ANALYSIS OF THE JOSEPH M. FARLEY NUCLEAR PLANT'S CONTRIBUTION TO CHEMICALS IN THE CHATTAHOOCHEE RIVER, UNIT ONE STUDY

SUMMARY

The Joseph M. Farley Nuclear Plant Environmental Technical Specifications (ETS), Section 3.1.1(a)-1, require a chemical study of the Chattahoochee River. The objective of the study is to determine the plant's contribution to increases above ambient concentrations for chemicals in the waters of the Chattahoochee River and to provide data for use in assessing any significant adverse impact observed on aquatic biota of the Chattahoochee River. Any such impact on the biota by the operation of Farley Nuclear Plant is addressed in a separate report. Beginning with the commercial operation of Unit No. 1, the study was to last for a period of one year. The analysis period was extended to thirteen months to provide a larger data base.

To assist in the analysis of the data, the analyses are summarized in numerical and graphical form. The graphical form gives a pictorial representation of the trends for each parameter. These trends are presented for two different groupings of the data. The May-December grouping provides an indication of the change in the concentration of the tested parameters as one proceeds downstream. If the intake sample point has any abnormalities which would affect the discharge sample point, then these abnormalities can be observed. However, only data for eight months, including the additional data for the month of December, 1978, are available for each parameter at each test point.

A second grouping gives the trends for the upstream, discharge, and downstream points for thirteen months. This larger number of data points helps eliminate any statistical errors which may have occurred. A problem arises in that any contributions to pollution levels at the intake will not be taken into account. This may tend to fault erroneously the plant for increases in pollutant levels.

Based upon the data available, the conclusion is reached that Farley Nuclear Plant does not contribute significantly to the ambient concentration of chemicals in the Chattahoochee River.

INTRODUCTION

The Joseph M. Farley Nuclear Plant Environmental Technical Specifications (ETS), Section 3.1.1(a)-1, require a chemical study of the Chattahoochee River. The objective of the study is to determine the plant's contribution to increases above ambient concentrations for chemicals in the waters of the Chattahoochee River and to provide data for use in assessing any significant adverse impact observed on aquatic biota of the Chattahoochee River. Any impact on the biota of the Chattahoochee River by the operation of Farley Nuclear Plant is addressed in a separate report entitled Environmental Non-Radiological Monitoring of Aquatic Communities in the Chattahoochee River. Beginning with the commercial operation of Unit No. 1, the study was to last for a period of one year. Unit No. 1 began commercial operation on December 1, 1977. The analysis period was extended to thirteen months to provide a larger data base.

The parameters which were sampled are given in Table 3.1.1-1 of the ETS. This table is reproduced as Table I of this report. The sampling locations are given in Figure 3.1-1 of the ETS and reproduced as Figure I of this report.

Occasionally a parameter's concentration was not determined because of technical difficulties. The dates when this occurred are indicated in the tabulation of monthly chemical data (Appendix I). Additionally, through an administrative oversite, the required parameters were not monitored at the intake structure until May, 1978. It is regrettable that the oversite occurred; however, this loss of data did not interfere with determining the plant's contribution to chemical concentrations in the river.

To assist in the analysis of the data, the analyses are summarized in numerical form (Tables II and III) and in graphical form (Appendices II and III). The graphical form gives a pictorial representation of the trends for each parameter. These trends are presented for two different groupings of the data. Appendix II presents the data for May - December, 1978 for all locations. This grouping provides an indication of the change in the concentration of the tested parameters as one proceeds downstream. If the intake sample point has any abnormalities which would affect the discharge sample point, then these abnormalities can be observed. However, only data for eight months, including the additional data for the month of December, 1978, are available for each parameter at each test point.

A second grouping, Appendix III, gives the trends for the upstream, discharge, and downstream points for thirteen months. This larger number of data points helps eliminate any statistical errors which may have occurred. A problem arises in that any contributions to pollution levels at the intake will not be taken into account. This may tend to fault erroneously the plant for increases in pollutant levels.

The analyses were conducted according to the methods specified in the FEDERAL REGISTER, Volume 41, dated December 1, 1976. A 95% confidence interval for the accuracies of each test was determined. These accuracies for each test method are given in Tables II and III.

The temperature was taken each time the dissolved oxygen was determined. These temperatures were instantaneous readings and as such are

not part of the data recorded for the report on the thermal contribution of Farley Nuclear Plant to the Chattahoochee River.

DATA ANALYSIS

Four Sampling Point Analysis

The averages for the concentrations of the parameters for the four point analysis are given in Table II and the trend analyses are given in Appendix II. A review of all data reveals that only in three instances does the variations of the means exceed the 95% confidence interval. These are nitrogen, iron, and silica. Of these three, nitrogen and iron are on the low side of the confidence limit for the discharge. The silica concentration is on the high side of the confidence interval; however, the intake concentration is higher than the discharge concentration.

The trend analysis of the data reveals that a positive slope exists for four parameters. These are dissolved oxygen, calcium, potassium, and dissolved phosphorus. Since an increase in dissolved oxygen is considered beneficial, this parameter will not be discussed further in this section.

Potassium at the discharge is 2.22% higher than at the intake. This difference is considered insignificant because of the small difference between the intake and discharge. Additionally, it is again emphasized that the differences within this grouping are well within the accuracy of the analytical method.

The concentration of calcium is higher at the discharge by 0.8% for the upstream point, by 2.74% for the intake point, but is lower by 2.10% for the downstream value. Since the discharge is lower than the downstream value, it may be stated that if the plant contributes to the calcium level, such contribution is small compared with nature's contribution. However, the accuracy of the test accounts for variations in this parameter.

The dissolved phosphorus concentration is 0.037 ppm for upstream, 0.032 ppm for intake, 0.039 ppm for discharge and 0.036 ppm for downstream; however, the August concentration for the discharge point is missing. By omitting the concentrations for the month of August, the averages would be 0.040 ppm, 0.034 ppm, 0.039, ppm and 0.038 ppm for the upstream, intake, discharge, and downstream points, respectively. Since the upstream, discharge, and the downstream concentrations are approximately equal, then it appears that the plant does not contribute significantly to the dissolved phosphorus levels in the river.

There are six cases in which the discharge concentrations exceed the intake concentrations. These are dissolved oxygen, potassium, calcium, dissolved phosphorus, turbidity, and chloride. The dissolved oxygen, calcium, dissolved phosphorus, and potassium have been adequately explained in previous sections.

The sample for turbidity for the discharge is taken at a point where the discharge water enters the river. The velocity of the discharge is such that there is a possibility that the sediment in the river is stirred-up in a localized area. The downstream sample point has a marked decrease in turbidity. The discharge turbidity therefore is assumed to be a localized phenomenon and of negligible impact.

The chloride concentration is 0.65 ppm greater at the discharge than at the intake. These values are well within the confidence limits for the chloride test. The downstream concentration is lower than the discharge, intake, and upstream concentration. The higher concentration at the discharge compared with the downstream proves that any addition of chloride by the plant has been negated by the time the water reaches the downstream location. Additionally, since 50% of the waters in the United States have a chloride concentration of at least 9 ppm, then any plant contribution of chloride is insignificant.

In conclusion, based upon the four sampling point analysis, the Farley Nuclear Plant did not contribute significantly to ambient concentrations of chemicals in the Chattahoochee River. This statement is primarily based upon the fact that in only one case did the average concentration for the discharge lie on the high side of the 95% confidence interval about the mean. In this one case the concentration of this pollutant is greater at the intake than at the discharge.

Three Sampling Point Analysis

The averages for the thirteen months of data are given in Table III and the trend analyses in Appendix III. An analysis of the data indicates that in no instance do any of the average concentrations fall outside of the 95% confidence interval about the mean.

The trend analysis reveals that a positive slope exists for four parameters. These are sodium, magnesium, manganese, and potassium. The differences in the sodium concentrations between the discharge and other points are less than one percent. These small differences between the points indicate that no trend can be established. Magnesium is found to increase as one proceeds down the river. A small difference in the upstream and discharge concentrations confirms that the Farley Nuclear Plant does not contribute to the magnesium concentration in the river. The manganese concentration at the discharge is less than at upstream and downstream points. Potassium does show a slightly higher concentration at the discharge than at the other points. However, again it must be emphasized that the differences between the concentrations are within the error produced by the analytical method.

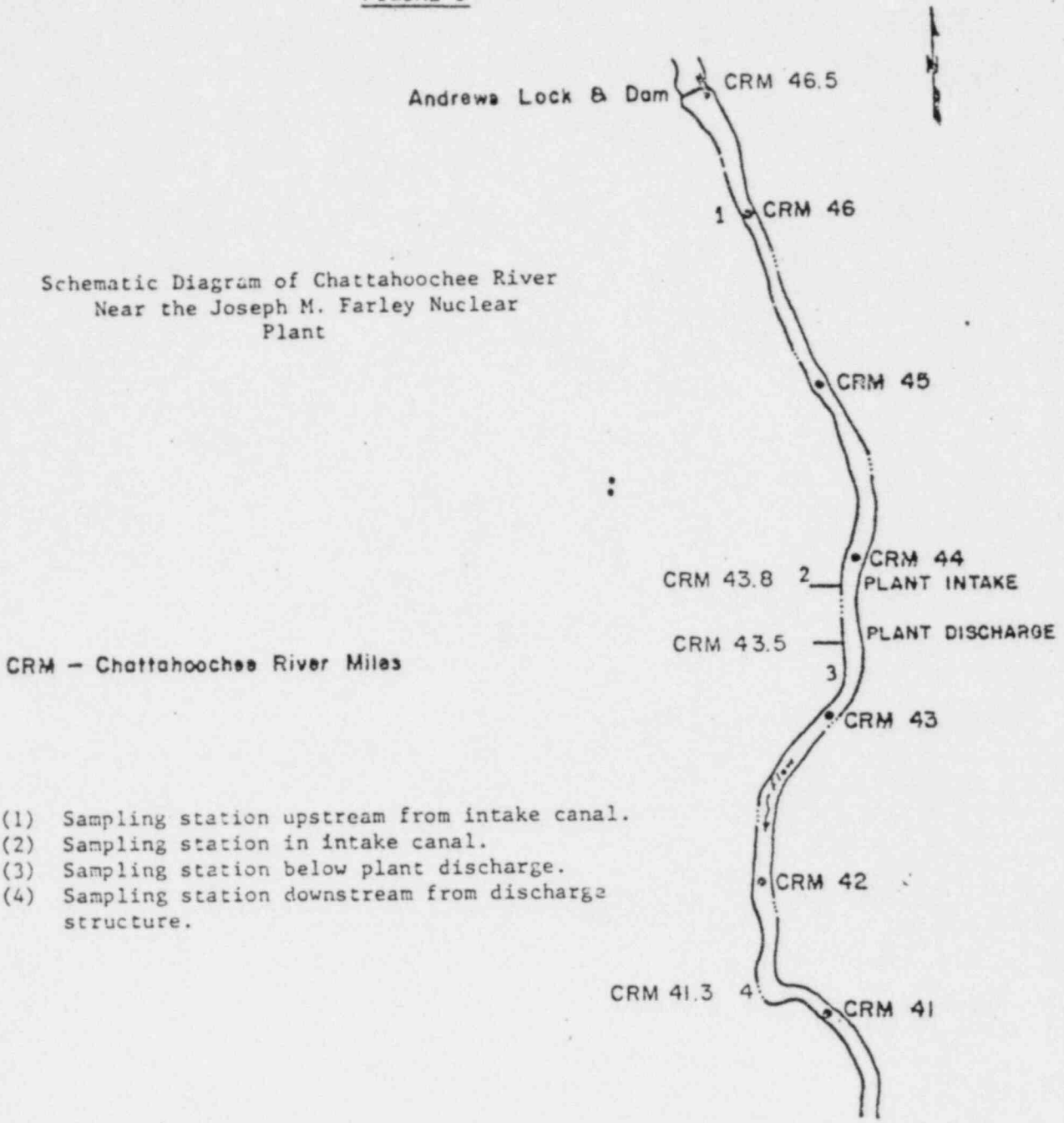
There are three parameters in which the discharge gives higher values than the other points but still produces a negative sloping curve. These are chloride, silica, and turbidity. The chloride and turbidity have been addressed in the section for the four point analysis. The arguments presented in that section apply here. The silica curve for the four point analysis indicates that the discharge concentration is higher than the upstream and downstream but that the intake is higher than all points. It is therefore assumed that some abnormaility exists at the intake which causes the high concentration of silica at the discharge.

The remaining parameter to be discussed, dissolved oxygen, is found to be lower at the discharge than at the other points. However, reviewing the data in Appendix I, the April dissolved oxygen is unusually low at the discharge. With the April value not included in the average then the difference between the upstream and discharge is about one percent which is considered insignificant. The exact reason for the low readings cannot be established. Regardless of whether or not the April reading is in error, the difference of 0.4 ppm is insignificant.

In conclusion, for the three test sampling point analysis the Farley Nuclear Plant does not contribute significantly to ambient concentrations of chemicals in the Chattahoochee River. This statement is based upon the fact that the difference between the means of the three sample points is within the accuracies of the test methods.

FIGURE I

Schematic Diagram of Chattahoochee River Near the Joseph M. Farley Nuclear Plant



CRM – Chattahoochee River Miles

(1) Sampling station upstream from intake canal.
(2) Sampling station in intake canal.
(3) Sampling station below plant discharge.
(4) Sampling station downstream from discharge structure.

ALABAMA POWER COMPANY
JOSEPH M. FARLEY NUCLEAR PLANT
ENVIRONMENTAL TECHNICAL SPECIFICATIONS

THERMAL MONITORING & NON-RADIOLOGICAL WATER SAMPLING STATIONS
FIGURE 3.1-1

TABLES

TABLE 3.1-1

LISTING OF NONRADIOLOGICAL CHEMICAL PARAMETERS TO BE ANALYZED DURING THE OPERATIONAL PHASE OF THE FARLEY NUCLEAR PLANT

Test
Boron (mg/l)
Phosphorus, total (mg/l)
Phosphorus, dissolved (mg/l)
Sulfate (mg/l)
Ammonia (mg/l)
Nitrogen-Nitrate-Nitrite (mg/l)
Calcium (mg/l)
Manganese (mg/l)
Magnesium (mg/l)
Iron (mg/l)
Sodium (mg/l)
Potassium (mg/l)
Chlorine, total residual (mg/l)
Chloride (mg/l)
Silica (mg/l)
Lithium (mg/l)
Dissolved Oxygen (mg/l)
Turbidity (JTU)
Total Dissolved Solids (mg/l)
pH (Standard units)
Temperature (^{o}C)

TABLE 1

TABLE II

Summary of Chemical Data
May - December, 1978
Upstream, Intake, Discharge
and Downstream Sample Points

Farley Nuclear Plant
Non-Radiological Chemical Surveillance

May 1978 - December 1978

	Up-stream	Intake	Discharge	Down-stream	Average	Standard Deviation (1)	95% Confidence Interval (2)
Temperature °C	22.7	22.7	24.1	22.6			
Dissolved Oxygen-mg/l	8.0	7.5	7.9	7.9	7.8	0.5	1.0
pH - units	7.4	7.5	7.4	7.4	7.4	0.5	1.0
Total Dissolved Solids-mg/l	65.6	61.3	52.8	50.4	57.5	5	10
Chlorine, total-mg/l	<0.1	<0.1	<0.1	<0.1	<0.1		
Boron-ug/l	130.0	104.0	91.0	109.6	108.5	27	54
Phosphorus, Total-mg/l	0.058	0.057	0.053	0.057	0.056	0.003	0.006
Phosphorus, Dissolved-mg/l (3)	0.037	0.032	0.039	0.036	0.036	0.003	0.006
Sulfate mg/l	6.6	7.2	6.9	6.3	6.7	0.6	1.2
Ammonia mg/l	0.05	0.04	0.04	0.04	0.04	0.01	0.02
Nitrogen-Nitrate-mg/l	0.43	0.80	0.39	0.35	0.49	0.02	0.04
Calcium mg/l	6.2	6.0	6.2	6.3	6.2	0.6	1.2
Manganese ug/l	98.5	126.5	86.0	95.5	101.6	17	34
Magnesium mg/l	1.14	1.11	1.04	1.14	1.11	0.2	0.4
Iron mg/l	1.43	1.85	1.00	1.48	1.44	0.08	0.16
Sodium mg/l	8.1	8.0	7.3	7.9	7.8	0.5	1.0
Potassium mg/l	1.71	1.76	1.80	1.74	1.76	0.07	0.14
Chloride mg/l	6.2	6.0	6.6	5.6	6.1	0.5	1.0
Silica mg/l	8.0	8.78	8.57	7.83	8.33	0.07	0.14
Lithium ug/l	<10.0	<10.0	<10.0	<10.0	<10.0	4	8
Turbidity JTU	12.0	13.8	14.0	12.0	12.8	2.5	5.0

(1) Standard deviation was determined for the test method by running several hundred known samples.
(2) The confidence interval was determined by multiplying the standard deviation by two.
(3) These values are for May - December 1978 only.

TABLE III

Summary of Chemical Data
December 1977 - December 1978
Upstream, Discharge, and Downstream
Sample Points

Farley Nuclear Plant
Non-Radiological Chemical Surveillance

December 1977 - December 1978

	Upstream	Discharge	Downstream	Average	Standard Deviation (1)	95% Confidence Interval (2)
Temperature °C	17.9	19.3	17.8			
Dissolved Oxygen-mg/l	9.0	8.6	9.0	8.9	0.5	1.0
pH - units	7.3	7.2	7.3	7.3	0.5	1.0
Total Dissolved Solids-mg/l	58.9	50.7	49.0	52.9	5.0	10
Chlorine, total-mg/l	<0.1	<0.1	<0.1	<0.1		
Boron-ug/l	110.8	81.4	91.5	94.6	27	54
Phosphorus, Total-mg/l	0.058	0.056	0.058	0.057	0.03	0.006
Phosphorus, Dissolved-mg/l (3)(4)	0.037	0.032	0.039	0.036	0.003	0.006
Sulfate mg/l	6.9	6.7	6.5	6.7	0.6	1.2
Ammonia mg/l	0.05	0.04	0.04	0.04	0.01	0.02
Nitrogen-Nitrate-mg/l	0.45	0.42	0.38	0.42	0.02	0.04
Calcium mg/l	6.5	5.8	5.8	6.0	0.6	1.2
Manganese ug/l	88.4	71.7	94.8	85.0	1.7	34
Magnesium mg/l	1.05	1.05	1.13	1.08	0.2	0.4
Iron mg/l	1.57	1.44	1.56	1.52	0.08	0.16
Sodium mg/l	7.0	7.1	7.0	7.0	0.5	1.0
Potassium mg/l	1.69	1.79	1.76	1.75	0.07	0.14
Chloride mg/l	5.2	5.6	4.9	5.2	0.5	1.0
Silica mg/l	8.30	8.77	8.18	8.42	0.07	0.14
Lithium ug/l	<10	<10.0	<10.0	<10	4	8
Turbidity JTU	15.0	16.0	15.0	15.7	2.5	5.0

(1) Standard deviation was determined for the test method by running several hundred known samples.
(2) The confidence interval was determined by multiplying the standard deviation by two.
(3) These values are for June - December only.
(4) These values are the same as the four point analysis.

APPENDICES

APPENDIX I

Monthly Determinations
of Chemical Data

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
December 13, 1977

	Upstream	Intake (a)	Discharge	Downstream
Temperature °C	11.0		14.0	11.5
Dissolved Oxygen-mg/l	9.8		9.2	10.2
pH - units	7.6		7.3	7.6
Total Dissolved Solids-mg/l	57.0		62.0	65.0
Chlorine, total-mg/l	<0.01		<0.01	<0.01
Boron-ug/l	124.0		105.0	86.0
Phosphorus, Total-mg/l	0.042		0.035	0.046
Phosphorus, Dissolved-mg/l	(a)		(a)	(a)
Sulfate mg/l	8.9		7.4	9.5
Ammonia mg/l	0.02		0.03	0.02
Nitrogen-Nitrate-mg/l	0.59		0.61	0.64
Calcium mg/l	4.8		(b)	4.8
Manganese ug/l	46		54	93
Magnesium mg/l	0.90		0.83	2.9
Iron mg/l	1.29		1.02	1.65
Sodium mg/l	6.7		7.5	8.1
Potassium mg/l	2.1		2.5	2.8
Chloride mg/l	4.0		4.5	4.5
Silica mg/l	7.90		8.76	8.0
Lithium ug/l	<10.0		<10.0	(b)
Turbidity JTU	12.0		13.0	13.0

(a) Analysis not conducted because of administrative error .
(b) Analysis not conducted because of technical difficulties.

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
January 17, 1978

	Upstream	Intake [a]	Discharge	Downstream
Temperature °C	6.0		7.0	6.0
Dissolved Oxygen-mg/l	11.8		10.6	11.6
pH - units	6.8		7.0	7.2
Total Dissolved Solids-mg/l	37.0		41.0	31.0
Chlorine, total-mg/l	<0.01		< 0.01	< 0.01
Boron-ug/l	72.0		(b)	50.0
Phosphorus, Total-mg/l	0.041		0.060	0.064
Phosphorus, Dissolved-mg/l [a]				
Sulfate mg/l	8.3		6.8	7.7
Ammonia mg/l	0.03		0.03	0.03
Nitrogen-Nitrate-mg/l	0.66		0.66	0.58
Calcium mg/l	12.0		(b)	(b)
Manganese ug/l	29		34	34
Magnesium mg/l	0.47		0.58	0.48
Iron mg/l	0.83		0.70	0.69
Sodium mg/l	5.8		6.0	5.8
Potassium mg/l	1.86		1.97	2.02
Chloride mg/l	4.5		4.75	4.25
Silica mg/l	6.79		7.67	6.83
Lithium ug/l	< 10.0		< 10.0	< 10.0
Turbidity JTU	6.3		6.7	3.4

(a) Analysis not conducted because of administrative error.
(b) Analysis not conducted because of technical difficulties.

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
February 15, 1978

	Upstream	Intake [a]	Discharge	Downstream
Temperature °C	6.7		7.5	6.5
Dissolved Oxygen-mg/l	11.6		12.4	12.6
pH - units	7.5		7.0	7.2
Total Dissolved Solids-mg/l	75		67	70
Chlorine, total-mg/l	< 0.01		< 0.01	< 0.01
Boron-ug/l	95.0		87.0	87.0
Phosphorus, Total-mg/l	0.072		0.068	0.061
Phosphorus, Dissolved-mg/l [a]				
Sulfate mg/l	5.0		3.72	5.0
Ammonia mg/l	0.07		0.06	0.07
Nitrogen-Nitrate-mg/l	(b)		(b)	(b)
Calcium mg/l	8.0		4.0	3.6
Manganese ug/l	94		81	72
Magnesium mg/l	0.54		0.53	0.54
Iron mg/l	2.47		3.13	2.38
Sodium mg/l	3.5		3.6	3.41
Potassium mg/l	1.40		1.56	1.40
Chloride mg/l	3.0		3.5	3.25
Silica mg/l	10.5		10.39	10.63
Lithium ug/l	<10.0		<10.0	<10.0
Turbidity JTU	36.0		38.0	36.0

(a) Analysis not conducted because of administrative error.

(b) Analysis not conducted because of technical difficulties.

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
March 16, 1978

	Upstream	Intake (a)	Discharge	Downstream
Temperature °C	11.0		12.0	11.0
Dissolved Oxygen-mg/l	10.8		10.2	10.8
pH - units	6.4		6.6	6.6
Total Dissolved Solids-mg/l	49		53	44
Chlorine, total-mg/l	(b)		(b)	(b)
Boron-ug/l	21.0		14.0	32.0
Phosphorus, Total-mg/l	0.068		0.067	0.065
Phosphorus, Dissolved-mg/l	(a)		(a)	(a)
Sulfate mg/l	7.4		7.1	5.3
Ammonia mg/l	0.14		0.11	0.12
Nitrogen-Nitrate-mg/l	0.43		(b)	0.18
Calcium mg/l	6.0		4.4	4.8
Manganese ug/l	52		48	51
Magnesium mg/l	1.66		0.90	0.76
Iron mg/l	2.18		2.09	2.15
Sodium mg/l	3.92		3.98	3.87
Potassium mg/l	1.37		1.43	1.32
Chloride mg/l	3.5		3.2	3.5
Silica mg/l	9.00		9.35	9.28
Lithium ug/l	<10.0		<10.0	<10.0
Turbidity JTU	23.0		23.0	23.0

(a) Analysis not conducted because of administrative error.

(b) Analysis not conducted because of technical difficulties.

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
April 12, 1978

	Upstream	Intake (a)	Discharge	Downstrea
Temperature °C	16.7		18.0	16.7
Dissolved Oxygen-mg/l	8.4		5.8	7.6
pH - units	7.1		6.8	6.8
Total Dissolved Solids-mg/l	30.0		14.0	24.0
Chlorine, total-mg/l	<0.01		<0.01	<0.01
Boron-ug/l	85.0		43.0	66.0
Phosphorus, Total-mg/l	0.066		0.072	0.068
Phosphorus, Dissolved-mg/l	(a)		(a)	(a)
Sulfate mg/l	7.1		5.4	6.8
Ammonia mg/l	0.07		0.06	0.06
Nitrogen-Nitrate-mg/l	0.35		0.28	0.37
Calcium mg/l	4.8		5.6	5.6
Manganese ug/l	76		27	76
Magnesium mg/l	0.92		1.90	0.92
Iron mg/l	2.13		0.52	1.52
Sodium mg/l	6.5		5.5	6.7
Potassium mg/l	1.4		1.4	1.3
Chloride mg/l	3.5		4.00	3.5
Silica mg/l	8.93		9.28	9.14
Lithium ug/l	<10.0		<10.0	<10.0
Turbidity JTU	19.0		18.0	20.0

(a) Analysis not conducted because of administrative error.

(b) Analysis not conducted because of technical difficulties.

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
May 23, 1978

	Upstream	Intake	Discharge	Downstream
Temperature °C	24.1	24.2	26.0	23.9
Dissolved Oxygen-mg/l	8.6	8.0	8.2	8.4
pH - units	7.4	7.5	7.3	7.25
Total Dissolved Solids-mg/l	(b)	29.0	4.0	20.0
Chlorine, total-mg/l	<0.01	<0.01	<0.01	<0.01
Boron-ug/l	33.0	(b)	30.0	40.0
Phosphorus, Total-mg/l	0.059	0.060	0.057	0.060
Phosphorus, Dissolved-mg/l	(a)	(a)	(a)	(a)
Sulfate mg/l	5.0	(b)	5.0	5.0
Ammonia mg/l	<0.01	<0.01	<0.01	<0.01
Nitrogen-Nitrate-mg/l	0.50	0.49	0.49	0.494
Calcium mg/l	5.6	4.8	5.2	6.2
Manganese ug/l	64	264	47	65
Magnesium mg/l	0.70	1.16	0.70	0.70
Iron mg/l	1.80	4.06	1.66	1.58
Sodium mg/l	3.5	3.6	3.8	3.7
Potassium mg/l	(b)	(b)	(b)	(b)
Chloride mg/l	5.5	4.0	4.25	3.75
Silica mg/l	7.32	7.67	7.74	7.11
Lithium ug/l	<10.0	<10.0	<10.0	<10.0
Turbidity JTU	18.0	19.0	20.0	16.0

(a) Analysis not conducted because of administrative error.

(b) Analysis not conducted because of technical difficulties.

Farley Nuclear Plant
Non-Radiological Chemical Surveillance

June 13, 1978

	Upstream	Intake	Discharge	Downstream
Temperature °C	25.5	25.2	25.5	24.6
Dissolved Oxygen-mg/l	7.9	7.8	7.8	7.9
pH - units	6.9	6.8	6.7	6.9
Total Dissolved Solids-mg/l	115.0	61.0	64.0	62.0
Chlorine, total-mg/l	<0.01	<0.01	<0.01	<0.01
Boron-ug/l	106.0	38.0	30.0	69.0
Phosphorus, Total-mg/l	0.134	0.089	0.107	0.110
Phosphorus, Dissolved-mg/l	0.107	0.084	0.102	0.103
Sulfate mg/l	4.9	10.7	7.4	7.1
Ammonia mg/l	0.04	0.04	0.03	0.03
Nitrogen-Nitrate-mg/l	0.58	0.44	0.54	0.50
Calcium mg/l	6.0	6.0	5.2	5.6
Manganese ug/l	134	131	59	99
Magnesium mg/l	1.1	1.0	1.0	1.0
Iron mg/l	3.48	3.76	3.18	2.80
Sodium mg/l	6.0	6.0	6.6	6.0
Potassium mg/l	1.5	1.5	1.6	1.5
Chloride mg/l	3.50	3.75	4.00	3.75
Silica mg/l	11.0	11.0	10.9	10.2
Lithium ug/l	<10	<10	<10	<10
Turbidity JTU	31.0	33.0	34.0	25.0

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
July 12, 1978

	Upstream	Intake	Discharge	Downstream
Temperature °C	27.2	27.6	28.9	27.3
Dissolved Oxygen-mg/l	8.2	7.4	7.8	7.3
pH - units	7.15	7.4	7.2	7.3
Total Dissolved Solids-mg/l	60	93	44	43
Chlorine, total-mg/l	<0.01	<0.01	<0.01	<0.01
Boron-ug/l	86.0	77.0	97.0	72.0
Phosphorus, Total-mg/l	0.054	0.044	0.052	0.057
Phosphorus, Dissolved-mg/l	0.036	0.026	0.022	0.032
Sulfate mg/l	8.9	7.1	7.7	8.3
Ammonia mg/l	0.05	0.06	0.05	0.05
Nitrogen-Nitrate-mg/l	0.11	0.09	0.11	0.15
Calcium mg/l	5.6	6.8	6.0	6.0
Manganese ug/l	84	111	97	180
Magnesium mg/l	1.1	0.8	1.0	1.0
Iron mg/l	0.88	1.45	1.05	1.42
Sodium mg/l	6.9	6.5	6.9	6.5
Potassium mg/l	1.6	1.5	1.6	1.6
Chloride mg/l	4.5	4.0	4.5	4.0
Silica mg/l	8.4	13.5	8.4	9.0
Lithium ug/l	<10	<10	<10	<10
Turbidity JTU	7.8	9.2	10.0	10.0

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
August 22, 1978

	Upstream	Intake	Discharge	Downstream
Temperature °C	22.2	22.2	23.6	22.2
Dissolved Oxygen-mg/l	7.4	7.2	7.8	8.3
pH - units	7.2	7.3	7.2	7.2
Total Dissolved Solids-mg/l	79.0	75.0	84.0	74.0
Chlorine, total-mg/l	<0.01	<0.01	<0.01	<0.01
Boron-ug/l	121.0	70.0	77.0	113.0
Phosphorus, Total-mg/l	0.051	0.025	0.051	0.052
Phosphorus, Dissolved-mg/l	0.024	0.019	(b)	0.021
Sulfate mg/l	9.2	5.7	7.4	4.5
Ammonia mg/l	0.09	0.05	0.04	0.03
Nitrogen-Nitrate-mg/l	0.22	0.19	0.19	0.19
Calcium mg/l	6.0	6.4	6.8	6.8
Manganese ug/l	132	119	115	118
Magnesium mg/l	1.2	1.2	1.4	1.5
Iron mg/l	1.17	1.35	1.33	1.83
Sodium mg/l	9.3	8.5	8.5	8.7
Potassium mg/l	1.5	1.8	1.6	1.6
Chloride mg/l	4.3	4.0	4.0	4.0
Silica mg/l	8.3	8.5	9.2	8.1
Lithium ug/l	<10	<10	<10	<10
Turbidity JTU	8.6	7.8	8.7	8.0

(b) Analysis not conducted because of technical difficulties.

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
September 19, 1978

	Upstream	Intake	Discharge	Downstream
Temperature °C	28.2	28.2	29.0	28.2
Dissolved Oxygen-mg/l	5.8	5.5	6.2	5.8
pH - units	7.5	7.3	7.3	7.4
Total Dissolved Solids-mg/l	55	79	59	58
Chlorine, total-mg/l	<0.01	<0.01	<0.01	<0.01
Boron-ug/l	53	71	56	53
Phosphorus, Total-mg/l	0.038	0.063	0.033	0.038
Phosphorus, Dissolved-mg/l	0.010	0.016	0.023	0.011
Sulfate mg/l	2.5	2.7	4.1	2.8
Ammonia mg/l	0.11	0.12	0.08	0.13
Nitrogen-Nitrate-mg/l	0.51	3.68	0.46	0.27
Calcium mg/l	9.2	6.4	7.2	6.4
Manganese ug/l	171	147	129	191
Magnesium mg/l	1.1	0.9	1.0	1.0
Iron mg/l	0.88	0.77	0.74	0.79
Sodium mg/l	8.6	8.9	8.6	8.6
Potassium mg/l	1.9	1.8	1.9	1.9
Chloride mg/l	16.0	14.0	16.0	14.0
Silica mg/l	8.5	8.4	8.6	8.2
Lithium ug/l	<10	<10	<10	<10
Turbidity JTU	5.2	5.4	8.5	5.1

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
October 17, 1978

	Upstream	Intake	Discharge	Downstream
Temperature °C	21.0	21.0	23.0	21.0
Dissolved Oxygen-mg/l	7.7	7.5	7.0	7.5
pH - units	8.2	8.3	8.2	8.2
Total Dissolved Solids-mg/l	32	32	42	35
Chlorine, total-mg/l	<0.1	<0.1	<0.1	<0.1
Boron-ug/l	196	127	117	164
Phosphorus, Total-mg/l	0.035	0.041	0.038	0.036
Phosphorus, Dissolved-mg/l	0.015	0.017	0.022	0.017
Sulfate mg/l	5.5	5.7	5.5	5.1
Ammonia mg/l	0.04	0.03	0.05	0.04
Nitrogen-Nitrate-mg/l	0.07	0.02	0.08	0.03
Calcium mg/l	5.2	5.6	6.0	7.2
Manganese ug/l	98	76	89	73
Magnesium mg/l	1.4	1.3	1.3	1.3
Iron mg/l	0.92	0.94	0.98	0.74
Sodium mg/l	10.1	10.1	10.5	10.5
Potassium mg/l	1.9	1.9	1.9	1.9
Chloride mg/l	4.0	4.8	5.5	4.5
Silica mg/l	7.4	7.4	8.8	7.6
Lithium ug/l	<10	<10	<10	<10
Turbidity JTU	7.6	6.7	10.0	7.3

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
November 28, 1978

	Upstream	Intake	Discharge	Downstream
Temperature °C	18.0	18.5	18.0	18.2
Dissolved Oxygen-mg/l	(b)	(b)	(b)	(b)
pH - units	7.6	7.8	7.8	7.7
Total Dissolved Solids-mg/l	50	53	54	52
Chlorine, total-mg/l	<0.1	<0.1	<0.1	<0.1
Boron-ug/l	278	202	168	173
Phosphorus, Total-mg/l	0.038	0.076	0.034	0.042
Phosphorus, Dissolved-mg/l	0.027	0.024	0.027	0.024
Sulfate mg/l	7.8	8.2	8.5	7.0
Ammonia mg/l	<0.01	<0.01	0.02	0.01
Nitrogen-Nitrate-mg/l	0.52	0.69	0.49	0.48
Calcium mg/l	4.0	5.6	6.4	7.2
Manganese ug/l	68	78	78	85
Magnesium mg/l	1.1	1.1	1.1	1.1
Iron mg/l	0.91	1.09	1.11	1.12
Sodium mg/l	9.2	9.2	9.4	9.4
Potassium mg/l	1.7	1.7	1.7	1.7
Chloride mg/l	6.5	8.3	9.5	6.0
Silica mg/l	6.7	6.5	7.0	6.3
Lithium ug/l	<10	<10	<10	<10
Turbidity JTU	7.4	8.4	9.3	7.7

(b) Analsyis not conducted because of technical difficulties.

Farley Nuclear Plant
Non-Radiological Chemical Surveillance
December 11, 1978

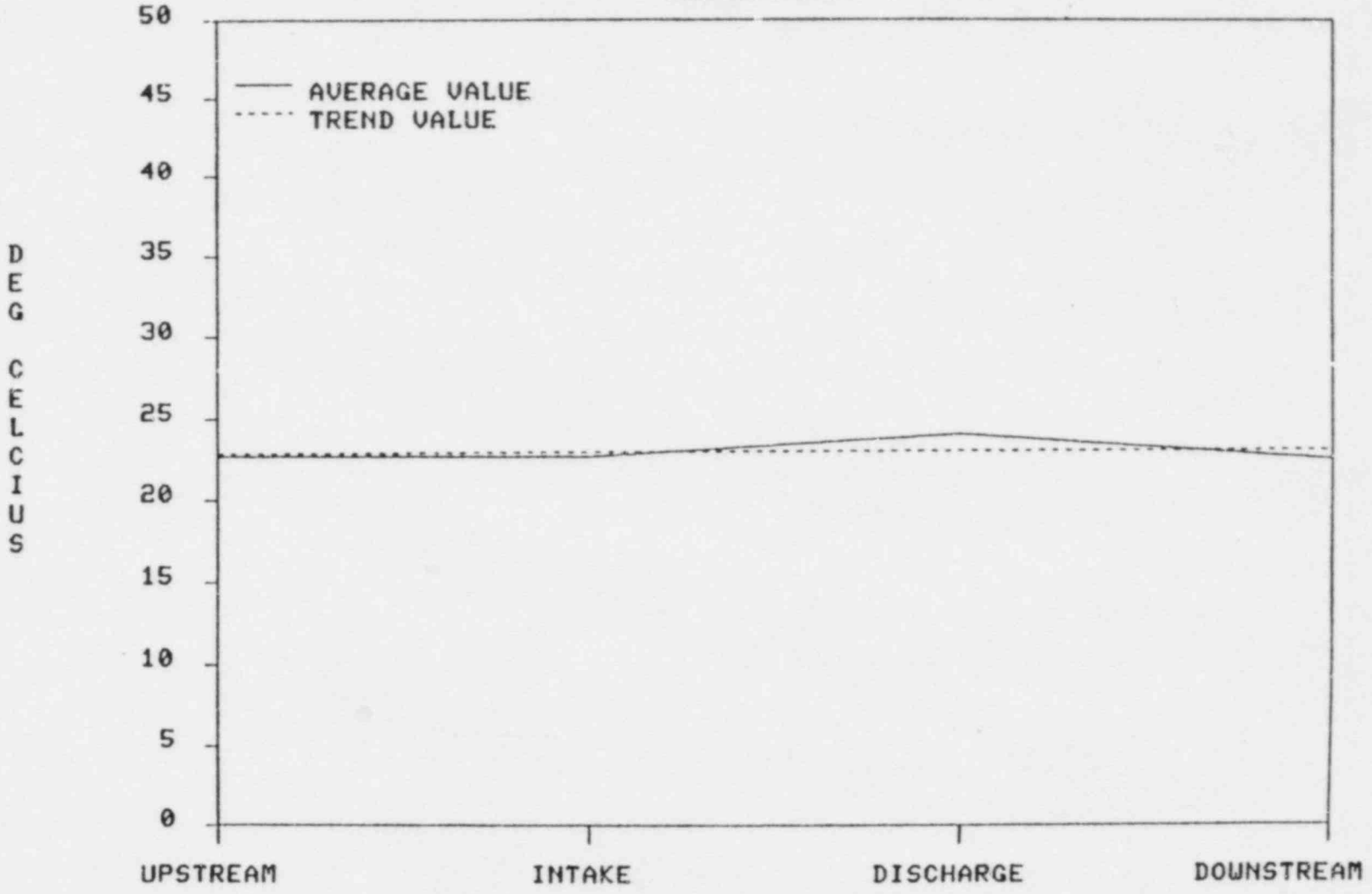
	Upstream	Intake	Discharge	Downstream
Temperature °C	15.0	15.0	18.7	15.0
Dissolved Oxygen-mg/l	10.5	9.2	10.8	10.3
pH - units	7.3	7.3	7.3	7.3
Total Dissolved Solids-mg/l	68	68	71	59
Chlorine, total-mg/l	<0.1	<0.1	<0.1	<0.1
Boron-ug/l	170	145	153	185
Phosphorus, Total-mg/l	0.058	0.055	0.050	0.061
Phosphorus, Dissolved-mg/l	0.043	0.039	0.035	0.043
Sulfate mg/l	11.5	10.6	11.9	12.8
Ammonia mg/l	0.02	0.01	0.02	0.02
Nitrogen-Nitrate-mg/l	0.91	0.78	0.75	0.66
Calcium mg/l	7.6	5.4	6.8	5.2
Manganese ug/l	101	83	74	95
Magnesium mg/l	1.4	1.4	1.4	1.4
Iron mg/l	1.42	1.38	1.12	1.56
Sodium mg/l	11.1	11.0	10.9	9.9
Potassium mg/l	2.1	2.1	2.3	2.0
Chloride mg/l	5.0	5.0	5.3	4.5
Silica mg/l	7.2	7.3	7.9	6.0
Lithium ug/l	<10	<10	<10	<10
Turbidity JTU	14	13	13	13

APPENDIX II

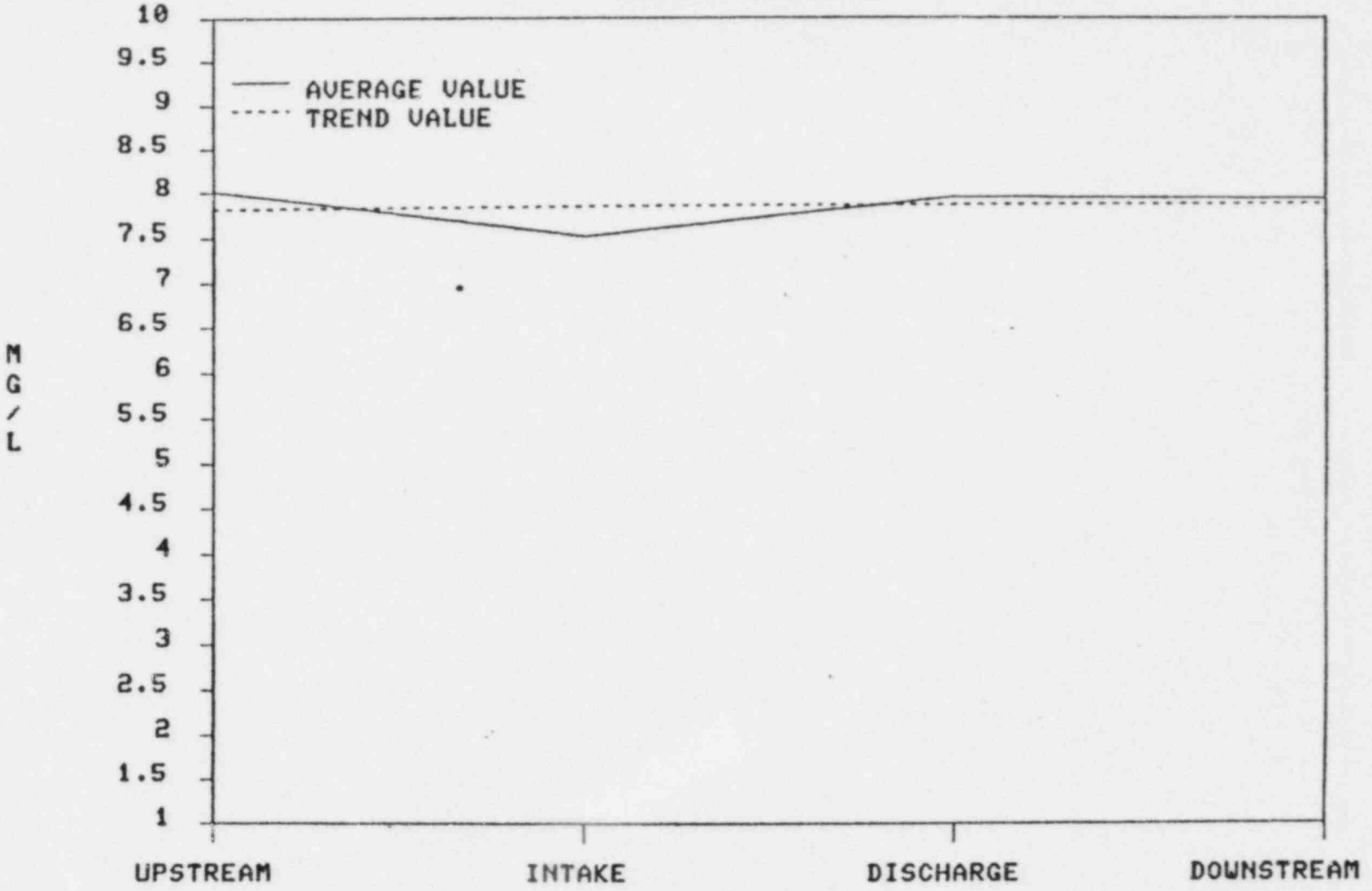
Trend Analysis for Four Point Analysis

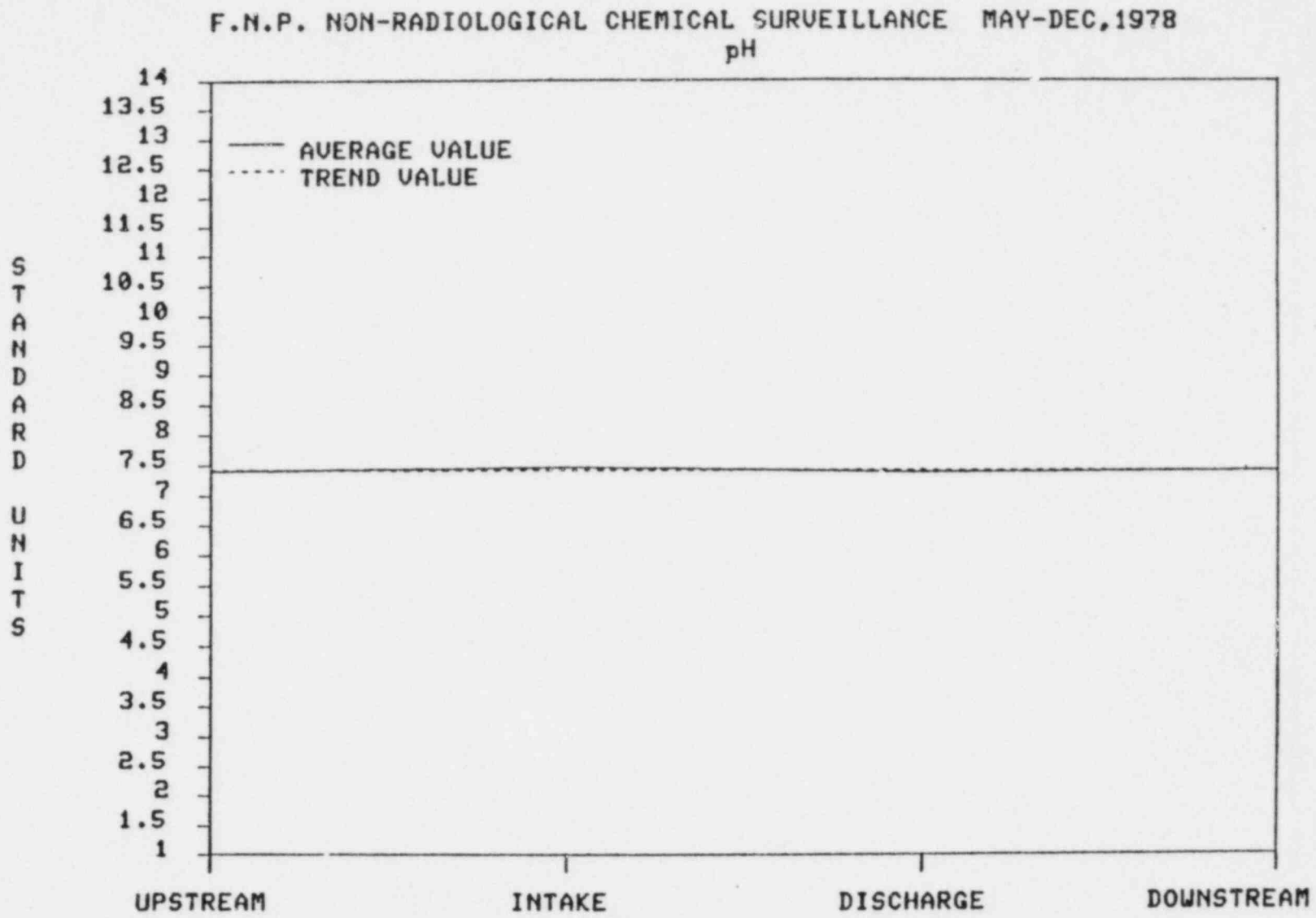
F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978

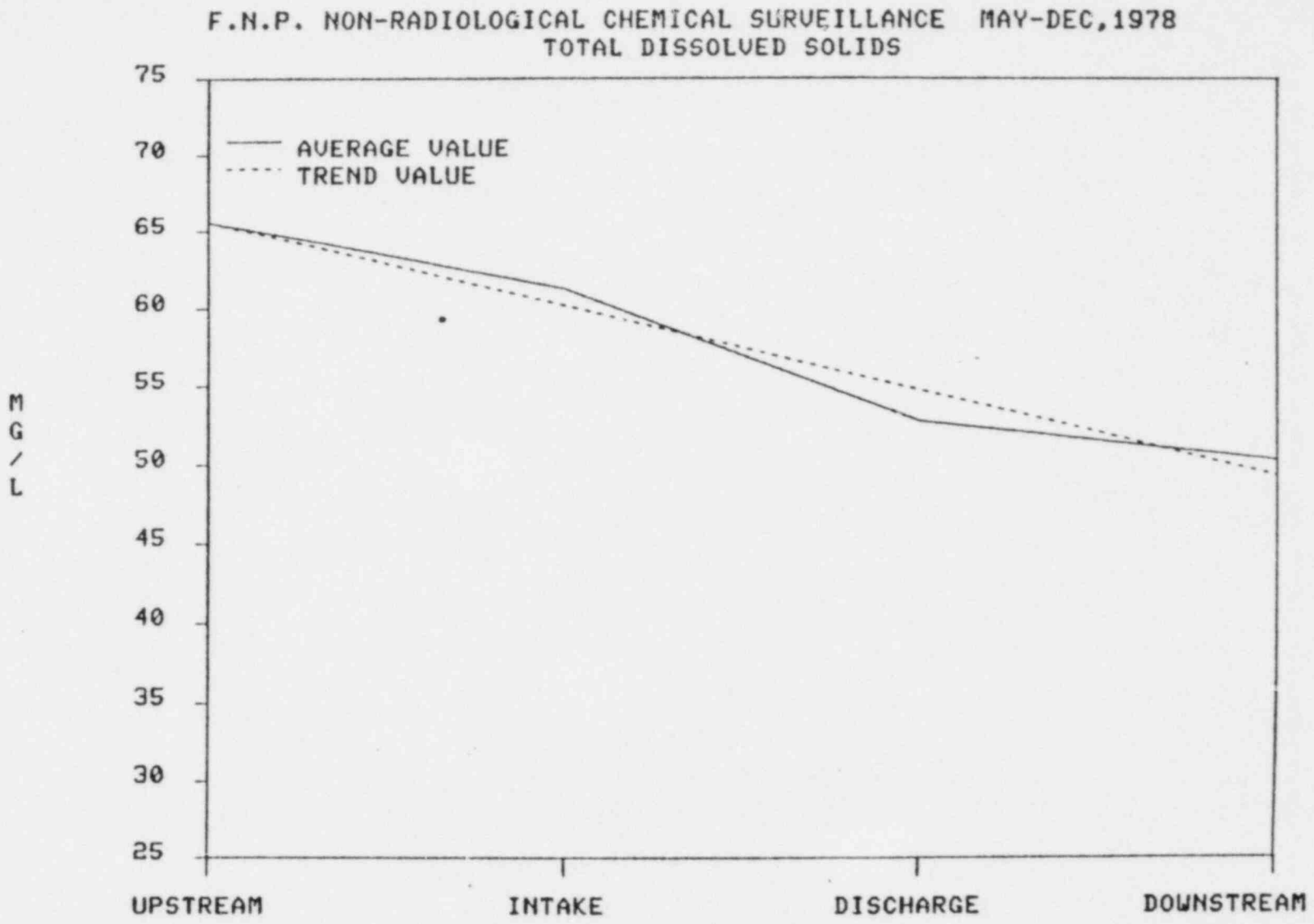
TEMPERATURE



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
DISSOLVED OXYGEN

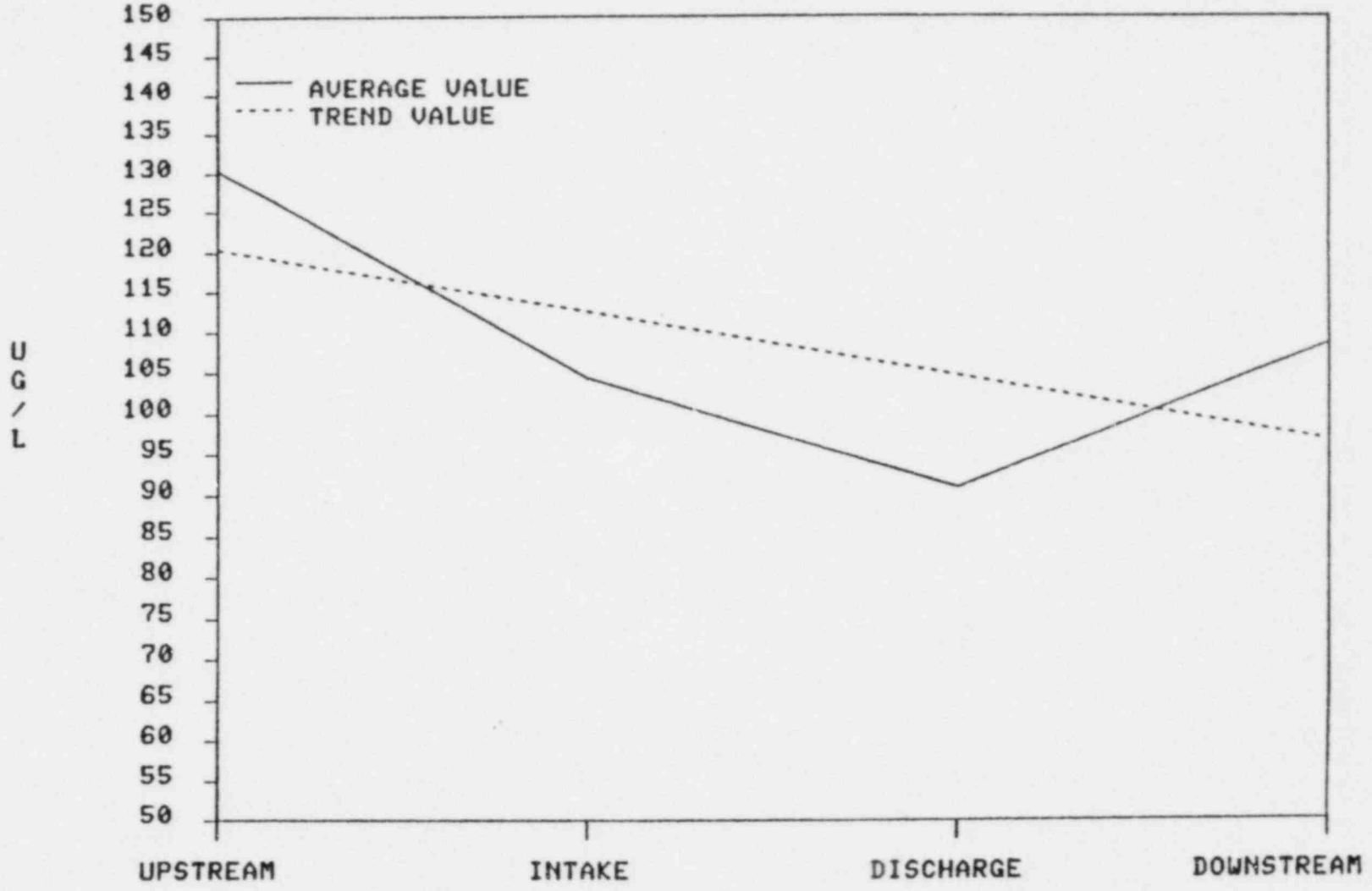



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
pH
AVERAGE VALUE
TREND VALUE
STANDARD UNITS
14
13.5
13
12.5
12
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
UPSTREAM
INTAKE
DISCHARGE
DOWNSTREAM

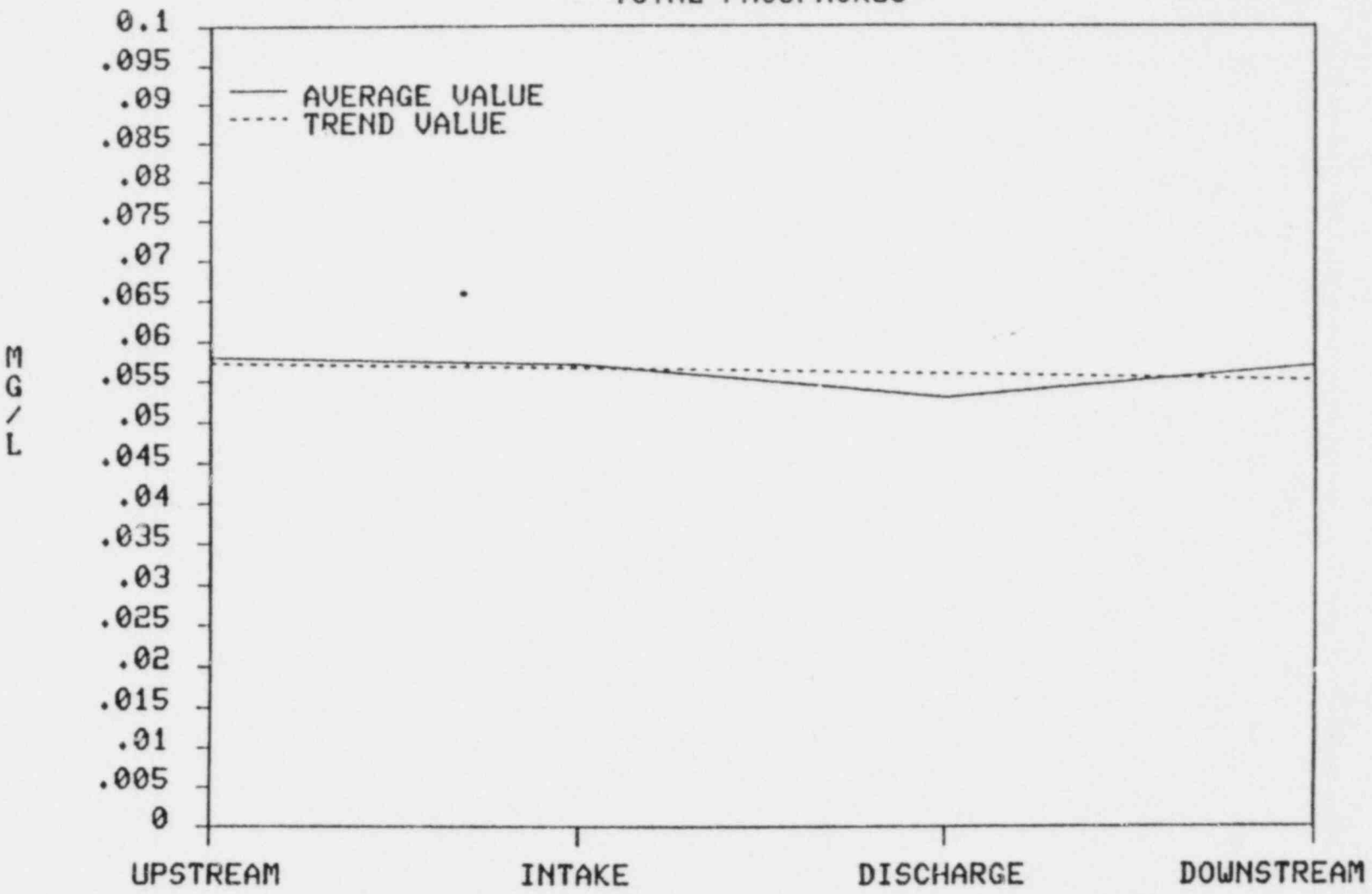

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
TOTAL DISSOLVED SOLIDS
AVERAGE VALUE
TREND VALUE
MG/L
75
70
65
60
55
50
45
40
35
30
25
UPSTREAM
INTAKE
DISCHARGE
DOWNSTREAM

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978

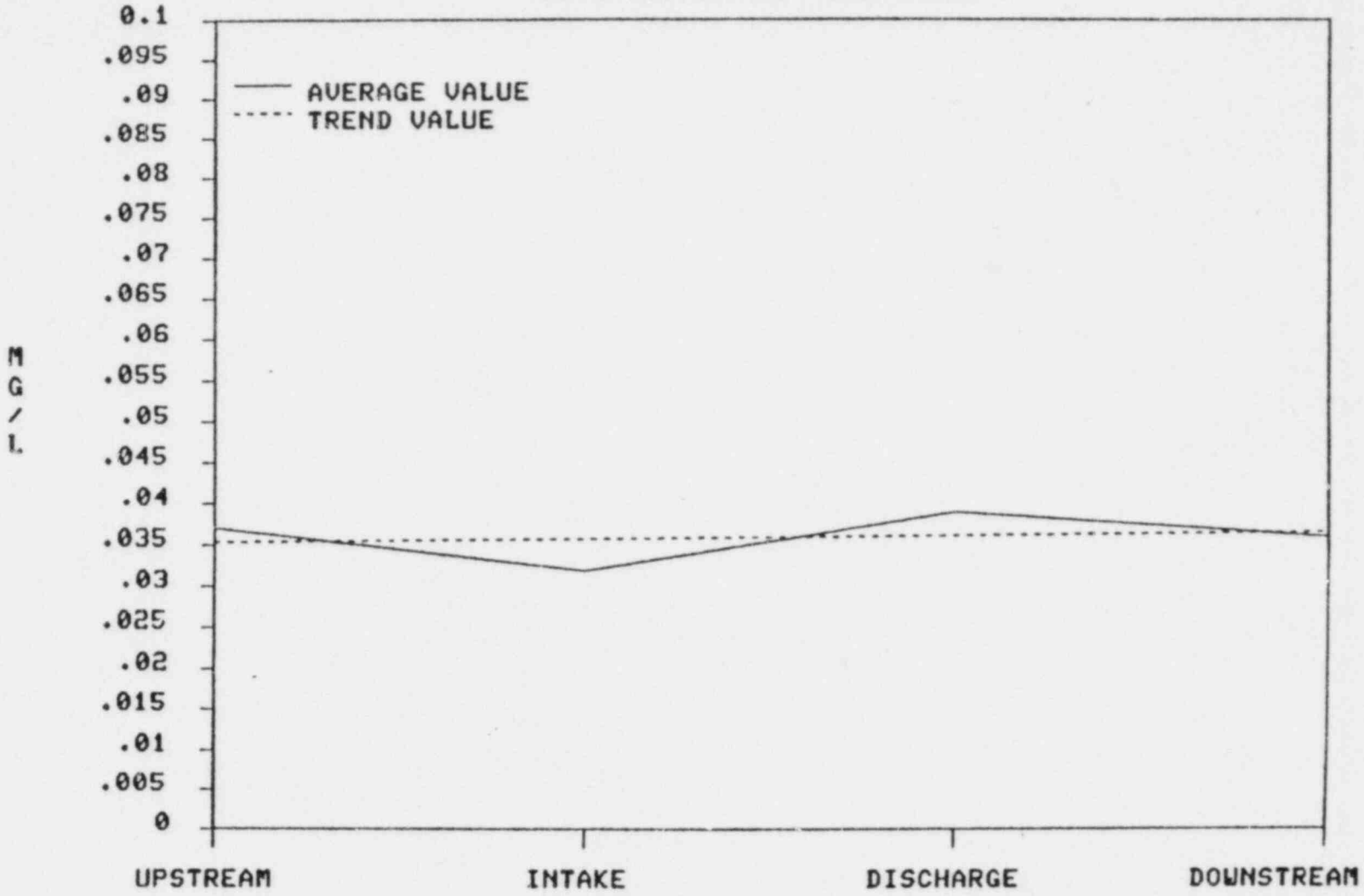
BORON

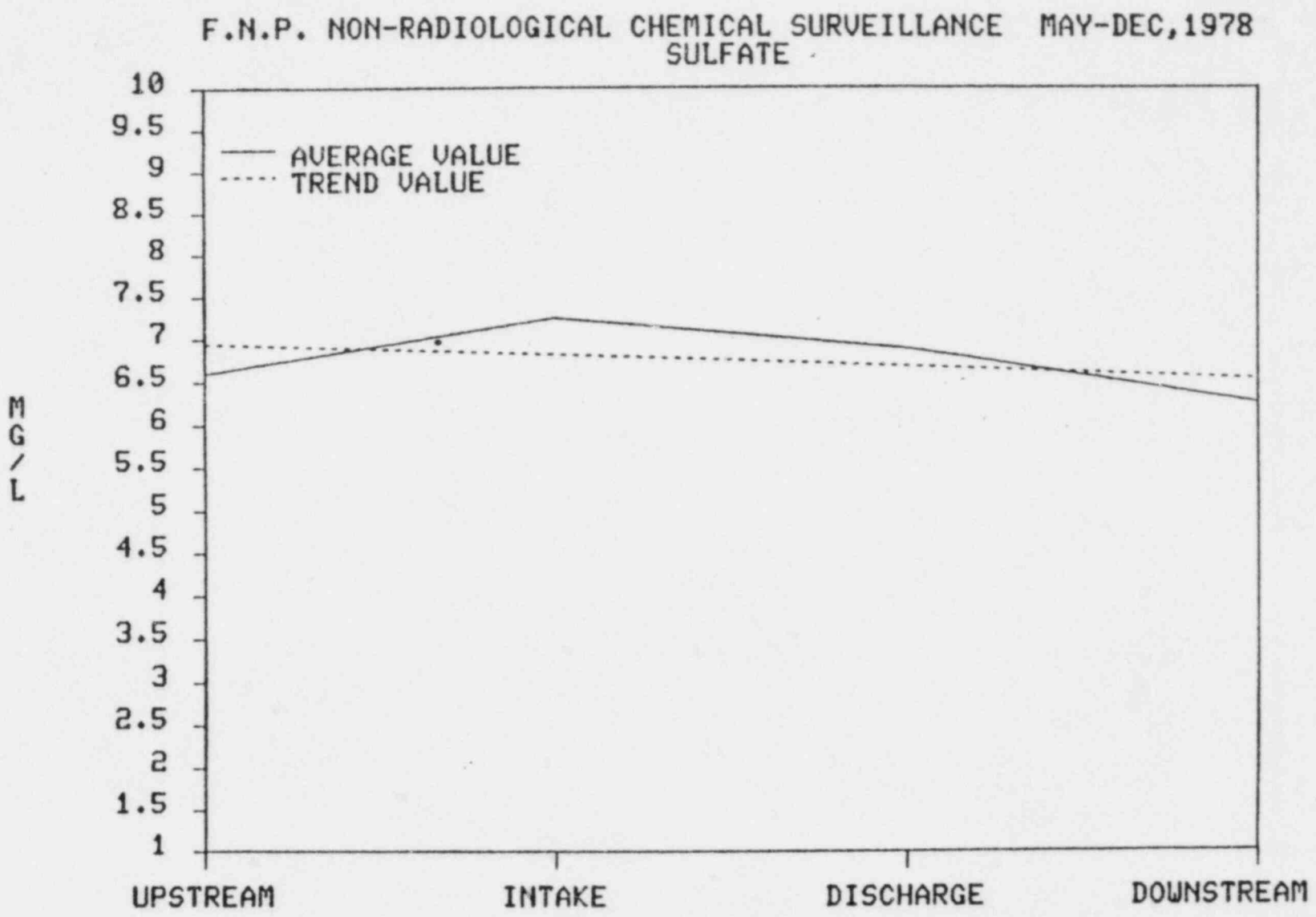


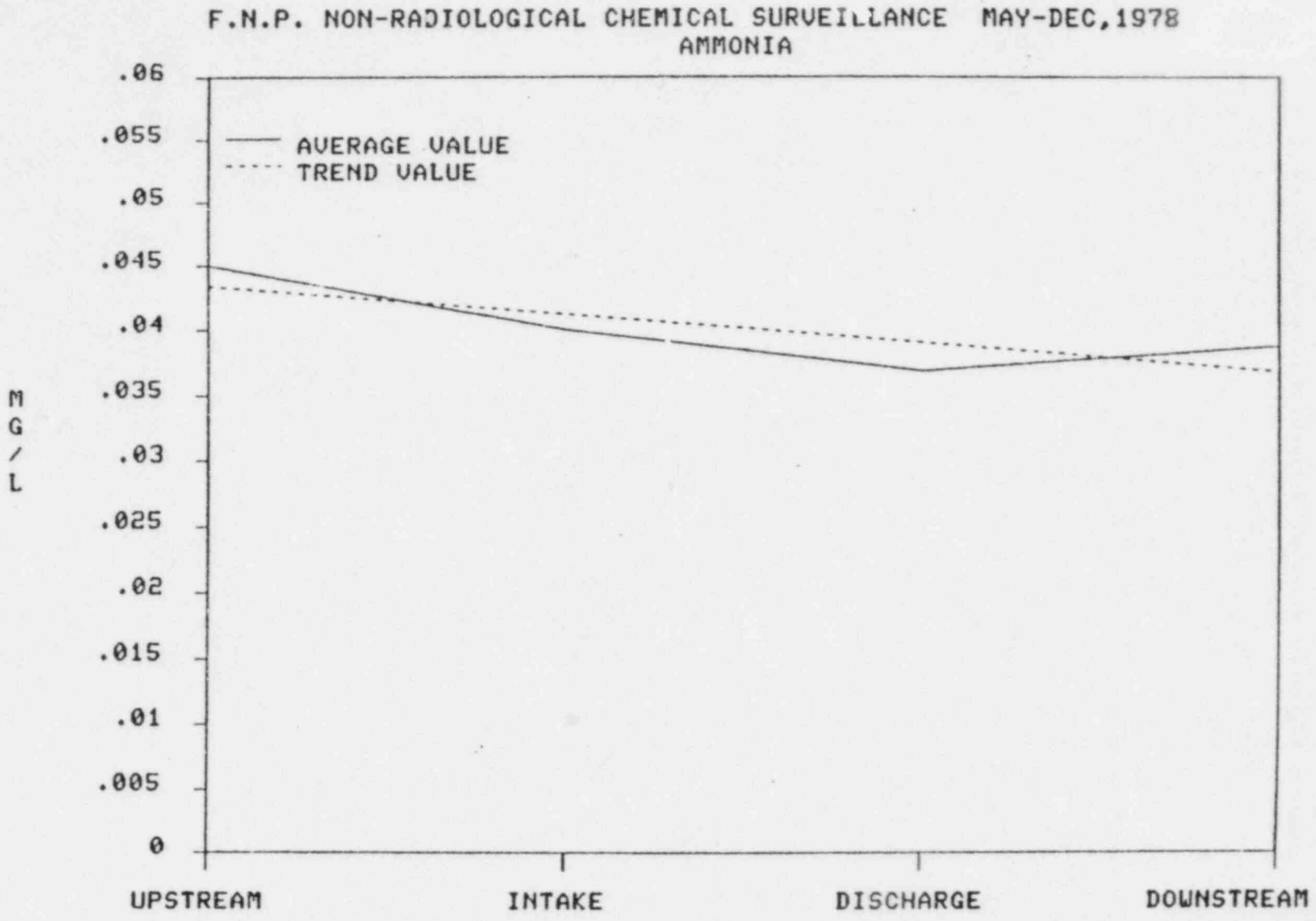
F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
TOTAL PHOSPHORUS

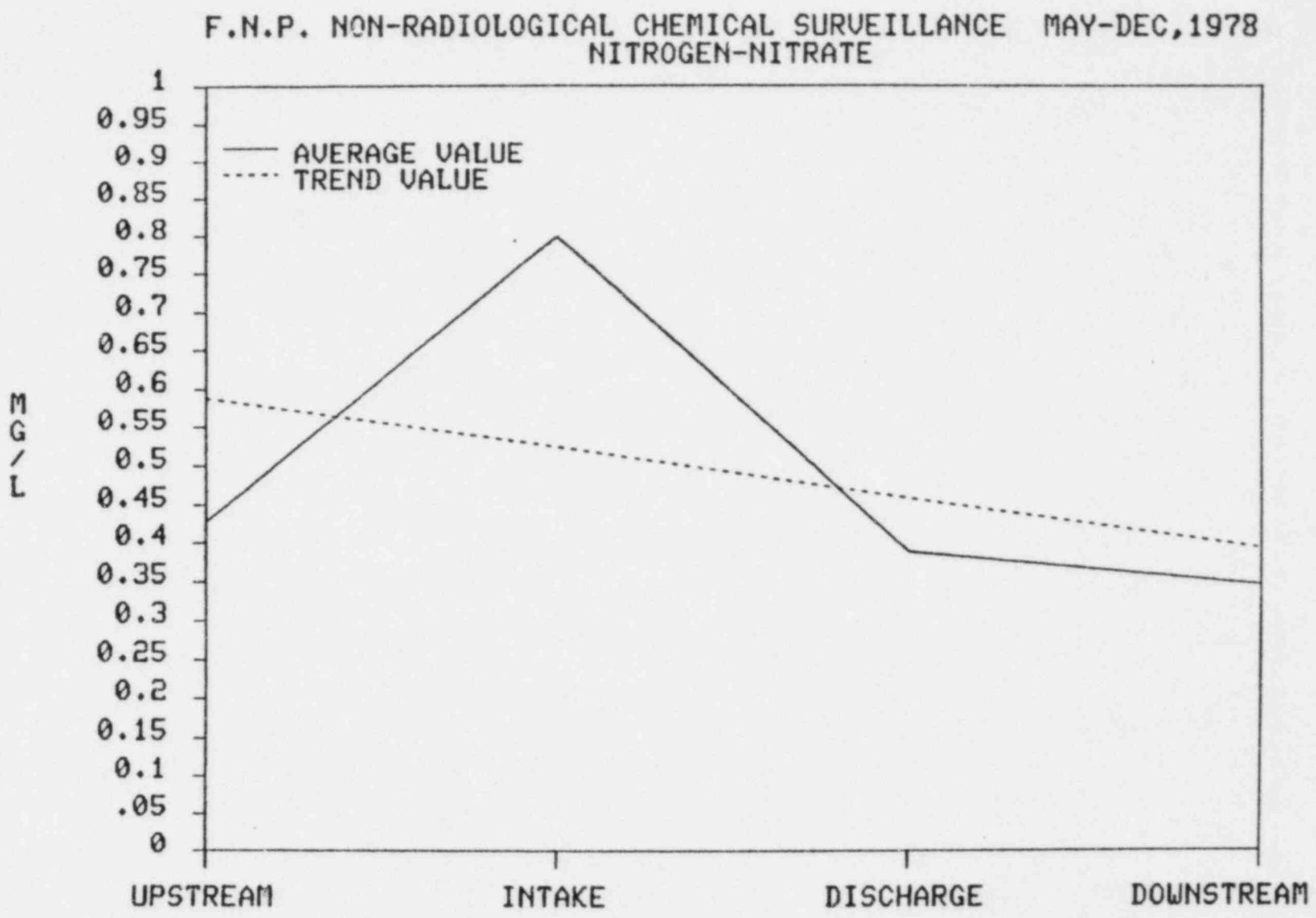


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
TOTAL DISSOLVED PHOSPHORUS

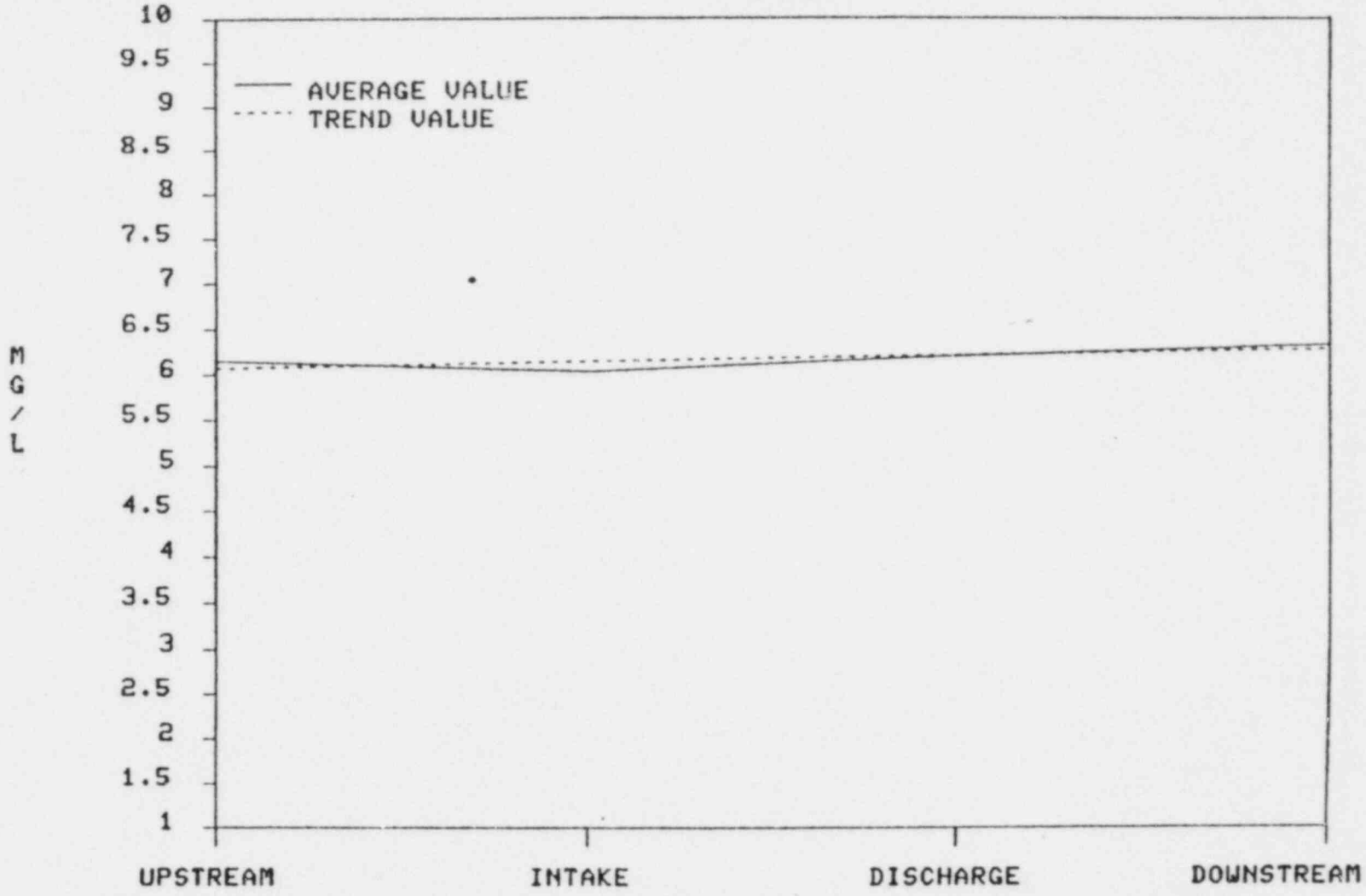


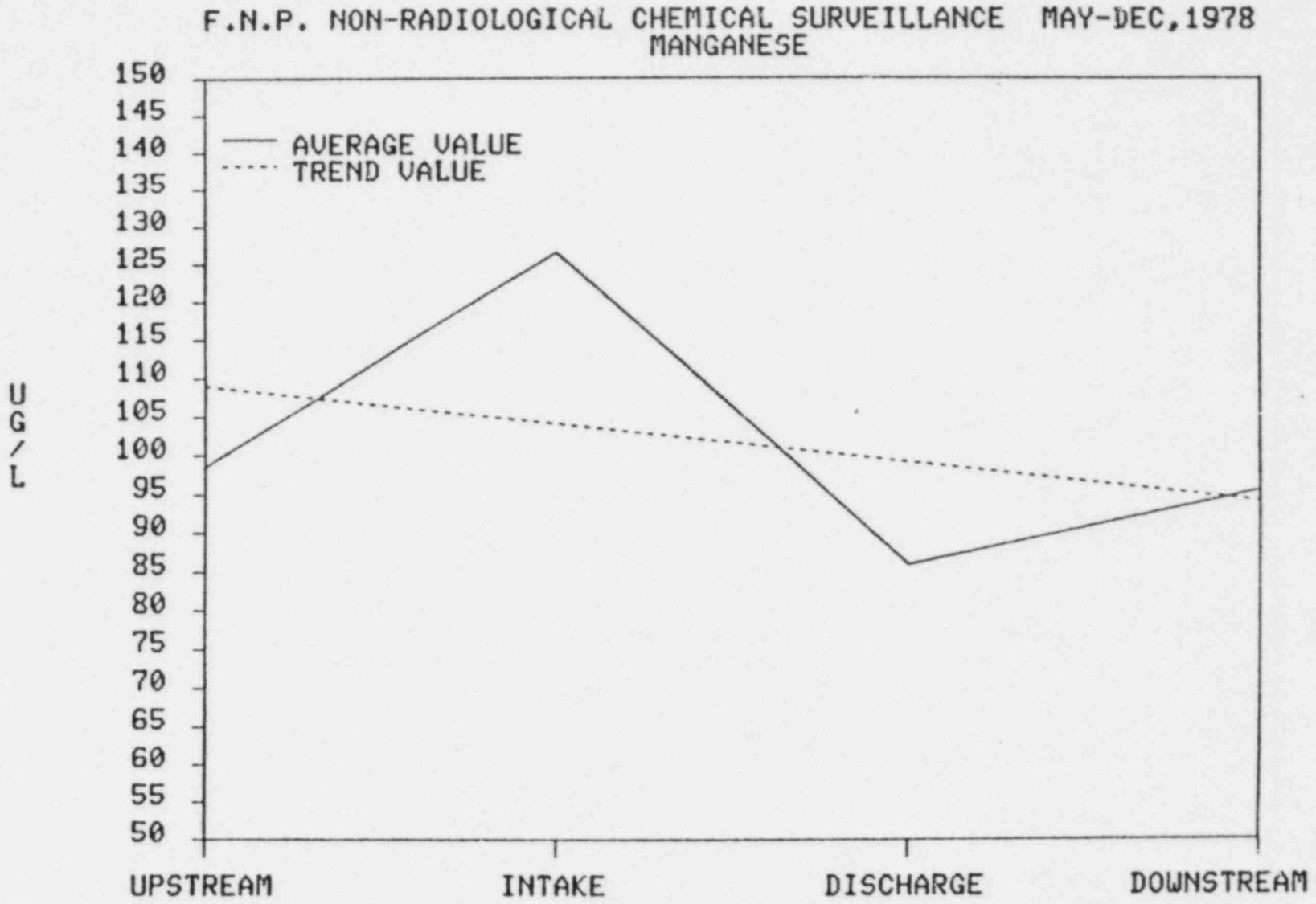

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
SULFATE
AVERAGE VALUE
TREND VALUE
MG/L
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
UPSTREAM
INTAKE
DISCHARGE
DOWNSTREAM


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
AMMONIA
AVERAGE VALUE
TREND VALUE
MG/L
.06
.055
.05
.045
.04
.035
.03
.025
.02
.015
.01
.005
0
UPSTREAM
INTAKE
DISCHARGE
DOWNSTREAM


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
NITROGEN-NITRATE
AVERAGE VALUE
TREND VALUE
MG/L
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
.05
0
UPSTREAM
INTAKE
DISCHARGE
DOWNSTREAM

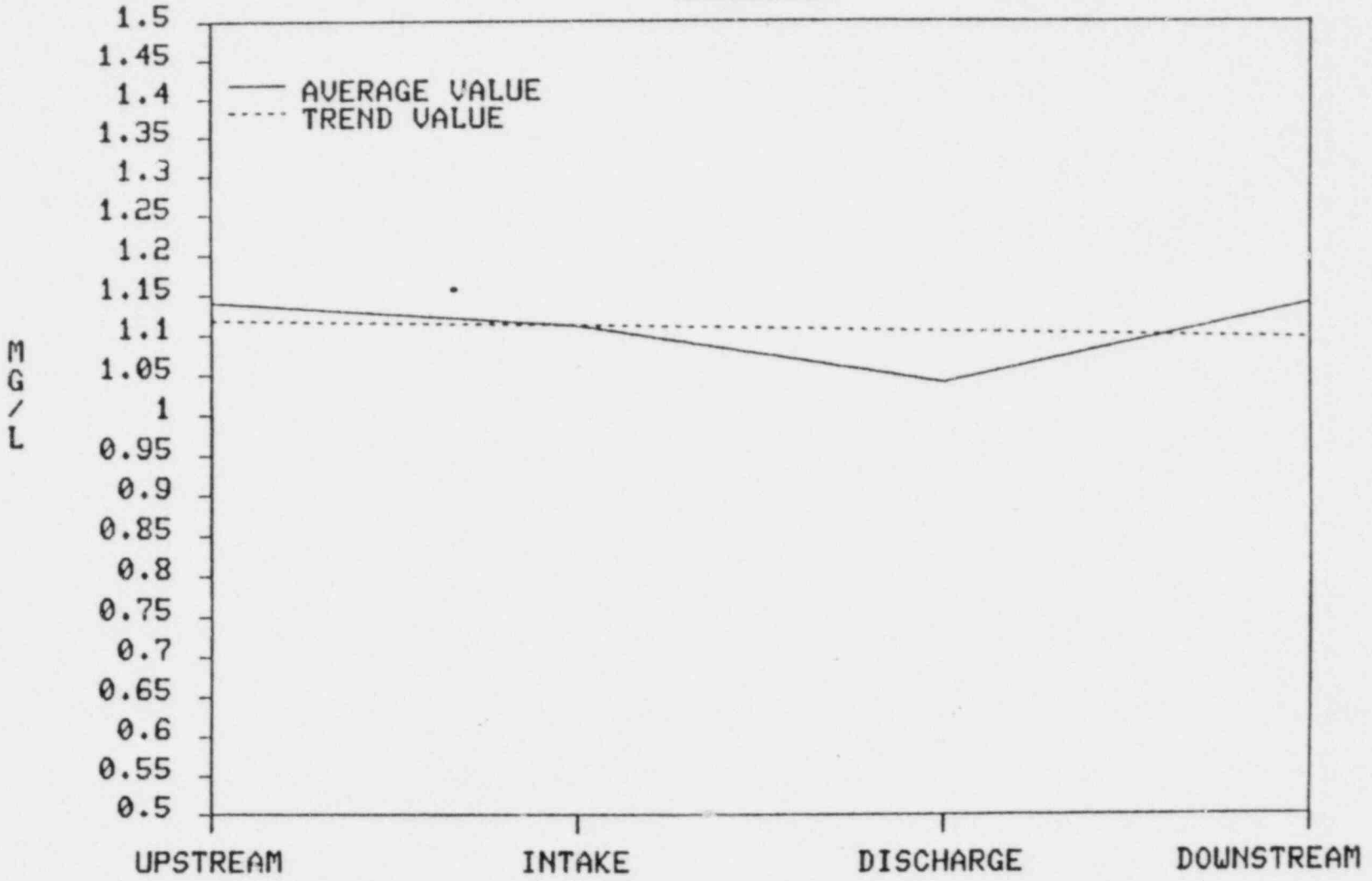
F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
CALCIUM

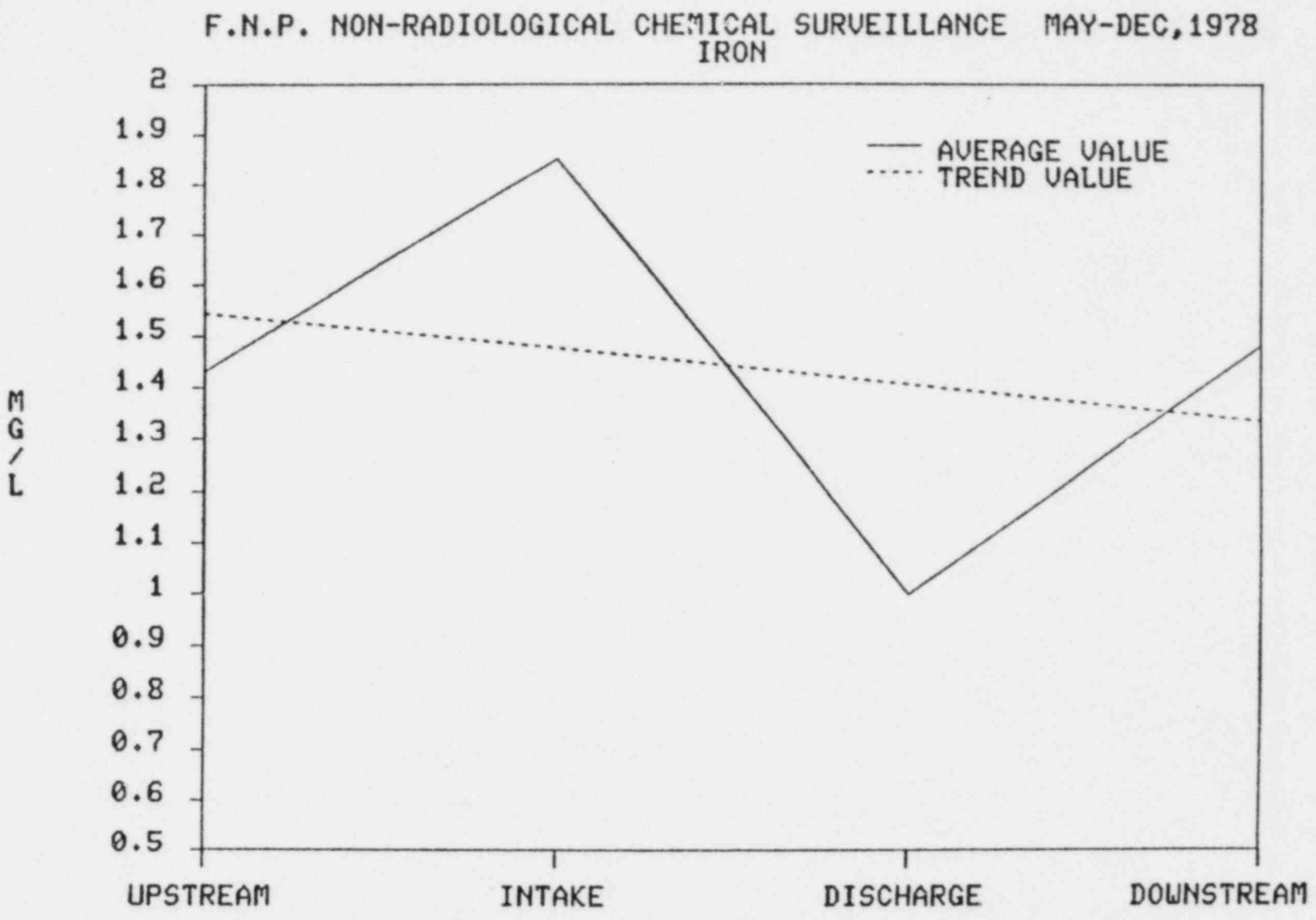


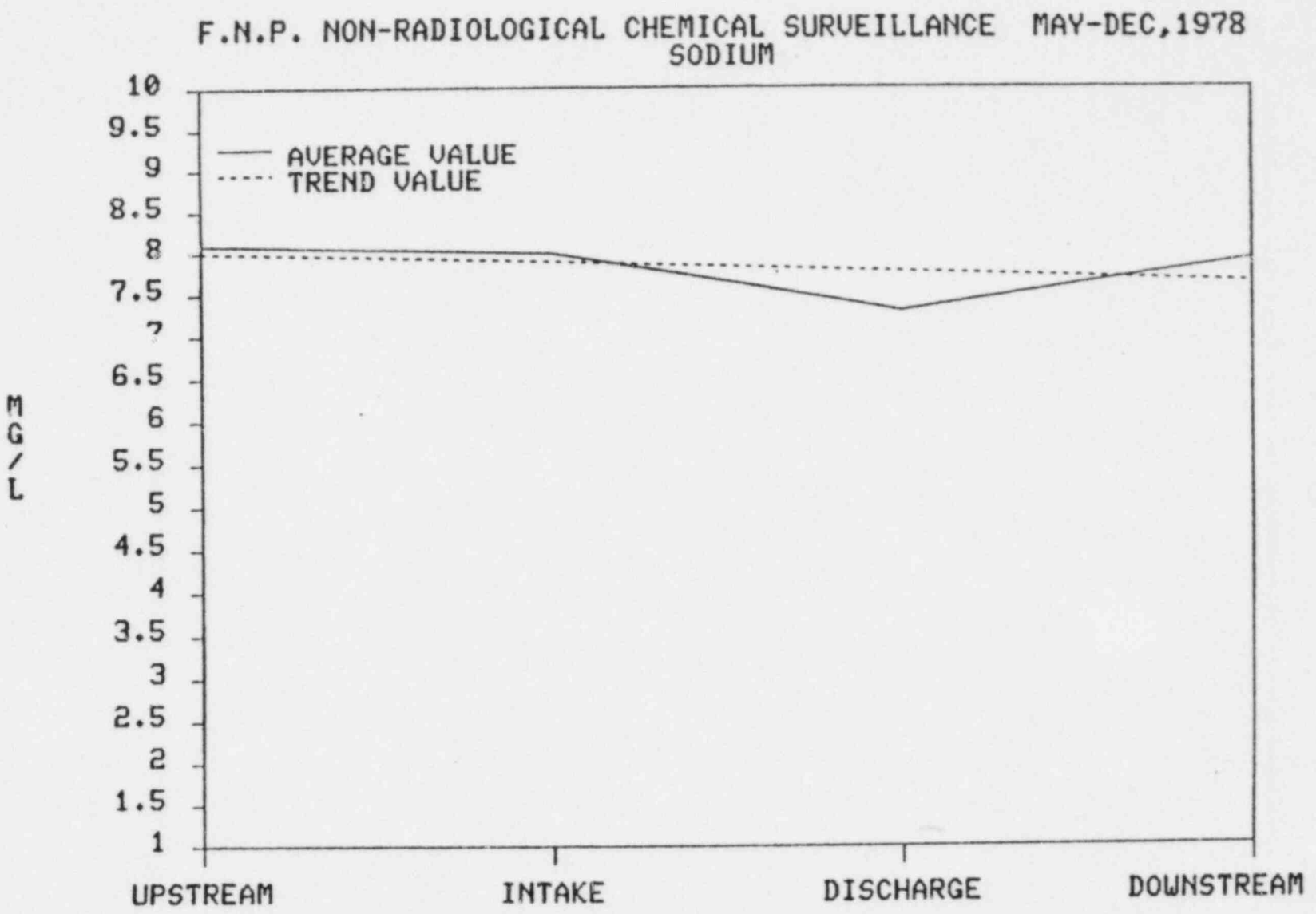

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
MANGANESE
AVERAGE VALUE
TREND VALUE
UG/L
150
145
140
135
130
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
UPSTREAM
INTAKE
DISCHARGE
DOWNSTREAM

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978

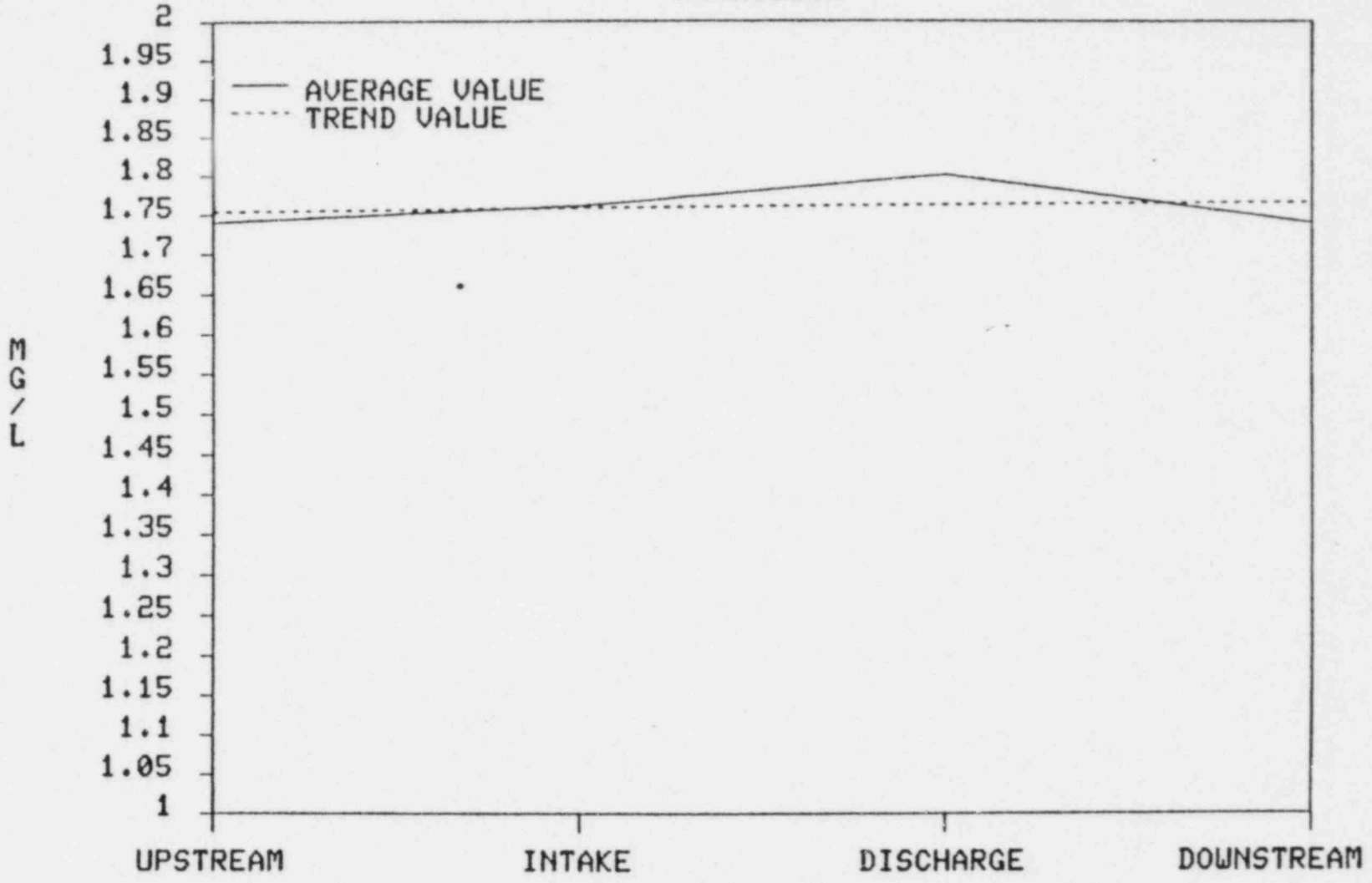
MAGNESIUM



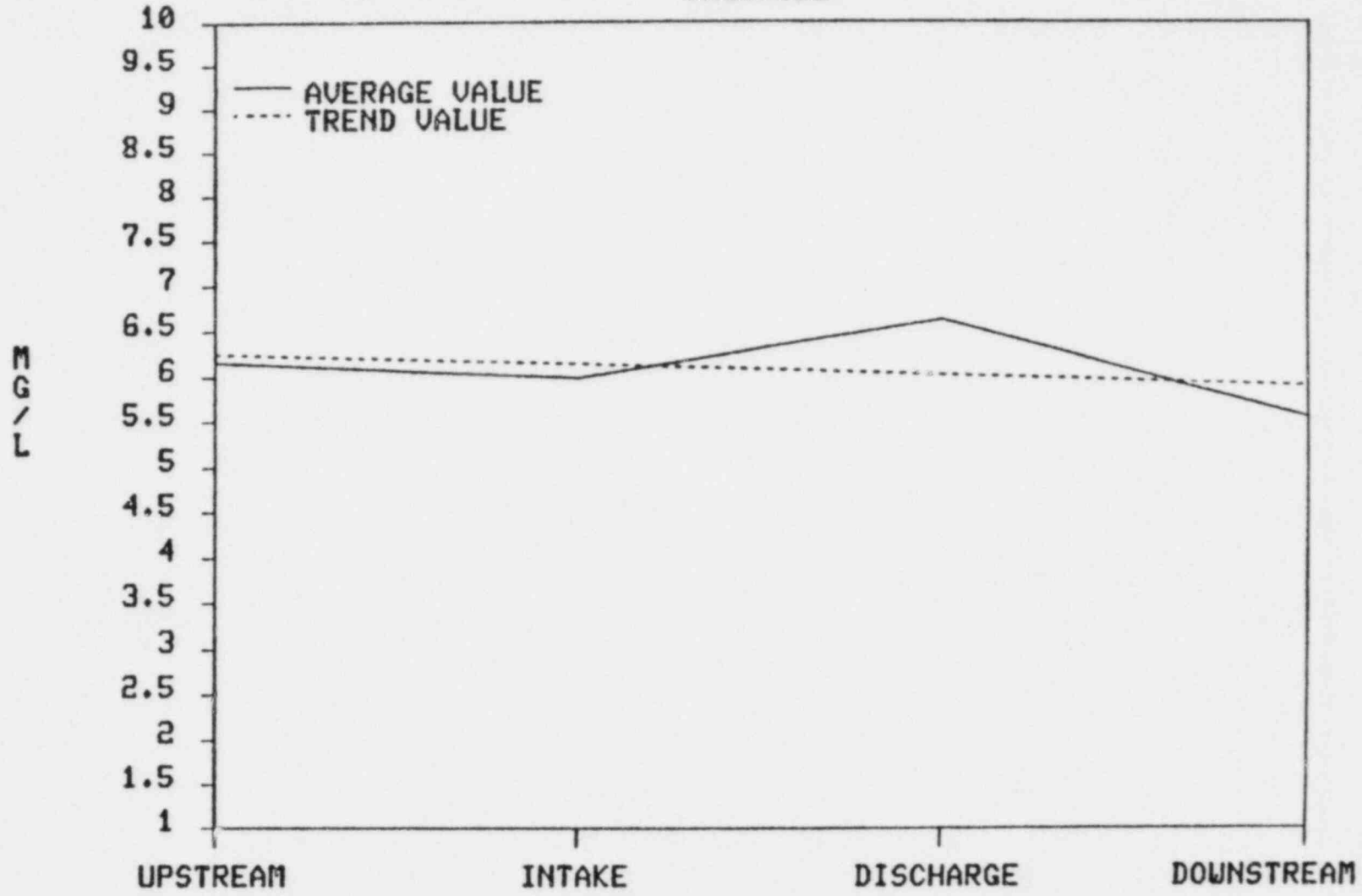

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
IRON
AVERAGE VALUE
TREND VALUE
MG/L
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
UPSTREAM
INTAKE
DISCHARGE
DOWNSTREAM


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
SODIUM
AVERAGE VALUE
TREND VALUE
MG/L
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
UPSTREAM
INTAKE
DISCHARGE
DOWNSTREAM

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
POTASSIUM

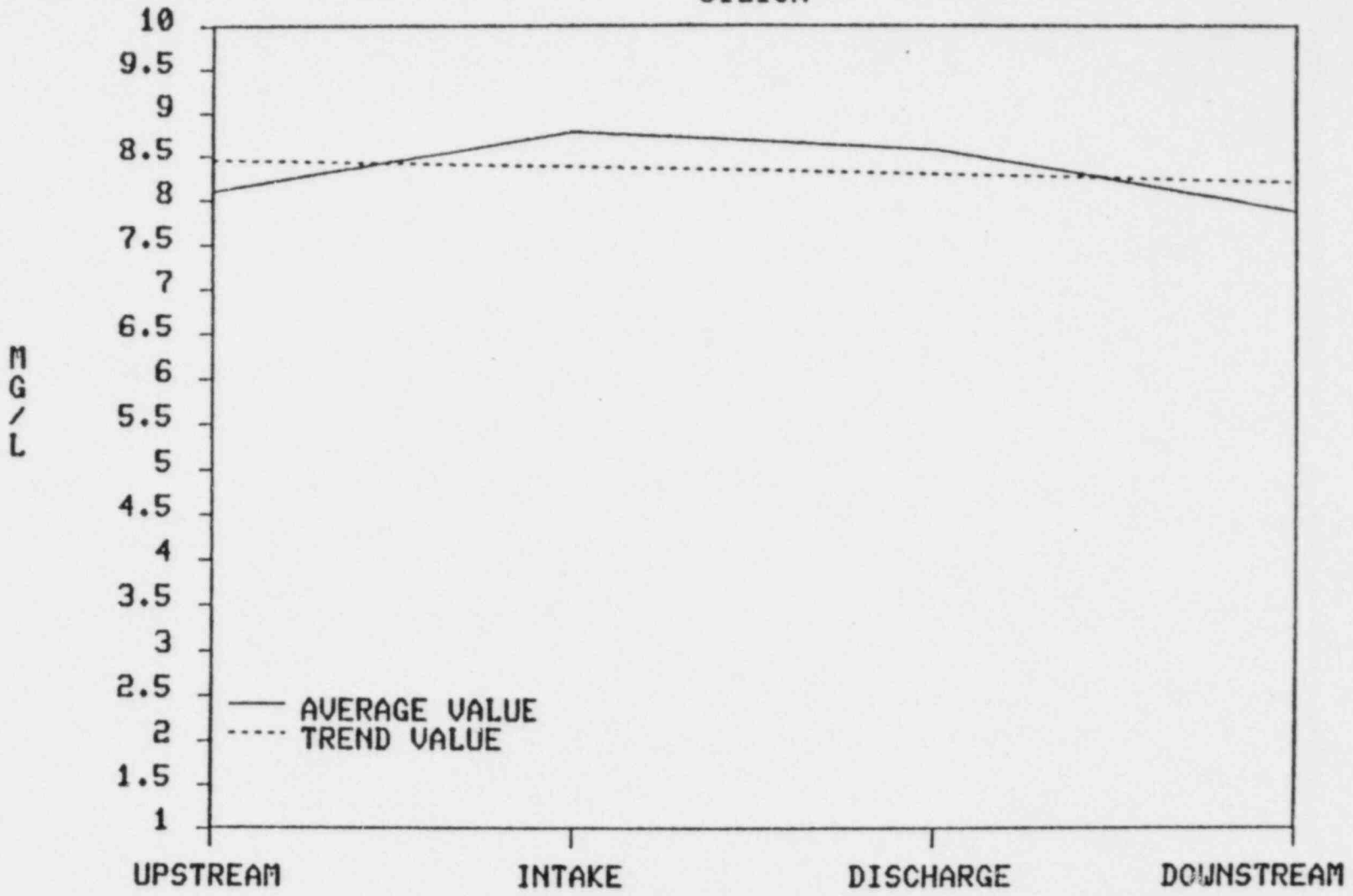


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978
CHLORIDE



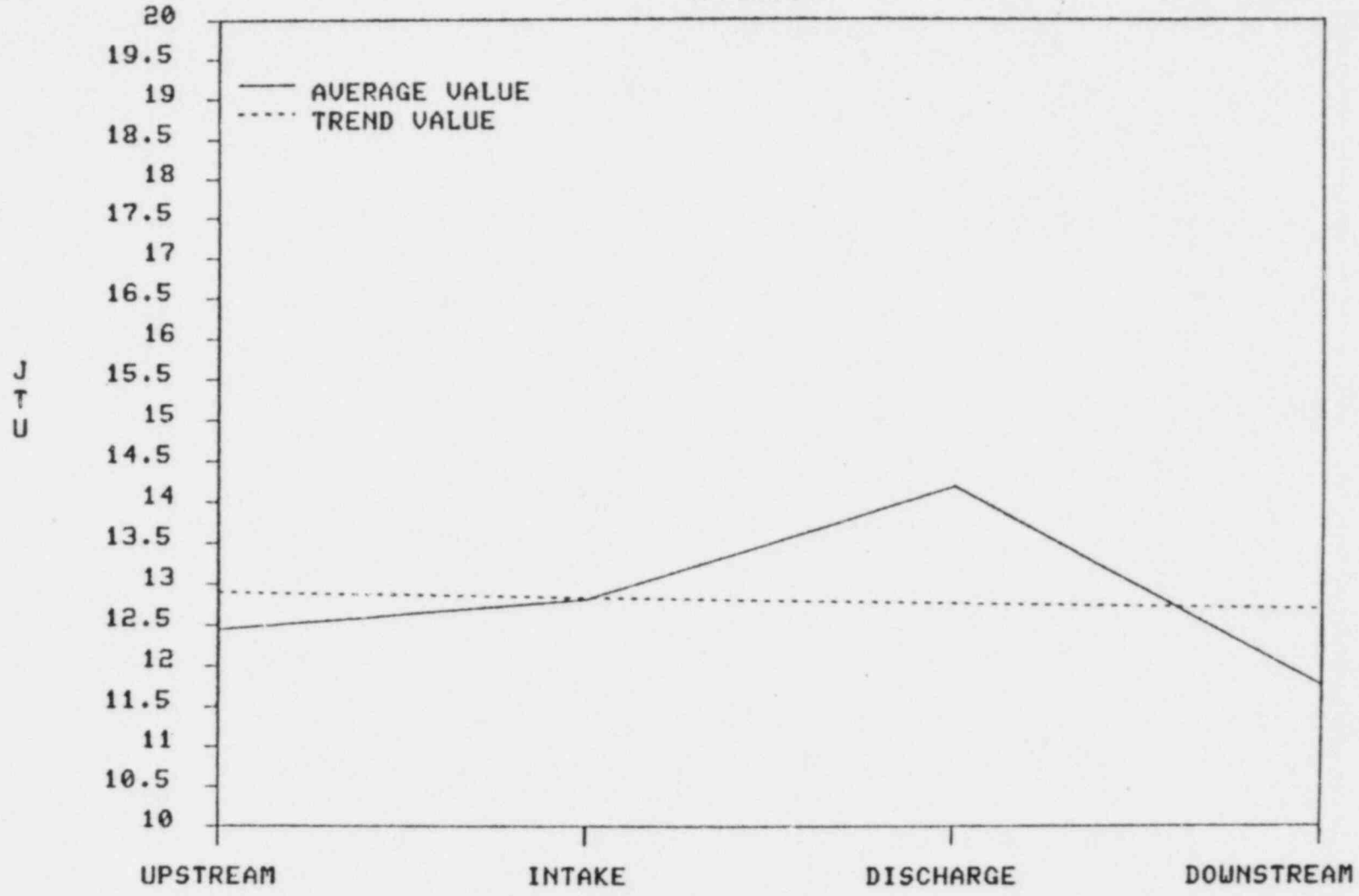
F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978

SILICA



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE MAY-DEC,1978

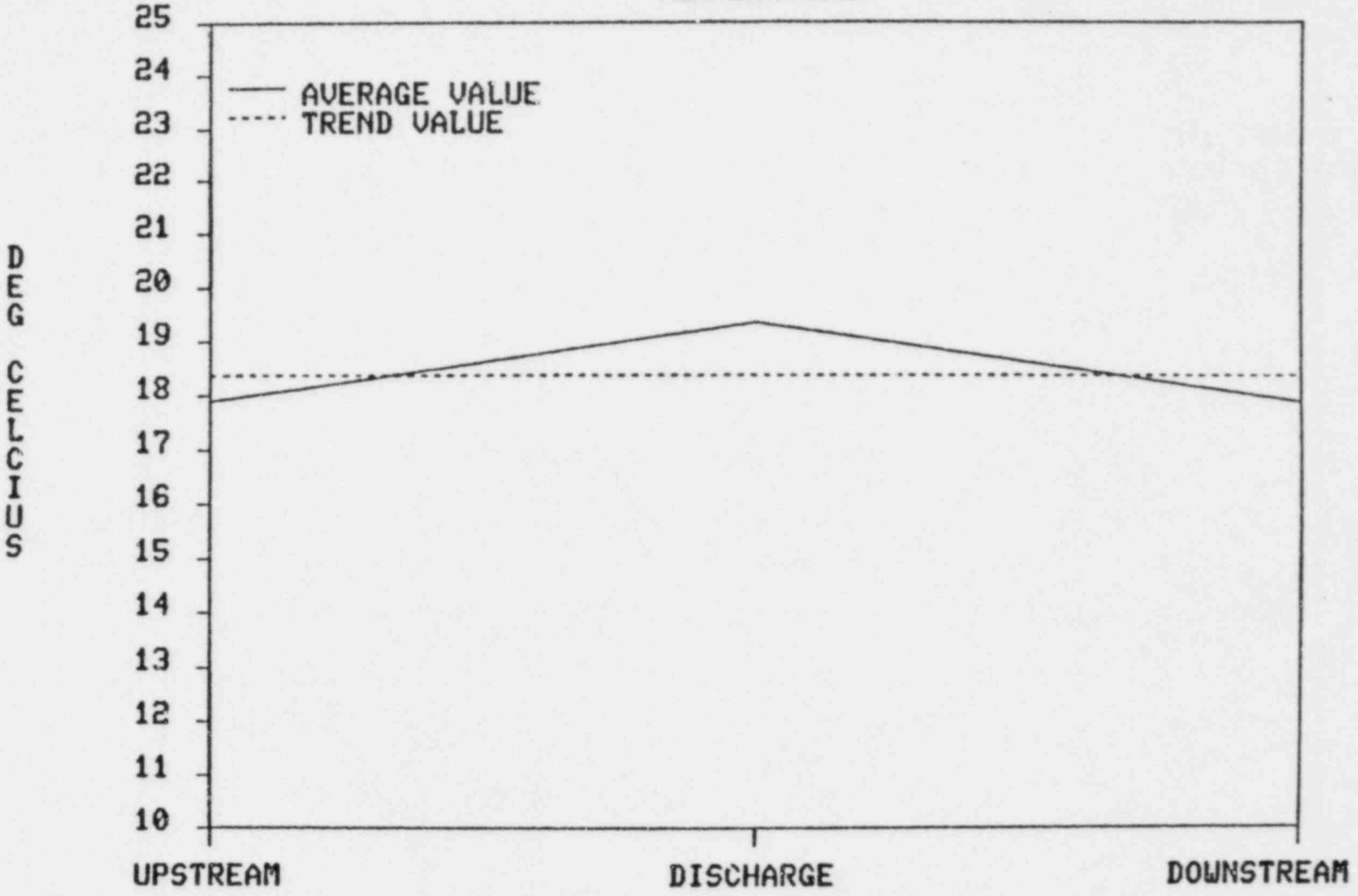
TURBIDITY



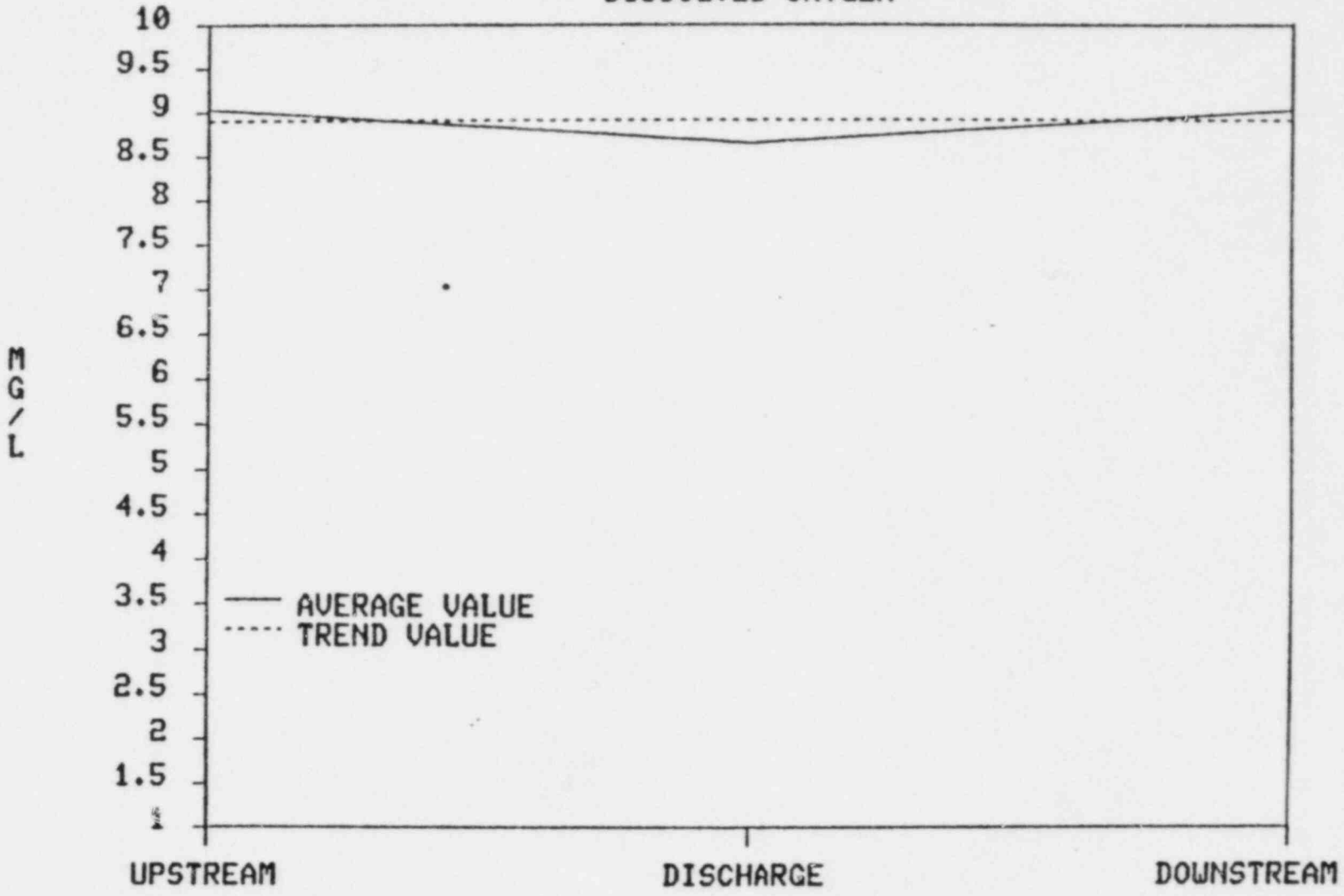
APPENDIX III

Trend Analysis for Three Point Analysis

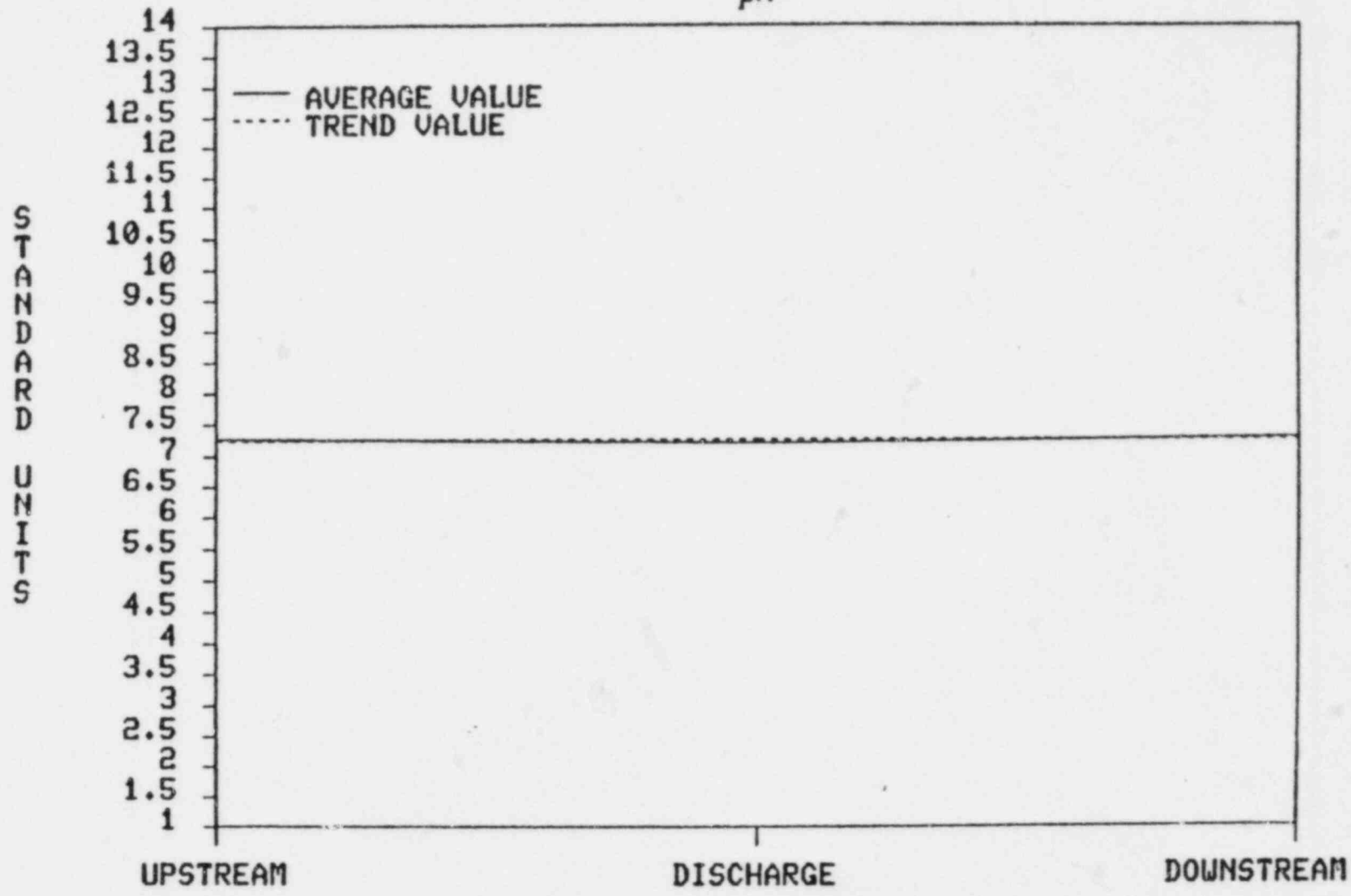
F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
TEMPERATURE

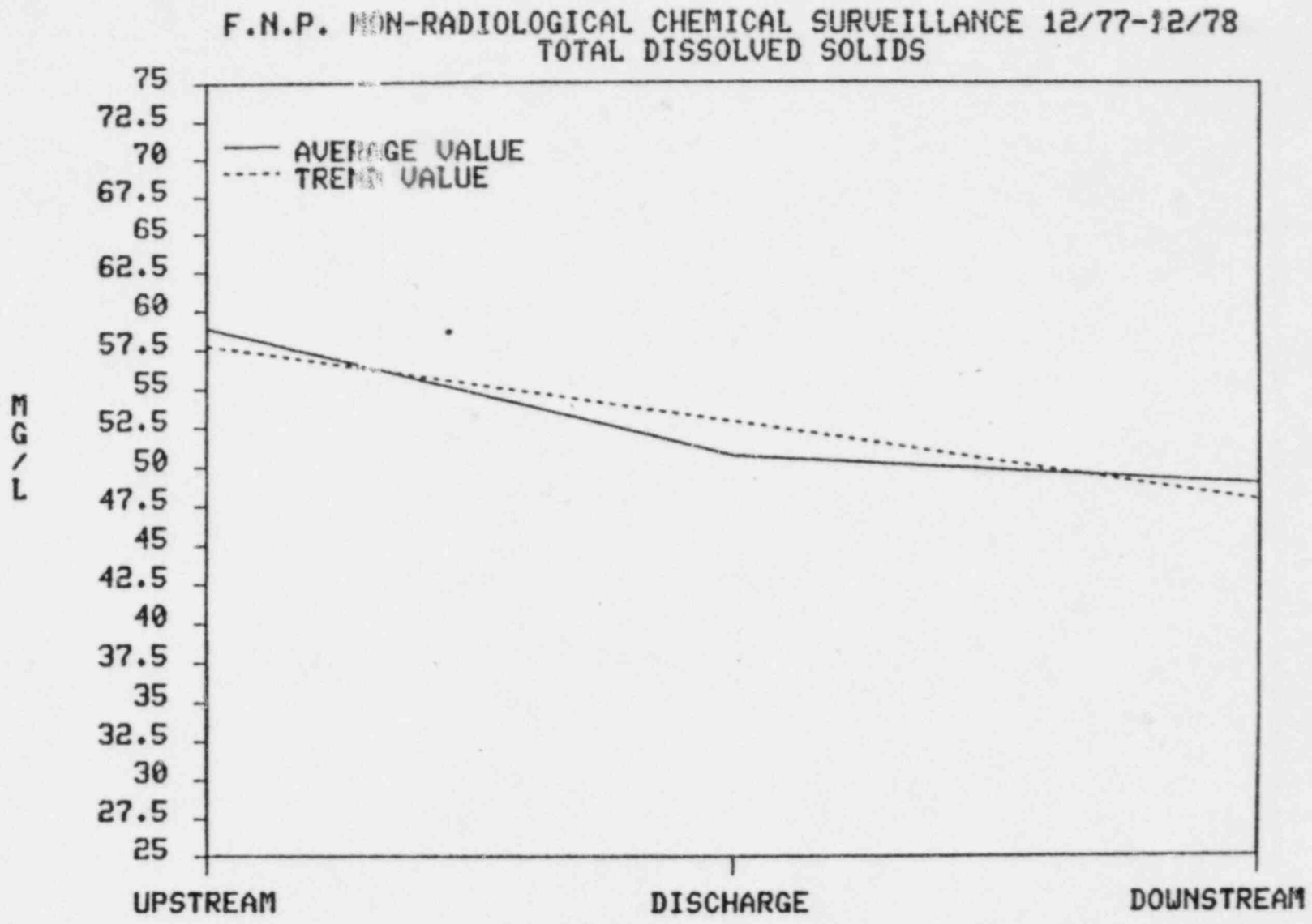


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
DISSOLVED OXYGEN

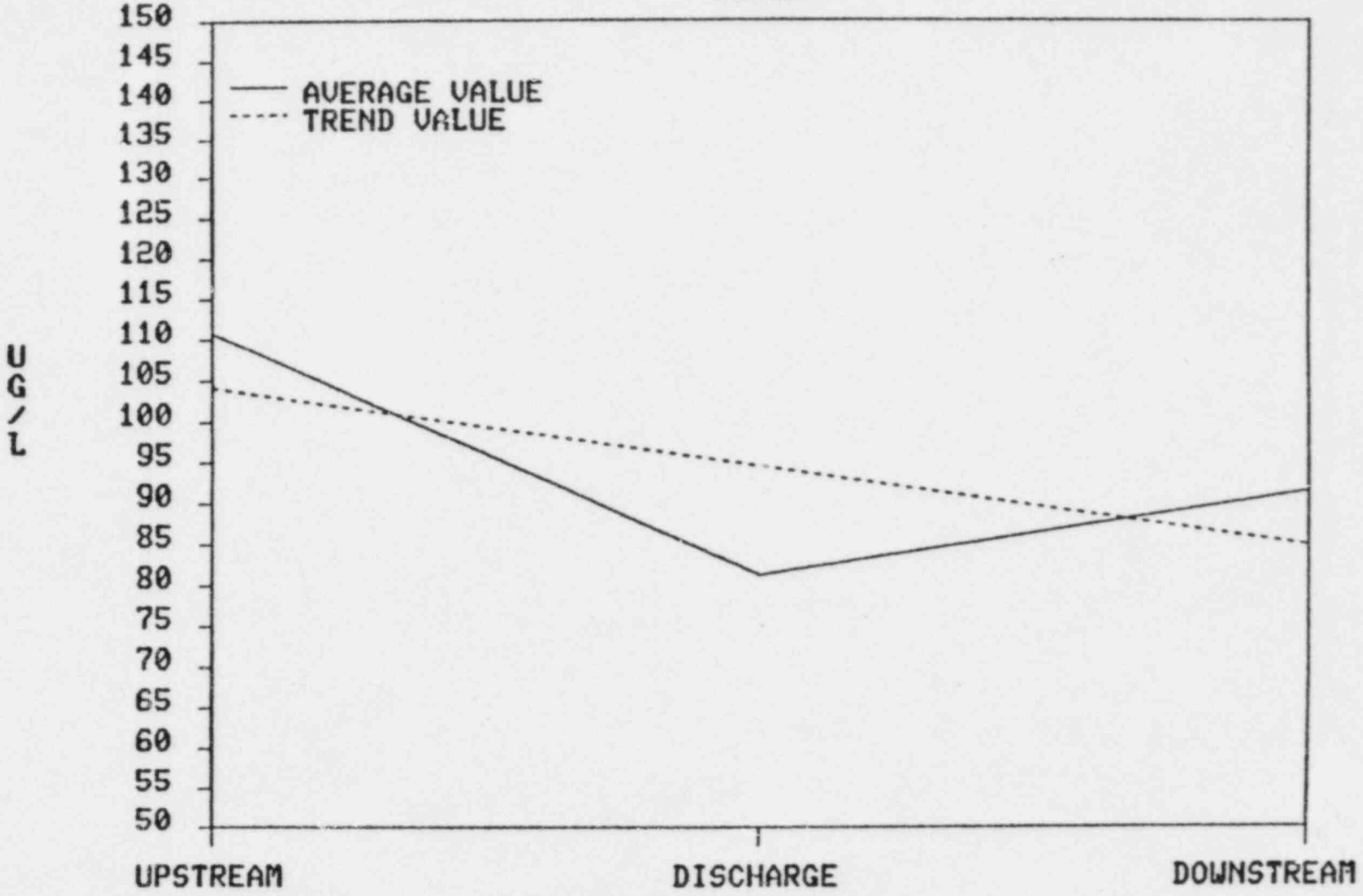


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78

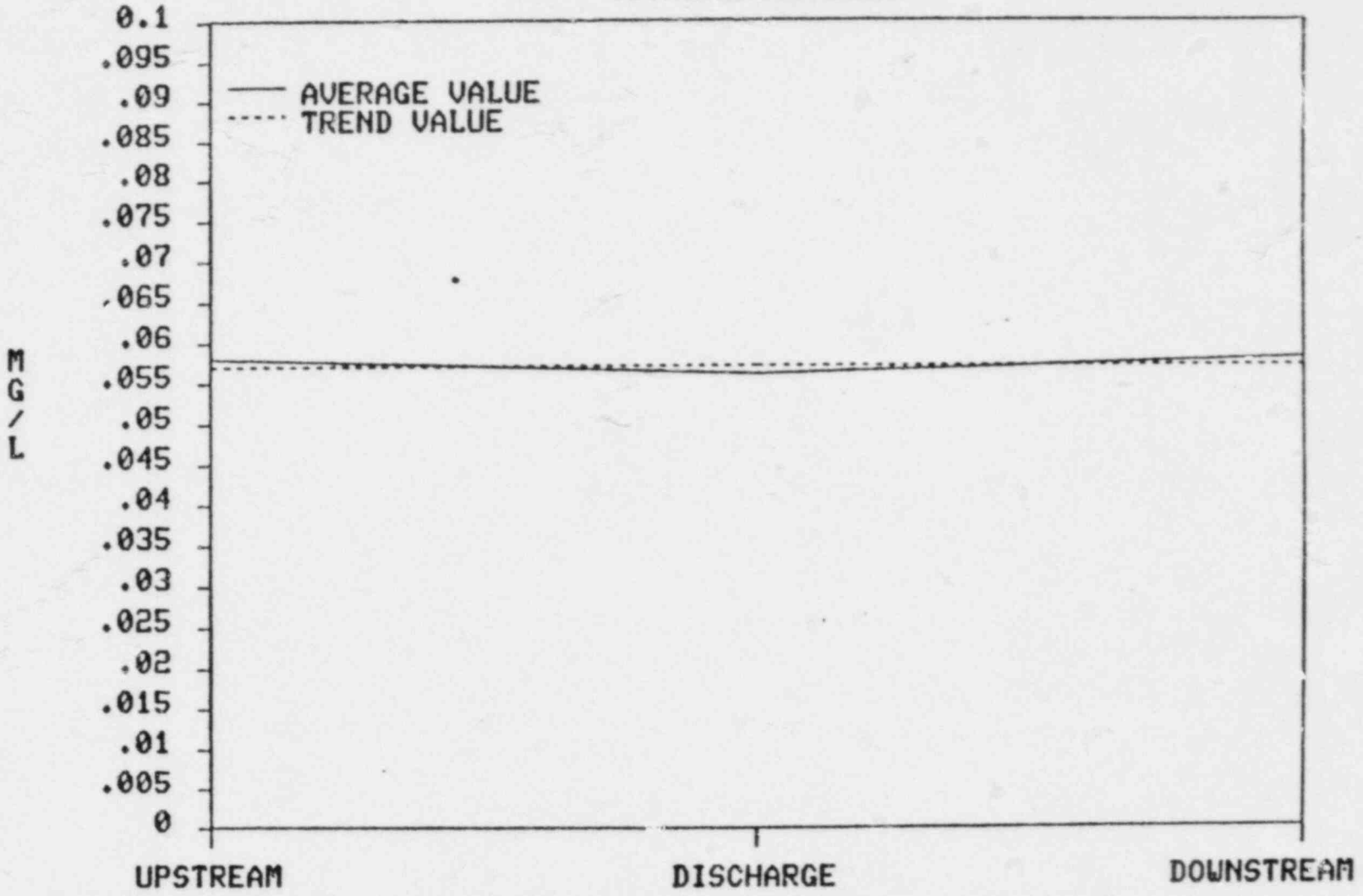


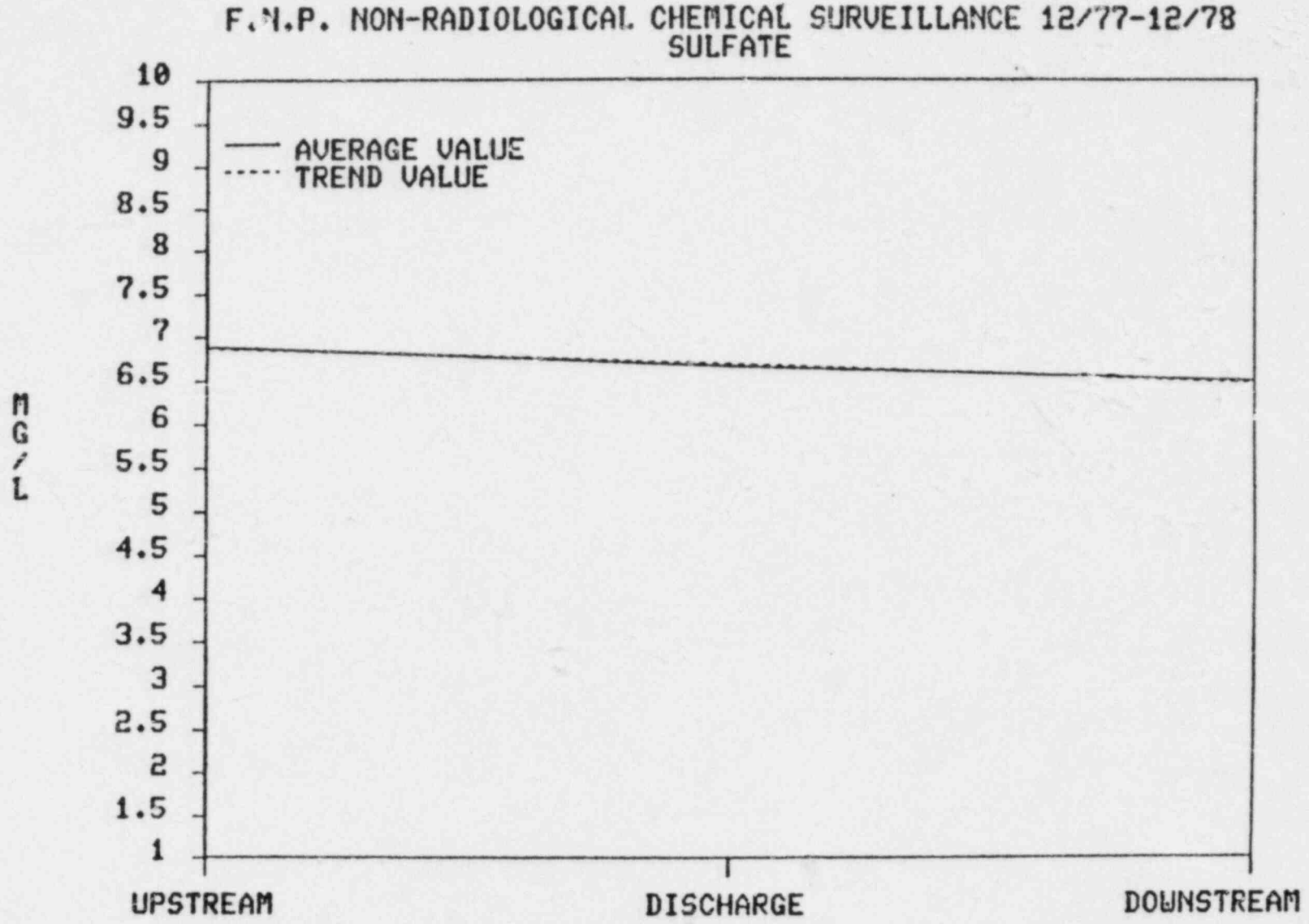

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
TOTAL DISSOLVED SOLIDS
AVERAGE VALUE
TREND VALUE
MG/L
75
72.5
70
67.5
65
62.5
60
57.5
55
52.5
50
47.5
45
42.5
40
37.5
35
32.5
30
27.5
25
UPSTREAM
DISCHARGE
DOWNSTREAM

F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
BORON



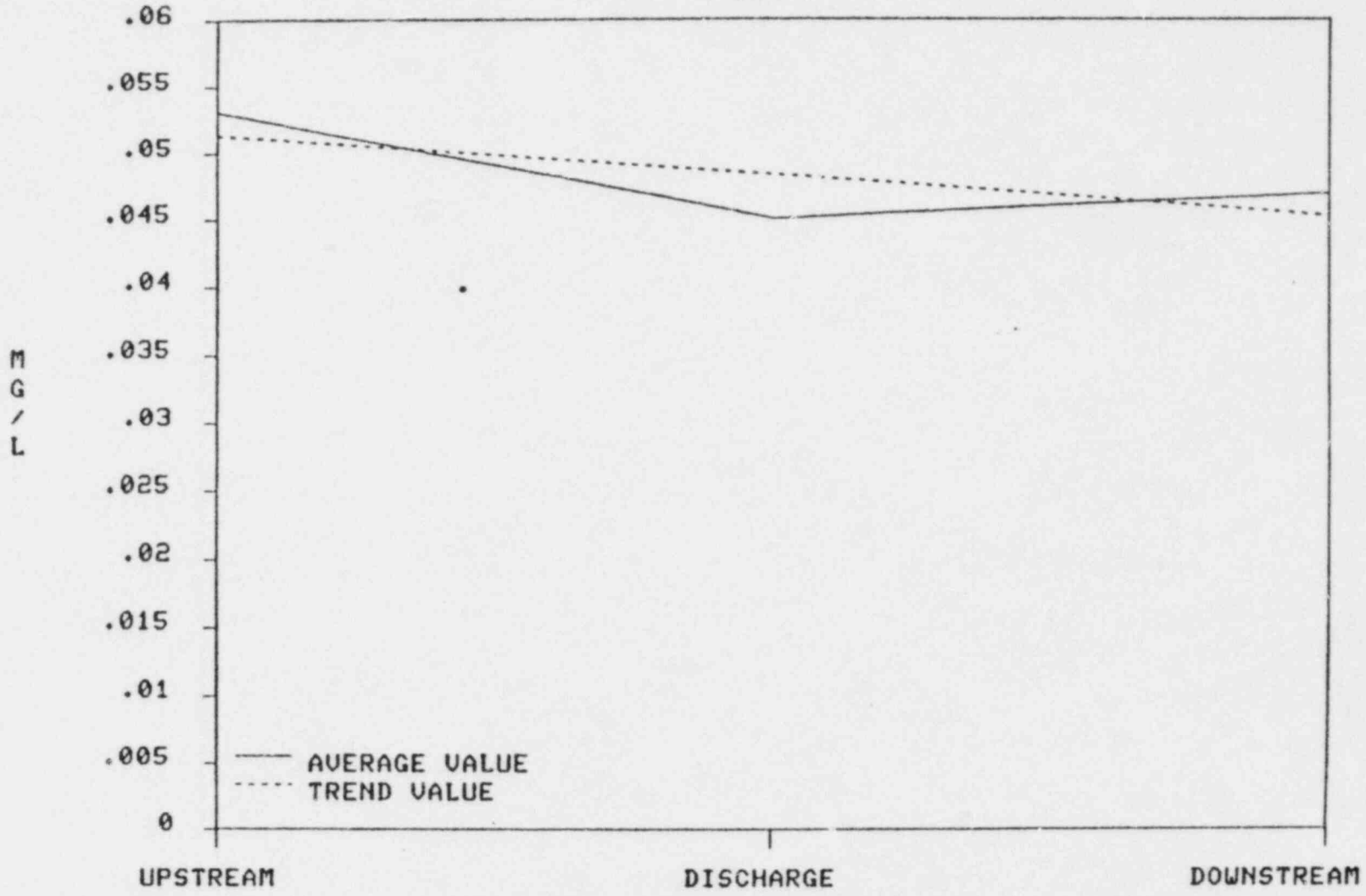
F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
TOTAL PHOSPHORUS

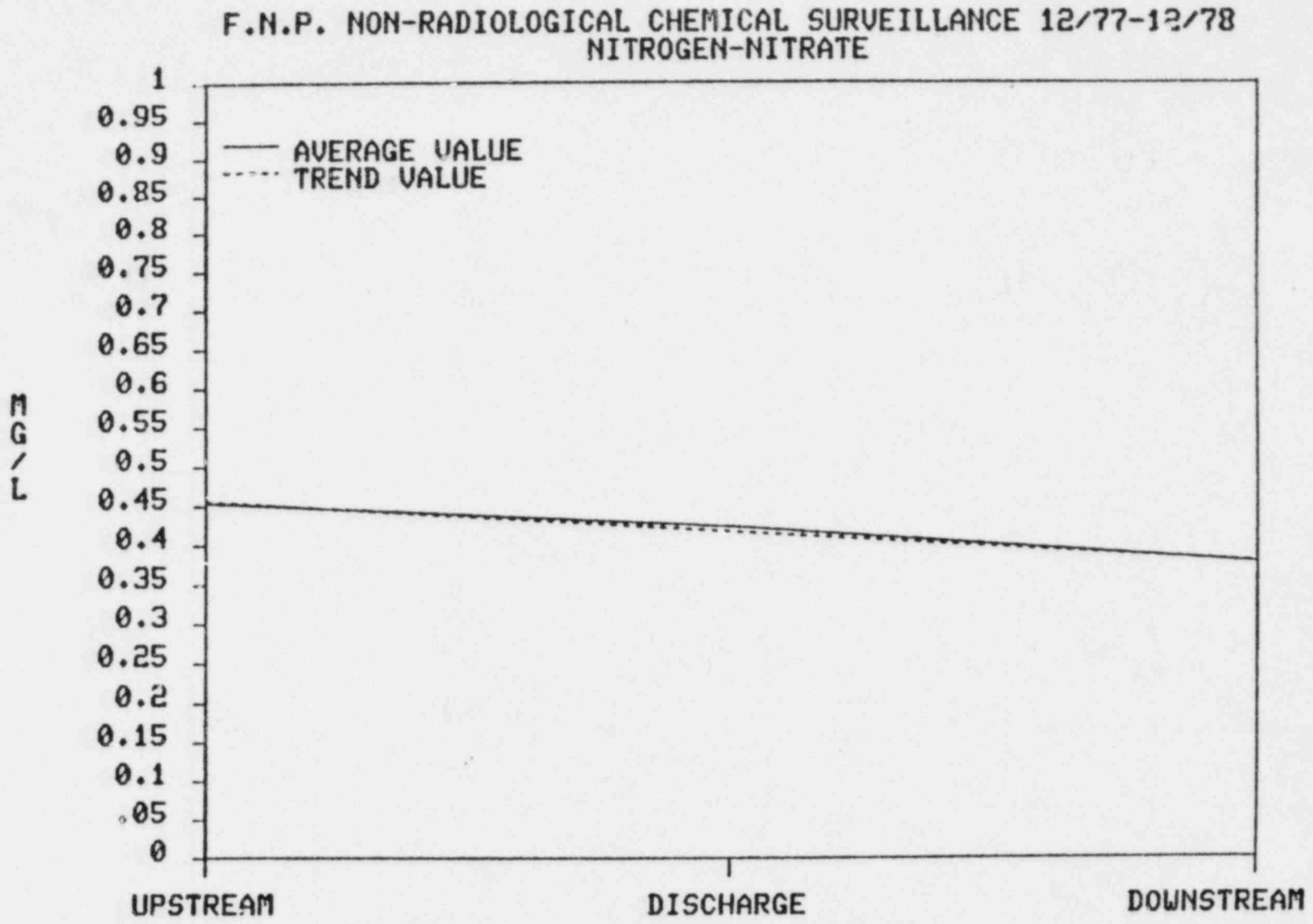



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
SULFATE
AVERAGE VALUE
TREND VALUE
MG/L
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
UPSTREAM
DISCHARGE
DOWNSTREAM

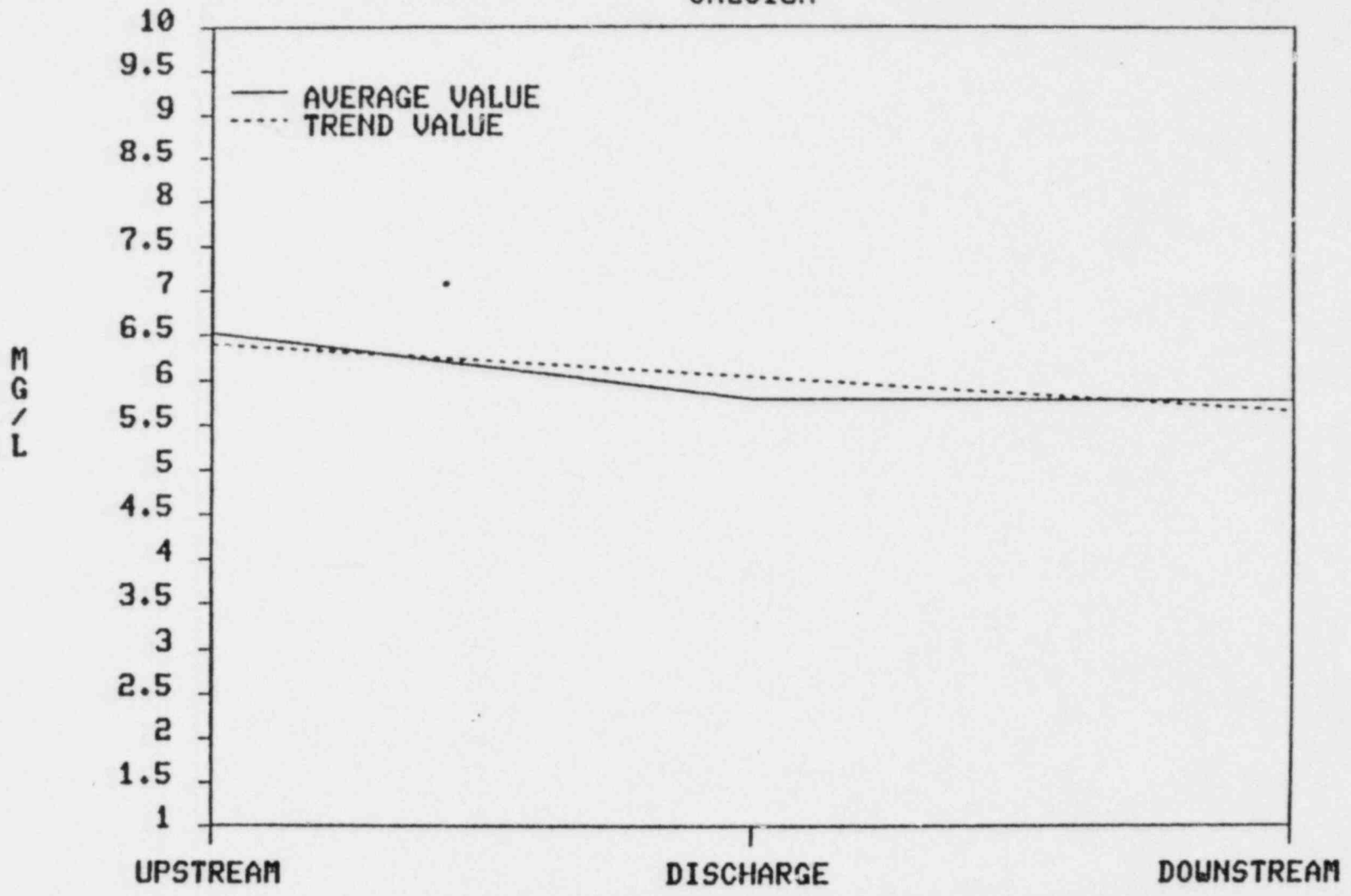
F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78

AMMONIA

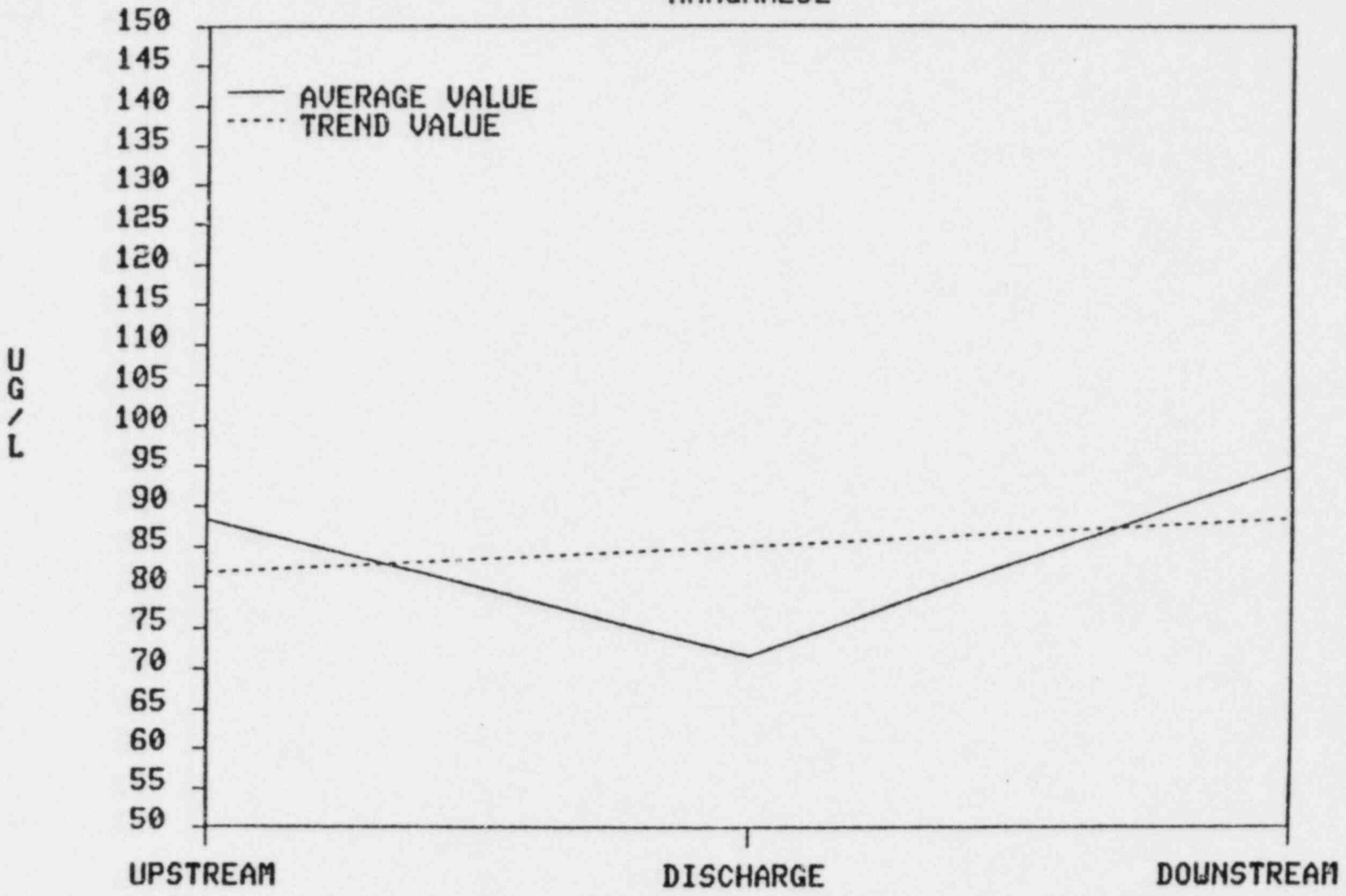



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
NITROGEN-NITRATE
AVERAGE VALUE
TREND VALUE
MG/L
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
.05
0
UPSTREAM
DISCHARGE
DOWNSTREAM

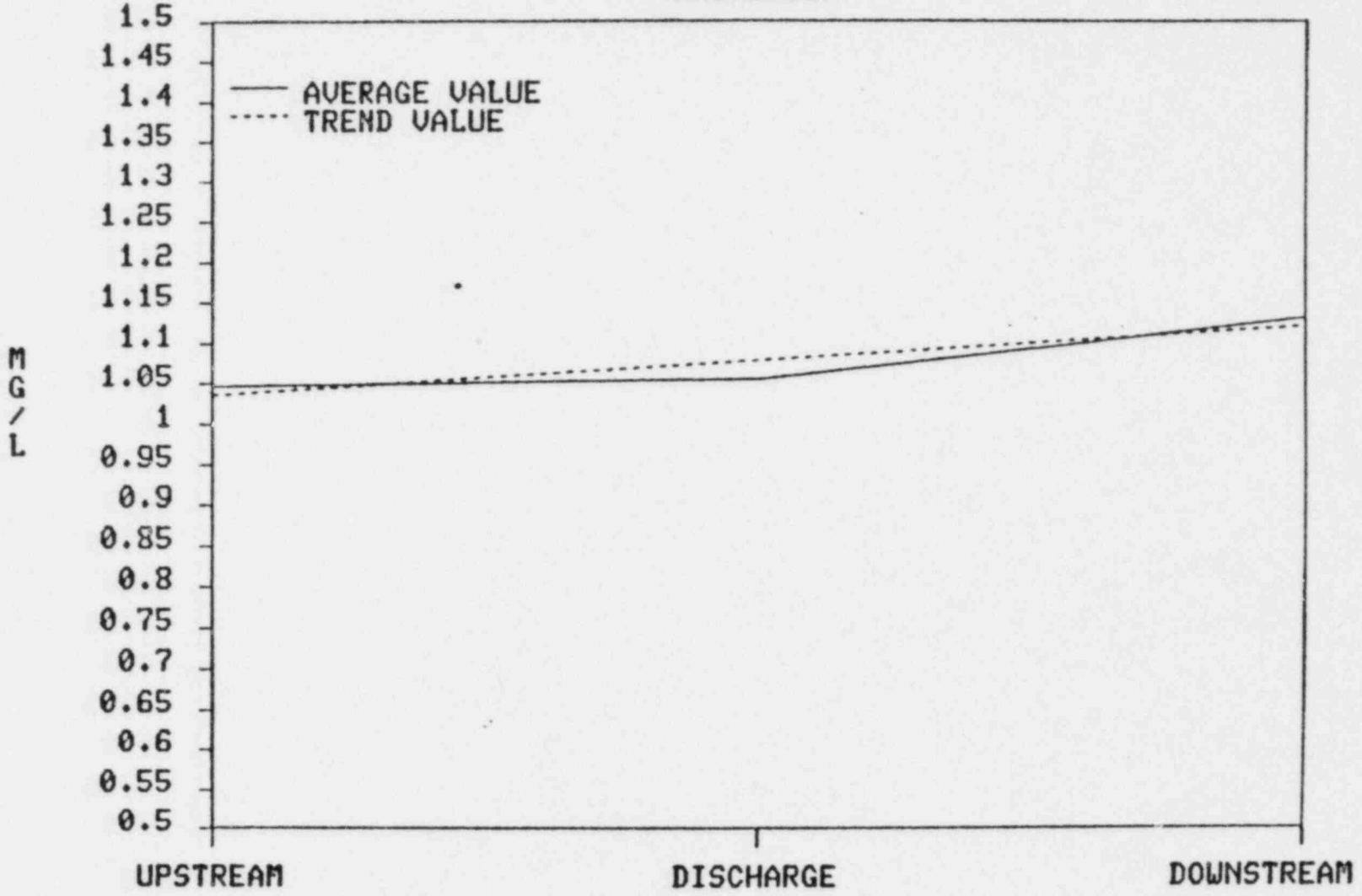
F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
CALCIUM



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
MANGANESE

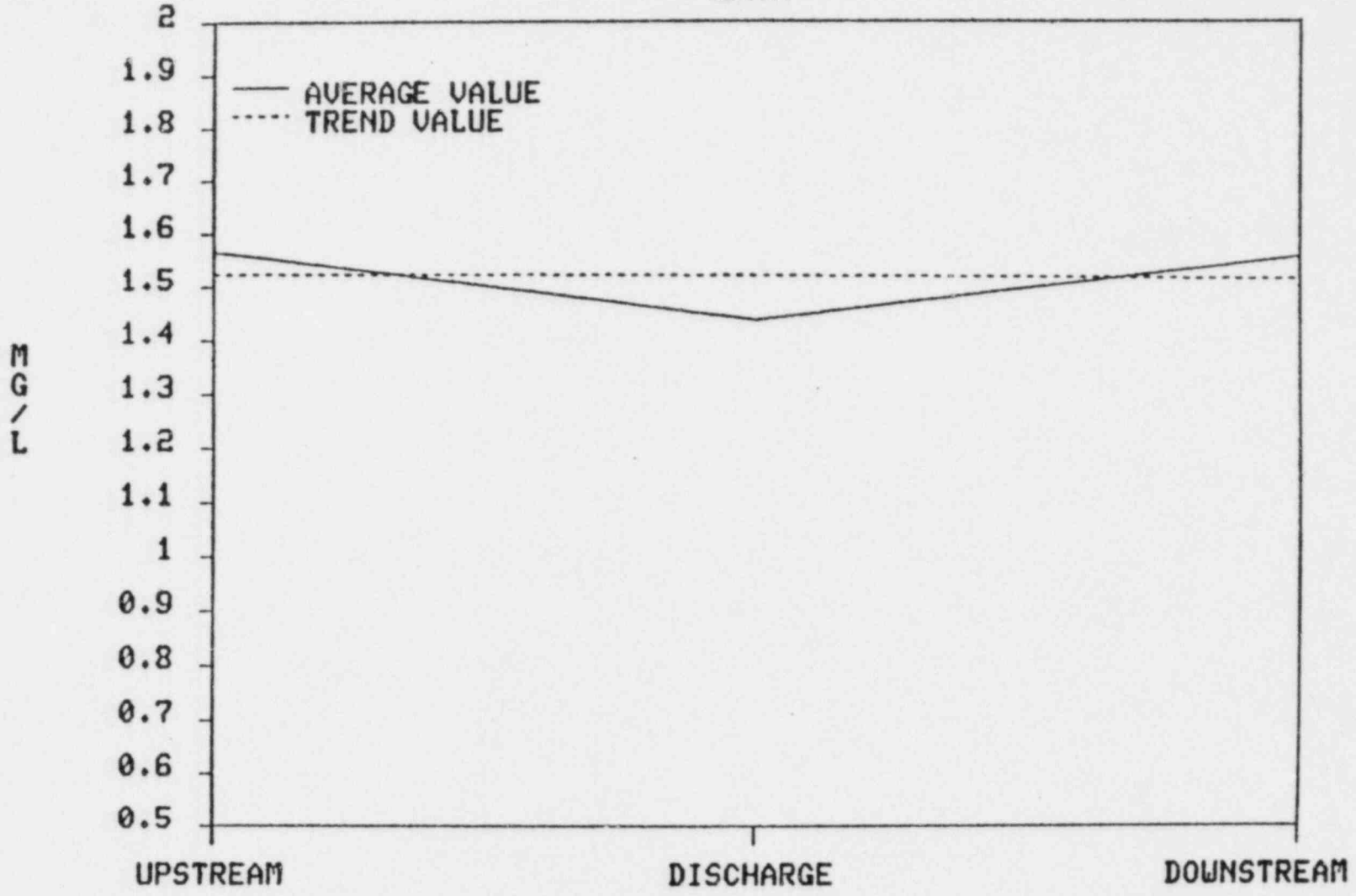


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
MAGNESIUM

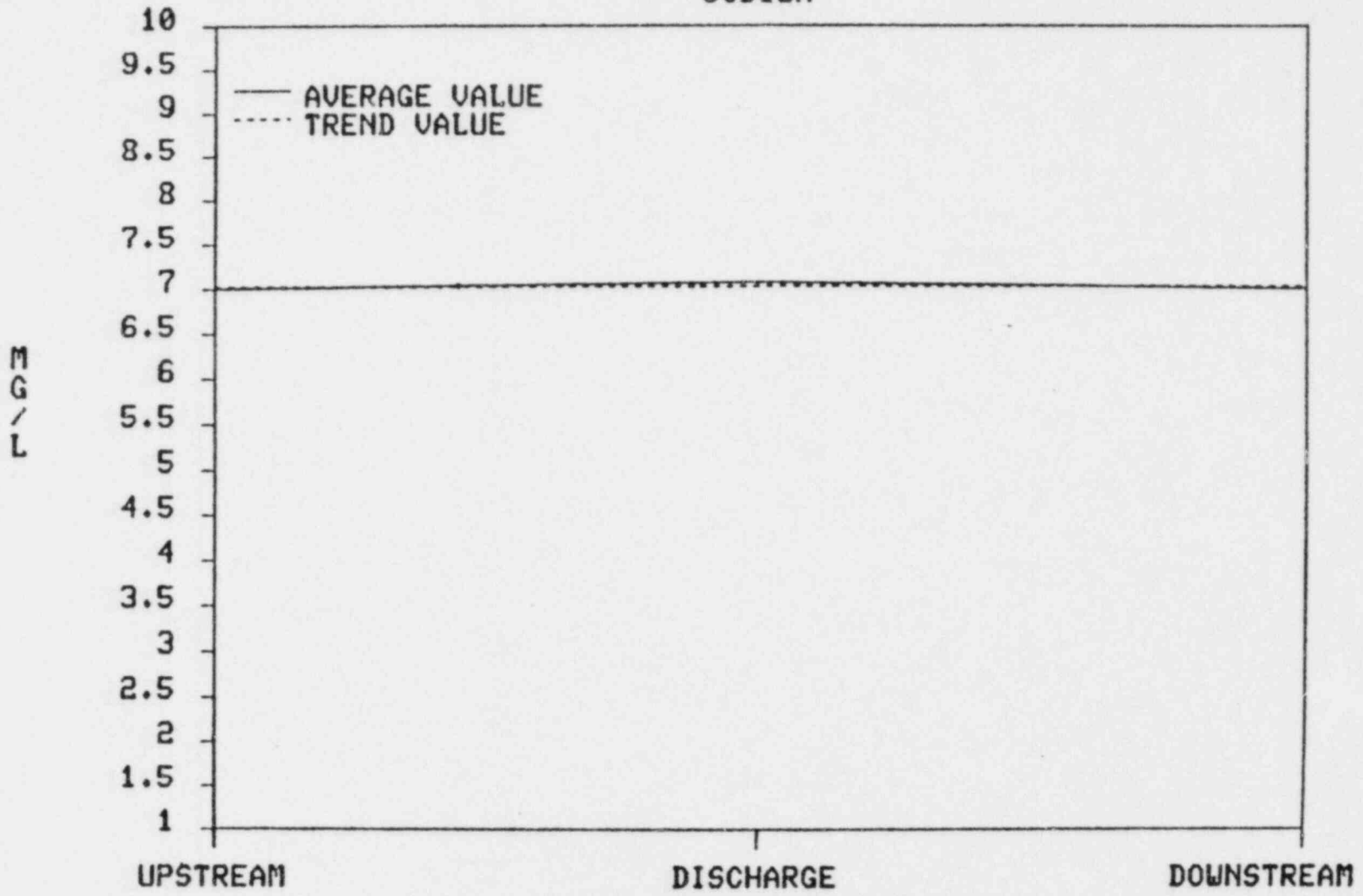


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78

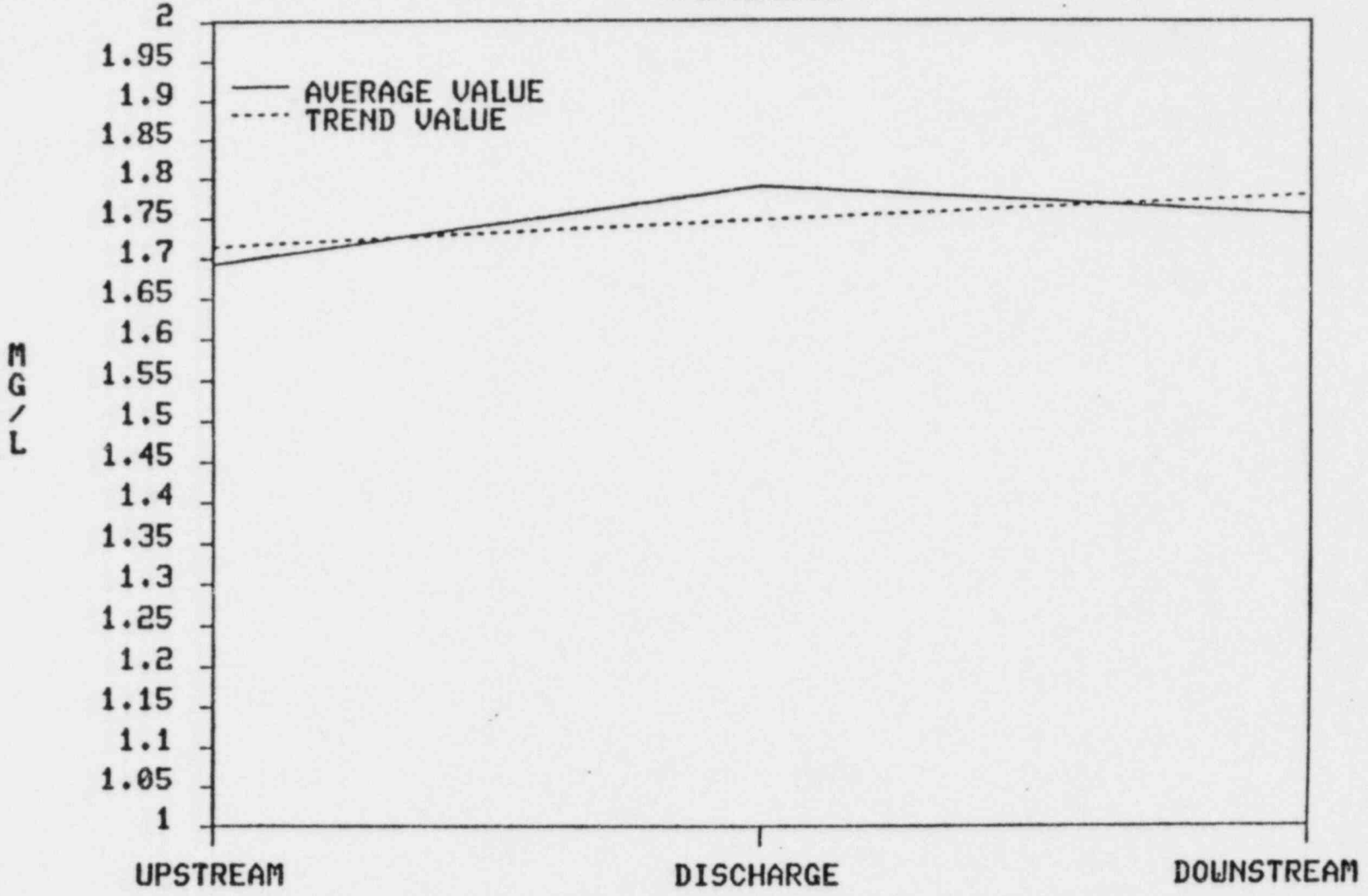
IRON



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
SODIUM

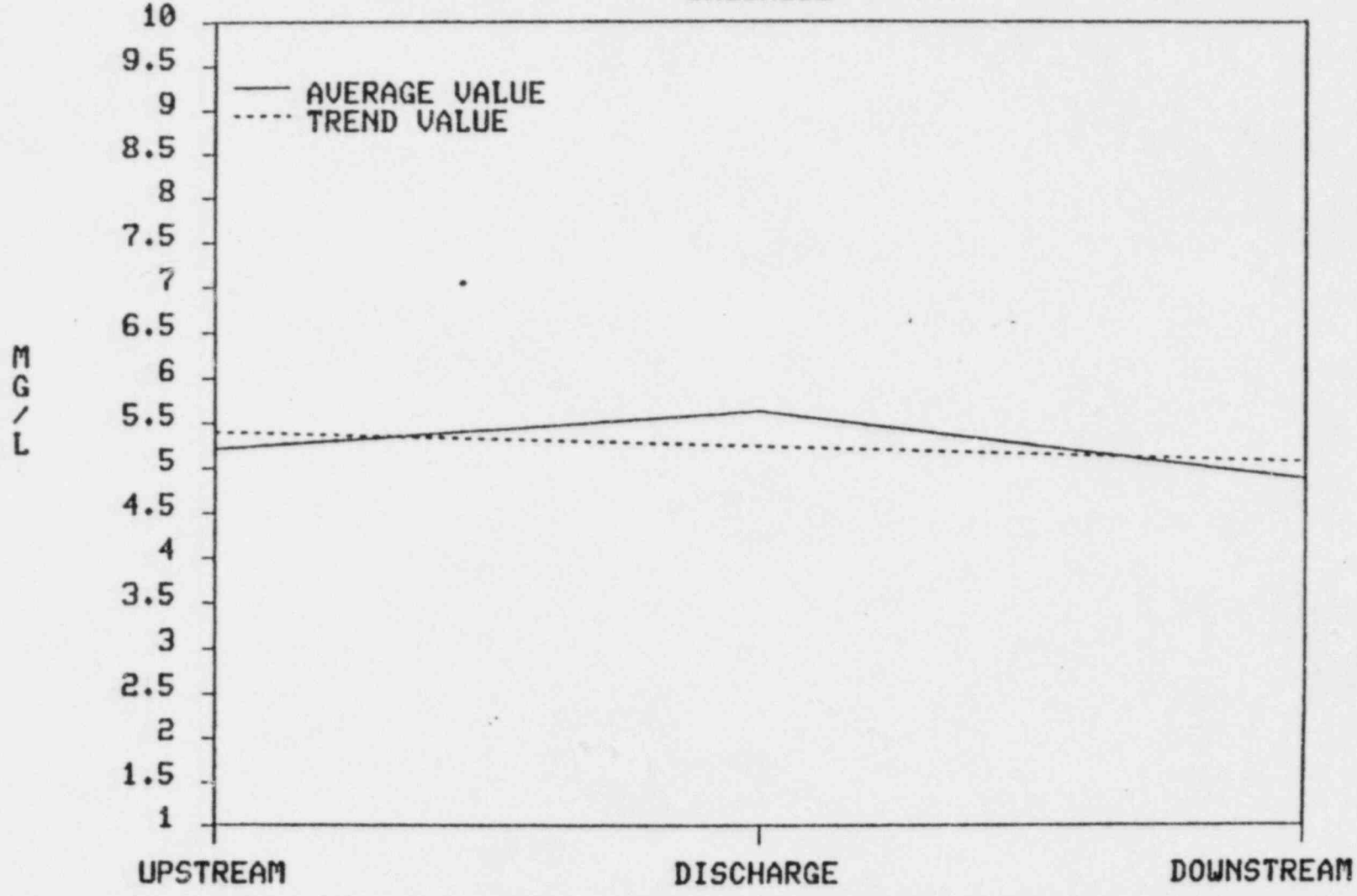


F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
POTASSIUM



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78

CHLORIDE



F.N.P. NON-RADIOLOGICAL CHEMICAL SURVEILLANCE 12/77-12/78
SILICA