3.2 Results of Simulations of the Future Water Quality

The scenarios are simulated for the years 1994 to 1995, however the worst condition for the oxygen condition occurred in mid August where the temperatures are at its highest on the same time as the discharge is low.

Tables of the resulting water classes of BOD, NH4 and O2 have been generated for each scenario, see Table M.3.7 to M.3.9. These are based on a review of the time series of concentrations of BOD, NH4 and O2 together with a review of planplots of concentrations in mid August, see Figure M.3.4 to M.3.11.

BOD 1_1D

After implementing 1st stage, class II condition was reached for BOD in the modeled part of the river system except for Sazliyka, see Figure M.3.4 scenario 1_1D. Sazliyka River downstream Radnevo just manages to reach classes II for BOD, whereas upstream Radnevo the BOD concentration level reach class III or more. Relative to scenario 0_3 year 2015 without treatment there have been improvements of the water quality in Chepelarska River downstream Assenovgrad, in Harmanliyska and in Maritza river downstream the cities of Pazardjik, Stamboliyski and Plovdiv.

BOD 1_3D

This scenario includes secondary treatment of all project cities. Class II or better is reached in the river system except for Sazliyka River, see Figure M.3.5. Relative to scenario 1_1D improvements can be seen in Luda Yana, Stryama River, in Maritza River downstream Belovo, just downstream the tributaries of Stara and Vacha River. At Dimitrovgrad the BOD concentration decreases under 2 g/m3 due to reduction of the load from the upstream cities and tributaries.

In Sazliyka River the water quality do not improve despite the load from Radnevo and Galabovo is reduced, the load from Stara Zagora dominate this tributary. In the lower part of Maritza River the BOD concentration decreases as a result of the upstream improved treatment.

BOD 2_3D

Compared with scenario 1_3D this scenario has only primary treatment on 3rd priority cities, which are marked with yellow on the planplots.

Like for the previous scenarios, class II is met for the river system except Sazliyka River, see Figure M.3.5.

Compared with scenario 1_1D, improvements are seen in the lover part of Stryama River and in Maritza River around Dimitrovgrad as a result of the upstream reduction in the load.

BOD 3_3D

Scenario 3_3D has only primary treatment on both 2nd and 3rd priority cities. Except for a slight improvement in Stryama River, no visible changes relative to scenario 1_1D can be seen, see Figure M.3.5. As stated in the previous chapter the difference between the two scenarios in the BOD load is small 1 %.

BOD 1_3

Scenario 1_3 has secondary treatment for all priority cities and a 30 % BOD reduction of the top 10 industries.

Relative to scenario 1_3D major improvements may be found in the lower part of Maritza River due to reduction of the BOD load from Kristal Katunlitza, and industries in Stara Zagora, Plovdiv Stamboliyski, Pazardjik and Dimitrovgrad, see Table M.3.7 and Figure M.3.6.

In Sazliyka river class II is reached downstream Radnevo.

BOD 2_3

Scenario 2_3 has secondary treatment for 1st and 2nd priority cities and only primary treatment for 3rd priority cities. The top 20 industrial BOD emitter reduces the load with 30 %. The BOD load of livestock in farms is reduced with 30%

Relative to scenario 2_3D significant improvements are found in the lower part of Maritza River, see Figure M.3.6. In Sazliyka River a slight improvement is also visible, however class II is not meet downstream Stara Zagora until just before Radnevo.

Compared with scenario 1_3 no major differences are found in Sazliyka and the lower part of Maritza River However the BOD concentration is lower in scenario 1_3 in Stryama and Luda Yana Rivers.

BOD 3_3 and 4_3

Scenario 3_3 and 4_3 has secondary treatment for 1st priority cities and only primary treatment for 2nd and 3rd priority cities. The top 10 industrial BOD emitter reduces the load with 90 % and top 10-20 industries reduce the BOD load with 30 %. The load of all livestock reduce the BOD load with 30%

These scenario are the only scenario meeting class II or better for the river system including Sazliyka River, see Table M.3.7 and Figure M.3.6.

Total NH4-N 1_1D, 1_3D, 2_3D, 3_3D and 1_3

The load of NH4 to the river system changes only a few percent for all scenarios not including either nitrification or a reduction in the NH4 load from the fertilizer factories in Stara Zagora and Dimitrovgrad. Therefore the scenarios 1_1D to 1_3 are commented together, and only scenario 1_3 is presented, see Table M.3.8 and Figure M.3.8.

Class II is meet in Maritza River, except downstream the cities of Pazardjik, Stamboliyski Plovdiv. In the lower part of Maritza River downstream Dimitrovgrad and

in Harmanliyska and Luda Yana class III is meet, however the classification of Luda Yana is due to use of to high boundary concentrations of NH4 in the simulations.

In Sazliyka River worse than class III is simulated. No of the scenarios comes near the general objective for the river system of class II for NH4.

Total NH4-N 2_3 and 3_3

These two scenarios include a 90 %reduction of load from the fertilizer factories in Stara Zagora and Dimitrovgrad.

Relative to the other scenario class II is met in Maritza River except just downstream the major cities of Pazardjik, Stamboliyski and Plovdiv. In Sazliyka River an improvement can be seen as class III is meet downstream Galabovo. Upstream this city the water quality in terms of NH4 is still worse than class III.

Total NH4-N 4_3

A final scenario was set up in an attempt to reach class II for the whole river system implementing nitrification of domestic load in Stara Zagora and Haskovo, see Figure M.3.11.

Class II is meet in Harmanliyska River, and Class III is meet downstream Galabovo. Upstream Galabovo the condition has improved but it is still worse than class III.

If class II have to be meet for NH4 further reductions in the load form industries and livestock have to be implemented.

Oxygen 0_3, 1_1D, 1_3D, 2_3D, 3_3D

In general class II is meet for Maritza River without treatment. The problem with oxygen conditions can be restricted to Sazliyka River where the lower part downstream Galabovo is classified above class III. Upstream Galabovo the class is III.

The scenarios implementing treatment of domestic load all result in an improvement, resulting in class II to III upstream Radnevo. Below Radnevo the class is III or worse than III, see Table M.3.9 and Figure M.3.9.

Due to a higher slope of the river bead the reaeration is higher in the upper part of Sazliyka River resulting in a better O2 water class close to Stara Zagora. In the lower part of Sazliyka River the slope is not so steep giving a low reaeration and consequently a lower oxygen concentration.

Besides BOD, NH4 consume oxygen through bacterial mediated oxidation (nitrification) into NO3. For each g NH4, 4.6 g O2 is consumed during this process. The NH4 concentration therefore is important for the resulting O2 concentration in the river. Due to the fertilizer factory in Stara Zagora the NH4 concentration is high and an improvement of the oxygen concentration can not be expected before this load is reduced.

Oxygen 2_3 and 3_3

Scenarios 2_3 and 3_3 implement a 90 % reduction of the NH4 load from the fertilizer factory in Stara Zagora.

For both scenarios are valid that the oxygen meet class II or better in most of Sazliyka River except for a small section before confluence with Maritza River, see Figure M.3.6.

Oxygen 4_3

Scenario 4_3 is identical to scenario 3_3 but include nitrification at Stara Zagora and Haskovo.
Class II or better is meet in Sazliyka river, only at a very small section before Maritza river the concentration may just drop below 4 g O2/m3.

This scenario will meet the criteria for class II for the whole river system, see Figure M.3.11.

Carrying capacity in Sazliyka River versus future classification

Sazliyka River is the part of the river system in Maritza basin witch is most severely effected by human activities when looking at the BOD, NH4 and O2 condition.

Due to the low discharge in Sazliyka river relative to the load coming from the cities, industries and agriculture in the catchment Class II can not be meet for NH4, BOD and O2 without special measures have to be implemented in addition to BOD reduction of domestic load.

One way to solve this problem is to accept a higher class in restricted areas of the river. Another possibility is to set up more restrict rules for emission of load into this part of the river than for the rest of the basin.

3.3 Evaluation of Proposed Alternative Load Reductions

Reduction of domestic BOD scenarios 1_1D, 1_3D, 2_3D, 3_3D

The simulations of the proposed scenarios for reduction of the load in Maritza Basin show, that a reduction of domestic BOD from the priority cities without nitrification will result in class II for BOD and O2 in the modeled part of the basin with the exception of Sazliyka River.

In Sazliyka River, class II for neither BOD, oxygen nor NH4 will be meet if not the load from industries and livestock load is reduced. Neither will class II be reached for NH4 in Harmanliyska River and the lower part of Maritza River.

The proposed scenarios only reducing the domestic BOD do not fulfil the goal for the future water quality concerning Sazliyka River, Harmanliyska and part of Maritza River.

Reduction of domestic, industrial BOD and livestock BOD, scenario 1_3

This scenario meet the class II for BOD and O2 in the main Maritza river, but fails to meet class II for BOD, NH4 and O2 in Sazliyka River and class II for NH4 in Harmanliyska river and in Maritza River downstream Dimitrovgrad.

Reduction of domestic BOD, industrial BOD, livestock BOD, and fertilizer plant load, scenario 2_3, 3_3

A reduction of the BOD from industry will meet the class II for BOD and O2 in the whole river system including Sazliyka River only if the top 20 industries reduces their load and on the same time the load form livestock is reduced by 30 %, see scenario 3_3.

For scenario 3_3 however class II for NH4 is not meet just downstream the cities of Stamboliyski, Pazardjik and Plovdiv, and in Sazliyka and Harmanliyska Rivers.

Reduction of domestic industrial and livestock BOD and reduction of NH4 fertilizer load

This scenario fulfil the requirements for class II of BOD and O2 in the modeled rivers, however class II for NH4 is still to high in Sazliyka River and downstream the cities of Stamboliyski, Pazardjik and Plovdiv.

Tributaries not covered by the model

The model cover the main Maritza River including the tributaries of Sazliyka, Harmanliyska lower part, Stryama River, Pyassachnik River, Luda Yana, Topolnitza, and Chepelarska River lower part.

The model does not cover tributaries as Vacha, Stara, Potoka and Chepinska Rivers.

The effect of reducing the BOD and TN load from these cities will have limited, or no effect on the modeled part of the river, because the BOD and NH4 at the time when the water enters Maritza river have been mineralized or turned into NO3.

The effect on the water quality of the load reduction in the not modeled tributaries may be important and necessary, but it is not possible to quantify these with the model.

Using the biological index map it is possible to identify the effected part of these tributaries and thereby identify the potential important cities for treatment.

It shows out, that all the 3rd priority cities in the not modeled tributaries are classified as being moderately or heavy polluted downstream these cities.

It can therefore be concluded that the planned reduction of the load from the 3rd priority cities in Vacha, Stara, Potoka and Chepinska Rivers are justified.

TABLE M.1.1 DAILY AVERAGE LOAD OF BOD, TN, NH4 AND NO3 PRODUCED IN THE MARITZA BASIN TO THE RIVER SYSTEM

Type of source	No. Or area	Kg BOD Day	Kg TN day	Kg NH4-N Pr. day	Kg NO3-N pr. day
Domestic	City + village: 502	48000	8900	4500	1500
Industries	Number: 248	36100	15600	14000	
Pig farm	pigs: 316.000	11100	3200	900	
Cattle (government)	Cattle: 35.600	1600	3200	2900	
Fowls (government)	Fowls: 441.600	1300	300	200	
Pig private in villages	pigs: 120.000	4100	1200	900	
Cattle private in villages	Cattle: 119.300	2700	5300	4900	
Non point forest & grassland			2200		2200
Non point arable land	10300.00		7000		7000
Sum		**104900**	**46900**	**28300**	**10700**

TABLE M.1.2 UNIT LOADS USED FOR ESTIMATION OF LOAD FROM POPULATION AND LIVESTOCK

Unit loads pr. Capita or livestock	Kg BOD/d	Kg TN/d	Kg NH3/d	Kg NO3-N/d	Comment
PE Rural population, not sewed	0.0135	0.0032	0.0012	0.0012	
PE No treatment sewed population	0.0540	0.0080	0.0048	0	Standard for Bulgaria
PE Mechanical +Activated sludge	0.0054	0.0032	0.0012	0.0017	JICA WQ survey 1997
PE Mechanical treated	0.0378	0.0068	0.0048	0.0000	No nitrification
PE Mechanical+biological, Nitrification	0.0054	0.0056	0.0005	0.0043	90 % NH4 reduction
Pig wet cleaning 3 step WWTP,	0.014	0.01	0.001	0.009	Manole pig farm
Pig in farms and in villages	0.035	0.01	0.008	0	Estimate
Cow in farms	0.05	0.09	0.08	0	Estimate
Cow in villages on grass in summer	0.025	0.045	0.04	0	Estimate
Chicken	0.003	0.0007	0.0005	0	Estimate

TABLE M.1.3 LOAD PRODUCED FROM MAJOR CITIES OR INDUSTRIES

Location	BOD Kg/day	TN Kg/day	NH4-N Kg/day	NO3-N Kg/day
Assenovgrad	3248	470	276	0
Chirpan	1312	179	104	2
Dimitrovgrad	4581	5066	4791	0
Galabovo	1214	135	61	1
Harmanli	1031	156	89	5
Haskovo	4289	630	372	5
Lyubimetz	330	42	20	7
Panagyurishte	307	84	32	33
Parvomay	1403	155	63	8
Pazardjik	6099	789	414	10
Plovdiv	5127	1719	856	561
Radnevo	597	90	50	6
Sadovo	143	21	13	0
Septemvri	559	75	42	2
Simeonovgrad	312	50	28	4
Stamboliyski	2297	578	497	6
Stara Zagora	18993	10087	9000	14
Svilengrad	555	94	50	11
Velingrad	3253	448	253	0
vv Kristal Katunitza	9616	192	0	0
WWTP-Haskovo industry	817	54	5	0
Total	62836	20643	16740	675

TABLE M.1.4 MOST IMPORTANT INDUSTRIAL BOD AND TN POLLUTERS RANKED BY BOD LOAD

Location	Institution	Business	BOD5 kg/d	TN Kg/d	NH3 Kg/d
Katunitza	"Kristal 91"	Food processing	9616	192	0
Stara Zagora	"Agrobiohim"	Chemical	7257	8640	8205
Stara Zagora	"Zagorka" Brewery Ltd	Food processing	2520	84	0
Dimitrovgrad	SC Neohim	Chemicals	1698	4645	4543
Stamboliyski	"Vitamina" Ltd.	Food processing	1357	18	0
Pazardjik	"Maritsa" KK Ltd.	Food processing	1307	109	31
Plovdiv	"Kristal 91" sweet factory	Food processing	1120	75	8
WWTP-Haskovo industry	Joint Ind TWWKS	Waste Treatment	817	54	5
Galabovo	TEPS "Maritza East" 1	Electric Power	746	65	20
Parvomay	"Bulkons" Ltd.	Food processing	677	45	5
Stara Zagora	Meat Factory Ltd.	Food processing	456	46	18

TABLE M.1.5 LOAD ENTERING THE MODEL PART OF THE RIVER FROM MAJOR CITIES AND INDUSTRIES

Location	Distance Km	BOD Kg/day	TN Kg/day	NH4-N Kg/day	NO3-N Kg/day
Assenovgrad	0.0	3248	470	276	0
Chirpan	10.5	808	177	105	28
Dimitrovgrad	0.0	4581	5066	4791	0
Galabovo	0.0	1214	135	61	1
Harmanli	0.0	1031	156	89	5
Haskovo	12.6	2398	615	363	110
Lyubimetz	0.0	330	42	20	7
Panagyurishte	14.0	161	77	30	38
Parvomay	0.0	1403	155	63	8
Pazardjik	0.0	6099	789	414	10
Plovdiv	0.0	5127	1719	856	561
Radnevo	0.0	597	90	50	6
Sadovo	0.0	143	21	13	0
Septemvri	3.5	476	75	43	5
Simeonovgrad	0.0	312	50	28	4
Stamboliyski	0.0	2297	578	497	6
Stara Zagora	14.0	8471	10085	9326	197
Svilengrad	0.0	555	94	50	11
Velingrad	34.9	647	373	183	151
vv Kristal Katunitza	0.0	9616	192	0	0
WWTP-Haskovo industry	0.00	817	54	5	0
Total		47083	20543	16986	1148

TABLE M.1.6 DOMESTIC, INDUSTRIAL AND LIVESTOCK LOAD FROM AGGREGATED FROM SUB CATCHMENTS, PREPARED TO BE PUT INTO THE MODEL

Boundary	Boundary no	Area Km2	BOD Kg/day	TN Kg/day	NH4 Kg N/day	NO3 Kg N/day
Maritza upper b.	1	1173	1398	1013	431	498
Chepinska Upper b.	2	919	197	565	204	349
Stara upper b.	4	366	495	367	142	195
Chepelarska upper b.	7	979	549	627	262	332
Topolnitza upper b.	11	1447	304	316	95	203
Luda Yana upper b.	13	572	230	525	286	226
Pyassachnik upper b.	15	349	121	126	41	78
Stryama upper b.	16	1086	1735	1176	533	539
Sazliyka upper b.	18	1156	1722	1791	1292	396
Harmanliyska upper b.	21	986	715	1011	439	528
	3	429	1449	834	435	312
	5	1689	553	842	309	500
	6	1564	3065	2657	1262	1211
	8	1993	1828	2479	1049	1320
	9	1576	1237	2062	1001	987
	10	1634	1321	1666	716	871
	12	410	541	400	173	194
	14	212	454	346	186	132
	17	608	590	774	345	394
	19	611	452	841	622	192
	20	1576	894	1296	886	357
Total		21335	19850	21713	10708	9815

TABLE M.2.1 MONITORING STATIONS USED FOR CALIBRATION

River	Station no.
Maritza river	85, 260, 263, 265, 157, 92, 267, 93, 268, 96, 272
Topolnitza r.	259
Ludu Yana	102, 154
Stryama	103
Sazliyka	105, 270
Harmanli	271

TABLE M.3.1 SCENARIOS SET UP FOR MODELING OF WATER QUALITY
NUMBERS INDICATE PERCENT REDUCTION OF LOAD

Scenario	BOD Reduction in %									TN Red. %
	Domestic				Industry			Livestock		2
	Priority Order			Nitrifi cation	Most Loaded Industry			Farm	Other	Fertilizer Industries
	1st	2nd	3rd		1 - 10	11- 20	Other			
2015 or 0_3	0	0	0	0	0	0	0	0	0	0
1_1D	90	0	0	0	0	0	0	0	0	0
1_3D	90	90	90	0	0	0	0	0	0	0
2_3D	90	90	30	0	0	0	0	0	0	0
3_3D	90	30	30	0	0	0	0	0	0	0
1_3	90	90	90	0	30	0	0	0	0	0
2_3	90	90	30	0	30	30	0	30	0	90
3_3	90	30	30	0	90	30	0	30	30	90
4_3	90	30	30	90	90	30	0	30	30	90

TABLE M.3.2 REDUCTION OF BOD, TN AND NH4-N LOAD ACCORDING TO TREATMENT

Treatment	**BOD Red. %**	**TN Red. %**	**NH4 Red. %**
Primary	30	15	0
Primary + secondary	90	30	8
Primary + sec.+ nitrification	90	30	90

TABLE M.3.3 % REDUCTION IN LOADING TO MARITZA RIVER SYSTEM RELATIVE TO YEAR 2015 WITHOUT IMPLANTATION

%	1995	2015	1_1D	1_3D	2_3D	3_3D	1_3	2_3	3_3	4_3
BOD	-5	0	-23	-33	-28	-24	-40	-38	-50	-50
TN	-2	0	-3	-3	-3	-3	-9	-36	-38	-38
NH4	-2	0	1	2	2	2	-4	-39	-38	-41

TABLE M.3.4 LOAD OF BOD IN TONS PR. YEAR ACCORDING TO SCENARIO

BOD	1995	2015	1_1D	1_3D	2_3D	3_3D	1_3	2_3	3_3	4_3
Domestic	48.0	53.2	28.0	17.4	22.6	26.8	17.4	22.6	26.8	26.8
Industry	36.1	36.1	36.1	36.1	36.0	36.1	28.0	28.2	13.4	13.4
Livestock	20.8	20.8	20.8	20.8	20.8	20.8	20.8	17.0	15.0	15.0
Forest+grass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sum	104.9	110.1	84.9	74.3	79.4	83.8	66.2	67.8	55.2	55.2

TABLE M.3.5 LOAD OF TN IN TONS PR. YEAR ACCORDING TO SCENARIO

TN	1995	2015	1_1D	1_3D	2_3D	3_3D	1_3	2_3	3_3	4_3
Domestic	8.9	9.8	8.6	8.3	8.5	8.7	8.3	8.5	8.7	8.8
Industry	15.6	15.6	15.6	15.6	15.6	15.6	13.5	3.5	3.6	3.6
Livestock	13.2	13.2	13.2	13.2	13.2	13.2	13.2	11.8	10.7	10.7
Forest+grass	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
sum	40.0	40.8	39.7	39.4	39.6	39.8	37.3	26.0	25.1	25.2

TABLE M.3.6 LOAD OF NH4-N IN TONS PR. YEAR ACCORDING TO SCENARIO

NH4	1995	2015	1_1D	1_3D	2_3D	3_3D	1_3	2_3	3_3	4_3
Domestic	4.5	5.0	4.8	5.0	5.1	5.2	5.0	5.1	5.2	4.2
Industry	14.0	14.0	14.4	14.5	14.5	14.4	12.8	2.7	3.4	3.4
Livestock	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	9.4	9.4
Forest+grass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sum	28.5	29.0	29.2	29.5	29.6	29.5	27.7	17.8	18.0	17.0

TABLE M.3.7 BOD CLASSES OF MODELED PART OF MARITZA RIVER ACCORDING TO IMPLEMENTED LOAD REDUCTION

III*: beyond class III

River/ tributaries	2015	1_1D	1_3D	2_3D	3_3D	1_3	2_3	3_3	4_3
Maritza upper MU	I-II	I-II	I-II	I-II	I-II	I-II	I-II	I-II	I-II
Maritza mid MM	II	I-II	I-II	I-II	I-II	I-II	I-II	I-II	I-II
Maritza low MD	II-III	I-II	I	I	I	I	I	I	I
Sazliyka	II-III*	II-III*	II-III*	II-III*	II-III*	I-III*	I-III*	I-II	I-II
Harmanliyska	III	I	I	I	I	I	I	I	I
Stryama	I-II	I-II	I	I	I	I	I	I	I
Pyassachnik	I	I	I	I	I	I	I	I	I
Luda Yana	II	II	I-II	II	II	I-II	I-II	I-II	I-II
Topolnitza r.	I	I	I	I	I	I	I	I	I
Chepelarska r.	II	I	I	I	I	I	I	I	I

TABLE M.3.8 NH4 CLASSES OF MODELED PART OF MARITZA RIVER ACCORDING TO IMPLEMENTED LOAD REDUCTION

III*: beyond class III

River/ tributaries	2015	1_1D	1_3D	2_3D	3_3D	1_3	2_3	3_3	4_3
Maritza upper MU	II-III	II-III	II-III	II-III	II-III	II-III	II-III	II-III	II-III
Maritza mid MM	II-III	II-III	II-III	II-III	II-III	II-III	II-III	II-III	II-III
Maritza low MD	II-III	II-III	II-III	II-III	II-III	II-III	II	II	II
Sazliyka	III*	III*	III*	III*	III*	III*	III-III*	III-III*	III-III*
Harmanliyska	III	III	III	III	III	III	III	III	II
Stryama	II	II	II	II	II	II	II	II	II
Pyassachnik	II	II	II	II	II	II	II	II	II
Luda Yana	III	III	III	III	III	III	III	III	II
Topolnitza r.	II	II	II	II	II	II	II	II	II
Chepelarska r.	II	II	II	II	II	II	II	II	II

TABLE M.3.9 OXYGEN CLASSES OF MODELED PART OF MARITZA RIVER ACCORDING TO IMPLEMENTED LOAD REDUCTION

III*: beyond class III

River/ tributaries	2015	1_1D	1_3D	2_3D	3_3D	1_3	2_3	3_3	4_3
Maritza upper MU	I	I	I	I	I	I	I	I	I
Maritza mid MM	I-II	I-II	I-II	I-II	I-II	I-II	I	I	I
Maritza low MD	I-II	I-II	I-II	I-II	I-II	I-II	I	I	I
Sazliyka	III-III*	II-III*	II-III*	II-III*	II-III*	II-III*	I-III	I-III	I-II
Harmanliyska	II	II	II	II	II	I	I	I	I
Stryama	I	I	I	I	I	I	I	I	I
Pyassachnik	I	I	I	I	I	I	I	I	I
Luda Yana	I	I	I	I	I	I	I	I	I
Topolnitza r.	I	I	I	I	I	I	I	I	I
Chepelarska r.	I	I	I	I	I	I	I	I	I

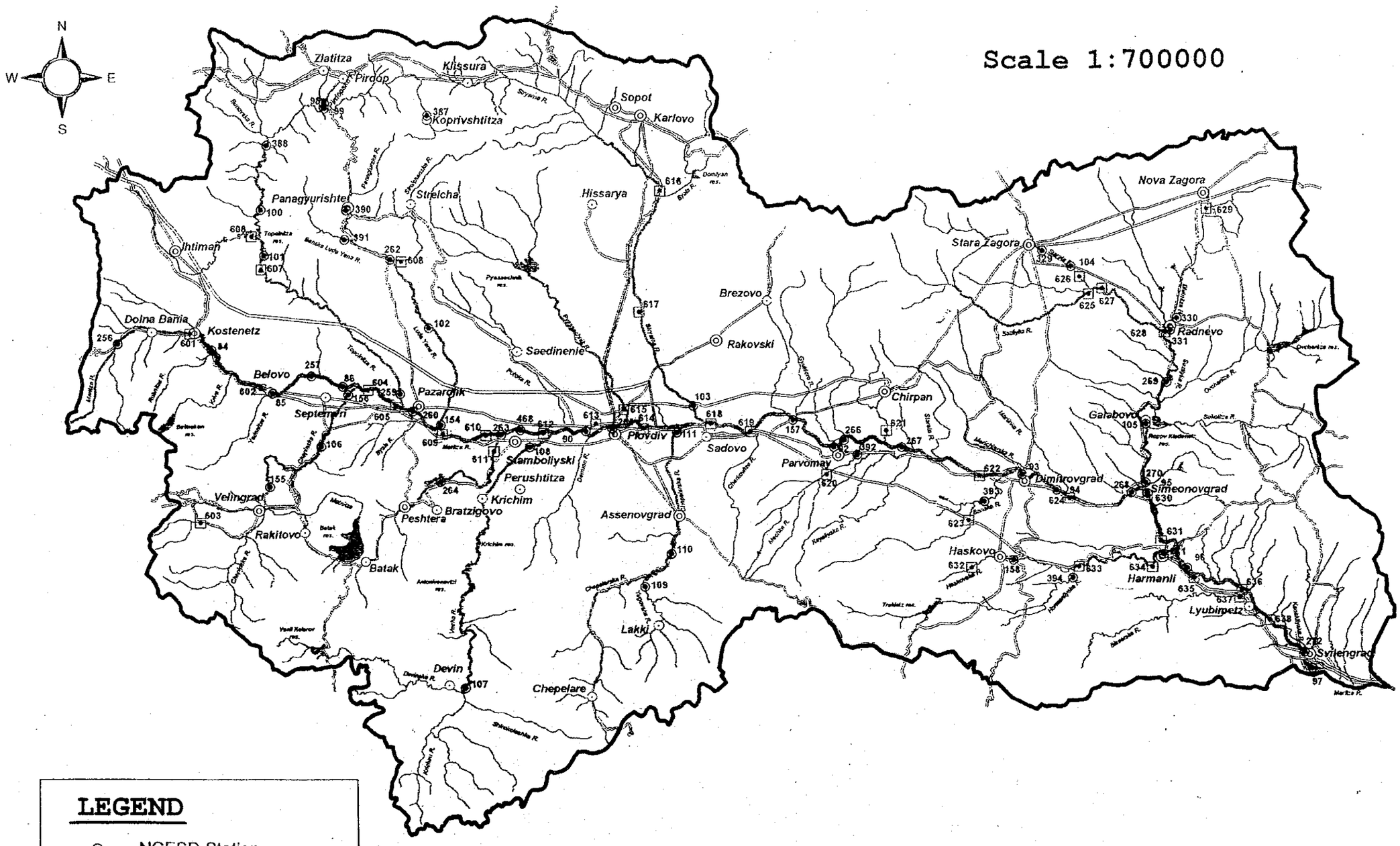


FIG.M.1.1 LOCATION OF SURFACE WATER MONITORING STATIONS IN THE MARITZA BASIN

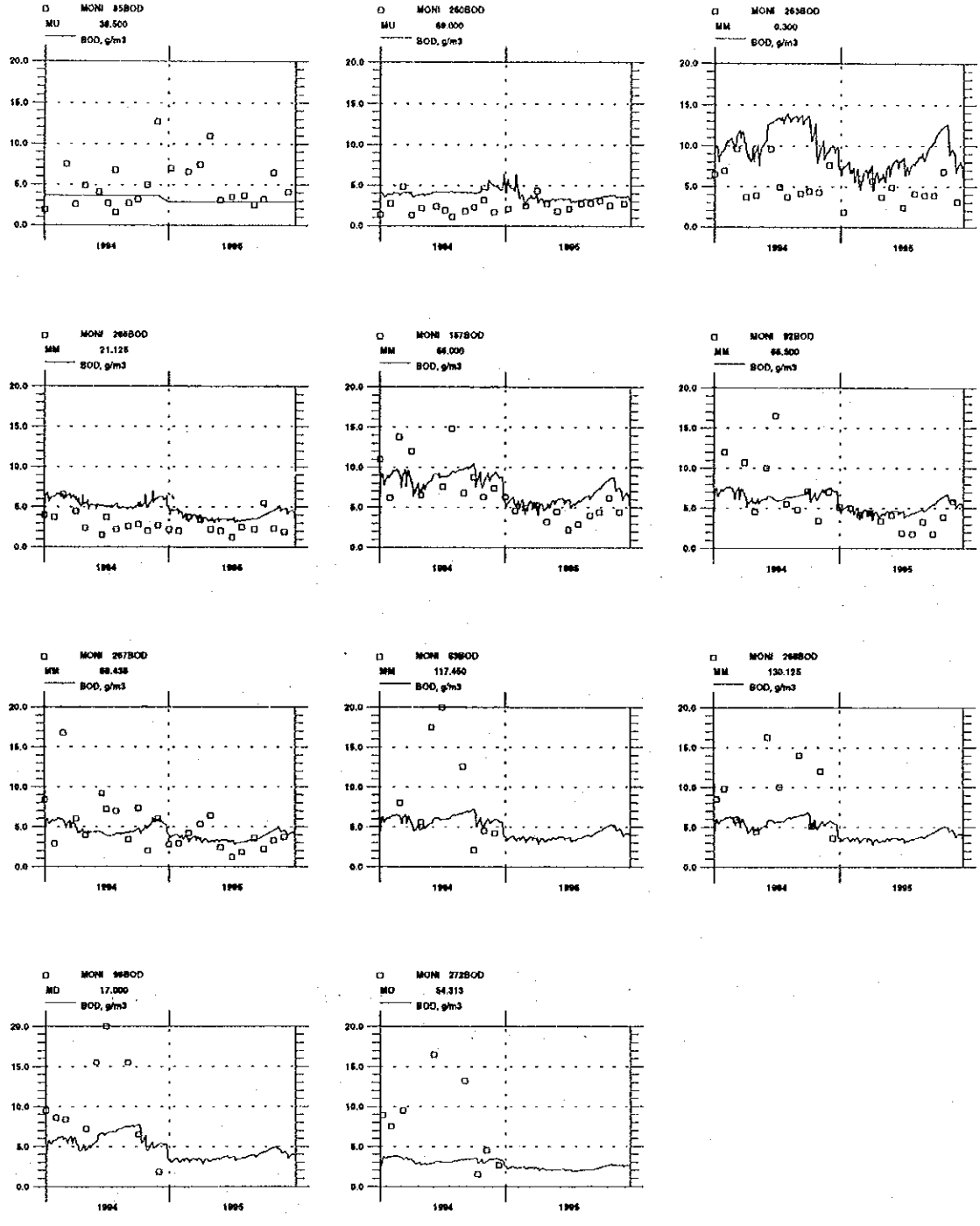


FIG.M.1.2 SIMULATED AND MEASURED BOD CONCENTRATION IN MARITZA RIVER 1994-1995

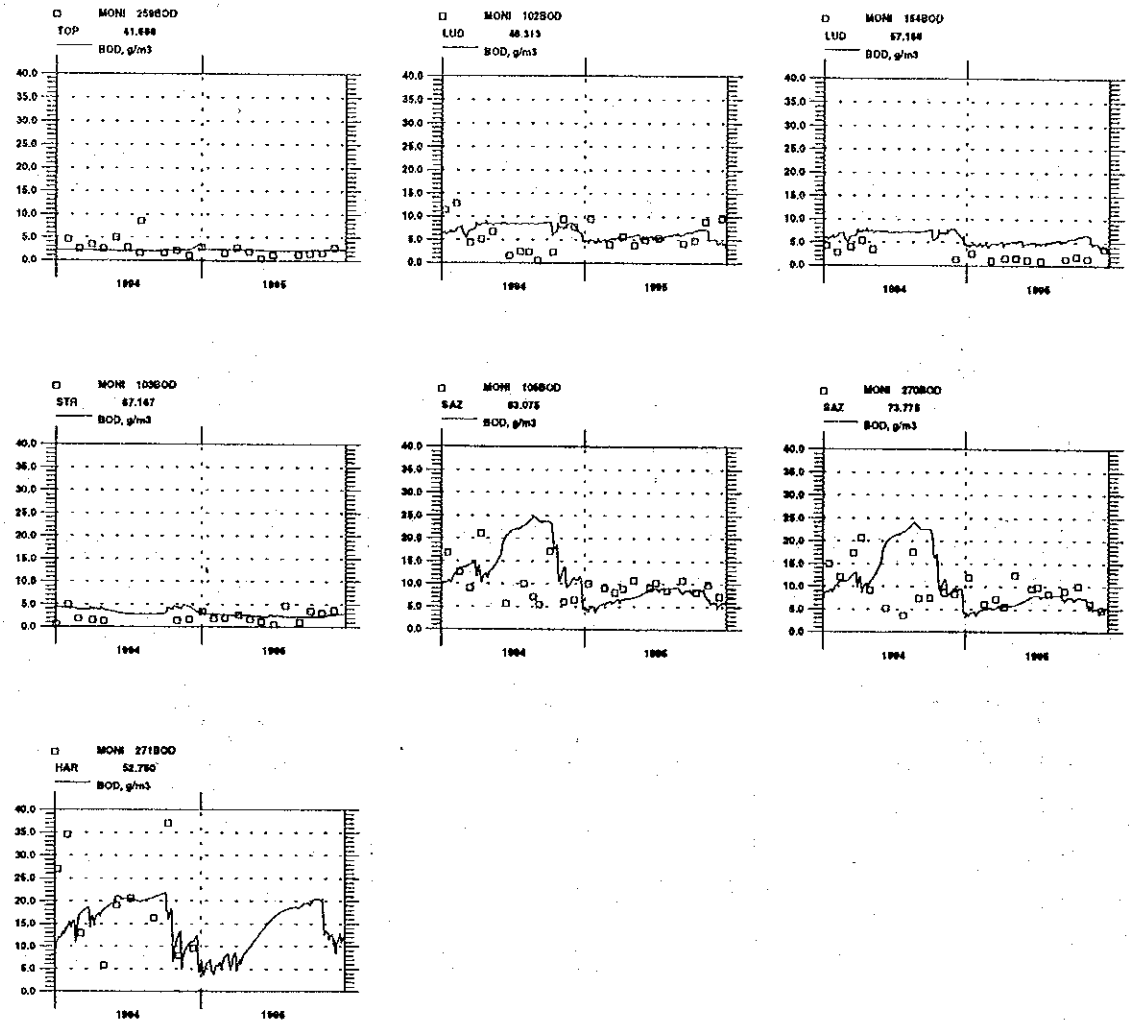


FIG.M.1.3 SIMULATED AND MEASURED BOD CONCENTRATION IN TRIBUTARIES,1994-1995

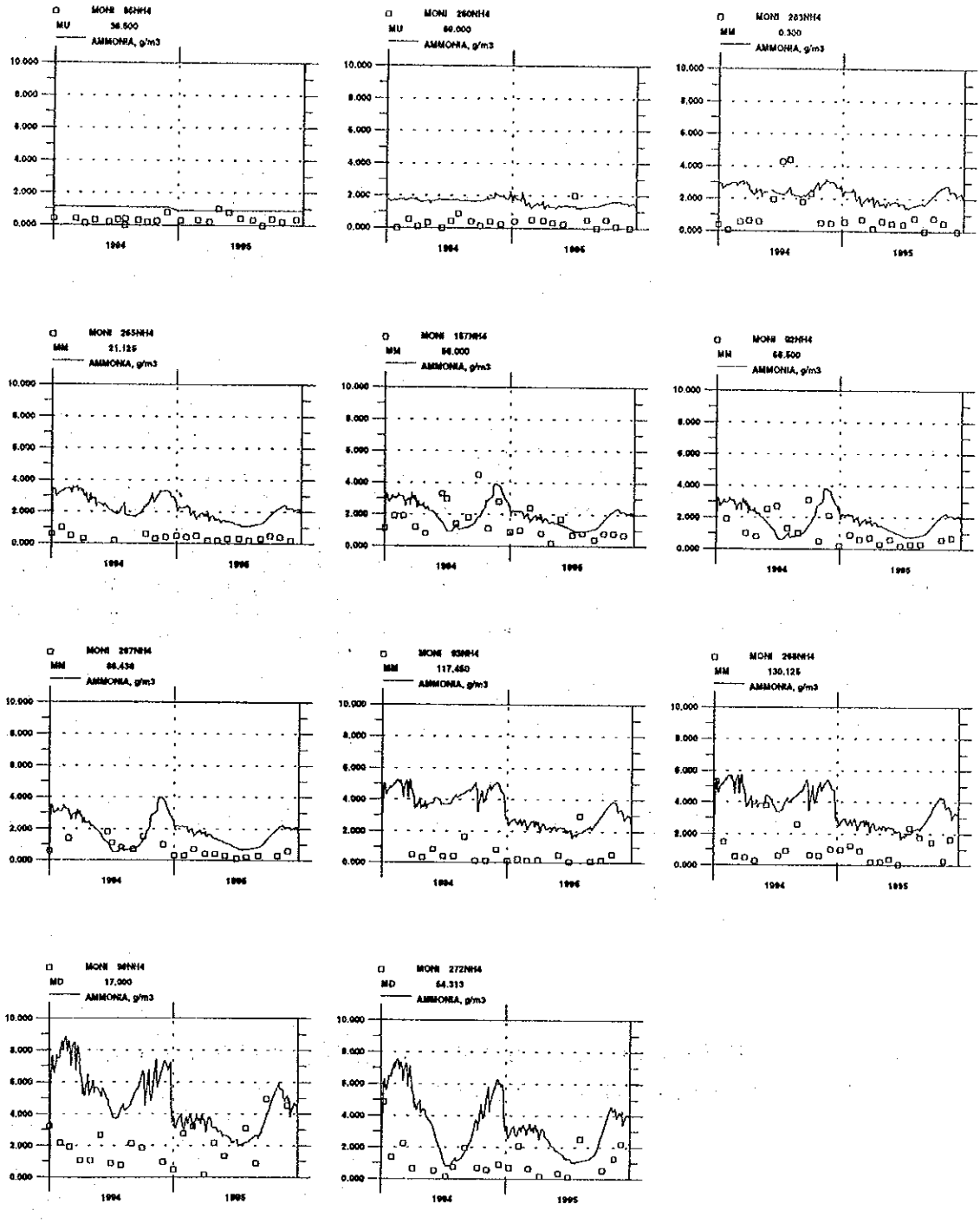


FIG.M.1.4 SIMULATED AND MEASURED NH4-N CONCENTRATION IN MARITZA RIVER 1994-1995

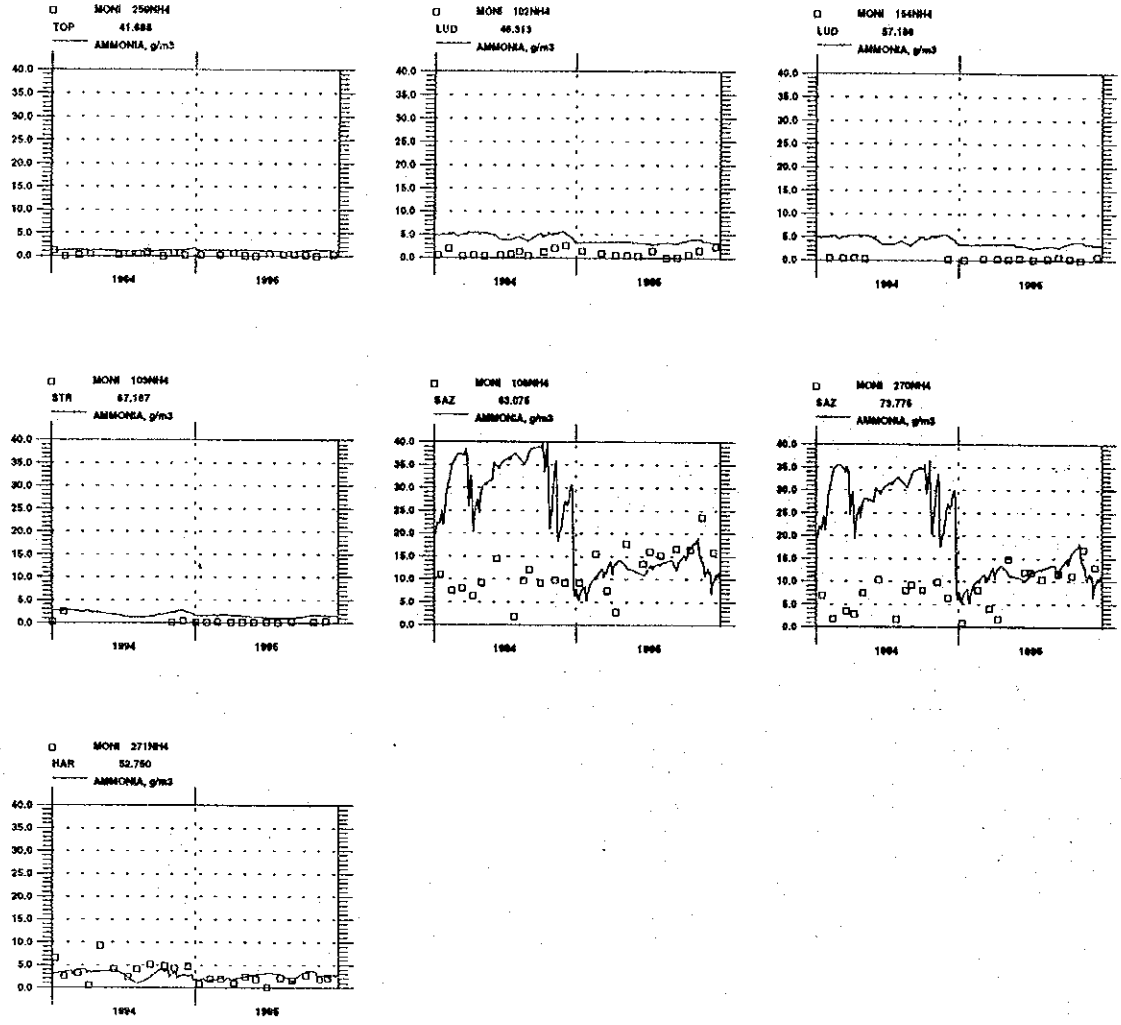


FIG.M.1.5 SIMULATED AND MEASURED NH4-N CONCENTRATION IN TRIBUTARIES,1994-1995

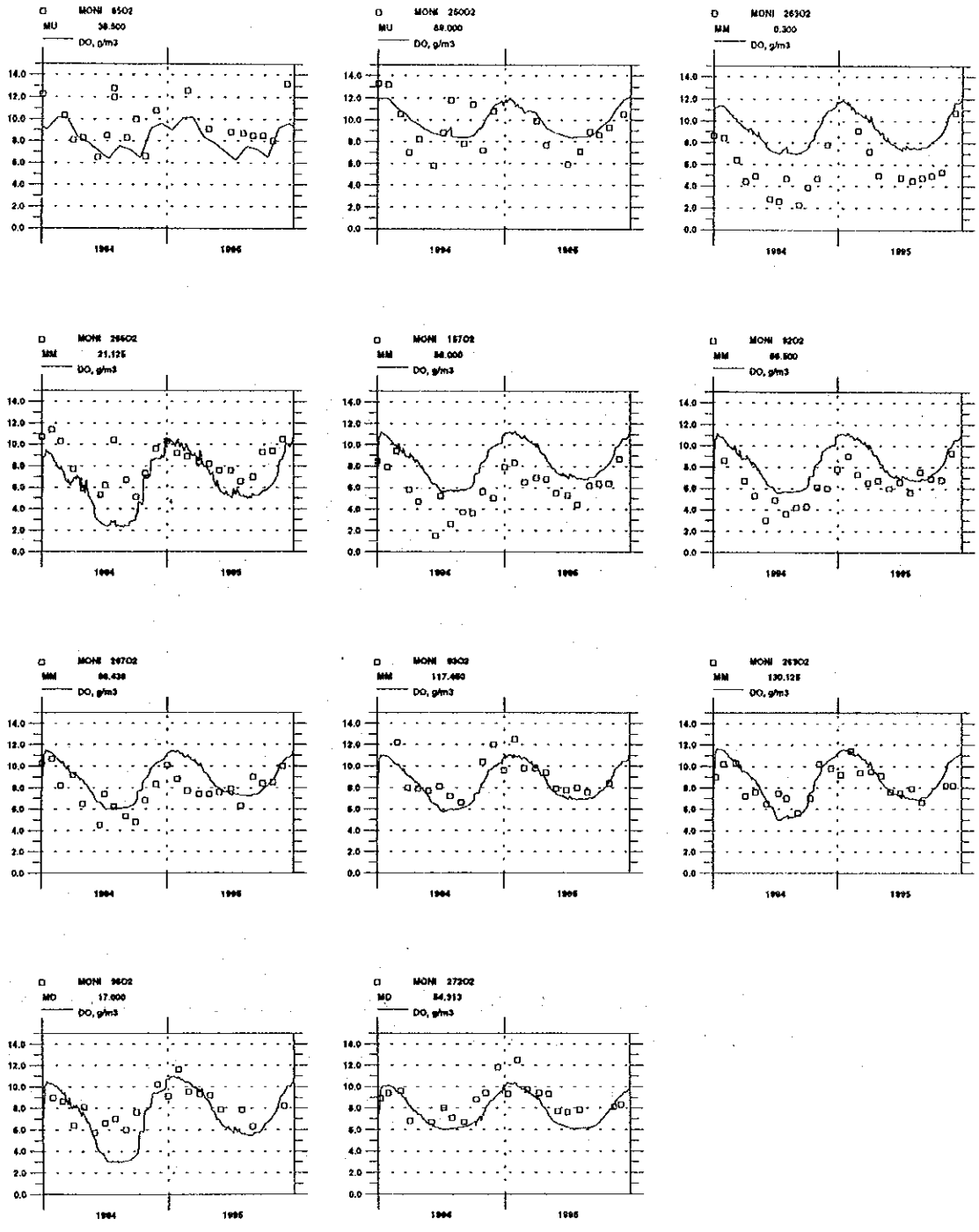


FIG.M.1.6 SIMULATED AND MEASURED OXYGEN CONCENTRATION IN MARITZA RIVER 1994-1995

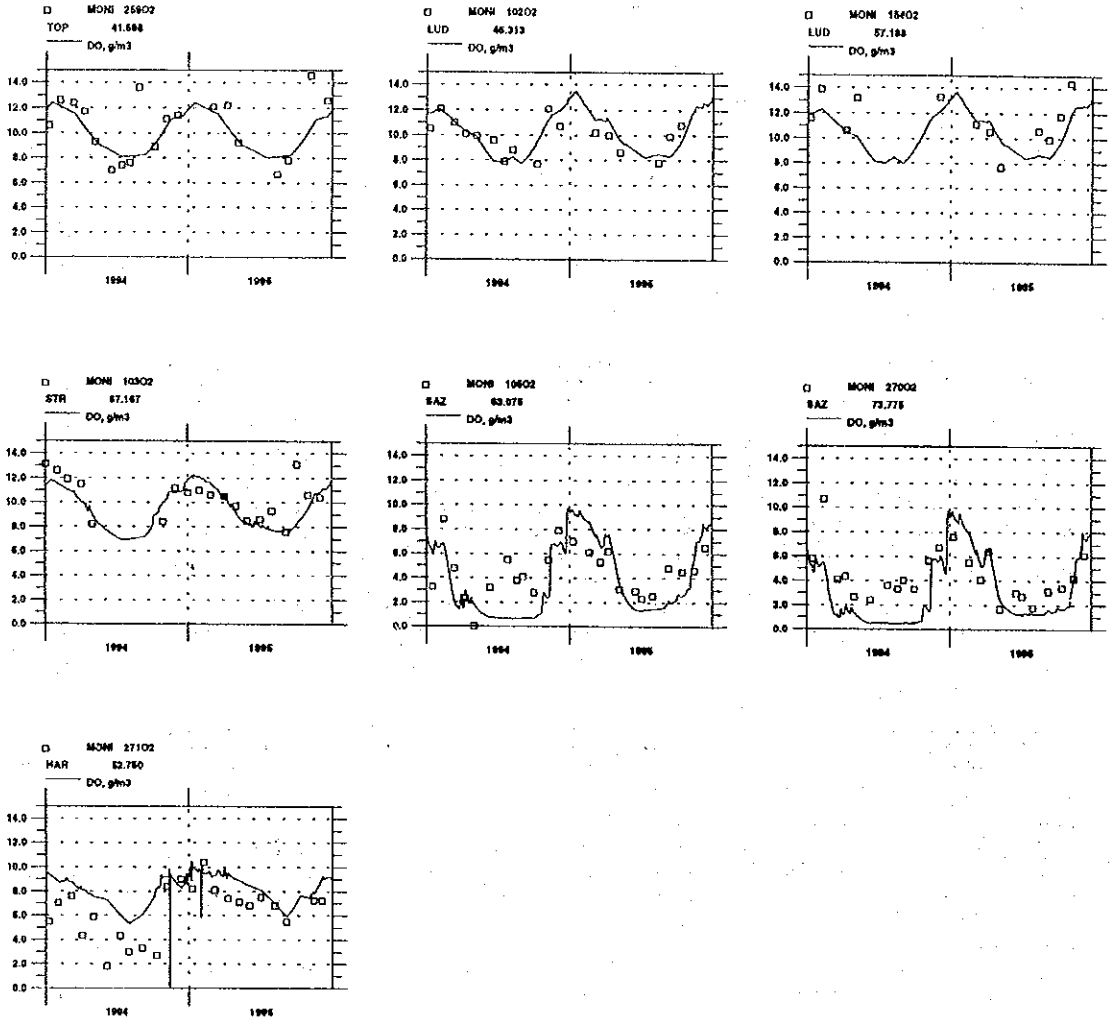


FIG.M.1.7 SIMULATED AND MEASURED OXYGEN CONCENTRATION IN TRIBUTARIES,1994-1995

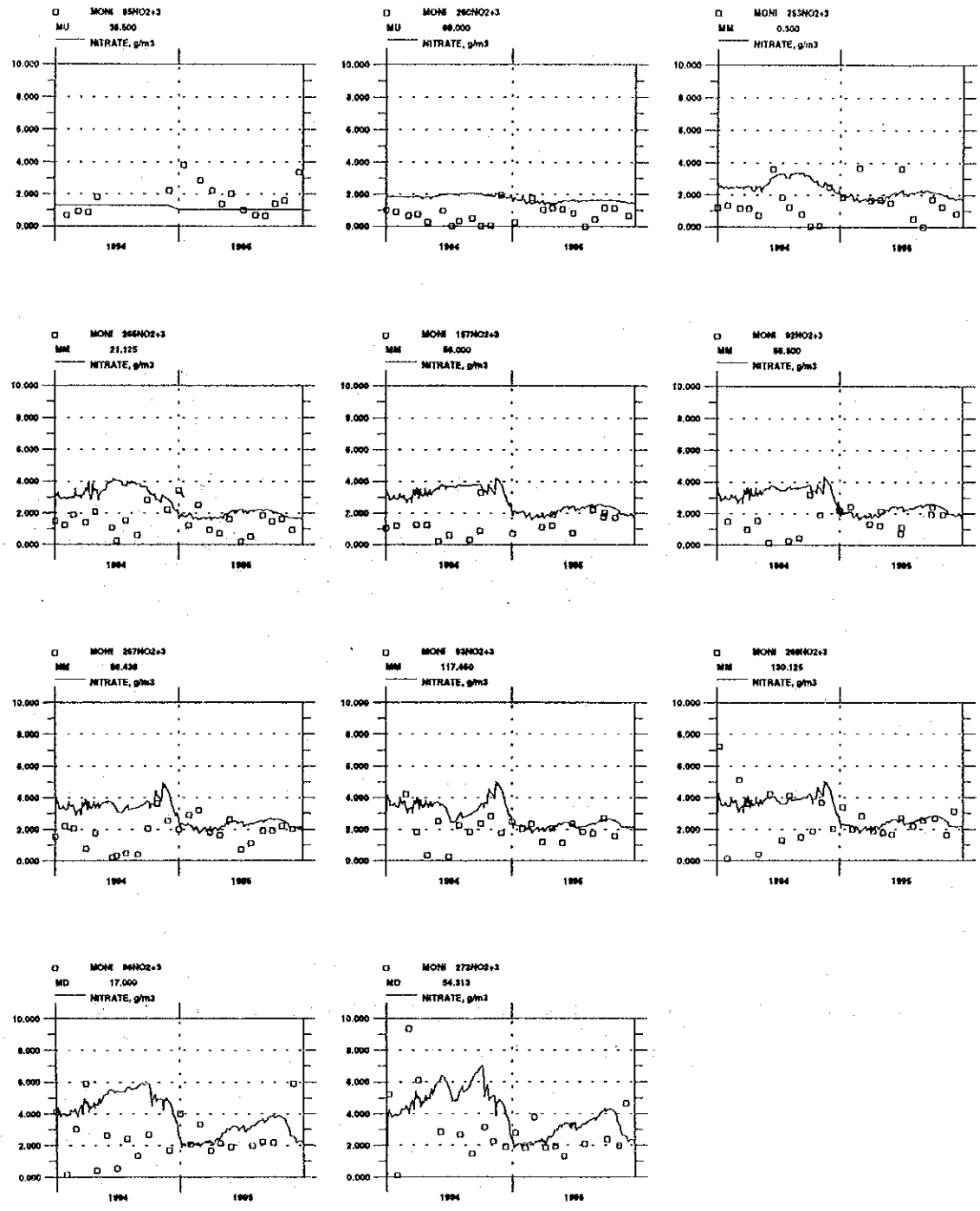


FIG.M.1.8 SIMULATED AND MEASURED NO3-N CONCENTRATION IN MARITZA RIVER 1994-1995

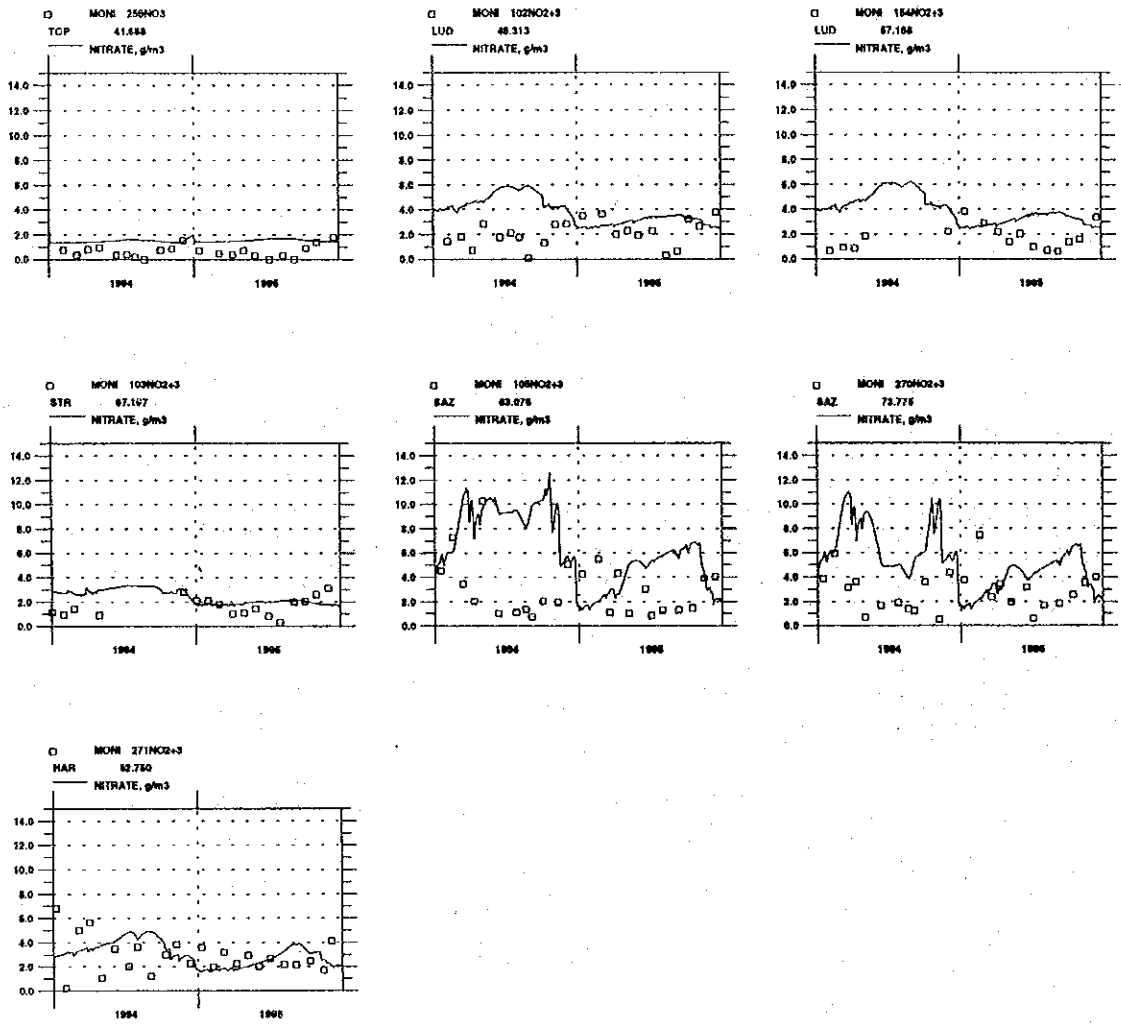


FIG.M.1.9 SIMULATED AND MEASURED NO3-N CONCENTRATION IN TRIBUTARIES,1994-1995

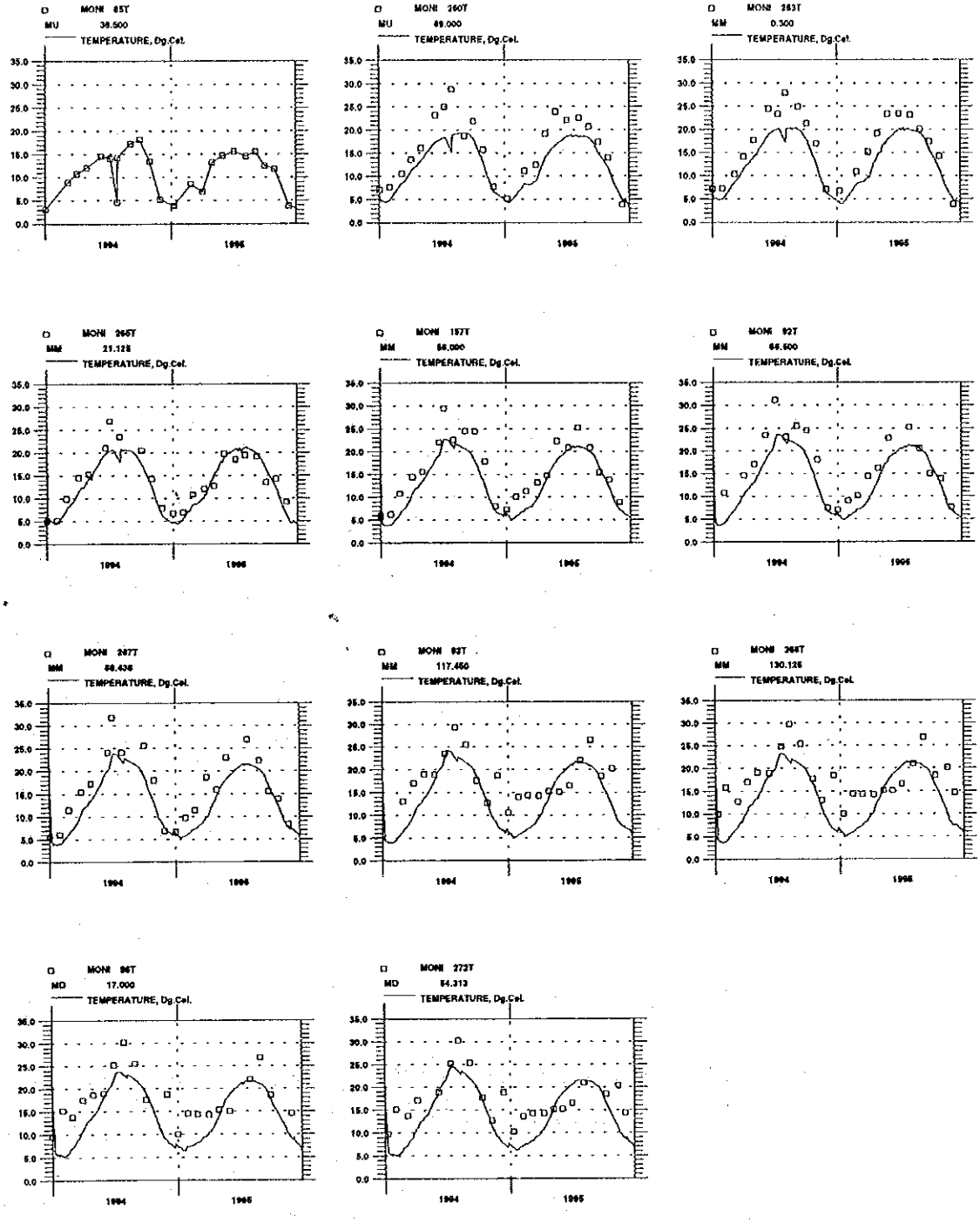


FIG.M.1.10 SIMULATED AND MEASURED TEMPERATURE IN MARITZA 1994-1995

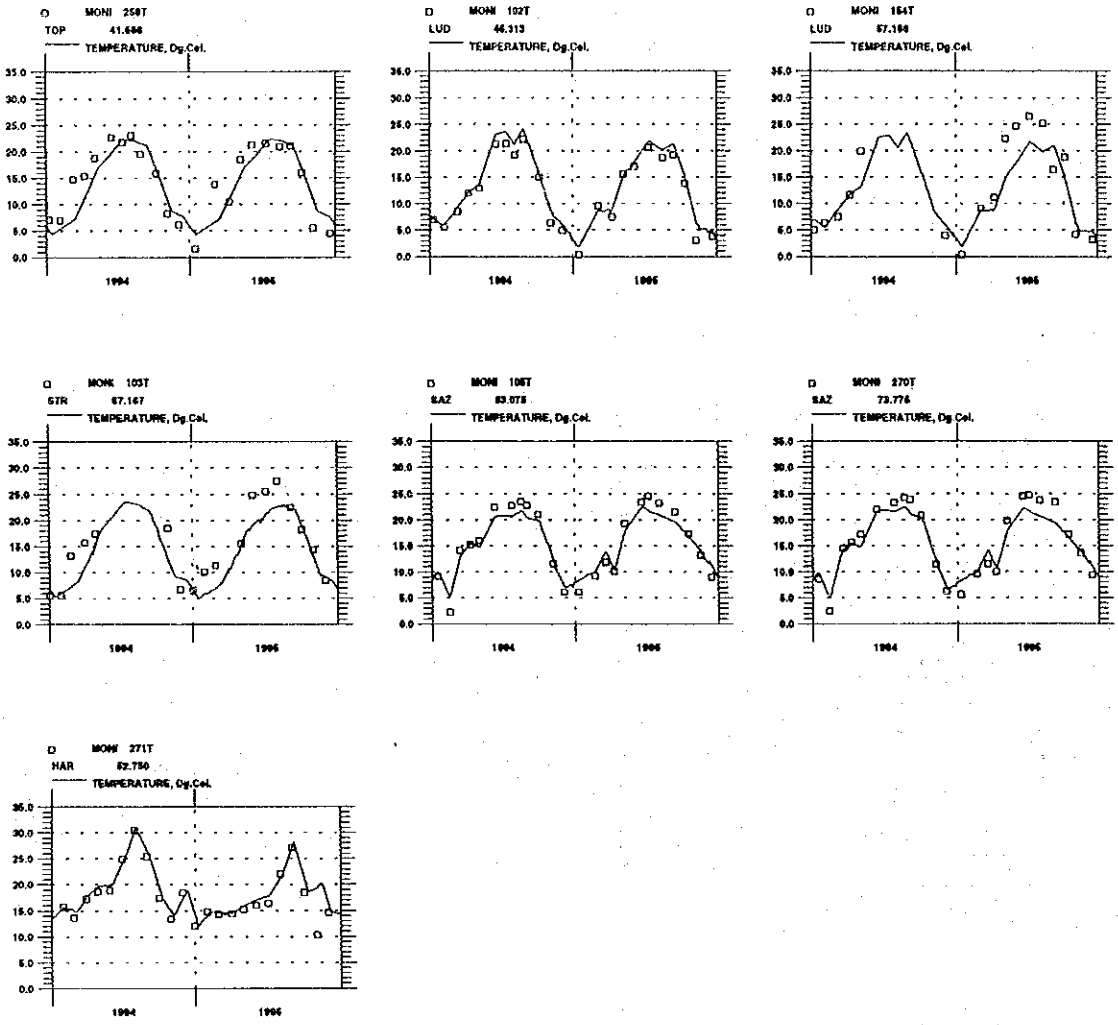


FIG.M.1.11 SIMULATED AND MEASURED TEMPERATURE IN TRIBUTARIES,1994-1995

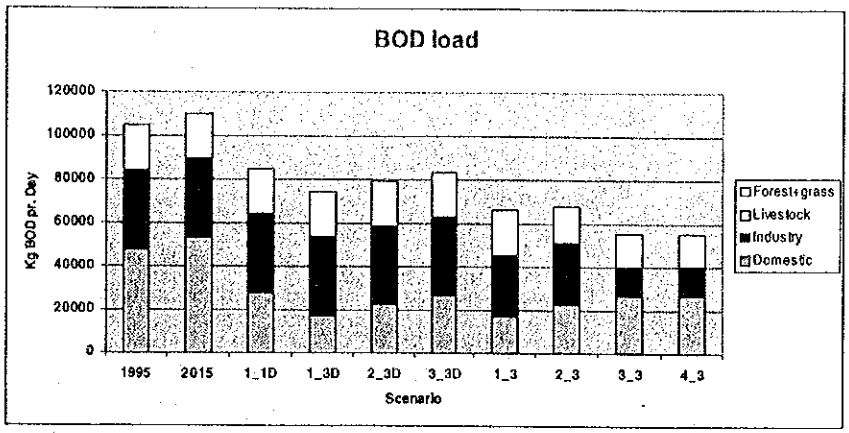


FIG.M.3.1 LOAD OF BOD TO THE MARITZA BASIN,AS FUNCTION OF DIFFERENT ALTERNATIVE SCENARIOS

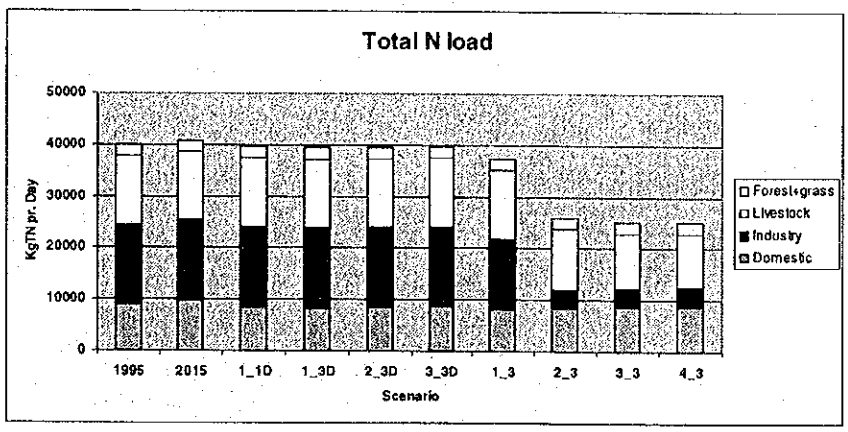


FIG.M.3.2 LOAD OF TOTAL N TO THE MARITZA BASIN,AS FUNCTION OF DIFFERENT ALTERNATIVE SCENARIOS

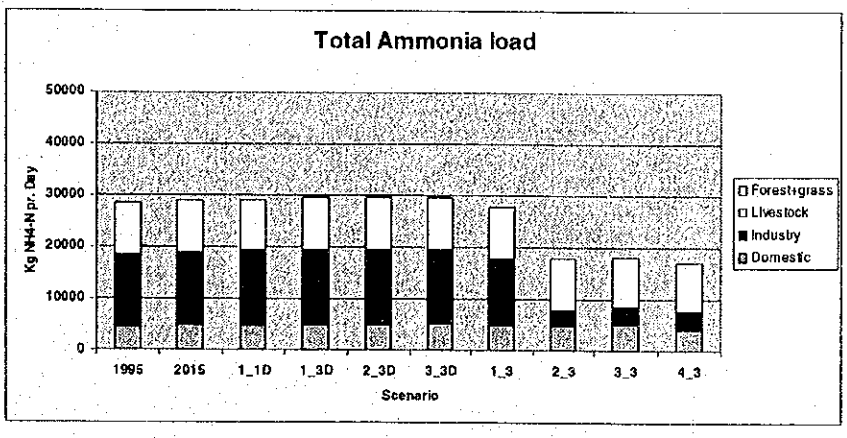


FIG.M.3.3 LOAD OF NH4-N TO THE MARITZA BASIN,AS FUNCTION OF DIFFERENT ALTERNATIVE SCENARIOS

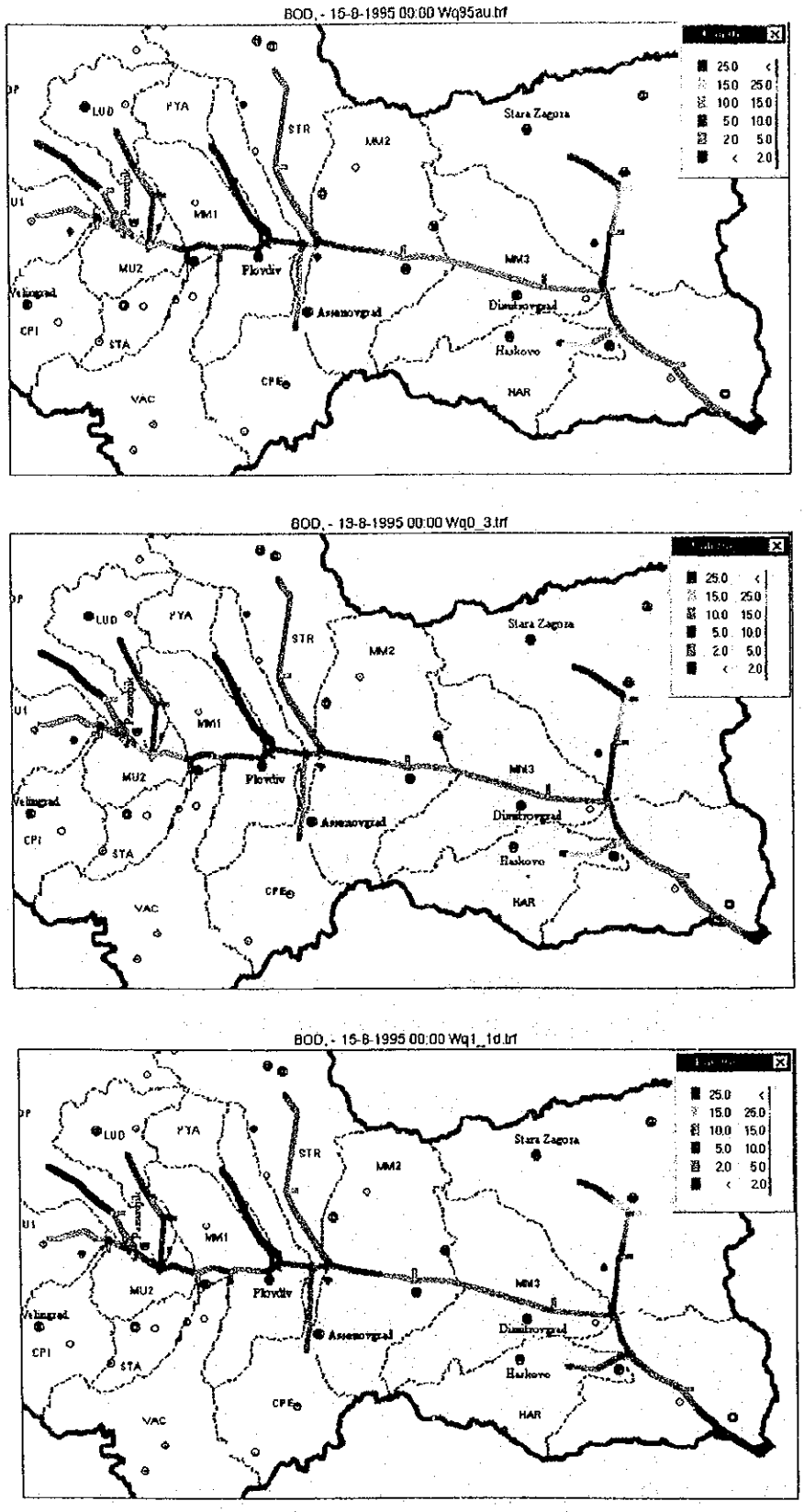


FIG.M.3.4 SIMULATED BOD CONCENTRATIONS MID AUGUST YEAR 1995, 2015 AND SCENARIOS 1_1D. BLUE:CLASS I. GREEN:CLASSII. YELLOW:CLASS III. RED AND BLACK:ABOVE CLASS III.

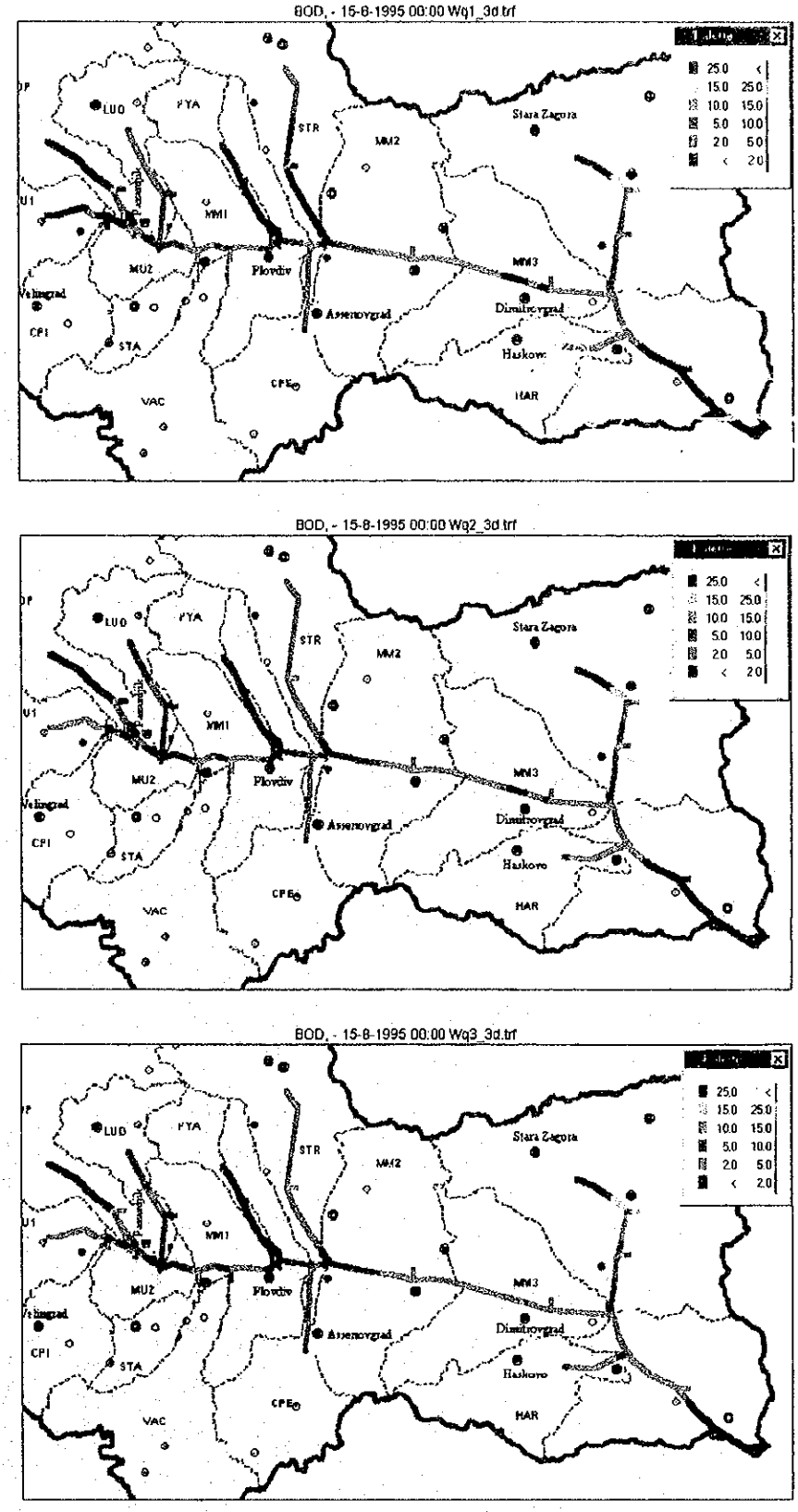


FIG.M.3.5 SIMULATED BOD CONCENTRATIONS MID AUGUST YEAR 1_3D,2_3D AND 3_3D. BLUE:CLASS I. GREEN:CLASSII. YELLOW:CLASS III. RED AND BLACK:ABOVE CLASS III.

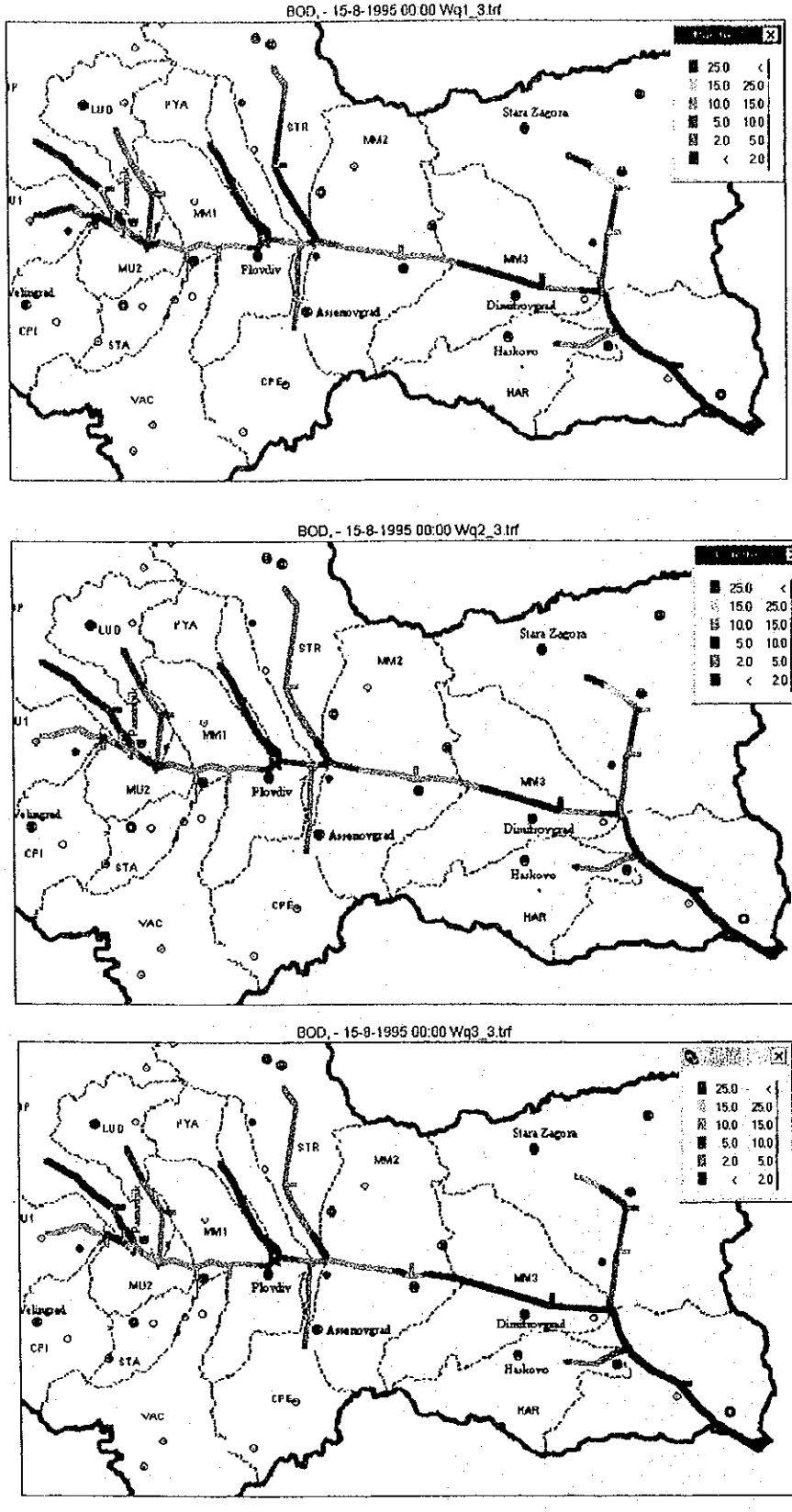


FIG.M.3.6 SIMULATED BOD CONCENTRATIONS MID AUGUST,SCENARIO 1_3,2_3 AND 3_3. BLUE:CLASS I. GREEN:CLASSII. YELLOW:CLASS III. RED AND BLACK:ABOVE CLASS III.

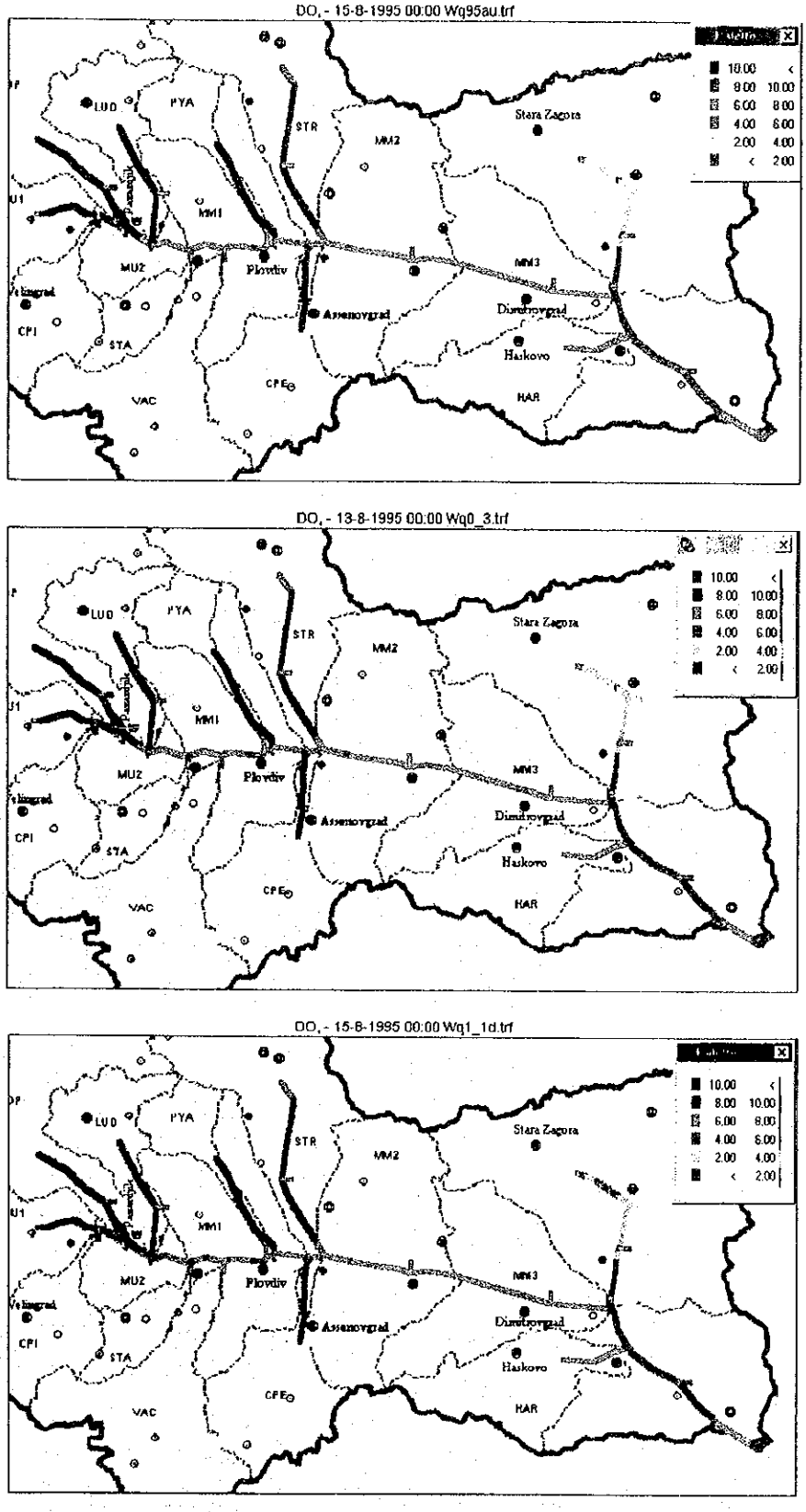


FIG.M.3.7 SIMULATED O2 CONCENTRATIONS MID AUGUST YEAR 1995, 2015 AND SCENARIO 1_1D. BLUE:CLASS I. GREEN:CLASSII. YELLOW:CLASS III. RED AND BLACK:ABOVE CLASS III.

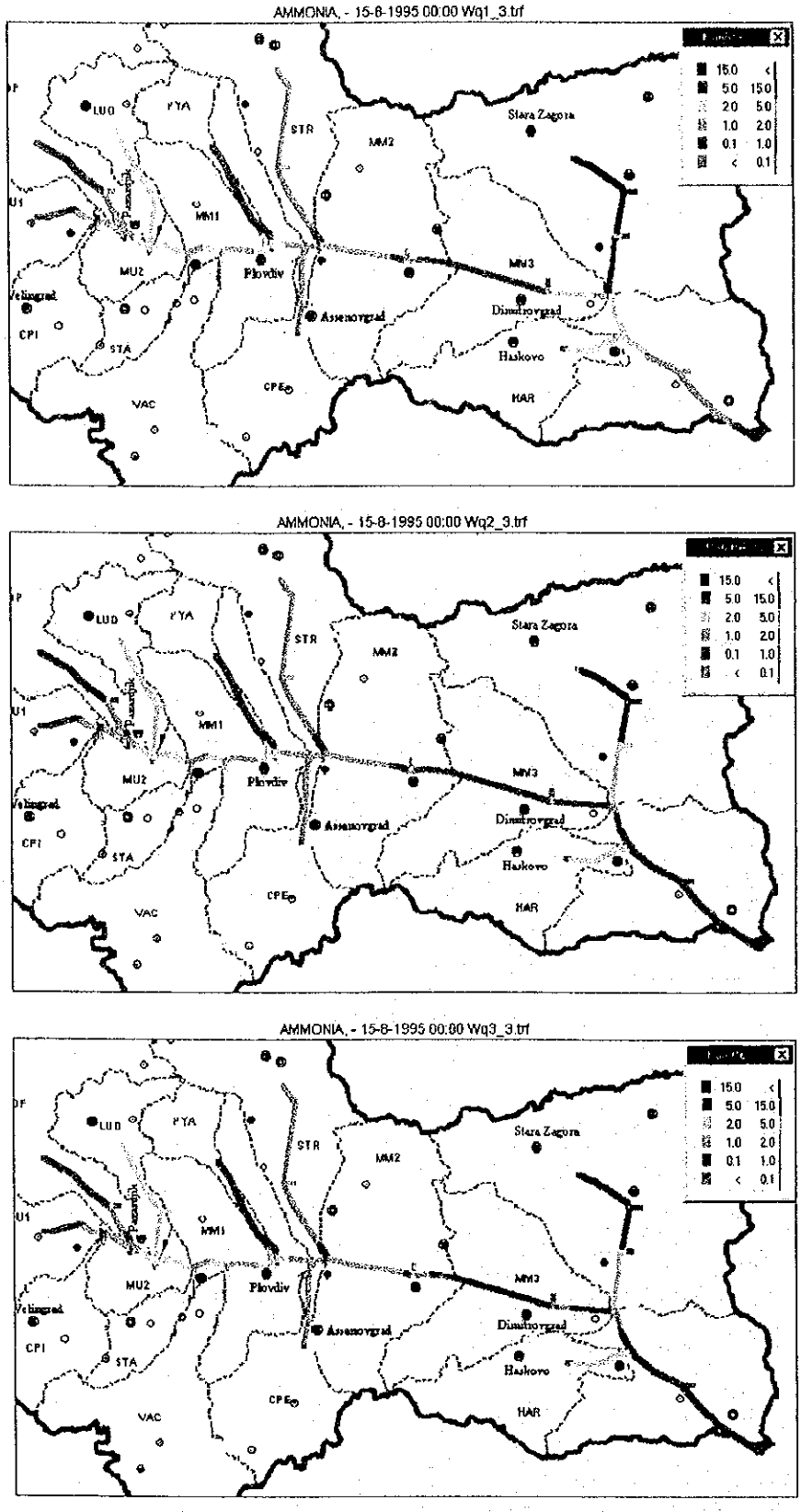


FIG.M.3.8 SIMULATED NH4 CONCENTRATIONS MID AUGUST,SCENARIO 1_3,2_3 AND 3_3. BLUE:CLASS I. GREEN:CLASSII. YELLOW:CLASS III. RED AND BLACK:ABOVE CLASS III.

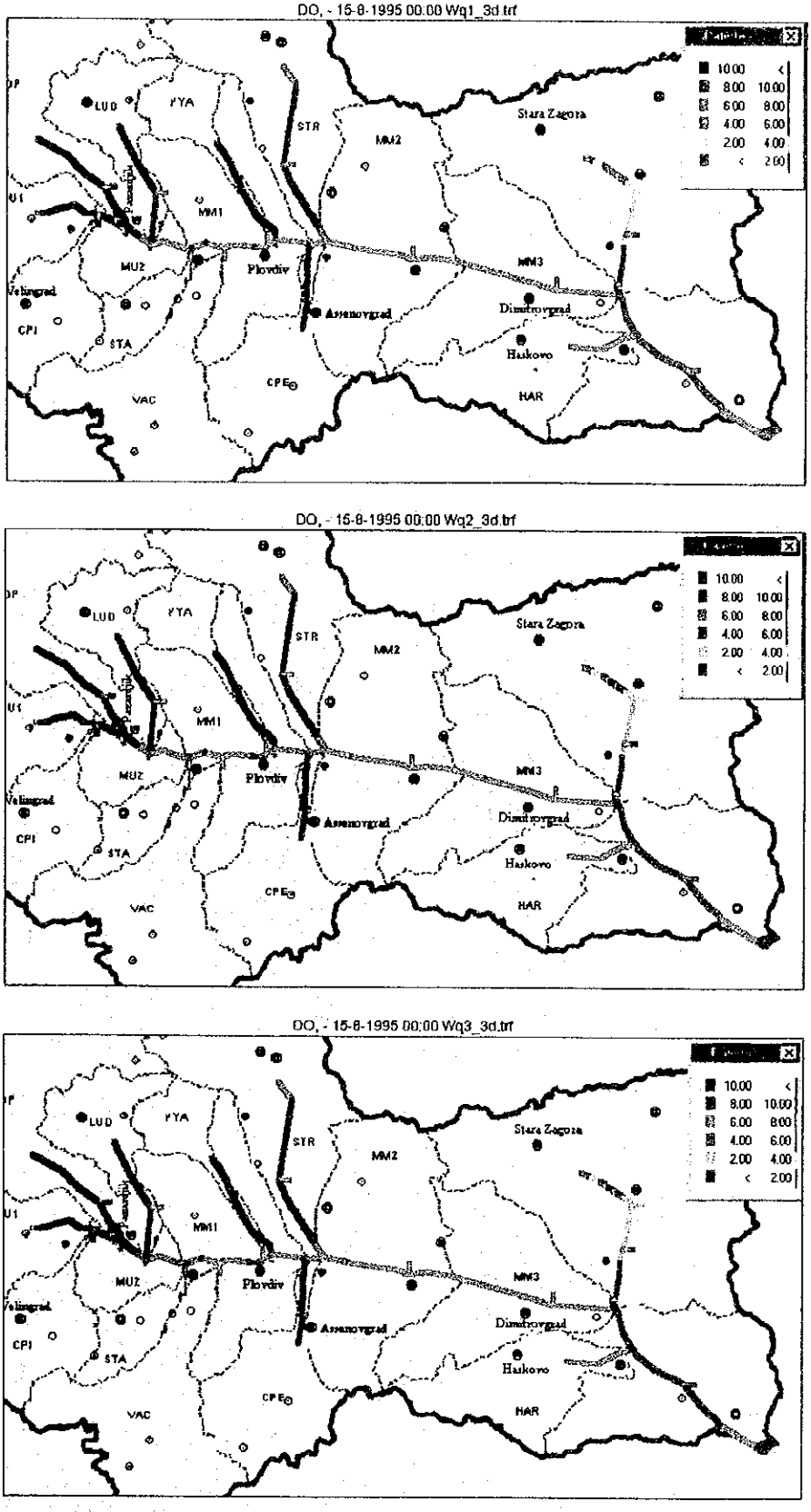


FIG.M.3.9 SIMULATED O2 CONCENTRATIONS MID AUGUST SCENARIO 1_3D,2_3D AND 3_3D. BLUE:CLASS I. GREEN:CLASSII. YELLOW:CLASS III. RED AND BLACK:ABOVE CLASS III.

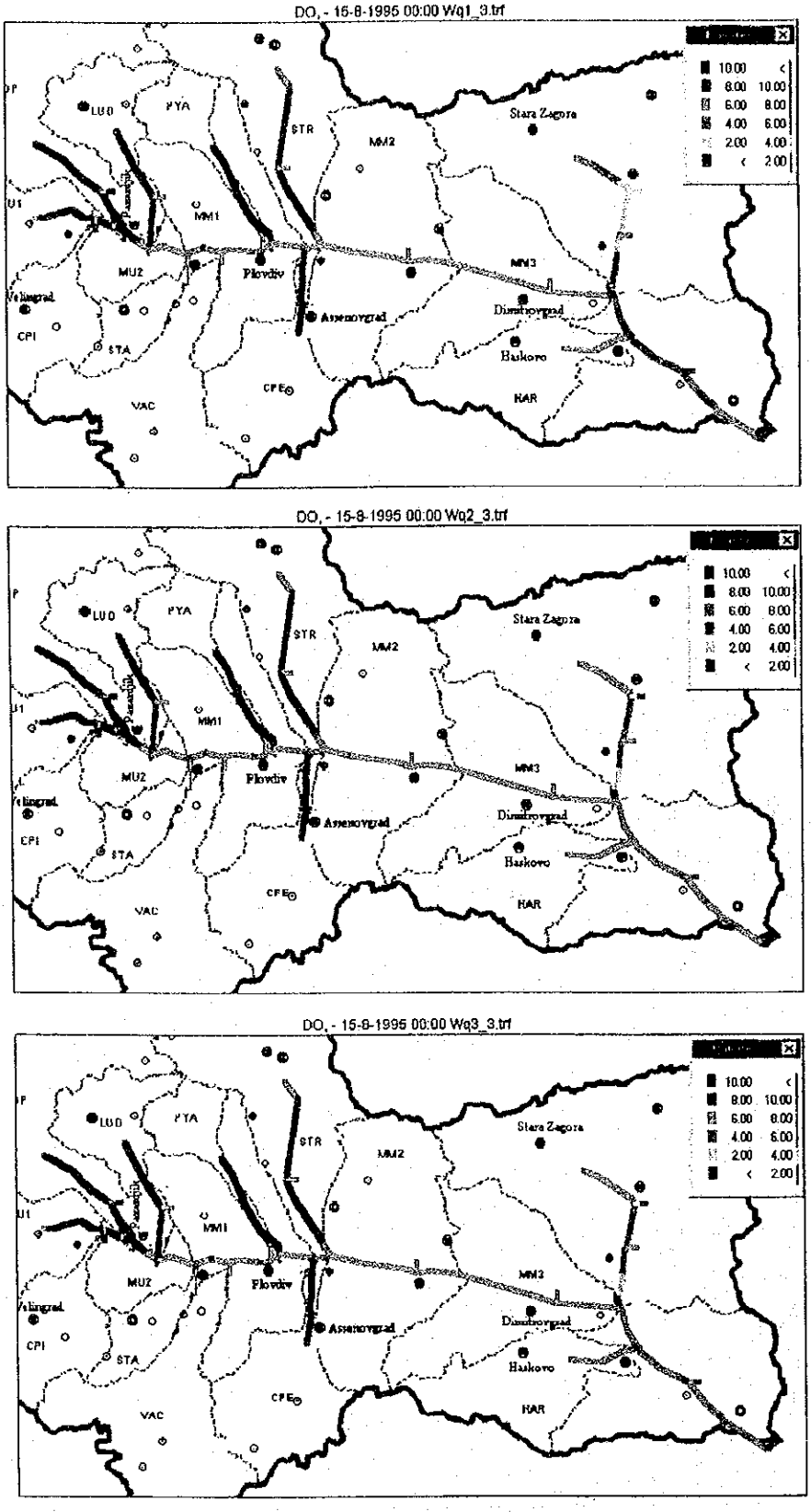


FIG.M.3.10 SIMULATED O2 CONCENTRATIONS MID AUGUST,SCENARIO 1_3,2_3 AND 3_3. BLUE:CLASS I. GREEN:CLASSII. YELLOW:CLASS III. RED AND BLACK:ABOVE CLASS III.

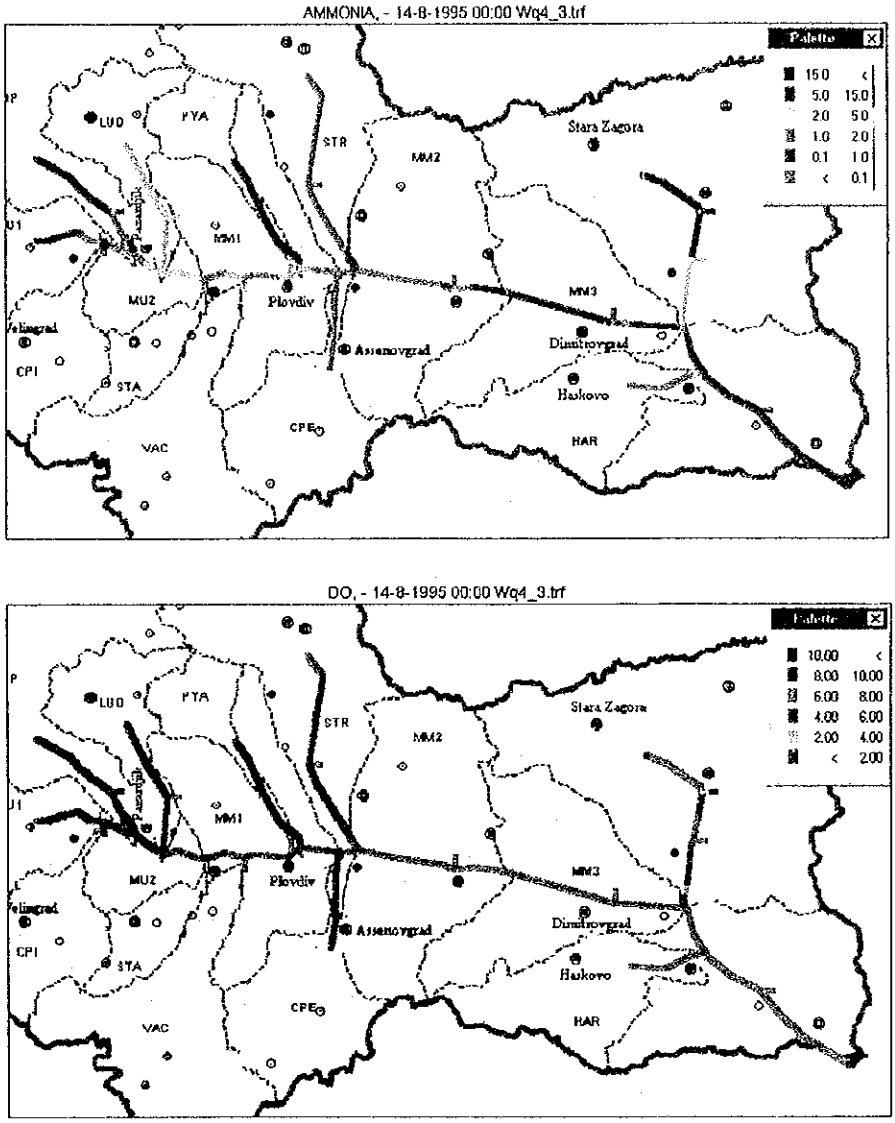


FIG.M.3.11 AMMONIA AND OXYGEN SIMULATED OXYGEN IN MID OF AUGUST,SCENARIO 4_3. BLUE:CLASS I. GREEN:CLASSII. YELLOW:CLASS III. RED AND BLACK:ABOVE CLASS III.

APPENDIX M

LIST OF FILES USED IN WQ SIMULATION

WQ files:

HD set up file	:	HD-Real.rdf
Cross section files	:	X-Sect.pst X-Sect.ix0 X-Sect.ix1
Boundary conditions	:	WQ-real.bsf
Advection dispersion:	:	Wq1mar.tsf
Water Quality data	:	wqmanr6.wqf
Supplentemary data	:	HD-suppl.ssf
HD-resultfile	:	real9495.rrf
Data base with time series of point source Load:	:	P_load2
Data base with time series of Catchment Load:	:	Nonpoin2
Database with WQ monitoring data	:	Moni

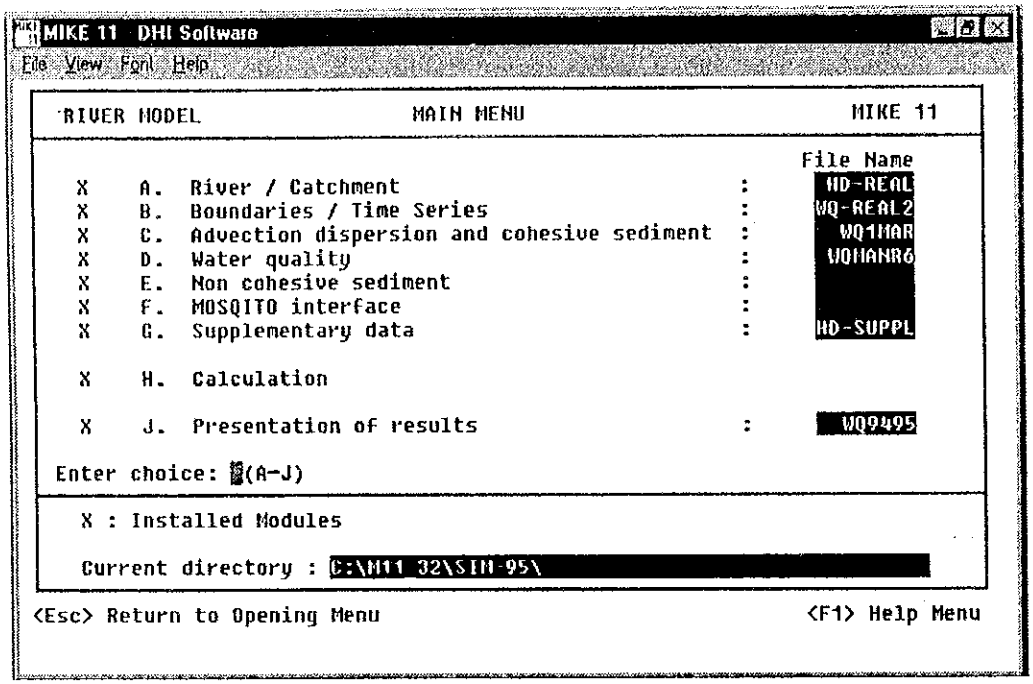
WQ Result files:

WQ6_95.trf: WQ result from Simulation 15 presented in Progress report no.2
WQ6_95.txf: WQ transport result file Simulation 15 presented in Progress report no. 2

WQ8_95.trf: WQ result from Simulation 16 with new industrial loading 1994-1995
WQ8_95.txf: WQ transport result from Simulation 16 with new industrial loading 1994-1995

AD files

HD set up file	:	HD-Real.rdf
Cross section files	:	X-Sect.pst X-Sect.ix0 X-Sect.ix1
Boundary conditions	:	AD-simpl.bsf
Advection dispersion:	:	AD3mar.tsf
Supplentemary data	:	HD-suppl.ssf
HD-resultfile	:	real9495.rrf
Data base with time series of point source Load:	:	Nonpoin2



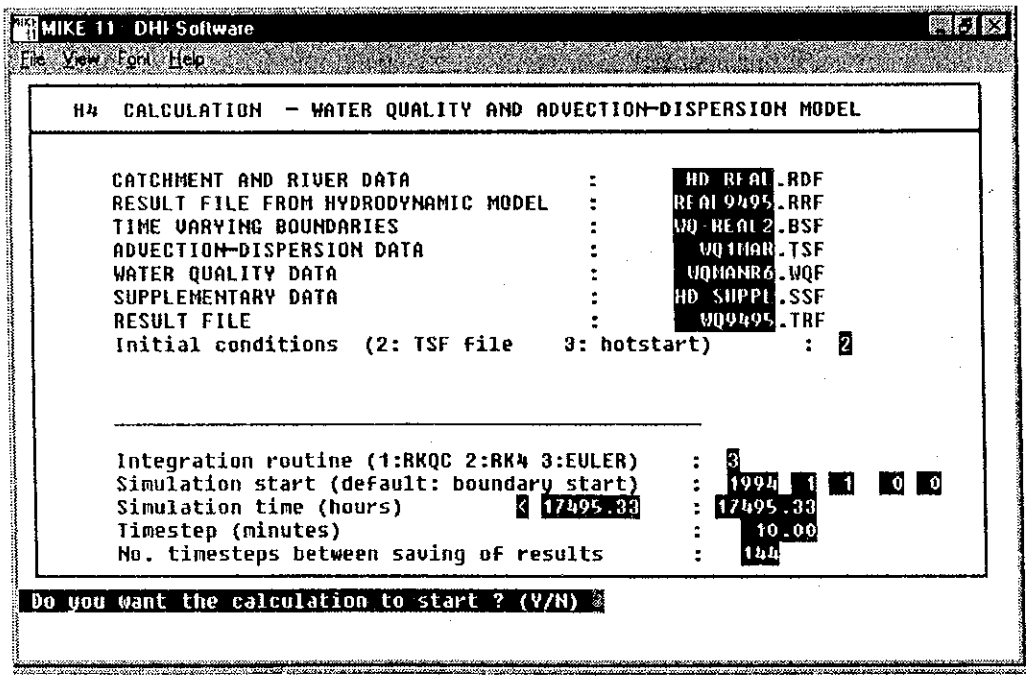


FIG. 1 MAIN AND CALCULATION MENU FOR WQ SIMULATION OF 1994 - 1995 UNDER DISTURBED CONDITION

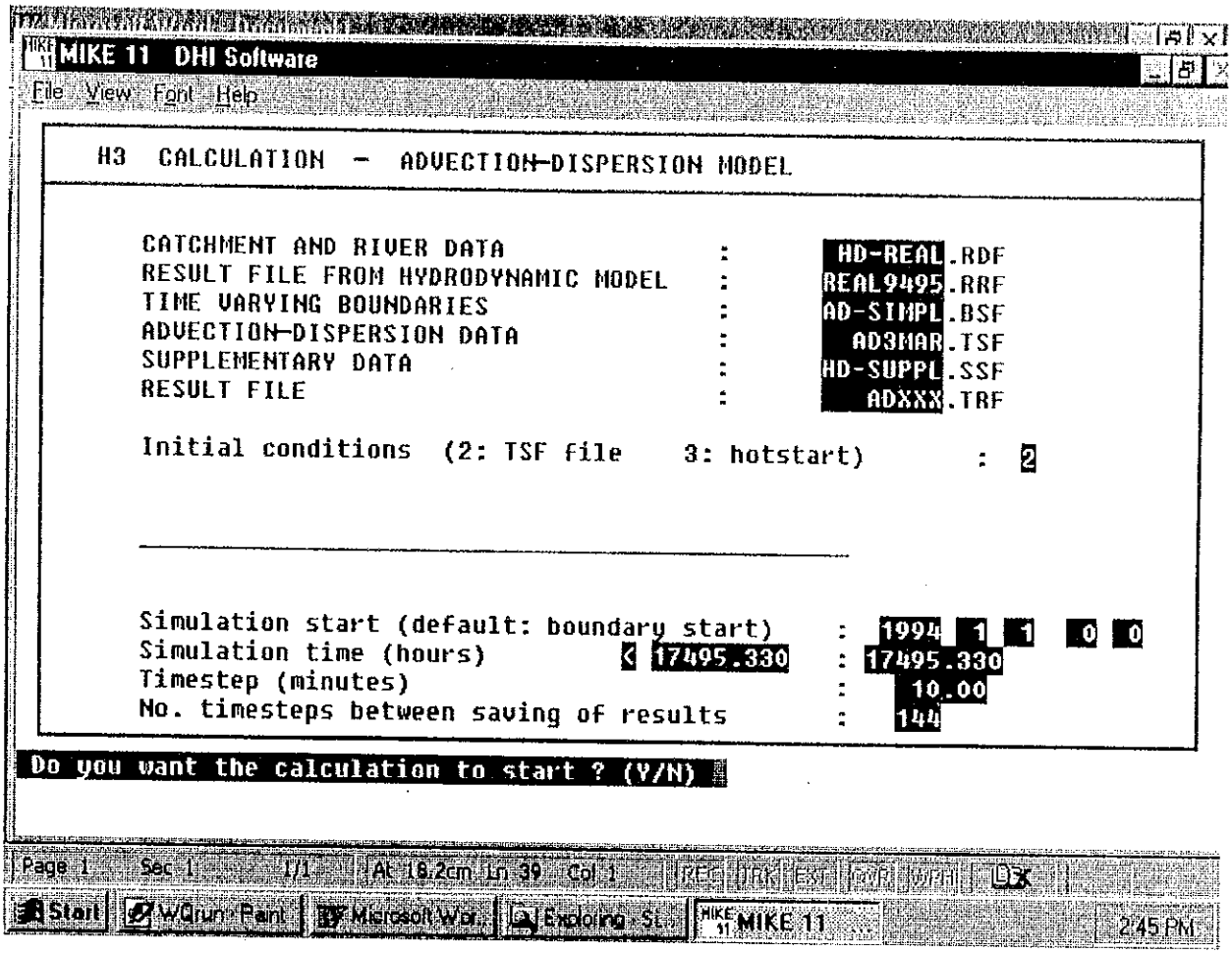


FIG. 2 CALCULATION MENU FOR AD SIMULATION OF 1994 - 1995 UNDER DISTURBED CONDIITONS