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(192)

Internal Memo
Lahontan Regional Water Quality Control Board

To: Judith Unsicker, ES IV

From: John Steude, WRCE
Alan Miller, SWRCE

Date: 6/1/01

Subject: Summary of water quality analysis for potential CWA 303(d) listing of the lower of the West Fork of the Carson River.

Introduction

This memo presents the results of a statistical analysis of water quality data for the West Fork of the Carson River. Specifically, the Mean of Monthly Means (MOMM) for nine water quality parameters were calculated and plotted for twenty years (1981 – 2000) of data obtained for the lower reaches of the West Fork of the Carson River. MOMM values represent the grand annual average of all monthly values for a specific sampling location obtained in a particular month (typically, one sample per month). The water quality parameters analyzed (i.e., TDS, Cl, SO_4, TP, B, % Na, TN, TKN, and NO_3) correspond to the water quality objectives for the Carson River in the *Water Quality Control Plan for the Lahontan Region* (Basin Plan). Table 3-14 of the Basin Plan contains numeric water quality objectives by reach for each of the parameters listed above (Appendix I). This memo presents a comparison of the objectives and the statistical data.

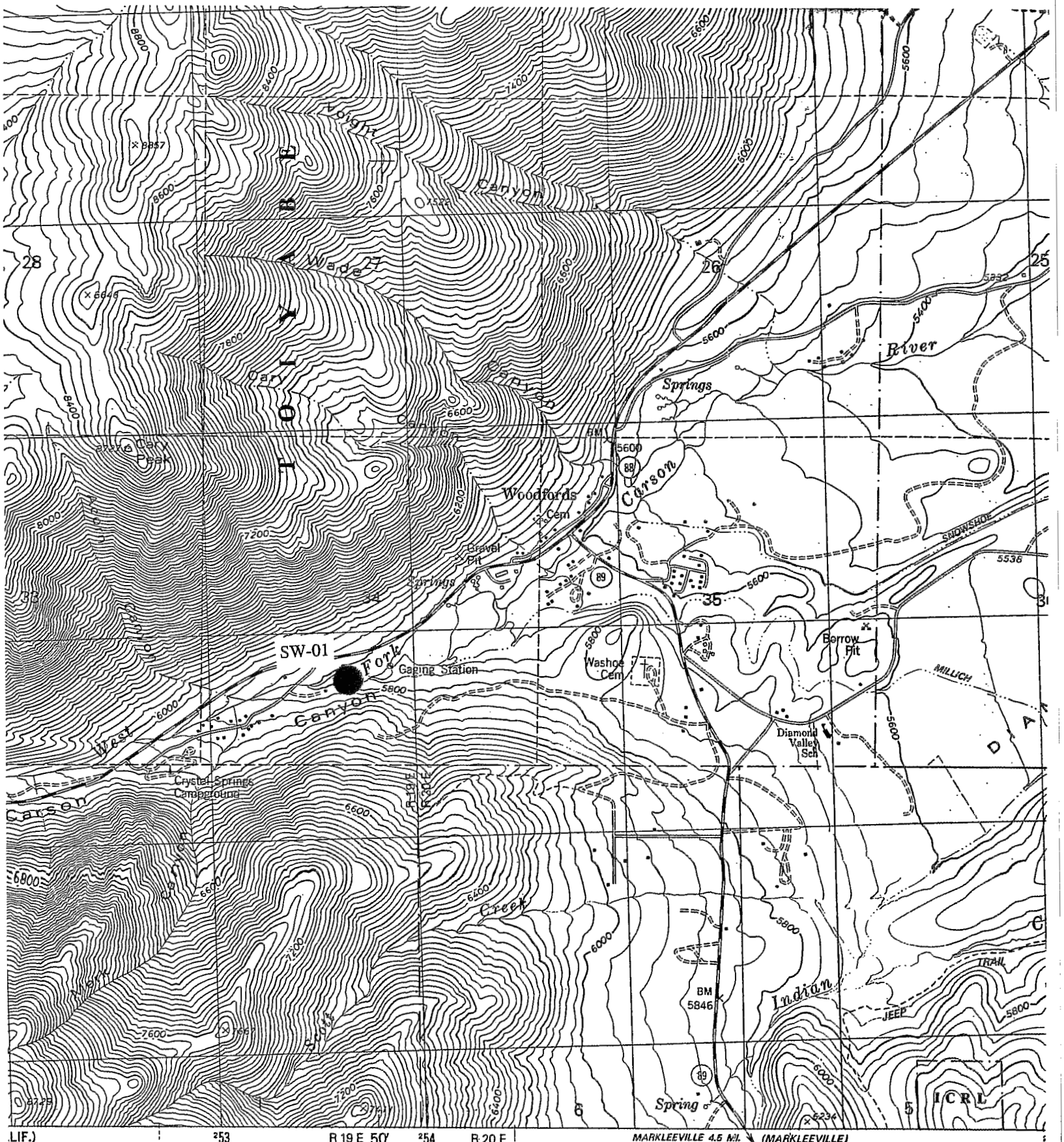
Five-year moving averages of the MOMM data for each parameter were also analyzed to aid in the identification of any trends in water quality. The first five-year moving average was calculated by averaging the first five years of MOMM results. For each subsequent year, a new average was calculated after subtracting the oldest year and adding the next year.

The purpose of this evaluation is to determine whether water quality objectives are being met in the West Fork of the Carson River and to determine if these waters should be considered for listing as impaired under the Clean Water Act Section 303(d) requirements.

The South Tahoe Public Utility District (STPUD) routinely conducts monthly sampling and analyzes of water from the lower reaches of the West Fork of the Carson River. The STPUD sampling points of interest in this evaluation, SW-01 and SW-05, are located near Woodfords, California (T 11 N, R 19 E) and Paynesville, California (T 11 N, R 20 E), respectively. The locations are shown on Figures 1 and 2. STPUD also conducts monitoring at Stateline (SW-06) and Dressler (SW-09) located on the Carson River in Nevada. These locations, however, are typically not monitored during winter months and would produce skewed MOMM values. The location at Dressler is only sampled during May and November each year. Hence, no MOMM results are presented here for Stateline and Dressler.

At Paynesville, the Nevada Division of Environmental Protection (NDEP) also conducts sampling and analyses of water quality. No map has been provided for this sampling location and it should be noted that NDEP does not analyze all of the parameters corresponding to water

Figure 1 – Woodfords Sampling Location (SW-01)
(Adapted from USGS Woodfords 7.5' Quadrangle)



Survey

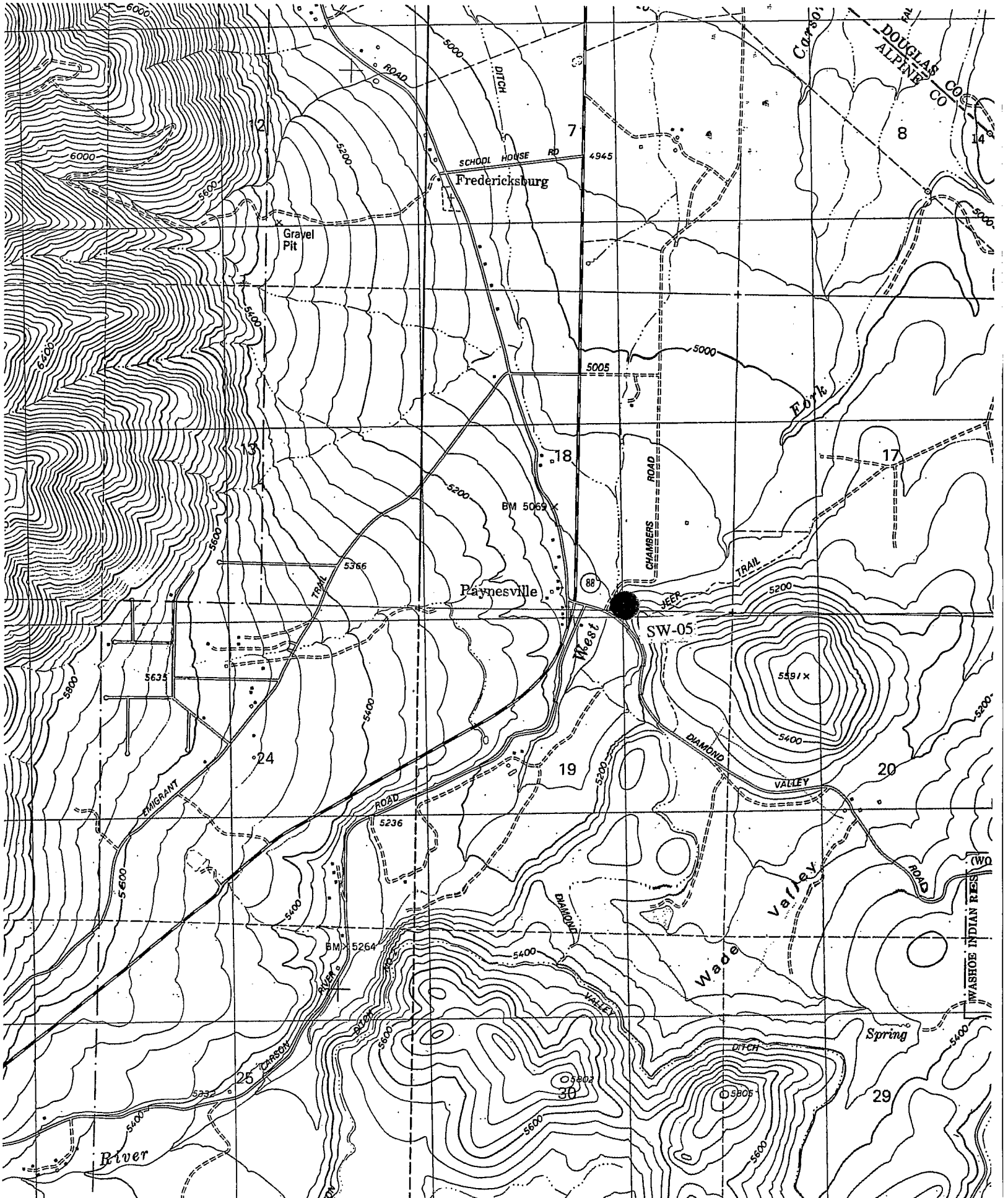
1979

SCALE 1:24 000

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

Figure 2 – Paynesville Sampling Location (SW-05)
(Adapted from USGS Woodfords 7.5' Quadrangle)



quality objectives in California. Since 1995, NDEP has conducted their sampling and analysis every two months, instead of monthly, as was the case before 1995. Nevertheless, data obtained from Nevada can be used to supplement and correlate the data from California.

Results

The results of MOMM calculations for the past 20 years indicate that TDS and Cl values are within objective values. However, values for SO4, TP, B, % Na, TN, TKN, and NO3 are not meeting objectives. A summary of the MOMM results is shown in the table below. In all cases, the values presented here are in milligrams per liter (mg/L).

SUMMARY OF CALIFORNIA RESULTS FOR THE CARSON RIVER – WEST FORK

Parameter	Woodfords MOMM ('81 – '00)	Woodfords MOMM Objective	Woodford Percent of Objective*	Paynesville MOMM ('81 – '00)	Paynesville MOMM Objective	Paynesville Percent of Objective*
TDS	52	55	94	60	70	85
CL	1.0	1.0	105**	1.7	2.5	67
SO4	**3.4**	2.0	**170**	**4.2**	2.0	**208**
Total P	**0.03**	0.02	**137**	0.03	0.03	111**
B	**0.05**	0.02	**228**	**0.03**	0.02	**140**
% Na	**21.7**	20.0	**109**	**23.0**	20.0	**115**
Total N	**0.22**	0.15	**144**	**0.27**	0.25	**109**
TKN	**0.20**	0.13	**155**	**0.21**	0.22	94
NO3	**0.04**	0.02	**187**	**0.06**	0.03	**191**

* Percent of objective calculated as: (MOMM / Objective) x 100.
** In compliance when using the same number of significant figures as in the objective.

Results of the MOMM calculations for each water quality parameter are tabulated in Appendix II. The results in Appendix II are graphically presented on the following pages for each parameter listed above. The graphs are presented in this order:

- Comparison of MOMM values and five-year moving averages with the objectives for Woodfords. (Figures 3, 6, 9, 12, 15, 18, 21, 24, and 27)

- Comparison of MOMM values and five-year moving averages with the objectives for Paynesville. (Figures 4, 7, 10, 13, 16, 19, 22, 25, and 28)

- A graphical comparison of the Paynesville MOMM values from both STPUD and NDEP. (Figures 5, 8, 11, 14, 17, 20, 23, 26, and 29)

This order was selected for easy comparisons between Woodfords and Paynesville data as well as easy comparisons of STPUD and NDEP data for each parameter (e.g., all TDS results are presented in Figures 3, 4, and 5).

Discussion

Total Dissolved Solids

The MOMM values for TDS at Woodfords and Paynesville over the past twenty years are 52 and 60, respectively. Compared with objectives of 55 for Woodfords and 70 for Paynesville, these MOMM values are within water quality objectives (Figures 3 and 4). Average values for the past five years at Woodfords and Paynesville are 54 and 61 and suggest that current TDS levels are within the objective values. The comparison of California and Nevada data for Paynesville shows close agreement (Figure 5). The 20-year MOMM values from California and Nevada are 60 and 61, respectively.

Chloride Ion

The MOMM values for Cl at Woodfords and Paynesville over the past twenty years are 1.0 and 1.7, respectively. Compared with objectives of 1.0 and 2.5, respectively, the value for Woodfords is at the objective level and the Paynesville value is well below the objective value (Figures 6 and 7). Average values for the past five years are 1.2 and 1.3 indicating that the current trend at Woodfords is above the objective for Cl while, at Paynesville, the current trend is below the objective. The California and Nevada Cl values at Paynesville are also in close agreement and support the determination that Cl levels are within the objective for Paynesville (Figure 8).

Sulfate Ion

The MOMM values for SO4 at Woodfords and Paynesville over the past twenty years are 3.4 and 4.2, respectively. Compared with an objective of 2.0 for both locations, the data indicate that the SO4 MOMM values are consistently above the objective (Figures 9 and 10). Average values for the past five years (2.4 and 2.6) indicate that the current trend is closer to the objective value than the 20-year MOMM, but still above the objective value. The SO4 data from Nevada for the past five years (no earlier SO4 data was reported) indicate that the average SO4 value is 2.0 which is the same as the objective value. In this case, the California and Nevada data are not in close agreement and an unexplained discrepancy is noted (Figure 11).

Total Phosphorus

The MOMM values for TP at Woodfords and Paynesville over the past twenty years are both 0.03. Compared with objectives of 0.02 and 0.03, respectively, the value for Woodfords is above the objective and the value for Paynesville is equal to the objective (Figures 12 and 13).

Average values for the past five years of 0.04 and 0.03 indicate that the recent trend is above the objective at Woodfords and equal to the objective at Paynesville. It should also be noted that the recent Woodfords data is heavily weighted by the high TP value for 1997. The Paynesville TP data from California and Nevada is supported by the same MOMM value of 0.03 (Figure 14).

Boron

The MOMM values for B for the past twenty years are 0.05 and 0.03 for Woodfords and Paynesville, respectively. Compared with an objective value of 0.02 for the MOMM, both locations are above the objective value (Figures 15 and 16). It should be noted that the results are heavily weighted by very high annual averages in 1985 for both locations and in 1988 for Woodfords. The five year average values of 0.02 and 0.01 for Woodfords and Paynesville, respectively, indicate that recent trends are within the objectives for both locations. NDEP does not include B in their test series (Figure 17).

Percent Sodium

The MOMM values for % Na are not valid for the entire twenty-year record. Until June 1993, the values of 1.0 reported by STPUD were not reasonable and could not be used in this evaluation. Therefore, only the MOMM values from 1994 forward are considered valid and are utilized for the statistical analysis. The MOMM values for % Na at Woodfords and Paynesville are 21.7 and 23.0, respectively. Compared with an objective of 20.0 at both locations, the MOMM values for % Na are slightly above the objective (Figures 18 and 19). Nevada does not include % Na in their test series (Figure 20).

Total Nitrogen

The MOMM values for TN for the past twenty years at Woodfords and Paynesville are 0.22 and 0.27, respectively. Compared with objective values of 0.15 and 0.25, both locations are above the MOMM objectives (Figures 21 and 22). Average values of 0.24 and 0.26 for the past five years indicate that current trends of TN are above the objectives. The MOMM value for TN from Nevada data is 0.31. This value supports the California data that indicates the MOMM value for TN is above the objective for Paynesville (Figure 23).

Total Kjeldahl Nitrogen

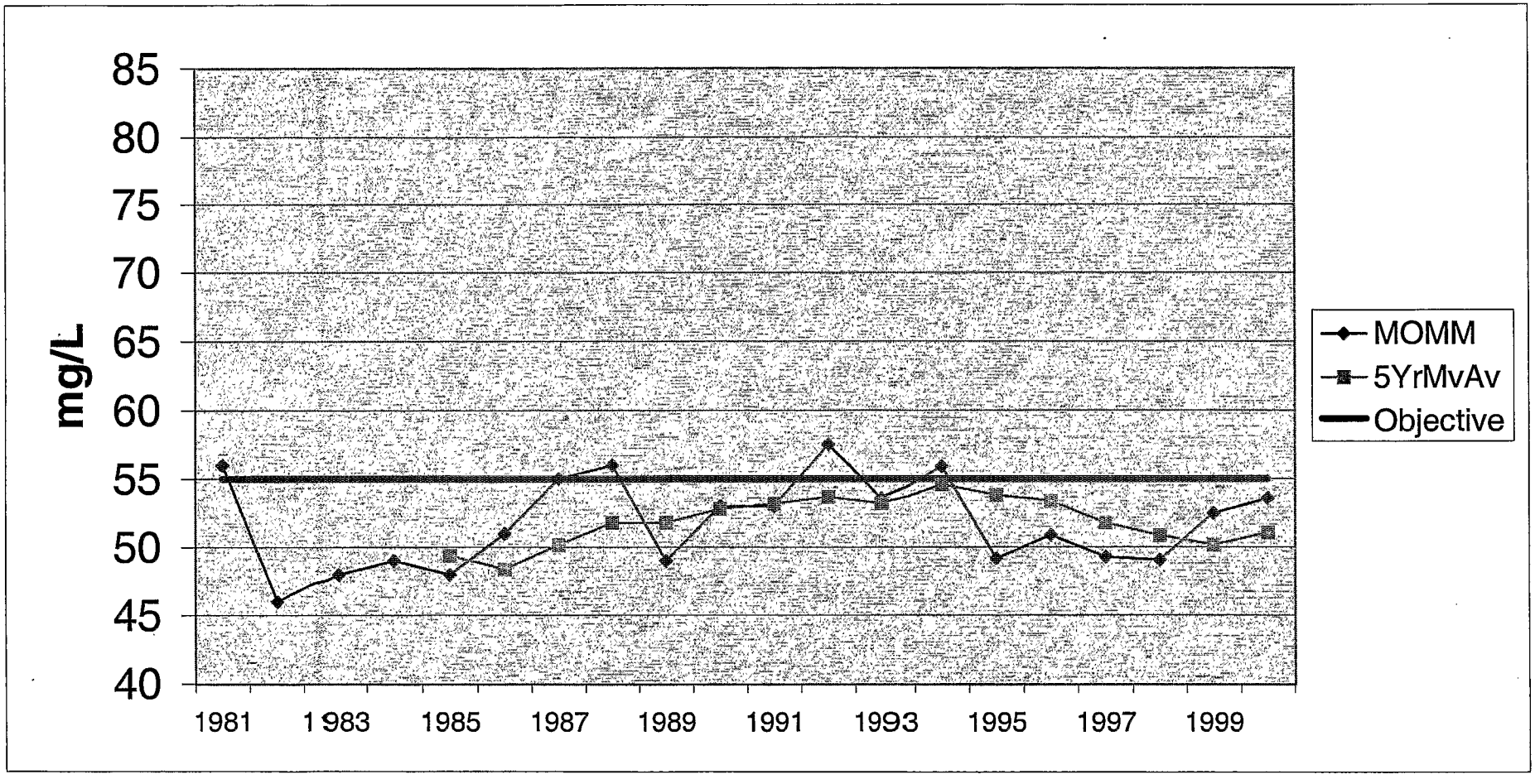
The MOMM values for TKN (organic N) for the past nine years at Woodfords and Paynesville are 0.20 and 0.21, respectively. (No TKN data was reported prior to 1991.) Compared with objectives of 0.13 and 0.22, the MOMM value for Woodfords is above the objective and the Paynesville value is within the objective (Figures 24 and 25). Average MOMM values of 0.19 and 0.20 for the past five years are slightly better than the longer record indicates, but are not significantly different. The MOMM value for TKN in Paynesville is in close agreement with the value of 0.22 determined from Nevada data (Figure 26).

Nitrate Ion

The MOMM values for NO3 for the past twenty years at Woodfords and Paynesville are 0.04 and 0.06, respectively. Compared with objective values of 0.02 and 0.03, both locations have MOMM values for NO3 that are above the objectives (Figures 27 and 28). Average values of 0.04 and 0.05 from the past five years are very similar to the values determined from the

FIGURE 3 - TOTAL DISSOLVED SOLIDS AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE



twenty-year record. The MOMM value for NO3 determined from Nevada data at Paynesville is 0.08 and is significantly higher than the California data (Figure 29).

Conclusions

With the exceptions of TDS and Cl, all other water quality parameters (i.e., SO4, TP, B, % Na, TN, TKN, NO3) are above the objective MOMM values in the Basin Plan. Given these results, it may be prudent to consider listing the West Fork of the Carson River as impaired with respect to selected water quality parameters.

FIGURE 3 - TOTAL DISSOLVED SOLIDS AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

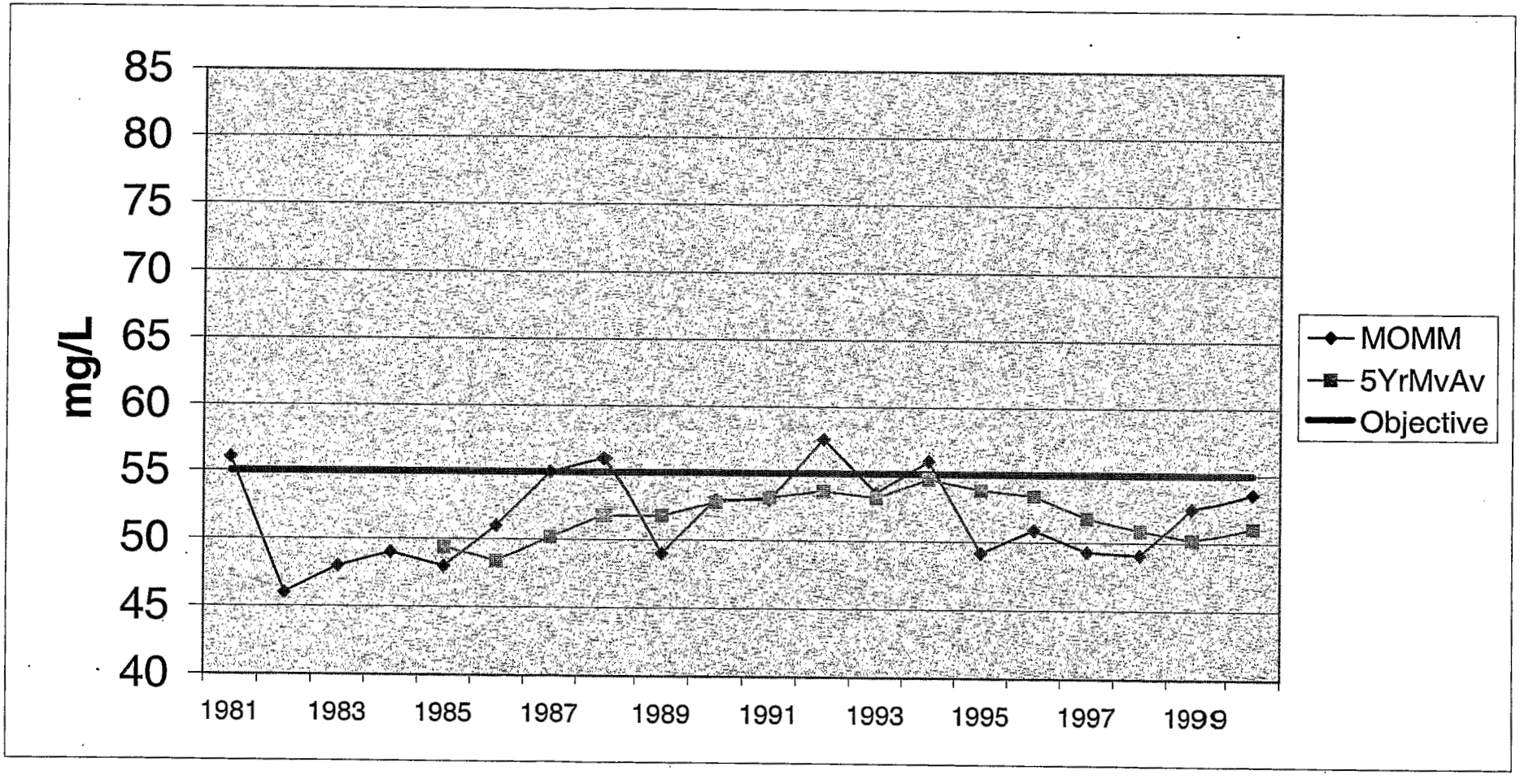


FIGURE 3 - TOTAL DISSOLVED SOLIDS AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
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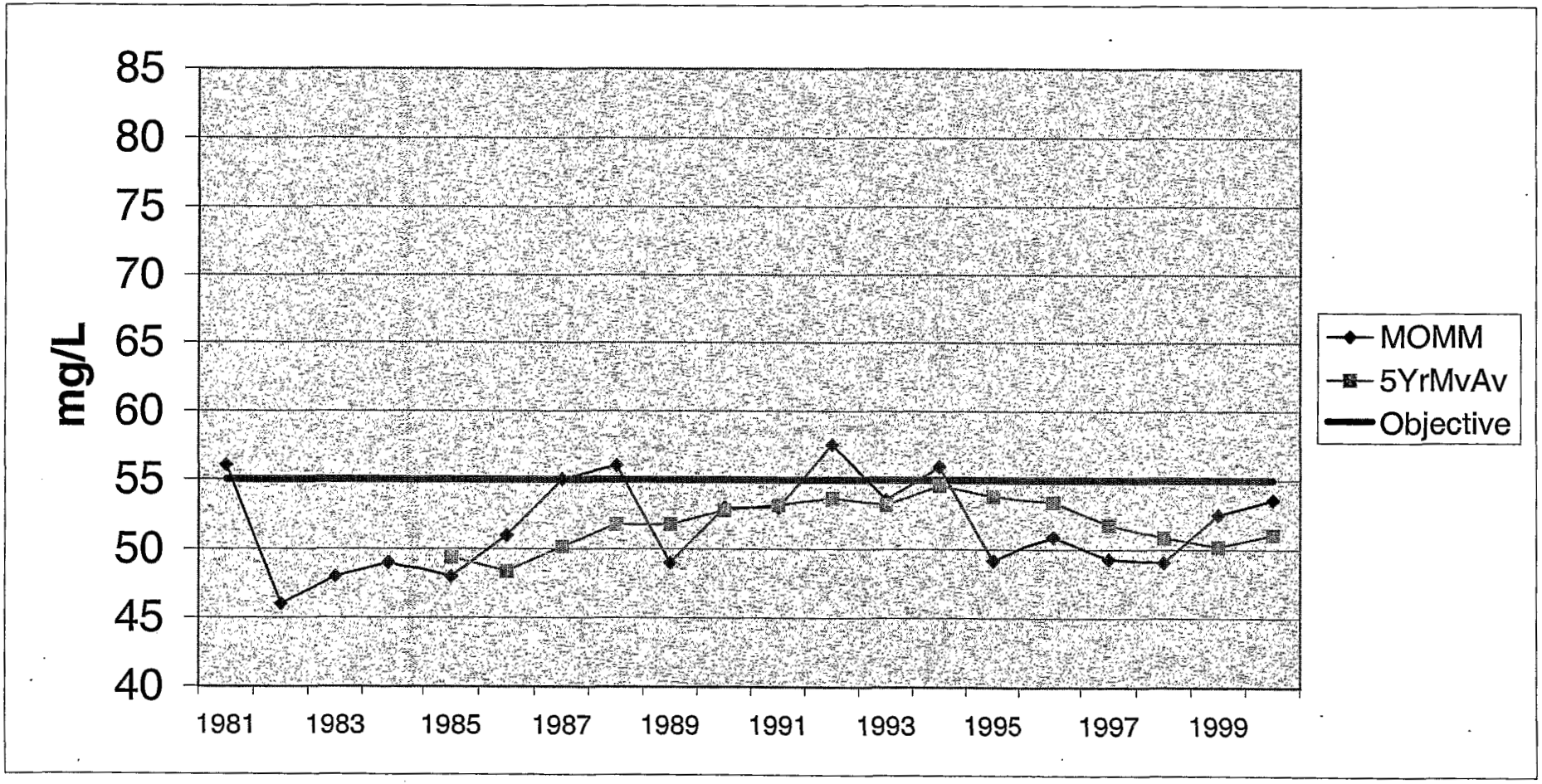


FIGURE 4 - TOTAL DISSOLVED SOLIDS AT PAYNESVILLE

WEST FORK OF CARSOM RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

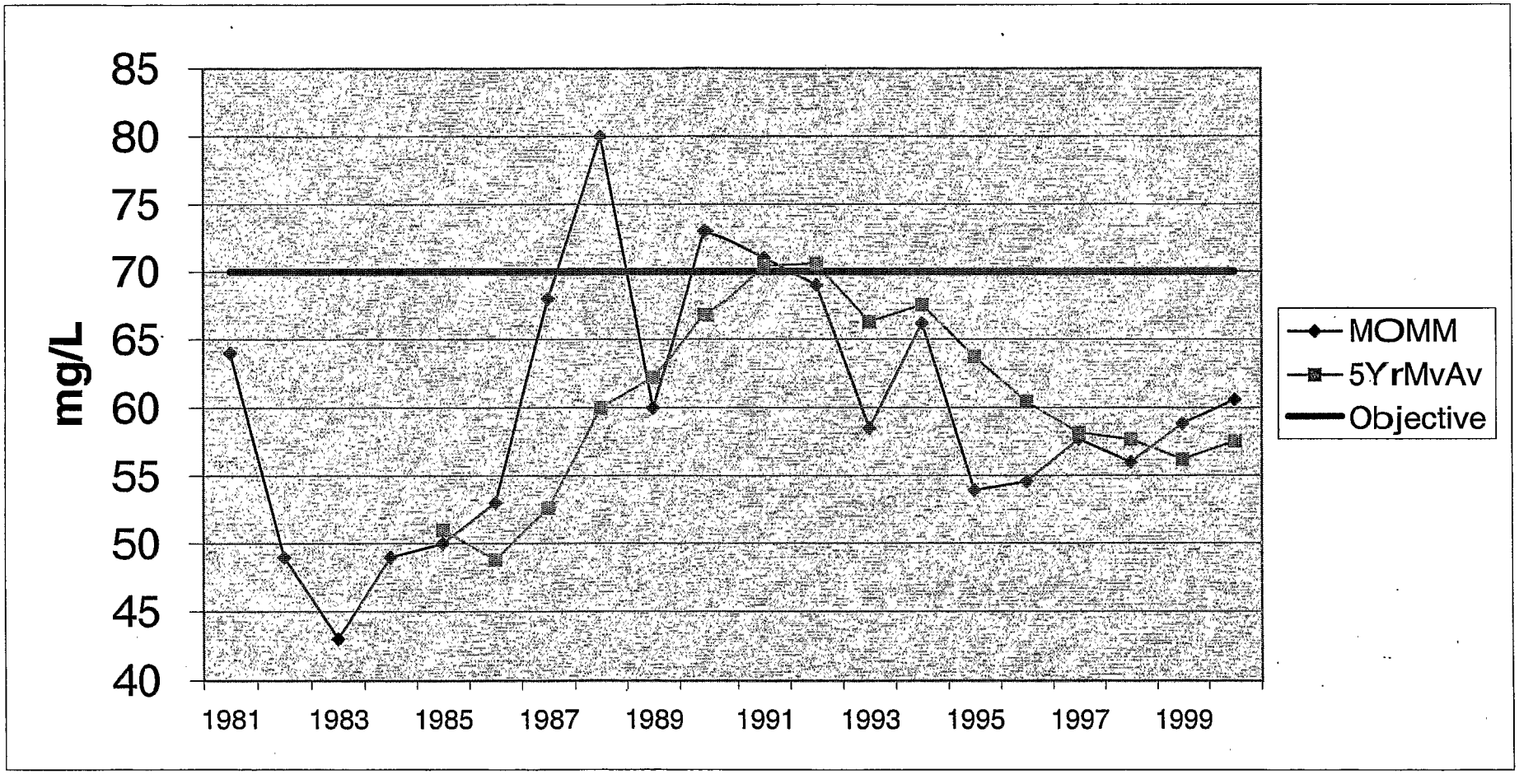


FIGURE 5 - TOTAL DISSOLVED SOLIDS AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE

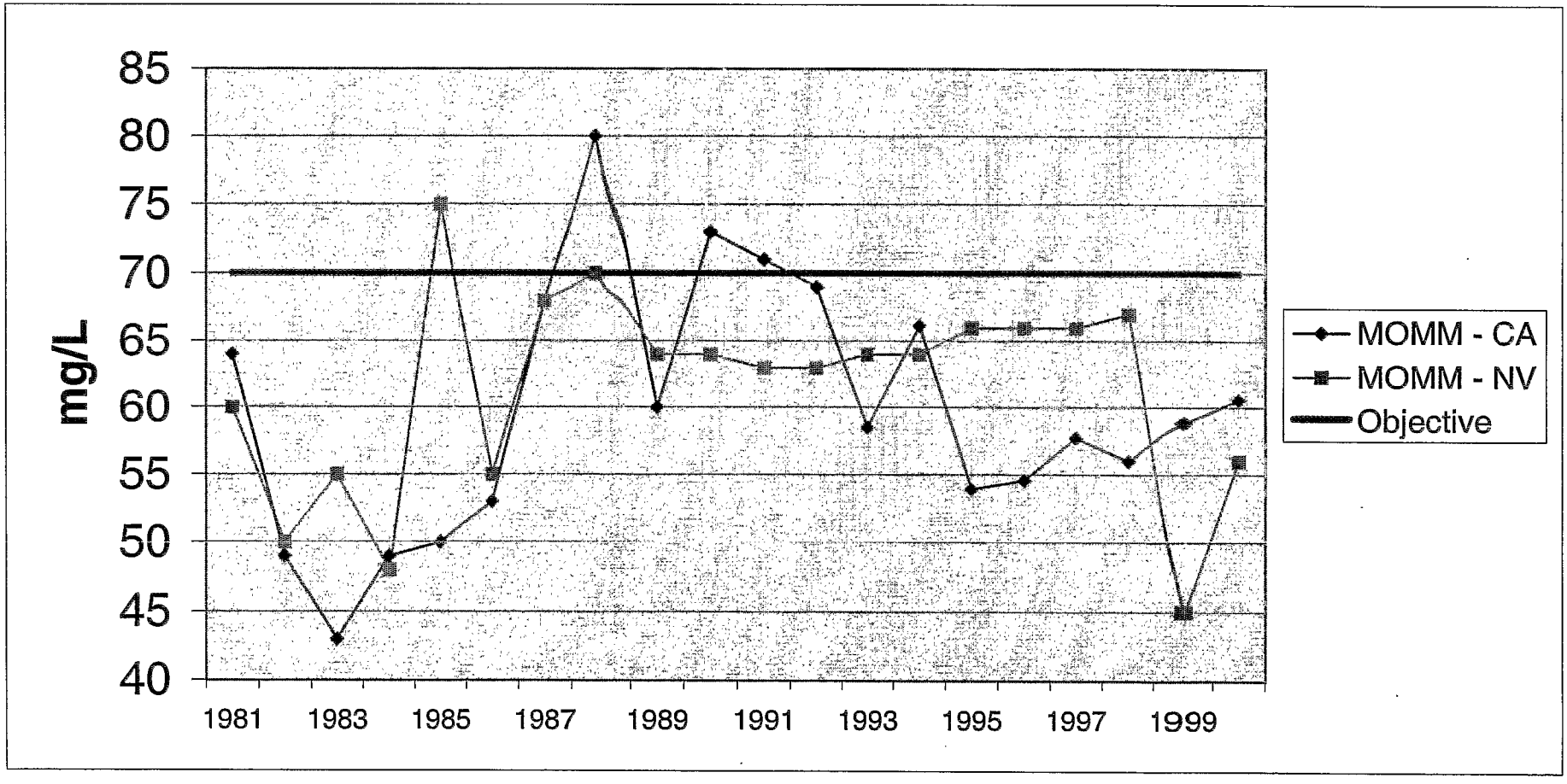


FIGURE 6 - CHLORIDE AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

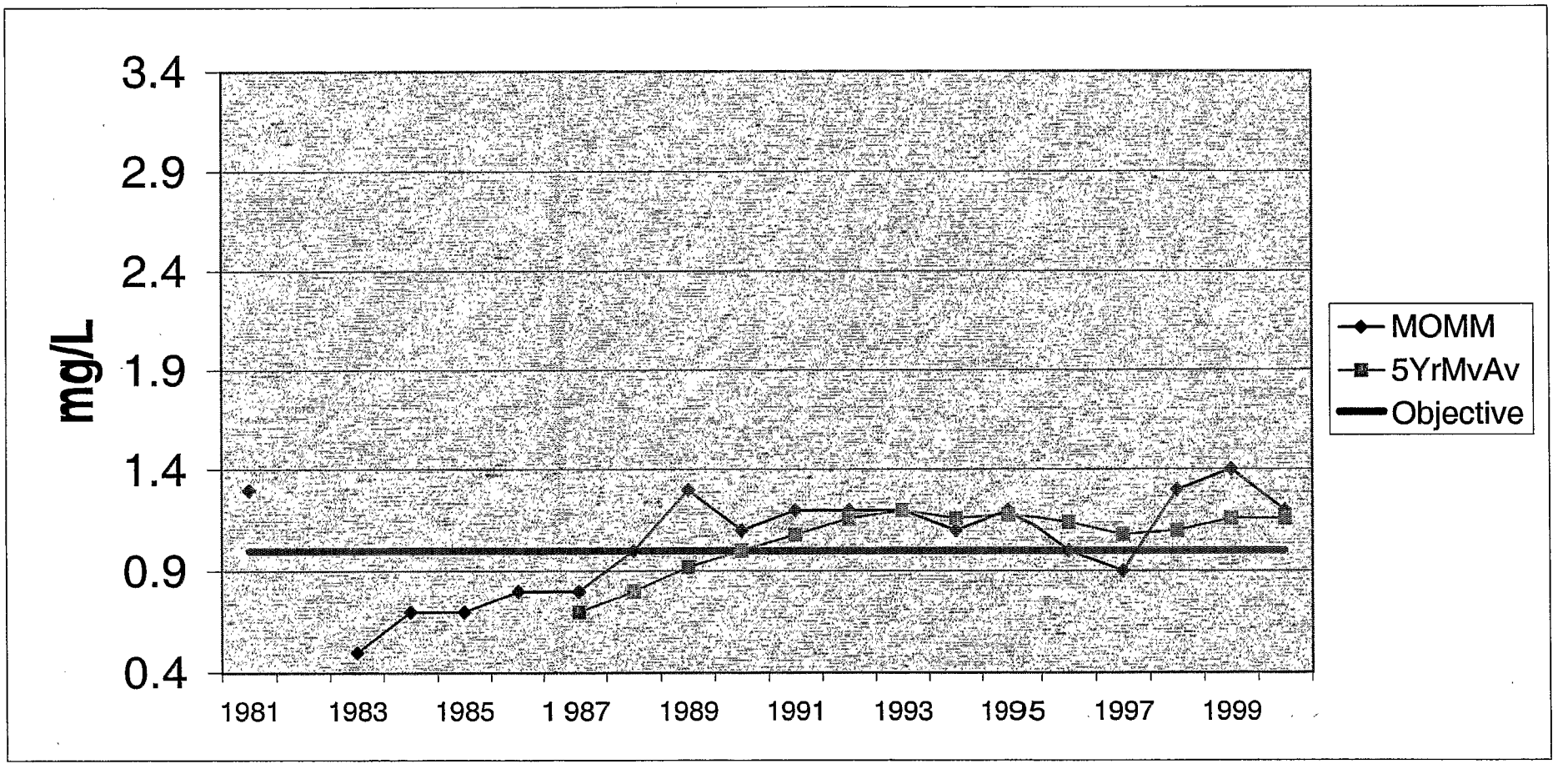


FIGURE 7 - CHLORIDE AT PAYNESVILLE

WEST FORK OF CARSOM RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

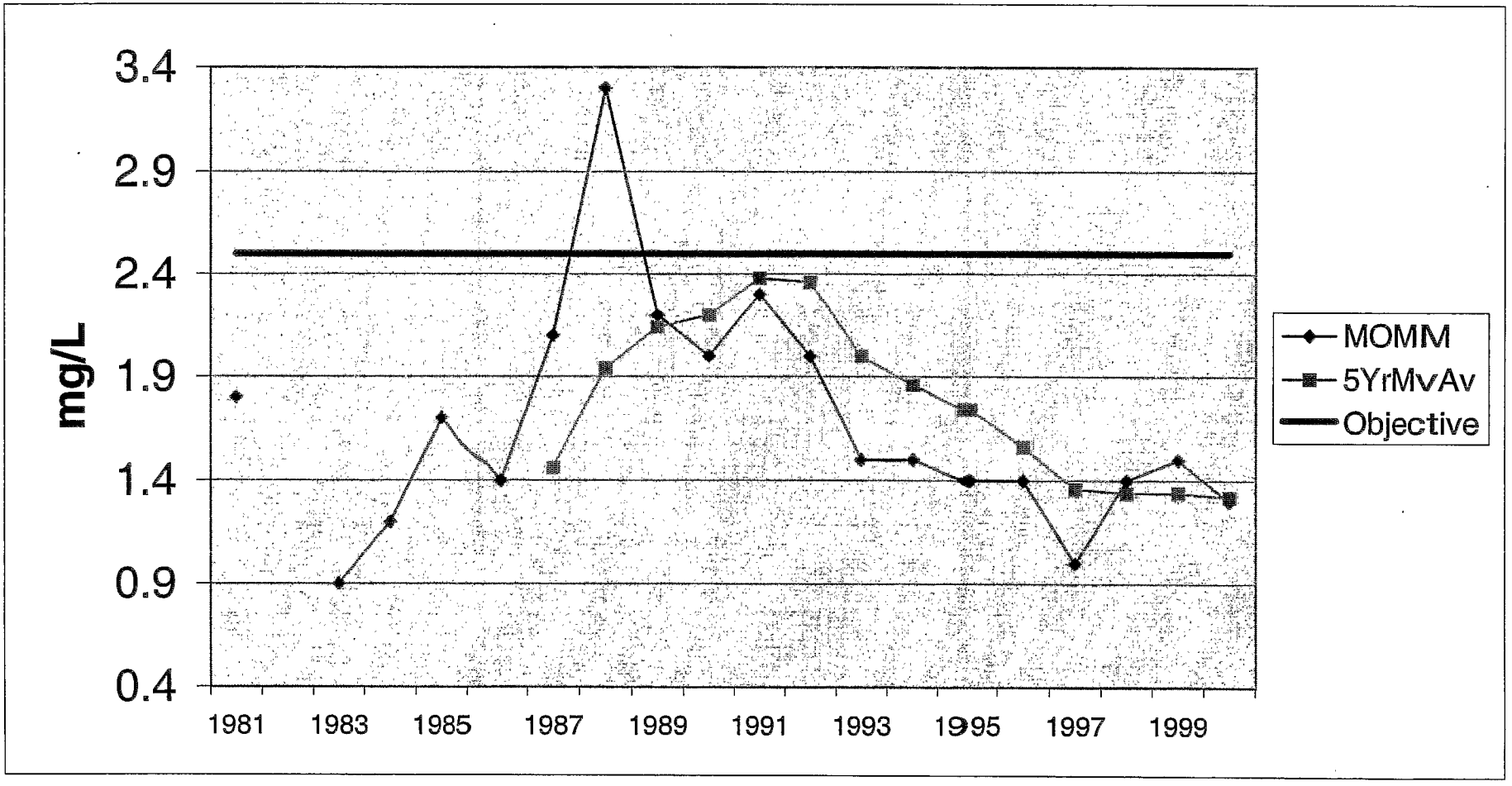


FIGURE 8 - CHLORIDE AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE

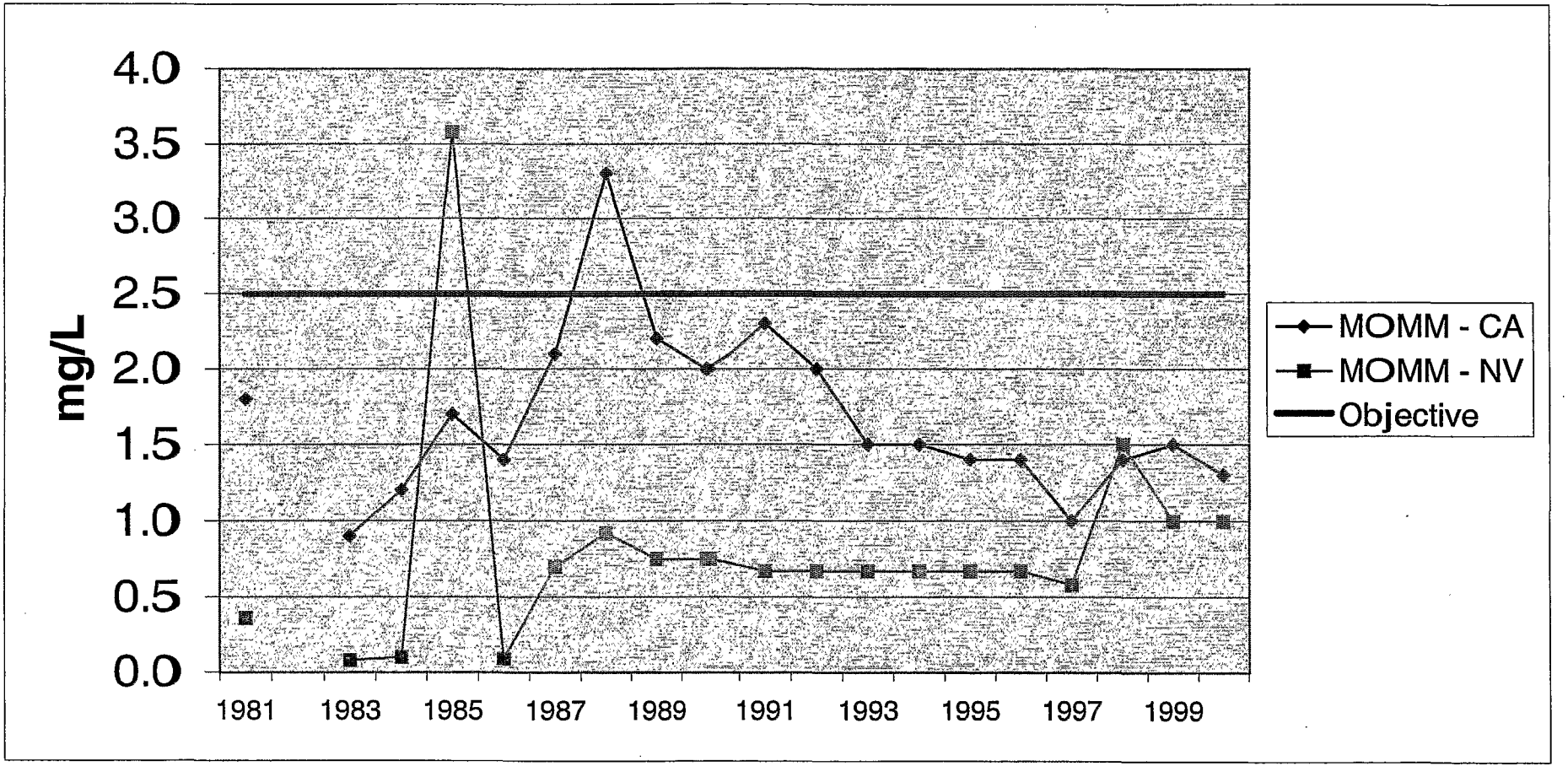


FIGURE 9 - SULFATE AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

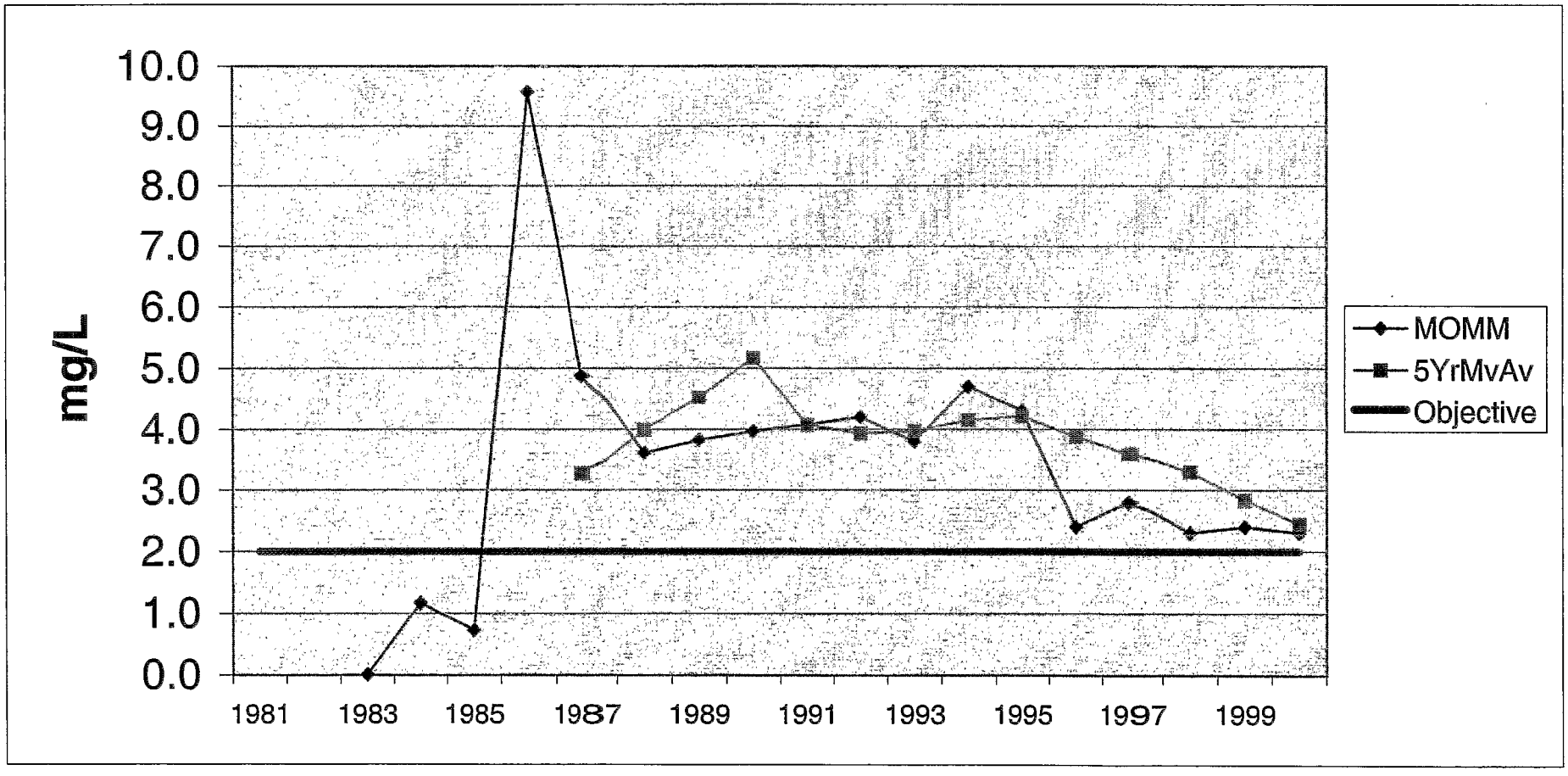


FIGURE 10 - SULFATE AT PAYNESVILLE

WEST FORK OF CARSOM RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

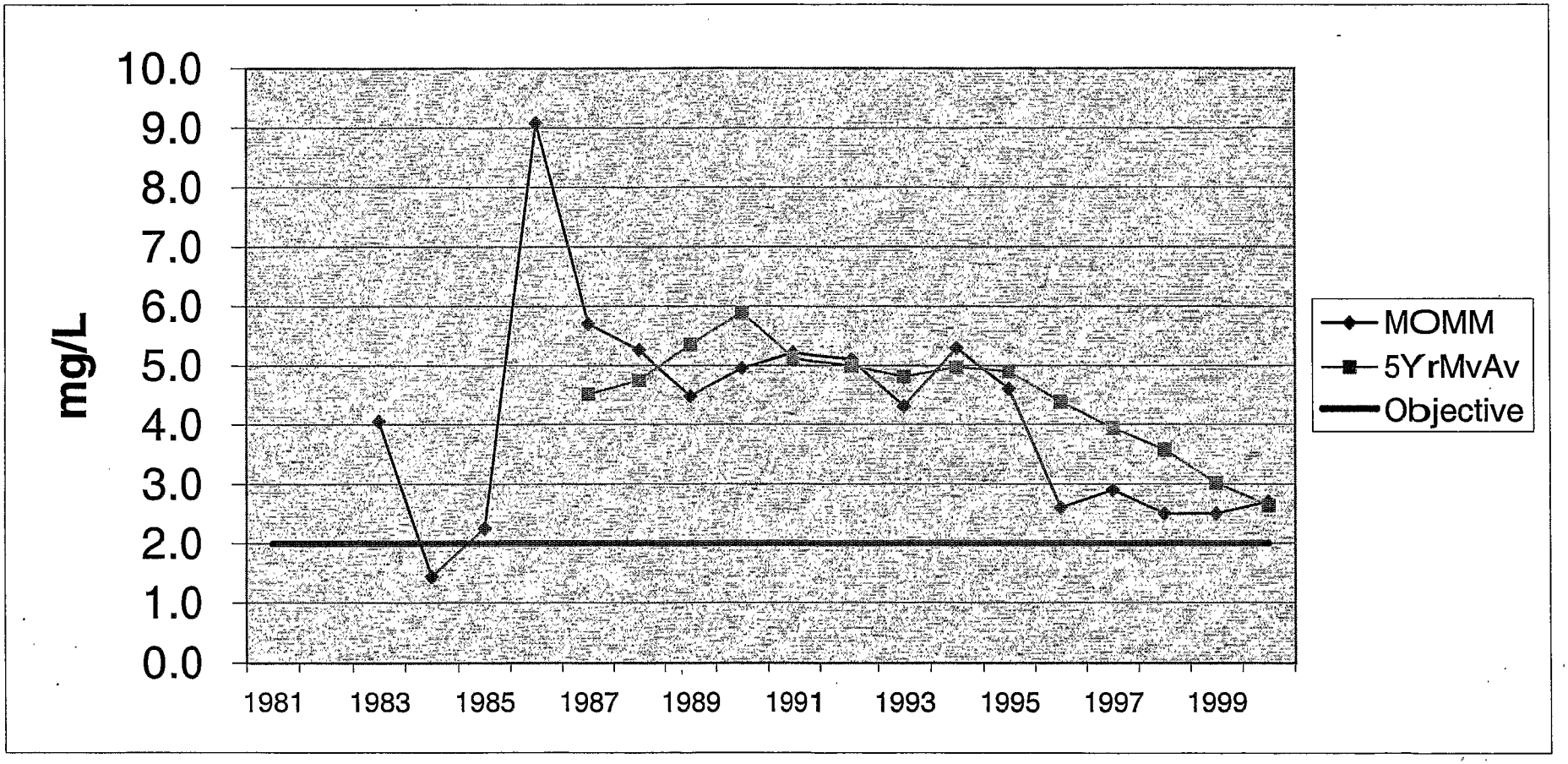


FIGURE 11 - SULFATE AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE

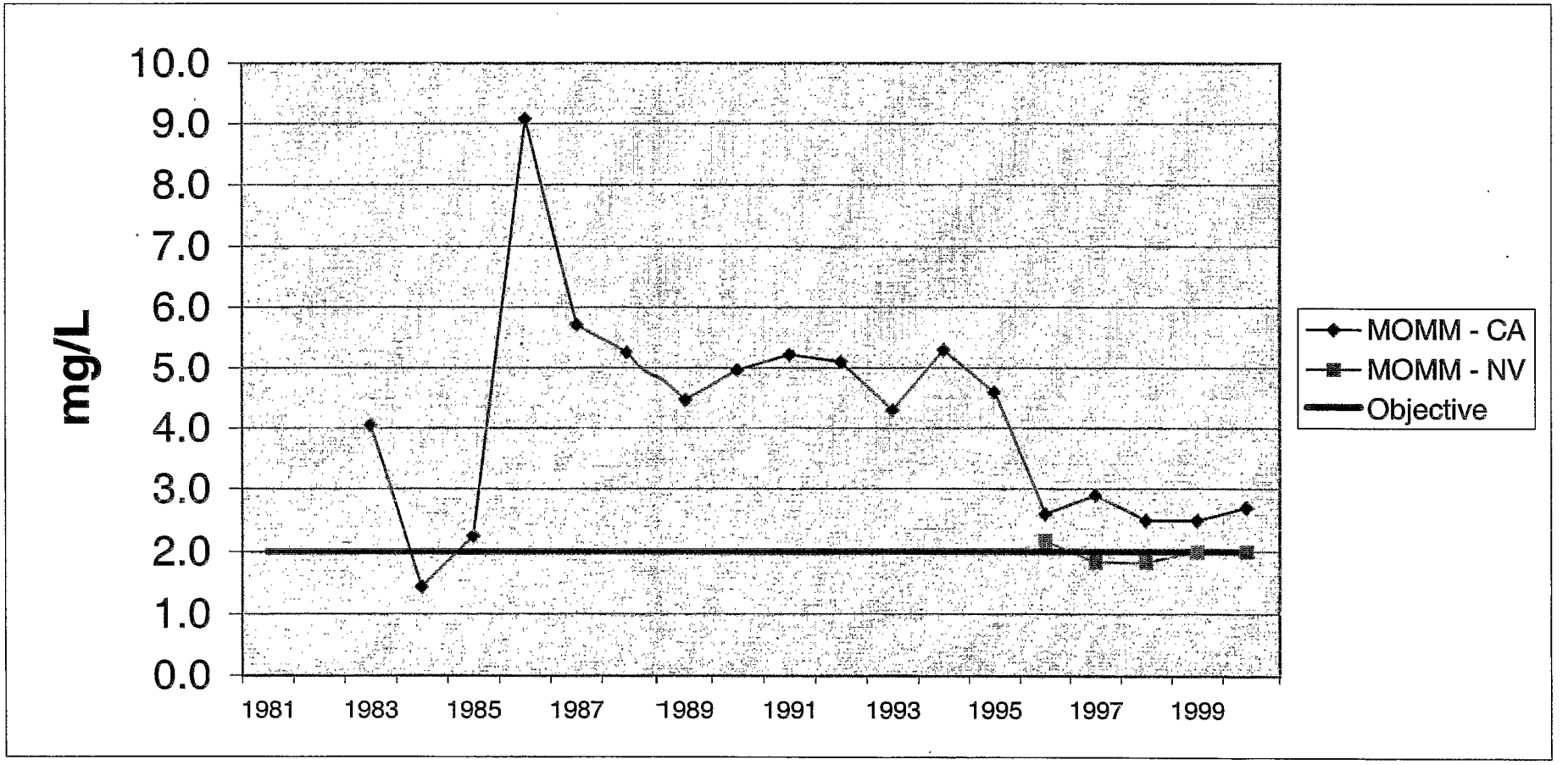


FIGURE 12 - TOTAL PHOSPHORUS AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

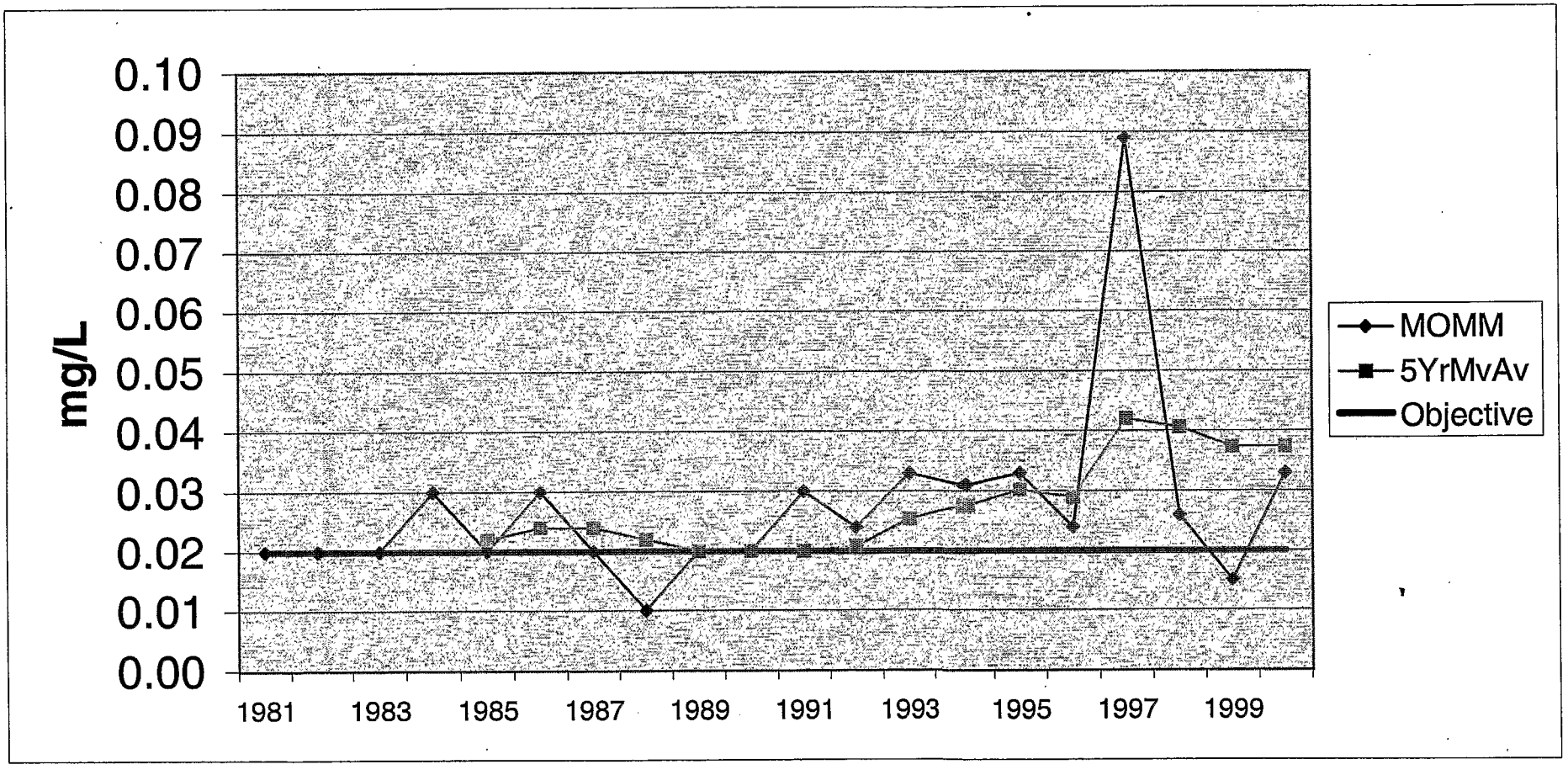


FIGURE 13 - TOTAL PHOSPHORUS AT PAYNESVILLE

WEST FORK OF CARSOM RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

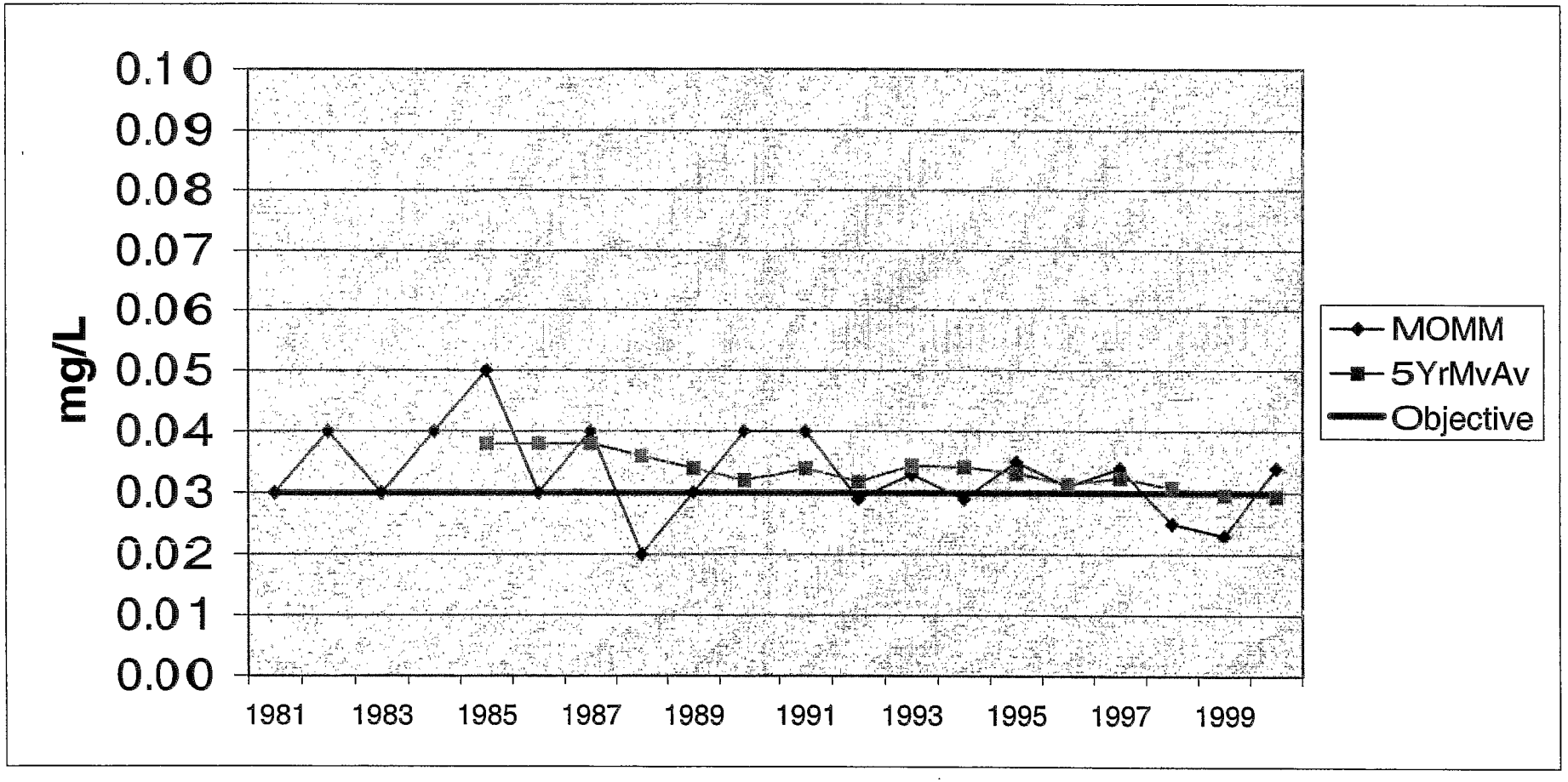


FIGURE 14 - TOTAL PHOSPHORUS AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE

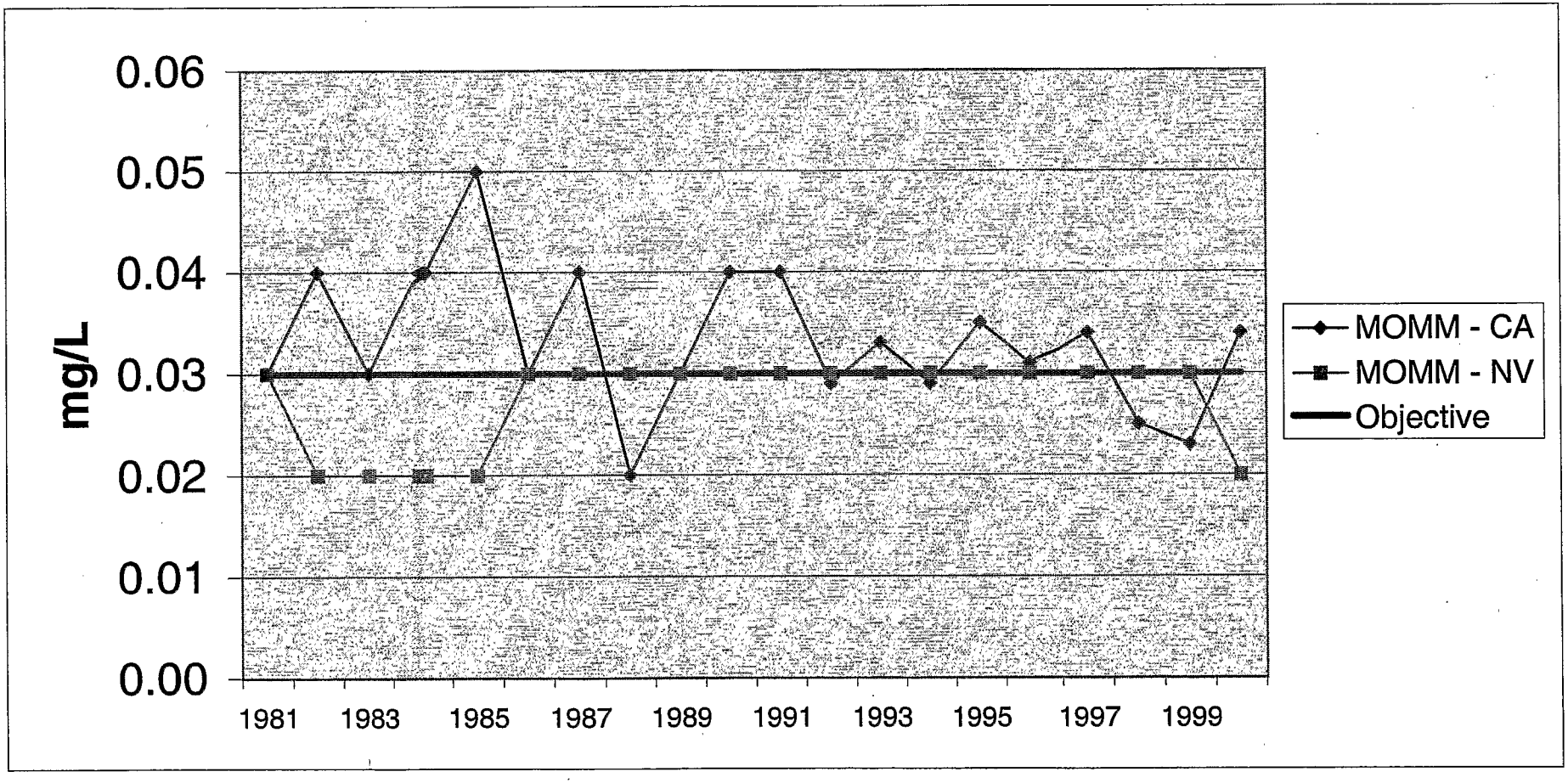


FIGURE 15 - BORON AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

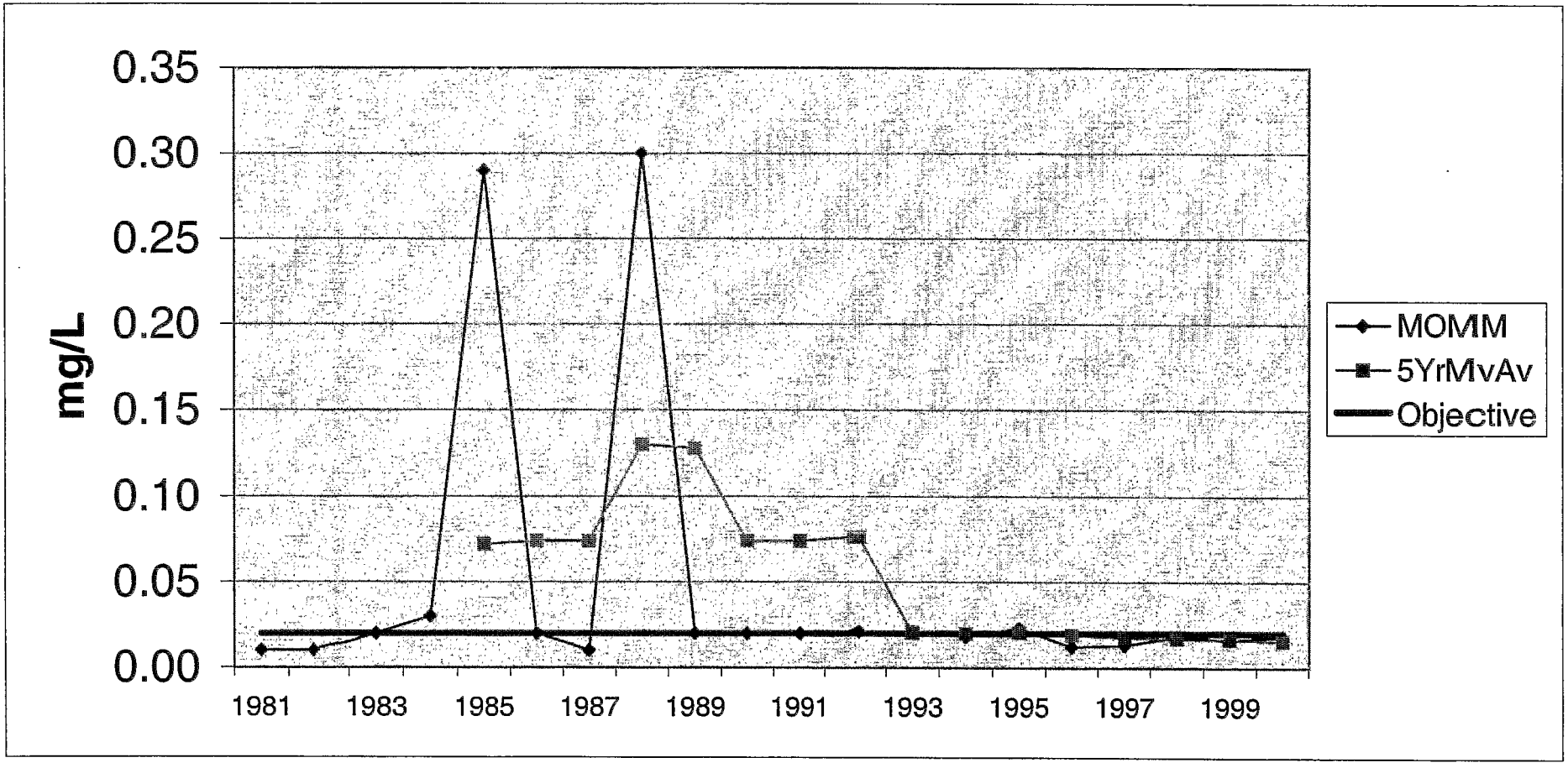


FIGURE 16 - BORON AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

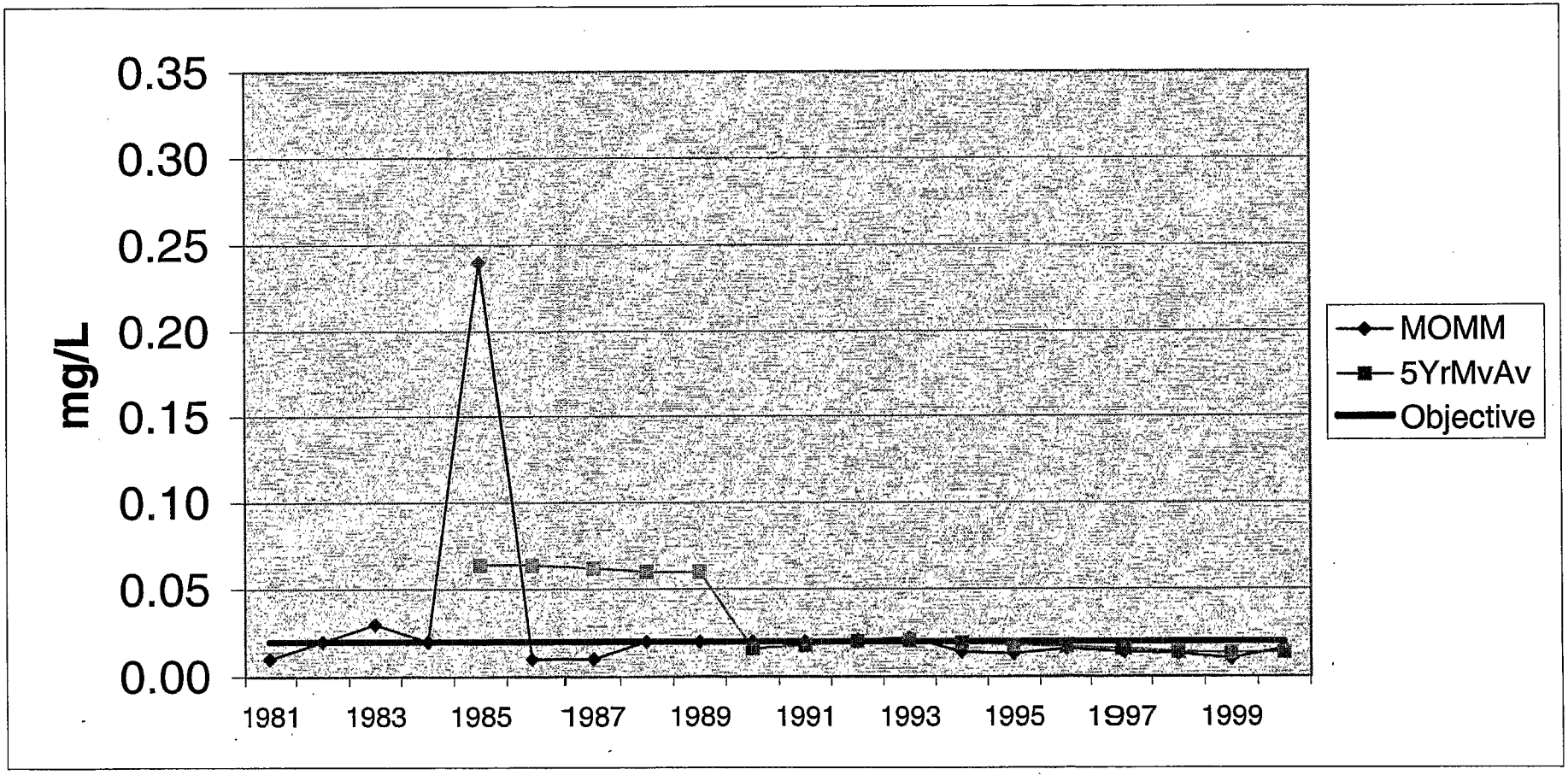


FIGURE 17 - BORON AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE

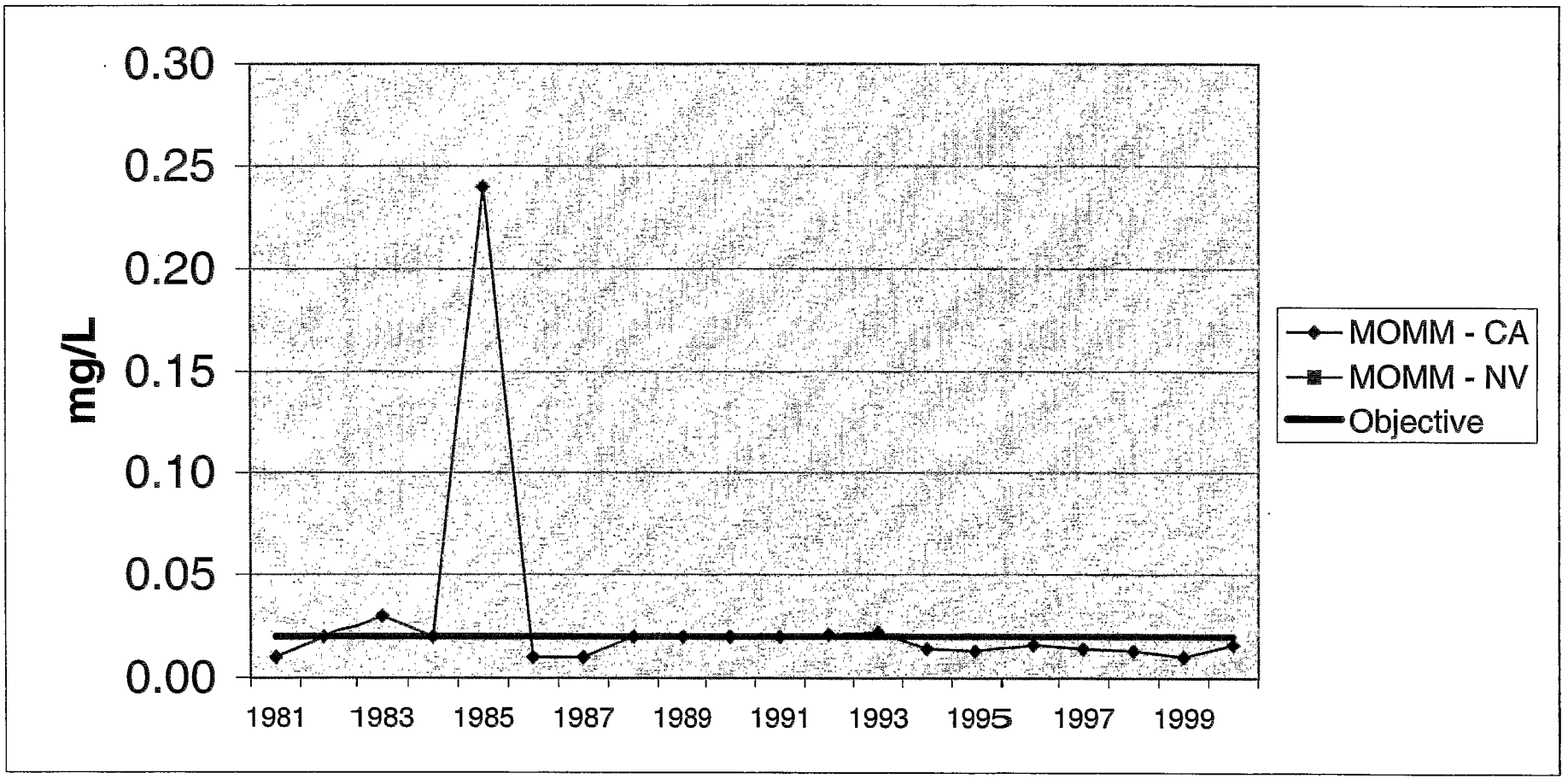


FIGURE 18 - % SODIUM AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

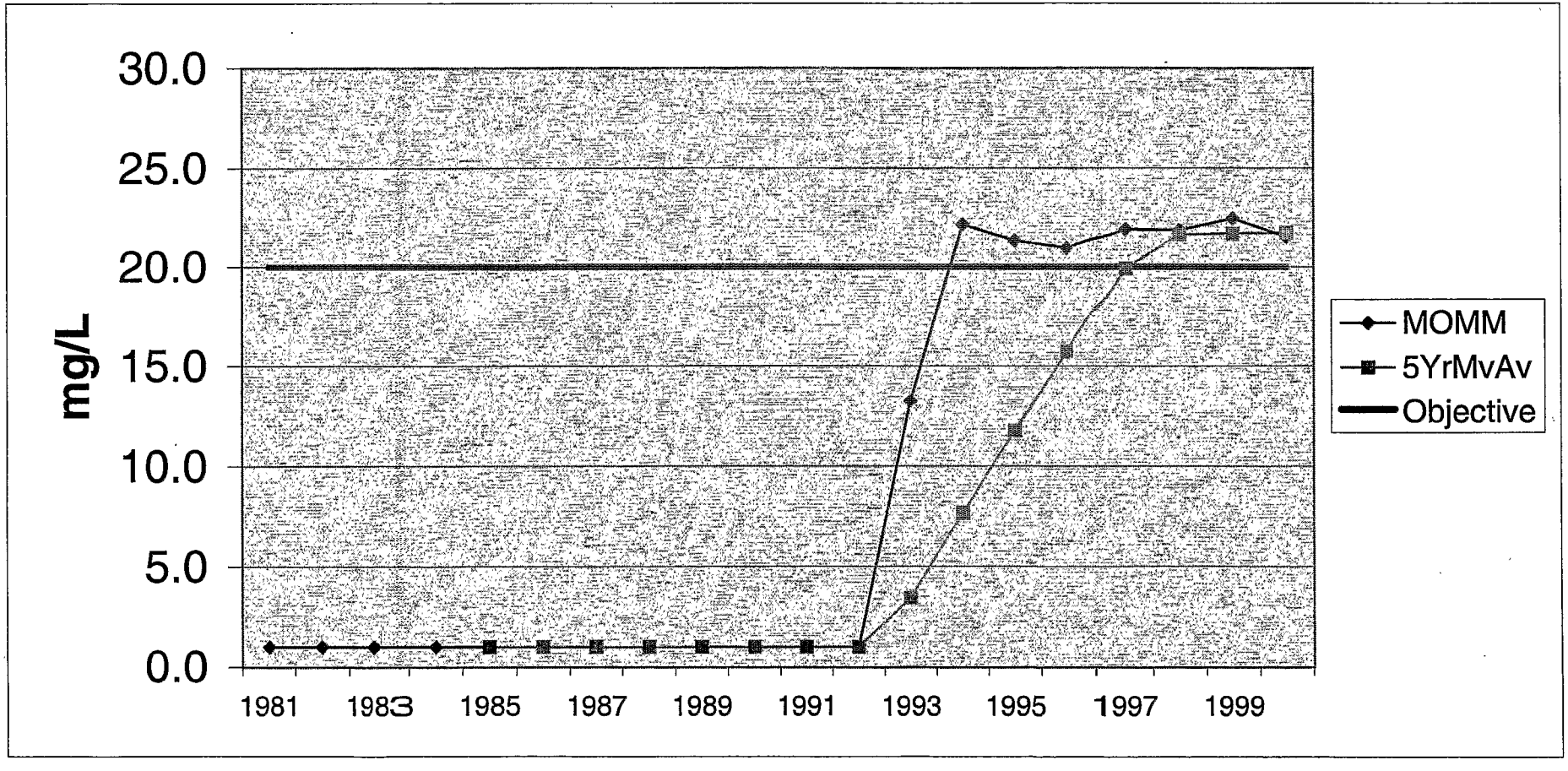


FIGURE 19 - % SODIUM AT PAYNESVILLE

WEST FORK OF CARSOM RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

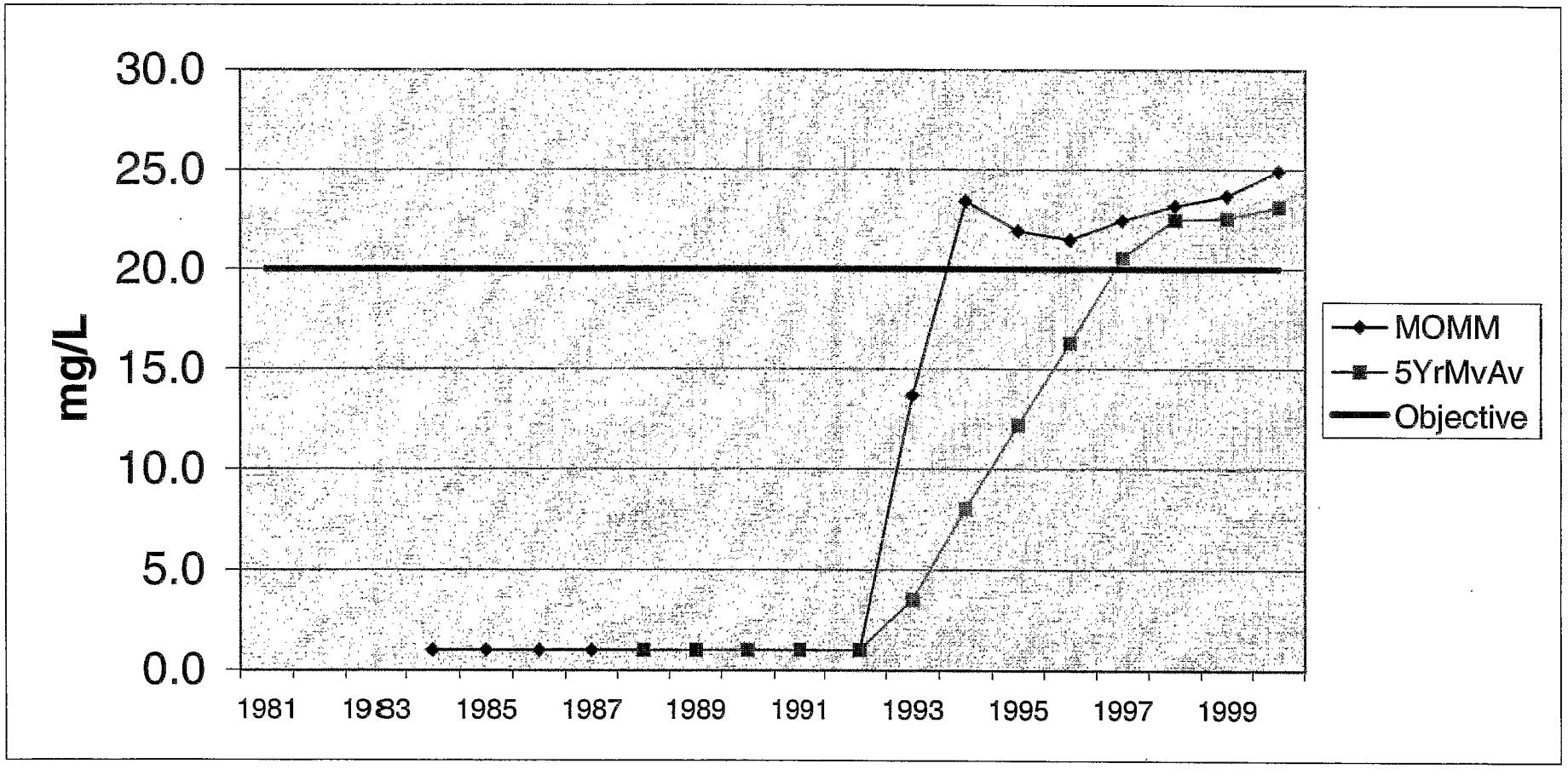


FIGURE 20 - % SODIUM AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE

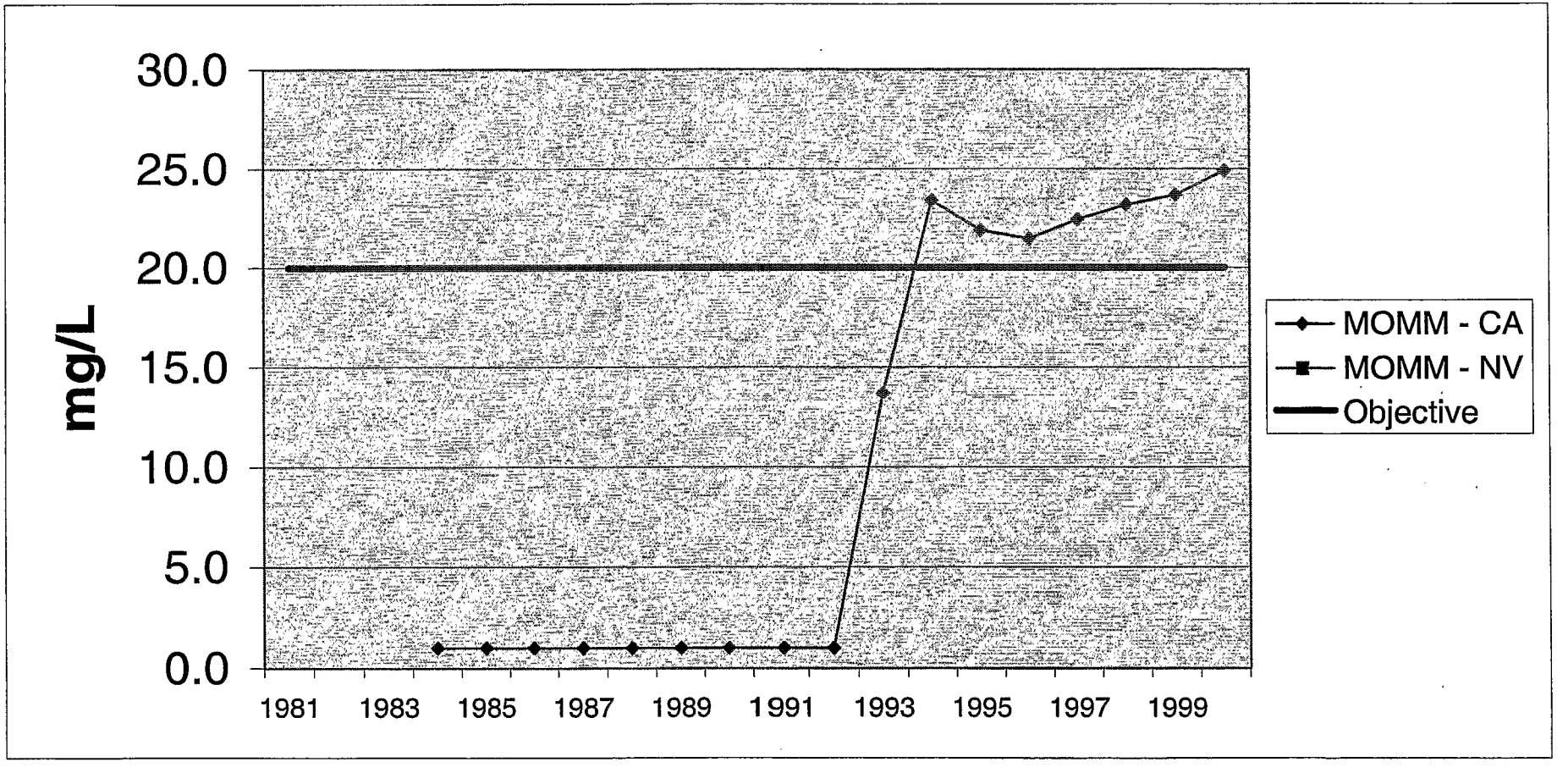


FIGURE 21 - TOTAL NITROGEN AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

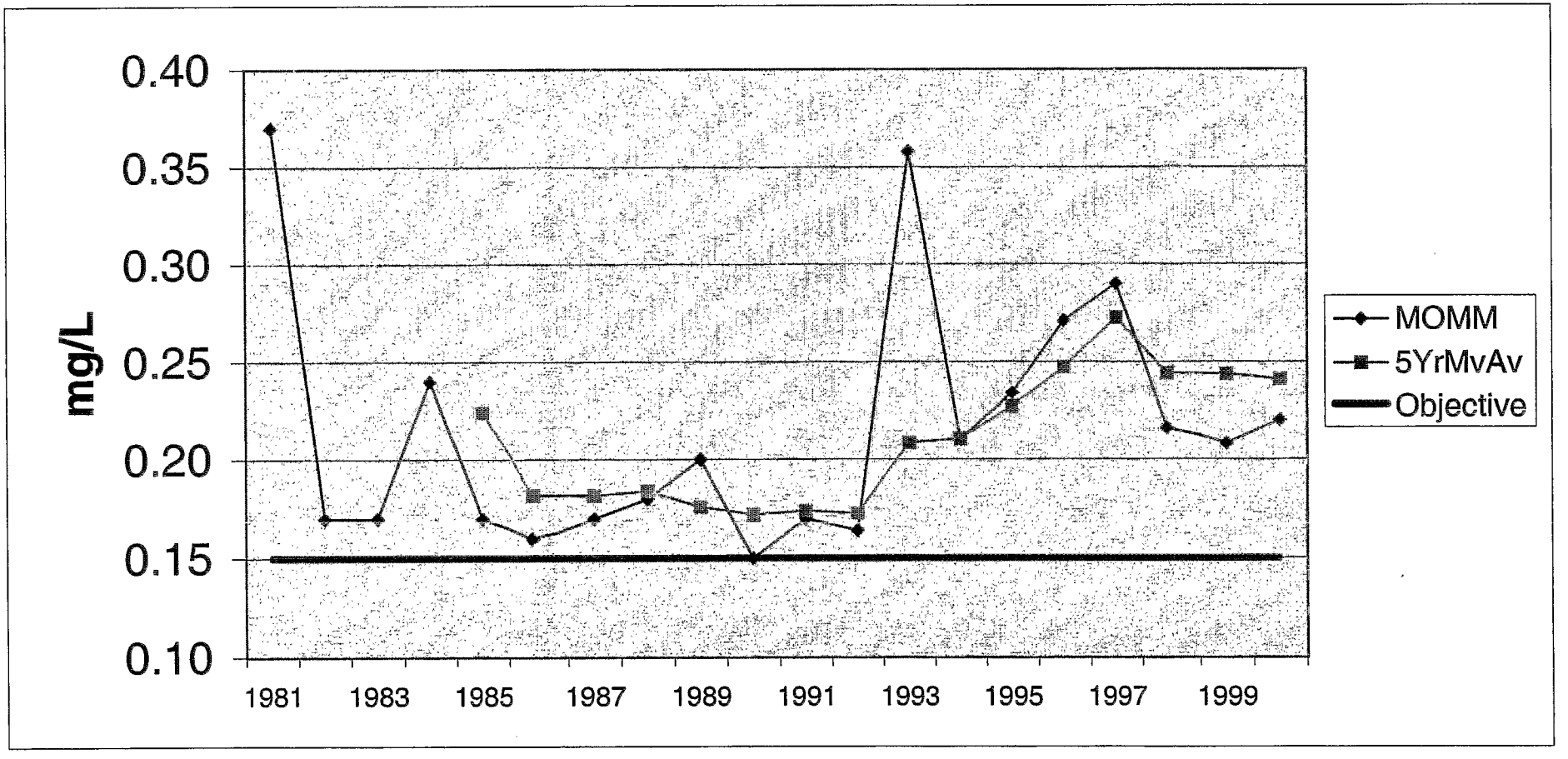


FIGURE 22 - TOTAL NITROGEN AT PAYNESVILLE

WEST FORK OF CARSOM RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

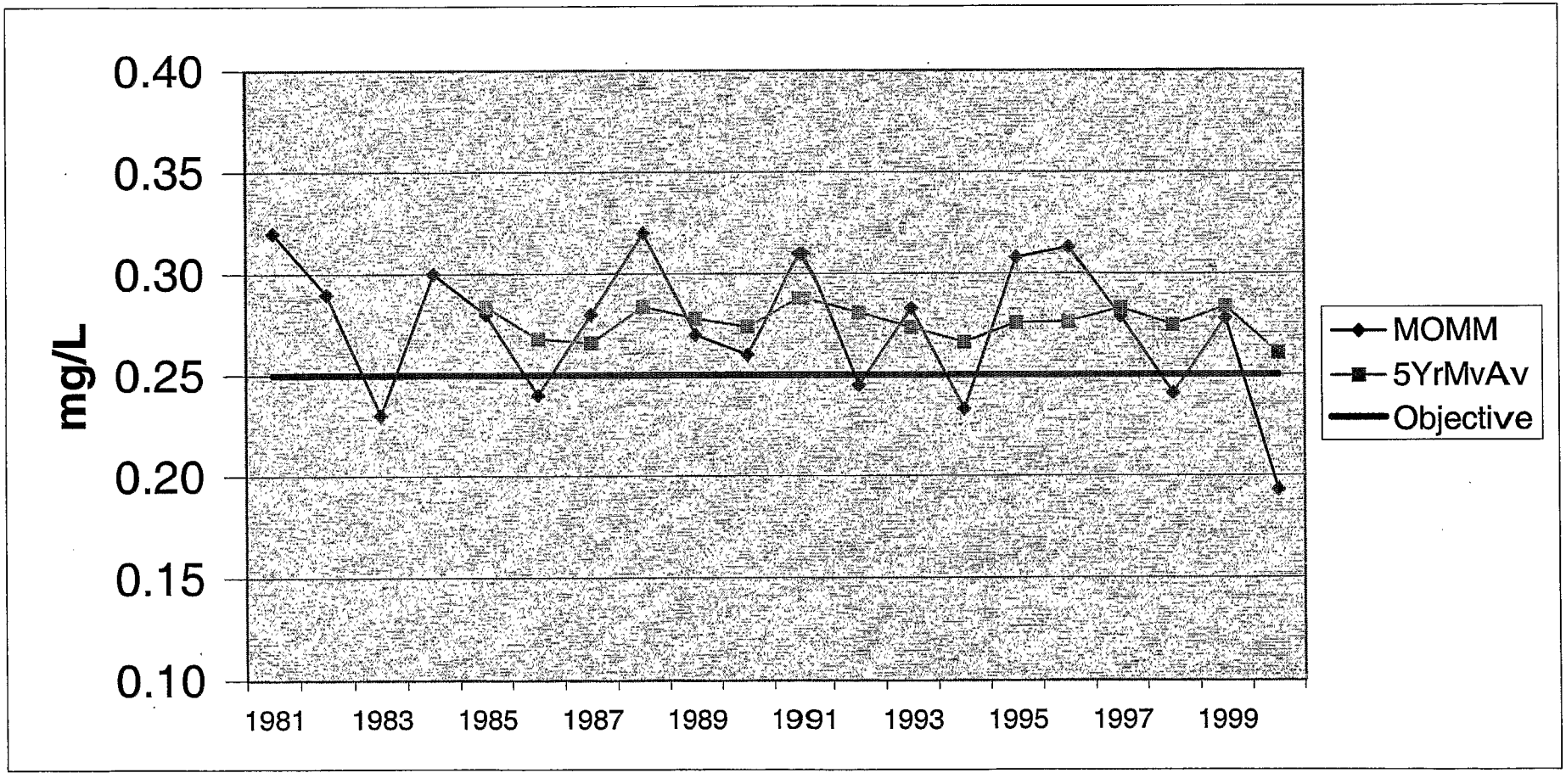


FIGURE 23 - TOTAL NITROGEN AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE

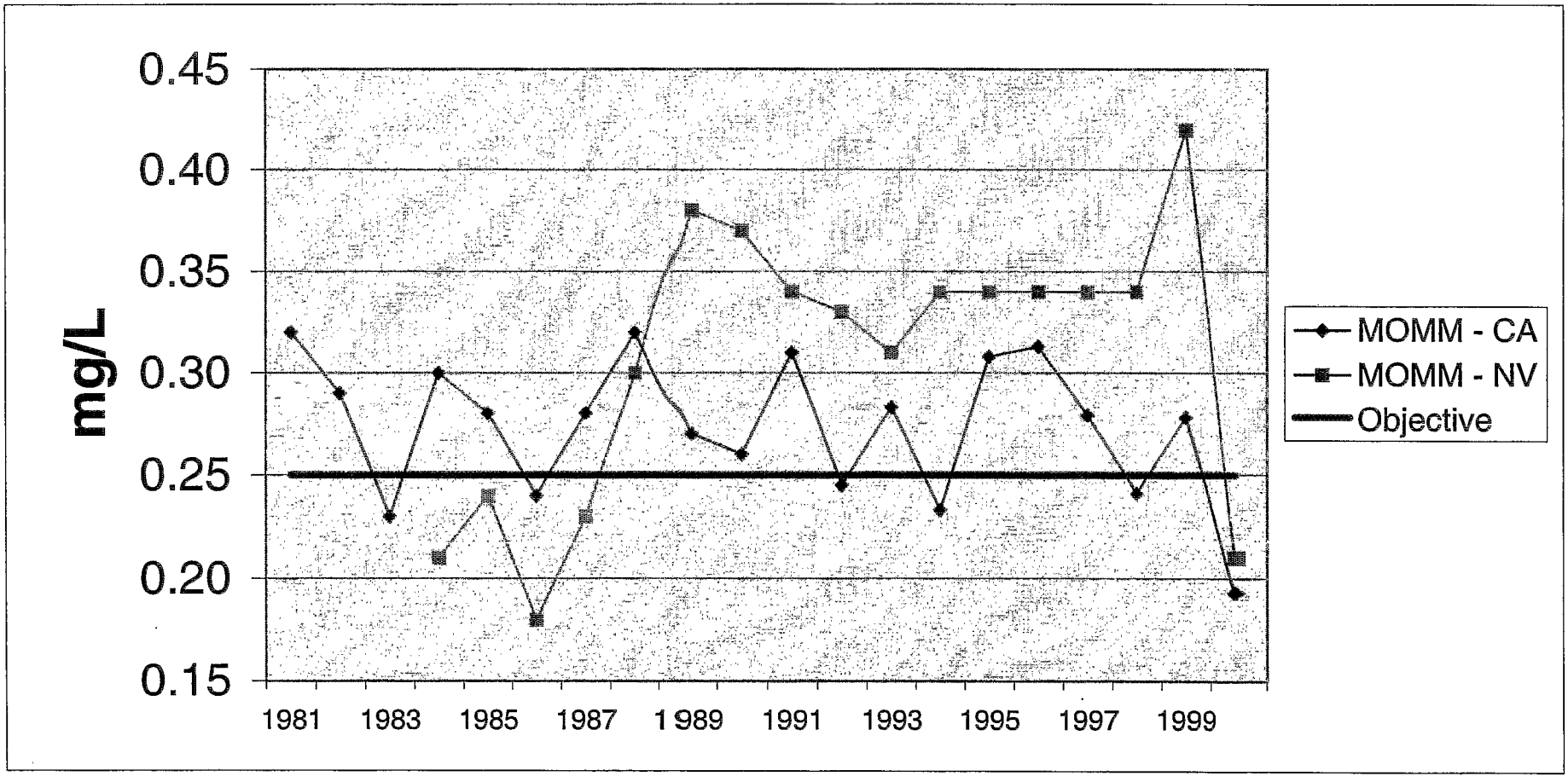


FIGURE 24 - TOTAL KJELDAHL NITROGEN AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

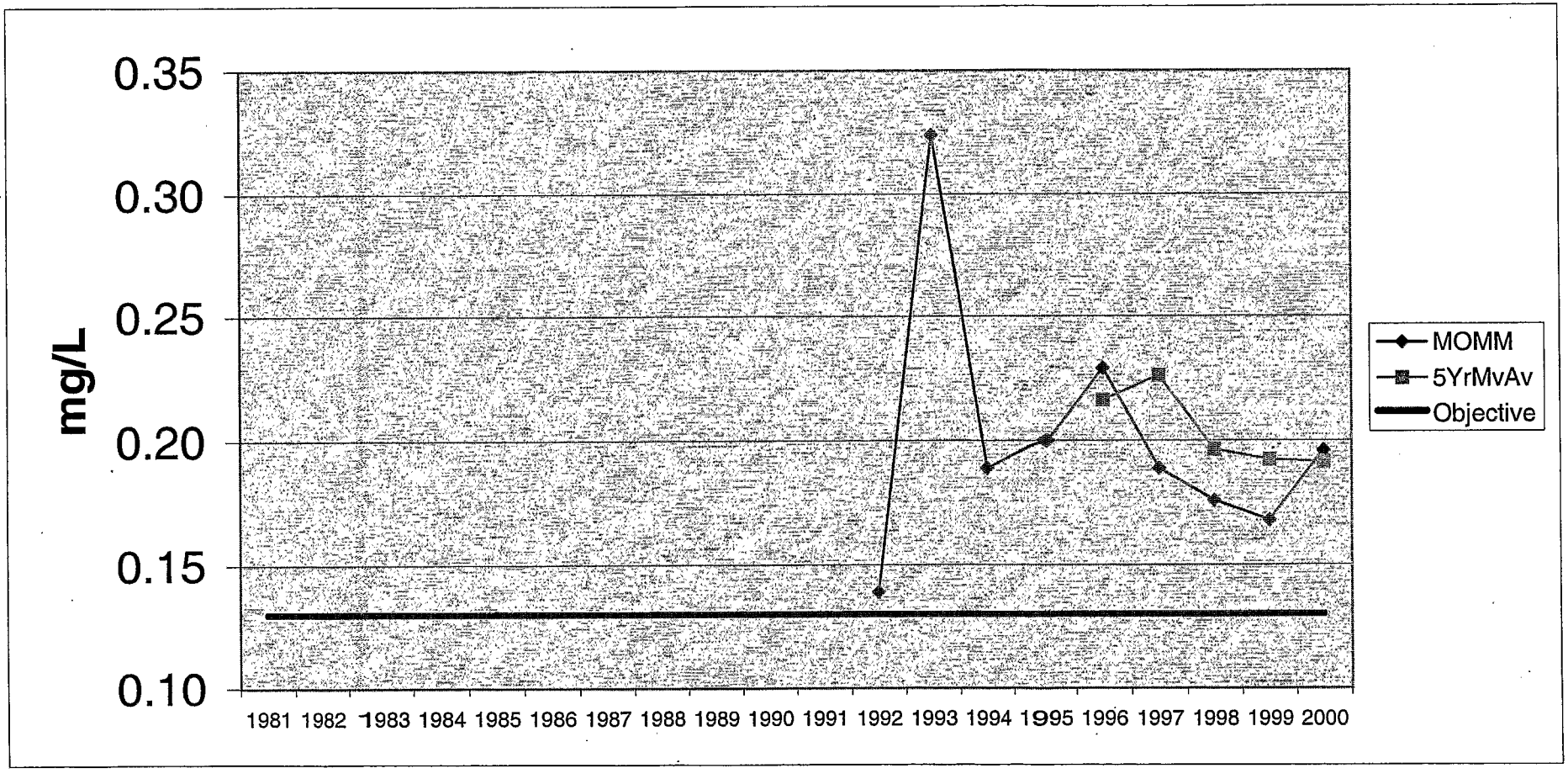


FIGURE 25 - TOTAL KJELDAHL NITROGEN AT PAYNESVILLE

WEST FORK OF CARSOM RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

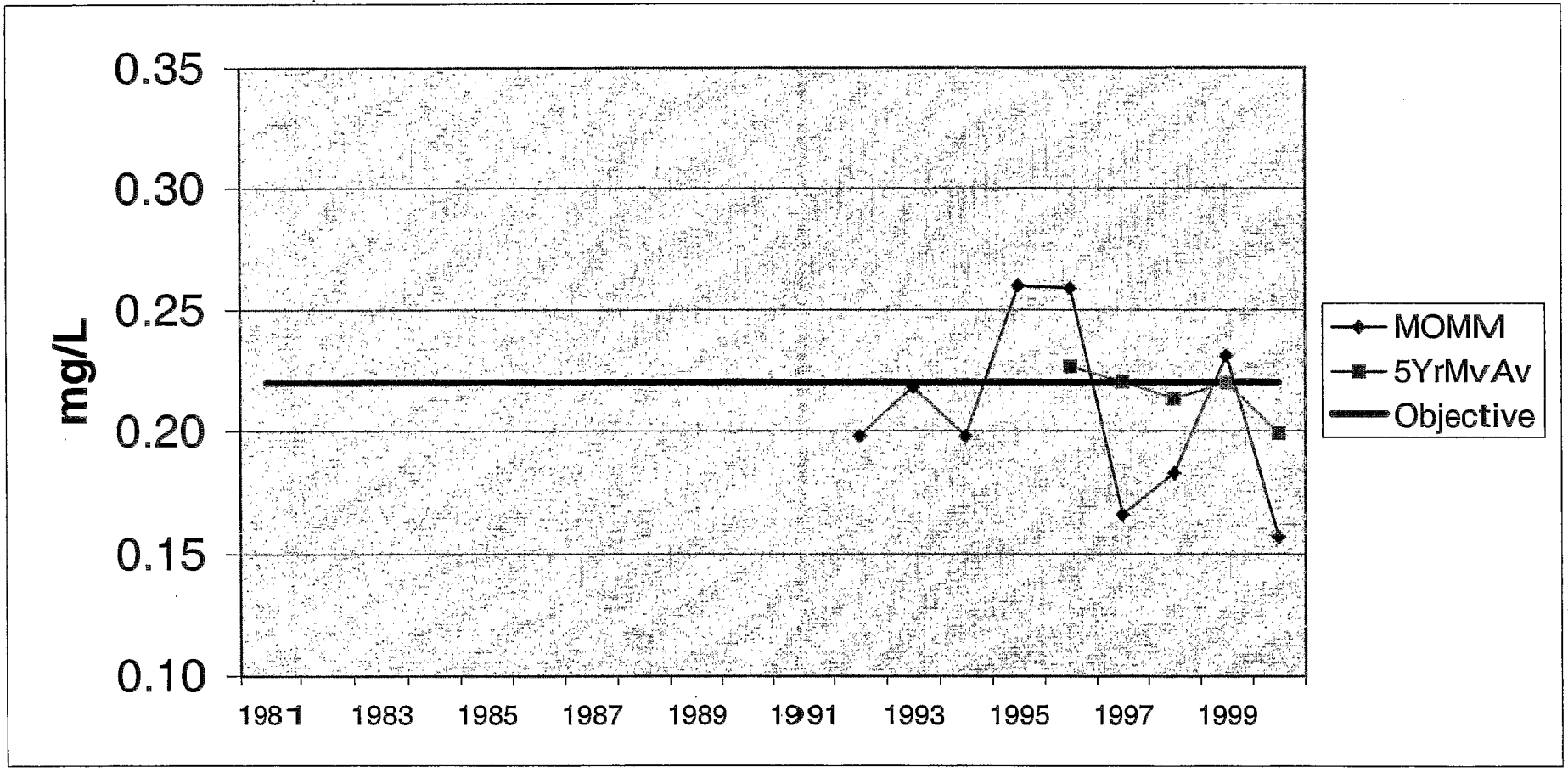


FIGURE 26 - TOTAL KJELDAHL NITROGEN AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE

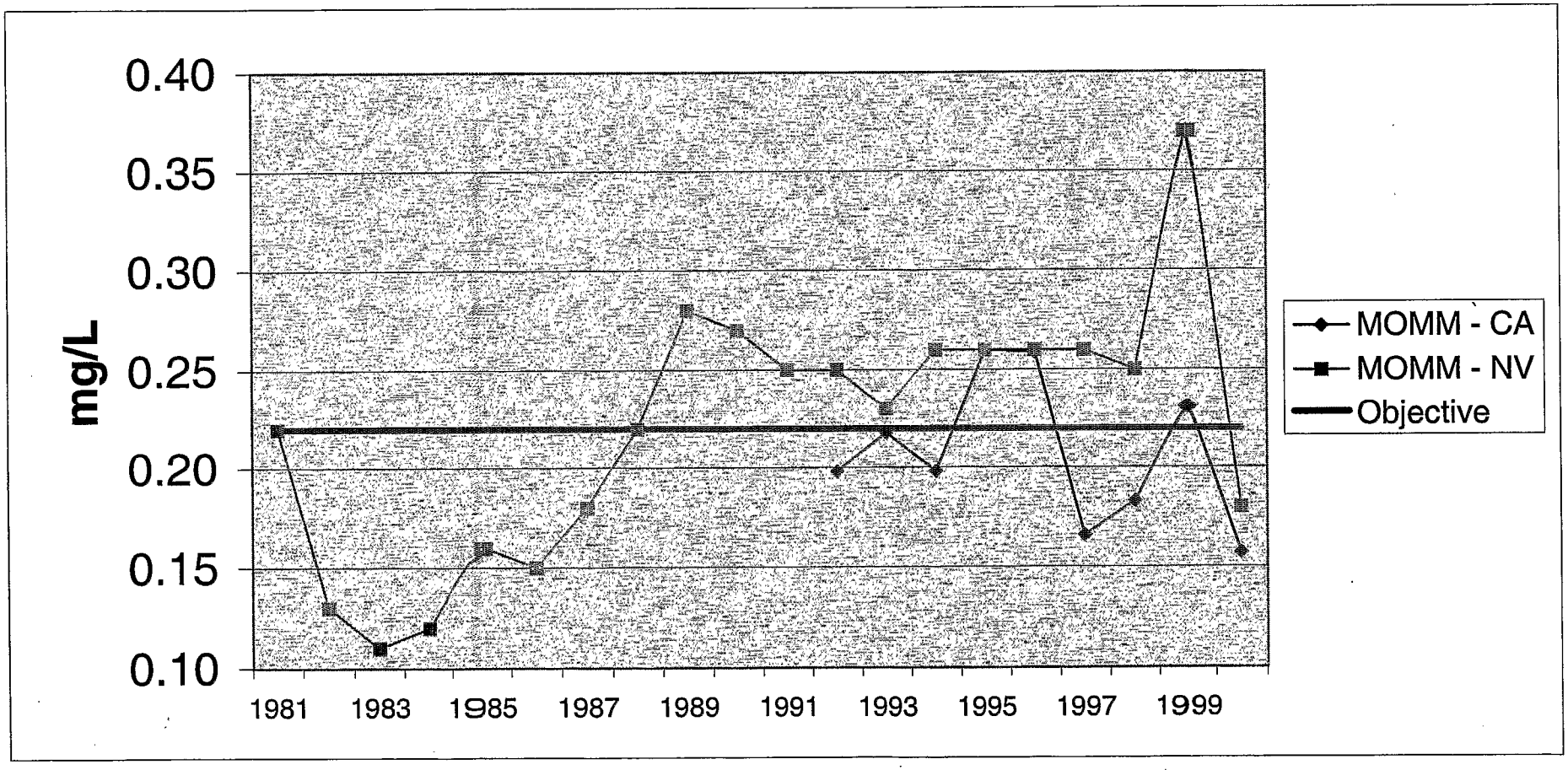


FIGURE 27 - NITRATE AT WOODFORDS

WEST FORK OF CARSON RIVER AT WOODFORDS - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

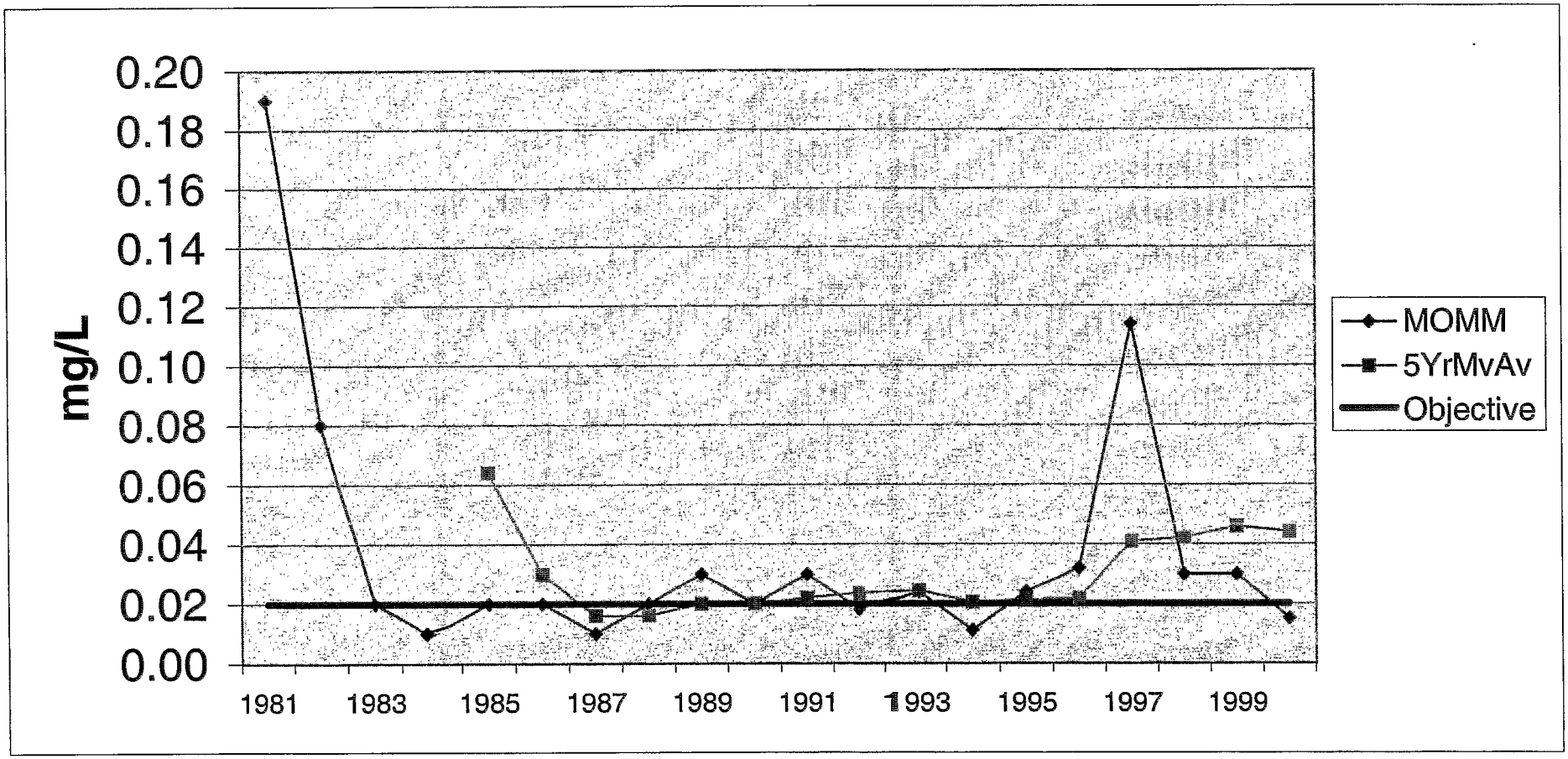


FIGURE 28 - NITRATE AT PAYNESVILLE

WEST FORK OF CARSOM RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEAN DATA
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE WITH THE OBJECTIVE

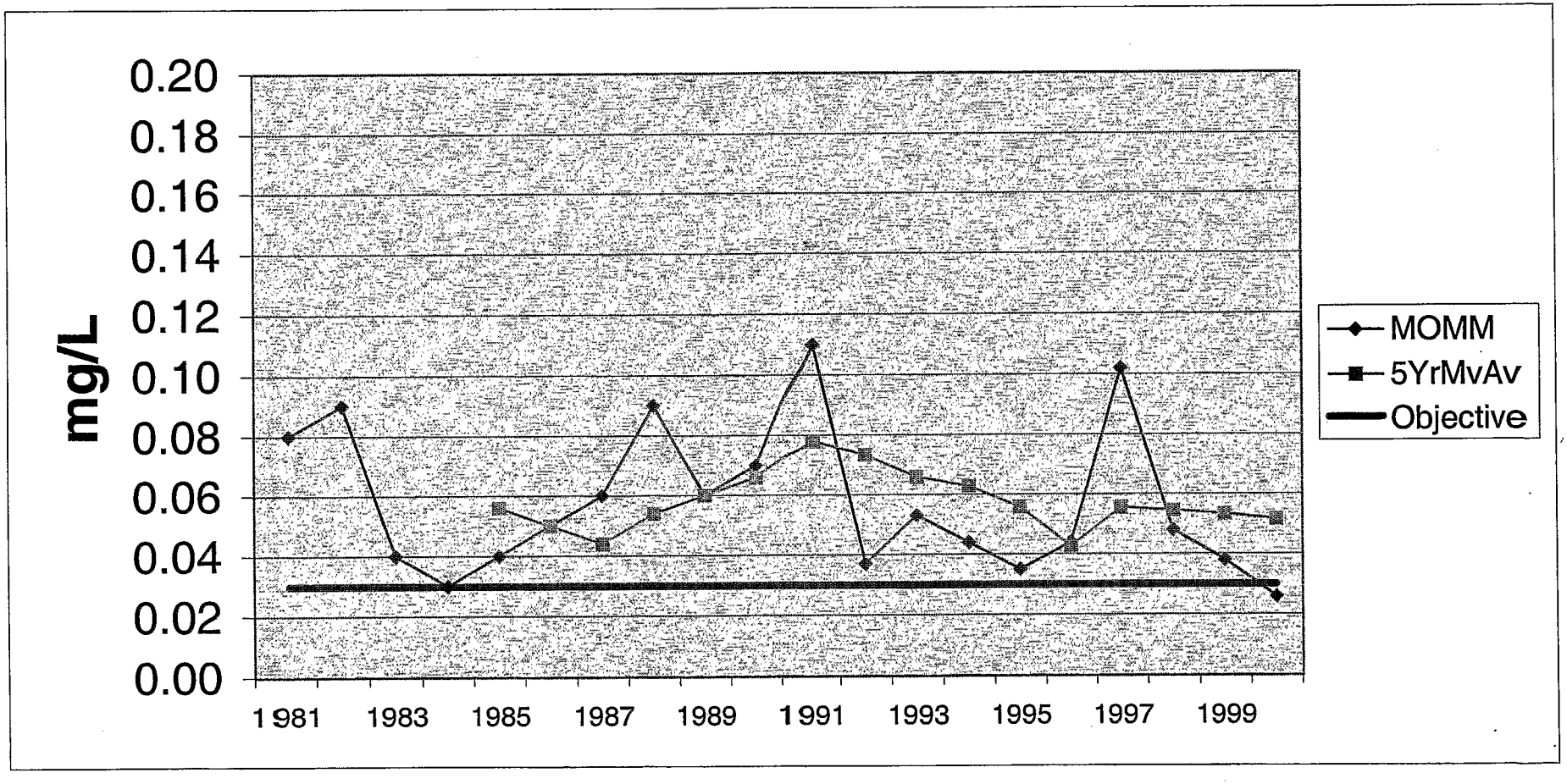
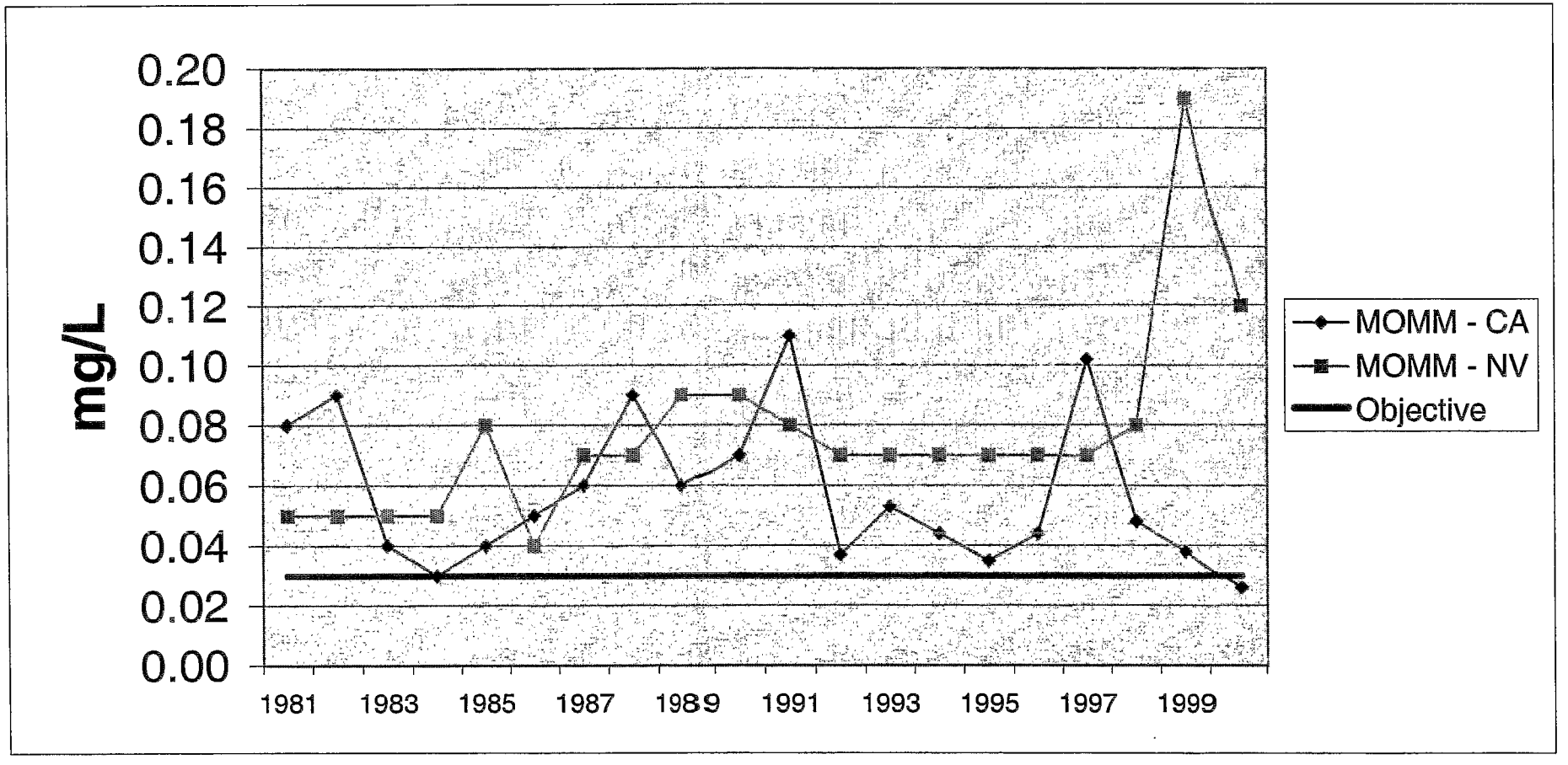


FIGURE 29 - NITRATE AT PAYNESVILLE

WEST FORK OF CARSON RIVER AT PAYNESVILLE - MEAN OF MONTHLY MEANS DATA
COMPARISON OF CALIFORNIA AND NEVADA DATA WITH THE OBJECTIVE FOR PAYNESVILLE



Appendix I

Water Quality Objectives for the Carson River

Table 3-14
WATER QUALITY OBJECTIVES FOR CERTAIN WATER BODIES
EAST & WEST FORK CARSON RIVER HYDROLOGIC UNITS

See Fig. 3-7	Surface Waters	Objective (mg/L except as noted)[4]								
		TDS	Cl	SO_4	Total P	B	% Na	Total N	TKN	NO_3-N
1	West Fork Carson River at Woodfords[1]	55	1.0	2.0	0.02	0.02	20	0.15	0.13	0.02
2	West Fork Carson River at Stateline[1]	70	2.5	2.0	0.03	0.02	20	0.25	0.22	0.03
3	Indian Creek Res.[1]	305	24	-	0.04	-	-	4.0	-	-
4	East Fork Carson River[2]	80 100	4.0 6.0	4.0 8.0	0.02 0.03	0.12 0.25	25 30	0.20 0.30	-	-
5	Bryant Creek [2,3]	140 200	15 25	35 50	0.02 0.03	0.20 0.50	- 50	0.20 0.30	-	-

[1] Values shown are mean of monthly mean for the period of record.
[2] Annual average value/90th percentile value.
[3] In addition, the following numerical water quality objectives shall apply specifically to surface waters of the Bryant Creek Basin:

Parameter	Maximum Value (mg/l except as noted)
Turbidity (NTU)	15
Alkalinity, total as $CaCO_3$	70 (minimum)
Acidity, total as $CaCO_3$	10
Dissolved Iron	0.5
Manganese	0.5
Color, PCu	15
Aluminum	0.1
Copper	0.02
Arsenic	0.05

[4] Objectives are as mg/L and are defined as follows:

B	Boron	NO_3-N	Nitrogen as Nitrate
Cl	Chloride	TKN	Nitrate, Total Kjeldahl
N	Nitrogen, Total	P	Phosphorus, Total
% Na	Sodium, Percent		

$$\frac{(Na \times 100)}{Na+Ca+Mg+K} = \%Na$$

Na, Ca, Mg, and K expressed as milliequivalents per liter (meq/L) concentrations.

SO_4	Sulfate
TDS	Total Dissolved Solids (Total Filterable Residue)

Appendix II

Tabulated MOMM Results for the West Fork of the Carson River

CARSON RIVER @ WOODFORDS
MEAN OF MONTHLY MEAN DATA**

	TDS	Objective	Cl	Objective	SO4	Objective	Total P	Objective	B	Objective
1981	56	55	1.3	1.0		2.0	0.02	0.02	0.01	0.02
1982	46	55		1.0		2.0	0.02	0.02	0.01	0.02
1983	48	55	0.5	1.0	0.0	2.0	0.02	0.02	0.02	0.02
1984	49	55	0.7	1.0	1.2	2.0	0.03	0.02	0.03	0.02
1985	48	55	0.7	1.0	0.7	2.0	0.02	0.02	0.29	0.02
1986	51	55	0.8	1.0	9.6	2.0	0.03	0.02	0.02	0.02
1987	55	55	0.8	1.0	4.9	2.0	0.02	0.02	0.01	0.02
1988	56	55	1.0	1.0	3.6	2.0	0.01	0.02	0.30	0.02
1989	49	55	1.3	1.0	3.8	2.0	0.02	0.02	0.02	0.02
1990	53	55	1.1	1.0	4.0	2.0	0.02	0.02	0.02	0.02
1991	53	55	1.2	1.0	4.1	2.0	0.03	0.02	0.02	0.02
1992	58	55	1.2	1.0	4.2	2.0	0.02	0.02	0.02	0.02
1993	54	55	1.2	1.0	3.8	2.0	0.03	0.02	0.02	0.02
1994	56	55	1.1	1.0	4.7	2.0	0.03	0.02	0.02	0.02
1995	49	55	1.2	1.0	4.3	2.0	0.03	0.02	0.02	0.02
1996	51	55	1.0	1.0	2.4	2.0	0.02	0.02	0.01	0.02
1997	49	55	0.9	1.0	2.8	2.0	0.09	0.02	0.01	0.02
1998	49	55	1.3	1.0	2.3	2.0	0.03	0.02	0.02	0.02
1999	53	55	1.4	1.0	2.4	2.0	0.02	0.02	0.02	0.02
2000	54	55	1.2	1.0	2.3	2.0	0.03	0.02	0.02	0.02
MOMM	52		1.0		3.4		0.03		0.05	
Objective	55		1.0		2.0		0.02		0.02	
MOMM-Obj					1.4		0.01		0.03	
Objective %	94		105		170		137		228	

* % Na data is erroneous until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

	% Na*	Objective	Total N	Objective	TKN	Objective	NO3	Objective
1981	1.0	20.0	0.37	0.15		0.13	0.19	0.02
1982	1.0	20.0	0.17	0.15		0.13	0.08	0.02
1983	1.0	20.0	0.17	0.15		0.13	0.02	0.02
1984	1.0	20.0	0.24	0.15		0.13	0.01	0.02
1985	1.0	20.0	0.17	0.15		0.13	0.02	0.02
1986	1.0	20.0	0.16	0.15		0.13	0.02	0.02
1987	1.0	20.0	0.17	0.15		0.13	0.01	0.02
1988	1.0	20.0	0.18	0.15		0.13	0.02	0.02
1989	1.0	20.0	0.20	0.15		0.13	0.03	0.02
1990	1.0	20.0	0.15	0.15		0.13	0.02	0.02
1991	1.0	20.0	0.17	0.15		0.13	0.03	0.02
1992	1.0	20.0	0.16	0.15	0.14	0.13	0.02	0.02
1993	13.3	20.0	0.36	0.15	0.32	0.13	0.02	0.02
1994	22.2	20.0	0.21	0.15	0.19	0.13	0.01	0.02
1995	21.4	20.0	0.23	0.15	0.20	0.13	0.02	0.02
1996	21.0	20.0	0.27	0.15	0.23	0.13	0.03	0.02
1997	21.9	20.0	0.29	0.15	0.19	0.13	0.11	0.02
1998	21.9	20.0	0.22	0.15	0.18	0.13	0.03	0.02
1999	22.5	20.0	0.21	0.15	0.17	0.13	0.03	0.02
2000	21.5	20.0	0.22	0.15	0.20	0.13	0.02	0.02
MOMM	21.7		0.22		0.20		0.04	
Objective	20.0		0.15		0.13		0.02	
MOMM-Obj	1.7		0.07		0.07		0.02	
Objective %	109		144		155		187	

* % Na data is erroneous until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

CARSON RIVER @ PAYNESVILLE
MEAN OF MONTHLY MEAN DATA**

	TDS	Objective	Cl	Objective	SO4	Objective	Total P	Objective	B	Objective
1981	64	70	1.8	2.5		2.0	0.03	0.03	0.01	0.02
1982	49	70		2.5		2.0	0.04	0.03	0.02	0.02
1983	43	70	0.9	2.5	4.1	2.0	0.03	0.03	0.03	0.02
1984	49	70	1.2	2.5	1.4	2.0	0.04	0.03	0.02	0.02
1985	50	70	1.7	2.5	2.3	2.0	0.05	0.03	0.24	0.02
1986	53	70	1.4	2.5	9.1	2.0	0.03	0.03	0.01	0.02
1987	68	70	2.1	2.5	5.7	2.0	0.04	0.03	0.01	0.02
1988	80	70	3.3	2.5	5.3	2.0	0.02	0.03	0.02	0.02
1989	60	70	2.2	2.5	4.5	2.0	0.03	0.03	0.02	0.02
1990	73	70	2.0	2.5	5.0	2.0	0.04	0.03	0.02	0.02
1991	71	70	2.3	2.5	5.2	2.0	0.04	0.03	0.02	0.02
1992	69	70	2.0	2.5	5.1	2.0	0.03	0.03	0.02	0.02
1993	59	70	1.5	2.5	4.3	2.0	0.03	0.03	0.02	0.02
1994	66	70	1.5	2.5	5.3	2.0	0.03	0.03	0.01	0.02
1995	54	70	1.4	2.5	4.6	2.0	0.04	0.03	0.01	0.02
1996	55	70	1.4	2.5	2.6	2.0	0.03	0.03	0.02	0.02
1997	58	70	1.0	2.5	2.9	2.0	0.03	0.03	0.01	0.02
1998	56	70	1.4	2.5	2.5	2.0	0.03	0.03	0.01	0.02
1999	59	70	1.5	2.5	2.5	2.0	0.02	0.03	0.01	0.02
2000	61	70	1.3	2.5	2.7	2.0	0.03	0.03	0.02	0.02
MOMM	60		1.7		4.2		0.03		0.03	
Objective	70		2.5		2.0		0.03		0.02	
MOMM-Obj					2.2				0.01	
Objective %	85		67		208		111		140	

* % Na data is erroneous until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

	% Na*	Objective	Total N	Objective	TKN	Objective	NO3	Objective
1981		20.0	0.32	0.25		0.22	0.08	0.03
1982		20.0	0.29	0.25		0.22	0.09	0.03
1983		20.0	0.23	0.25		0.22	0.04	0.03
1984	1.0	20.0	0.30	0.25		0.22	0.03	0.03
1985	1.0	20.0	0.28	0.25		0.22	0.04	0.03
1986	1.0	20.0	0.24	0.25		0.22	0.05	0.03
1987	1.0	20.0	0.28	0.25		0.22	0.06	0.03
1988	1.0	20.0	0.32	0.25		0.22	0.09	0.03
1989	1.0	20.0	0.27	0.25		0.22	0.06	0.03
1990	1.0	20.0	0.26	0.25		0.22	0.07	0.03
1991	1.0	20.0	0.31	0.25		0.22	0.11	0.03
1992	1.0	20.0	0.25	0.25	0.20	0.22	0.04	0.03
1993	13.7	20.0	0.28	0.25	0.22	0.22	0.05	0.03
1994	23.4	20.0	0.23	0.25	0.20	0.22	0.04	0.03
1995	21.9	20.0	0.31	0.25	0.26	0.22	0.04	0.03
1996	21.5	20.0	0.31	0.25	0.26	0.22	0.04	0.03
1997	22.4	20.0	0.28	0.25	0.17	0.22	0.10	0.03
1998	23.2	20.0	0.24	0.25	0.18	0.22	0.05	0.03
1999	23.7	20.0	0.28	0.25	0.23	0.22	0.04	0.03
2000	24.9	20.0	0.19	0.25	0.16	0.22	0.03	0.03
MOMM	23.0		0.27		0.21		0.06	
Objective	20.0		0.25		0.22		0.03	
MOMM-Obj	3.0		0.02				0.03	
Objective %	115		109		94		191	

* % Na data is erroneous until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

CARSON RIVER @ WOODFORDS MEAN OF MONTHLY MEAN DATA**
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE

	TDS	5YrMvAv	Cl	5YrMvAv	SO4	5YrMvAv	Total P	5YrMvAv	B	5YrMvAv
1981	56		1.3				0.02		0.01	
1982	46						0.02		0.01	
1983	48		0.5		0.0		0.02		0.02	
1984	49		0.7		1.2		0.03		0.03	
1985	48	49	0.7		0.7		0.02	0.02	0.29	0.07
1986	51	48	0.8		9.6		0.03	0.02	0.02	0.07
1987	55	50	0.8	0.7	4.9	3.3	0.02	0.02	0.01	0.07
1988	56	52	1.0	0.8	3.6	4.0	0.01	0.02	0.30	0.13
1989	49	52	1.3	0.9	3.8	4.5	0.02	0.02	0.02	0.13
1990	53	53	1.1	1.0	4.0	5.2	0.02	0.02	0.02	0.07
1991	53	53	1.2	1.1	4.1	4.1	0.03	0.02	0.02	0.07
1992	58	54	1.2	1.2	4.2	3.9	0.02	0.02	0.02	0.08
1993	54	53	1.2	1.2	3.8	4.0	0.03	0.03	0.02	0.02
1994	56	55	1.1	1.2	4.7	4.2	0.03	0.03	0.02	0.02
1995	49	54	1.2	1.2	4.3	4.2	0.03	0.03	0.02	0.02
1996	51	53	1.0	1.1	2.4	3.9	0.02	0.03	0.01	0.02
1997	49	52	0.9	1.1	2.8	3.6	0.09	0.04	0.01	0.02
1998	49	51	1.3	1.1	2.3	3.3	0.03	0.04	0.02	0.02
1999	53	50	1.4	1.2	2.4	2.8	0.02	0.04	0.02	0.02
2000	54	51	1.2	1.2	2.3	2.4	0.03	0.04	0.02	0.02
MOMM	52		1.0		3.4		0.03		0.05	
Objective	55		1.0		2.0		0.02		0.02	
MOMM-Obj					1.4		0.01		0.03	
Objective %	94		105		170		137		228	

* % Na data is erroneous until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

	% Na*	5YrMvAv	Total N	5YrMvAv	TKN	5YrMvAv	NO3	5YrMvAv
1981	1.0		0.37				0.19	
1982	1.0		0.17				0.08	
1983	1.0		0.17				0.02	
1984	1.0		0.24				0.01	
1985	1.0	1.0	0.17	0.22			0.02	0.06
1986	1.0	1.0	0.16	0.18			0.02	0.03
1987	1.0	1.0	0.17	0.18			0.01	0.02
1988	1.0	1.0	0.18	0.18			0.02	0.02
1989	1.0	1.0	0.20	0.18			0.03	0.02
1990	1.0	1.0	0.15	0.17			0.02	0.02
1991	1.0	1.0	0.17	0.17			0.03	0.02
1992	1.0	1.0	0.16	0.17	0.14		0.02	0.02
1993	13.3	3.5	0.36	0.21	0.32		0.02	0.02
1994	22.2	7.7	0.21	0.21	0.19		0.01	0.02
1995	21.4	11.8	0.23	0.23	0.20		0.02	0.02
1996	21.0	15.7	0.27	0.25	0.23	0.22	0.03	0.02
1997	21.9	19.9	0.29	0.27	0.19	0.23	0.11	0.04
1998	21.9	21.6	0.22	0.24	0.18	0.20	0.03	0.04
1999	22.5	21.7	0.21	0.24	0.17	0.19	0.03	0.05
2000	21.5	21.7	0.22	0.24	0.20	0.19	0.02	0.04
MOMM	21.7		0.22		0.20		0.04	
Objective	20.0		0.15		0.13		0.02	
MOMM-Ob	1.7		0.07		0.07		0.02	
Objective	109		144		155		187	

* % Na data is erroneous until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

CARSON RIVER @ PAYNESVILLE - MEAN OF MONTHLY MEAN DATA**
COMPARISON OF ANNUAL DATA AND 5 YEAR MOVING AVERAGE

	TDS	5YrMvAv	Cl	5YrMvAv	SO4	5YrMvAv	Total P	5YrMvAv	B	5YrMvAv
1981	64		1.8				0.03		0.01	
1982	49						0.04		0.02	
1983	43		0.9		4.1		0.03		0.03	
1984	49		1.2		1.4		0.04		0.02	
1985	50	51	1.7		2.3		0.05	0.04	0.24	0.06
1986	53	49	1.4		9.1		0.03	0.04	0.01	0.06
1987	68	53	2.1	1.5	5.7	4.5	0.04	0.04	0.01	0.06
1988	80	60	3.3	1.9	5.3	4.7	0.02	0.04	0.02	0.06
1989	60	62	2.2	2.1	4.5	5.4	0.03	0.03	0.02	0.06
1990	73	67	2.0	2.2	5.0	5.9	0.04	0.03	0.02	0.02
1991	71	70	2.3	2.4	5.2	5.1	0.04	0.03	0.02	0.02
1992	69	71	2.0	2.4	5.1	5.0	0.03	0.03	0.02	0.02
1993	59	66	1.5	2.0	4.3	4.8	0.03	0.03	0.02	0.02
1994	66	68	1.5	1.9	5.3	5.0	0.03	0.03	0.01	0.02
1995	54	64	1.4	1.7	4.6	4.9	0.04	0.03	0.01	0.02
1996	55	60	1.4	1.6	2.6	4.4	0.03	0.03	0.02	0.02
1997	58	58	1.0	1.4	2.9	3.9	0.03	0.03	0.01	0.02
1998	56	58	1.4	1.3	2.5	3.6	0.03	0.03	0.01	0.01
1999	59	56	1.5	1.3	2.5	3.0	0.02	0.03	0.01	0.01
2000	61	58	1.3	1.3	2.7	2.6	0.03	0.03	0.02	0.01
MOMM	60		1.7		4.2		0.03		0.03	
Objective	70		2.5		2.0		0.03		0.02	
MOMM-Obj					2.2				0.01	
Objective %	85		67		208		111		140	

* % Na data is erroneous until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

	% Na*	5YrMvAv	Total N	5YrMvAv	TKN	5YrMvAv	NO3	5YrMvAv
1981			0.32				0.08	
1982			0.29				0.09	
1983			0.23				0.04	
1984	1.0		0.30				0.03	
1985	1.0		0.28	0.28			0.04	0.06
1986	1.0		0.24	0.27			0.05	0.05
1987	1.0		0.28	0.27			0.06	0.04
1988	1.0	1.0	0.32	0.28			0.09	0.05
1989	1.0	1.0	0.27	0.28			0.06	0.06
1990	1.0	1.0	0.26	0.27			0.07	0.07
1991	1.0	1.0	0.31	0.29			0.11	0.08
1992	1.0	1.0	0.25	0.28	0.20		0.04	0.07
1993	13.7	3.5	0.28	0.27	0.22		0.05	0.07
1994	23.4	8.0	0.23	0.27	0.20		0.04	0.06
1995	21.9	12.2	0.31	0.28	0.26		0.04	0.06
1996	21.5	16.3	0.31	0.28	0.26	0.23	0.04	0.04
1997	22.4	20.6	0.28	0.28	0.17	0.22	0.10	0.06
1998	23.2	22.5	0.24	0.27	0.18	0.21	0.05	0.05
1999	23.7	22.5	0.28	0.28	0.23	0.22	0.04	0.05
2000	24.9	23.1	0.19	0.26	0.16	0.20	0.03	0.05
MOMM	23.0		0.27		0.21		0.06	
Objective	20.0		0.25		0.22		0.03	
MOMM-Ob	3.0		0.02				0.03	
Objective	115		109		94		191	

* % Na data is erroneous until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

CARSON RIVER @ PAYNESVILLE
COMPARISON OF STPUD & NDEP
MEAN OF MONTHLY MEAN DATA**

	California TDS	Nevada TDS	Objective	California Cl	Nevada Cl	Objective	California SO4	Nevada SO4	Objective	California Total P	Nevada Total P
1981	64	60	70	1.8	0.36	2.50			2.0	0.03	0.03
1982	49	50	70			2.50			2.0	0.04	0.02
1983	43	55	70	0.9	0.08	2.50	4.1		2.0	0.03	0.02
1984	49	48	70	1.2	0.10	2.50	1.4		2.0	0.04	0.02
1985	50	75	70	1.7	3.58	2.50	2.3		2.0	0.05	0.02
1986	53	55	70	1.4	0.09	2.50	9.1		2.0	0.03	0.03
1987	68	68	70	2.1	0.70	2.50	5.7		2.0	0.04	0.03
1988	80	70	70	3.3	0.92	2.50	5.3		2.0	0.02	0.03
1989	60	64	70	2.2	0.75	2.50	4.5		2.0	0.03	0.03
1990	73	64	70	2.0	0.75	2.50	5.0		2.0	0.04	0.03
1991	71	63	70	2.3	0.67	2.50	5.2		2.0	0.04	0.03
1992	69	63	70	2.0	0.67	2.50	5.1		2.0	0.03	0.03
1993	59	64	70	1.5	0.67	2.50	4.3		2.0	0.03	0.03
1994	66	64	70	1.5	0.67	2.50	5.3		2.0	0.03	0.03
1995	54	66	70	1.4	0.67	2.50	4.6		2.0	0.04	0.03
1996	55	66	70	1.4	0.67	2.50	2.6	2.2	2.0	0.03	0.03
1997	58	66	70	1.0	0.58	2.50	2.9	1.8	2.0	0.03	0.03
1998	56	67	70	1.4	1.50	2.50	2.5	1.8	2.0	0.03	0.03
1999	59	45	70	1.5	1.00	2.50	2.5	2.0	2.0	0.02	0.03
2000	61	56	70	1.3	1.00	2.50	2.7	2.0	2.0	0.03	0.02
MOMM	60	61		1.7	0.8		4.2	2.0		0.03	0.03
Objective* **	70	70		2.5	2.5		2.0	2.0		0.03	0.03
MOMM-Obj							2.2				
Objective %	85	88		67	32		208	98		111	92

* % Na data is erroneous for CA until June, 1993: Only 1994 forward is used in average.

** Units are mg/L

*** Objectives are California objectives only, but Nevada data is compared to the California objective

	Objective	California B	Nevada B	Objective	California % Na*	Nevada % Na*	Objective	California Total N	Nevada Total N	Objective	California TKN	Nevada TKN
1981	0.03	0.01		0.02			20.0	0.32		0.25		0.22
1982	0.03	0.02		0.02			20.0	0.29		0.25		0.13
1983	0.03	0.03		0.02			20.0	0.23		0.25		0.11
1984	0.03	0.02		0.02	1.0		20.0	0.30	0.21	0.25		0.12
1985	0.03	0.24		0.02	1.0		20.0	0.28	0.24	0.25		0.16
1986	0.03	0.01		0.02	1.0		20.0	0.24	0.18	0.25		0.15
1987	0.03	0.01		0.02	1.0		20.0	0.28	0.23	0.25		0.18
1988	0.03	0.02		0.02	1.0		20.0	0.32	0.30	0.25		0.22
1989	0.03	0.02		0.02	1.0		20.0	0.27	0.38	0.25		0.28
1990	0.03	0.02		0.02	1.0		20.0	0.26	0.37	0.25		0.27
1991	0.03	0.02		0.02	1.0		20.0	0.31	0.34	0.25		0.25
1992	0.03	0.02		0.02	1.0		20.0	0.25	0.33	0.25	0.20	0.25
1993	0.03	0.02		0.02	13.7		20.0	0.28	0.31	0.25	0.22	0.23
1994	0.03	0.01		0.02	23.4		20.0	0.23	0.34	0.25	0.20	0.26
1995	0.03	0.01		0.02	21.9		20.0	0.31	0.34	0.25	0.26	0.26
1996	0.03	0.02		0.02	21.5		20.0	0.31	0.34	0.25	0.26	0.26
1997	0.03	0.01		0.02	22.4		20.0	0.28	0.34	0.25	0.17	0.26
1998	0.03	0.01		0.02	23.2		20.0	0.24	0.34	0.25	0.18	0.25
1999	0.03	0.01		0.02	23.7		20.0	0.28	0.42	0.25	0.23	0.37
2000	0.03	0.02		0.02	24.9		20.0	0.19	0.21	0.25	0.16	0.18
MOMM		0.03			23.0			0.27	0.31		0.21	0.22
Objective* **		0.02			20.0			0.25	0.25		0.22	0.22
MOMM-Obj		0.01			3.0			0.02	0.06			
Objective %		140			115			109	123		94	100

	Objective	California NO3	Nevada NO3	Objective
1981	0.22	0.08	0.05	0.03
1982	0.22	0.09	0.05	0.03
1983	0.22	0.04	0.05	0.03
1984	0.22	0.03	0.05	0.03
1985	0.22	0.04	0.08	0.03
1986	0.22	0.05	0.04	0.03
1987	0.22	0.06	0.07	0.03
1988	0.22	0.09	0.07	0.03
1989	0.22	0.06	0.09	0.03
1990	0.22	0.07	0.09	0.03
1991	0.22	0.11	0.08	0.03
1992	0.22	0.04	0.07	0.03
1993	0.22	0.05	0.07	0.03
1994	0.22	0.04	0.07	0.03
1995	0.22	0.04	0.07	0.03
1996	0.22	0.04	0.07	0.03
1997	0.22	0.10	0.07	0.03
1998	0.22	0.05	0.08	0.03
1999	0.22	0.04	0.19	0.03
2000	0.22	0.03	0.12	0.03
MOMM		0.06	0.08	
Objective* **		0.03	0.03	
MOMM-Obj		0.03	0.05	
Objective %		191	255	