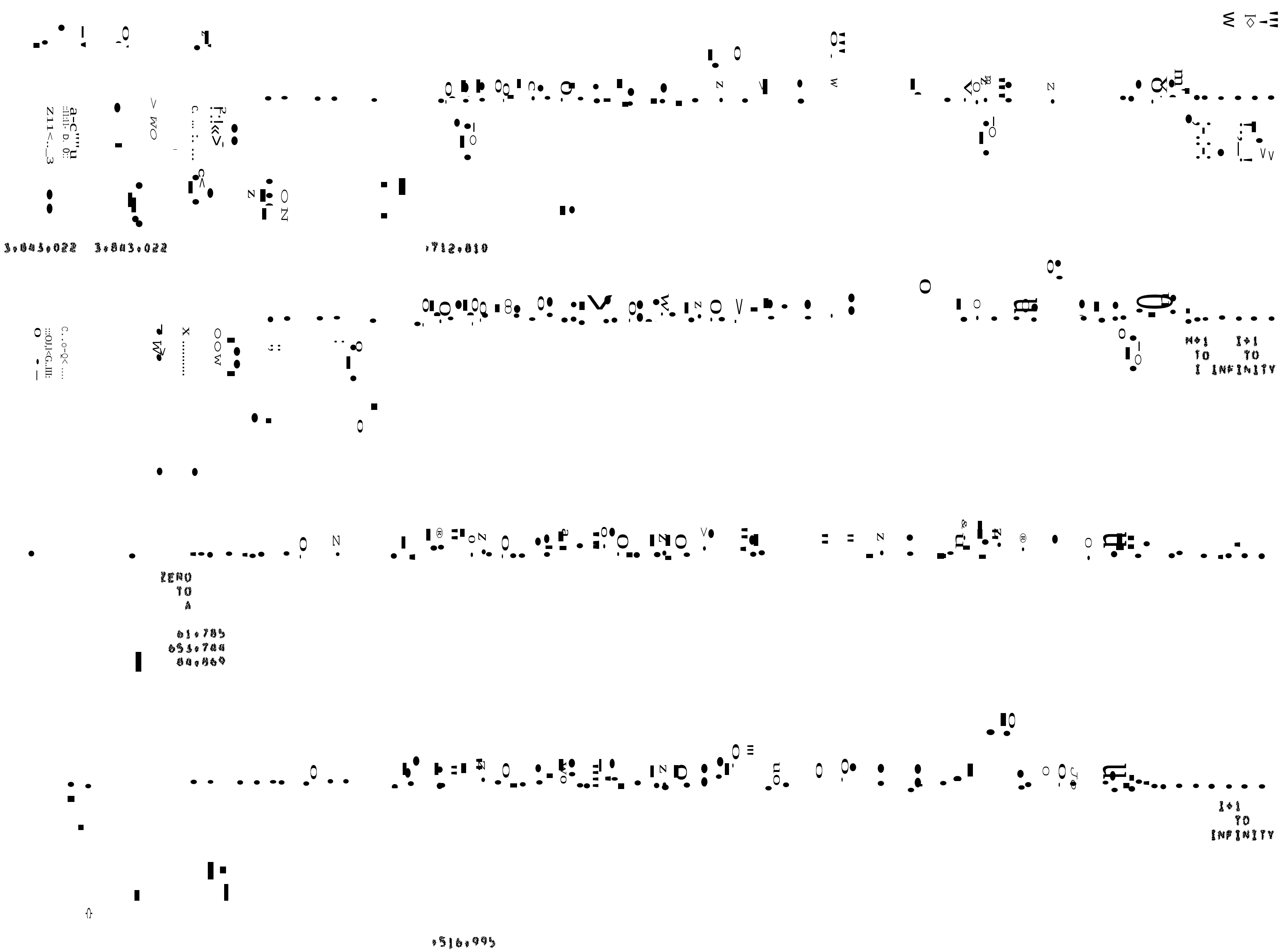
RA T!O Q(RCJ !,0000000 TO CMANGE REC YR CONSUMPTION TO COMPUTED VR CONSUMPTION (A WAVS 1,0000000)
RA T!O Q(RN) eqQbiH> lJ TO CHANGE REC VR CONSUMPTION TO NORMA IZED VR CONSUMPTION
RAT !O Q(RA) !•0486342 TO CHA GE REC YR CONSUMPTION TO TEST YR •A• CONSUMPTION
RA!!O Q(RB) !,!028q75 TO CHANGE REC YR CONSUMPTION TO TEST YR •8• CUNSUMPT!ON
RATIO S(RAl l,olo0002 TO CHANGE A\.\. THE REC YR Bl\,LS TO AL THE T!ST VR •A• BILLS
RATIO B(RBl !,0404000 TO CMANGii AU THE REC VR BILLS TO ALL THE TEST VR •B• SILLS
RAl!D SXS(RA) 1,01000!7 TO CHANGE THE REC VR BILLS (EKCET S•ALLEST MtTER) TO TEST VR do B!L\.8 (EXCEPT SMALLEST M!.HRJ
RATjQ 6XS(R$1 loOil00qSI TO CHANGE THE REC VR SILLS (EXCEPT SMALLEST METER) TO T!ST VR •Be 8lt.L8 (EXCEPT SMAI.I.EST METER

NUMBER OF RAT[BLOCKS • 1
NUMS[R OF METER SIZES • 8

RECORDED DATA YEAR R

RATE BI.OCK UPPER I.IM!T (CCF)	REC NO OF SILLS P£k RATE BLOCK	REC CONSUMPTION PER RA!E 8LOCK CCF PER VEAR	CONSUMPTION CMARGES PRESENT	PROPOSED
5	18142	$8Q08	,51000	,sq000
30	128135	!qH1!0	,40000	04b000
q?Q?	IUal	184b40U	,38000	,uu000

METER S!lU (INCHES)	AVG NO OF 811.1.5 av METER S!H	METER CNARGES $ PER MONTM PRESENT	PROPOSED
0hi!S	ll U<,	2,550	l!,qso
1,000	17H5,	u,S00	S, OO
!,500	i!US,	a,000	9,4!00
,,000	lqU,	12.S00	14,500
J,OOO	nO,	n,OOO	2&,000
u,0u0	!6b,	u0,000	4b0000
0,000	125,	e0,000	qz,000
S,000	•••	a<s,000	t S.OOO


3,843,022
3,843,022
,712,810
M+1 TO I
I+1 TO INFINITY
ZERO TO A
61,785
653,784
84,869
I+1 TO INFINITY
,516,995

COMPUTED

1,003,022

5
30
9999
TOTALS
0

5
30
9999
TOTALS
0

4-34

5
30
9999
TOTALS
0

66,227 4,030,693

PAGE 4

TEST YEAR

PAGf! CUMPUT£0 Vt:AR

RATE BLOCK UPPER l,IM!TS	CONSUMPTION BLOC< fWANTlitS CCF•PfR•YEAR	CONSUMPTION CHA GES PRlSlNT ▾ PfR CCF	CONSUMPTION REVENUES PREHNT U	CONSUMPTION C"ARGES PROP08f.D $ PER CCF	CONSUMPTION REVENUES PROPOSED U
,	nn o3e	,5!000	J()Qt3t.19	,SQOOO	IJ01tQQ2
lO	h7!2o8!0	eLIOOOO	o85ol2	,UbOOO	787•893
qqqq	t.3•To!7•	,38000	S!!oOlo	,4MOOO	502t7S7
!OUI..S					
0	3t8t!lo022	,00000	ltSqt;,,jqq	,00000	1•8«2ob42

PAGE •• NQRNAI!UD YEAR

RAH BlOCK UPPE L!MjJS	CONSUMPTION 8LOCK WUANTlT!ES CCF..Ptlh•VEAR	CONSUMPTION CHA GES PRESENT ▾ PER CCF	CONSUMPTION REVENUES PRESENT U	CONSUMPTION CHARG S PROPOSED $ PER CCF	CONSUMPTION REHNUES PROPOSED $$
S	182.830	,51000	H t20l	,sqOOO	·1•870
30	!o705tqb3	. &000	&82d85	,40000	784t743
qqtjq	!dUO,bSO	,38000	soq•••r	,44000	58qt88&
TOTAlS					
0	lt8t?Qttl62	pOOOOO	!o5Q!o07	,00000	!o83&••q8

PAGe 7• lUI YEAR wAw

RAlt LOCK LIMITS	CONSUMPTION BLOCK fJUANTIT!ES CCFwPfR•'IEAR	CONSUMPIION CHARf, S P ESENT P1CC'	CONSUMPT!ON REVENUES PRESf.NT U	CONSU PT!ON CHARGES PROPUSEO $ P!R CCF	CONSUMPTION REVENUES PROPOSED U
S	600dq6	,S!OOO	ij08o203	.59000	ij72o 35
30	!o802.Q36	,t!0000	121o!75	,l!bOOO	82QolS2
qqqq	lo e7o357	,38000	5oU2t]Q6	,44000	b28oOl1
TOTALS					
0	i! 030dt93	Q00000	1t671t77tt	,00000	1•••••&2)

PAC.(cl, TEST VfAR ' iJ""

NATE BLUCK L!PPt>l L!M!!S	CONSUMPTION OLUC• .JUANTIES CCf"wJJEFI•VF.AR	CON$\JMPT!ON CHARGES PNf S NT I PEN CCF	CONSUMPTION RtHNUoS PReSENT n	CONSUMPTION CHARGES PWOPOSf.ll $ PER CCF	CONSUMPTION REVENUES PROPOSED U
	81Bd5•	,5!000	4!Idb!	,50000	482o6?.Q
.!0	loq03dl0	1'114000fJ	HIt 244	,«bOOO	87So430
qqq	!<51bo09S	• j(\000	S7bo4S8	,44000	bb7o478
TOTALS					
0	4t2.$1:1,tJ5Q	,00000	ltf5'JtfHd	,00000	2o02So7H

8 • Z, REVENUE CALCULATION • METER SU6•RUUT!NE

PAGE 9 I METER SIZES, RATES, AND REVENUES

********** COMPUTED AND ORMAL!ZEO YEARS **********

METER SUES	RECORDED NUM8ER OF BlLLS	METER CHARGES PRESENT	REVENUES PRESENT	METER CHARGES PROPOSED	REVENUES PROPOSED
,en	!l 7i!2.	.S O	J5bt2ql	i!,qso	41lo ISO
1,00'0	IHYS,	4,800	ao.aso	s,soo	no&&l
!,500	i1H6,	s.000	u. o•	q,zoo	no qo
<,000	!qu,	!2.500	i!4o025	!4,500	211511
3,000	i!76,	n,ooo	bo)OA	Zb,OOO	7ol7b
u,000	!U,	00,000	7tM40	Ub,OOO	8o55b
o,000	!25,	80,000	IOoOOO	q ,000	llo500
e,000	• • •	ti!S,000	loOOQ	145,000	3o08Q
TOTALS					
,000	!&<q&e,	.000	5!5ol88	,000	sqo, on

ob25					
t,000					
1,500					
a,000					
!,000					
•.000·					
c,000					
o,000					
TOTALS					
.000					

ill

lit $$09$$$$8$0$$$9$$$$$ TEST YEAR •A• **********

!II 6(A) AND 8XS(RA)

TEST V[AR NUMBER OF 81,,8	METER CHARGES PR[S[NT	REVENUES PRESENT	METER CHARGES PROPOSED	REVENUES PROPOSED
!UiYH,	1,550	H4oOIO	,Q50	ua.toq
18155,	4,800	8Tol0l	5,500	•q•B I
216$,	a,000	UoiU	q,Z00	n,ou
jqOI,	u,s00	ZOo2U	14,500	i!8oiQS
i119,	u,ooo	6oOII	2b,OOO	7o208
1&8,	40,000	7o5IO	4b,OOO	8oU2
U&,	80,000	!Oo!OO	qz,000	llli>l5
au,	125,000	Jo030	!45,000	lt5l5
lhli7,	,000	5i4o5'7	.000	605o$ q

,,,..... TEST YEAR •B• ..... 8CR8) AND BX8(H8)

!45elq,	Z.S O	Hl,seq	z,q5o	Olo o224
1833&,	G,800	88.014	5,500	100o8Qq
nn,	8,000	22o304	q,zoo	Z5obqb
jqb!,	llo500	Uo508	!4,500	Uo42Q
Zu,	n,ooo	••47&	u,OOO	7oHO
140,	40,000	?o540	4&,000	6oH8
us	80,000	!Ool01	*qz,000*	llloH!
lll	125,000	3t0b0	145,000	3t550
11t45SZ,	,000	5l4o081	,000	b 10'528

C 1 GRAND TOTALS - REVENUE IN DOLLARS PER YEAR

PAGE 10

ROUTINE	COMPUTED VUR YEAR PRESENT	COMPUTED VUR YEAR PROPOSEO	NORMAl!Z£0 YEAR PRUENT	NORMAl!Z£0 YEAR PROPOSED	TUT VUR do PRESENT	TUT VUR do PROPOUO	TUT YEAR •8•. PRESENT	TUT YEAR •8•. PROPOSED
6•1 a. TOTAI.S	lo5 bo}qq S!5o288 2ol!!oU8	loe•a•••• s•coUJ 2o437o45§	!o59!o0TS 515o288 ao!OooJbl	lo83bo4q8 "4t81l ih4l!oUI	111•71•174 Uco591 2o!•o•!11	lo9ZqoUl b05o5U 2oU5t\qz	I o?55oOU 53Go081 2o!no Uo	2oOZSo7J7 bl6oSi18 2oU2olU
RRCR AOJU8TEO TOTAL.&	2o08So924	i!t407o71o	*l•060obbS*	2t40!oMB	z,h••n•	co504o262	Zohlo215	2obl0o0l8

4-37

TARIFF TYPE 1 SERVICE CHARGE — MONTHLY BILLING CYCLE

INPUT DATA	IDENT	VALUES
RECORUEO CONSUMPTION CCF PER METER YEAR	Q(R)	283,0
NORMAL UEO	Q(N)	iU,O
1£81 TEAR A FOR CA81	Q(A)	;n1,o
TEST YEAR B FORECAST	Q!Sl	300,0
RECORDED AVG NO OF 8!1.1.8 PER YEAR	S!Rl	lb2q s,o
TEST VUR • FORECAST	S(A)	1&6227,4
TEST VUR B FORECAST	8(8)	lo955!,q
RECORDED AVG NO OF Sll.i.S PER VEAR (EXCEPT SMAlLEST MEYER)	BKS(R)	21246,0
TUT YEAR A FORECAST	SXS(A)	U4T8,5
TEST V[AR B FORECAST	BX8(8)	21713,2
RECOROEO REVENUE	R(R)	i!085qH,0
REVENUE VIA WATER USE TABcE BV COMPUTlR	R(C)	UI!U7,.

CALCULATEO RATIOS FROM INPUT OATA

RA1!O iJ(RC)	1,0000000	TO CHANGE REC VR CONSUMPTION TO COMPUTED VR CONSUMPTION CA WAYS !,0000000)
RA!!O (RN)	,qqb4bb4	TO CHANGE R[t VR CONSUMPTION TO NORMALIZED VR CONSUMPTION
RAT!O Q O A)	1,0488]42	TO CHANGE REC YR CONSUMPTION TO T!ST YR •A• C0N8UHPT!ON
RAT!O Q(RB)	!,102Bqa	TO CHANGE REC VR CONSU PT!ON TO T!ST YR ··CONSUMPTION
RAT!O S(RA)	1,0200002	TO CHANG! ALl. THE REC YR BILLS TO ALL THE TfST VR •A• B!L S
RAT!O B(RB)	I,0QO«OOO	TO CHANGE ALL !H REC VR BILLS TO ALL THE 1[81 VR •B• BILLS
RAT!O B S(RA)	!,O\000!1	TO CHANG[IHE REC VR BILLS (EXCEPT SMALLEST MfTERl TO TEST VR ••• BILLS !EXCEPT SMALLEST METER)
RATIO 8X$(R0)	1,oaooqs1	TO CHANGE THE REt VR B!LI.S (EXCEPT 8MAI,LE8T METER) TO TEST VR •8• S!LI.8 (EXCEPT SMALLEST M TERl
RRCR	,Q877 95	REVENUE OJUSTNENT FACTOR (R[C VR R / COMPUTED VR R)

RATIO

NUMBER OF RATE BLOCKS • 3
NUMBER OF METER 8!ZES • 8

RECOROED DATA YEAR R

•n BLOCK UPPER !.!MIT (CCFl	REC NO OF SILLS PER RATE BLOCK	REC CONSUMPTION PER RAIE BI,.OtK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOBEO
$	18 I Ri!	58QOS	,5!000	,sq000
]0	128185	!H7110	,40000	,46000
qq q	!o Q!	1841>404	,38000	,uOOO

MUER snu (INCHUl	AVG NO OF BIU8 eV METER SUE	METER # PEN P !SENT	CHARGES •O TH PROPOSED
,b2'5	IH1U,	2,5 0	<,qs0
t,000	pqys,	4,800	;, 00
I ,s00	1H8,	s,000	q,z00
i,OOO	lq z.	!2,500	1 ,s00
3,000	il1b'	u,OOO	21>,000
u,000	l&b,	40,000	4b,OOO
••000	!ZS,	00,000	q2,000
s,000	Z4,	125,000	tas,000

EXHIBIT E.4

WATER USE .ANI!L'rSIS REVENUE CALCULI\.TION

Service Cha.rtle Tariff

Monthly Billing

Block	Number of Bills	Ccf	0 - 5 6 = 5	6- 30 6 = 25	Over 30
o - 5	18,142	58,908	58,908		
6 - 30	128,185	1,937,710	640,925	1,296,765	
Over 30	16,641	1,846,404	83,205	416,025	1,347,174
Total	162,968	3,843,022	783,038	1,712,810	1,347,114

Consumption Charges:	Queptity	Present Rates	Revenues
O - 5	783,038	$ 0.51	$ 399,349
6 - 30	1,712,810	.40	685,124
Over 30	1,347,174	.38	511,926
Subtotal			1,596,399
Service Charges:			
5/8" Heter	139,722	$ 2.55	$ 356,291
111 "	17,975	Ulo	86,280
1 11 "	2,738	6.00	21,904
2" "	1,922	12.50	24,025
3" "	276	23.00	6,348
4" "	186	4o.oo	7,440
6" "	125	Do.oo	10,000
811 "	24	125.00	3,000
Subtotal	162,968		515,288

Total Revenues per \later Use AnelyEis	2,111,687
1972 Recorded Revenues Assume	2,085,924
Correction Factor RRCR	98.78

Q)" ,002 CCF/ =141 QCCF/
162,968/(2 Mete" . /Meter Yeor

EXHIBIT f.1

WAT!!lt USE ANALYSIS TABLl!:

Minimum Chargl> T&'iff

Bimonthly BUli:tt.g with Monthly Tarif't Speeitieation

Rate Block Limits (CCF) and Charges: Tariff	WUA	Consumption Block 100 cu. ft.	Number of Bills By Meter Size: 5/8"	1"	1½"	2"	3"	4"	6"	8"	Total	Minimum Bills in Block	Average Consumption in Block	Consumption: Total	In Min. Block	> Minimums
		0	1,332								1,332					
0-5 2.55$ Month	0-10 5.10$ Bimonth	1	1,110	95	30	17		2			1,854	11.4	1	1,854	144	1,710
		2	2,248	107	20	9					02,384	o 136	2	4,768	272	4,496
		3	3,013	162	8	10					a3.19J	180	3	9,579	540	9,039
		4	4,001	151	16	20					m4,188	187	4	16,752	748	16,004!
		5	4,917	239	14	21					,191	274	5	25,955	1,370	24,585
		6	5,570	243	12	13					-..o5,B38	268	6	35,028	1,600	33,420
		7	6,243	344	19	14					6,620	,;;377	7	46,340	2,639	43,701
		8	6,951	450	25	19		1			U\7,446	495	8	59,568	3,960	55,608
		9	7,055	441	12	17	1	1			7,527	472	9	67'743	4,248	6),49.5
		10	7,583	483	32	11	1				8,110	5.?,7.	10	§1 100	5 270	75
		11	7,115	535	21	11					7,682	567	11	84,502	6,237	78,265
		12	7,356	579	28	14					7,977	621	12	95,724	7.452	88,272
6-JO ..!J2l CCF							2					583	13	97,838	7,519	90,259
												618	14	105,238	8,652	96,586
												579	15	103,050	8,685	94,365
												657	16	104,3.52	10,512	93tSlf0
		17	5,982	587	29	7	1					o 626	17	105,536	10,642	94,894
		18	5,246	589	33	14						a 636	18	105,876	11t448	94,428
		19	4,486	583	41	13						637	19	97,337	12,10)	85,234
		20	3,977	522	36	19						579	20	91,120	11,500	79,540
		21 – 22	6,920	1,075 280/798	65	22						367	21.5	173,604	7,fff}O	165,714
		23 – 24	5,370	1,007	57	15					6,449	72	23.5	151,366	1,692	11,9,674
		25 – 26	4,152	887	69	10					5,118	79	25.5	130,361	2t014	128,)47
		27 – 28	3,176	820	64	14					4,074	78	27.5	111,	2,145	109,802
		29 – 30	2,240	751	57	8		2			3,058	67	29.5		976	88,104
		31 – 35	3,530	1,353	154	56	2	2			5,097	214	32.7		998	767
		36 – 40	1,809	972	189 80/129	83					3,053	143	37.8	150,407	5,45?	405 125,0?4
		41 – 50	1,284	1,192	308	114	3		4		2,905	121	44.9	74,064	5,270	68,794
													.1	49,049	65	48,984
31-9999		71 –			105			4		2	456	10	75.0	34,221	750	33,471
	61-9999	81 – 90	48	121	119							4	85.1	29,353	340	29,013
		91 – 100	43	70	73							1	95.5	24,062	96	23,966
	,1M CCF	101 – 125	52	120	154							17	112.6	53,812	1,914	51,898
		126 – 150	13	43	101.							3	137.6	39,893	413	39,480
		151 – 200	15	47	l21							9	173.7	64,452	1,563	62,889
		201 – JOO	8	23	114							15	244.7	110,841	3,670	107,171
		301 – 400	4	2	27							9	347.2	72,571	3,125	69,446
		401 – 500	1		21	116	68	65	8		295	1	446.1	53,984	446	53,538
		501 – 1,000		6	32								692.2	204,202		204,202
		over 1														23,273
		Totals	139,722	17,975	2,738	1,922	276	186	125	24	162,968	10,470		3,84.3,022	166,894	J,676,12S
		Bills W/Q.< Respective Minimum Q	50,623	8,676	1,005	688	30	29	19	23	61,093			. 100.001	4.Jifll	95.61f!>
		Min. w/o 5/d"	0	8,&76	1,005	Mlll	J(l	29	W	3	10,470					
		oXS(;l)	0	17'975	2,'/J8	l,g22	276	186	125	24	23,246					

97,709 Bills

105,

LINE

1,359,713 CCF

1,347,331 CCF

4-40

SUMMARY PAGE — DATA AND RATIOS FROM PREFACE PAGE PLUS R(C) AND RRCR

INPUT OA U	!DiNT	VALUES
RECORDED CONSUMPTION CCF PER METfR YEAR	Q(Rl	141,5
NORMALIZED	Q(N)	141,$
!EST V[AR A FOR£CA8T	Q(A)	145,,
TEST YEAR e FORECAST	0(6)	150,0
RECORDED AVG NO OF S!l.l.S PER VEAR	B(R)	!blqoe,o
TEST VEA A FO €CA8T	B(A)	lhZZ7,4
TEST VUR e FORECAST	B!B)	lbq551,Q
RECoROEO AVG NO OF BILLS PER VEAR (EKCEPT SMAl.l.!ST MET£R)	BX$(R)	BZ4o,o
TEST VUR A FORECAST	U@(A)	l3478,5
TUT V AR B FORECAST	8XS! l	U1U,2
RECORDED REVENUE	R(Rl	teo&b4q,o
REVENUE VIA ••TER USE TABLE BY COMPUTER	R(C)	181obu,o

CALCULAI[D RIT!08 FROM INPUT DATI

A TID Q(RC) !,0000000 TO CHANGE R!C VR CONSU•PT!ON TO COMPUTED YR CONSUMPTION !ALWAYS loOOOOOOO)
RAllO Q(RN) 1,0000000 TO CHANGE REC VR CONSUMPTION TO NORMALIZED VR CONSUM,T!ON
RAT!O Y(RI) !,OSOII00« TO CHANGE REC VR CONSUMPTION TO TEST YR •A• CONSUMPTION

H!O SIRA) !,OZOU!T TO CHANGE

RAT!O Q(R81 !₀IOHU• TO CHANGE REC VR CO•&uMPT!ON 10 TEST VR •B• CONSUMPTION
THE Rlt VR BILLS TO ALL THE T[Sl VR •A• SILLS

RATIO 6(R8) I,041b521 T0 CHANGE ALl THE REC YR SILLS TO ALL THE TEST VR •8• BILLS

RATIO BKS(RA) TO CHANG! THE REC YR B!L 8 (EXC!PT SMALLEST M TER) TO T£ST VR BIl.LS (EXCEPT SMAI.I.t8T METER)

RATIO 8XS(R8l 1,0100011

RAT!O RRCR 1,0aooqs1 TO CHANGE THE REC VR BILLS (EXCEPT SMALLEST METER) TO TEST YR •8• BILLS (!XCEPT 8MAI.I.EST METERl
,qq55Q&6 REVENUE ADJUSTMENT FACTOR (REC YR R / COMPUTED VR R)

UMSfR OF RAT LOCKS • J
NUMR OF M!TER S!Z!$• &

RECORDED DATA VoAR R

RATE BLOCK UPPER L!M!f CCCFl	REC NO OF B!I.LS ER RATE BI.OCK	Ret P!R RATE	CONSUMPTION iji.OC CCF PER YEAR	CONSUMPTION CHARGES PRESENT	PROPOSED
	t.$00		o	U	
10	.000		&	3	$66, JO, aq,
&0	],000				
qqqq	Q,000			,	
	.,000			S	
	a,000			O	
M[T!R		AVG		H	
UZU		NO OF		,	
(!NCHUJ		811.1.1	BV	1	
		Mnu		0	
		un		0	
.••S			M	5	
1,œ		50	1		

, lq, U,

	127088	5,10000	S
	<000q0	,40000	
	ll«7H!	,!5000	'
			q
MfER $ PER PRUENT	CHARGES MONTH PROPOSED		0
			0
5,!00	§,qoo		0
q,000	11,000		
lboOOO	!&,•oo		0
25,000	q,ooo		,
•.000	52,000		4
ao,000	q2,000		6
lb0,000	uO, 000		0
zs0,000	zqo,000		0
			0
			4
			Q
			0
			0
			0

ROUT !NE	CQM UTI!:O YEAR PRESENT	CQM UTI!:O YEAR PROPOSED	NORMAl. IUD YEAR PRESENT	NORMAl. IUD YEAR PROPOSED	TEST YEAR ••• PREiENT	TEST YEAR ••• PROPOUO	TEST YEAR •8• PRESENT	TEST YEAR •8• PROPOSED
6•l B•a TOUI.S	lo4>8Y,U8 u .06o lo8UoM8	loeyM9o35& 148oZ7o a.oqr,uo	lo&87o588 129o01>0 lo8Uoi>U	l•q· ·l5& 148oi!74 a,oqr,uo	lo7&!t7H 130.350 1o sqz•ou	2oOJ4oql5 149o757 *lo* !UoUZ	lo843ol09 U!oU3 !o970o8U	ZoiZ8tqU2 1St•no 2o280olqb
RRCR >OJusno IO!Ai.S	!o808oeoq	co088•3••	loSOBoo«q	2o066ol'&	loent?ss	2o!75oOo2	*loq&bolb1*	2•210t1Se

EXHIBIT F.3-2

ONE SHOT OA ESTREVS DATA INPUT SHEET

CALIFORNIA PUBLIC UTILITIU COMMISSION
Utilities Division, Hydraulic Branch

492.12B
8/78

NOTES:
1. For Climate - Mureq - Revenue run, insert word ONESHOT on card 1, spaces 1 to 7 and leave card 1A, spaces 8 though 39 blank. Fill in rest of card 1.
2. For revenue estimate only, leave card 1, spaces 1 to 7 blank, but fill in remainder of cards 1 and 1A.
3. Fill in fields from left to right. Essentially all values right justified except when decimal indicated ▽.

CARD	ITEM	UNITS
1	B, BXS	BILLS / YEAR
1	R	$ / YEAR
1A	Q	CCF/METER-YEAR
2	RATE BLOCK UPPER LIMITS	CCF
3	BILLS BY RATE BLOCK	BILLS / YEAR
4	METER SIZES	INCHES
5	BILLS BY METER SIZES	BILLS / YEAR
6,7	METER CHARGES	$ / MONTH
8,9	CONSUMPTION CHARGES	$ / CCF
10	CONSUMPTION PER RATE BLOCK	CCF / YEAR

WATER USE ANALYSIS TABLE & TARIFF DATA — GROWTH RATIOS — RATE BLOCKS — METERS — CONSUMPTION — METERS — RATES

CONSUMPTION BILLS B
B(R)[B(N)] B(A) B(B) BXS(R)[BXS(N)] BXS(A) BXS(B) R(R) TREND
1

CONSUMPTION Q
ESTREVS
Q(R) Q(N) Q(A) Q(B)
1A

O = SERVICE I = MINIMUM (Circle one)
M: MONTHLY B: BIMONTHLY

RATE BLOCK UPPER LIMITS
RUN IDENTIFICATION
No. RBMS No. 18
2

BILLS BY RATE BLOCK
DATE YY/MM/DD
3

METER SIZES
4

BILLS BY METER SIZE
5

PRES. RATES
6

PROP. RATES
7

PRES. RATES
8

PROP. RATES
9

CONSUMPTION PER RATE BLOCK
10

EXKIBIT f.4

WAT!m 1JSE 1\.NALI'S:'m REVEifUE <:.U.CUIA'rlON

Ni!l:l.mUIll Chll.:r'ge Tari«

Bimonthly 111ing

mock	Hum er of Bills	Min:l.mUIll Ccf	O - J.O 6... 10	ll-"6o 6=50	Over 150
O- 10	50,623£/	327,888	327,888		
u-6o	97,709	2,000,909	977,090	1,023,819	
over 6o	4,166	1!347,331	41,66o	208;!300	1z097 z31l
Total a/	152,498	676£128	1,346,638!!/	1,232,112	lz097z31l
Minimums b/	10:470				
Total Bills	~~162 968~~				

	Quantitil:	Present:/ Rates	Revenues
n:l.mum (10 Ccf)	152,498	$ 5.1	$ m;1
ll-6o	1,232,119	-	492,848
Over6o	1,097,311	.38	417,001
Subtotal			).,687,589

Minim			
1"	8,676	$ 9.6o	$ 83,290
	J.,005	16.00	16,o8o
	688	25.00	17,200
	30	46.00	1,380
	29	a0.00	2,320
	19	16o.oo	3,o4o
	23	25().00	5.750
Subtotal	10,470		12Q,o6o

!otal Revenues per Water Use Analysis 1,816,649

'!:/ Bills with Q) Minimum Q except for sma.llest size me""uer in smallest bl.ock where they are all those referred to in £1 below.

£1 Bills except 'for smallest size meter with Q(' Min:l.mllllll Q.

!/ Smallest size me""..er bills with associated 'Cc:f ifor QMinimum Q.

Y Ignore this sum as Q charge is in r:;12,4Q8 bill qwmtity charge.

!/ Monthly Minimum Charges dcubled ovsr that <>f monthly tuiiff.

EXHIBIT G.1

WATER USE ANALYSIS TABIE

Service Charge Tariff
Bi-Monthly Billing with Monthly Tariff Specification

Rate Block Limits (CCF) & Charges		Consumption Block 100 cu. ft.	Number of Bills By Meter Size								Consumption Total	
Tariff	WUA		2"	3"	4"	6"	8"	Total				
0-5 4#	0-10	0	1,332					1,332				
		1	1,710	95	30	17		1,854			1,854	
		2	2,2	107	20	9		2,384			4,768	
		3	3,013	162	8	10		3,193			9,579	
			14.001	151	16	20		4,188			16,752	
		5	4,917	239	14	21		5,191			25,955	
		6	5,570	243	12	13		5,838			35,028	
		7	6,243	344	19	1		6,620			46,340	
		8	6,951	490	25	19	1	7,446			59,568	
		9	7,055	441	12	17	1	7,527			67,743	
			7,583	483	32	11	1	8,110	53,683 Bills		81,100	348,687 Bills
	J.I-60 · gf	11	7,115	535	21	11		7,682			84,502	
		12	7,356	579	28	14		7,977			95,724	
		13	6,943	553	24	6		7,526			97,838	
		1	6,899	587	23	8		7,517			105,238	
		15	6,291	536	30	11	2	6,870			103,050	
		16	5,865	610	26	21		6,922			104,352	
		IT	5,582	587	29	9	1	6,208			105,536	
		18	5,246	589	33	14		5,882			105,876	
		19	4,486	583	41	13		5,123			97,337	
		20	3,977	522	36	19		4,556	2	105,049 Bills	91,120	2,134,622 Bills
		21 - 22	6,920	1,075	65	22		8,082			173,604	
		23- 24	5,370	1,007	57	15		6,449			151,366	
		25- 26	4,152	887	69	10		5,118			130,361	
		27 - 28	3,176	820	64	14		4,074			111,947	
		29.30	2,240	751	57	8	2	3,058			90,080	
		31 - 35	3,530	1,353	154	96	2	5,097			166,765	
		36-llo	1,809	972	189	83		3,053			115,395	
		41 - 50	1,284	1,192	308	114	3	2,905	4		130,467	
		51 - 60	469	556	229	89	6	1,359	1		74,064	
31-9999 f	61-9999 4	61 - 70	149	336	197	70		753	1	4,236 Bills	49,049	1,359,713 Bills
		71- 80	56	198	105	87		456	2		34,221	
		81.90	48	121	119	53	2	345	2		29,353	
		91 - 100	43	70	73	65	1	252			24,062	
		101 - 125	52	120	15io	127	15	8	478	2		53,812
		— 1,0	13	43	10!o	117	10	3	290			39,893
		151 - 200	15	47	121	157	22	6	371	1	2	64,452
		201 - 300	8	23	110	233	52	8	453	10	5	110,841
		301- 400	4	2	2T	113	28	26	209	6	3	72,571
		Ool- 500	1		21	60	16	10	121	8	1	53,984
		501 - 1,000		6		116	66		295	8		204,202
		over 1,000					112		213	90	1	623,273
		'!'otol	139,To!2						162,968	125	24	3,843,022
		l!ll$(R)	0						23,246	125	24	

1. [illegible]
2. For revenue estimate only, leave card 1, spaces 1 to 7 blank, but fill in remainder of cards 1 and 1A.
3. Fill in fields from left to right. Essentially all values right justified except when decimal indicated ▽.

CARD	ITEM	UNITS
1	B, BXS	BILLS / YEAR
1	R	$ / YEAR
1A	Q	CCF/METER-YEAR
2	RATE BLOCK UPPER LIMITS	CCF
3	BILLS BY RATE BLOCK	BILLS / YEAR
4	METER SIZES	INCHES
5	BILLS BY METER SIZES	BILLS / YEAR
6,7	METER CHARGES	$ / MONTH
8,9	CONSUMPTION CHARGES	$ / CCF
10	CONSUMPTION PER RATE BLOCK	CCF / YEAR

CONSUMPTION — BILLS — B — B(R)[B(N)] B(A) B(B) BXS(R)[BXS(N)] BXS(A) BXS(B) R(R) TREND — 1

CONSUMPTION — Q — ESTREMS — Q(R) Q(N) Q(A) Q(B) — 1A

O = SERVICE I = MINIMUM (Circle one) — M = MONTHLY S = SEASONAL

RATE BLOCK UPPER LIMITS — RUN IDENTIFICATION — No. RBMS — 2

BILLS BY RATE BLOCK — DATE YY/MM/DD — 3

METER SIZES — 4

BILLS BY METER SIZE — 5

PRES. RATES — 6

PROP. RATES — 7

PRES. RATES — 8

PROP. RATES — 9

CONSUMPTION PER RATE BLOCK — 10

ROUTINE	COMPUTED YUR PRUENT	COMPUTED YUR PROPOSED	NORMAL IUD VUR PRESENT	NORMAL IUD VUR PROPOSED	TEST YEAR ••• PRESENT	TEST YEAR ••• PROPOSED	TUT YUR •B• PRUENT	TUT YUR •B• PROPOS[O
8•1	looHoh7	loqllo07Q	l•bHob&7	loQH,orq	lo751•78b	loOUoUb	I•838,052	lo!22o7ql
e.	lo030o57	lo!B•ouo	!o0l0o57&	lolnouo	loOaqqq4	l•lllt118	loOe&oiU	loiUo05&
TOTAl.$	i!o704oUJ	lo!Ut705	2o704oZ4l	ltlilo 705	i!o&oooqso	3o2Uol14	Zo90eo2U	3•35'•841
RRCR AOJU3TEO TOTAlS	i!o7111oo46	lo!HoOi!•	i!o1!boU8	lol37o02Q	2o6U•82q	3o2Uqo211	2oqlqo54&	hl7!o!al

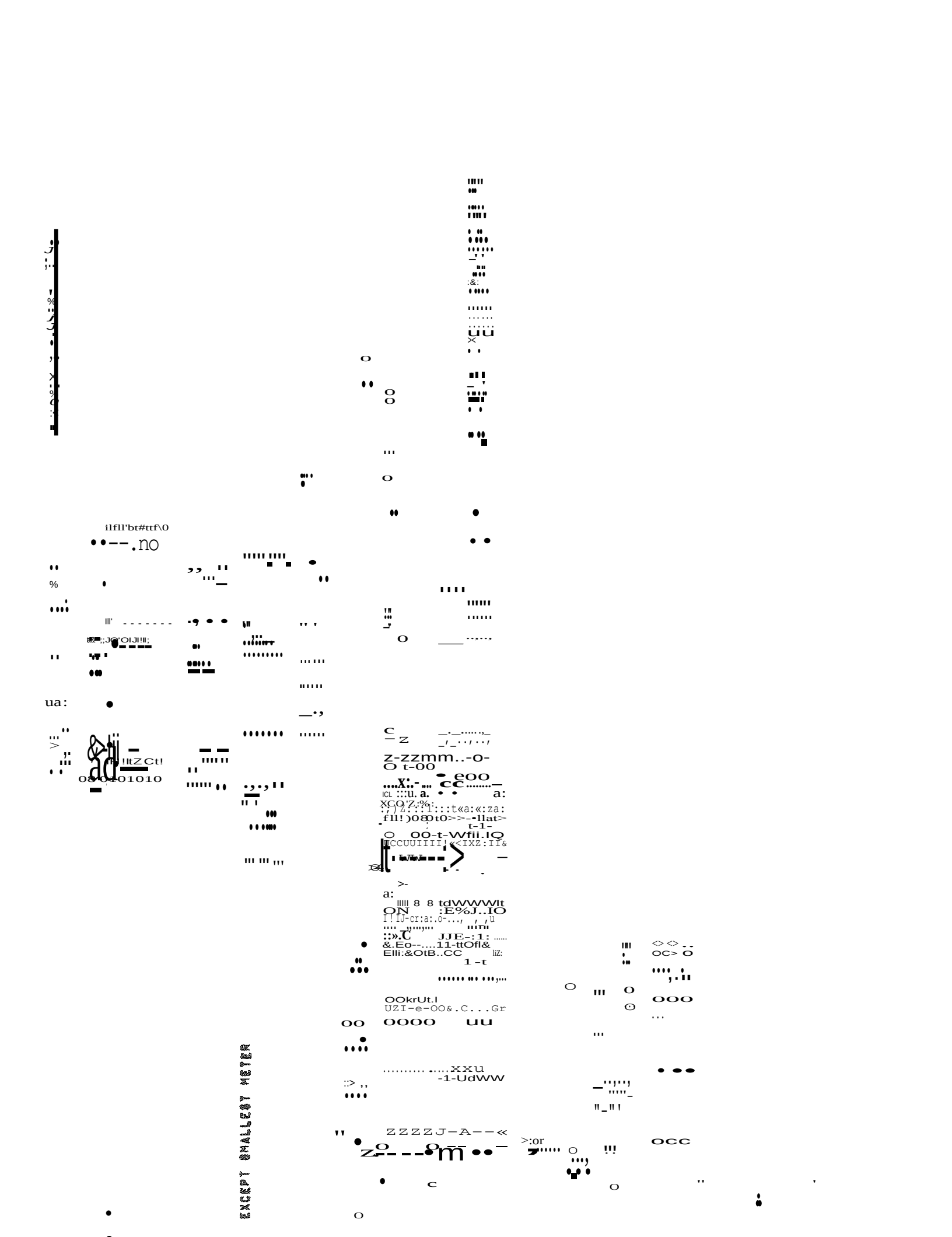

EXCEPT SMALLER? MEANS

TABLE BY COMPUTER

EXHIBIT G.4

WATER USE ANAL1SIS RIM!:NUE <:A.LCUIATION

Service <:lla.rgTar:i.f'f

Bimonthly Billing

Block	Number of Bills	{!c:f	O - 1.0 .::I = 1.0	ll-Oo .6=50	Over 6o
O - 10	53,683	348,687	348,687		
u-60	1.05,o49	2,134,622	1,050,490	l.,o84,132	
over6o	41236	1,59,713	42,36o	2llz8oo	1,105,55,2
Tots1	162,968	3,843,022	1,441 537	1,295,232	1,102,553

nsumption Charges:	quantitz	Present Ra.tes	Revenues
O- 10	1,441,537	$ 0.51	$ 735,184
-60	1,295,932	.4o	518,373
r60	1,105,553	.38	420,110
Subtots1			1,'673,667

Lmce Charges:			
f5/8" Meter	139,722	$ 5.10	$ 712,582
! 1" ff	17,915	9.0o	172,:560
¡ 1!" lt	2,738	16.00	43,8o8
2!i "	1,922	25.00	48,050
3" n	276	46.00	12,696
4" n	186	ao.oo	14,88o
6fi fi	125	16o.oo	.OOO
8" "	24	25().00	6,000
swtotsl	162,968		1,030,576

ftsl Revenuss per Water Use AM.J.ys:l.s $2,704,243

Calculation of Ratios Q(RN), Q(RA), AND Q(RB)

Min.imu!IICharge

lie note from page 4-9 that for a Service Charge Tariff, the subject ratios were:

Q(RN) .. $\frac{\text{§at}}{Q_R}$ .. §f:j

Q(RA) " $\frac{Q_R}{}$,. §f

Q(RB) - $\frac{R}{}$,. §f: :5

These ratios represent the total consumption charged at the quantity rates for the normalized and test years as compared to the recorded year consumption. By "spreading," these volumes of water are segregated _into appropriate rate blocks.

All the water consumed will net be charged and spread in a Minimum Charge Tariff'. The part not spread (but charged by meter sizes) IIIUSt be removed from the total consumption. Thet meter charie minimum consumption must however reflect changes in the growth of "meter sizes except the .smallest" i.e., (BXS) in a similar manner to thet discussed in Chapter 4. -

To simplify the procedur.e, no growth of unit consumption *tor* thase minimum bills is assumed. Tbis approximation should bs satis:f'actocy as the total amount of minimum bill consumption is usually small. Referring to Exhibit D.l, we note that:

Total <;onsumption less Consumption in Mini""""" BJ.oclui equa.l.s Consumption greater than respective meter minimums

For the recorded year R, this relationslrl,p can bs expressed as:

$$Q(R) - Q_{MB}(R) = Q_{Q>M}(R)$$

Caleulation of Ratios Q(RN), Q(RA), AND Q(RB)

Minimum Charge

In formula form this becomes:

$Q_{Q>M}(R)$ " $\frac{9(R)B\{R\}}{anob}$ (R)

Read Q,..,M(R) from Water Use Analysis table (lirectly; See Exhibit D.l, last column on right. Equal to sum of card 10 entries.

$Q_{MB}(R)$ " $\frac{Q(R)B\{R\},}{anob}$ $Q_{Q>M}(R)$

Read O....,(R) from Water Use Analys:l.s table <r.U-ectly; See Exhibit D.1, 2nd colllllllll from right or compute based upon preceding equation.

{N) ''' $\frac{g\ N\}B(Nl}{\&nob'}$ (R) s(RN)

and,

!IN) " $\frac{\text{QfN B(If}\}}{anob}$ = {R)B:XS(RN) / ::0: >M(R)

Where:

anob = Annual number of equivalent bills per customer as calculated from WUA table data.

= M for monthly billing procedure, i.e. 12.

= B for bimonthly billing procedure, i.e. 6.

$Q_{Q>M}(A)$ is the quantity of water charged at quantity rates for year A while $Q_{Q>M}(R)$ corresponds to card 10 data and to the recorded billings contained in card 3. The ratios then become for the two test years:

$Q(RA)$ " $\frac{\Sigma Q_{Q>M}(A)}{\Sigma Q_{Q>M}(R)}$ " $\frac{Q(A)B\{A)}{\frac{anob}{\Sigma Q_{Q>M}(R)}}$ - (R) BXS(RA)

Q(RB) $\frac{g(B)B\backslash B) - Q_{MB}(R)\ BXS(RB)}{anob \quad \Sigma Q_{Q>M}(R)}$

which are similar in form to the Service Charge ratios where the f ow:!.ng are "constants: 'Q>M(R), {R), and anob. Note these ret:los are calculated autanatieally the canputer and not by the :Eng:l.neezo.

{;el"Culetion of B(RN), B{RA), and B(RB)

Minimum Charge

We note :!"rom -l.O that to cal.cul.ete the subject ratios 'for a Service Charge Tari:f':f', we use the following :f'ormulaa:

$$B\{RN) = 1.O$$

$$B\{RA) =$$

$$B(RB) = :1$$

As there are no meter minimum charge quantities, these relationships are sufficient.

With a Minimum Charge Tariff, however, we must eliminate from part of the calculations those bills for meters except the smallest which use less than the respective minimum quantities, i.e., quantity BXSM.

At the same time, we must typically recognize overall bill growth by wltiplying bills by B(RA)which applies to all bills end BXS(RA}which appHee only to bills except :for the smallest size.

Bills segregation by rate block also is required end is approximated in the :following :f'ormulas for a typical test year having N rete blocks (see also accompanying sketch):

For block 1 and recorded year R:

$$B_1(R) = \frac{B_1(R)}{B(R)} \left[\ll B(R) - BXSM(R) \right]$$

For all blocks end year A:

$$ll_1\{A) = \frac{B_1\{R)}{B'fii\}} [\, B\{R) \cdot B\{RA) - BJCSM(R) \cdot BXS(RA) \,]$$

$$= \frac{ll_1\{R)}{B'fii)} [\, B\{A) - BXSM\{A)J$$

$$ll_2\{A) = \frac{B_2(R)}{B'fii\}} [\, B(A) - BXSM\{A>]$$

$$B:N(A) = \frac{<R>}{B'fii)} \left[B(A\} - BXSM(A \right. :1$$

Note:

B(R) = :f$(R) – :Bl{SM(R)

..:B(R) = $B_1(R)$ + BiR) + •••• + {R)

= Recorded bills in respective blocks as shown on Card 3. See Exhibit D shaded area which is typicaUy $B_2(R)$.

B(A) = :<:B(R) • B{RA)

BXSM{A) = .sum of bills except the smallest for whih consumption was less than the respective meter minimums for test year A. Equal typically to:. BXSM(A) = BXSM{R) • BXS(RA)

It is calculated by computer as part of "Revenue <:al ulation Meter Sub-routine ll-2" and entitled "'l:'otal of Test Tear Number of Bills."

(RA) = Multiplier for bills in N rate block used to estimate Test Year A bills based upon recorded bills in that rate block.

B_1(RA) = 1\(A) / 1\(R) = :<:BtA – BXSM A / :<:B R – BXSM R

B_2 (RA) = B_2(A) / B_2{R) = BlA) – / B_3{R) – = A) / BN(R)

Therefore, for all blocks and year A:

$$B(RA) = \frac{B(A) - BXSM(A)}{B(R) - BXSM(R)}$$

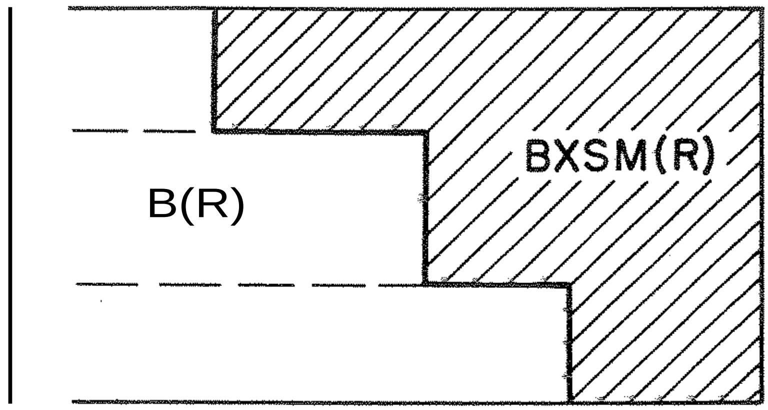
The ratio B(RA), therefore, becomes almcst iderxt:l. al to that used in the Service Charge calculations except that the removal of minimum bills is approximated as shown above by use of the terms BXSM(R) and BXSM(A). The computer handles this problem automatically as required.

Finally, for Test Year B:

$$B(RB) = \frac{B(B) - BXSM(B)}{B(R) - BXSM(R)}$$

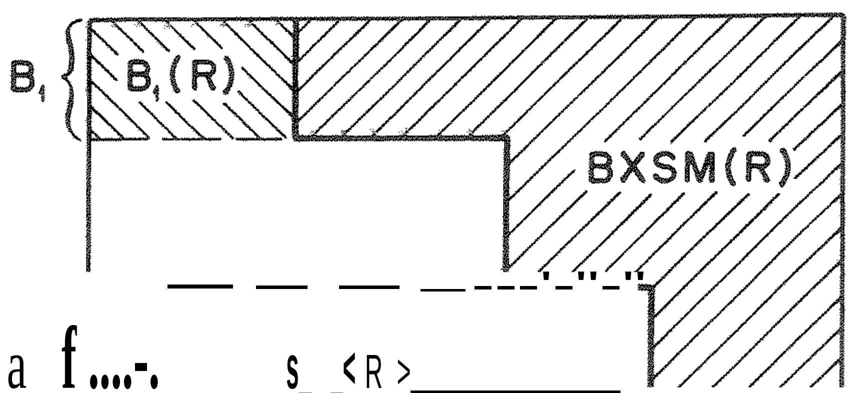
Note, these ratios are calcul.ated automatically by the computer and not by the Engineer,

TYPICAL WATER USE ANALYSIS TABLE SCHEMATIC



$$B(R) = B(R) + BXSM(R)$$

$$B(R) = B_1(R) + B_2(R) + \cdots + B_N(R)$$



$B_1(R) \downarrow B_N(R)$ } f (Card 3)

EXHIBIT J

CCMPUTER USE OF BlCS(RA) AND BX.S(RB)
AS A FUNC'i'ION OF TARIFF 'ITPE

The o0omputer uses the BXS(RA) and BX.S(RB) ratios in slightl.y different ways depending upon whether a minimum charge or a servi.ce char.ge tariff is being calculated. The two following simplified exampl.es demonstra:"ue this procedure which is reported on the printout under the heeding B-2 Revenue – Meter Sub-&uti.ne. In both cases, the smallest size meter is .625 inches.

Minimum Charge Tariff[11/]

Meter Size	No. of Bills Recorded.	No. of Bills Test Year A
.750	y	Y • BXS(RA)
1.000	Z	Z • BXS(RA)
	Y+Z	(Y+Z)BXS(RA)

Service Charge Tariff

Meter Size	No. of Bills Recorded	No. of Bills Test Year A
.625	X	Difference
.750	y	Y • BXS(RA)
1.000	Z	Z • BXS(RA)
	JC+Y+Z	(X+Y+Z)•B(RA)

Difference = (X+Y+Z) • B(RA) – (HZ) • BXS(RA)

While the smallest size meter is not used obviously in the minimum type calculation for determining meter revenue, it must always be listed elong wi.th ell other meters on Card 4.

11/ Note Exhibit I for the procedure used in approximating the number of bills for all meters except the smallest where consumption oeeds respective mster size minimums.

CHAP'I'E.R 5

ONES OMPUTATION

A. Procedure

As noted in the abstract, this type of run was developed to provide rapid analysis of the ef:fect o:f consumption upon revenues. To use it, the Engineer merely includes the Forms CI (omi ting an entry t'or cols. 43-44) and *CD* with the ESTREVS ForrJ/ and adds the word ONESHOT to {;a.r<l. 1, spaces l. through 7.

Since this procedure was <l.eveloped prior to the formation of the Committee, it has been modified to bring it into line with the {;ommittee's recommendation through providing the Engineer with the option to enter the -word HORIZONTAL on Card 1, spaces '66 through 75. Thst instruction removes the time trend of unit consumption Qt for years A and B and thus overall consumption changes only with respect to customer growth. Unit <consumption for years A and B is thus the normalized consumption. See Chapter 6 and Exhibit M for the Committee recommendations.

E. Background

To connect CLI .A'l.'E to ESTREVS and thus carry out ONESHOT, the LINKUP program was developed. The flow diagram for LINKUP is shown on Exhibit K.2 and the summary description is in Exhibit K.l. The flow <l.iagram shows that if forecast water consumption data is available, i.e., "yes", only the data as shown in Form ESTREVS is required to obtain estimated revenue figures from the computer. If such data is not available, then additional data to be recorded on Forms CI and CD is required, after which the computer will deve1op "estimated **revenue-s** ..

J) See Exhibit L.l, pages 1-10, for typical time trend run ONESprintout. Page 1 shows the Forms CI and CD data, while page lO shows the ESTREVS input data. Exhibit L.2 shows typical printout sheets for a HORIZONTAL ;r-un.

Basically, LINKUP eonnects CLIMATE and MUREG to ESTREVS by delivering recorded normalized and foreeast water e msumpt:ion, i.e.,

Q{R), (N), Q{A), and Q{B)

to the latter program.

A key advantage of using ONESHO'l' is that after the Engineer ,estimates his basi.c customer information (water use analysis, gro-wth, and prieing data), the sensitivity relating to selection of reference weather sta:tion ean be readily determined as the data input Form ESTREVS can be reud with any number of difi'erent weather stations. Thus the significance of changes of water consumption in terms of revenue {the final objective of this undertaking) can be quickly evaluated. In many cases, it may eliminate considerable r.eseareh on weather station ·Choice, reliable data, etc. This approach requires, however, that customer estimating rather than consumption estimating be done first, whkh is a reversal 'over the general past staff procedure and that the estimated water consumption be reasonable.

C. Examples

See Exhibit L.l for the original ONESHOT procedure and Exhibit L.2 for the procedure adopted by the Committee in which time trend is ignored. Note L.l-7 versus L.2-2, Q values.

On Exhibit L.1, page L.1-1 shows the Cand CD data wh:Lch was used to carry out CLIMATE with results shown on p;;.ge L.l-7. Page L.l-8 shO"..re the ES"!'REVS input data while L.l-9 provides the revenues. Page L.l-10 summarizes ESTREVS. Only L.l-9 and L.l-10 naed be :retained as ESTREVS records.

EXHIBIT K.1
Sheet 1 of 2

ONESHOT FLOW DIAGRAM DESCRIPTION

Overall Program: ONESHOT

Calling Program: LINKUP

Subroutines: WEATHER

MUREG

ESTREVS

LINKUP

- reads user-supplied variable input — Furnish Form ESTP.EVS
- either
  - calls subroutines WEATHER and MUREG obtaining further input tram them — Furnish Forms C& CD

    cr
  - reads further input directly from user — Form ESTREVS, Line 1A required
- calculate ratios required by water revenue estimating subroutine ESTREVS
- calls subroutine ESTREVS

WEATHER

- reads user-supplied variable input — Forms CI & CD
- searches Weather Bureau tape for ('recipitation and temperature data \or reads precipitation and temperature from card input)
- rforms adjustments to data adjusts for maximum monthly precipitation limit and inter- polates for missing datal adjusts for billing cycle)
- provides adjusted valuss to stepwise multiple regression subroutine M'VP.EG {lists data and reasons for dropping data from list of adjust.ed values to he used subsequently)

MUREG

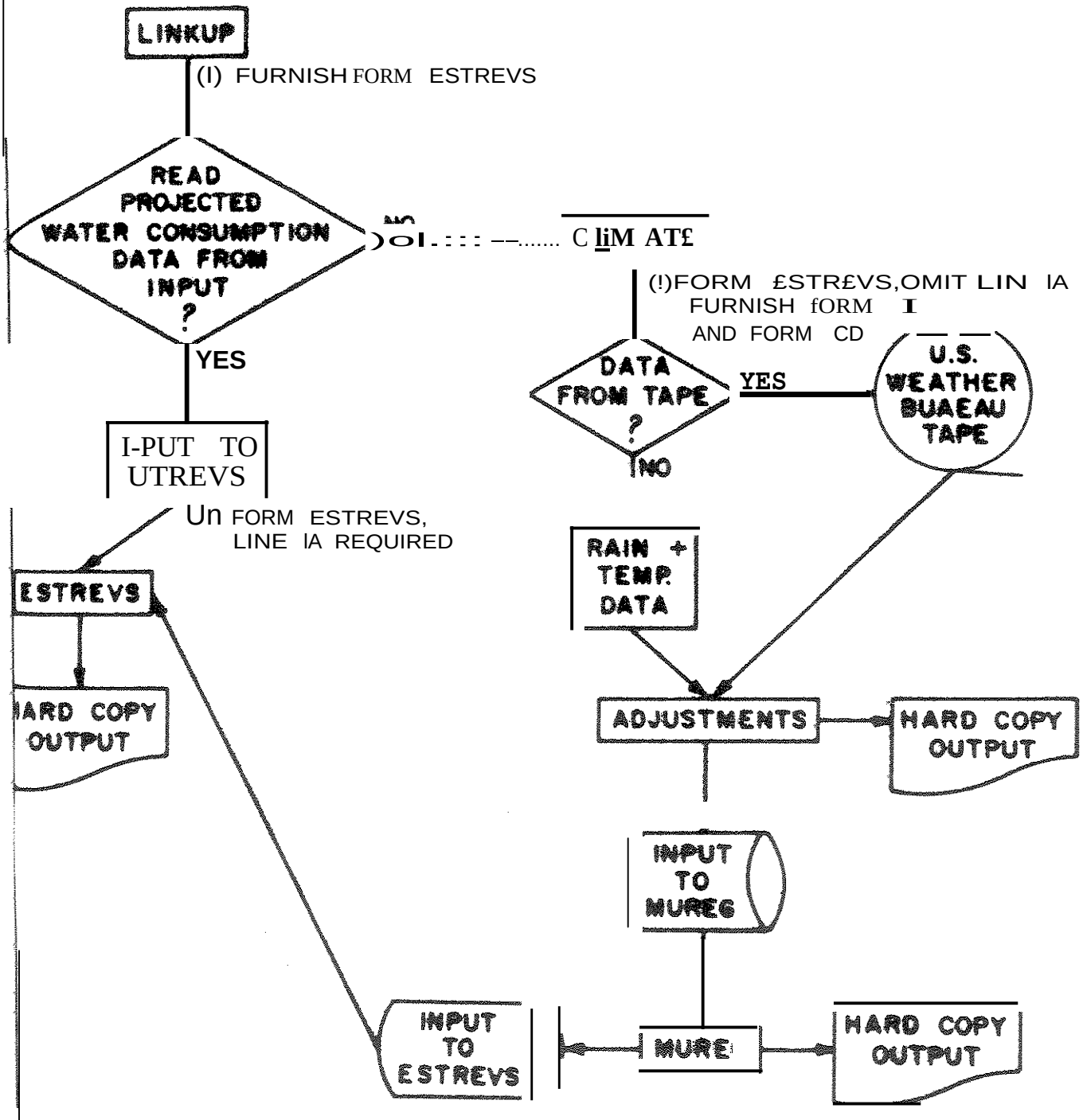
- a stepwise multiple regression subroutine which provides normalized projected consumption valuss !or input into subroutine ESTREVS

ESTREVS

- reads user-supplied variable input — Form ESTREVS
- upon instruction, uses only last recorded normalized consumption as basis or Test Years A&B consumption; otherwise uses trended consumption valuss
- computes estimated revenuss for water utilities

FLOW DIAGRAM

WITH U$£ *Off* DATA INPUT SHEETS SHOWM



!Hi

j

.iif"e"W'--e-I;'YW$>&W'I'Pi'"7'0'1'0' IIIf<IM[.'YJr.f3'

NON -HORIZONTAlONE-SHOT RUN

EXHIBIT L.i -1

DATE 0612511

SHTiflN NAME ONE SHOT OEMO

!NPIJI TYPE

AX!MIJM Ali.DWEO a,

BILLING TYPE

GROUPING !VPE A

S!UT!NG YEAR FOR RAIN & TEMP lq••

MEAN MA!MITEMP PERIOD (V!ARS) 30

START YEAR NA!ER CONSUMPTION Dill I !Qo&

AT!R CDNIUNPIIO• PERIOD (VEIRSl

ITAT!UN NUMERICAL !DENT ! 1716

FORM CI INPUT DATA (from Exhibit A.I)

Ca/cu!afed bq computer !'rom CI inf'ormation

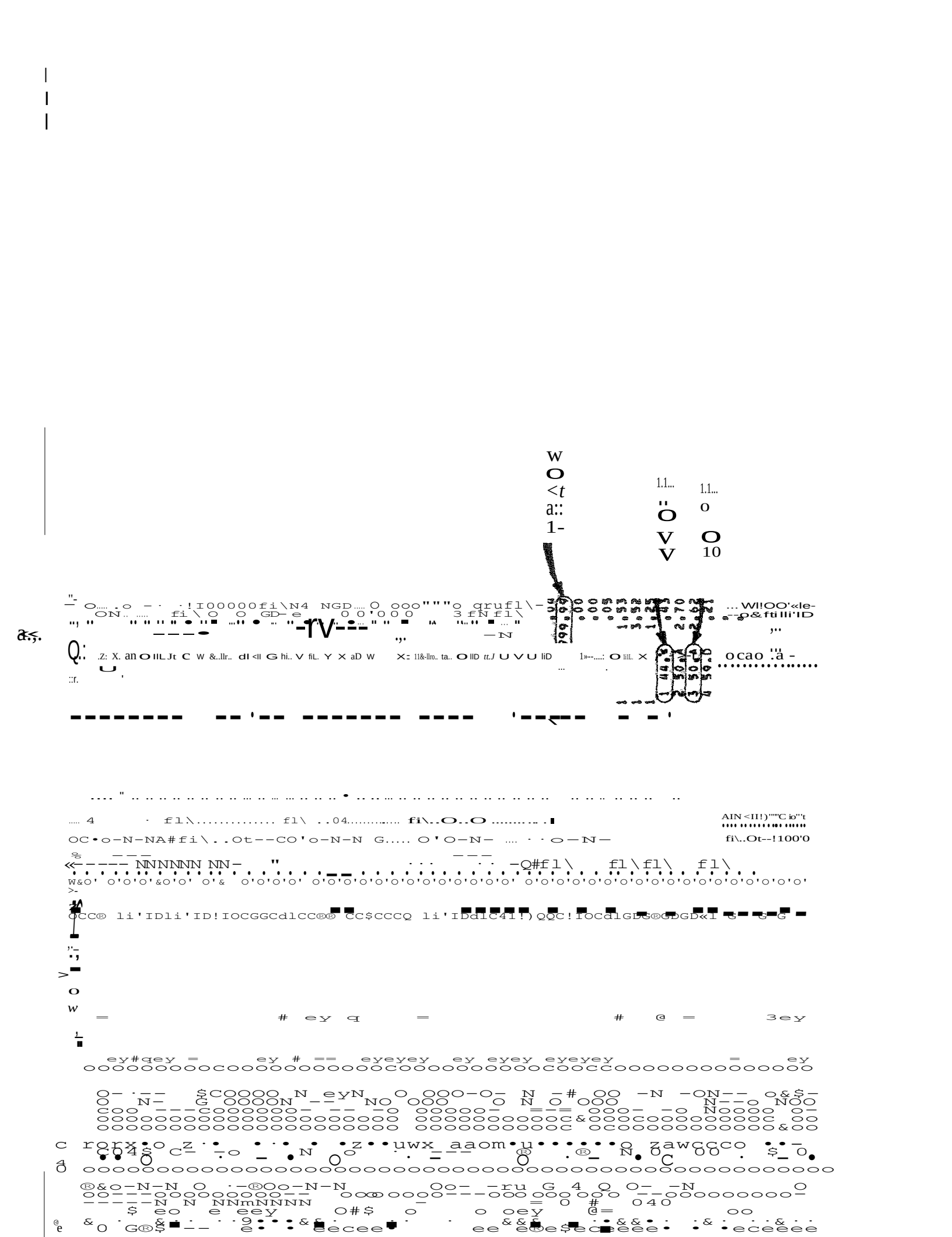
FORM CD

RECORDED DATA (from Exhibit A.2)

lDENt!F !CATION	YEAR	C0N$UMP!i0N	STATION
ONE SHOT DEMO	*lqbb*	404,20	5738
ONE SHOT DE·'10 7&	!067	426,10	5736
ONE SHOT OEMO 76	t%s	•t•,oo	5H6
ONE SHOT OE•O 76	!060	392,00	5738
ONE Sf10! OEMO *70*	t•ro	•1s ro	sm
ON[SHOT DEMO *1o*	!07!	4J2,00	S7 I8
ONf Sf10T O!MO 76	!072	0!3,20	5738
ONE SHOT DEMO To	*1•1£*	•ZO,SO	5738
ONE SHOT 0r::•0 76	!974	420,10	5738

_Note' Er?5"neer requested ir> C I d C/) thor lost t;tf'or be ;g74 even fhov.f.h Weofher /Qpe confoined 1.97S dofo. Nine year span run.

EXHIBIT L.1-1



---"----"-·;co ·;t rr s··r f 0 V A L u f $""-iiF — AUfiJsled for miixTmum montllly rainfall and billing cycle

YEA	RAIN	TEMP	•ATER
u,	1,U	M,O	40 ,20
u,	u,00	b0o3	4;!&,10
u,	Ue7S	.I.I	414,00
n,	14,6§	Uol	l z. o
70,	u.u	ea,z	41So10
m	e,u	o.	uu, o
n,	e,n	&lol	uu,u
n,	!&. 1	&lo	U20, 0
14,	u,oq	u,0	UO,IO

NUMSER OF OBURVAT!ONS

SUM R ADJ @ !I,UI

SUM T ADJ • 110,1>8.

NO,VRS, We DATA uno • 30 — *If 2 or more consective.iletns (months,lemperofure or rainfall) missing,yeor wi II be dropped and missing years will be listed.*

til

i:b

MULTIPLE REGRESSION ANALYSIS

PROBLEM ONE SHOTEMO 76

OM!RUTION$ q

	t	R	T	
UM OF VARIA8c!8				
	,UOOOR+OJ	'101!2!+03	,55!UE+Ol	,37396E+04
MEAN OF VARIABlES				
	,70000E+Oi	,II903E+Ol	. 12'>0E+Oi!	,41591E+03
$1ANOAR0 DEVIATIONS				
	,i!Uh€+01	,3!U9HOI	,sqau.oo	,11829E+02
CORRElATION CO€FF!CIENTB				
t	'10000!+01	,U873E+OO	,437nE+OO	,40594E+OO
R	oi! 8Hh00	oiOOOOE+OI	,5UHE+OO	o,b790U•OI
T	,u7onooo	.sunuoo	,I 0000£+0 I	,04507£•01
Q	,aosqae•oo	u,b7'102E•Ol	,US07E•OI	.tooooE+01

Columns always prinfed oufin same order.

Used to determine $\frac{\text{Std Err Y}}{\text{Mean Q}}$

Standard Deviation of $Y = \sqrt{\frac{\Sigma(Q(R) - Q(M))^2}{n-1}}$

---Exponenf:. oorr-elofion ofT wtlh Q is .tJG4507 (typical)

(j1
I
<D

STEPWISE REGRESSION CASE

DE NOENT VARIABLE

f•LEVEL TO ENTER ,00000

F•LEVEL TO REMOVE ,00000

STANDARD ERROR OF V .11828S1E+02

SUP NO,

ENTERED VARIABLE _____ *Alw'?Ys t,bufneednof be step No. I*

F•UVEL	lole!!l
3TANOARO ERROR OF V	0 1155043U02
MULTIPLE CORRELATION	,4o$qq
R•SQUAREO	,I b4 *10*
RES OEG OF FREEDOM	7
SUM OF SQ RESIDUALS	,quooE+o3
EXPLAINED VARIATION	0 !844$!+03
CONSTANT TERM	*2ql,71776*

See sfandord fexts for defailed explanaftot> of' sfofisfical terms.

VARIABLE	SETA PRIME	BETA	SE(BETA)	
1	,4QSQ4h00	.17533E+01	oi4QIQE+OI	oii7S2E•CI

sTEP NO,

ENTERED VARIABLE *-'1-------AIW'?)IS R bul t>eed nof be slep no. 2*

F•LEVEL	.20290
STANDARD ERROR O,V	.1227692E+02
MULfiPLCORR LAT!ON	.43824
N•SQUAREO	.19206
RES OEG OF FREEDOM	6
SUM OF SQ Rl8!DUALS	.90434E+03
EXPLAINED VARIATION	.21497E+03
CONSUN! TERM	288.59797

Higher the better

VARIABLE	BETA PRIM[	BUA	3£!8HA)	STUDENT T
1	,U4Y4E+OO	,!Q20QE+01	o!U&IE+O!	• II HBE+O
2	•oloQUE+OO	•,UU1E•OO	0 140QTE+OI	.,45000£>01!)

Prefer volue of least > it0 I

Coeffi'cienf.s of regression '"fuation if only printout lhrough Step i! is to he used.

STEP NO. 3

ENTERED VARIABLE 3 ——— ———— *Al""?)?S T*

,O!lob */1/.sedfo determine Sfd£rr. Y/meo,r;*

F•UVEI.

8TANOARO ERROR OF V	,UU170E+02
NUI.TIPI.E CORRii.AT!ON	,un1
R•SOVAR!O	,lq410
RES OEG OF FREEDOM	S
8UM OF SQ RESIDUAl.$	,q0205E+OJ
EMPI.AIN€0 VARIATION	.u72&£+03
CONSTANT TERM	35!,767U

VARIABLE	SETA PR1ME	BtTA	8E(8ETA)	8TUO[NT T
1	,uuqqE•oo	,.!00UOE+0!	olqi64E+Ol	oiOlqzE+OI
2	•oi4078E+OO	.,s2ousE0oO	,!BlolE+0I	••i!8988E•00
3	.,gqll4£•01	••I1803£•01	,touqa+o2	o,!!Z50E+OO-

ANALV5!8 OF VARIANCE

TUM	u	DF	
TOTAl.	oiii JE•OQ	8	
REG	,217ibE+Ol	3	,?UUE+02
ERR	,quosE+n	5	•!8041h0l

Pt?r Committee recommem:hfion,
note Befo ho.s illogico!.sfsn,retvm ro Step Z. ono'.·
o) Colcvlote Sto'. Err. Y/mum Q for vse in .se!e<:fi'?9 .spon. .
b) If 9 !J<'Or .span is opflmum, Colculo!i? con.sutnpfion b!J cqvof/on (Fro,,., Sft?p Z)

Q74N<:CFjl>fY•i'88.597!J7+/.!Jll)!lf..o!J4Jl/l ·
: !88.597!Jl,..I.!Jl(JJ(T4}-(,J4JT(II./8)•4l.J.66
c) Tllen /no<lify Con.sumpti<m ond $utnmory portions of £3TR£VS

f'i&.O.ItiUAI.,lS

ou	V.OU RV!O	V.CAI.CU\.ATED	DIFFERENCE	8QUAR£D	F!RST O!FF!R!NCU	IQUARED	RATIO Y•OIV•C	RUIOUA /810 [RPOR RAT !O e4 •3 •.1! •I 0 +I ▪ •J +4
▌	,UOUOE.Ol	o4!039E+03	.,otsYohot	,38280£+02	,O	.O	. *sugz*	X
▀	o4ii IOE+03	,40,43£+03	•l•uq«•o	ol7785E+Ol	oZ285oE+Ol	oUU!£+03	1,04071	M
3	,4!400E+03	,41104!+03	,zquu.ot	0 8H44E+OI	•el3707hOl	oi8787E+Ol	leOOUI	X
4	•3qi190E+ 03	,41!q7U03	•ol qg&8E+02	,3U58E+03	•eli!030E+02	e465llE+Ol	*,qnn*	X
▼	e4U10£+01	,4U77E+03	,lqzqn+ot	,1723!£+01	,zoqq?E+ O	,uoan+OJ	lo004U	X
▷	,4!290 +0!	,U058E+03	•o7UI!!+OI	,5,000[002	•,9U07E+OI	**e92hSE+Oi!**	,98174	X
7	,U!ZOhOl	,4U 13!+03	ol18bU+Oi	ol40h!+03	,,9550hoa	**oUZUE+OJ**	1,02817	X
6	,420 01+03	,418UE•03	,lqU$E•OI	,Jnau+ol	.,,nsu•ol	·•7'14!+02	1,00412	X
	o42010h03	,422$7[+03	.,uuoE•OI	,b08!U+OI	.,443.5!+01	oi970•E+02	▪ ▪	X

P RCENTAGE OF OBSERVATION& FALLING IN THE A80V£ CLASSES

55 U 0 *0*

Va/i;es obfained by vse of' Sfep No .3
eq_uofiori wifh R "'1(5· and r avg.

0 0 0 22 0

OURB!NoWAT80N 8TAT!8T!C ,24107£+01

SUM OF SQUARES OF FIRST DIFFERENCES OF RESIDUAL IS .37216E+01

RANGE OF Y•088E VED 18 .40300E+02

ANGE OF V•CALCULATEO !5 .13139E+02

	VUR	Q	SUMRA	SUMTA
NORMALIZED	o74000E+Ol	.42457E+03	.11181E+02	.60686E+02
TEST YR A	,nooOe+oa	.42658E+03	.11181E+02	.60686E+02
TEST YR B	oHOOOhOi!	.42858E+03	.11181E+02	.60686E+02

Estimated Water Consumption

ADJUSTED RoSQUAREO .28944

STO, ERR, V / MEAN Q .03233

END Of REGRESSION

.., tvote: Rofio forSpon of .9 Ysor.s wifh tJofo f'rom Meon of 1/oriobles & Sfep.; f'rom prior .shut. In fhis case, psr Cammdlee, use step C f'rom L.l -G fo hand calculafe Q 74N •4.1!'3.65 ccf7uy insfead of 4<?4.57 C'C'"""/MY shown here. Q 75N d: O 76N ol.so defertr/ined per sfep i! eq.uot/on using t•75 and 76 respectivejy.

5-12

WATER IDENTIFICATION : ONESHOTDEM DATE : 76/ 9/ 1 TARIFF TYPE : MINIMUM CHARGE MONTHLY BILLING CYCLE
PREFACE PAGE • ESTIMATED WATER REVENUES • LISTING OF DATA ♦ RATIOS USED IN THIS RUN

INPUT DATA	!DENT	VALUES
RECORDED CONSUMPTION CCF PER METER YEAR		
NORMALIZED	Q(R)	420,1
TEST TEAR A FORECAST	Q(N)	424,1>
T£8!YEAR 8 FOR CAST	Q(A)	*41b,b*
	QCB)	428,b
RECORDED AVG NO OF SILLS PER YEAR	B(Rl	u1ao,o
TEST TEAR A FORECAST	B(A)	I•Bh,O
TEST TEAR G FORECAST	B(Bl	,0
RICDRDID lVI NO OF SILLS PER liAR (IICIPT $MILLIS METER)	8K8(R)	70b,O
!EST YEAR A FORICIST	BK8(A)	squ,o
TED! VIIR 8 FORECAST	BKS(B)	,0
RltoRDIO RIVINUI	R(R)	14q yo,o

Received outomotico/ly from CLIMATE *vio* LINKUP

FORM ESTREVS
Cords 1 and fA

CALCULATED RATIOS FROM !NPU! DATI

RATIO Q(RC) !,0000000 TO CHANGE REC VR CONSUMPTION TO COMPUT£0 TR CONSUMPTION !ALWAYS loOOOOOOO)
RATIO Q(RN) 1,010 481 TO CHINGE REC VR CONSUMPTION TO NORMALIZED VR CONSUMPTION
RATIO Q(RA) 1,OSil3425 TO CHANGE REC YR CONSUMPTION TO TEST VR •A• CONSUMPTION
RATIO G(RBl ,0000000 TO CHANGE >IEC VR CONSUM T!ON TO TEST VR •B• CONSUMPTION
RATIO B(RA) I,OlU$18 TO CHANGE ALL TWE REC VR S! LS TO ALL THE T!8T VR •A• BILLS
RATIO S(RBl ,0000000 TO CHANGE ALL THE REC VR &ILLS TO ILL THE TEST VR •8• 8!LL8
RATIO BK8(RA) !,OHUSI TO CHANGE THE REC VR BILLS (EXCEPT SMALL£$METER! TO TEST VR ••• BILLS !EXCEPT SMALLEST METER)
RATIO BXS(R5l ,0000000 TO CHANGE TME REC VR BILLS (EXCEPT SMALLEST HET R) TO T£ST YR •B• BILLS (EXCEPT SMALL£81 METER)

NUMS!R0' RAT€ BlOCKS o 5
NUMBER 0' MlT!RSIZES • *1*

RECORDED DATA YEAR R

Corel "'C.

RATE ClOCK UPPER liMIT cccn	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR *Card #10*	CONSUMPTiON CHARGES PRESENT	CONSUMPTiON CHARGES PROPOSED
10	47577	i!,&bOOO	3,75000
30	94350	,25400	,37500
100	210211	,20100	,30300
500	244922	ol4 00	.uOOO
1000	73041	.!0600	.15000
		Cord#(}	*C'ord"'9*

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER S PER PRUENT	CHARGES MONTH PROPOSED
2625			
5103			
4228			
1390			
88			
,&25	us.	i!,ho	1,750
,750	3709,	3,!50	q,000
,,000	141&,	0,000	5,&50
!,500	!115,	6,850	1!,000
2,000	250,	10,300	u,ooo
J 0000	8,	2!,000	]0,000
4,000	6,	Jo,000	SO,000
Cord fl'4	*Cord':s*	*C'ordfftJ*	*Cord 11/*

FORM ESTR EVS
Cords 2 fo 10

WIT IDENTIFICATION & UNESHOTDEM !)Aft t 1&1 'If t TARIFF TYPE & MINIMUM CHANGE

C & GRAND TOTALS = REVENUE IN DOLLANS PER YEAN

	CO >'PUHV YE/R		'HJq"'AL llE!> V[/ll		1!5'1' 'f'FAR •••		HST 'if' AV ••"	
	PQfSENl	PQUPf\S1O	l'f/ESt.•·lf	P»ovosu.	Puf!t !!lf	PllUPIJSt:tl	Pltf;.Sf "<T	PP<OPUSU•
•• ʼʼ, HIU\,5	l!a(hi!Ol UtlUO !Olt':!lU	l' hSSi !O•bbl Ul•2l.5	!tltd¥4 UtlliO 1Ut114	l'llttl'S Otfl&l U!t17b	!ll'f•ll5'5 2Jf1S8 ii'Ot21t.l	200t&'J1 ilt71UI l12ol\l42		
»RC» AOJVSf[O 10ULS	149,670				214,218			

REVENUE ESTIMATES

used lo determine RRCR shown on L.! !O.
RRCR applied to Normalized and Test.
Years A and 8 revenue estimates.

EXHIBIT L.1-5

FtUN :rtJCNTI'P""JI::>rrTVN / OIV!"lJFfOfOE'M OAT'E I 701 '91 1 TARIFF TYPE I Ml1141MUM CHARGE
SUMMARY PAGE • DATA AND RATIOS FROM PR[FAC[PAG€ PbU8 R(Cl AND RRCR

	INPUT OAU	!OEN1	VAI.UE8
RECORDED CONSUMPTiON CCF PER ME1R YEAR		Q(R)	410₀1
NORMALIUD		Q(Nl	U«,&
1[81 V!AR A FORECAST		Q(A)	qh,b
TEST YEAR 8 FORECAST		Q(B)	428,b
RECORDED AVG NO OF Blli,S PER YEAR		S(Rl	1'140,0
TEST VUR • FORECAST		S(Al	19836,0
TUT VUR B FORECAST		B(Sl	,0
RECORDED AVG NO OF BILLS PER VEAR (EXCEPT BMAci.EST METER)		BX3(R)	no ,O
YUT VUR • FOR£CA8T		BXG(A)	5915₀0
TUT VUR B FORECAST		BX8(B)	,0
R€CoRDEO REVENUE		R(R)	auqo7o,o
REVENUE VIA WATER USE TABcE SV COMPUTER		R!Cl	IU54c,8

CAlCULATED RATIOS FROM INPUT DATA

RAT!O Q(RCl 1,0000000 TO CHANGE REC VR CONSUMPTION TO COMPUTED VR CONSUMPTION (ALWAYS 1,0000000)
RA flO Q(RN) !,O!Obq6! TO CHANGE REC VR CONSUMPTION TO NORMALIZED VR CONSUMPTION
RATIO Q(RA) !,0521425 TO CHANGE REC VR CONSUMPTION TO TEST VR •A• cONSU PT!ON
RATIO Q(RBl ,OOOOOOO TO CHANGE REC VR CONSUMPTION TO TEST VR •B• CONSUMPTION
RAT!O SCRAl !,OlU5!8 TO CHANG! ALL THE REC YR B!LI.S TO ALL THE TEST YR •A• BILLS
RAnO B(R8l ,0000000 TO CMANGE AI.I. THE REC VR 6!1.1.8 TO •LL THE TEST YR •B• BILL&
'RAT!O BXS(RA) l₀Ol6Ol8! TO CHANGE THE REC VR 8!1.1.8 (EXC[PT 8HALI.E8T METER) TO TEST VR ••• BILLS !EXCEPT SMALl.£!! METERJ
RATIO BXS(RS) ,0000000 TO CHANGE !ME EC VR 8!1.1.8 (EXCEPT SHALI.E8T HETERl TO T£ST YR •8• BXLL8 !EXCEPT SMALLEST METER)
RATIO RRCR •Q208037 REVENUE ADJUSTMENT FACTOR CREC YR R / COMPUTED YR R)

MUMBEOF R4TE BLOC S o 5
NUMBER OF METeR *8!%8* • 7

Nore inclvston of IU<CR volue

RECORDED OATA YEAR *R*

RATE BLOCK UPPER t.IM!T (CCFl	R!CNO OF SII.LS PER RATE BLOCK	REt CONSUMPTION PER RATE BLOCK CCF PER VUR	CONSUMPTION CHARGES PRESENT	PROPOSED
IO	Zo 5	47577	i!,hOOO	lo 75000
30	S!Ol	q4350	,i!5400	,17500
100	Uil6	ii!Olll	,i!0700	o30l00
S00	u O	i!44q2i!	,IUOO	,15000
1000	66	HOG I	,!OUO	,!5000

METER SUES (!NCHU)	&VG NO OF Ui.I.S aV METER SUE	METER PER PRESENT	CHARGE$ MONTH PROPOSED
. ZS	2US,	.,860	.1₀750
,7$0	nqq,	3,150	4,000
),000	l41b.	4,000	S,b50
j,SOO	275,	O,SSO	!1,000
Z,000	i!SO,	10,300	!b,ooo
),000	6,	2!,000	Jo,000
aQOOO	A,	30 ₉ 0lH!	SO,tlU 0

DATE : 76/ 9/ 1

TARIFF TYPE I MINIMUM CWARGE

C : GRAND TOTALS - REVENUE IN DOLLARS PER YEAR

HORIZONTAL ONE-SHOT RU

ROUTINE	COMPUTED YEAR PRESENT	COMPUTED YEAR PROPOSED	NORMALIZED YEAR PRESENT	NORMALIZED YEAR PROPOSED	TEST YEAR •Ao PR!3!NT	TEST YEAR •Ao PROP08EO	TEST VEAR •B• PR!SENT	TEST VEAR •B• PROPOS!D
B•1	l40tl03	lqlt5 2	lUI 9374	1Htl15	!4bt511	l00oll2		
B•2	2i!ol40	30ob&l	Ut340	30obbl	U•U6	llo784		
TOTALS	!Uo543	U2t2U	IH•71•	22lo7H	u,q,uo	Uloqlb		
RRCR ADJUSTED TOTALS	149,670	204,615	!50t7U	206,054	156,233	213,549		

Note *on!J minor changes rrom* L. I - 9

EXHIBIT L.2-1

RUN IDENTIFICATION : ONESHOTDEM DATE : 76/ 9/ 1 TARIFF TYPE : MINIMUM CHARGE MONTHLY BILLING CYCLE

SUMMARY PAGE - DATA AND RATIOS FROM PREFACE PAGE PLUS R(C) AND RRCR

INPUT DATA	IDENT	VALUES
RECORDED CONSUMPTION CCF PIP METER YEIR	G(R)	UiO ,I
NORMAL!lEO	Q(N)	uzu,&
TEST ViAR I FORECAST	Q(A)	Qi4,b
TeST VIIR B FORECAST	Q(Bl	uu,.
RlCORDED AVG NO OF 611.1.8 PER YEAR	B(Rl	lqlUO,O
!UT VUR ▮ FOR!CIST	B(A)	IQ8H,o
!UY VUR e FORt CUI	6(8)	,0
RECORDED AVG NO OF St\,I.S Pi:R VliR !EXCEPT SMII.I.E81 MET!Rl	BXS(R)	510b,O
TEST VUR A FOREC S!	BXS(A)	ql,0
TUT YEAR B FORECAST	8XS(B)	,0
RECORDED REVENUE	R(R)	1aqe70,o
REVENUE VIA • TtR uSE TABLE BV cOM UfER	Reel	una ,e

Result ofinserfing word HortZotlfol on Cord I

CALCULATED RATIOS FROM INPUT DATA

RA 1!1l	Q(RC)	!,0000000	10 CHANGE EC VR CONSUMPTION TO COMPUTED VR C0N8U PT!ON (ALWAYS 1,0000000)
••no	O(RNl	!,0!0&48!	TO CHANGE REC YR CONSUMPTION TO NORMA IZEO VR CONSUMPTION
••no	Q(RAl	I,Ot17H6q	TQ C ANGE REC VR CONSUMPTION TO TEST VR •A• CONSUMPTION
AT!O	Q(R)	,0000000	TO CHANGE REC YR CONSUMPTION TO TEST VR •8• CONSUMPTION
RATIO	S(Ril	!,Olo IS	TO CHANGE ALL TM[REC VR SILLS TO ALL THE TEST VR •A• BILLS
RATIO	B(RBl	,0000000	TO CHANGE ALL TM£ Rfe VR 8!t.L.$ TO Alt. THE TEST YR •So BILLS
RA T!O	6XS(RA)	I,Oho SI	TO CHANG! TMf R[C VR BILLS (EXCEPT SMALLEST METER) TO TEST VR •A• BILLS (XCEPT SMALL£ST METER)
RATIO	SXS(RB)	,0000000	10 CHANGE THE REC VR BII.LS (EXCEPT SMA.t.EST METER) TO TEST YR •8• BI.LS (EXCEPT SMA••EST METER)
RATIO	RRCR	,qzoaon	£VENUE ADJUSTMENT FACTOR (REC VR R / COMPUTED VR R)

A/ofe chonge !'rom no/1-Horizorrfo, rur1 per L.I-9

NUN8!HOF RAT660CK5 • S
NUMAIR OF METER S!Z!S• 7

No change expected

RECORDED DATA YEAR

RAT G!,OCW UPPER !.I M II CCCn	REC NO OF U'I.S PER RATE BLOCK	R£C CON6UMP1!ON PER RATE BI.OCK CCF PER YUR	CONSUMPTION CHARGES PRESENT	PROPOSED
10	bl	41577	<,a.ooo	l,Y 000
:lo	9101	qu o	,nuoo	,31500
100	42;!8	U0211	,zo7oo	,30300
S00	\}qQ	luuqu	,14200	.1 000
1000	sa	IJOR!	,I 0&00	,15000

METER uzu (INCHES)	AVG NO OF 6! !.$ ev MET£ un	METE S PER P UENT	CMARGES MONT" PROPOSED
•&25	ZU5,	z,n&o	J,7 0
,750	}1aQ,	!,I 0	M,000
▮.000	IU!b,	4,000	5,1>'50
lo 00	ii75,	.850	!1,000
z,000	< 0.	IOolOO	.000
},000	A,	21,000	H,000
0,000	6,	J!'•:(•	I)'•0o\1

CHAPTER 6

PUC - CWA CONSUMPTION REVENUE COMMITTEE METHOD

With the encouragement of the Chief of the Hydraulic Branch of the CPUC, a committee composed of representatives from he Commi sion and li nia Water Association was organized in late 1975 to attempt to develop a fundamental method of forecasting normalized water consumption (basically of the r idential or commercial class), which could be used as a standard.Y

Af'ter several meetings and independent analyses, the cormnittee made a final rec:ommendatioJY to Chief' of the Hydra liBranch on June :12, 1976 which was accepted. The recommendation was made on the assumption that the long-term increase of water consumption as a function of time that has been observed over many years will not persist in the next few years as a r ulct of water conservation efforts, price elasticity, and other causes. (While a decrease of consumption has generally been ob erved in recent years in this state, should a reversal be observed, the staff' might return to its former method of forecasting unit consumption changing with time.)

The method arrived at is based upon the use of' annual rather than quarterly or other shorter increment data plus other simplifications in the application of' statisti<:al theory. These simpli:fi ations were made knowingly, but it is our belief that under the limitations imposed by the requirement that the staff assist in the regulation of o·ver 400 utilities, they appear to provide reasonable estimates.

---

1) The committee was composed of' the following:

CPUC

A. Tokmakoff, Chairw.an
D. H. Weiss

W. Caveney, So. Calif. Water Co.
R. Ha.y+vens, San .Gabriel Water Co.
E. Catey, Calif· Water Serve. 'Co.
14. Ferry, Brown & Caldwell, Consultjng Engr.
D. Conway, Park Water Co.

gj See Exhibit M..

It should also be no'ted that after some use of the Committee method as shown below, the computer may be pa.rtie.lly reprogrammed to allow "for auto!llati analysis (such as is done w:ith ONESHOT) via the Commit'tee's method. See Exhibit N.

RECOMMENDATION OF THE BASIC METHOD OF WATER CONSUMPTION ESTI¥ATION IN TERMS OF THE EXISTING PUC COMPUTER PROGRAMS

A. Basic Procedure

I. Graph observati:>ns (:vecorded unit consumption) versus time. Use up to 13 years of data {when available). Each point is a value r).

2. Pe:vform ONESHOT :vuns covering spans of 5 :to 13 years {when available) with the last yea:v of the span always being the last complete recorded year.

3. Note that occasionally for a particular run, coefficients having illogical signs}/ will appear. \\'hen that oocurs, review the MURE:l portion of the printout and wo:vk backwards from the number three step to the number one step, disregarding those steps with illogi<:al signs. Take the first ste:p one finds that contains all logioal signs and using the basic regression equation discussed in Chapter 2, Part A.3. and compute estimated normalized and other consumptions as required by hand. Determine \the stands;,:-d error - span mean consumption rates for use in the following step.!!/

Note that as an alternate, the Engineer may also use tbe procedures of Chapter 3 with forms MI and MD to eliminate illogi<:al variables, or substitute weather information. ONESHOT can p;,:-ovide source data for the forms.

4. Select as the ret:erence run that one having a span which proviues the least standard error of the ,equation as a. :peroentage of span mean oons=ption.

3/ Illogi>Cal signs being a plus for rainfall and a minus *t:or* temperature. See

4/ The 'Standard Error is defined as: $SE = \sqrt{\frac{\sum (Q(o) - Q(r))^2}{n - k - 1}}$

The ,Mean Consumption i-s li'St.ed on the right ha-nd eol:u.Jrh"1 of the printout under the term, Mean of the Variables

5. The reference run regression equation $Q = K + at + bR_{avg} + e^{T}_{avg}$ is to be used to obtain the estimate of normalized consumption for the last recorded year.2/ That value will be taken as the normalized consumption for that year plus the following two years. R and T are the 30-year billing adjusted values. As usual, monthly rainfall input is to be limited to 4 inches maximum.

Remember by entering the word HORIZONTAL in the ESTREVS form, that operation will be carried out automatically in the ONESHOT program.

6. Add to the graph noted in paragraph 1, the adjusted points (corresponding to the mean or normalized rainfall and temperature) using the coefficients from the reference run.§.!

7. Adopt results if they appear reasonable. If they do not, discuss results with the Assistant Hydraulic Engineer for Results of Operations Studies.

B. Substitute Procedure

Instead of using ONESHOT, the engineer may as noted in Chapter 2, Part B, use CLIMATE requesting a series of runs with 5 to 13-year spans using only Forms CI (fill in columns 43-44) and CD. He then may analyze these runs as per Steps 3, 4 and 5 above, and then use the &TREYS program to compute revenue for the selected span run only.

C. Example

See Exhibit L.1 for development of typical MUREG equation by hand using a time trend run.

See Exhibit L.2 for a HORIZONTAL run.

2.1 If the last recorded year data is not used in the regression analysts, the extrapolated value to the last recorded year will be used as the normalized value.

Adding the calculated points (corresponding to the rainfall and temperature associated with each year in the selected span) will also indicate the validity of the reference run equation. Each point is a value of Q(c). The closer the points Q(r) to Q(c) means the better the equation. These values are printed out as shown on L.1-7. Note that even though the adjusted R-squared value is poor, indicating only moderate fit and/or little slope, the Q(r) and Q(e) values are not too far apart.

Recommendation of the Basic Method of
Water Consumption Estimation

A. Basic Procedure

1. Graph observations \recorded unit consumption) versus time. Use up to 13 years of data (when available).

2. Perform multiple regression analysis runs covering spans of 5 to 13 years (when available) with the last year of the span alwqs being the last complete recorded year.

3. For any particular sp 1run, reject those coef·:ncients having illogical signend redo the particul.ar run without them.

4. Select as the reference run that one having a span which provides the least standard errcr of the equation as a percentage of span mean consumption.

5. The reference run regression equation Q = K + at + bR + cT is to be used to obtain the stimate of normalized consumption for the last recorded year.g; That value will be taken as the normalized consumption for that year plus the following two years. R + T are the 3()-year billing adjusted values. As usual, monthly rainfall input is to be limited to 4 inches maximum.

6. Add to the graph in paragraph 1, the adjusted poii>ts (corresponding to the mean or normalised rainfall and empereture) using the coefficients from the reference *run.21*

7. Adopt results if they appear reasonable.

B. Alternate Procedures

utilise other procedures if the above do.es not appear satisfa<:tory.

jJ Illogical signs being a plus for rainfall and a minus for temperature.

g/ If the last recorded year data is not used in the regression ana ysis, the .extrapolated value to the lest recorded year will be used as the normalized value. Note c so and d ?_ o.

/ Adding the cal.culated points (corresponding to the rainfall and temperature associated with each year in the se ected span) will also indicate the validity of the reference run equation.

EXHIBIT N

FUTURE COMPUTER PROGRAMMING

A revised ONESHOT program taking into account the Committee's recommendations would do the following:

1. Per CLIMATE input for all CI and CD entry out up to nine CLIMATE runs covering a range of 5 to 13 observations.
2. Check the signs of Student T to be sure Variable 2 (rainfall) is negative and Variable 3 (temperature) is positive. If one or both are of incorrect sign (illogical), drop the vsriable. Order of variable analysis precedence for each particular span run is to be from the third step back through the second to the first step. If procedure results in dropping all three variables, that span run is to be omitted from consideration. Indicate by message, action taken. Print out all variables, however, whether or not used.
3. Using last acceptable step, calculate consumption as is done currently in the CLIMATE, printout, and store for each span run.
4. Printout and store standard error ratio for last acceptable step for each span run.
5. Determine from all runs which one has least standard error ratio and transfer those consumption values to [redacted].
6. Perform ESTREVS calculation to determine revenue for least standard error span run.

While the procedure described above constitutes the Hydraulic Branch's final requirement for a revenue estimating program, it would be wise in setting up the program to bear in mind that at some future date it may wish to carry out step 2 using the Student's T table.

CHAPTER 7

SUMMARY

The prodedures discussed in this report are simple but require that the Engineer understand the Water Use Analysis Table. With practiee, the methods discussed can be carried out most expeditiously and in addition, will leave very clear records for those who follow and must use the water consumption and revenue estimate reports in the future for other rate cases, offsets, etc., (all the printout pages need not be retained – retention of the input and summary pages only provide sufficient information to qaickly rerun aQy work to get the complete job as required).

With additional rate case work, new applications and approaches to using these computer programs Will evolve which Will further reduce engineering effort and time or provide the basis of more deta.il.ed analysis 1n G.:U'fieult eases.

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

EXHIBITS (Continued)

EXHIBITS

EXHIBITS (Continued)

ABSTRACT

This guide has been prepared to supplement Standard Practice No. U-25, Guide to Adjusting and Estimating Operating Revenues for Water Utilities, April 30, 1968. It makes available a description of the existing Hydraulic Branch computer programs and procedures that may be used to estimate such revenues and provides detailed-instruction as to their use.

The recommended method of water consumption estimating for the commercial class as developed by the PUC-CWA Consumption-Revenue Committee (hereinafter referred to as "Committee") is described in terms of the existing computer programs.

One of the procedures (ONESHOT) enables the Engineer by simply entering on data sheets such information as recorded water consumption, weather station identification, and revenue structure data to determine in one step, normalized and forecast revenues.

The CLIMATE program also is of special interest as it allows a series of runs with different time spans to be run with only one set of input data which is often of particular value in carrying out the Committee's recommended procedure.

NOTATION

Term	Definition	Units
Q(R)	*Recorded Water Consumption (Unit Consumption)	ccf/meter - year
Q(N)	Computed or Engineer Furnished Normalized Water Consumption Forecast (Unit Consumption)	ccf/meter - year
Q(A)	Computed or Engineer Furnished Test Year A Water Consumption Forecast (Unit Consumption)	ccf/meter - year
Q(B)	Computed or Engineer Furnished Test Year B Water Consumption Forecast (Unit Consumption)	ccf/meter - year
Q(C)	Computed Water Consumption for the Recorded Year R (Unit Consumption)	ccf/meter - year
B(R)	*Recorded Bills (Total)	Bills/year
B(N)	Normalized Bills (Total) Forecast	Bills/year
B(A)	*Test Year A Bills (Total) Forecast	Bills/year
B(B)	*Test Year B Bills (Total) Forecast	Bills/year
$\simeq$ Q(R)	Computed Recorded Water Consumption (Total)	ccf/year
$\simeq$ Q(N)	Computed Normalized Water Consumption (Total)	ccf/year
$\simeq$ Q(A)	Computed Test Year A Water Consumption (Total)	ccf/year
$\simeq$ Q(B)	Computed Test Year B Water Consumption (Total)	ccf/year
Q(RN)	Computed Consumption Growth Ratio based upon Recorded and Normalized Year Values	Dimensionless
Q(RC)	Computed Consumption Growth Ratio based upon Recorded and Computed Values for Year R. Always Equal to 1.0.	Dimensionless
Q(RA)	Computed Consumption Growth Ratio based upon Recorded and Test Year A Values	Dimensionless
Q(RB)	Computed Consumption Growth Ratio based upon Recorded and Test Year B Values	Dimensionless
B(RN)	Computed Bill Growth Ratio based upon Recorded and Normalized Year Values	Dimensionless
B(RA)	Computed Bill Growth Ratio based upon Recorded and Test Year A values	Dimensionless
B(RB)	Computed Bill Growth Ratio based upon Recorded and Test Year B Values	Dimensionless

* Engineer furnished data.

NOTATION

Term	Definition	Units
BXS(R)	*Recorded Bills (except smallest meter) Forecast	Bills/year
BXS(N)	Normalized Bills (except smallest meter) Forecast	Bills/year
BXS(A)	*Test Year A Bills (except smallest meter) Forecast	Bills/year
BXS(B)	*Test Year B Bills (except smallest meter) Forecast	Bills/year
BXS(RN)	Computed Bill Growth Ratio based upon Recorded and Normalized Year Values except for Smallest Meters	Dimensionless
BXS(RA)	Computed Bill Growth Ratio based upon Recorded and Test Year A Values except for Smallest Meters	Dimensionless
BXS(RB)	Computed Bill Growth Ratio based upon Recorded and Test Year B Values except for Smallest Meters	Dimensionless
R(R)	*Recorded Revenue	Dollars
Q_t	Unit consumption as a function of time and normalized weather	ccf/meter - year
k	Number of Independent Variables	Dimensionless
n	Number of Observations	Dimensionless
t	Year	Year
R_{J_x}	Monthly Recorded Rainfall, January, Year X (typical)	Inches
T_{J_x}	Monthly Recorded Avg. Temperature, January, Year X (typ)	^{o}F
$R_{adj.}$	Annual Rainfall Adjusted for Meter Reading Cycle	Inches
$T_{adj.}$	Annual Temperature Adjusted for Meter Reading Cycle	^{o}F
Ravg	Average of Adjusted Annual Rainfall over a Nominal 30-year Period (Printout: SUM R ADJ)	Inches
Tavg	Average of Adjusted Annual Temperature over a Nominal 30-year Period (Printout: SUM T ADJ)	^{o}F
K	Constant	ccf/meter - year
Q(r)	Recorded unit water consumption for each of the span years. Called Y-OBSERVED on printout.	ccf/meter - year
Q(c)	Calculated unit water consumption for each of the span years. Called Y-CALCULATED on printout.	ccf/meter - year
Q(m)	Mean of recorded unit water consumption for the span years	ccf/meter - year

* Engineer furnished data.

CHAPTER 1

INTRODUCTION

The main body of this report describes individually, and then in integrated form, three programs/procedures[1] used by the Hydraulic Branch primarily in commercial class revenue estimating, i.e., WEATHER, MUREG, and ESTREVS. The integrated overall program (ONESHOT) is achieved via the use of a fourth program entitled LINKUP.

When ONESHOT is used, it carries out the following six operations in sequence.

WEATHER (Temperature and Precipitation)[2]

1. Obtains weather data for a particular weather station from a PUC modified U.S. Weather Bureau magnetic tape which contains essentially all weather information of record (but at least from 1931) for all California weather stations.[3]
2. Interpolates for a missing month's temperature and/or precipitation. When two or more consecutive months' data is missing, it alerts user that such is missing and deletes that year's records from subsequent calculations.
3. Makes other engineer-desired adjustments to the raw data, i.e., adjusts recorded rainfall and temperatures for billing cycle procedures and engineer-specified maximum

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1/ We have taken the liberty of using program identification not used by the Data Processing Branch in order to simplify understanding.

2/ WEATHER is only used in conjunction with MUREG (steps 1 through 5 above). The joint program is entitled CLIMATE.

3/ While the Hydraulic Branch obtains temperature and precipitation only from the tape, other weather information is available from it which can be accessed independently of the procedures described here. A complete new tape or an annual supplement is purchased each year by the Commission from the Environmental Data Service, NOAA, Asheville, N.C. 28801.

allowable monthly rainfall limits. Prints out the data from steps 1 and 2, plus the annual adjusted averages and a multi-year annual adjusted average as specified by the engineer.

MUREG

4. Automatically combines above information with engineer-furnished recorded water consumption data and uses it in a multiple regression program where complex mathematical calculations are made. Provides valuable statistical information for judging validity of results.4/

5. Estimates normal year and forecasts future year(s) water consumption assuming a time trend.

ESTREVS

6. Receives above estimates and calculates revenue as a function of tariff and billing procedure, rates (present/proposed), customers, and customer growth projection assuming either a time trend or no trend with time after the establishment of the recorded year normalized consumption.

The basic program CLIMATE is described in Chapter 2. It requires the use of only two forms, CI and CD.5/

Chapter 3 illustrates how basic information from CLIMATE may be used in conjunction with changing weather data and adding or omitting variables prior to using separately the multiple regression program MUREG. Only forms MI and MD are required.

4/ In simplified analysis, the standard error of the equation divided by the mean of the recorded consumption over the regression time span considered is the fundamental measure of equation fit. See Chapter 6, Committee Method.

5/ The Hydraulic Branch request for any EDP services form not shown in this

1 - INTRODUCTION

The program to calculate revenue, ESTREVS, is described in Chapter 4, along with its single form ESTREVS (492.12B). The obtaining of billing and consumption data for either a monthly or bimonthly billing is shown.

Chapter 5 shows how CLIMATE and ESTREVS may be combined (ONESHOT) to get revenue directly using forms CI, CD, and ESTREVS.

Chapter 6 discusses the report of the Committee and describes two alternate approaches to carrying out the recommended procedure using the existing programs and forms referred to above.

All programming is in general accordance with Standard Practice U-25 and the modified Bean Theory (a description of the graphical approach to that theory is given on pages 5-3 through 5-7 of that document).[6/]

Approximate average out-of-pocket cost, including Engineer's preparation time and analysis for a typical case of ONESHOT, is $170, compared to about $700 when hand calculations and reference books are used. Time saving is about one and a half weeks for San Francisco work. The branch has about 30 such cases per year.

As noted above, the three basic programs can also be used separately. A typical application would be the use of ESTREVS to make rapid multiple studies of changes in rates once overall consumption characteristics have been estimated.

The report includes as Exhibit N, a description of how the MUREG portion of the existing ONESHOT program may be modified in the future so that we will be able essentially to perform automatically the complete revenue estimating process according to the Committee method.

6/ Only linear multiple regression is used with the computer as compared to linear and curvilinear techniques shown in U-25.

To sum up, the entire practice is based upon the assumption that past is prologue and thus by fitting a linear equation to past water sales results and, using a mean of past weather data, future water sales can be projected on a "normalized" basis. No accounting for weather or economic changes is considered as, in both those areas, no generally accepted procedures for predicting the future are currently available. That does not mean that the Engineer is not encouraged to research out other weather factors, etc., that may in the future improve the techniques described here.

CHAPTER 2

CLIMATE PROGRAM

A. Program Description

The program consists of the WEATHER and MUREG programs in one package. Thus, it combines the U.S. Weather Bureau library of historical weather information for California (on tape) with the Control Data Corporation library MUREG (Multiple Regression) Program and, in addition, estimates normalized water consumption for the last recorded and for the two following years. The program specifically does the following:

1. Input parameter records (Data obtained from Engineer furnished forms CI and CD shown as Exhibits A.1 and A.2 and calculated per pg. 5-6).
   a. Date, Run Identification and Weather Station Identification Number (latter available in U.S. Climatological Data Books).
   b. Lists whether card or tape input data is to be used; i.e., the Engineer must indicate whether he wishes to use weather information from the Weather Bureau tape or whether he wishes to insert his own rainfall or temperature data via cards.
   c. Maximum rainfall to be considered in any one month as specified by Engineer (Standard value is 4.0).
   d. Billing type by Engineer (monthly or bimonthly).
   e. Data grouping (annual or quarterly).[1/]

1/ Based upon the Committee's procedure, only annual data is to be used in analysis and CLIMATE is designed on that basis. The WEATHER portion however will provide quarterly adjusted data for separate MUREG analysis if required.

f. Time spans to be used in the development of adjusted rainfall and temperature averages (Rain/Temperature Mean Period) and MUREG analysis (Water Consumption Period).[2/] Note, the MUREG analysis is not restricted to end on the last year of the tape. Note also, if 30-year mean rainfall and temperature values are to be used as the normalized values, 31 years of rainfall and temperature data must be available on the tape. A reference is available upon request from the Weather Bureau listing all tape weather data.

g. Starting year for spans referred to in Item f., above (computer calc.).

h. Number of times to drop a year in order to get different MUREG time span runs. Years are dropped only from the beginning of the span.[3/]

i. Water sales (consumption) are a function of time.

2. WEATHER Computations - The program retrieves data and computes as follows:

a. Obtains "raw" historical weather data from the tape and prints it out. Alternately, it is possible to use cards to insert weather data so that the Engineer, upon special occasions, can

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2/ Up to thirty years of observation of recorded meter water consumption on an annual or quarterly basis can be furnished by the Engineer.

3/ This is an optional procedure and is only usable with CLIMATE. Leave input data sheet line blank when ONESHOT is called for (Exhibit A.1, line 10).

add monthly data in cases where data is missing from the tape or substitute his own weather information for all or part of that furnished by the Weather Bureau.[4/]

b. In preparing the above raw data, the program interpolates between monthly records if one month is missing from the rainfall and temperature data. It indicates that procedure by printing out symbol "777" and a flag on the raw data sheets. If more than one month of data is missing, it omits the entire year from weather averaging and MUREG calculations. That is, it does not print out that year's or quarter's adjusted weather data. However, the program will complete the MUREG analysis and extrapolation after taking into account the missing data.

c. It adjusts the recorded monthly rainfall[5/] to any specified maximum level between 1 and 9 inches per month.

d. It adjusts that data for continuous meter reading cycles, either monthly or bimonthly, per Standard Practice U-25.[6/]

4/ The computer will also "dump" the weather records contained in the library weather station. The Engineer can thus determine how many years of useful data is available from the Weather Bureau records. For example, he may find only 16 years' information is available for developing 30-year mean rainfall and temperature figures and thus may wish to use another station for the other 15 years' data. This combining operation may be done after dumping through the use of card input. "Dump" refers to a complete storage printout.

Note that the program will "dump out" if you direct the computer to use 30 years of weather data associated with a station when less than 30 years data is on the tape. The raw and adjusted data printed out, however, will be useful when going back to the regular MUREG program when using card input. Time and money will be saved however if the previously referred to weather reference book is consulted prior to computer use.

5/ The figures 999.99 under precipitation indicate a trace of rainfall which we define as zero rainfall.

6/ See Exhibit A.3 for procedure applying to both annual and quarterly data.

e. It summarizes "adjusted" weather data for MUREG analysis on an annual or quarterly basis. It calculates an average of adjusted rainfall and temperature for the specified historical period whose last year corresponds to the last year of the MUREG analysis and prints it out. That average is called the normalized rainfall and temperature, and is listed on the printout as SUM R ADJ and SUM T ADJ.

3. Computations for MUREG - The program performs multiple regression and determines normalized consumption as follows:

a. The MUREG program takes the recorded water consumption data and the annual adjusted rainfall and temperature data and carries out ordinary stepwise[7/] multiple regression analysis (using consumption as the dependent variable). The result is a forecast of water consumption based upon the equation:

$$Q_t = K + at + bR_{avg} + cT_{avg}$$ [8/]

where the adjusted average values of R and T are to be inserted into the equation along with appropriate values of time t for the last recorded and the two forecast years A and B, in order to obtain normalized and forecast year consumptions. K, a, b, and c are constants determined by the analysis. In the printouts, K is called the CONSTANT TERM and a, b, and c, BETA.

b. The program currently calculates and prints out water consumption based upon the normalized rainfall and temperature for the last

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7/ The order in which the independent variables are printed out is a mea of the contribution of that variable in explaining the correlation.

8/ Signs of the coefficients are determined by the regression analysis a are automatically printed out as well as utilized by the computer in making forecasts.

recorded consumption year. It also calculates and prints out water consumption for two years following the last recorded year using the time trend coefficient developed in MUREG.

c. After the development of the existing program, the Committee concluded that BETA coefficients for R and T with illogical signs should be eliminated from the basic formula when they occur. Until MUREG is modified it is necessary to perform that step by hand as discussed in Chapter 6 so that the values of "c" and "d" coefficients of the fundamental equation must always be restricted to:

$$c \leqslant o \text{ and } d \geqslant o$$

Normalized and forecast consumption values therefore will be slightly different from that given in the printout under those circumstances.

4. Computations of Statistical Data

The program computes Adjusted R^2 (Adjusted Coefficient of Determination - Squared) which is useful in comparing runs where a different number of years are used as well as the ratio of Standard Error of the Equation divided by the Mean Consumption over the time span considered. (Water Consumption Period)

5. Typical Printouts

Exhibit A.4 illustrates the operation of some features of WEATHER referred to above. For example, pages A.4- 1, 2, 3, and 4 show data was missing from the Weather Bureau tape. Pages A.4-1 and A.4-2 show two or more consecutive missing items in 1946 and 1957, as indicated by "777" and a flag message. As a result, those years plus two others not shown on the printout were dropped from

the data used to develop mean rainfall and temperature as noted on page A.4-3. The mean shown in this case on page A.4-4 is only 26 years, compared to our standard 30-year mean.

Note also that while one month's temperature data was missing on page A.4-3, year 1970 was not dropped. Instead, the computer interpolated the missing temperature value from the preceding and following temperatures and used that value to calculate the annual average adjusted temperature for 1970, as shown on page A.4-4, i.e., 62.5° Fahrenheit. See also Exhibit L.1 for additional examples of the computer performed adjustments of WEATHER.

A typical CLIMATE printout consists of pages L.1-1 through L.1-7 of Exhibit L (pages 5-6 through 5-12).

B. Time Spans

As analysis is generally made by reviewing time spans ranging from 5 to 13 years, always using when possible, the last recorded year as one of the observations. At least five observations are required to use the program, thus cases may arise where spans of at least six years or more are needed to provide the required input data. Whether or not weather data is to be substituted for missing data to obtain a complete set of spans is left to the judgment of the Engineer.

When a suitable value for dropping is inserted adjacent to columns 43-44 of Form CI, e.g. 8, the computer will carry out the WEATHER program once after which it will utilize that basic input and its computed adjusted data to perform a series of MUREG runs covering time spans from the maximum of 13 years down to 5 years.

To aid in span run selection, the standard error ratio will be printed out (see Chapter 6) after each span run, just below the Adjusted R square val

C. Data Forms Required

The forms to be used in CLIMATE consist of Forms CI and CD. These provide the instructions and input data to the computer. A self-explanatory example is provided in Exhibits A.1 and A.2. Note that Unit Consumption (Sales) must always be determined in the same way as Water Use Analysis calculated values and is calculated for each year by dividing the total consumption by the total number of bills, irrespective of whether they are partial or complete bills. See Q(R) calculation in Exhibits D.1 and F.1 (pages 4-22 and 4-40).

The results of the use of Exhibits A.1 and A.2, are as noted above, are shown in Exhibit L.1, pages L.1-1 through L.1-7 (starting page 5-6).

EXHIBIT A.I

Control Card for CPUC Hydraulic Branch CLIMATE Program
CLIMATE Instructions

	Description of Field	Columns	Min. Sample
1.	Identification	01-16	
2.	If Rain/Temp Data Come From Tape, Code (T) If Rain/Temp Data Come From Cards, Code (C)	18-18	T
3.	Maximum Rainfall (Allowable Range is 1-9 inches)	20-20	4
4.	If Billing Cycle is Monthly, Code (M) If Billing Cycle is Bimonthly, Code (B)	22-22	M
5.	If Data Grouping is Quarterly, Code (Q) If Data Grouping is Annual, Code (A)	24-24	A
6.	Rain/Temp Mean Period (Years)	29-30	30
7.	Last Water Consumption Year (Last Two Digits of Year)	32-33	74
8.	Number of Years of Water Consumption Data (Span)	35-36	9
9.	Station Number	38-41	5738
10.	Number of Times to Drop a Year starting with Initial Year (Optional)	43-44	-9

Use this sheet with sheet CD
All values to be right-Justified

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CPUC Hydraulic Branch CLIMATE Program - CLIMATE Data

If ANNUAL: One line Per Year

If QUARTERLY: Four lines Per Year

IDENTIFICATION	YR	WATER CONSUMPTION	Station NUMBER
MINI SAMPLE	66	4042	5738
	67	4261	
	68	4140	
	69	3921	
	70	4157	
	71	4129	
	72	4332	
	73	4205	
	74	4201	

EXHIBIT A.3
Sheet 1 of 3

BILLING CYCLES AND RAINFALL ADJUSTMENTS

Standard Practice U-25, page 5-3, paragraph 10 describes how monthly rainfall and temperature readings are to be adjusted to better correlate them with annual water sales data. The adjustments which are a function of meter reading cycle (also called billing cycle) may be written as follows for continuous meter reading:

Monthly Meter Reading

$$R_{adj.}_{x} = \frac{R_{D_{x-1}}}{2} + \Sigma\left(R_{J_x} \longrightarrow R_{D_x}\right) - \frac{R_{D_x}}{2}$$

$$T_{adj.}_{x} = \frac{1}{12}\left[\frac{T_{D_{x-1}}}{2} + \Sigma\left(T_{J_x} \longrightarrow T_{D_x}\right) - \frac{T_{D_x}}{2}\right]$$

Bimonthly Meter Reading

$$R_{adj.}_{x} = \frac{R_{N_{x-1}}}{4} + \frac{3}{4} R_{D_{x-1}} + \Sigma\left(R_{J_x} \longrightarrow R_{D_x}\right) - \frac{R_{N_x}}{4} - \frac{3R_{D_x}}{4}$$

$$T_{adj.}_{x} = \frac{1}{12}\left[\frac{T_{N_{x-1}}}{4} + \frac{3}{4} T_{D_{x-1}} + \Sigma\left(T_{J_x} \longrightarrow T_{D_x}\right) - \frac{T_{N_x}}{4} - \frac{3}{4} T_{D_x}\right]$$

BILLING CYCLES AND RAINFALL ADJUSTMENTS

Where $R_{adj._x}$ $T_{adj._x}$ = Annual Adjusted Values required for Year X. Printed out by computer as Adjusted Values.

$R_{D_{x-1}}$ $T_{D_{x-1}}$ = Typical monthly values such as December for year preceding Year X. Obtained from Weather. Bureau tape as raw data. The monthly R values then are adjusted by computer so as never to exceed the Engineer specified monthly maximum and are used by the computer to calculate the annual Adjusted Values.

As the Engineer may be required to anlyze sales on a quarterly rather than annual basis, WEATHER includes the capability of adjusting the Weather Bureau raw data on that basis (CLIMATE at this time is not able to handle quarterly data and thus MUREG must be used in conjunction with that type of analysis). The adjustments may be written as follows where $R_{adj._{1Q}}$ and $T_{adj._{1Q}}$ refer typically to first quarter data. R input is again limited to the Engineer specified maximum monthly value.

Monthly Meter Reading

$$R_{adj._{1Q}} = \frac{R_{D_{x-1}} + R_{J_x}}{2} + \frac{R_{J_x} + R_{F_x}}{2} + \frac{R_{F_x} + R_{M_x}}{2}$$

$$= \frac{R_{D_{x-1}}}{2} + R_{J_x} + R_{F_x} + \frac{R_{M_x}}{2},$$

$$T_{adj._{1Q}} = \frac{1}{3}\left[\frac{T_{D_{x-1}}}{2} + T_{J_x} + T_{F_x} + \frac{T_{M_x}}{2}\right]$$

BILLING CYCLES AND RAINFALL ADJUSTMENTS

Bimonthly Meter Reading

$$R_{adj.\,1Q} = \frac{1}{2}\left(\frac{R_{N_{x-1}}}{2} + R_{D_{x-1}} + \frac{R_{J_x}}{2}\right) + \frac{1}{2}\left(\frac{R_{D_{x-1}}}{2} + R_{J_x} + \frac{R_{F_x}}{2}\right) + \frac{1}{2}\left(\frac{R_{J_x}}{2} + R_{F_x} + \frac{R_{M_x}}{2}\right)$$

$$= \frac{R_{N_{x-1}}}{4} + \frac{3}{4} R_{D_{x-1}} + \frac{3}{4} R_{J_x} + \frac{3}{4} R_{F_x} + \frac{R_{M_x}}{4}$$

$$T_{adj.\,1Q} = \frac{1}{3}\left[\frac{T_{N_{x-1}}}{4} + \frac{3}{4} T_{D_{x-1}} + \frac{3}{4} T_{J_x} + \frac{3}{4} T_{F_x} + \frac{T_{M_x}}{4}\right]$$

While the basis of these equations is continuous meter reading, their application to non-continuous meter reading is believed satisfactory although it should theoretically result in a decrease of the standard error ratio.

CLIMATE PRINTOUT

EXHIBIT A.4-1

TAPE INPUT -- RAW DATA

					STATE	DIV	STATION	YEAR	MO	TEMP	PRECIP
0406	897394304	059C	00103	04	4	6	8973	943	4	59.C	1.03
0406	897394305	062B	99999	04	4	6	8973	943	5	62.B	999.99
0406	897394306	062C	00000	04	4	6	8973	943	6	62.C	.00
0406	897394307	066F	00000	04	4	6	8973	943	7	66.F	.00
0406	897394308	067D	00000	04	4	6	8973	943	8	67.D	.00
0406	897394309	065F	00000	04	4	6	8973	943	9	65.F	.00
0406	897394310	063<	00031	04	4	6	8973	943	10	63.<	.31
0406	897394311	059D	00009	04	4	6	8973	943	11	59.D	.09
0406	897394312	055C	00559	04	4	6	8973	943	12	55.C	5.59
0406	897394401	053G	00065	04	4	6	8973	944	1	53.G	.65
0406	897394402	052F	00725	04	4	6	8973	944	2	52.F	7.25
0406	897394403	057A	00223	04	4	6	8973	944	3	57.A	2.23
0406	897394404	056D	00038	04	4	6	8973	944	4	56.D	.38
0406	897394405	060H	00001	04	4	6	8973	944	5	60.H	.01
0406	897394406	062G	00000	04	4	6	8973	944	6	62.G	.00
0406	897394407	064H	00000	04	4	6	8973	944	7	64.H	.00
0406	897394408	066I	00000	04	4	6	8973	944	8	66.I	.00
0406	897394409	066H	00000	04	4	6	8973	944	9	66.H	.00
0406	897394410	062F	00002	04	4	6	8973	944	10	62.F	.02
0406	897394411	056D	00494	04	4	6	8973	944	11	56.D	4.94
0406	897394412	055F	00059	04	4	6	8973	944	12	55.F	.59
0406	897394501	052I	00005	04	4	6	8973	945	1	52.I	.05
0406	897394502	053I	00380	04	4	6	8973	945	2	53.I	3.80
0406	897394503	053C	00383	04	4	6	8973	945	3	53.C	3.83
0406	897394504	057E	00000	04	4	6	8973	945	4	57.E	.00
0406	897394505	060B	00001	04	4	6	8973	945	5	60.B	.01
0406	897394506	064D	00002	04	4	6	8973	945	6	64.D	.02
0406	897394507	068D	00000	04	4	6	8973	945	7	68.D	.00
0406	897394508	071C	00000	04	4	6	8973	945	8	71.C	.00
0406	897394509	0708	99999	04	4	6	8973	945	9	70.B	999.99
0406	897394510	065E	00042	04	4	6	8973	945	10	65.E	.42
0406	897394511	057I	00048	04	4	6	8973	945	11	57.I	.48
0406	897394512	056A	00372	04	4	6	8973	945	12	56.A	3.72
0406	897394601	055B	00025	04	4	6	8973	946	1	55.B	.25
0406	897394602	052B	00084	04	4	6	8973	946	2	52.B	.84
0406	897394603	056E	00309	04	4	6	8973	946	3	56.E	3.09
0406	897394604	059D	00054	04	4	6	8973	946	4	59.D	.54
0406	897394605	060H	00000	04	4	6	8973	946	5	60.H	.00
0406	897394606	065F	00000	04	4	6	8973	946	6	65.F	.00
0406	897394607	068A	00000	04	4	6	8973	946	7	68.A	.00
0406	897394608	068H	00000	04	4	6	8973	946	8	68.H	.00
0406	897394609	777	777	04	4	6	8973	946	9	777.	777.00
0406	897394610	777	777	04	4	6	8973	946	10	777.	777.00
0406	897394611	777	777	04	4	6	8973	946	11	777.	777.00
0406	897394612	777	777	04	4	6	8973	946	12	777.	777.00
0406	897394701	051H	00014	04	4	6	8973	947	1	51.H	.14
0406	897394702	058A	00058	04	4	6	8973	947	2	58.A	.58
0406	897394703	059<	00064	04	4	6	8973	947	3	59.<	.64
0406	897394704	060H	00023	04	4	6	8973	947	4	60.H	.23
0406	897394705	063C	00006	04	4	6	8973	947	5	63.C	.06
0406	897394706	066E	00001	04	4	6	8973	947	6	66.E	.01

WEATHER BUREAU SYMBOLOGY

Symbol	Value
<	0
A	1
B	2
C	3
D	4
E	5
F	6
G	7
H	8
I	9

MISSING TEMPERATURE & PRECIPITATION
2 OR MORE MISSING MONTHS
∴ DELETE YEAR 1946

MSSNG TEMPMSSNG PREC
MSSNG TEMPMSSNG PREC
MSSNG TEMPMSSNG PREC
MSSNG TEMPMSSNG PREC

FLAG

				STATE	DIV	STATION	YEAR	MO	TEMP	PRECIP
0406	897395601 052D	00939	04	4	6	8973	956	1	52.D	9.39
0406	897395602M049B	00053	04	4	6	8973	956	2	49.B	.53
0406	897395603 055A	00000	04	4	6	8973	956	3	55.A	.00
0406	897395604M055E	00178	04	4	6	8973	956	4	55.E	1.78
0406	897395605M060I	00003	04	4	6	8973	956	5	60.I	.03
0406	897395606 064B	00000	04	4	6	8973	956	6	64.B	.00
0406	897395607 066<	00000	04	4	6	8973	956	7	66.<	.00
0406	897395608M067E	00000	04	4	6	8973	956	8	67.E	.00
0406	897395609M068E	00000	04	4	6	8973	956	9	68.E	.00
0406	897395610 063A	99999	04	4	6	8973	956	10	63.A	999.99
0406	897395611 062E	00000	04	4	6	8973	956	11	62.E	.00
0406	897395612 056G	00000	04	4	6	8973	956	12	56.G	.00
0406	897395701 052<	00420	04	4	6	8973	957	1	52.<	4.20
0406	897395702 057B	00137	04	4	6	8973	957	2	57.B	1.37
0406	897395703 056E	00126	04	4	6	8973	957	3	56.E	1.26
0406	897395704M057B	00063	04	4	6	8973	957	4	57.B	.63
0406	897395705M777	00046	04	4	6	8973	957	5	777.	.46
0406	897395706M777	99999	04	4	6	8973	957	6	777.	999.99
0406	897395707 071B	99999	04	4	6	8973	957	7	71.B	999.99
0406	897395708 071F	00000	04	4	6	8973	957	8	71.F	.00
0406	897395709 068<	00000	04	4	6	8973	957	9	68.<	.00
0406	897395710 065A	00100	04	4	6	8973	957	10	65.A	1.00
0406	897395711M058H	00069	04	4	6	8973	957	11	58.H	.69
0406	897395712 059<	00268	04	4	6	8973	957	12	59.<	2.68
0406	897395801 057A	00197	04	4	6	8973	958	1	57.A	1.97
0406	897395802 059C	00678	04	4	6	8973	958	2	59.C	6.78
0406	897395803 056G	00473	04	4	6	8973	958	3	56.G	4.73
0406	897395804 062I	00288	04	4	6	8973	958	4	62.I	2.88
0406	897395805M064D	00003	04	4	6	8973	958	5	64.D	.03
0406	897395806 066I	00000	04	4	6	8973	958	6	66.I	.00
0406	897395807 068I	00000	04	4	6	8973	958	7	68.I	.00
0406	897395808 072B	00000	04	4	6	8973	958	8	72.B	.00
0406	897395809 071H	00004	04	4	6	8973	958	9	71.H	.04
0406	897395810 070E	99999	04	4	6	8973	958	10	70.E	999.99
0406	897395811 061C	99999	04	4	6	8973	958	11	61.C	999.99
0406	897395812 059A	00000	04	4	6	8973	958	12	59.A	.00
0406	897395901 056H	00169	04	4	6	8973	959	1	56.H	1.69
0406	897395902 053D	00469	04	4	6	8973	959	2	53.D	4.69
0406	897395903 060F	99999	04	4	6	8973	959	3	60.F	999.99
0406	897395904 062A	00020	04	4	6	8973	959	4	62.A	.20
0406	897395905 062I	00000	04	4	6	8973	959	5	62.I	.00
0406	897395906 067<	00000	04	4	6	8973	959	6	67.<	.00
0406	897395907 072G	99999	04	4	6	8973	959	7	72.G	999.99
0406	897395908 071<	00000	04	4	6	8973	959	8	71.<	.00
0406	897395909 070<	99999	04	4	6	8973	959	9	70.<	999.99
0406	897395910 066G	99999	04	4	6	8973	959	10	66.G	999.99
0406	897395911 063F	99999	04	4	6	8973	959	11	63.F	999.99
0406	897395912 057G	00182	04	4	6	8973	959	12	57.G	1.82
0406	897396001 051G	00420	04	4	6	8973	960	1	51.G	4.20
0406	897396002 054D	00258	04	4	6	8973	960	2	54.D	2.58
0406	897396003 057B	00045	04	4	6	8973	960	3	57.B	.45

MSSNG TEMP
MSSNG TEMP

DELETE YEAR 1957

PRISM PRODUCT -- RAW DATA

					STATE	DIV	STATION	YEAR	MO	TEMP	PRECIP
0406	897396810	064G	00038	04	4	6	8973	968	10	64.G	.38
0406	897396811	060M	00041	04	4	6	8973	968	11	60.M	.41
0406	897396812	0538	00199	04	4	6	8973	968	12	53.B	1.99
0406	897396901	M056F	01326	04	4	6	8973	969	1	56.F	13.26
0406	897396902	053G	00585	04	4	6	8973	969	2	53.G	5.85
0406	897396903	056A	00028	04	4	6	8973	969	3	56.A	.28
0406	897396904	060F	00055	04	4	6	8973	969	4	60.F	.55
0406	897396905	063D	00002	04	4	6	8973	969	5	63.D	.02
0406	897396906	M065<	00000	04	4	6	8973	969	6	65.<	.00
0406	897396907	069D	00002	04	4	6	8973	969	7	69.D	.02
0406	897396908	071H	00000	04	4	6	8973	969	8	71.H	.00
0406	897396909	067<	99999	04	4	6	8973	969	9	67.<	999.99
0406	897396910	065A	00000	04	4	6	8973	969	10	65.A	.00
0406	897396911	063B	00119	04	4	6	8973	969	11	63.B	1.19
0406	897396912	057B	00012	04	4	6	8973	969	12	57.B	.12
0406	897397001	055I	00223	04	4	6	8973	970	1	55.I	2.23
0406	897397002	059<	00239	04	4	6	8973	970	2	59.<	2.39
0406	897397003	058D	00161	04	4	6	8973	970	3	58.D	1.61
0406	897397004	059B	00000	04	4	6	8973	970	4	59.B	.00
0406	897397005	063F	00000	04	4	6	8973	970	5	63.F	.00
0406	897397006	065I	00000	04	4	6	8973	970	6	65.I	.00
0406	897397007	M069G	00000	04	4	6	8973	970	7	69.G	.00
0406	897397008	777	E99999	04	4	6	8973	970	8	777.	999.99
0406	897397009	068H	00000	04	4	6	8973	970	9	68.H	.00
0406	897397010	065B	00002	04	4	6	8973	970	10	65.B	.02
0406	897397011	059H	00580	04	4	6	8973	970	11	59.H	5.80
0406	897397012	054E	00430	04	4	6	8973	970	12	54.E	4.30
0406	897397101	054G	00044	04	4	6	8973	971	1	54.G	.44
0406	897397102	055E	00076	04	4	6	8973	971	2	55.E	.76
0406	897397103	056E	00022	04	4	6	8973	971	3	56.E	.22
0406	897397104	058E	00070	04	4	6	8973	971	4	58.E	.70
0406	897397105	060F	00035	04	4	6	8973	971	5	60.F	.35
0406	897397106	065D	00000	04	4	6	8973	971	6	65.D	.00
0406	897397107	070D	00000	04	4	6	8973	971	7	70.D	.00
0406	897397108	074E	00000	04	4	6	8973	971	8	74.E	.00
0406	897397109	071<	00000	04	4	6	8973	971	9	71.<	.00
0406	897397110	M064C	00017	04	4	6	8973	971	10	64.C	.17
0406	897397111	0580	00029	04	4	6	8973	971	11	58.0	.29
0406	897397112	051F	00724	04	4	6	8973	971	12	51.F	7.24
0406	897397201	053A	00000	04	4	6	8973	972	1	53.A	.00
0406	897397202	M056D	00021	04	4	6	8973	972	2	56.D	.21
0406	897397203	059F	00000	04	4	6	8973	972	3	59.F	.00
0406	897397204	060F	00000	04	4	6	8973	972	4	60.F	.00
0406	897397205	0638	99999	04	4	6	8973	972	5	63.B	999.99
0406	897397206	M067<	00016	04	4	6	8973	972	6	67.<	.16
0406	897397207	070E	00000	04	4	6	8973	972	7	70.E	.00
0406	897397208	073A	00003	04	4	6	8973	972	8	73.A	.03
0406	897397209	M069A	00007	04	4	6	8973	972	9	69.A	.07
0406	897397210	065G	00010	04	4	6	8973	972	10	65.G	.10
0406	897397211	059E	00419	04	4	6	8973	972	11	59.E	4.19
0406	897397212	055E	00151	04	4	6	8973	972	12	55.E	1.51

1946 DELETED = MISSING RAIN DATA 2 OR MORE CONSECUTIVE MONTHS
1946 DELETED = MISSING TEMP DATA 2 OR MORE CONSECUTIVE MONTHS
1947 DELETED = MISSING RAIN DATA 2 OR MORE CONSECUTIVE MONTHS
1947 DELETED = MISSING TEMP DATA 2 OR MORE CONSECUTIVE MONTHS
1955 DELETED = MISSING TEMP DATA 2 OR MORE CONSECUTIVE MONTHS
1957 DELETED = MISSING TEMP DATA 2 OR MORE CONSECUTIVE MONTHS

MSSNG TEMP ← 1970 YEAR NOT DELETED

← SUMMARY OF DELETIONS
4 YEARS DELETED
NO. OF YEARS USED FOR
MEAN = 30 - 4 = 26 YEARS

ADJUSTED VALUES

YEAR	RAIN	TEMP	WATER
60.	11.54	61.8	198.60
61.	4.41	61.7	210.60
62.	9.03	60.4	195.00
63.	13.14	61.8	195.90
64.	4.61	61.4	209.00
65.	13.76	61.8	198.50
66.	8.69	62.5	203.10
67.	16.30	62.6	200.30
68.	6.93	62.7	209.30
69.	11.11	62.3	200.60
70.	12.31	62.5	216.40
71.	6.93	61.9	218.10
72.	7.32	62.6	220.50

YEAR 1970 NOT DELETED

NUMBER OF OBSERVATIONS = 13

SUM R ADJ = 9.721

SUM T ADJ = 61.612

NO.YRS. WB DATA USED = 26

NO. OF YEARS USED TO OBTAIN SUM R ADJ.
SUM T ADJ.

CHAPTER 3

MUREG PROGRAM

The CLIMATE Program discussed in Chapter 2 is based upon always using time, rainfall, and temperature as independent variables and utilizes forms CI and CD (Exhibit A) which refer to CLIMATE information and data, respectively.

If one wishes to perform a multiple regression analysis only and eliminate or add variables, Forms MI and MD should be used, as discussed below and illustrated in Exhibit B.[1/]

A. Standard Run identical to MUREG portion of CLIMATE

For three independent variables and one dependent variable, enter data as shown in Exhibits B.1 and B.2. The order of variables t, R, T and Q always must remain in the same location as shown in B.2.

Note that if the Engineer wishes to substitute different annual adjusted rainfall and temperature values than those produced by the CLIMATE then this procedure may be used in place of the use of cards as discussed in Chapter 2. Substitution of alternative or missing weather data in the formulas of Exhibit A.3 will provide the required adjusted values for use in MUREG.

B. Run with One or More Independent Variables Eliminated

For example, to eliminate variable T, remove the term (4F10) as shown in Exhibit B.3 Card 2, Columns 01-06 and replace it with (F10, F10, 10X, F10) which uses 17 columns. Therefore, change the column limits as shown. The right-most F10 refers to the dependent variable Q, and thus never should be changed in location. Also change in two places, the total number of variables considered per columns 04-05 of Card 1 and the Regression Control Card. Do not change sheet MD (Exhibit B.2) for which cards may have already been punched.

1/ Printouts are not provided as they are similar to the MUREG portion of CLIMATE re Exhibit L.1, pages 5-9 through 5-12.

C. Run with more than three independent variables

To explore the use of more variables, see Exhibits B.4 and B.5 wi a five variable example. Note the dependent variable must always be listed in righthand end of array, as shown in Form MD, Exhibit B.5. Insert on Variable Control Card, Columns 24-25 the value "5". Modify Card 2, beginnning in Column as shown; and indicate proper number of variables on Card 1 and the Regression Control Card.

D. Omitting a Year's Data

Note also if unreliable or incomplete data exists for a year(s), the associated input may be omitted from the MD sheet. For example, in the case of Exhibits B.4 and B.5, 1971 data was omitted from the MD sheet and the number of observations on the MI sheet reduced to 9. This same procedure is automatica used in the CLIMATE program and can be observed by comparing the Input Data with the Adjusted Data Printouts.

E. Change of Meter Reading Procedure during Time Span

If for example, the procedure changes during a 13-year span from say that associated with monthly to bimonthly billing, then CLIMATE should be us to obtain the required annual R adj and T adj values as a function of billing f each sub-span. The R avg and T avg may be based upon either assumed billing procedure as they are relatively insensitive to that factor. The R adj and T a values may then be used with the MUREG program to obtain a correlation after which the R avg and T avg values are used to estimate consumption.

F. Statistical Indicators in the Printouts

The following are brief definitions of some of the terms that are printed out by the computer particularly in the MUREG section: Y refers to unit consumption Q_t.

1. Standard Error of Y - Is the standard deviation of the dependent variable (unit water consumption). It is a measure of the spread between the calculated and recorded values. The smallest spread is desirable.

2. Multiple Correlation - Is a measure of the direct relationship of Y with other variables. The ideal number is plus or minus one. Due to a small amount of data, high correlation coefficients do not necessarily mean perfect results. It is also a measure of slope of the regression line and therefore can be misleading when using this standard practice.

3. R-squared - Multiple correlation squared.

4. F-Level - Measures the effect of introducing new independent variables into the analysis. In some cases, statisticians limit introduction of data by setting F-Level at a specific amount. Our standard practice does not consider the question of adding other independent variables.

5. Residual Degrees of Freedom - The number equals the sets of data available minus the number of coefficients minus one. The better the degree of freedom, the better the answer, statistically. Obviously, with the degrees of freedom of one (5-year data) very little choice is available.

6. Student T - Measures the confidence we may have of coefficients determined for the regression equation. The higher the better. ± 1 or more is preferred.

7. Durbin-Watson Statistic - Is a measure of the randomness of the residuals (i.e., Q(c) - Q(r)). The most reliable correlation have the most randomness.

EXHIBIT B.1

Control Cards for CPUC Hydraulic Branch MUREG Program
MUREG Instructions

Card One: Primary MUREG Control Card (Right Justified)

Description of Field	Columns	
Number of Variables (including dependent variable)	04-05	4
Number of Observations	08-10	9
Columns 15, 20, and 25 ....Punch....		"1"
Columns 30, 35, 40, and 45 ....Punch....		"0"
	55	"1"
Job Identification	56-71	CAL WATER AS4116

Card Two: Input Formal Specification Card	01-06	"(4F10)"

Data Cards: One for Each Observation - Use Special Coding Sheet MD

Card Following Observation Cards: Regression Control Card

Number of Variables (same as on Card 1)	04-05	4
	10	"1"
	25	"0"
	25	"1"

Variable Control Card:

Note: Dependent Variable must always be last

04-05	"1"
09-10	"2"
14-15	"3"
19-20	"4"
____	____
____	____
____	____
____	____

and so on for as many variable as are used (max.: eight per card)

End of Job Card:	Columns 01-10	"End of Job"
End of Regressions Card:	Columns 01-18	"End of Regressions"

CPUC Hydraulic Branch - MUREG Program - MUREG Data

t Indep. Var. 1	R Indep. Var. 2	T Indep. Var. 3	Q Dep. Var. 4	___ Dep. Var. 5	___ Dep. Var. 6

1. Use Decimals
2. Left Justified
3. Dep. Variable Rightmost

66.	7.46	60.8	404.12		
67.	13.106	60.8	426.1		
68.	12.715	61.3	414.0		
69.	14.165	61.3	392.9		
70.	13.115	62.2	415.7		
71.	8.121	60.3	412.9		
72.	8.717	61.1	433.2		
73.	16.917	61.5	420.5		
74.	12.09	62.0	420.1		

3-6

EXHIBIT 82

9/76

MB

EXHIBIT B.3

Control Cards for CPUC Hydraulic Branch MUREG Program
MUREG Instructions

Card One: Primary MUREG Control Card (Right Justified)

Description of Field	Columns	
Number of Variables (including dependent variable)	04-05	3
Number of Observations	08-10	9
Columns 15, 20, and 25 ....Punch....		"1"
Columns 30, 35, 40, and 45 ....Punch....		"0"
	55	"1"
Job Identification	56-71	CAL WATER A54116

Card Two: Input Formal Specification Card 01-~~06~~ 17 (F10, F10, 10X, F10) "~~(4F10)~~"

Data Cards: One for Each Observation - Use Special Coding Sheet MD

Card Following Observation Cards: Regression Control Card

Number of Variables (same as on Card 1)	04-05	3
	10	"1"
	25	"0"
	25	"1"

Variable Control Card:

Note: Dependent Variable must always be last

04-05	"1"
09-10	"2"
14-15	"3"
19-20	"4"
____	____
____	____
____	____
____	____

and so on for as many variable as are used (max.: eight per card)

End of Job Card:	Columns 01-10	"End of Job"
End of Regressions Card:	Columns 01-18	"End of Regressions"

EXHIBIT B.4

Control Cards for CPUC Hydraulic Branch MUREG Program
MUREG Instructions

Card One: Primary MUREG Control Card (Right Justified)

Description of Field	Columns	
Number of Variables (including dependent variable)	04-05	5
Number of Observations	08-10	9
Columns 15, 20, and 25 ....Punch....		"1"
Columns 30, 35, 40, and 45 ....Punch....		"0"
	55	"1"
Job Identification	56-71	CAL WATER A54116

Card Two: Input Formal Specification Card 01-06 "(5F10)" ~~"(4F10)"~~

Data Cards: One for Each Observation - Use Special Coding Sheet MD

Card Following Observation Cards: Regression Control Card

Number of Variables (same as on Card 1)	04-05	5
	10	"1"
	25	"0"
	25	"1"

Variable Control Card:

Note: Dependent Variable must always be last

04-05	"1"
09-10	"2"
14-15	"3"
19-20	"4"
24-25	"5"
____	____
____	____
____	____

and so on for as many variable as are used (max.: eight per card)

End of Job Card: Columns 01-10 "End of Job"

End of Regressions Card: Columns 01-18 "End of Regressions"

CPUC Hydraulic Branch - MURFG Program - MUREG Data

t	R	T	Ø (DUMMY)	Q	____	1. Use Decimals
Indep. Var. 1	Indep. Var. 2	Indep. Var. 3	IN Dep. Var. 4	Dep. Var. 5	Dep. Var. 6	2. Left Justified
						3. Dep. Variable Rightmost

6.5	12.20	6.1.7		174.73	
6.6	9.317	6.2.7		179.182	
6.7	14.07	6.3.5		176.36	
6.8	8.212	6.3.1		184.97	
6.9	10.87	6.2.4		181.35	
7.0	8.26	6.3.2		197.02	
7.2	7.98	6.3.0		195.16	
7.3	13.43	6.2.1		182.40	
7.4	9.08	6.2.7	1.0	182.48	

EXHIBIT B5

MD

CHAPTER 4

ESTREVS PROGRAM

As noted in Chapter 1, the ESTREVS Program estimates and calculates revenue as a function of tariff type, billing procedure, rates, and existing and projected consumption and customers; all in general accordance with Standard Practice U-25. As described in Chapter 5, ESTREVS is automatically connected to CLIMATE when the Engineer submits an ESTREVS data input form (Exhibit C) along with forms CI and CD (Exhibit A). Much of what is discussed here is of background nature as the Engineer normally need know only how to fill in the ESTREVS form.

Basically, the program uses Engineer furnished billing growth data estimates along with Engineer or computer determined values of Q(R), Q(N), Q(A) and Q(B) to develop the following ratios which are used to project an applicant's Water Use Analysis Table from its recorded values to that which would approximately exist in the normalized and test years.[1/]

$$Q(RN) = \frac{\Sigma Q(N)}{\Sigma Q(R)} = \frac{Q(N)B(N)}{Q(R)B(R)} = \frac{Q(N)}{Q(R)}$$

$$B(R) = B(N) \quad \text{Thus } B(RN) = 1.0$$

$$B(RA) = \frac{B(A)}{B(R)}$$

$$Q(RA) = \frac{\Sigma Q(A)}{\Sigma Q(R)} = \frac{Q(A)B(A)}{Q(R)B(R)}$$

$$B(RB) = \frac{B(B)}{B(R)}$$

$$Q(RB) = \frac{\Sigma Q(B)}{\Sigma Q(R)} = \frac{Q(B)B(B)}{Q(R)B(R)}$$

In conjunction with the above equations, the following relationships are used to project growth of billings corresponding to those meters that are larger than the smallest size:

$$BXS(RA) = \frac{BXS(A)}{BXS(R)}$$

$$BXS(RB) = \frac{BXS(B)}{BXS(R)}$$

1/ The ratios shown here apply to the service charge type of tariff. A slightly more complex version of these ratios is used for minimum charge tariff per Exhibits H and I.

A. Required Input Data for ESTREVS

Three types of input data are required:

--a Water Use Analysis Table preferably based upon the latest recorded year data,

--Growth data to be used by the computer to establish ratios required to project customer and consumption changes,

--Pricing data for minimum or service charges and unit consumption as a function of time, rate block location, and billing period.

The Water Use Analysis discussed in Part 1 that follows is required to establish a reference listing of bills as a function of meter size and consumption rate block. This basic customer reference is then expanded as a function of growth of customers and consumption by the use of growth ratios as discussed in Part 2, starting on page 4-7.[2/]

In Part 3 (page 4-12) the basic pricing data is collected to record present and proposed tariff rates. All this information is then inserted in the computer's memory per use of the ESTREVS Form (492.12B).

The preparation of data input is not difficult after the Engineer has tried it one or two times. The only place problems may arise is in the choice of data for Cards 3 (Bills per Rate Block), 5 (Bills by meter size), and 10 (Consumption per Rate Block). Cards are used for feeding the computer and are made from data on the ESTREVS Form. Spaces 79 and 80 are used to identify the cards. That selection process requires study of the Water Use Analysis Table as it is a function of tariff type.

To simplify understanding, Water Use Analysis Tables based upon monthly billing cycles are discussed first, after which bimonthly billing

2/ Note that overall consumption is based upon the last recorded consumption value of MUREG. As discussed in Chapter 2, unit consumption equals the Water Use Analysis calculated value and is determined by dividing the total sales consumption by the total number of bills, irrespective of whether they were partial or complete bills. See Exhibits D.1 and F.1.

cycles are reviewed. Part 4 (starting on page 4-13) provides details as to how to generally prepare data, while Part 5 (starting on page 4-17) describes how basic data is to be modified when bimonthly billing exists.

1. Water Use Analysis Tables

When using the program, the Water Use Analysis Table[3] must be in the format similar to that furnished by Cal-American.[4] That company and the smaller Santa Clarita Water Company now have this type of table directly printed out via computer. In addition, Santa Clarita has a monthly printout, as well as an annual printout, which may be useful for more sophisticated analysis.

Exhibit D.1 (and related Exhibit D.4) were developed by Cal-American to estimate minimum tariff revenue. We have modified them to obtain Exhibits E.1 and E.4, which are in the format to be used in a Service Charge Tariff estimate.

With respect to the Minimum Charge Water Use Analysis Table, it should be noted that the average consumption in each of the blocks, i.e., column entitled, "Average Consumption in Block," is a calculated one based upon

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3/ The Water Use Analysis (WUA) Tables shown list the total number of bills issued per year. Note that the horizontal lines such as shown on Exhibits D.1 and E.1 split the table in accordance with a tariff defined on a monthly basis. If billing is on a bimonthly basis, some input to the ESTREVS Form is modified as discussed in Part 5 of this chapter and as illustrated in Exhibits F.1 and G.1.

4/ The Cal-American table is the basic one from which a typical single meter table such as shown in Standard Practice U-25, page 6-2, is derived and therefore a method for combining the single meter tables is not described in this report. The case of small utilities failing to report meter sizes greater than the smallest is discussed on page 4-20.

rounded values,[5/] thus the three columns on the extreme right of Exhibit D.1 are not exactly correct. The small error resulting from that assumption is eventually corrected through the use of the overall revenue adjustment factor ratio (called RRCR), which relates recorded revenue to computed revenue for the recorded year R.

a. Minimum Charge Tariff

Let us consider first a tariff format as shown on Exhibit D.1 with associated manual calculations on Exhibit D.4. This exhibit illustrates the estimated CCF sold as a function of rate blocks. It also shows the bills associated with those sales. The solid stepped line on the left side of Exhibit D.1 separates the bills for which consumption was less than the respective minimum (which is a function of meter size) from those which exceeded that minimum. Consumption was less than the minimum for bills listed above the stepped line, while it exceeded the minimum if it occurred below the line (except for smallest size meter in smallest block). Note illustration in upper right of Exhibit D.1.

For example, it is estimated that in the 6-30 CCF rate block 125,285 bills were associated with collecting revenues due on 1,908,995 CCF. Each of these bills

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5/ For example, the "average consumption in block" of 2 CCF is based upon meter readings which could have actually varied from 1.50 to 2.49 CCF but which have all been rounded off to 2 CCF by the meter reader. (See Standard Practice U-25, page 2-3.) For consumption in larger ranges such as 31-35 CCF, an average value should be calculated from the actual bills as is indicated in the exhibit where average consumption in Block is listed as 32.7 CCF rather than 33.0 CCF.

was based upon usage of water beyond the respective meter size minimum consumption. Also in the example shown here, the minimum consumption for the 5/8-inch meter is 5 CCF while for the 1-inch meter, it is 10.6 CCF. This pricing is based upon charging customers with the 1-inch meter $2.55 plus the consumption cost for (10.6 - 5.0) CCF at $0.40 per CCF or $4.80 per month. Other meter minimum charges are based upon the same principle as shown in Exhibit D.1

Exhibit D.4 also shows how the above Exhibit D.1 type information is used to spread consumption to take into account proper rate block billing charges[6/] (Exhibits F.1 and F.4 provide similar information for bimonthly billing cycles).

b. Service Charge Tariff

Exhibit E.1 is almost identical to Exhibit D.1 except that only the data required for a Service Charge is shown. Exhibit E.4 is similar to Exhibit D.4 and fulfills the same purpose. (Exhibits G.1 and G.4 illustrate the bimonthly cycle application.)

c. Data Input Form ESTREVS (492.12B) Details

Exhibits D.2 and E.2 illustrate filled-in forms with data provided from Exhibits D.1 and E.1, respectively, plus information as developed by methods described later in this practice. Units for each quantity are shown at the top of

6/ See Standard Practice U-25 for details. Note that the computer takes all this data and carries out the procedures shown for each year.

the form. Exhibits D.3 and E.3 provide typical ESTREVS printouts for both tariff types. Data from the form is used to make up 11 cards labeled 1, 1A and 2 through 10. Card numbers are used for identification of the data form location throughout the following discussion.

The sources of data from the Water Use Analysis Table for use in ESTREVS are shown typically in Exhibits D.1 and E.1 for monthly billing cycles. Examples with bimonthly billing follow.

1. Minimum Charge Tariff

   Exhibit D.1 illustrates a water table with the source of much of the card data identified.

   Card 3 (bills by rate blocks) values are to be obtained from above the heavy stepped line for the smallest size meter and below the line for all other meters. Apart from the bills in the first block, the number of bills in each rate block is the total bills that used more than the minimum amount for each meter size. For example, in Exhibit D.1 for the 6 - 30 CCF rate block, the number of bills for that block will be the total number of bills in the shaded area.

   For the first block, however, the number of bills will be total number of bills for the smallest meter size in the first block.

Card 10 data is obtained from the right hand side of Exhibit D.1 and represents the consumption per rate block[7] associated with Card 3. Note that color/shade coding is used in the fields to further aid in choice of the number required to be filled in. Compare also Exhibit D.2 to Exhibit D.3.

Card 5 data consists of the number of bills that used less than the minimum for each meter size excluding the smallest meter size. It is obtained from the bottom of Exhibit D.1.

2. Service Charge Tariff

For a Service Charge Tariff the figure to be used are those from Exhibit E.1 as tabulated in Exhibit E.4. There is no stepped line required in analyzing such a tariff because no fixed amounts of consumption are available for specific meter sizes for a minimum charge. Compare Exhibit E.3 to Exhibit E.4.

Data for Card 3, therefore, comes directly from the right hand side of Exhibit E.1. Card 5 data comes from the bottom of the Exhibit, with Card 10 data from the extreme right-hand edge.

2. Growth Data

The following input data is to be provided by the Engineer and entered in Cards 1 and 1A. It is used by the computer to calculate the appropriate ratios listed in the right-hand column as follows:

7/ With the exception of the first block, the consumption is that associated with bills greater than the respective minimums.

Input Data	Symbol	Computed Ratio
Recorded water consumption CCF/meter-year:	Q(R)	
Normalized water consumption CCF/meter year	Q(N)	Q(RN)
Test Year A forecast consumption CCF/meter year	Q(A)	Q(RA)
Test Year B forecast consumption CCF/meter year	Q(B)	Q(RB)
Recorded bills (total) per Year: 8/	B(R)	
Test Year A forecast bills for the year	B(A)	B(RA)
Test Year B forecast bills for the year	B(B)	B(RB)
Recorded bills (except smallest meter) per year: 8/	BXS(R)	
Test Year A forecast bills for the year	BXS(A)	BXS(RA)
Test Year B forecast bills for the year	BSX(B)	BSX(RB)
Revenue adjustment factor determined by dividing recorded revenue (RR) by computed revenue (CR) as determined by Water Use Table for Year R 9/		RRCR

Note that when the combined CLIMATE - ESTREVS Program (ONESHOT) is used, the above Q-labeled data on consumption is not to be inserted by the Engineer as it will be calculated by the computer and automatically delivered to the ESTREVS subroutine.

a. Ratio Q(RN) used to convert the water consumption in rate blocks and in total from that which existed during the recorded year to that which would exist during a normalized year. It is identical to the Usage Factor of Standard Practice U-25, page 6-3, paragraph Normalized year consumption refers to the water consumption that would be forecast for the recorded year by the Modified Bean Mult Regression Method. In considering the normalized year, no change

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8/ Actual number of bills, irrespective of monthly or bimonthly billing cycle. Minimum value however for any (R) value must be 1.0 and it must be entered

9/ Computed Revenue (CR) calculated by computer using Q(R), B(R), and BXS(R) as found in recorded year Water Use Analysis Table.

10/ We have ignored the procedure discussed in Standard Practice U-25 on page 6 paragraphs 10 through 12.

the number of bills is assumed between it and the recorded year. The general expression is:

$$\text{Ratio } Q(RN) = \frac{\text{Total Forecast Water Consumption (Normalized) for Recorded Year R}}{\text{Total Recorded Water Consumption for Recorded Year R}}$$

$$= \frac{\Sigma Q(N)}{\Sigma Q(R)} = \frac{Q(N)}{Q(R)}$$

For a minimum charge tariff the ratio applies only to consumption greater than the meter minimums as discussed in Exhibit J.

b. Ratios Q(RA) and Q(RB) are used to account for the estimated change in the water consumption by rate blocks and in total from a recorded year to the values the staff estimates for the two following test years A and B. It is identical in definition to the Usage Factor above, except for reference to projected years.

$$\text{Ratio } Q(RA) = \frac{\text{Total Forecast Water Consumption for Year A}}{\text{Total Recorded Water Consumption for Recorded Year}} = \frac{\Sigma Q(A)}{\Sigma Q(R)}$$

$$\text{Ratio } Q(RB) = \frac{\text{Total Forecast Water Consumption for Year B}}{\text{Total Recorded Water Consumption for Recorded Year}} = \frac{\Sigma Q(B)}{\Sigma Q(R)}$$

As noted previously, this information can be furnished directly by the CLIMATE Program, to ESTREVS via LINKUP. For a minimum charge tariff the ratio applies only to consumption greater than the meter minimums as discussed in Exhibit J.

c. Ratios B(RA) and B(RB) account for the Engineer's estimated change in the total number of bills. These ratios are identical to the Growth Factor of Standard Practice U-25, page 6-3, paragraph 7.

As noted previously, by definition, that the number of bills in the recorded year equals that of the normalized year, and that

$$B(R) = B(N)$$

and

$$\text{Year A} = \text{Year R} + 1$$

$$\text{Year B} = \text{Year A} + 1 = \text{Year R} + 2$$

$$\text{Ratio B(RA)} = \frac{\text{Total Bills for Year A}}{\text{Total Bills for Year R}} = \frac{B(A)}{B(R)}$$

$$\text{Ratio B(RB)} = \frac{\text{Total Bills for Year B}}{\text{Total Bills for Year R}} = \frac{B(B)}{B(R)}$$

d. The Engineer's estimated changes in the number of bills (except for those associated with the smallest meter) is designated by the terms BXS(RA) and BXS(RB). By use of these ratios, the Engineer can account for different growth rates between the total group of meters and those of a size greater than the smallest size. The slight error occurring in revenue estimating due to lumping meter growth together rather than estimating growth by individual sizes is ignored. Different growth rates are typical in most rate cases. For cases where utilities lump all meters together irrespective of size, see page 4-20.

$$\text{Ratio BXS(RA)} = \frac{\text{Bills (Except Smallest Meter) for Year A}}{\text{Bills (Except Smallest Meter) for Year R}} = \frac{BXS(A}{BXS(R}$$

$$\text{Ratio BXS(RB)} = \frac{\text{Bills (Except Smallest Meter) for Year B}}{\text{Bills (Except Smallest Meter) for Year R}} = \frac{BXS(B}{BXS(R}$$

The computer uses these ratios in slightly different ways depending upon whether a *minimum charge* or a *service charge* tariff is being calculated. See Exhibit J.

e. Ratio RRCR is used to adjust revenue figure from that which we theoretically computed from the number of bills and the consumption to that which was actually collected in the recorded year, i.e., the Revenue Adjustment Factor as discussed in Standard Practice U-25, page 6-3, paragraph 5. It accounts for a number of errors that creep into these practical calculations.

$$\text{Ratio RRCR} = \frac{\text{Recorded Revenue Year R}}{\text{Computed Revenue Year R}} = \frac{R(R)}{R(C)}$$

f. Miscellaneous

1. The use of this program does not depend upon the methods used in estimating the values listed on Cards 1 and 1A.
2. Note also that the computer internally uses a large number of decimals but generally prints out results of calculations only to a small number of places. Therefore the arithmetic sometimes appears to be slightly incorrect.
3. In the illustrative examples (Exhibits D.2, E.2, F.2 and G.2), the total bills (B) are assumed to increase by 2 percent a year and the bills except for the smallest size (BXS) by 1 percent a year (See Card 1). Water consumption grows on the average as shown. For demonstration purposes, we have generally assumed $Q(R) = Q(N)$.

3. Rate or Pricing Data

Present and proposed meter charge pricing data is to be entered on Cards 6 and 7 while consumption pricing is to be similarly entered on Cards 8 and 9. The number of entries correspond to Card 2, Items RB and MS, respectively. Remember color coding!

Note, however, that with a minimum charge tariff, the unit consumption charge for the first block (Cards 8 and 9, spaces 1 through 7) is to be the minimum charge, not the equivalent unit consumption charge. For example, in Exhibit D.2, the minimum charge at present rates is $2.55 per month, while the unit consumption charge for 5 CCF is $0.51 (as shown on the service charge input data sheet, Exhibit E.2).

4. Data Input Form ESTREVS (492.12B) Details - Monthly Billing

a. General

1. All values to be right justified except when triangle is indicated.
2. The triangle indicates the location of the decimal point. If a value is less than 1, fill in spaces to the right of the triangle. If a value does not exist, or is zero, nothing need be filled in.
3. Fields - This term refers to the place in which the values of ratios, rate blocks, etc., are inserted. Fields are to be generally filled in starting at the left side and in rising sequence, but data within each field must be right justified unless specifically prohibited.
4. Each set of data must consist of eleven cards, that is, the 492.12B form must be completely filled out except for a ONESHOT run where Card 1A is ignored. Card identification is in spaces 79-80.
5. Remember the colors of this form are to assist the Engineer by alerting him as to the number of entries required, as indicated on Card 2, Items RB and MS. RB (medium green) refers to the number of rate blocks while MS (white) refers to the number of meter sizes. They indicate respectively the number of fields to be filled in, per card, i.e., 2, 3, 8, 9 and 10, and 4, 5, 6 and 7.

6. The form may be modified in the future, and such will be indicated by changing the last letter of the identification 492.12B.

b. Card Input

Note basic units listed in upper right portion of ESTREVS Form.

1. Card 1 is to contain the basic billing and revenue information as recorded. In addition, the word "ONESHOT" is to be inserted in spaces 1 through 7 to command the computer to perform a "one-shot run" if that is so desired. If time trend is not desired in ONESHOT, then the word HORIZONTAL is to be placed in spaces 66 through 75 (labeled TREND).

   Card 1A is to be filled in only when a revenue estimate without a consumption estimate (ONESHOT) is required. Note units are CCF/meter-year.

   Card values must lie between 0 and 9999999.9 except for letter input.

2. Card 2 contains the rate block upper limits and is also to be used to indicate a minimum or service type tariff through use of "1" or "0". In addition it is used to indicate whether billing is monthly or bimonthly by entering in white space 75, symbol M or B as appropriate.

   Card 2 also contains an identification field and plus a listing of number of rate blocks and meter sizes.

   Item RB: This is the count of rate block upper limit values. The values can run from 1 through 9.

Item MS: This is the count of meter sizes which are to be entered on Card 4. Values start at 1.

Rate Block Upper Limits: These are integer numbers running in value from 1 to 9999999. The number of entries must agree with Item RB. The right-most field is used to represent "infinity," and may be any integer number larger than the highest rate block limit actually used. For example: 999, or larger, if the greatest actual rate block upper limit was 650.

3. Card 3 is to contain Recorded Bills by Rate Block, as discussed on pages 4-6 and 4-7, plus job request date.

   Card Values: Integer numbers with the number of fields used corresponding to Card 2, Item RB.

4. Card 4, Meter Sizes: List all meters in the system. Examples: 5/8-inch entered as .625; 3-inch entered as 3.000, or 3; 14½-inch entered as 14.500, or 14 .5 (zeros to the right of the decimal point need not be entered). As many entries as Card 2, Item MS are to be used.

5. Card 5 is for Recorded Bills by Meter Size: Integer numbers as discussed on page 4-7. Entries correspond to Card 2, Item MS and Card 4.

6. Cards 6 and 7, Present Rates - Meters, and Proposed Rates - Meters:

   Values from .001 to 9999.999. Zeros preceding the decimal may be left blank as in other decimal entries. Entries to correspond to Card 2, Item MS, and Card 4.

7. Cards 8 and 9, Present and Proposed Rates - Consumption:

   Decimal numbers ranging in value from .00001 to 99.99999, with as many entries as Card 2, Item RB.

8. Card 10, Recorded Consumption by Rate Blocks, as discussed on page 4.

   Integer numbers. As many entries as Card 2, Item RB are required.

5. Data Input Form (492.12B) Details - Bimonthly Billing

While tariffs are usually defined in monthly terms, the billing cycle may be bimonthly. If that is the case, the pull-out of data from the WUA must be in accordance with the actual pricing out of the bills, e.g., a bimonthly minimum charge is twice that of a monthly minimum charge.

Exhibits F and G illustrate minimum and service charges on the assumption that the bills and total consumption shown on the WUA represent the bimonthly billing cycle case. You will note the break-lines between the rate blocks have changed from the monthly billing exhibits, and, in addition, the line separating the minimum bills from those reporting consumption greater than the respective minimums has also shifted up to higher values, thus reflecting allowable consumptions in the bimonthly case. These changes must be reflected in the data input form as follows:

1. Minimum Charge Tariff (Exhibits F.1 through F.4)

   Card 2: Double Meter Monthly Rate Block Upper Limits (CCF)

   Cards 6 & 7: Double Meter Monthly Tariff Rates ($/month)

   Cards 8 & 9: Double Meter Monthly Tariff Rates for 1st block only, which is the basic monthly minimum charge (spaces 1 - 7). Do not change consumption charges ($/CCF).

   Other Cards: Read Bills and consumption figures as defined on WUA Table and beginning on page 4-18.

2. Service Charge Tariff (Exhibits G.1 through G.4)

Card 2: Same as Card 2 above

Cards 6 & 7: Same as Cards 6 and 7 above

Other Cards: Same as Other Cards above

3. Billing Type

Per Part A.4.b.2 (page 4-14) always insert M or B in space 75 of Card 2. If nothing is entered, the computer will assume a monthly billing cycle exists.

B. Examples of Each Type of Tariff Computation

1. Minimum Charge Tariff - Monthly (See Exhibit D.3)

Preface page (The first page of the printout set--note each page is numbered in sequence) lists the input data. The recorded appropriate bills and consumption data are repeated on pages 1 and 2. On page 2, the recorded data is ratioed up or down via Ratio Q(RN) in order to develop data for the normali year, after which the consumption is "spread." Q(RC) is used to determine RRCR (Exhibit L however provides a better demonstration of the determination and use of the computed year to determine the RRCR value as recorded and normalized consumption were not equal as was assumed here.)

On page 3, the same operation is repeated for test year A. In this case, the computer also ratios the bills by block by taking recorded informatio and multiplying it by Ratio B(RA). The ratioed rate block consumption is obtained by taking recorded information and multiplying it by Ratio Q(RA).

Test year B is shown on page 4.

On page 5, the consumption revenue sub-routine is begun. The normalized consumption quantities are multiplied by the two different consumption charge rates (present and proposed rates in dollars per CCF) to get revent based on consumption. On pages 6, 7 and 8, the operation is repeated. The to consumption in the second column from the left is not summed up for the minimu charge tariff as the first (lowest) block quantity refers to bills and not CCF as is indicated by the asterisk.

On page 9, the meter revenue sub-routine is begun. The revenue due to meters is calculated. Note, for example, that in test year A the number of bills is equal to the recorded information times Ratio BXS(RA). Finally, page 10, the revenue based on both sub-routines are summed up and then multiplied by Ratio RRCR to calculate the final revenues entitled "Adjusted Totals."

The RRCR value is determined by computing revenues based upon recorded year values of consumption, etc. and comparing it with the recorded value of revenue. That factor is used throughout the rest of the computations (for normalized and test years). The Summary Page lists the computed RRCR.

2. Service Charge Tariff - Monthly (See Exhibit E.3)

Procedure is generally the same as shown above. Input data, however, is slightly different, as discussed above. You will also notice throughout the printout that there are slight differences between the service and minimum tariff calculations, which are all in line with the standard procedure.

Of special interest is that the meter sub-routine is such that the overall sum of meter bills is projected by Ratios B(RA) and B(RB), but the bills derived from all meters larger than the smallest is projected by Ratios BXS(RA) and BXS(RB). As a result, the growth of the smallest sized meters is developed by differences as was mentioned on page 4-10 and Exhibit J.

3. Minimum and Service Charge Tariffs - Bimonthly

Exhibits F.2 and G.2 illustrate completed ESTREVS input sheets for bimonthly billing. See typical printouts pages F.3 and G.3.

C. Rate Changes During a Recorded Year

The program has been developed on the basis of no recorded or proposed rate changes during a year.

To handle a rate change during a recorded year, the following alternatives should be considered (ignore RRCR factor):

1. Obtain Water Use Analysis Tables for each part of the year and perform two separate revenue analyses.
2. Assume present rates held throughout the year and make an independent computation of the additional revenues.
3. Calculate an average annual pricing schedule and apply to the Water Use Analysis Table.
4. Using same Water Use Analysis Table, determine revenues at the different rates and interpolate the annual results.

D. Small Utilities

Small utilities often omit reporting on their Water Use Analysis Tables the existence of meter sizes greater than the smallest size. When that occurs and is acceptable to the Engineer, the approximation to be used is to assign BXS(R) = 1.0 and BXS(A) = BXS(B) = 0. Proceed from that point assuming no meters exist that are larger than the smallest and therefore all meters are equal to the smallest in size (usually 5/8" x 3/4"). The RRCR factor will tend to compensate for the erroneous meter count.

EXHIBIT C

ONE SHOT OR ESTREVS DATA INPUT SHEET

CALIFORNIA PUBLIC UTILITIES COMMISSION
Utilities Division, Hydraulic Branch

492.128
8/76

NOTES:
1. For Climate - Mureg - Revenue run, insert word ONESHOT on card 1, spaces 1 to 7 and leave card 1A, spaces 8 though 39 blank. Fill in rest of card 1.
2. For revenue estimate only, leave card 1, spaces 1 to 7 blank, but fill in remainder of cards 1 and 1A.
3. Fill in fields from left to right. Essentially all values right justified except when decimal indicated ▽.

CARD	ITEM	UNITS
1	B, BXS	BILLS / YEAR
1	R	$ / YEAR
1A	Q	CCF / METER-YEAR
2	RATE BLOCK UPPER LIMITS	CCF
3	BILLS BY RATE BLOCK	BILLS / YEAR

CARD	ITEM	UNITS
4	METER SIZES	INCHES
5	BILLS BY METER SIZES	BILLS / YEAR
6,7	METER CHARGES	$ / MONTH
8,9	CONSUMPTION CHARGES	$ / CCF
10	CONSUMPTION PER RATE BLOCK	CCF / YEAR

WATER USE ANALYSIS TABLE & TARIFF DATA — GROWTH RATIOS — RATE BLOCKS — METERS — CONSUMPTION — METERS — RATES

B(R)[B(N)] B(A) B(B) BXS(R)[BXS(N)] BXS(A) BXS(B) R(R) TREND

BILLS B — 1

CONSUMPTION Q — ESTREVS — 1A

Q(R) Q(N) Q(A) Q(B)

O = SERVICE I = MINIMUM (Circle one) — M = MONTHLY B = BIMONTHLY

RATE BLOCK UPPER LIMITS — 2

RUN IDENTIFICATION — O or I — No. R — No. B — M S

BILLS BY RATE BLOCK — 3

DATE Y Y / M M / D D

METER SIZES — 4

BILLS BY METER SIZE — 5

PRES. RATES — 6

PROP. RATES — 7

PRES. RATES — 8

PROP. RATES — 9

CONSUMPTION PER RATE BLOCK — 10

162,968/12 Meters — Meter Year

EXHIBIT D.1

WATER USE ANALYSIS TABLE

Minimum Charge Tariff

Monthly Billing

Card #3 — Card #4 — Card #10

Rate Block Limits (CCF) and Charges	Consumption Block 100 cu. ft.	5/8"	1"	1½"	2"	3"	4"	6"	8"	Total	Minimum Bills in Block	Average Consumption in Block	Consumption Q(R) Total(1)	Consumption $Q_{MB}(R)$ In Min. Block(2)	Consumption $Q_{Q>M}(R)$ Q> Minimums(3)
	0	1,332								1,332					
0-5	1	1,710	95	30	17		2			1,854	144	1	1,854	144	1,710
2.55$/Month	2	2,248	107	20	9					2,384	136	2	4,768	272	4,496
	3	3,013	162	8	10					3,193	180	3	9,579	540	9,039
	4	4,001	151	16	20					4,188	187	4	16,752	748	16,004
	5	4,917	239	14	21					5,191	274	5	25,955	1,370	24,585
	6	5,570	243	12	13					5,838	268	6	35,028	1,608	33,420
	7	6,343	344	19	14					6,620	377	7	46,340	2,639	43,701
	8	6,981	450	25	19		1			7,446	495	8	59,568	3,960	55,608
	9	7,055	441	12	17	1	1			7,527	472	9	67,743	4,248	63,495
	10	7,583	483	32	11	1				8,110	527	10	81,100	5,270	75,830
	11	7,115		21	11					7,682	353	11	84,502	3,883	80,619
	12	7,350	579	28	14					7,977	42	12	95,724	504	95,220
6-30	13	6,947	553	24	6					7,526	30	13	97,838	390	97,448
	14	6,899	587	23	8					7,517	31	14	105,238	434	104,804
.40$/CCF	15	6,291	536	30	11	2				6,870	43	15	103,050	645	102,405
	16	5,865	610	26	21					6,522	47	16	104,352	752	103,600
	17	5,582	587	29	9	1				6,208	39	17	105,536	663	104,873
	18	5,245	589	33	14					5,882	47	18	105,876	846	105,030
	19	4,486	563		13					5,123	38	19	97,337	722	96,615
	20	3,977	522	36	19				2	4,556	21	20	91,120	420	90,700
	21 - 22	6,920	1,075	65	22					8,082	22	21.5	173,604	473	173,131
	23 - 24	5,370	1,007	57	15					6,449	15	23.5	151,366	353	151,013
	25 - 26	4,152	887	69	10					5,118	10	25.5	130,361	255	130,106
	27 - 28	3,176	820	64	14					4,074	14	27.5	111,947	385	111,562
	29 - 30	2,240	751	57			2			3,058	9	29.5	90,080	265	89,815
	31 - 35	3,530	1,353	154	56	2	2			5,097	4	32.7	166,765	131	166,634
	36 - 40	1,809	972	189	83					3,053		37.8	115,395		115,395
	41 - 50	1,284	1,192	308	114	3			4	2,905	7	44.9	130,467	314	130,153
	51 - 60	469	556	229	89				1	1,350	5	54.9	74,064	275	73,789
	61 - 70	149	336	197	70				1	753	1	65.1	49,049	65	48,984
	71 - 80	56	198	105	87	4	4		2	456	6	75.0	34,221	450	33,771
31-9999	81 - 90	48	121	119	53	2			2	345	2	85.1	29,353	170	29,183
	91 - 100	43	70	73	65	1				252		95.5	24,062		24,062
.38$/CCF	101 - 125	52	120	154	127	15	8	2		478	2	112.6	53,812	225	53,587
	126 - 150	13	43	104	117	10	3			290		137.6	39,893		39,893
	151 - 200	15	47	121	157	22	6	1	2	371	3	173.7	64,452	521	63,931
	201 - 300	8	23	114	233	52	8		5	453	6	244.7	110,841	1,468	109,373
	301 - 400	4	2	27	113	28	26	6		209	1	347.2	72,571	347	72,224
	401 - 500	1		21	64	16	10	8	1	121		446.1	53,984		53,984
	501 - 1,000		6	32	116	68	65	8		295		692.2	204,202		204,202
	over 1,000				32	42	48	90	1	213		2,928.3	623,273		623,273
	Totals	139,722	17,975	2,738	1,922	276	186	125	24	162,968	3,858		3,843,022	35,755	3,807,267
	Bills w/Q < Respective Minimum Q	17,221	3,036	427	345	14	12	4	20	21,079			100.00%	.93%	99.07%
	Min. w/o 5/8"	0	3,036	427	345	14	12	4	20	3,858					
	BXS(R)	0	17,975	2,738	1,922	276	186	125	24	23,246					

Annotations in table: Card #2 (0-5, 2.55$/Month); Card #8 (31-9999, .38$/CCF); Card #5; Card #1; 17,221 Bills; 125,285 Bills; 16,604 Bills; 18,142 Bills; 128,185 Bills; 16,641 Bills; 921 Bills; 2,900 Bills; 37 Bills; 58,902 CCF; 1,937,710 CCF; 1,846,404 CCF; 55,834 CCF; 1,842,438 CCF; MINIMUM BILLS ABOVE LINE; 12 (TYP); Q > MINIMUMS = 3,807,267 CCF; B Q<M; B Q>M

(1) No. of bills by meter size, Total X Avg. Consumption Block.
(2) Min. No. of bills in block " X " " "
(3) = (1) - (2)

4-22

EXHIBIT D.2

ONE SHOT or ESTREVS DATA INPUT SHEET

CALIFORNIA PUBLIC UTILITIES COMMISSION
Utilities Division, Hydraulic Branch

492.12B
9/78

NOTES:
1. For Climate - Moreg - Revenue run, insert word ONESHOT on card 1, spaces 1 to 7 and leave card 1A, spaces 8 though 39 blank. Fill in rest of card 1.
2. For revenue estimate only, leave card 1, spaces 1 to 7 blank, but fill in remainder of cards 1 and 1A.
3. Fill in fields from left to right. Essentially all values right justified except when decimal indicated ▽.

CARD	ITEM	UNITS	CARD	ITEM	UNITS
1	B, BXS	BILLS / YEAR	4	METER SIZES	INCHES
1	R	$ / YEAR	5	BILLS BY METER SIZES	BILLS / YEAR
1A	Q	CCF/METER-YEAR	6,7	METER CHARGES	$ / MONTH
2	RATE BLOCK UPPER LIMITS	CCF	8,9	CONSUMPTION CHARGES	$ / CCF
3	BILLS BY RATE BLOCK	BILLS / YEAR	10	CONSUMPTION PER RATE BLOCK	CCF / YEAR

WATER USE ANALYSIS TABLE & TARIFF DATA

GROWTH RATIOS

Card 1 — BILLS (B)

1–7	B(R) [B(N)] 8–15	B(A) 16–23	B(B) 24–31	BXS(R) [BXS(N)] 32–39	BXS(A) 40–47	BXS(B) 48–55	R(R) 56–65	TREND 66–75
	162968.0	166227.4	169551.9	23246.0	23478.5	23713.2	11601707.0	

Card 1A — CONSUMPTION (Q)

1–7	Q(R) 8–15	Q(N) 16–23	Q(A) 24–31	Q(B) 32–39
ESTREVS	293.0	283.0	251.0	300.0

RATE BLOCKS

0 = SERVICE 1 = MINIMUM (Circle one); M = MONTHLY, B = BIMONTHLY

Card 2 — RATE BLOCK UPPER LIMITS

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	RUN IDENTIFICATION 64–73	74	75	No. RB	No. MS
5	30	9999							CACORM M/M	0	M	3	8

Card 3 — BILLS BY RATE BLOCK

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	DATE YY/MM/DD 64–70
17221	125285	16604							75 9 18

METERS

Card 4 — METER SIZES

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	64–70	71–77
.625	1.000	1.500	2.000	3.000	4.000	6.000	8.000			

Card 5 — BILLS BY METER SIZE

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	64–70	71–77
17221	3036	427	345	14	12	4	20			

RATES — METERS

Card 6 — PRES. RATES

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	64–70	71–77
2.55	4.80	6.00	12.50	23.00	40.00	80.00	125.00			

Card 7 — PROP. RATES

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63	64–70	71–77
2.95	5.50	9.20	14.50	26.00	46.00	92.00	145.00			

RATES — CONSUMPTION

Card 8 — PRES. RATES

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63
.255	.40	.38						

Card 9 — PROP. RATES

1–7	8–14	15–21	22–28	29–35	36–42	43–49	50–56	57–63
.295	.46	.44						

Card 10 — CONSUMPTION PER RATE BLOCK

1–8	9–16	17–24	25–32	33–40	41–48	49–56	57–64	65–72
55834	1908995	1842438						

EXHIBIT D.3-1

RUN IDENTIFICATION : CECORN MIN   DATE : 75/ 9/18   TARIFF TYPE : MINIMUM CHARGE   MONTHLY BILLING CYCLE

PREFACE PAGE = ESTIMATED WATER REVENUES = LISTING OF DATA + RATIOS USED IN THIS RUN

INPUT DATA	IDENT	VALUES	
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	283.0	Card #1A
NORMALIZED	Q(N)	283.0	
TEST YEAR A FORECAST	Q(A)	291.0	
TEST YEAR B FORECAST	Q(B)	300.0	
RECORDED AVG NO OF BILLS PER YEAR	B(R)	162968.0	Card #1
TEST YEAR A FORECAST	B(A)	166227.4	
TEST YEAR B FORECAST	B(B)	169551.9	
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BXS(R)	23246.0	
TEST YEAR A FORECAST	BXS(A)	23478.5	
TEST YEAR B FORECAST	BXS(B)	23713.2	
RECORDED REVENUE	R(R)	1601707.0	

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC) 1.0000000 TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN) 1.0000000 TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA) 1.0492020 TO CHANGE REC YR CONSUMPTION TO TEST YR =A= CONSUMPTION
RATIO Q(RB) 1.1036817 TO CHANGE REC YR CONSUMPTION TO TEST YR =B= CONSUMPTION
RATIO B(RA) 1.0202173 TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR =A= BILLS
RATIO B(RB) 1.0408407 TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR =B= BILLS
RATIO BXS(RA) 1.0100017 TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR =A= BILLS (EXCEPT SMALLEST METER)
RATIO BXS(RB) 1.0200981 TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR =B= BILLS (EXCEPT SMALLEST METER)

NUMBER OF RATE BLOCKS = 3
NUMBER OF METER SIZES = 8

RECORDED DATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	REC NO OF BILLS PER RATE BLOCK	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
5	17221	55834	2.55000	2.95000
30	125285	1908995	.40000	.46000
9999	16604	1842438	.38000	.44000
Card #2 WUA	Card #3 WUA	Card #10 WUA	Card #8 WUA	Card #9 WUA

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER CHARGES $ PER MONTH PRESENT	METER CHARGES $ PER MONTH PROPOSED
.625	17221.	2.550	2.950
1.000	3036.	4.800	5.500
1.500	427.	8.000	9.200
2.000	345.	12.500	14.500
3.000	14.	23.000	26.000
4.000	12.	40.000	46.000
6.000	4.	80.000	92.000
8.000	20.	125.000	145.000
Card #4 WUA	Card #5	Card #6	Card #7

A I CONSUMPTION SPREADING ROUTINE .

PAGE 1 I COMPUTED YEAR

DISTRIBUTION OF WATER USAGE INTO VARIOUS CONSUMPTION BLOCKS.

RATE BLOCK UPPER LIMIT	RECORDED NO BILLS PER RATE BLOCK	RECORDED CONSUMPTION PER RATE BLK CCF-PER-YEAR U(RL)	CONSUMPTION PER RATE BLK ZERO TO A	A+1 TO B	B+1 TO C	C+1 TO D	D+1 TO E	E+1 TO F	F+1 TO G	G+1 TO H	H+1 TO I	I+1 TO INFINITY
5	17,221	56,838	55,858	55,838								
30	125,285	1,908,995	1,908,995	820,825	1,282,570							
9999	16,504	1,842,838	1,842,838	83,020	815,100	1,344,318						
TOTALS												
0	159,110	3,807,267	3,807,267	765,279	1,697,670	1,344,318						

A I CONSUMPTION SPREADING ROUTINE .

PAGE 2 I NORMALIZED YEAR

DISTRIBUTION OF WATER USAGE INTO VARIOUS CONSUMPTION BLOCKS.

RATE BLOCK UPPER LIMIT	RECORDED NO BILLS PER RATE BLK	RECORDED CONSUMPTION PER RATE BLK CCF-PER-YEAR U(RN)	CONSUMPTION PER RATE BLK ZERO TO A	A+1 TO B	B+1 TO C	C+1 TO D	D+1 TO E	E+1 TO F	F+1 TO G	G+1 TO H	H+1 TO I	I+1 TO INFINITY
5	17,221	55,838	55,838	55,838								
30	125,285	1,908,995	1,908,995	820,825	1,282,570							
9999	16,604	1,842,838	1,842,838	83,020	815,100	1,344,318						
TOTALS												
0	159,110	3,807,267	3,807,267	765,279	1,697,670	1,344,318						

PAGE 3 I TEST YEAR =A=

DISTRIBUTION OF WATER USAGE INTO VARIOUS CONSUMPTION BLOCKS.

RATE BLOCK UPPER LIMIT	NO BILLS CONSUMPTION PER RATE BLOCK U(RA)	PER RATE BLK CCF-PER-YEAR	ZERO TO A	A+1 TO B	B+1 TO C	C+1 TO D	D+1 TO E	E+1 TO F	F+1 TO G	G+1 TO H	H+1 TO I	I+1 TO INFINITY
5	17,569	58,581	58,581									
30	127,818	2,002,921	639,990	1,363,852								
9999	16,988	1,933,090	88,698	825,492	1,828,899							
TOTALS												
0	162,327	3,994,592	782,569	1,787,328	1,828,899							

PAGE 4 I TEST YEAR =B=

DISTRIBUTION OF WATER USAGE INTO VARIOUS CONSUMPTION BLOCKS.

RATE BLOCK UPPER LIMIT	NO BILLS CONSUMPTION PER RATE BLOCK U(RB)	PER RATE BLK CCF-PER-YEAR	ZERO TO A	A+1 TO B	B+1 TO C	C+1 TO D	D+1 TO E	E+1 TO F	F+1 TO G	G+1 TO H	H+1 TO I	I+1 TO INFINITY
5	17,924	61,623	61,623									
30	130,402	2,196,925	852,009	1,456,916								
9999	17,282	2,055,845	85,411	432,053	1,515,002							
TOTALS												
0	165,608	4,314,393	998,043	1,888,969	1,515,002							

PAGE 5. COMPUTED YEAR * BILLS

RATE BLOCK UPPER LIMITS	CONSUMPTION BLOCK QUANTITIES CCF-PER-YEAR	CONSUMPTION CHARGES PRESENT $ PER CCF	CONSUMPTION REVENUES PRESENT $$	CONSUMPTION CHARGES PROPOSED $ PER CCF	CONSUMPTION REVENUES PROPOSED $$
5	159,110 *	2.55000	405,730	2.95000	469,375
30	1,697,670	.40000	679,068	.46000	780,928
9999	1,344,318	.38000	510,841	.44000	591,500
TOTALS					
0		.00000	1,595,639	.00000	1,841,803

PAGE 6. NORMALIZED YEAR * BILLS

RATE BLOCK UPPER LIMITS	CONSUMPTION BLOCK QUANTITIES CCF-PER-YEAR	CONSUMPTION CHARGES PRESENT $ PER CCF	CONSUMPTION REVENUES PRESENT $$	CONSUMPTION CHARGES PROPOSED $ PER CCF	CONSUMPTION REVENUES PROPOSED $$
5	159,110 *	2.55000	405,730	2.95000	469,375
30	1,697,670	.40000	679,068	.46000	780,928
9999	1,344,318	.38000	510,841	.44000	591,500
TOTALS					
0		.00000	1,595,639	.00000	1,841,803

PAGE 7. TEST YEAR -A- * BILLS

RATE BLOCK UPPER LIMITS	CONSUMPTION BLOCK QUANTITIES CCF-PER-YEAR	CONSUMPTION CHARGES PRESENT $ PER CCF	CONSUMPTION REVENUES PRESENT $$	CONSUMPTION CHARGES PROPOSED $ PER CCF	CONSUMPTION REVENUES PROPOSED $$
5	162,327 *	2.55000	413,933	2.95000	478,864
30	1,787,324	.40000	714,930	.46000	822,169
9999	1,424,899	.38000	541,462	.44000	626,956
TOTALS					
0		.00000	1,670,324	.00000	1,927,989

PAGE 8. TEST YEAR -B- * BILLS

RATE BLOCK UPPER LIMITS	CONSUMPTION BLOCK QUANTITIES CCF-PER-YEAR	CONSUMPTION CHARGES PRESENT $ PER CCF	CONSUMPTION REVENUES PRESENT $$	CONSUMPTION CHARGES PROPOSED $ PER CCF	CONSUMPTION REVENUES PROPOSED $$
5	165,606 *	2.55000	422,501	2.95000	488,544
30	1,886,967	.40000	754,787	.46000	868,005
9999	1,515,002	.38000	575,701	.44000	666,601
TOTALS					
0		.00000	1,752,788	.00000	2,023,150

B = 2. REVENUE CALCULATION = METER SUB-ROUTINE

PAGE 9 METER SIZES, RATES, AND REVENUES

METER SIZES	RECORDED NUMBER OF BILLS	METER CHARGES PRESENT	REVENUES PRESENT	METER CHARGES PROPOSED	REVENUES PROPOSED	TEST YEAR NUMBER OF BILLS	METER CHARGES PRESENT	REVENUES PRESENT	METER CHARGES PROPOSED	REVENUES PROPOSED
	********** COMPUTED AND NORMALIZED YEARS **********					********** TEST YEAR =A= B(RA) AND BXS(RA) **********				
1.000	3036.	4.800	14,573	5.500	16,698	3066.	4.800	14,719	5.500	16,865
1.500	427.	8.000	3,416	9.200	3,928	431.	8.000	3,450	9.200	3,968
2.000	345.	12.500	4,313	14.500	5,003	348.	12.500	4,356	14.500	5,053
3.000	14.	23.000	322	26.000	364	14.	23.000	325	26.000	368
4.000	12.	40.000	480	46.000	552	12.	40.000	485	46.000	558
6.000	4.	80.000	320	92.000	368	4.	80.000	323	92.000	372
8.000	20.	125.000	2,500	145.000	2,900	20.	125.000	2,525	145.000	2,929
TOTALS										
.000	3858.	.000	25,923	.000	29,813	3897.	.000	26,183	.000	30,111
						********** TEST YEAR =B= B(RB) AND BXS(RB) **********				
1.000						3097.	4.800	14,866	5.500	17,034
1.500						436.	8.000	3,485	9.200	4,007
2.000						352.	12.500	4,399	14.500	5,103
3.000						14.	23.000	328	26.000	371
4.000						12.	40.000	490	46.000	563
6.000						4.	80.000	326	92.000	375
8.000						20.	125.000	2,550	145.000	2,958
TOTALS										
.000						3936.	.000	26,444	.000	30,412

C : GRAND TOTALS - REVENUE IN DOLLARS PER YEAR

PAGE 10

ROUTINE	COMPUTED YEAR PRESENT	COMPUTED YEAR PROPOSED	NORMALIZED YEAR PRESENT	NORMALIZED YEAR PROPOSED	TEST YEAR -A- PRESENT	TEST YEAR -A- PROPOSED	TEST YEAR -B- PRESENT	TEST YEAR -B- PROPOSED
B-1	1,595,639	1,841,803	1,595,639	1,841,803	1,670,324	1,927,989	1,752,788	2,023,150
B-2	25,923	29,813	25,923	29,813	26,183	30,111	26,444	30,412
TOTALS	1,621,563	1,871,616	1,621,563	1,871,616	1,696,507	1,958,100	1,779,233	2,053,562
RRCR ADJUSTED TOTALS	1,601,707	1,848,698	1,601,707	1,848,698	1,675,734	1,934,123	1,757,446	2,028,416

RUN IDENTIFICATION : CACORN MIN DATE : 75/ 9/18 TARIFF TYPE : MINIMUM CHARGE MONTHLY BILLING CYCLE

SUMMARY PAGE = DATA AND RATIOS FROM PREFACE PAGE PLUS R(C) AND RRCR

INPUT DATA	IDENT	VALUES
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	283.0
NORMALIZED	Q(N)	283.0
TEST YEAR A FORECAST	Q(A)	291.0
TEST YEAR B FORECAST	Q(B)	300.0
RECORDED AVG NO OF BILLS PER YEAR	B(R)	162968.0
TEST YEAR A FORECAST	B(A)	166227.4
TEST YEAR B FORECAST	B(B)	169551.9
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BXS(R)	23246.0
TEST YEAR A FORECAST	BXS(A)	23478.5
TEST YEAR B FORECAST	BXS(B)	23713.2
RECORDED REVENUE	R(R)	1601707.0
REVENUE VIA WATER USE TABLE BY COMPUTER	R(C)	1621562.6

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC)	1.0000000	TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN)	1.0000000	TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA)	1.0492020	TO CHANGE REC YR CONSUMPTION TO TEST YR "A" CONSUMPTION
RATIO Q(RB)	1.1036817	TO CHANGE REC YR CONSUMPTION TO TEST YR "B" CONSUMPTION
RATIO B(RA)	1.0202173	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "A" BILLS
RATIO B(RB)	1.0408407	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "B" BILLS
RATIO BXS(RA)	1.0100017	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "A" BILLS (EXCEPT SMALLEST METER)
RATIO BXS(RB)	1.0200981	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "B" BILLS (EXCEPT SMALLEST METER)
RATIO RRCR	.9877552	REVENUE ADJUSTMENT FACTOR (REC YR R / COMPUTED YR R)

Not on Preface page

NUMBER OF RATE BLOCKS = 3
NUMBER OF METER SIZES = 8

RECORDED DATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	REC NO OF BILLS PER RATE BLOCK	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
5	17221	55834	2.55000	2.95000
30	125285	1908995	.40000	.46000
9999	16604	1842438	.38000	.44000

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER CHARGES $ PER MONTH PRESENT	METER CHARGES $ PER MONTH PROPOSED
.625	17221.	2.550	2.950
1.000	3036.	4.800	5.500
1.500	427.	8.000	9.200
2.000	345.	12.500	14.500
3.000	14.	23.000	26.000
4.000	12.	40.000	46.000
6.000	4.	80.000	92.000
8.000	20.	125.000	145.000

EXHIBIT D.4

WATER USE ANALYSIS REVENUE CALCULATION

Minimum Charge Tariff

Monthly Billing

Block	Number of Bills	Q > Minimum Q: Ccf	0 - 5 Δ = 5	6 - 30 Δ = 25	Over 30
0 - 5	17,221[c]	55,834	55,834		
6 - 30	125,285	1,908,995	626,425	1,282,570	
Over 30	16,604	1,842,438	83,020	415,100	1,344,318
Total[a]	159,110	3,807,267	765,279[d]	1,697,670	1,344,318
Minimums[b]	3,858				
Total Bills	162,968				

	Quantity	Present Rates	Revenues
Minimum	159,110	$ 2.55	$ 405,731
6 - 30	1,697,670	.40	679,068
Over 30	1,344,318	.38	510,841
Subtotal			1,595,640
Minimum Charges:			
1" Meter	3,036	$ 4.80	$ 14,573
1½" "	427	8.00	3,416
2" "	345	12.50	4,312
3" "	14	23.00	322
4" "	12	40.00	480
6" "	4	80.00	320
8" "	20	125.00	2,500
Subtotal	3,858		$ 25,923
Total Revenues per Water Use Analysis			$1621,563
1972 Recorded Revenues			
Residential			1,133,247
Commercial			276,133
Industrial			2,680
Public Authority			189,647
Total Revenues			1,601,707
Correction Factor RRCR			98.78

a/ Bills with Q > Minimum Q, except for smallest size meter in smallest block where they are all those referred to in c/ below.

b/ Bills with Q < Minimum Q, except for smallest size meter.

c/ Smallest size meter bills with associated Ccf for Q < Minimum Q.

d/ Ignore this sum as Q charge is in 159,110 bill quantity charge.

EXHIBIT E.1

WATER USE ANALYSIS TABLE

Service Charge Tariff
Monthly Billing

Rate Block Limits (CCF)	Consumption Block 100 cu. ft.	Number of Bills By Meter Size 5/8"	1"	1½"	2"	3"	4"	6"	8"	Total	Consumption Total
	0	1,332								1,332	
0-5	1	1,710	95	30	17		2			1,854	1,854
.514 CCF	2	2,248	107	20	9					2,384	4,768
	3	3,013	162	8	10					3,193	9,579
	4	4,001	151	16	20					4,188	16,752
	5	4,917	239	14	21					5,191	25,955
	6	5,570	243	12	13					5,838	35,028
	7	6,243	344	19	14					6,620	46,340
	8	6,951	450	25	19		1			7,446	59,568
	9	7,055	441	12	17	1	1			7,527	67,743
	10	7,583	483	32	11	1				8,110	81,100
	11	7,115	535	21	11					7,682	84,502
	12	7,356	579	28	14					7,977	95,724
	13	6,943	553	24	6					7,526	97,838
	14	6,899	587	23	8					7,517	105,238
	15	6,291	536	30	11	2				6,870	103,050
6-30	16	5,865	610	26	21					6,522	104,352
.404 CCF	17	5,582	587	29	9	1				6,208	105,536
	18	5,246	589	33	14					5,882	105,876
	19	4,486	583	41	13					5,123	97,337
	20	3,977	522	36	19				2	4,556	91,120
	21 - 22	6,920	1,075	65	22					8,082	173,604
	23 - 24	5,370	1,007	57	15					6,449	151,366
	25 - 26	4,152	887	69	10					5,118	130,361
	27 - 28	3,176	820	64	14					4,074	111,947
	29 - 30	2,240	751	57	8		2			3,058	90,080
	31 - 35	3,530	1,353	154	56	2	2			5,097	166,765
	36 - 40	1,809	972	189	83					3,053	115,395
	41 - 50	1,284	1,192	308	114	3			4	2,905	130,467
	51 - 60	469	556	229	89	6			1	1,350	74,064
	61 - 70	149	336	197	70				1	753	49,049
	71 - 80	56	198	105	87	4	4		2	456	34,221
31-9999	81 - 90	48	121	119	53	2			2	345	29,353
	91 - 100	43	70	73	65	1				252	24,062
.384 CCF	101 - 125	52	120	154	127	15	8	2		478	53,812
	126 - 150	13	43	104	117	10	3			290	39,893
	151 - 200	15	47	121	157	22	6	1	2	371	64,452
	201 - 300	8	23	114	233	52	8	10	5	453	110,841
	301 - 400	4	2	27	113	28	26	6	3	209	72,571
	401 - 500	1		21	64	16	10	8	1	121	53,984
	501 - 1,000		6	32	116	68	65	8		295	204,202
	over 1,000				32	42	48	90	1	213	623,273
	Total	139,722	17,975	2,738	1,922	276	186	125	24	162,968	3,843,022
	RNS(R)	0	17,975	2,738	1,922	276	186	125	24	23,246	

Card #5

Card #3

Q(R)

18,142 Bills

120,126 Bills

16,641 Bills

Card #10

58,908 CCF

1,937,110 CCF

1,846,404 CCF

EXHIBIT E.2

ONE SHOT OR ESTREVS DATA INPUT SHEET

CALIFORNIA PUBLIC UTILITIES COMMISSION
Utilities Division, Hydraulic Branch

492.12B
8/76

NOTES:
1. For Climate - Mareg - Revenue run, insert word ONESHOT on card 1, spaces 1 to 7 and leave card 1A, spaces 8 though 39 blank. Fill in rest of card 1.
2. For revenue estimate only, leave card 1, spaces 1 to 7 blank, but fill in remainder of cards 1 and 1A.
3. Fill in fields from left to right. Essentially all values right justified except when decimal indicated ▽.

CARD	ITEM	UNITS
1	B, BXS	BILLS / YEAR
1	R	$ / YEAR
1A	Q	CCF/METER-YEAR
2	RATE BLOCK UPPER LIMITS	CCF
3	BILLS BY RATE BLOCK	BILLS / YEAR
4	METER SIZES	INCHES
5	BILLS BY METER SIZES	BILLS / YEAR
6,7	METER CHARGES	$ / MONTH
8,9	CONSUMPTION CHARGES	$ / CCF
10	CONSUMPTION PER RATE BLOCK	CCF / YEAR

WATER USE ANALYSIS TABLE & TARIFF DATA
GROWTH RATIOS
RATES — METERS — RATE BLOCKS
CONSUMPTION — METERS

B(R)[B(N)] B(A) B(B) BXS(R)[BXS(N)] BXS(A) BXS(B) R(R) TREND

BILLS
CONSUMPTION

ESTREVS

Q(R) Q(N) Q(A) Q(B)

O = SERVICE I = MINIMUM (Circle one) M = MONTHLY B = BIMONTHLY

RATE BLOCK UPPER LIMITS

RUN IDENTIFICATION

No. No. R B M S

BILLS BY RATE BLOCK

DATE YY / MM / DD

METER SIZES

BILLS BY METER SIZE

PRES. RATES

PROP. RATES

PRES. RATES

PROP. RATES

CONSUMPTION PER RATE BLOCK

INPUT DATA	IDENT	VALUES
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	283.0
NORMALIZED	Q(N)	282.0
TEST YEAR A FORECAST	Q(A)	291.0
TEST YEAR B FORECAST	Q(B)	300.0
RECORDED AVG NO OF BILLS PER YEAR	B(R)	162968.0
TEST YEAR A FORECAST	B(A)	166227.4
TEST YEAR B FORECAST	B(B)	169551.9
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BXS(R)	23246.0
TEST YEAR A FORECAST	BXS(A)	23478.5
TEST YEAR B FORECAST	BXS(B)	23713.2
RECORDED REVENUE	R(R)	2085924.0

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC)	1.0000000	TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN)	.9964664	TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA)	1.0488342	TO CHANGE REC YR CONSUMPTION TO TEST YR "A" CONSUMPTION
RATIO Q(RB)	1.1028975	TO CHANGE REC YR CONSUMPTION TO TEST YR "B" CONSUMPTION
RATIO B(RA)	1.0200002	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "A" BILLS
RATIO B(RB)	1.0404000	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "B" BILLS
RATIO BXS(RA)	1.0100017	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "A" BILLS (EXCEPT SMALLEST METER)
RATIO BXS(RB)	1.0200981	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "B" BILLS (EXCEPT SMALLEST METER)

NUMBER OF RATE BLOCKS = 3
NUMBER OF METER SIZES = 8

RECORDED DATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	REC NO OF BILLS PER RATE BLOCK	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
5	18142	58908	.51000	.59000
30	128185	1937710	.40000	.46000
9999	16641	1846404	.38000	.44000

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER $ PER MONTH PRESENT	CHARGES PROPOSED
.625	139722.	2.550	2.950
1.000	17975.	4.800	5.500
1.500	2738.	8.000	9.200
2.000	1922.	12.500	14.500
3.000	276.	23.000	26.000
4.000	186.	40.000	46.000
6.000	125.	80.000	92.000
8.000	24.	125.000	145.000

A : CONSUMPTION SPREADING ROUTINE .

PAGE 1 : COMPUTED YEAR

RATE BLOCK UPPER LIMIT	RECORDED NO BILLS PER RATE BLOCK	RECORDED CONSUMPTION PER RATE BLK CCF-PER-YEAR	CONSUMPTION PER RATE BLK CCF-PER-YEAR Q(RC)	DISTRIBUTION OF WATER USAGE INTO VARIOUS CONSUMPTION BLOCKS. ZERO TO A	A+1 TO B	B+1 TO C	C+1 TO D	D+1 TO E	E+1 TO F	F+1 TO G	G+1 TO H	H+1 TO I	I+1 TO INFINITY
5	18,142	58,908	58,908	58,908										
30	128,185	1,937,710	1,937,710	640,925	1,296,785									
9999	16,641	1,846,404	1,846,404	83,205	416,025	1,347,174								
TOTALS														
0	162,968	3,843,022	3,843,022	783,038	1,712,810	1,347,174								

PAGE 2 : NORMALIZED YEAR

RATE BLOCK UPPER LIMIT	RECORDED NO BILLS PER RATE BLOCK	RECORDED CONSUMPTION PER RATE BLK CCF-PER-YEAR	CONSUMPTION PER RATE BLK CCF-PER-YEAR Q(RN)	DISTRIBUTION OF WATER USAGE INTO VARIOUS CONSUMPTION BLOCKS. ZERO TO A	A+1 TO B	B+1 TO C	C+1 TO D	D+1 TO E	E+1 TO F	F+1 TO G	G+1 TO H	H+1 TO I	I+1 TO INFINITY
5	18,142	58,908	58,700	58,700										
30	128,185	1,937,710	1,930,803	640,925	1,289,938									
9999	16,641	1,846,404	1,839,880	83,205	416,025	1,340,650								
TOTALS														
0	162,968	3,843,022	3,829,482	782,830	1,705,963	1,340,650								

PAGE 3 : TEST YEAR =A=

RATE BLOCK UPPER LIMIT	NO BILLS PER RATE BLOCK	CONSUMPTION PER RATE BLK CCF-PER-YEAR	DISTRIBUTION OF WATER USAGE INTO VARIOUS CONSUMPTION BLOCKS. ZERO TO A	A+1 TO B	B+1 TO C	C+1 TO D	D+1 TO E	E+1 TO F	F+1 TO G	G+1 TO H	H+1 TO I	I+1 TO INFINITY
5	18,505	61,785	61,785									
30	130,749	2,032,336	653,784	1,378,593								
9999	16,974	1,936,572	84,869	424,348	1,427,357							
TOTALS												
0	166,227	4,030,693	800,398	1,802,938	1,427,357							

PAGE 4 : TEST YEAR =H=

RATE BLOCK UPPER LIMIT	NO BILLS PER RATE BLOCK	CONSUMPTION PER RATE BLK CCF-PER-YEAR	DISTRIBUTION OF WATER USAGE INTO VARIOUS CONSUMPTION BLOCKS. ZERO TO A	A+1 TO B	B+1 TO C	C+1 TO D	D+1 TO E	E+1 TO F	F+1 TO G	G+1 TO H	H+1 TO I	I+1 TO INFINITY
5	18,875	64,969	64,969									
30	133,368	2,137,095	666,818	1,470,277								
9999	17,313	2,036,398	86,966	432,832	1,516,995							
TOTALS												
0	169,552	4,238,459	818,754	1,903,110	1,516,995							

PAGE 5. COMPUTED YEAR

RATE BLOCK UPPER LIMITS	CONSUMPTION BLOCK QUANTITIES CCF-PER-YEAR	CONSUMPTION CHARGES PRESENT $ PER CCF	CONSUMPTION REVENUES PRESENT $$	CONSUMPTION CHARGES PROPOSED $ PER CCF	CONSUMPTION REVENUES PROPOSED $$
5	783,038	.51000	399,349	.59000	461,992
30	1,712,810	.40000	685,124	.46000	787,893
9999	1,347,174	.38000	511,926	.44000	592,757
TOTALS					
0	3,843,022	.00000	1,596,399	.00000	1,842,642

PAGE 6. NORMALIZED YEAR

RATE BLOCK UPPER LIMITS	CONSUMPTION BLOCK QUANTITIES CCF-PER-YEAR	CONSUMPTION CHARGES PRESENT $ PER CCF	CONSUMPTION REVENUES PRESENT $$	CONSUMPTION CHARGES PROPOSED $ PER CCF	CONSUMPTION REVENUES PROPOSED $$
5	782,830	.51000	399,243	.59000	461,870
30	1,705,963	.40000	682,385	.46000	784,743
9999	1,340,650	.38000	509,447	.44000	589,886
TOTALS					
0	3,829,442	.00000	1,591,075	.00000	1,836,498

PAGE 7. TEST YEAR -A-

RATE BLOCK UPPER LIMITS	CONSUMPTION BLOCK QUANTITIES CCF-PER-YEAR	CONSUMPTION CHARGES PRESENT $ PER CCF	CONSUMPTION REVENUES PRESENT $$	CONSUMPTION CHARGES PROPOSED $ PER CCF	CONSUMPTION REVENUES PROPOSED $$
5	800,398	.51000	408,203	.59000	472,235
30	1,802,938	.40000	721,175	.46000	829,352
9999	1,427,357	.38000	542,396	.44000	628,037
TOTALS					
0	4,030,693	.00000	1,671,774	.00000	1,929,623

PAGE 8. TEST YEAR -B-

RATE BLOCK UPPER LIMITS	CONSUMPTION BLOCK QUANTITIES CCF-PER-YEAR	CONSUMPTION CHARGES PRESENT $ PER CCF	CONSUMPTION REVENUES PRESENT $$	CONSUMPTION CHARGES PROPOSED $ PER CCF	CONSUMPTION REVENUES PROPOSED $$
5	818,354	.51000	417,361	.59000	482,829
30	1,903,110	.40000	761,244	.46000	875,430
9999	1,516,995	.38000	576,458	.44000	667,478
TOTALS					
0	4,238,459	.00000	1,755,063	.00000	2,025,737

B = 2. REVENUE CALCULATION = METER SUB=ROUTINE

PAGE 9 : METER SIZES, RATES, AND REVENUES

METER SIZES	RECORDED NUMBER OF BILLS	METER CHARGES PRESENT	REVENUES PRESENT	METER CHARGES PROPOSED	REVENUES PROPOSED	TEST YEAR NUMBER OF BILLS	METER CHARGES PRESENT	REVENUES PRESENT	METER CHARGES PROPOSED	REVENUES PROPOSED
	********** COMPUTED AND NORMALIZED YEARS **********					********** TEST YEAR =A= B(RA) AND BXS(RA) **********				
.625	139722.	2.550	356.291	2.950	412.180	142749.	2.550	364.010	2.950	421.109
1.000	17975.	4.800	86.280	5.500	98.863	18155.	4.800	87.143	5.500	99.851
1.500	2738.	8.000	21.904	9.200	25.190	2765.	8.000	22.123	9.200	25.442
2.000	1922.	12.500	24.025	14.500	27.869	1941.	12.500	24.265	14.500	28.148
3.000	276.	23.000	6.348	26.000	7.176	279.	23.000	6.411	26.000	7.248
4.000	186.	40.000	7.440	46.000	8.556	188.	40.000	7.514	46.000	8.642
6.000	125.	80.000	10.000	92.000	11.500	126.	80.000	10.100	92.000	11.615
8.000	24.	125.000	3.000	145.000	3.480	24.	125.000	3.030	145.000	3.515
TOTALS										
.000	162968.	.000	515.288	.000	594.813	166227.	.000	524.597	.000	605.569
						********** TEST YEAR =B= B(RB) AND BXS(RB) **********				
.625						145839.	2.550	371.889	2.950	430.224
1.000						18336.	4.800	88.014	5.500	100.849
1.500						2793.	8.000	22.344	9.200	25.696
2.000						1961.	12.500	24.508	14.500	28.429
3.000						282.	23.000	6.476	26.000	7.320
4.000						190.	40.000	7.590	46.000	8.728
6.000						128.	80.000	10.201	92.000	11.731
8.000						24.	125.000	3.060	145.000	3.550
TOTALS										
.000						169552.	.000	534.081	.000	616.528

C 1 GRAND TOTALS = REVENUE IN DOLLARS PER YEAR

PAGE 10

ROUTINE	COMPUTED YEAR		NORMALIZED YEAR		TEST YEAR "A"		TEST YEAR "B"	
	PRESENT	PROPOSED	PRESENT	PROPOSED	PRESENT	PROPOSED	PRESENT	PROPOSED
B=1	1,596,399	1,842,642	1,591,075	1,836,498	1,671,774	1,929,623	1,755,063	2,025,737
B=2	515,288	594,813	515,288	594,813	524,597	605,569	534,081	616,528
TOTALS	2,111,688	2,437,455	2,106,363	2,431,311	2,196,371	2,535,192	2,289,144	2,642,265
RRCR ADJUSTED TOTALS	2,085,924	2,407,716	2,080,665	2,401,648	2,169,574	2,504,262	2,261,215	2,610,028

SUMMARY PAGE - DATA AND RATIOS FROM PREFACE PAGE PLUS R(C) AND RRCR

INPUT DATA

INPUT DATA	IDENT	VALUES
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	283.0
NORMALIZED	Q(N)	282.0
TEST YEAR A FORECAST	Q(A)	291.0
TEST YEAR B FORECAST	Q(B)	300.0
RECORDED AVG NO OF BILLS PER YEAR	B(R)	162968.0
TEST YEAR A FORECAST	B(A)	166227.4
TEST YEAR B FORECAST	B(B)	169551.9
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BXS(R)	23246.0
TEST YEAR A FORECAST	BXS(A)	23478.5
TEST YEAR B FORECAST	BXS(B)	23713.2
RECORDED REVENUE	R(R)	2085924.0
REVENUE VIA WATER USE TABLE BY COMPUTER	R(C)	2111687.6

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC)	1.0000000	TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN)	.9964664	TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA)	1.0488342	TO CHANGE REC YR CONSUMPTION TO TEST YR -A- CONSUMPTION
RATIO Q(RB)	1.1028975	TO CHANGE REC YR CONSUMPTION TO TEST YR -B- CONSUMPTION
RATIO B(RA)	1.0200002	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR -A- BILLS
RATIO B(RB)	1.0404000	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR -B- BILLS
RATIO BXS(RA)	1.0100017	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR -A- BILLS (EXCEPT SMALLEST METER)
RATIO BXS(RB)	1.0200981	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR -B- BILLS (EXCEPT SMALLEST METER)
RATIO RRCR	.9877995	REVENUE ADJUSTMENT FACTOR (REC YR R / COMPUTED YR R)

NUMBER OF RATE BLOCKS = 3
NUMBER OF METER SIZES = 8

RECORDED DATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	REC NO OF BILLS PER RATE BLOCK	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
5	18142	58908	.51000	.59000
30	128185	1937710	.40000	.46000
9999	16641	1846404	.38000	.44000

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER CHARGES $ PER MONTH PRESENT	METER CHARGES $ PER MONTH PROPOSED
.625	139722.	2.550	2.950
1.000	17975.	4.800	5.500
1.500	2738.	8.000	9.200
2.000	1922.	12.500	14.500
3.000	276.	23.000	26.000
4.000	186.	40.000	46.000
6.000	125.	60.000	92.000
8.000	24.	125.000	145.000

EXHIBIT E.4

WATER USE ANALYSIS REVENUE CALCULATION

Service Charge Tariff

Monthly Billing

Block	Number of Bills	Ccf	0 - 5 △ = 5	6 - 30 △ = 25	Over 30
0 - 5	18,142	58,908	58,908		
6 - 30	128,185	1,937,710	640,925	1,296,785	
Over 30	16,641	1,846,404	83,205	416,025	1,347,174
Total	162,968	3,843,022	783,038	1,712,810	1,347,174

Consumption Charges:	Quantity	Present Rates	Revenues
0 - 5	783,038	$ 0.51	$ 399,349
6 - 30	1,712,810	.40	685,124
Over 30	1,347,174	.38	511,926
Subtotal			1,596,399
Service Charges:			
5/8" Meter	139,722	$ 2.55	$ 356,291
1" "	17,975	4.80	86,280
1½" "	2,738	8.00	21,904
2" "	1,922	12.50	24,025
3" "	276	23.00	6,348
4" "	186	40.00	7,440
6" "	125	80.00	10,000
8" "	24	125.00	3,000
Subtotal	162,968		$ 515,288

Total Revenues per Water Use Analysis $2,111,687

1972 Recorded Revenues
Assume 2,085,924

Correction Factor RRCR 98.78

$Q(R) = \frac{3,843,002\ CCF/Yr.}{162,968/12\ Meters} = 141.0\ CCF/Meter\ Year$

EXHIBIT F.1

WATER USE ANALYSIS TABLE

Minimum Charge Tariff

Bimonthly Billing with Monthly Tariff Specification

Rate Block Limits (CCF) and Charges		Consumption Block	Number of Bills By Meter Size								Minimum	Average	Consumption		
Tariff	WUA	100 cu. ft.	5/8"	1"	1½"	2"	3"	4"	6"	8"	Total	Bills in Block	Consumption in Block	Total	In Min. Block	Q > Minimums
0-5 2.55$ Month	0-10 5.10$ Bimonth	0	1,332								1,332					
		1	1,710	95	30	17		2			1,854	144	1	1,854	144	1,710
		2	2,248	107	20	9					2,384	136	2	4,768	272	4,496
		3	3,013	162	8	10					3,193	180	3	9,579	540	9,039
		4	4,001	151	16	20					4,188	187	4	16,752	748	16,004
		5	4,917	239	14	21					5,191	274	5	25,955	1,370	24,585
		6	5,570	243	12	13					5,838	268	6	35,028	1,608	33,420
		7	6,243	344	19	14					6,620	377	7	46,340	2,639	43,701
		8	6,951	450	25	19		1			7,446	495	8	59,568	3,960	55,608
		9	7,055	441	12	17	1	1			7,527	472	9	67,743	4,248	63,495
		10	7,583	483	32	11	1				8,110	527	10	81,100	5,270	75,830
6-30 .40$ CCF	11-60 .40$ CCF	11	7,115	535	21	11					7,682	567	11	84,502	6,237	78,265
		12	7,356	579	28	14					7,977	621	12	95,724	7,452	88,272
		13	6,943	553	24	6					7,526	583	13	97,838	7,579	90,259
		14	6,809	587	23	8					7,517	618	14	105,238	8,652	96,586
		15	6,291	536	30	11	2				6,870	579	15	103,050	8,685	94,365
		16	5,865	610	26	21					6,522	657	16	104,352	10,512	93,840
		17	5,582	587	29	9	1				6,208	626	17	105,536	10,642	94,894
		18	5,246	589	33	14					5,882	636	18	105,876	11,448	94,428
		19	4,486	583	41	13					5,123	637	19	97,337	12,103	85,234
		20	3,977	522	36	19				2	4,556	579	20	91,120	11,580	79,540
		21 - 22	6,920	1,075 (280/795)	65	22					8,082	367	21.5	173,604	7,890	165,714
		23 - 24	5,370	1,007	57	15					6,449	72	23.5	151,366	1,692	149,674
		25 - 26	4,152	887	69	10					5,118	79	25.5	130,361	2,014	128,347
		27 - 28	3,176	820	64	14					4,074	78	27.5	111,947	2,145	109,802
		29 - 30	2,240	751	57	8		2			3,058	67	29.5	90,080	1,976	88,104
		31 - 35	3,530	1,353	154	56	2	2			5,097	214	32.7	166,765	6,998	159,767
		36 - 40	1,809	972	189 (60/129)	83					3,053	143	37.8	115,395	5,405	109,990
		41 - 50	1,284	1,192	308	114	3			4	2,905	121	44.9	130,467	5,433	125,034
		51 - 60	469	556	229	89	6			1	1,350	96	54.9	74,064	5,270	68,794
31-9999 .38$ CCF	61-9999 .38$ CCF	61 - 70	149	336	197	70				1	753	1	65.1	49,049	65	48,984
		71 - 80	56	198	105	87	4	4		2	456	10	75.0	34,221	750	33,471
		81 - 90	48	121	119	53	2			2	345	4	85.1	29,353	340	29,013
		91 - 100	43	70	73	65	1				252	1	95.5	24,062	96	23,966
		101 - 125	52	120	154	127	15 (7/8)	8	2		478	17	112.6	53,812	1,914	51,898
		126 - 150	13	43	104	117	10	3			290	3	137.6	39,893	413	39,480
		151 - 200	15	47	121	157	22	6	1	2	371	9	173.7	64,452	1,563	62,889
		201 - 300	8	23	114	233	52	8	10	5	453	15	244.7	110,841	3,670	107,171
		301 - 400	4	2	27	113	28	26	6	3	209	9	347.2	72,571	3,125	69,446
		401 - 500	1		21	64	16	10	8	1	121	1	446.1	53,984	446	53,538
		501 - 1,000		6	32	116	68	65	8		295		692.2	204,202		204,202
		over 1,000				32	42	48	90	1	213		2,928.3	623,273		623,273
		Totals	139,722	17,975	2,738	1,922	276	186	125	24	162,968	10,470		3,843,022	166,894	3,676,128
		Bills w/Q < Respective Minimum Q	50,623	8,676	1,005	688	30	29	19	23	61,093			100.00%	4.34%	95.66%
		Min. w/o 5/8"	0	8,676	1,005	688	30	29	19	23	10,470					
		BKS(R)	0	17,975	2,738	1,922	276	186	125	24	23,246					

50,623 Bills | 97,709 Bills | 4,166 Bills | MINIMUM BILLS ABOVE LINE | 105,049 Bills | 4,236 Bills | 53,683 Bills | 3,060 Bills | 7,340 Bills | 70 Bills | 348,687 CCF | 2,134,622 CCF | 1,359,713 CCF | 827,888 CCF | 2,000,909 CCF | 1,347,331 CCF

SUMMARY PAGE = DATA AND RATIOS FROM PREFACE PAGE PLUS R(C) AND RRCR

INPUT DATA	IDENT	VALUES
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	141.5
NORMALIZED	Q(N)	141.5
TEST YEAR A FORECAST	Q(A)	145.5
TEST YEAR B FORECAST	Q(B)	150.0
RECORDED AVG NO OF BILLS PER YEAR	B(R)	162968.0
TEST YEAR A FORECAST	B(A)	166227.4
TEST YEAR B FORECAST	B(B)	169551.9
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BX8(R)	23246.0
TEST YEAR A FORECAST	BX8(A)	23478.5
TEST YEAR B FORECAST	BX8(B)	23713.2
RECORDED REVENUE	R(R)	1808649.0
REVENUE VIA WATER USE TABLE BY COMPUTER	R(C)	1816648.0

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC)	1.0000000	TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN)	1.0000000	TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA)	1.0506004	TO CHANGE REC YR CONSUMPTION TO TEST YR "A" CONSUMPTION
RATIO Q(RB)	1.1066634	TO CHANGE REC YR CONSUMPTION TO TEST YR "B" CONSUMPTION
RATIO B(RA)	1.0206317	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "A" BILLS
RATIO B(RB)	1.0416821	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "B" BILLS
RATIO BX8(RA)	1.0100017	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "A" BILLS (EXCEPT SMALLEST METER)
RATIO BX8(RB)	1.0200981	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "B" BILLS (EXCEPT SMALLEST METER)
RATIO RRCR	.9955968	REVENUE ADJUSTMENT FACTOR (REC YR R / COMPUTED YR R)

NUMBER OF RATE BLOCKS = 3
NUMBER OF METER SIZES = 8

RECORDED DATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	REC NO OF BILLS PER RATE BLOCK	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
10	50623	327888	$.10000	$.90000
60	97709	2000909	.40000	.46000
9999	4166	1347331	.38000	.44000

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER CHARGES $ PER MONTH PRESENT	METER CHARGES $ PER MONTH PROPOSED
.625	50623.	$.100	$.900
1.000	8676.	9.600	11.000
1.500	1005.	16.000	18.400
2.000	688.	25.000	29.000
3.000	30.	46.000	52.000
4.000	29.	80.000	92.000
6.000	19.	160.000	184.000
8.000	23.	250.000	290.000

C : GRAND TOTALS - REVENUE IN DOLLARS PER YEAR

ROUTINE	COMPUTED YEAR		NORMALIZED YEAR		TEST YEAR -A-		TEST YEAR -B-	
	PRESENT	PROPOSED	PRESENT	PROPOSED	PRESENT	PROPOSED	PRESENT	PROPOSED
B-1	1,687,588	1,949,356	1,687,588	1,949,356	1,761,736	2,034,925	1,843,209	2,128,942
B-2	129,060	148,274	129,060	148,274	130,350	149,757	131,653	151,254
TOTALS	1,816,648	2,097,630	1,816,648	2,097,630	1,892,086	2,184,682	1,974,862	2,280,196
RRCR ADJUSTED TOTALS	1,808,649	2,088,394	1,808,649	2,088,394	1,883,755	2,175,062	1,966,167	2,270,156

ONE SHOT OR ESTREVS DATA INPUT SHEET

CALIFORNIA PUBLIC UTILITIES COMMISSION
Utilities Division, Hydraulic Branch

492.12B
9/76

NOTES:
1. For Climate - Mureq - Revenue run, insert word ONESHOT on card 1, spaces 1 to 7 and leave card 1A, spaces 8 though 39 blank. Fill in rest of card 1.
2. For revenue estimate only, leave card 1, spaces 1 to 7 blank, but fill in remainder of cards 1 and 1A.
3. Fill in fields from left to right. Essentially all values right justified except when decimal indicated ▽.

CARD	ITEM	UNITS
1	B, BXS	BILLS / YEAR
1	R	$ / YEAR
1A	Q	CCF / METER-YEAR
2	RATE BLOCK UPPER LIMITS	CCF
3	BILLS BY RATE BLOCK	BILLS / YEAR

CARD	ITEM	UNITS
4	METER SIZES	INCHES
5	BILLS BY METER SIZES	BILLS / YEAR
6,7	METER CHARGES	$ / MONTH
8,9	CONSUMPTION CHARGES	$ / CCF
10	CONSUMPTION PER RATE BLOCK	CCF / YEAR

WATER USE ANALYSIS TABLE & TARIFF DATA — GROWTH RATIOS — RATE BLOCKS — METERS — RATES — CONSUMPTION — METERS

B(R)[B(N)] B(A) B(B) BXS(R)[BXS(N)] BXS(A) BXS(B) R(R) TREND

BILLS — CONSUMPTION

ESTREVS

Q(R) Q(N) Q(A) Q(B)

O = SERVICE I = MINIMUM (Circle one) — M = MONTHLY B = BIMONTHLY

RUN IDENTIFICATION

DATE Y Y / M M / D D

RATE BLOCK UPPER LIMITS — BILLS BY RATE BLOCK — METER SIZES — BILLS BY METER SIZE — PRES. RATES — PROP. RATES — PRES. RATES — PROP. RATES — CONSUMPTION PER RATE BLOCK

EXHIBIT F.4

WATER USE ANALYSIS REVENUE CALCULATION

Minimum Charge Tariff

Bimonthly Billing

Block	Number of Bills	Q > Minimum Q: Ccf	0 - 10 : Δ = 10	11 - 60 : Δ = 50	Over 60
0 - 10	50,623 c/	327,888	327,888		
11 - 60	97,709	2,000,909	977,090	1,023,819	
Over 60	4,166	1,347,331	41,660	208,300	1,097,371
Total a/	152,498	3,676,128	1,346,638 d/	1,232,119	1,097,371
Minimums b/	10,470				
Total Bills	162,968				

	Quantity	Present e/ Rates	Revenues
Minimum (10 Ccf)	152,498	$ 5.10	$ 777,740
11 - 60	1,232,119	.40	492,848
Over 60	1,097,371	.38	417,001
Subtotal			1,687,589
Minimum Charges:			
1" Meter	8,676	$ 9.60	$ 83,290
1½" "	1,005	16.00	16,080
2" "	688	25.00	17,200
3" "	30	46.00	1,380
4" "	29	80.00	2,320
6" "	19	160.00	3,040
8" "	23	250.00	5,750
Subtotal	10,470		129,060
Total Revenues per Water Use Analysis			1,816,649

a/ Bills with Q > Minimum Q except for smallest size meter in smallest block where they are all those referred to in c/ below.

b/ Bills except for smallest size meter with Q ≤ Minimum Q.

c/ Smallest size meter bills with associated Ccf for Q ≤ Minimum Q.

d/ Ignore this sum as Q charge is in 152,498 bill quantity charge.

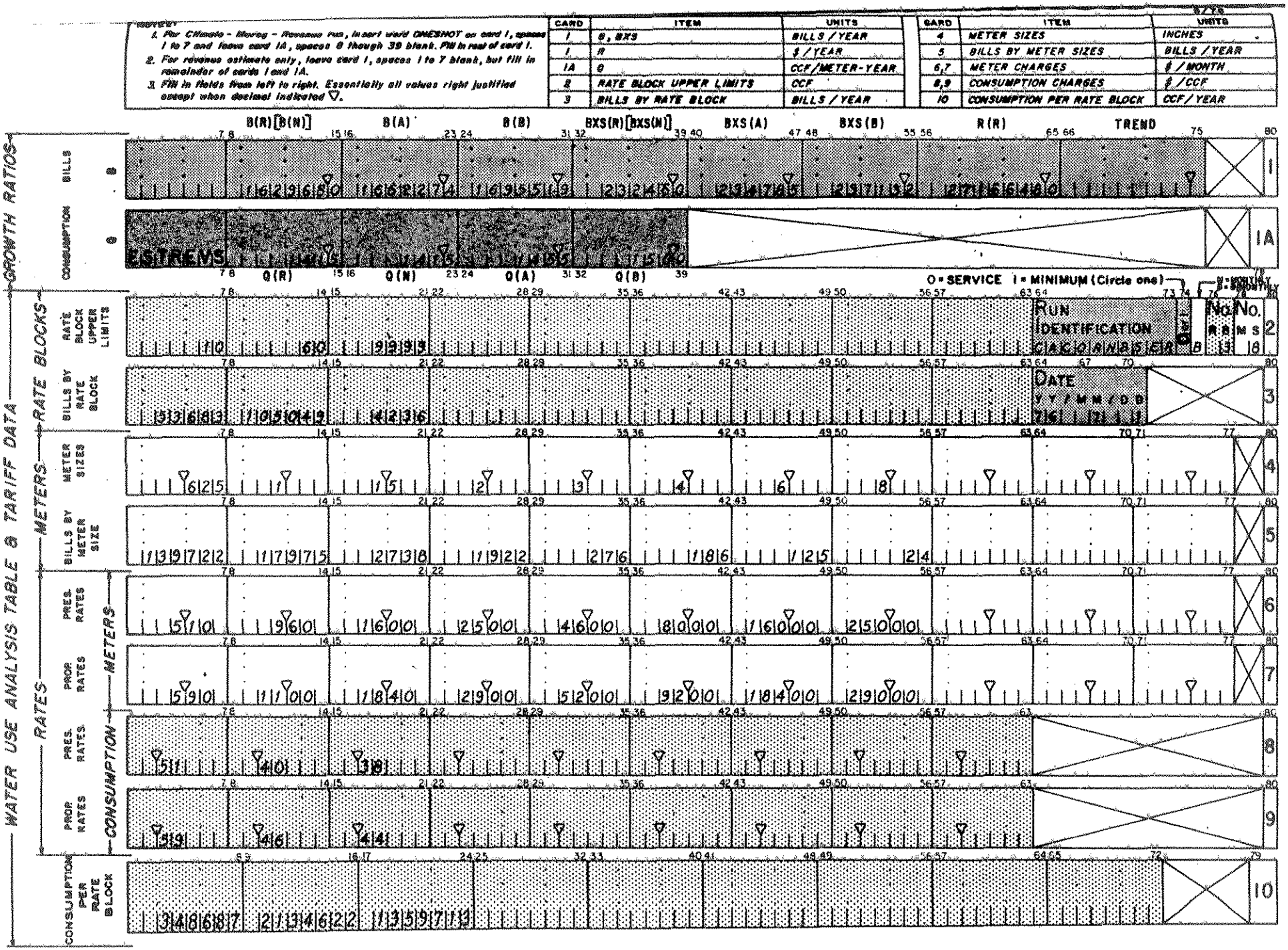
e/ Monthly Minimum Charges doubled over that of monthly tariff.

EXHIBIT G.1

WATER USE ANALYSIS TABLE

Service Charge Tariff
Bi-Monthly Billing with Monthly Tariff Specification

Rate Block Limits (CCF) & Charges: Tariff	WUA	Consumption Block 100 cu. ft.	Number of Bills By Meter Size: 5/8"	1"	1½"	2"	3"	4"	6"	8"	Total		Consumption Total	
0-5 .51$/CCF	0-10 .51$/CCF	0	1,332								1,332	53,683 Bills	1,854	348,687 Bills
		1	1,710	95	30	17		2			1,854		4,768	
		2	2,248	107	20	9					2,384		9,579	
		3	3,013	162	8	10					3,193		16,752	
		4	4,001	151	16	20					4,188		25,955	
		5	4,917	239	14	21					5,191		35,028	
		6	5,570	243	12	13					5,838		46,340	
		7	6,243	344	19	14					6,620		59,568	
		8	6,951	490	25	19		1			7,446		67,743	
		9	7,055	441	12	17	1	1			7,527		81,100	
		10	7,583	483	32	11	1				8,110		84,502	
6-30 .40$/CCF	11-60 .40$/CCF	11	7,115	535	21	11					7,682	105,049 Bills	95,724	2,134,622 Bills
		12	7,356	579	28	14					7,977		97,838	
		13	6,943	553	24	6					7,526		105,238	
		14	6,899	587	23	8					7,517		103,050	
		15	6,291	536	30	11	2				6,870		104,352	
		16	5,865	610	26	21					6,522		105,536	
		17	5,582	587	29	9	1				6,208		105,876	
		18	5,246	589	33	14					5,882		97,337	
		19	4,486	583	41	13					5,123		91,120	
		20	3,977	522	36	19				2	4,556		173,604	
		21 - 22	6,920	1,075	65	22					8,082		151,366	
		23 - 24	5,370	1,007	57	15					6,449		130,361	
		25 - 26	4,152	887	69	10					5,118		111,947	
		27 - 28	3,176	820	64	14					4,074		90,080	
		29 - 30	2,240	751	57	8		2			3,058		166,765	
		31 - 35	3,530	1,353	154	96	2	2			5,097		115,395	
		36 - 40	1,809	972	189	83					3,053		130,467	
		41 - 50	1,284	1,192	308	114	3			4	2,905		74,064	
		51 - 60	469	556	229	89	6			1	1,359		49,049	
31-9999 .38$/CCF	61-9999 .38$/CCF	61 - 70	149	336	197	70				1	753	4,236 Bills	34,221	1,359,713 Bills
		71 - 80	56	198	105	87	4	4		2	456		29,353	
		81 - 90	48	121	119	53	2			2	345		24,062	
		91 - 100	43	70	73	65	1				252		53,812	
		101 - 125	52	120	154	127	15	8	2		478		39,893	
		126 - 150	13	43	104	117	10	3			290		64,452	
		151 - 200	15	47	121	157	22	6	1	2	371		110,841	
		201 - 300	8	23	114	233	52	8	10	5	453		72,571	
		301 - 400	4	2	27	113	28	26	6	3	209		53,984	
		401 - 500	1		21	64	16	10	8	1	121		204,202	
		501 - 1,000		6	32	116	68	65	8		295		623,273	
		over 1,000				32	42	48	90	1	213			
		Total	139,722	17,975	2,738	1,922	276	186	125	24	162,968		3,843,022	
		EXS(R)	0	17,975	2,738	1,922	276	186	125	24	23,246			



NOTES:

1. For Climate - Money - Revenue run, insert word ONESHOT on card 1, spaces 1 to 7 and leave card 1A, spaces 8 through 39 blank. Fill in rest of card 1.
2. For revenue estimate only, leave card 1, spaces 1 to 7 blank, but fill in remainder of cards 1 and 1A.
3. Fill in fields from left to right. Essentially all values right justified except when decimal indicated ▽.

CARD	ITEM	UNITS
1	B, BXS	BILLS / YEAR
1	R	$ / YEAR
1A	Q	CCF/METER-YEAR
2	RATE BLOCK UPPER LIMITS	CCF
3	BILLS BY RATE BLOCK	BILLS / YEAR

CARD	ITEM	$/YR UNITS
4	METER SIZES	INCHES
5	BILLS BY METER SIZES	BILLS / YEAR
6,7	METER CHARGES	$ / MONTH
8,9	CONSUMPTION CHARGES	$ / CCF
10	CONSUMPTION PER RATE BLOCK	CCF / YEAR

C # GRAND TOTALS = REVENUE IN DOLLARS PER YEAR

ROUTINE	COMPUTED YEAR		NORMALIZED YEAR		TEST YEAR =A=		TEST YEAR =B=	
	PRESENT	PROPOSED	PRESENT	PROPOSED	PRESENT	PROPOSED	PRESENT	PROPOSED
8=1	1,673,667	1,933,079	1,673,667	1,933,079	1,751,786	2,023,236	1,838,052	2,122,791
8=2	1,030,576	1,189,626	1,030,576	1,189,626	1,049,194	1,211,138	1,068,162	1,233,056
TOTALS	2,704,243	3,122,705	2,704,243	3,122,705	2,800,980	3,234,374	2,906,215	3,355,847
RRCR ADJUSTED TOTALS	2,716,648	3,137,029	2,716,648	3,137,029	2,813,829	3,249,211	2,919,546	3,371,241

RUN IDENTIFICATION : CALCNUMBER DATE : 76/ 7/ 1 TARIFF TYPE : SERVICE CHARGE BIMONTHLY BILLING CYCLE

SUMMARY PAGE * DATA AND RATIOS FROM PREFACE PAGE PLUS R(C) AND RRCR

INPUT DATA	IDENT	VALUES
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	141.5
NORMALIZED	Q(N)	141.5
TEST YEAR A FORECAST	Q(A)	145.5
TEST YEAR B FORECAST	Q(B)	150.0
RECORDED AVG NO OF BILLS PER YEAR	B(R)	162968.0
TEST YEAR A FORECAST	B(A)	166227.4
TEST YEAR B FORECAST	B(B)	169551.9
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BXS(R)	23246.0
TEST YEAR A FORECAST	BXS(A)	23470.5
TEST YEAR B FORECAST	BXS(B)	23713.2
RECORDED REVENUE	R(R)	2716648.0
REVENUE VIA WATER USE TABLE BY COMPUTER	R(C)	2704243.0

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC)	1.0000000	TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN)	1.0000000	TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA)	1.0488342	TO CHANGE REC YR CONSUMPTION TO TEST YR "A" CONSUMPTION
RATIO Q(RB)	1.1028975	TO CHANGE REC YR CONSUMPTION TO TEST YR "B" CONSUMPTION
RATIO B(RA)	1.0200002	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "A" BILLS
RATIO B(RB)	1.0404000	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "B" BILLS
RATIO BXS(RA)	1.0100017	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "A" BILLS (EXCEPT SMALLEST METER)
RATIO BXS(RB)	1.0200981	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "B" BILLS (EXCEPT SMALLEST METER)
RATIO RRCR	1.0045872	REVENUE ADJUSTMENT FACTOR (REC YR R / COMPUTED YR R)

NUMBER OF RATE BLOCKS = 3
NUMBER OF METER SIZES = 8

RECORDED DATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	REC NO OF BILLS PER RATE BLOCK	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
10	93683	348687	.31000	.39000
60	105049	2134622	.40000	.46000
9999	4236	1359713	.38000	.44000

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER CHARGES $ PER MONTH PRESENT	PROPOSED
.625	139722.	5.100	5.900
1.000	17975.	9.600	11.000
1.500	2738.	16.000	18.400
2.000	1922.	25.000	29.000
3.000	276.	46.000	52.000
4.000	186.	80.000	92.000
6.000	125.	160.000	184.000
8.000	24.	250.000	290.000

EXHIBIT G.4

WATER USE ANALYSIS REVENUE CALCULATION

Service Charge Tariff

Bimonthly Billing

Block	Number of Bills	Ccf	0 - 10 Δ = 10	11 - 60 Δ = 50	Over 60
0 - 10	53,683	348,687	348,687		
11 - 60	105,049	2,134,622	1,050,490	1,084,132	
Over 60	4,236	1,359,713	42,360	211,800	1,105,553
Total	162,968	3,843,022	1,441,537	1,295,932	1,105,553

Consumption Charges:	Quantity	Present Rates	Revenues
0 - 10	1,441,537	$ 0.51	$ 735,184
11 - 60	1,295,932	.40	518,373
Over 60	1,105,553	.38	420,110
Subtotal			1,673,667

Service Charges:			
5/8" Meter	139,722	$ 5.10	$ 712,582
1" "	17,975	9.60	172,560
1½" "	2,738	16.00	43,808
2" "	1,922	25.00	48,050
3" "	276	46.00	12,696
4" "	186	80.00	14,880
6" "	125	160.00	20,000
8" "	24	250.00	6,000
Subtotal	162,968		1,030,576

Total Revenues per Water Use Analysis $2,704,243

EXHIBIT H
Sheet 1 of 2

Calculation of Ratios Q(RN), Q(RA), AND Q(RB)

Minimum Charge

We note from page 4-9 that for a Service Charge Tariff, the subject ratios were:

$$Q(RN) = \frac{\Sigma Q(N)}{\Sigma Q(R)} = \frac{Q(N)}{Q(R)}$$

$$Q(RA) = \frac{\Sigma Q(A)}{\Sigma Q(R)} = \frac{Q(A)\ B(A)}{Q(R)\ B(R)}$$

$$Q(RB) = \frac{\Sigma Q(B)}{\Sigma Q(R)} = \frac{Q(B)\ B(B)}{Q(R)\ B(R)}$$

These ratios represent the total consumption charged at the quantity rates for the normalized and test years as compared to the recorded year consumption. By "spreading," these volumes of water are segregated into appropriate rate blocks.

All the water consumed will not be charged and spread in a Minimum Charge Tariff. The part not spread (but charged by meter sizes) must be removed from the total consumption. That meter charge minimum consumption must however reflect changes in the growth of "meter sizes except the smallest" i.e., (BXS) in a similar manner to that discussed in Chapter 4.

To simplify the procedure, no growth of unit consumption for these minimum bills is assumed. This approximation should be satisfactory as the total amount of minimum bill consumption is usually small. Referring to Exhibit D.1, we note that:

> Total Consumption less Consumption in Minimum Blocks equals Consumption greater than respective meter minimums

For the recorded year R, this relationship can be expressed as:

$$Q(R) - Q_{MB}(R) = Q_{Q>M}(R)$$

EXHIBIT H
Sheet 2 of 2

Calculation of Ratios Q(RN), Q(RA), AND Q(RB)

Minimum Charge

In formula form this becomes:

$$Q_{Q>M}(R) = \frac{Q(R)B(R)}{anob} - Q_{MB}(R)$$

Read $Q_{Q>M}(R)$ from Water Use Analysis table directly; See Exhibit D.1, last column on right. Equal to sum of card 10 entries.

$$Q_{MB}(R) = \frac{Q(R)B(R)}{anob} - Q_{Q>M}(R)$$

Read $Q_{MB}(R)$ from Water Use Analysis table directly; See Exhibit D.1, 2nd column from right or compute based upon preceding equation.

$$Q_{Q>M}(N) = \frac{Q(N)B(N)}{anob} - Q_{MB}(R)BXS(RN)$$

and,

$$Q(RN) = \frac{\Sigma Q_{Q>M}(N)}{\Sigma Q_{Q>M}(R)} = \frac{\frac{Q(N)B(N)}{anob} - Q_{MB}(R)BXS(RN)}{\Sigma Q_{Q>M}(R)}$$

Where:

anob = Annual number of equivalent bills per customer as calculated from WUA table data.

= M for monthly billing procedure, i.e. 12.

= B for bimonthly billing procedure, i.e. 6.

$Q_{Q>M}(A)$ is the quantity of water charged at quantity rates for year A while $Q_{Q>M}(R)$ corresponds to card 10 data and to the recorded billings contained in card 3. The ratios then become for the two test years:

$$Q(RA) = \frac{\Sigma Q_{Q>M}(A)}{\Sigma Q_{Q>M}(R)} = \frac{\frac{Q(A)B(A)}{anob} - Q_{MB}(R)\ BXS(RA)}{\Sigma Q_{Q>M}(R)}$$

$$Q(RB) = \frac{\frac{Q(B)B(B)}{anob} - Q_{MB}(R)\ BXS(RB)}{\Sigma Q_{Q>M}(R)}$$

which are similar in form to the Service Charge ratios where the following are constants: $Q_{Q>M}(R)$, $Q_{MB}(R)$, and anob. Note these ratios are calculated automatically by the computer and not by the Engineer.

EXHIBIT I
Sheet 1 of 3

Calculation of B(RN), B(RA), and B(RB)

Minimum Charge

We note from 4-10 that to calculate the subject ratios for a Service Charge Tariff, we use the following formulas:

$$B(RN) = 1.0$$

$$B(RA) = \frac{B(A)}{B(R)}$$

$$B(RB) = \frac{B(B)}{B(R)}$$

As there are no meter minimum charge quantities, these relationships are sufficient.

With a Minimum Charge Tariff, however, we must eliminate from part of the calculations those bills for meters except the smallest which use less than the respective minimum quantities, i.e., quantity BXSM.

At the same time, we must typically recognize overall bill growth by multiplying bills by B(RA) which applies to <u>all</u> bills and BXS(RA) which applies only to bills except for the smallest size.

Bills segregation by rate block also is required and is approximated in the following formulas for a typical test year having N rate blocks (see also accompanying sketch):

For block 1 and recorded year R:

$$B_1(R) = \frac{B_1(R)}{B(R)} \left[\leq B(R) - BXSM(R) \right]$$

For all blocks and year A:

$$B_1(A) = \frac{B_1(R)}{B(R)} \left[\leq B(R) \cdot B(RA) - BXSM(R) \cdot BXS(RA) \right]$$

$$= \frac{B_1(R)}{B(R)} \left[\leq B(A) - BXSM(A) \right]$$

$$B_2(A) = \frac{B_2(R)}{B(R)} \left[\leq B(A) - BXSM(A) \right]$$

$$B_N(A) = \frac{B_N(R)}{B(R)} \left[\leq B(A) - BXSM(A) \right]$$

Note:

$$B(R) = \Sigma B(R) - BXSM(R)$$

$$\Sigma B(R) = B_1(R) + B_2(R) + ... + B_N(R)$$

= Recorded bills in respective blocks as shown on Card 3. See Exhibit D shaded area which is typically $B_2(R)$.

$$B(A) = \Sigma B(R) \cdot B(RA)$$

BXSM(A) = Sum of bills except the smallest for which consumption was less than the respective meter minimums for test year A. Equal typically to:. BXSM(A) = BXSM(R) • BXS(RA)

It is calculated by computer as part of "Revenue Calculation Meter Sub-routine B-2" and entitled "Total of Test Year Number of Bills."

$B_N(RA)$ = Multiplier for bills in N rate block used to estimate Test Year A bills based upon recorded bills in that rate block.

$$B_1(RA) = \frac{B_1(A)}{B_1(R)} = \frac{\Sigma B(A) - BXSM(A)}{\Sigma B(R) - BXSM(R)}$$

$$B_2(RA) = \frac{B_2(A)}{B_2(R)} = \frac{B_3(A)}{B_3(R)} = ... = \frac{B_N(A)}{B_N(R)}$$

Therefore, for all blocks and year A:

$$B(RA) = \frac{B(A) - BXSM(A)}{B(R) - BXSM(R)}$$

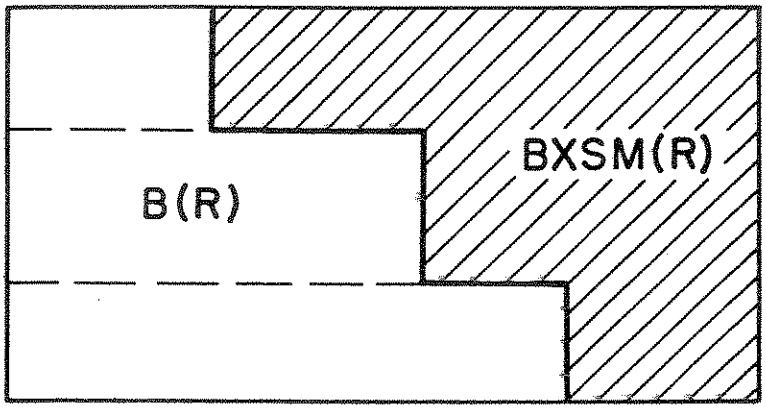
The ratio B(RA), therefore, becomes almost identical to that used in the Service Charge calculations except that the removal of minimum bills is approximated as shown above by use of the terms BXSM(R) and BXSM(A). The computer handles this problem automatically as required.

Finally, for Test Year B:

$$B(RB) = \frac{B(B) - BXSM(B)}{B(R) - BXSM(R)}$$

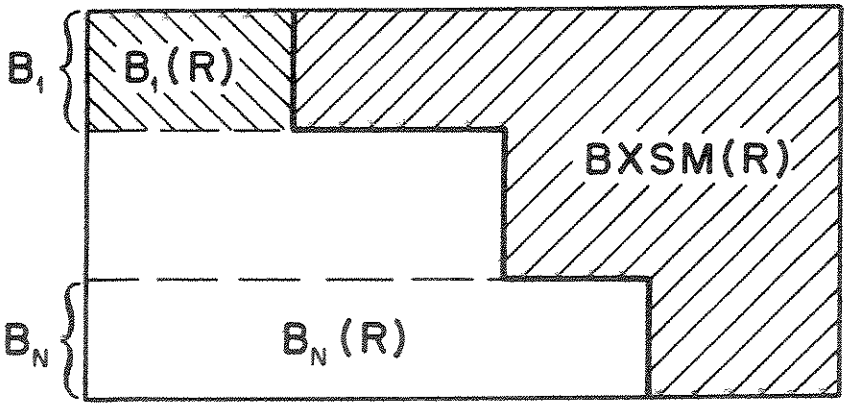
Note, these ratios are calculated automatically by the computer and not by the Engineer.

TYPICAL WATER USE ANALYSIS TABLE SCHEMATIC



$$\Sigma B(R) = B(R) + BXSM(R)$$

$$B(R) = B_1(R) + B_2(R) + \ldots . B_N(R)$$



$$\left.\begin{matrix} B_1(R) \\ \downarrow \\ B_N(R) \end{matrix}\right\} f\ (\text{Card } 3)$$

EXHIBIT J

COMPUTER USE OF BXS(RA) AND BXS(RB)
AS A FUNCTION OF TARIFF TYPE

The computer uses the BXS(RA) and BXS(RB) ratios in slightly different ways depending upon whether a minimum charge or a service charge tariff is being calculated. The two following simplified examples demonstrate this procedure which is reported on the printout under the heading B-2 Revenue - Meter Sub-Routine. In both cases, the smallest size meter is .625 inches.

Minimum Charge Tariff[11/]

Meter Size	No. of Bills Recorded	No. of Bills Test Year A
.750	Y	Y • BXS(RA)
1.000	Z	Z • BXS(RA)
	Y+Z	(Y+Z)BXS(RA)

Service Charge Tariff

Meter Size	No. of Bills Recorded	No. of Bills Test Year A
.625	X	Difference
.750	Y	Y • BXS(RA)
1.000	Z	Z • BXS(RA)
	X+Y+Z	(X+Y+Z)•B(RA)

Difference = (X+Y+Z) • B(RA) - (Y+Z) • BXS(RA)

While the smallest size meter is not used obviously in the minimum type calculation for determining meter revenue, it must always be listed along with all other meters on Card 4.

11/ Note Exhibit I for the procedure used in approximating the number of bills for all meters except the smallest where consumption exceeds respective meter size minimums.

CHAPTER 5

ONESHOT COMPUTATION

A. Procedure

As noted in the abstract, this type of run was developed to provide rapid analysis of the effect of consumption upon revenues. To use it, the Engineer merely includes the Forms CI (omitting an entry for cols. 43-44) and CD with the ESTREVS Form[1/] and adds the word ONESHOT to Card 1, spaces 1 through 7.

Since this procedure was developed prior to the formation of the Committee, it has been modified to bring it into line with the Committee's recommendation through providing the Engineer with the option to enter the word HORIZONTAL on Card 1, spaces 66 through 75. That instruction removes the time trend of unit consumption Q_t for years A and B and thus overall consumption changes only with respect to customer growth. Unit consumption for years A and B is thus the normalized consumption. See Chapter 6 and Exhibit M for the Committee recommendations.

B. Background

To connect CLIMATE to ESTREVS and thus carry out ONESHOT, the LINKUP program was developed. The flow diagram for LINKUP is shown on Exhibit K.2 and the summary description is in Exhibit K.1. The flow diagram shows that if forecast water consumption data is available, i.e., "yes", only the data as shown in Form ESTREVS is required to obtain estimated revenue figures from the computer. If such data is not available, then additional data to be recorded on Forms CI and CD is required, after which the computer will develop estimated revenues.

1/ See Exhibit L.1, pages 1-10, for typical time trend run ONESHOT printout. Page 1 shows the Forms CI and CD data, while page 10 shows the ESTREVS input data. Exhibit L.2 shows typical printout sheets for a HORIZONTAL run.

Basically, LINKUP connects CLIMATE and MUREG to ESTREVS by delivering recorded normalized and forecast water consumption, i.e.,

Q(R), Q(N), Q(A), and Q(B)

to the latter program.

A key advantage of using ONESHOT is that after the Engineer estimates his basic customer information (water use analysis, growth, and pricing data), the sensitivity relating to selection of reference weather station can be readily determined as the data input Form ESTREVS can be reused with any number of different weather stations. Thus the significance of changes of water consumption in terms of revenue (the final objective of this undertaking) can be quickly evaluated. In many cases, it may eliminate considerable research on weather station choice, reliable data, etc. This approach requires, however, that customer estimating rather than consumption estimating be done first, which is a reversal over the general past staff procedure and that the estimated water consumption be reasonable.

C. Examples

See Exhibit L.1 for the original ONESHOT procedure and Exhibit L.2 for the procedure adopted by the Committee in which time trend is ignored. Note L.1-7 versus L.2-2, Q values.

On Exhibit L.1, page L.1-1 shows the CI and CD data which was used to carry out CLIMATE with results shown on page L.1-7. Page L.1-8 shows the ESTREVS input data while L.1-9 provides the revenues. Page L.1-10 summarizes ESTREVS. Only L.1-9 and L.1-10 need be retained as ESTREVS records.

EXHIBIT K.1
Sheet 1 of 2

ONESHOT FLOW DIAGRAM DESCRIPTION

Overall Program:	ONESHOT
Calling Program:	LINKUP
Subroutines:	WEATHER
	MUREG
	ESTREVS

LINKUP

... reads user-supplied variable input	Furnish Form ESTREVS
... either	
... calls subroutines WEATHER and MUREG obtaining further input from them	Furnish Forms CI & CD
or	
... reads further input directly from user	Form ESTREVS, Line 1A required
... calculate ratios required by water revenue estimating subroutine ESTREVS	
... calls subroutine ESTREVS	

WEATHER

... reads user-supplied variable input	Forms CI & CD
... searches Weather Bureau tape for precipitation and temperature data (or reads precipitation and temperature from card input)	
... performs adjustments to data (adjusts for maximum monthly precipitation limit and interpolates for missing data; adjusts for billing cycle)	
... provides adjusted values to stepwise multiple regression subroutine MUREG (lists data and reasons for dropping data from list of adjusted values to be used subsequently)	

MUREG

... a stepwise multiple regression subroutine which provides normalized projected consumption values for input into subroutine ESTREVS

ESTREVS

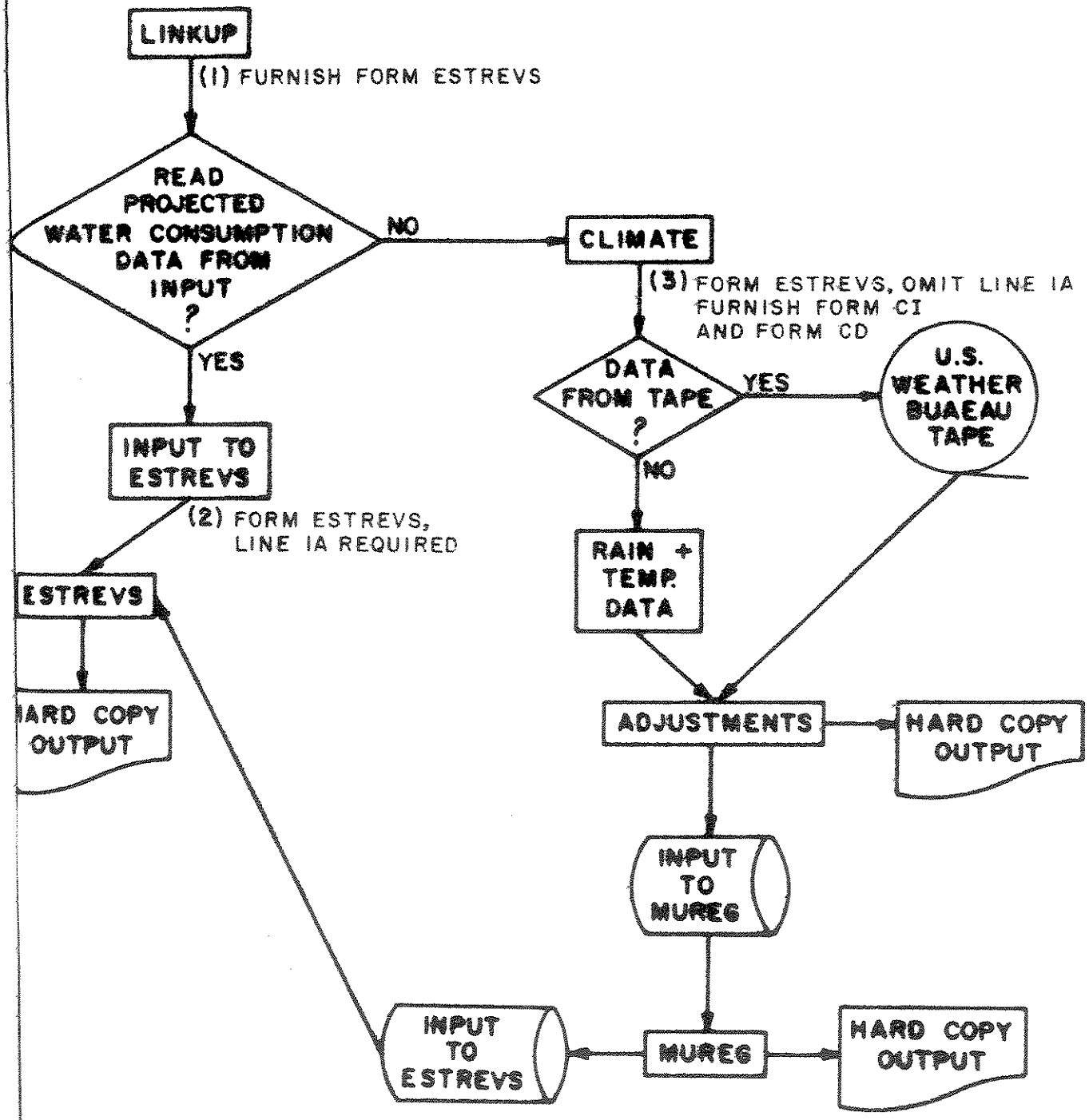
... reads user-supplied variable input — Form ESTREVS

... upon instruction, uses only last recorded normalized consumption as basis of Test Years A&B consumption; otherwise uses trended consumption values

... computes estimated revenues for water utilities

Flow Diagram

With use of Data Input Sheets shown



WATER CONSUMPTION ANALYSIS

NON-HORIZONTAL ONE-SHOT RUN

EXHIBIT L.1-1

DATE	:	08/25/76
STATION NAME	:	ONE SHOT DEMO 76
INPUT TYPE	:	T
MAXIMUM RAIN ALLOWED	:	4.
BILLING TYPE	:	M
GROUPING TYPE	:	A
STARTING YEAR FOR RAIN & TEMP	:	1944
MEAN RAIN/TEMP PERIOD (YEARS)	:	30
START YEAR WATER CONSUMPTION DATA	:	1966
WATER CONSUMPTION PERIOD (YEARS)	:	9
STATION NUMERICAL IDENT	:	5738

FORM CI INPUT DATA (from Exhibit A.1)

Calculated by computer from CI information

IDENTIFICATION	YEAR	CONSUMPTION	STATION
ONE SHOT DEMO 76	1966	404.20	5738
ONE SHOT DEMO 76	1967	426.10	5738
ONE SHOT DEMO 76	1968	414.00	5738
ONE SHOT DEMO 76	1969	392.90	5738
ONE SHOT DEMO 76	1970	415.70	5738
ONE SHOT DEMO 76	1971	412.90	5738
ONE SHOT DEMO 76	1972	433.20	5738
ONE SHOT DEMO 76	1973	420.50	5738
ONE SHOT DEMO 76	1974	420.10	5738

FORM CD
RECORDED DATA (from Exhibit A.2)

Note: Engineer requested in CI & CD that last year be 1974 even though Weather Tape contained 1975 data. Nine year span run.

EXHIBIT L.1-1

TAPE INPUT ** RAW DATA

					STATE	DIV	STATION	YEAR	MO	TEMP	PRECIP
0405	573894108	072B	99999	04	4	5	5738	941	8	72.B	999.99
0405	573894109	068M	00000	04	4	5	5738	941	9	68.M	.00
0405	573894110	060M	00057	04	4	5	5738	941	10	60.M	.57
0405	573894111	054B	00046	04	4	5	5738	941	11	54.B	.46
0405	573894112	048D	00423	04	4	5	5738	941	12	48.D	4.23
0405	573894201	046F	00171	04	4	5	5738	942	1	46.F	1.71
0405	573894202	048M	00176	04	4	5	5738	942	2	48.M	1.76
0405	573894203	053A	00153	04	4	5	5738	942	3	53.A	1.53
0405	573894204	057<	00448	04	4	5	5738	942	4	57.<	4.48
0405	573894205	061F	00058	04	4	5	5738	942	5	61.F	.58
0405	573894206	070F	00000	04	4	5	5738	942	6	70.F	.00
0405	573894207	076B	00000	04	4	5	5738	942	7	76.B	.00
0405	573894208	074A	00000	04	4	5	5738	942	8	74.A	.00
0405	573894209	068G	00000	04	4	5	5738	942	9	68.G	.00
0405	573894210	063F	00025	04	4	5	5738	942	10	63.F	.25
0405	573894211	052<	00182	04	4	5	5738	942	11	52.<	1.82
0405	573894212	045F	00216	04	4	5	5738	942	12	45.F	2.16
0405	573894301	045<	00184	04	4	5	5738	943	1	45.<	1.84
0405	573894302	050M	00122	04	4	5	5738	943	2	50.M	1.22
0405	573894303	054B	00388	04	4	5	5738	943	3	54.B	3.88
0405	573894304	059<	00127	04	4	5	5738	943	4	59.<	1.27
0405	573894305	066C	00000	04	4	5	5738	943	5	66.C	.00
0405	573894306	067<	99999	04	4	5	5738	943	6	67.<	999.99
0405	573894307	074M	00000	04	4	5	5738	943	7	74.M	.00
0405	573894308	071F	00000	04	4	5	5738	943	8	71.F	.00
0405	573894309	071F	00000	04	4	5	5738	943	9	71.F	.00
0405	573894310	061F	00033	04	4	5	5738	943	10	61.F	.33
0405	573894311	053D	00050	04	4	5	5738	943	11	53.D	.50
0405	573894312	047B	00123	04	4	5	5738	943	12	47.B	1.23
0405	573894401	046E	00244	04	4	5	5738	944	1	46.E	2.44
0405	573894402	048C	00352	04	4	5	5738	944	2	48.C	3.52
0405	573894403	054<	00025	04	4	5	5738	944	3	54.<	.25
0405	573894404	055G	00151	04	4	5	5738	944	4	55.G	1.51
0405	573894405	065B	00004	04	4	5	5738	944	5	65.B	.04
0405	573894406	068B	99999	04	4	5	5738	944	6	68.B	999.99
0405	573894407	073F	00000	04	4	5	5738	944	7	73.F	.00
0405	573894408	073A	00000	04	4	5	5738	944	8	73.A	.00
0405	573894409	072D	00005	04	4	5	5738	944	9	72.D	.05
0405	573894410	063F	00153	04	4	5	5738	944	10	63.F	1.53
0405	573894411	050M	00352	04	4	5	5738	944	11	50.M	3.52
0405	573894412	046D	00125	04	4	5	5738	944	12	46.D	1.25
0405	573894501	044<	00043	04	4	5	5738	945	1	44.<	.43
0405	573894502	050A	00270	04	4	5	5738	945	2	50.A	2.70
0405	573894503	050A	00262	04	4	5	5738	945	3	50.A	2.62
0405	573894504	059D	00021	04	4	5	5738	945	4	59.D	.21
0405	573894505	062D	00017	04	4	5	5738	945	5	62.D	.17
0405	573894506	072G	00015	04	4	5	5738	945	6	72.G	.15
0405	573894507	078B	00000	04	4	5	5738	945	7	78.B	.00
0405	573894508	073F	99999	04	4	5	5738	945	8	73.F	999.99
0405	573894509	070I	00028	04	4	5	5738	945	9	70.I	.28
0405	573894510	063F	00187	04	4	5	5738	945	10	63.F	1.87

TRACE

44.0° F

50.1° F

ADJUSTED VALUES ← *Adjusted for maximum monthly rainfall and billing cycle*

YEAR	RAIN	TEMP	WATER
66.	7.46	60.8	404.20
67.	13.06	60.8	426.10
68.	12.75	61.3	414.00
69.	14.65	61.3	392.90
70.	13.15	62.2	415.70
71.	8.21	60.3	412.90
72.	8.77	61.1	433.20
73.	16.97	61.5	420.50
74.	12.09	62.0	420.10

NUMBER OF OBSERVATIONS	=	9
SUM R ADJ	=	11.181
SUM T ADJ	=	60.686
NO.YRS. WB DATA USED	=	30 ← *If 2 or more consective items (months, temperature or rainfall) missing, year will be dropped and missing years will be listed.*

MULTIPLE REGRESSION ANALYSIS

PROBLEM ONE SHOTEMO 76

OBSERVATIONS 9

	t	R	T	Q
SUM OF VARIABLES	.63000E+03	.10712E+03	.55125E+03	.37396E+04
MEAN OF VARIABLES	.70000E+02	.11903E+02	.61250E+02	.41551E+03
STANDARD DEVIATIONS	.27386E+01	.31629E+01	.59262E+00	.11829E+02
CORRELATION COEFFICIENTS				
t	.10000E+01	.22873E+00	.43709E+00	.40594E+00
R	.22873E+00	.10000E+01	.56233E+00	-.67902E-01
T	.43709E+00	.56233E+00	.10000E+01	.64507E-01
Q	.40594E+00	-.67902E-01	.64507E-01	.10000E+01

Columns always printed out in same order.

Used to determine $\frac{\text{Std Err } Y}{\text{Mean } Q}$

Standard Deviation of $Y = \sqrt{\frac{\Sigma (Q(R) - Q(M))^2}{n-1}}$

Exponent: correlation of T with Q is .064507 (typical)

```
STEPWISE REGRESSION CASE          1

DEPENDENT VARIABLE                4

F-LEVEL TO ENTER             ,00000

F-LEVEL TO REMOVE            ,00000

STANDARD ERROR OF Y     ,1182851E+02


   STEP NO,               1

   ENTERED VARIABLE       1

     F-LEVEL                      1,38112
     STANDARD ERROR OF Y     ,1155643E+02
     MULTIPLE CORRELATION         ,40594
     R-SQUARED                    ,16479
     RES DEG OF FREEDOM                7
     SUM OF SQ RESIDUALS     ,93486E+03
     EXPLAINED VARIATION     ,18445E+03
     CONSTANT TERM             292,77778

       VARIABLE     BETA PRIME      BETA          SE(BETA)       STUDENT T
           1       ,40594E+00    ,17533E+01     ,14919E+01     ,11752E+01


   STEP NO,               2

   ENTERED VARIABLE       2

     F-LEVEL                      ,20250
     STANDARD ERROR OF Y     ,1227692E+02
     MULTIPLE CORRELATION         ,43824
     R-SQUARED                    ,19206
     RES DEG OF FREEDOM                6
     SUM OF SQ RESIDUALS     ,90434E+03
     EXPLAINED VARIATION     ,21497E+03
     CONSTANT TERM             288,59797

       VARIABLE     BETA PRIME      BETA          SE(BETA)       STUDENT T
           1       ,44474E+00    ,19209E+01     ,16281E+01     ,11798E+01
           2      -,16963E+00   -,63437E+00     ,14097E+01    -,45000E+00
```

Always t, but need not be step No. 1

See standard texts for detailed explanation of statistical terms.

Always R but need not be step no. 2

Higher the better

Prefer value at least > |1.0|

Coefficients of regression equation if only printout through Step 2 is to be used.

```
STEP NO.          3

ENTERED VARIABLE  3
```

Always T

```
  F-LEVEL                    .01266
  STANDARD ERROR OF Y    .1343170E+02
  MULTIPLE CORRELATION       .44057
  R-SQUARED                  .19410
  RES DEG OF FREEDOM              5
  SUM OF SQ RESIDUALS    .90205E+03
  EXPLAINED VARIATION    .21726E+03
  CONSTANT TERM           353.78762

    VARIABLE     BETA PRIME      BETA          SE(BETA)       STUDENT T
        1        .46399E+00    .20040E+01    .19284E+01     .10392E+01
        2       -.14078E+00   -.52648E+00    .18162E+01    -.28988E+00
        3       -.59134E-01   -.11803E+01    .10491E+02    -.11250E+00

  ANALYSIS OF VARIANCE
  TERM        SS              DF      MS
  TOTAL    .11193E+04          8
    REG    .21726E+03          3    .72419E+02
    ERR    .90205E+03          5    .18041E+03
```

Used to determine Std. Err. Y/mean Q

Per Committee recommendation, note Beta has illogical sign, return to Step 2 and:

a) Calculate Std. Err. Y/mean Q for use in selecting span.

b) If 9 year span is optimum, calculate consumption by equation (From Step 2)

$Q_{74N}^{CCF/MY} = 288.59797 + 1.9209\,t - .63437\,R$

$= 288.59797 + 1.9209(74) - .63437(11.18) = 423.66$

c) Then modify Consumption and Summary portions of ESTREVS

RESIDUALS

OBS	Y=OBSERVED	Y=CALCULATED	DIFFERENCE	SQUARED	FIRST DIFFERENCES	SQUARED	RATIO Y=O/Y=C	RESIDUAL/STD ERROR RATIO =4 =3 =2 =1 0 +1 +2 +3 +4
1	.40420E+03	.41039E+03	=.61876E+01	.38286E+02	.0	.0	.98492	X
2	.42610E+03	.40943E+03	.16669E+02	.27785E+03	.22856E+02	.52241E+03	1.04071	X
3	.41400E+03	.41104E+03	.29622E+01	.87744E+01	=.13707E+02	.18787E+03	1.00721	X
4	.39290E+03	.41197E+03	=.19068E+02	.36358E+03	=.22030E+02	.48532E+03	.95372	X
5	.41970E+03	.41377E+03	.19295E+01	.37231E+01	.20997E+02	.44089E+03	1.00466	X
6	.41290E+03	.42058E+03	=.76811E+01	.59000E+02	=.96107E+01	.92365E+02	.98174	X
7	.43320E+03	.42133E+03	.11869E+02	.14086E+03	.19550E+02	.38219E+03	1.02817	X
8	.42050E+03	.41853E+03	.19735E+01	.38946E+01	=.98951E+01	.97914E+02	1.00472	X
9	.42010E+03	.42257E+03	=.24660E+01	.60812E+01	=.44395E+01	.19709E+02	.99416	X
								** ** ** ** ** ** ** ** **
			PERCENTAGE OF OBSERVATIONS FALLING IN THE ABOVE CLASSES					0 0 0 22 55 22 0 0 0

Values obtained by use of Step No 3 equation with R avg. and T avg.

DURBIN=WATSON STATISTIC .24707E+01

SUM OF SQUARES OF FIRST DIFFERENCES OF RESIDUAL IS .37216E+01

RANGE OF Y=OBSERVED IS .40300E+02

RANGE OF Y=CALCULATED IS .13135E+02

	YEAR	Q	SUMRA	SUMTA
NORMALIZED	.74000E+02	.42457E+03	.11181E+02	.60686E+02
TEST YR A	.75000E+02	.42658E+03	.11181E+02	.60686E+02
TEST YR B	.76000E+02	.42858E+03	.11181E+02	.60686E+02

Estimated Water Consumption

ADJUSTED R=SQUARED =.28944

STD. ERR. Y / MEAN Q .03233

Note: Ratio for Span of 9 Years with Data from Mean of Variables & Step 3 from prior sheet. In this case, per Committee, use step 2 from L.1-6 to hand calculate Q 74N = 423.65 CCF/MY instead of 424.57 CCF/MY shown here. Q75N & Q76N also determined per step 2 equation using t = 75 and 76 respectively.

END OF REGRESSION

RUN IDENTIFICATION : ONESHOTDEM DATE : 76/ 9/ 1 TARIFF TYPE : MINIMUM CHARGE MONTHLY BILLING CYCLE

PREFACE PAGE * ESTIMATED WATER REVENUES * LISTING OF DATA + RATIOS USED IN THIS RUN

INPUT DATA	IDENT	VALUES	
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	420.1	Received automatically from CLIMATE via LINKUP
NORMALIZED	Q(N)	424.6	
TEST YEAR A FORECAST	Q(A)	426.6	
TEST YEAR B FORECAST	Q(B)	428.6	
RECORDED AVG NO OF BILLS PER YEAR	B(R)	19140.0	FORM ESTREVS Cards 1 and 1A
TEST YEAR A FORECAST	B(A)	19836.0	
TEST YEAR B FORECAST	B(B)	.0	
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BXS(R)	5706.0	
TEST YEAR A FORECAST	BXS(A)	5915.0	
TEST YEAR B FORECAST	BXS(B)	.0	
RECORDED REVENUE	R(R)	149670.0	

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC)	1.0000000	TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN)	1.0106481	TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA)	1.0523425	TO CHANGE REC YR CONSUMPTION TO TEST YR "A" CONSUMPTION
RATIO Q(RB)	.0000000	TO CHANGE REC YR CONSUMPTION TO TEST YR "B" CONSUMPTION
RATIO B(RA)	1.0362518	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "A" BILLS
RATIO B(RB)	.0000000	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "B" BILLS
RATIO BXS(RA)	1.0366281	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "A" BILLS (EXCEPT SMALLEST METER)
RATIO BXS(RB)	.0000000	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "B" BILLS (EXCEPT SMALLEST METER)

NUMBER OF RATE BLOCKS = 5
NUMBER OF METER SIZES = 7

RECORDED DATA YEAR R

Card #2

RATE BLOCK UPPER LIMIT (CCF)
10
30
100
500
1000

Card #3

REC NO OF BILLS PER RATE BLOCK
2625
5103
4228
1390
88

Card #10

REC CONSUMPTION PER RATE BLOCK CCF PER YEAR
47577
94350
210211
244922
73041

Card #8 / Card #9

CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
2.86000	3.75000
.25400	.37500
.20700	.30300
.14200	.15000
.10600	.15000

Card #4

METER SIZES (INCHES)
.625
.750
1.000
1.500
2.000
3.000
4.000

Card #5

AVG NO OF BILLS BY METER SIZE
2625.
3749.
1416.
275.
250.
8.
8.

Card #6 / Card #7

METER CHARGES $ PER MONTH PRESENT	METER CHARGES $ PER MONTH PROPOSED
2.860	3.750
3.150	4.000
4.000	5.650
6.850	11.000
10.300	16.000
21.000	30.000
30.000	50.000

FORM ESTREVS Cards 2 to 10

RUN IDENTIFICATION : ONESHOTDEM DATE : 76/ 9/ 1 TARIFF TYPE : MINIMUM CHANGE

C : GRAND TOTALS = REVENUE IN DOLLARS PER YEAR

PAGE 10

ROUTINE	COMPUTED YEAR PRESENT	COMPUTED YEAR PROPOSED	NORMALIZED YEAR PRESENT	NORMALIZED YEAR PROPOSED	TEST YEAR "A" PRESENT	TEST YEAR "A" PROPOSED	TEST YEAR "B" PRESENT	TEST YEAR "B" PROPOSED
B=1	140,203	191,552	141,374	193,115	147,055	200,857		
B=2	22,340	30,661	22,340	30,661	23,158	31,784		
TOTALS	162,543	222,213	163,714	223,776	170,214	232,642		
RRCR ADJUSTED TOTALS	149,670	204,615	150,789	206,054	156,733	214,218		

REVENUE ESTIMATES

Used to determine RRCR shown on L.1-10.
RRCR applied to Normalized and Test.
Years A and B revenue estimates.

RUN IDENTIFICATION : ONESHOTDEM DATE : 76/ 9/ 1 TARIFF TYPE : MINIMUM CHARGE MONTHLY BILLING CYCLE

SUMMARY PAGE = DATA AND RATIOS FROM PREFACE PAGE PLUS R(C) AND RRCR

INPUT DATA	IDENT	VALUES
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	420.1
NORMALIZED	Q(N)	424.6
TEST YEAR A FORECAST	Q(A)	426.6
TEST YEAR B FORECAST	Q(B)	428.6
RECORDED AVG NO OF BILLS PER YEAR	B(R)	19140.0
TEST YEAR A FORECAST	B(A)	19836.0
TEST YEAR B FORECAST	B(B)	.0
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BXS(R)	5706.0
TEST YEAR A FORECAST	BXS(A)	5919.0
TEST YEAR B FORECAST	BXS(B)	.0
RECORDED REVENUE	R(R)	149670.0
REVENUE VIA WATER USE TABLE BY COMPUTER	R(C)	162542.8

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC)	1.0000000	TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN)	1.0106481	TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA)	1.0523425	TO CHANGE REC YR CONSUMPTION TO TEST YR "A" CONSUMPTION
RATIO Q(RB)	.0000000	TO CHANGE REC YR CONSUMPTION TO TEST YR "B" CONSUMPTION
RATIO B(RA)	1.0362518	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "A" BILLS
RATIO B(RB)	.0000000	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR "B" BILLS
RATIO BXS(RA)	1.0366281	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "A" BILLS (EXCEPT SMALLEST METER)
RATIO BXS(RB)	.0000000	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR "B" BILLS (EXCEPT SMALLEST METER)
RATIO RRCR	.9208037	REVENUE ADJUSTMENT FACTOR (REC YR R / COMPUTED YR R)

NUMBER OF RATE BLOCKS = 5
NUMBER OF METER SIZES = 7

Note inclusion of RRCR value

RECORDED DATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	REC NO OF BILLS PER RATE BLOCK	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
10	2625	47577	2.86000	3.75000
30	5103	94350	.25400	.37500
100	4228	210211	.20700	.30300
500	1390	244922	.14200	.15000
1000	88	73041	.10600	.15000

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER CHARGES $ PER MONTH PRESENT	METER CHARGES $ PER MONTH PROPOSED
.625	2625.	2.860	3.750
.750	3749.	3.150	4.000
1.000	1416.	4.000	5.650
1.500	275.	6.850	11.000
2.000	250.	10.300	16.000
3.000	8.	21.000	30.000
4.000	8.	30.000	50.000

DATE : 76/ 9/ 1 TARIFF TYPE : MINIMUM CHARGE

C : GRAND TOTALS = REVENUE IN DOLLARS PER YEAR

HORIZONTAL ONE-SHOT RU

PAGE 10

ROUTINE	COMPUTED YEAR PRESENT	COMPUTED YEAR PROPOSED	NORMALIZED YEAR PRESENT	NORMALIZED YEAR PROPOSED	TEST YEAR "A" PRESENT	TEST YEAR "A" PROPOSED	TEST YEAR "B" PRESENT	TEST YEAR "B" PROPOSED
B=1	140,203	191,552	141,374	193,115	146,511	200,132		
B=2	22,340	30,661	22,340	30,661	23,158	31,784		
TOTALS	162,543	222,213	163,714	223,776	169,670	231,916		
RRCR ADJUSTED TOTALS	149,670	204,615	150,749	206,054	156,233	213,549		

Note only minor changes from L.1-9

5-16

EXHIBIT L.2-1

RUN IDENTIFICATION : ONESHOTDEM DATE : 76/ 9/ 1 TARIFF TYPE : MINIMUM CHARGE MONTHLY BILLING CYCLE

SUMMARY PAGE = DATA AND RATIOS FROM PREFACE PAGE PLUS R(C) AND RRCR

INPUT DATA	IDENT	VALUES
RECORDED CONSUMPTION CCF PER METER YEAR	Q(R)	420.1
NORMALIZED	Q(N)	424.6
TEST YEAR A FORECAST	Q(A)	424.6
TEST YEAR B FORECAST	Q(B)	424.6
RECORDED AVG NO OF BILLS PER YEAR	B(R)	19140.0
TEST YEAR A FORECAST	B(A)	19836.0
TEST YEAR B FORECAST	B(B)	.0
RECORDED AVG NO OF BILLS PER YEAR (EXCEPT SMALLEST METER)	BXS(R)	5706.0
TEST YEAR A FORECAST	BXS(A)	5915.0
TEST YEAR B FORECAST	BXS(B)	.0
RECORDED REVENUE	R(R)	149670.0
REVENUE VIA WATER USE TABLE BY COMPUTER	R(C)	162542.8

Result of inserting word Horizontal on Card 1

CALCULATED RATIOS FROM INPUT DATA

RATIO Q(RC)	1.0000000	TO CHANGE REC YR CONSUMPTION TO COMPUTED YR CONSUMPTION (ALWAYS 1.0000000)
RATIO Q(RN)	1.0106481	TO CHANGE REC YR CONSUMPTION TO NORMALIZED YR CONSUMPTION
RATIO Q(RA)	1.0473989	TO CHANGE REC YR CONSUMPTION TO TEST YR =A= CONSUMPTION
RATIO Q(RB)	.0000000	TO CHANGE REC YR CONSUMPTION TO TEST YR =B= CONSUMPTION
RATIO B(RA)	1.0368518	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR =A= BILLS
RATIO B(RB)	.0000000	TO CHANGE ALL THE REC YR BILLS TO ALL THE TEST YR =B= BILLS
RATIO BXS(RA)	1.0366281	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR =A= BILLS (EXCEPT SMALLEST METER)
RATIO BXS(RB)	.0000000	TO CHANGE THE REC YR BILLS (EXCEPT SMALLEST METER) TO TEST YR =B= BILLS (EXCEPT SMALLEST METER)
RATIO RRCR	.9208037	REVENUE ADJUSTMENT FACTOR (REC YR R / COMPUTED YR R)

Note change from non-Horizontal, run per L.1-9

No change expected

NUMBER OF RATE BLOCKS = 5
NUMBER OF METER SIZES = 7

RECORDED DATA YEAR R

RATE BLOCK UPPER LIMIT (CCF)	REC NO OF BILLS PER RATE BLOCK	REC CONSUMPTION PER RATE BLOCK CCF PER YEAR	CONSUMPTION CHARGES PRESENT	CONSUMPTION CHARGES PROPOSED
10	2625	47577	2.86000	3.75000
30	9103	94350	.25400	.37500
100	4228	210211	.20700	.30300
500	1390	244922	.14200	.15000
1000	88	73041	.10600	.15000

METER SIZES (INCHES)	AVG NO OF BILLS BY METER SIZE	METER CHARGES $ PER MONTH PRESENT	METER CHARGES $ PER MONTH PROPOSED
.625	2625.	2.860	3.750
.750	3749.	3.150	4.000
1.000	1416.	4.000	5.650
1.500	275.	6.850	11.000
2.000	250.	10.300	16.000
3.000	8.	21.000	30.000
4.000	8.	30.000	50.000

CHAPTER 6

PUC - CWA CONSUMPTION REVENUE COMMITTEE METHOD

With the encouragement of the Chief of the Hydraulic Branch of the CPUC, a committee composed of representatives from the Commission and California Water Association was organized in late 1975 to attempt to develop a fundamental method of forecasting normalized water consumption (basically of the residential or commercial class), which could be used as a standard.[1/]

After several meetings and independent analyses, the committee made a final recommendation[2/] to Chief of the Hydraulic Branch on June 12, 1976 which was accepted. The recommendation was made on the assumption that the long-term increase of water consumption as a function of time that has been observed over many years will not persist in the next few years as a result of water conservation efforts, price elasticity, and other causes. (While a decrease of consumption has generally been observed in recent years in this state, should a reversal be observed, the staff might return to its former method of forecasting unit consumption changing with time.)

The method arrived at is based upon the use of annual rather than quarterly or other shorter increment data plus other simplifications in the application of statistical theory. These simplifications were made knowingly, but it is our belief that under the limitations imposed by the requirement that the staff assist in the regulation of over 400 utilities, they appear to provide reasonable estimates.

1/ The committee was composed of the following:

CPUC	CWA
A. Tokmakoff, Chairman	W. Caveney, So. Calif. Water Co.
D. H. Weiss	R. Haytens, San Gabriel Water Co.
	E. Catey, Calif. Water Servc. Co.
	W. Ferry, Brown & Caldwell, Consulting Engr.
	D. Conway, Park Water Co.

2/ See Exhibit M.

It should also be noted that after some use of the Committee method as shown below, the computer may be partially reprogrammed to allow for automatic analysis (such as is done with ONESHOT) via the Committee's method. See Exhibit N.

RECOMMENDATION OF THE BASIC METHOD OF WATER CONSUMPTION ESTIMATION IN TERMS OF THE EXISTING PUC COMPUTER PROGRAMS

A. Basic Procedure

1. Graph observations (recorded unit consumption) versus time. Use up to 13 years of data (when available). Each point is a value Q(r).

2. Perform ONESHOT runs covering spans of 5 to 13 years (when available) with the last year of the span always being the last complete recorded year.

3. Note that occasionally for a particular run, coefficients having illogical signs[3] will appear. When that occurs, review the MUREG portion of the printout and work backwards from the number three step to the number one step, disregarding those steps with illogical signs. Take the first step one finds that contains all logical signs and using the basic regression equation discussed in Chapter 2, Part A.3. and compute estimated normalized and other consumptions as required by hand. Determine the standard error - span mean consumption rates for use in the following step.[4]

Note that as an alternate, the Engineer may also use the procedures of Chapter 3 with forms MI and MD to eliminate illogical variables, or substitute weather information. ONESHOT can provide source data for the forms.

4. Select as the reference run that one having a span which provides the least standard error of the equation as a percentage of span mean consumption.

3/ Illogical signs being a plus for rainfall and a minus for temperature. See p

4/ The Standard Error is defined as: $SE = \sqrt{\frac{\Sigma(Q(c) - Q(r))^2}{n - k - 1}}$

The Mean Consumption is listed on the right hand column of the printout under the term, Mean of the Variables.

5. The reference run regression equation $Q = K + at + bR_{avg} + cT_{avg}$ is to be used to obtain the estimate of normalized consumption for the last recorded year.[5/] That value will be taken as the normalized consumption for that year plus the following two years. R and T are the 30-year billing adjusted values. As usual, monthly rainfall input is to be limited to 4 inches maximum.

Remember by entering the word HORIZONTAL in the ESTREVS form, that operation will be carried out automatically in the ONESHOT program.

6. Add to the graph noted in paragraph 1, the adjusted points (corresponding to the mean or normalized rainfall and temperature) using the coefficients from the reference run.[6/]

7. Adopt results if they appear reasonable. If they do not, discuss results with the Assistant Hydraulic Engineer for Results of Operations Studies.

B. Substitute Procedure

Instead of using ONESHOT, the engineer may as noted in Chapter 2, Part B, use CLIMATE requesting a series of runs with 5 to 13-year spans using only Forms CI (fill in columns 43-44) and CD. He then may analyze these runs as per Steps 3, 4 and 5 above, and then use the ESTREVS program to compute revenue for the selected span run only.

C. Example

See Exhibit L.1 for development of typical MUREG equation by hand using a time trend run.

See Exhibit L.2 for a HORIZONTAL run.

5/ If the last recorded year data is not used in the regression analysis, the extrapolated value to the last recorded year will be used as the normalized value.

6/ Adding the calculated points (corresponding to the rainfall and temperature associated with each year in the selected span) will also indicate the validity of the reference run equation. Each point is a value of Q(c). The closer the points Q(r) to Q(c) means the better the equation. These values are printed out as shown on L.1-7. Note that even though the adjusted R-squared value is poor, indicating only moderate fit and/or little slope, the Q(r) and Q(c) values are not too far apart.

EXHIBIT M

Recommendation of the Basic Method of Water Consumption Estimation

A. Basic Procedure

1. Graph observations (recorded unit consumption) versus time. Use up to 13 years of data (when available).

2. Perform multiple regression analysis runs covering spans of 5 to 13 years (when available) with the last year of the span always being the last complete recorded year.

3. For any particular span run, reject those coefficients having illogical signs[1] and redo the particular run without them.

4. Select as the reference run that one having a span which provides the least standard error of the equation as a percentage of span mean consumption.

5. The reference run regression equation $Q = K + at + bR + cT$ is to be used to obtain the estimate of normalized consumption for the last recorded year.[2] That value will be taken as the normalized consumption for that year plus the following two years. R + T are the 30-year billing adjusted values. As usual, monthly rainfall input is to be limited to 4 inches maximum.

6. Add to the graph in paragraph 1, the adjusted points (corresponding to the mean or normalized rainfall and temperature) using the coefficients from the reference run.[3]

7. Adopt results if they appear reasonable.

B. Alternate Procedures

Utilize other procedures if the above does not appear satisfactory.

1/ Illogical signs being a plus for rainfall and a minus for temperature.

2/ If the last recorded year data is not used in the regression analysis, the extrapolated value to the last recorded year will be used as the normalized value. Note $c \leq o$ and $d \geq o$.

3/ Adding the calculated points (corresponding to the rainfall and temperature associated with each year in the selected span) will also indicate the validity of the reference run equation.

EXHIBIT N

FUTURE COMPUTER PROGRAMMING

A revised ONESHOT program taking into account the Committee's recommendations would do the following:

1. Per CLIMATE input forms CI and CD carry out up to nine CLIMATE runs covering a range of 5 to 13 observations.
2. Check the signs of Student T to be sure Variable 2 (rainfall) is negative and Variable 3 (temperature) is positive. If one or both are of incorrect sign (illogical), drop the variable. Order of variable analysis precedence for each particular span run is to be from the third step back through the second to the first step. If procedure results in dropping all three variables, that span run is to be omitted from consideration. Indicate by message, action taken. Print out all variables, however, whether or not used.
3. Using last acceptable step, calculate consumption as is done currently in the CLIMATE, printout, and store for each span run.
4. Printout and store standard error ratio for last acceptable step for each span run.
5. Determine from all runs which one has least standard error ratio and transfer those consumption values to LINKUP.
6. Perform ESTREVS calculation to determine revenue for least standard error span run.

While the procedure described above constitutes the Hydraulic Branch's final requirement for a revenue estimating program, it would be wise in setting up the program to bear in mind that at some future date it may wish to carry out step 2 using the Student's T table.

CHAPTER 7

SUMMARY

The procedures discussed in this report are simple but require that the Engineer understand the Water Use Analysis Table. With practice, the methods discussed can be carried out most expeditiously and in addition, will leave very clear records for those who follow and must use the water consumption and revenue estimate reports in the future for other rate cases, offsets, etc., (all the printout pages need not be retained - retention of the input and summary pages only provide sufficient information to quickly rerun any work to get the complete job as required).

With additional rate case work, new applications and approaches to using these computer programs will evolve which will further reduce engineering effort and time or provide the basis of more detailed analysis in difficult cases.