

APPENDIX 13

SAMPLE STATION 13

SUBSURFACE MONITORING ZONE - 72' FT.

BIG BERTHA ARTESIAN WELL

PA STATE GAME LANDS #95

PROJECT SL-110-7-101.5

MONITORING POINT 13

The discussion of this monitoring point will be divided into four (4) phases as outlined below:

1. General Conditions
2. Pre Closure Analysis
3. Post Closure Analysis
4. Summary of Analysis

I. General Conditions

The data and associated graphical materials relevant to and utilized in describing the relationships at this monitoring location are outlined below:

- Sheer 7 - Relationship of Geophysical Parameters
 - Sheet 8 - Geologic Cross Sections
 - Sheet 26 - Relationship of Hydrologic Parameters
 - Appendix 13 - Subsurface Monitoring Zone
- Narrative exhibits contained on the following pages.

This monitoring point is 72 ' below the surface of the artesian well (Big Bertha), as shown on Sheets 7 and 8. The flow relationships of the artesian well at this monitoring zone are given below:

- a. Velocity - the average velocity of water at this monitoring zone was 6.66 ft/min upward.
- b. Cumulative Quantity - the cumulative quantity of water contributed by this flow system was 17.4 gal/min
- c. Flow System Quantity - the average quantity of water contributed by this flow system was 6.8 gal/min. (.015 c.f.s.)

This monitoring point is representative of conditions in flow system B3. This sample zone represents conditions at the top of this flow system and indicates mixed waters just prior to entering the casing to discharge to the surface.

2. Pre Closure Analysis (monitoring Point 13)

The reviewer is directed to refer to the following materials during the discussion of the chemical analyses and trends at this monitoring point:

- a. Sheet 26 - which shows the sample data plotted using a time reference basis.
- b. The corresponding graphs (on the 6 pages immediately following the pre closure analysis) which show the data, the regression mean line, and the field of variance.
- c. Appendix 13 - which contains the raw sample data during pre closure which was utilized to develop the means, ranges, and regression analysis results.

1. p.H Relationship

The pH at this monitoring point varied from 5.63 - 5.99 the mean value being 5.83. A moderate relationship exists.

2. Specific Conductance Relationship

The specific conductance at this monitoring point varied from 1400-1600; the mean value calculated as 1472.

3. Acidity/Alkalinity Balance (rng/l)

The alkalinity varied from 25 - 51; the mean value was 40. Regression analysis of the alkalinity values showed: An extremely weak relationship exists where alkalinity concentration decreases as conductance increases. The acidity varied from 222 - 290; the mean value was 247 Regression analysis of the sulphate values showed: A moderate relationship exists where acidity concentration increases as conductance increases.

4. Sulphate Relationship (mg/l)

The sulphates varied from 607 - 1084 ; the mean value was 975. Regression analysis of the sulphate values showed: An extremely weak relationship exists where sulphates concentration decreases as conductance increases.

5. Total Iron Relationship (mg/l)

The total iron varied from 110 - 160 ; the mean value was 146. Regression analysis of the ferrous iron values showed: A weak relationship exists where total iron concentration decreases as conductance increases.

6. Ferrous Iron Relationship (mg/l)

The ferrous iron varied from 104 - 156 ; the mean value was 139 Regression analysis of the ferrous iron values showed: An extremely weak relationship exists where ferrous iron concentration decreases as conductance increases.

7. Ferric Iron Relationship (mg/l)

The ferric iron varied from 3 – 13 ; the mean value was 7 Regression analysis of the ferric iron values showed: An extremely weak relationship exists where ferrous iron concentration decreases as conductance increases.

3. Post Closure Analysis

The reviewer is referred to sheet 26 which shows the post-closure data plotted using a time reference basis with pre-closure data for comparative purposes. Closure caused a significant increase in specific conductance; which recovered to values similar to pre closure levels after the well was opened.

pH was slightly depressed as a result of closure, and remained slightly depressed.

Alkalinity was present prior to closure at very low concentrations in this zone and closure caused a significant reduction to nearly non alkaline conditions. Acidity was present in moderate concentrations prior to closure. This is perceived as storage effects accruing during closure.

A slight increase in sulphates occurred during closure, but returned rapidly to pre closure levels.

A slight increase in total iron concentration occurred during closure, with values returning rapidly to pre closure levels after the well was opened.

A slight increase in ferrous iron concentration occurred during closure. with values returning rapidly to pre closure levels after the well was opened.

Ferric iron levels increased slightly during closure but quickly returned to pre closure levels.

4. Summary of Monitoring Point 13 Analysis

Closure allowed a free mixing of the flow systems between the lower zones and the upper zones (with higher permeability's, higher recharge capacities and poorer quality). The upper zones dominated the lower zones and caused a depression in the water quality of the lower zones.

Closure caused only a slight modification of the characteristics of this flow system. These were perceived to be storage related. The reason for the similarity between pre and post closure values is because this flow system dominated the hydrologic interactions during closure.

SAMPLE 13

PROJECT SL110-7-101.5:RIG BERTHA

DATE	SPEC COND URHRS/CH	DISCHARGE C.F.S.	PH SU	ALKALINITY MG/L	ACIDITY MG/L	SULPHATES MG/L	TOTAL IRON MG/L	FERROUS IRON MG/L	FERRIC IRON MG/L	REC #
021783	1500	.04	5.72	38	242	981	142.0	137.0	5.0	1
022883	1500	.04	5.83	51	232	1013	110.0	104.0	6.0	2
030783	1400	.04	5.88	45	222	1079	136.0	132.0	4.0	3
031483	1600	.04	5.83	41	290	984	150.0	147.0	3.0	4
033183	1500	.04	5.63	25	233	992	148.0	138.0	10.0	5
040783	1450	.04	5.85	47	255	1084	154.0	141.0	13.0	6
041383	1450	.04	5.91	43	258	982	158.0	152.0	6.0	7
042083	1450	.04	5.83	26	234	607	160.0	147.0	13.0	8
042683	1400	.04	5.99	44	255	11051	160.0	156.0	4.0	9

SAMPLE .THIRTEEN

SPECIFIC CONDUCTANCE VS. PH

COEFFICIENT MATRIX AND AUGMENTED MATRIX

1325 1325 52.4700
1953750 77221.5000
REGRESSION COEFFICIENTS OF NORMAL EQUATION
7.082727272727
0.000850909091

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1500.0000	5.7200	5.8064	0.0864
1500.0000	5.8300	5.8064	0.0236
1400.0000	5.8800	5.8915	0.0115
1600.0000	5.8300	5.7213	0.1087
1500.0000	5.6300	5.8064	0.1764
1450.0000	5.8500	5.8489	0.0011
1450.0000	5.9100	5.8489	0.0611
1450.0000	5.8300	5.8489	0.0189
1400.0000	5.9900	5.8915	0.0985

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1

NUMBER OF X - Y PAIRS= 9

TOTAL SUMS OF SQUARE= .087

SUMS OF SQUARES DUE TO REGRESSION= .022124

SUMS OF SQUARES DUE TO DEVIATION= .064876

GOODNESS OF FIT= .254295

MULTIPLE CORRELATION COEFFICIENT

0.50428

STANDARD DEVIATION .090053

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	.02	1	.02
DEVIATION	.06	7	.01
TOTAL VARIATION	.09	8	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE

F TEST - SIGNIFICANCE OF REGRESSION =

2.39

LEVEL .05% - CRITICAL VALUE = 5.59

SAMPLE THIRTEEN

SPECIFIC CONDUCTANCE VS. ALKALINITY

COEFFICIENT MATRIX AND AUGMENTED MATRIX

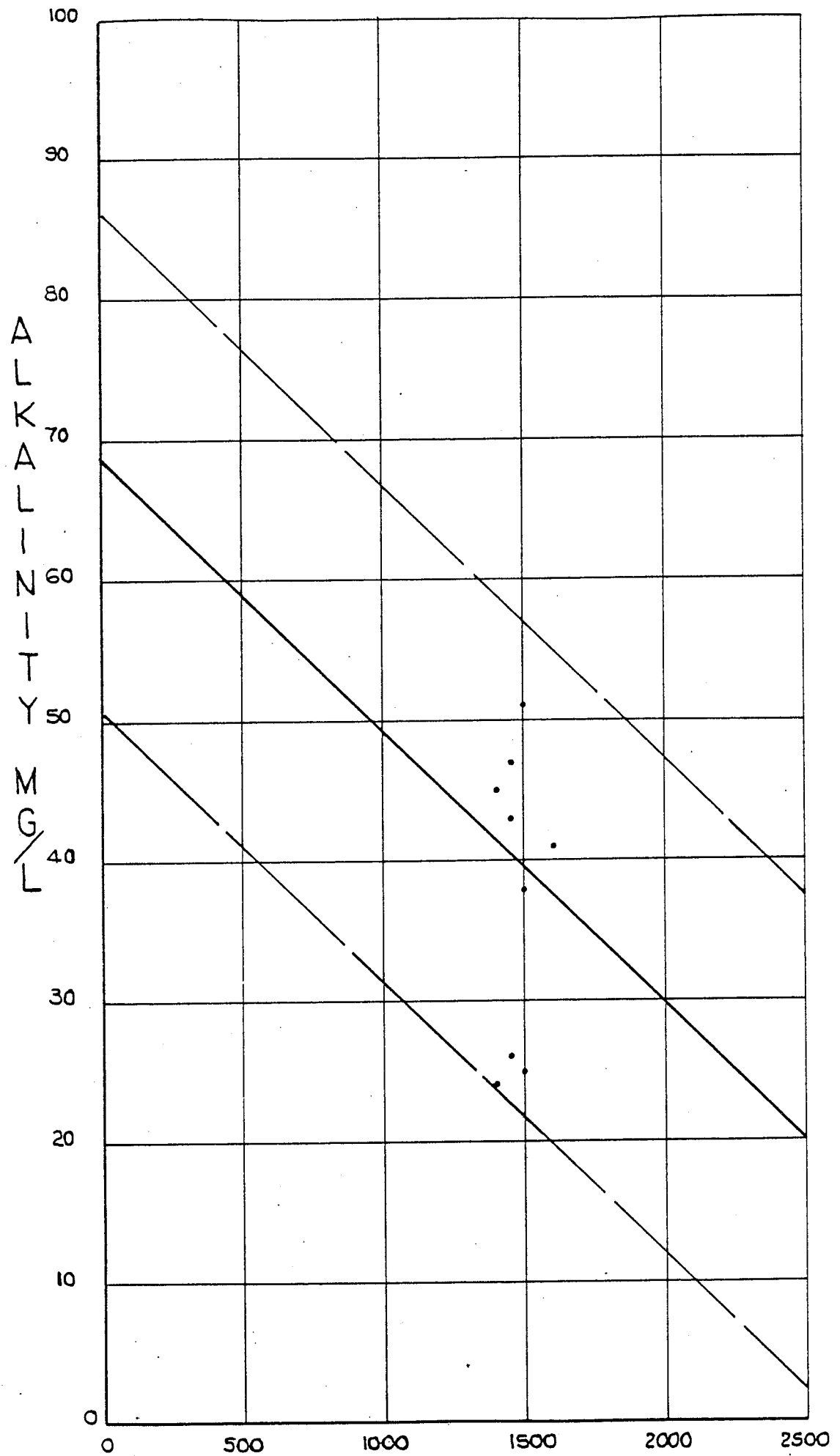
	1325	1325	360.0000
		1953750	529400.0000
REGRESSION COEFFICIENTS OF NORMAL EQUATION	68.909090909087		
	0.019636363636		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1500.0000	38.0000	39.4545	1.4545
1500.0000	51.0000	39.4545	11.5455
1400.0000	45.0000	41.4182	3.5818
1600.0000	41.0000	37.4909	3.5091
1500.0000	25.0000	39.4545	14.4545
1450.0000	47.0000	40.4364	-6.5636
1450.0000	43.0000	40.4364	2.5636
1450.0000	26.0000	40.4364	14.4364
1400.0000	44.0000	41.4182	2.5818

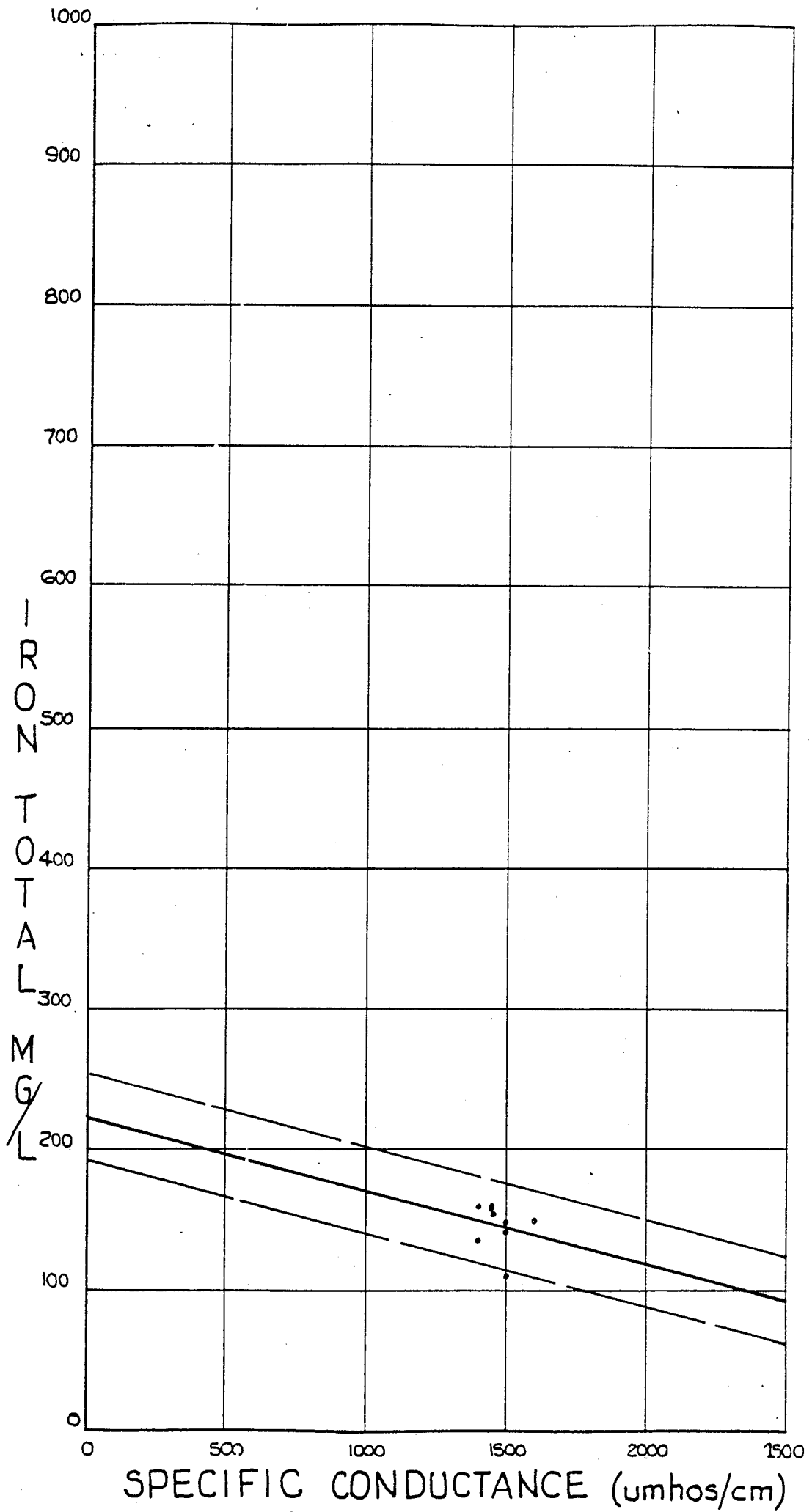
STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
 NUMBER OF X - Y PAIRS= 9
 TOTAL SUMS OF SQUARE= 646
 SUMS OF SQUARES DUE TO REGRESSION= 11.781818
 SUMS OF SQUARES DUE TO DEVIATION= 634.218182
 GOODNESS OF FIT= .018238
 MULTIPLE CORRELATION COEFFICIENT 0.13505
 STANDARD DEVIATION 8.903779

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	11.78	1	11.78
DEVIATION	634.22	7	90.60
TOTAL VARIATION	646.00	8	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
 F TEST - SIGNIFICANCE OF REGRESSION = 0.13
 LEVEL .05% - CRITICAL VALUE = 5.59



RIG BERTHA - SAMPLE ZONE 13



SAMPLE THIRTEEN

SPECIFIC CONDUCTANCE VS. FERROUS IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

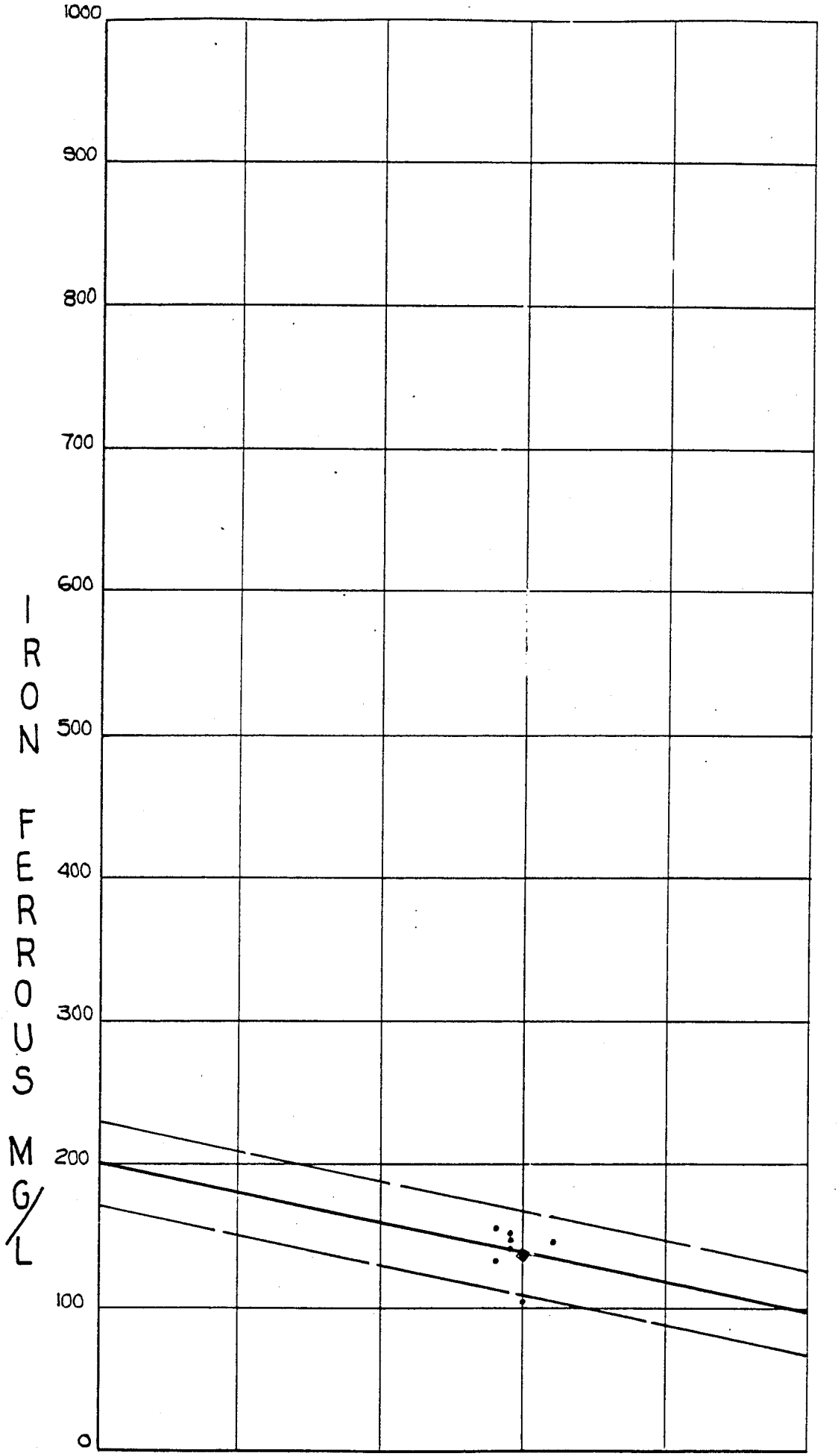
REGRESSION COEFFICIENTS OF NORMAL EQUATION
1325 1325 1254.0000
1953750 1844900.0000
200.363636363621
0.041454545455

ORIGINAL X - Y PAIRS	PREDICTED VALUES	DEVIATION
1500.0000 137.0000	138.1818	1.1818
1500.0000 104.0000	138.1818	34.1818
1400.0000 132.0000	142.3273	10.3273
1600.0000 147.0000	134.0364	12.9636
1500.0000 138.0000	138.1818	0.1818
1450.0000 141.0000	140.2545	-0.7455
1450.0000 152.0000	140.2545	11.7455
1450.0000 147.0000	140.2545	6.7455
1400.0000 156.0000	142.3273	13.6727

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 9
TOTAL SUMS OF SQUARE= 1868
SUMS OF SQUARES DUE TO REGRESSION= 52.509091
SUMS OF SQUARES DUE TO DEVIATION= 1815.490909
GOODNESS OF FIT= .02811
MULTIPLE CORRELATION COEFFICIENT 0.16766
STANDARD DEVIATION 15.064407

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	52.51	1	52.51
DEVIATION	1815.49	7	259.36
TOTAL VARIATION	1868.00	8	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 0.20
LEVEL .05% - CRITICAL VALUE = 5.59



SPECIFIC CONDUCTANCE (umhos/cm)

RIG BERTHA - SAMPLE ZONE 13

SAMPLE.THIRTEEN

SPECIFIC CONDUCTANCE VS. FERRIC IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

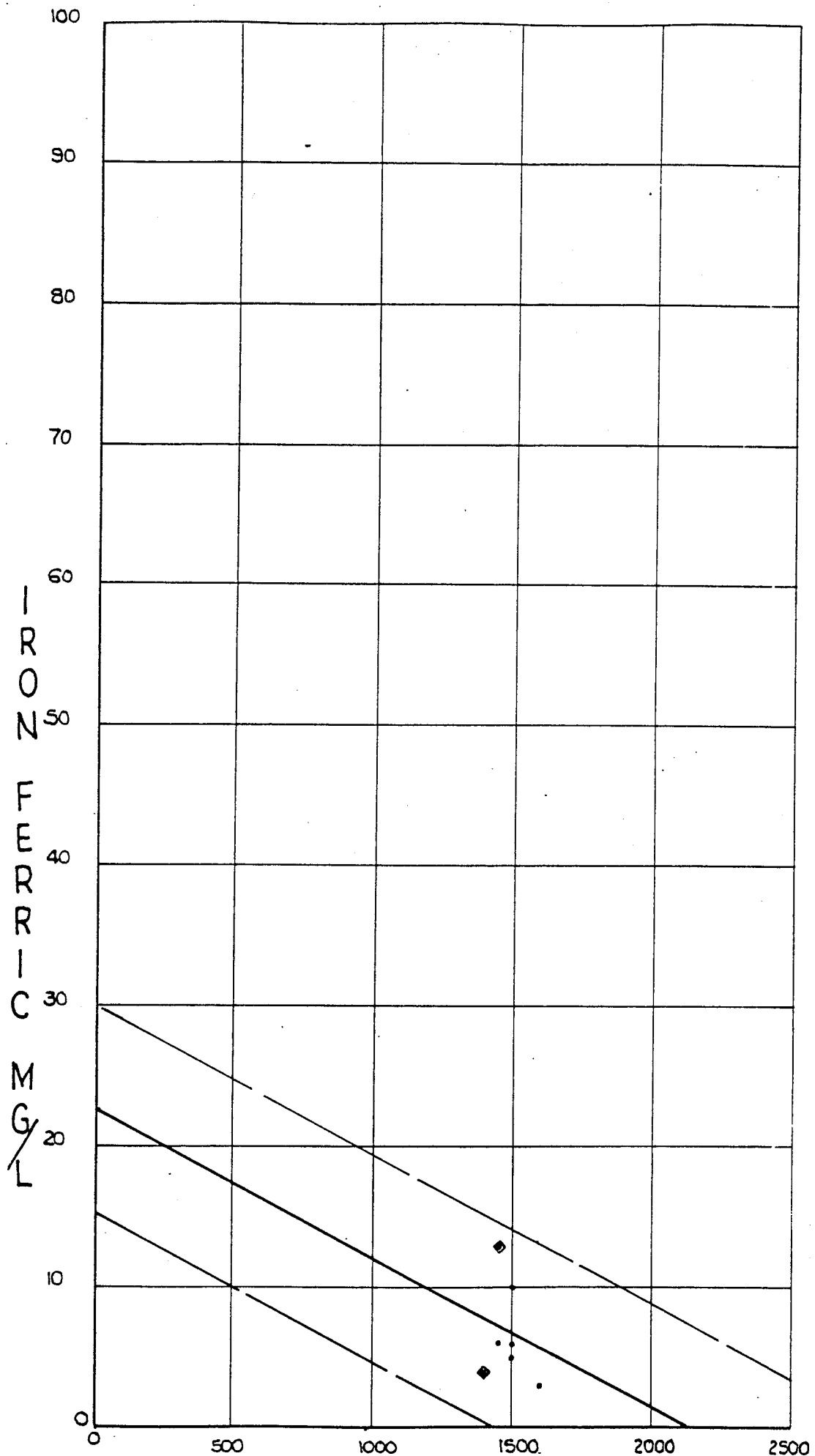
		1325	64.0000
	1325	1953750	93900.0000
REGRESSION COEFFICIENTS OF NORMAL EQUATION	22.636363636361		
-	0.010545454545		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1500.0000	5.0000	6.8182	1.8182
1500.0000	6.0000	6.8182	0.8182
1400.0000	4.0000	7.8727	3.8727
1600.0000	3.0000	5.7636	2.7636
1500.0000	10.0000	6.8182	3.1818
1450.0000	13.0000	7.3455	5.6545
1450.0000	6.0000	7.3455	1.3455
1450.0000	13.0000	7.3455	5.6545
1400.0000	4.0000	7.8727	3.8727

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
 NUMBER OF X - Y PAIRS= 9
 TOTAL SUMS OF SQUARE= 120.888889
 SUMS OF SQUARES DUE TO REGRESSION= 3.39798
 SUMS OF SQUARES DUE TO DEVIATION= 117.490909
 GOODNESS OF FIT= .028108
 MULTIPLE CORRELATION COEFFICIENT 0.16766
 STANDARD DEVIATION 3.832279

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	3.40	1	3.40
DEVIATION	117.49	7	16.78
TOTAL VARIATION	120.89	8	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
 F TEST - SIGNIFICANCE OF REGRESSION = 0.20
 LEVEL .05% - CRITICAL VALUE = 5.59



SPECIFIC CONDUCTANCE (umhos/cm)

RIG. REPT. 114 - SAMPLE ZONE 12

POST CLOSURE DATA LISTING *

SAMPLE THIRTEEN

DATE	SPEC. COND.	DISCHARGE	pH	ALKALINITY	ACIDITY	SULPHATES	TOTAL IRON	FEROUS IRON	FERRIC IRON
6/12	1900	.039	5.62	18	315	1349	193	84	9
6/16	1700	.039	5.26	11	273	983	160	159	1
6/21	1600	.039	5.62	18	283	1145	165	162	3
6/29	1500	.039	5.29	10	272	992	152	138	14
7/10	1600	.039	5.71	27	275	609	171	167	4
7/26	1600	.039	5.23	8	293	710	172	158	14
8/6	1600	.039	5.33	9	279	945	168	164	4
8/21	1700	.039	5.70	18	304	1134	174	166	8

* Units are as follows:

- specific conductance - umhos/cm
- discharge - C.f.s.
- pH - standard units
- all others - mg/L