2D Field Permeability Tests

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LAW ENGINEERING TESTING COMPANY

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September 29, 1966

Duke Power Company
General Offices
422 South Church Street
P. O. Box 2178
Charlotte, North Carolina 28201

Attention: L. C. Dail, Principal Civil Engineer

Subject: Field Permeability Tests
(Well Permeameter Method)
Oconee Nuclear Station Site
Oconee County, South Carolina
Job Number 5071

Gentlemen:

As requested, Law Engineering Testing Company has made field permeability tests using the well permeameter method at four locations selected by Bechtel Corporation at the site of the proposed Oconee Nuclear Station. This report describes the procedure used for these tests and presents the results obtained.

TEST PROCEDURE

The tests were run according to the Bureau of Reclamation's Field Permeability Tests, Designation E-19. The immediate vicinity of each of the following exploratory borings were selected as the locations for the wells: NA-4, NA-11A, NA-13, and NA-15. Two eight-inch diameter holes were drilled at each location, to the refusal of the auger used. The NA-4 test wells were drilled with a 27-inch auger. Generally, the test wells were within a 20-foot distance of the exploratory borings. The logs for all auger borings are attached. Refer to Appendix 2A, Figure 2A-2, for location of all wells.

In general, it was found that a 10-inch hole resulted with the use of the 8-inch power auger due to wobbling. The 27-inch power auger holes were measured to be 30-inches in diameter. Wells were prepared with care in order to cause as little disturbance to the surrounding soil as possible. No water was encountered in any of the wells. After the wells were excavated, the sides and bottoms were lightly cleaned where necessary, and the loose soil was removed from the bottom.

After cleaning, all wells were backfilled with 3/8 inch to Number 4 size crushed stone and covered with plastic sheets until the time of testing. The equipment used for these permeability tests is shown in Figure I. Each 50-gallon drum was calibrated in increments of 1/16 of an inch change in water level which corresponds to 0.0142 cubic feet of water.

For each test the permeability equipment was set up as shown in Figure I. The crushed stone was removed to a depth of about 1 foot in the well from the ground surface and the Roberts' Type valve float bob was adjusted so that a water level would be maintained constant at about 6-inch depth. All depths from the ground surface were measured from a baseline string stretched across the hole at ground level. The drum was filled up with water and the test started. The water for the tests was pumped from a creek approximately 200 feet west of State Road 45. At the time of testing, the water in the drums was observed to be light brown in color but otherwise free of visible sediments or impurities. Water and ground temperatures were taken and recorded at varied time intervals. Readings of water level (to the nearest 1/16th inch) and time (to the nearest minute) were taken throughout each test. Plots of cumulative water volume versus time were prepared during each test. In general, the dry soil at the start of the test absorbed water at a comparatively high rate, but as the soil below the test became saturated, the rate decreased to a point where it was practically constant. When this occurred, as evidenced by the plotted points on the curve falling on practically a straight line for several hours, the test was discontinued. The slope of the straight line gave the rate of flow to be used in computations of coefficient of permeability, k. The curves for all tests are shown in Figures 2D-1 through 2D-5.

RESULTS

Table I gives the permeability values obtained for the five tests. The formalae used in the calculations of the k values are shown in Figure II. The T_u values were determined from the nearby exploratory borings that have piezometer casings. In calculating the flow values, Q, the initial straight line position of the curves were used in accordance with the recommendation of the Bureau of Reclamation.(1)

Well No. NA-4W1 did not meet the minimum radius to depth ratio of 10 due to shallow refusal level. Therefore, the results of this well should be viewed critically. Well No. NA-15W1 could not be filled with the valve opening of 1 inch available with the equipment. A curve was drawn and the permeability calculated for this well for information purposes. The water level was assumed to be at the top of the well to compute the permeability value for NA-15W1. Further testing of the well NA-15W1 was carried out by manually filling the hole by means of a five gallon can to keep a constant head. The head was kept constant on the well for varying time intervals to determine the flow value. The two values of k obtained for this well are shown in Table I. A new test was run at the same location on the alternate well NA15-W2 which gave a slightly lower k value.

The values for the coefficient of permeability obtained from these tests correspond to the values found in the laboratory. The soil in the area has a Unified Calssification of SM; however, it behaves like MH because of the mica content. The permeability values given in Table I are approximately equal to the values given by the Federal Housing Administration(2) for the above Unified Classification soil types.

Should you have any questions regarding this report, please do not hesitate to contact us.

Very truly yours,

LAW ENGINEERING TESTING COMPANY

Armagan Sanver, Soils Engineer
Special Consultation Department

Charles S. Hedges, Manager
Special Consultation Department

cc: Bechtel Corporation

REFERENCES

(1) United States Department of the Interior Bureau of Reclamation, "Earth Manual" First Edition-Revised, Denver, Colorado, 1963, p.560

(2) Federal Housing Administration, "Engineering Soil Classification for Residential Developments", Washington, D. C., August 1959, p.33.

TABLE I

WELL NO.	h (ft)	r (ft)	$\frac{h}{r}$	T_u (ft)	Q (ft^3/min)	T (°C)	WT Condition	k (ft/min)
NA-4W2	3.83	2.50	1.53*	27.0	0.0175	23.5	Low	3.9×10^{-5}
NA-11AW2	14.0	0.833	16.8	31.0	0.133	20.5	High	3.3×10^{-4}
NA-13W1	6.17	0.833	7.42+	27.0	0.0275	20.0	Low	2.0×10^{-4}
NA-15W1	14.0	0.833	16.8	30.3	0.240	20.5	High	6.1×10^{-4}**
NA-15W2	12.25	0.833	14.7	30.5	0.190	21.0	High	5.1×10^{-4}

* $\frac{h}{r} \ll 10$, not acceptable

\+ $\frac{h}{r} < 10$, possibly acceptable

** For manual incremental test, $k = 7.4 \times 10^{-4}$ ft/min

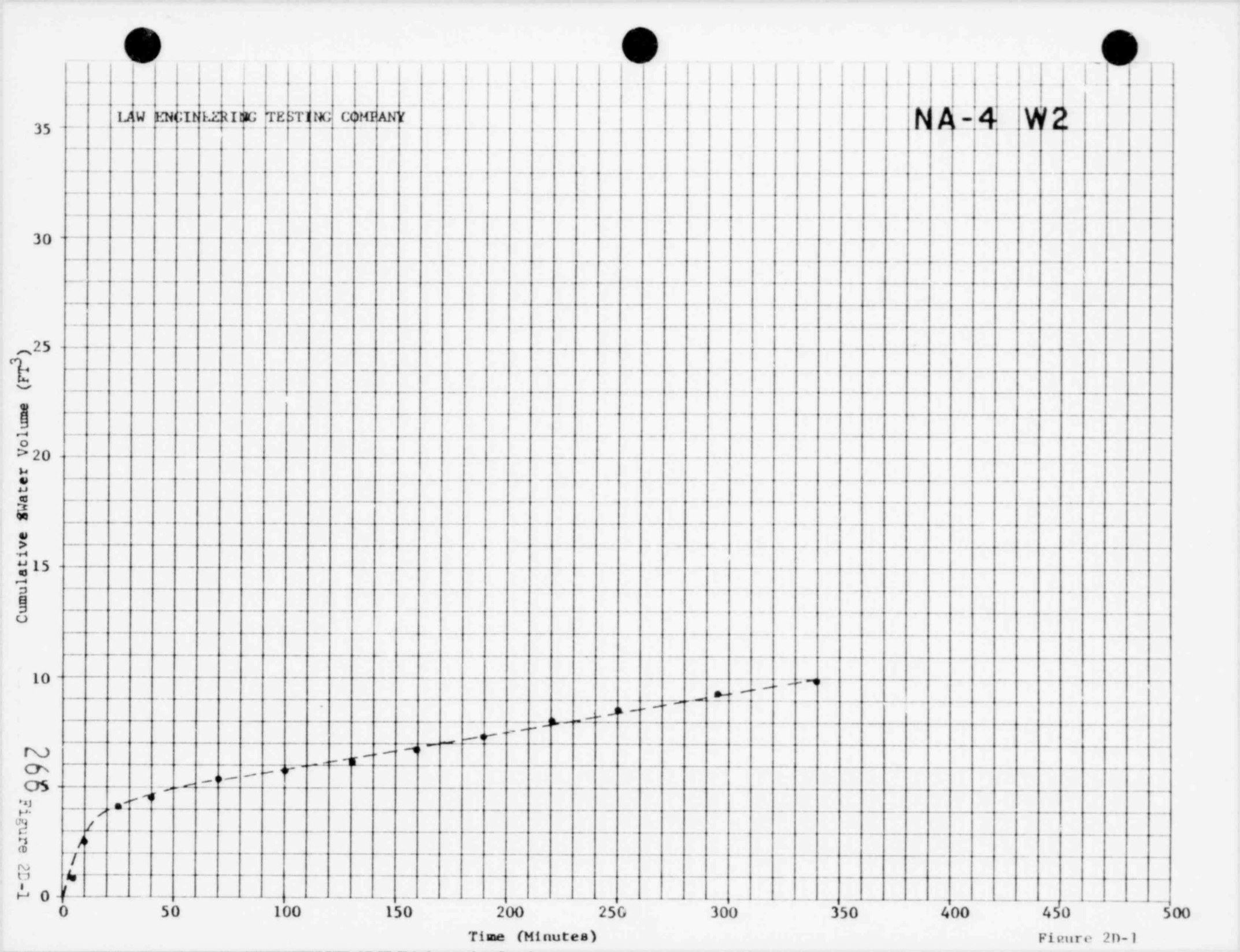

LAW ENGINEERING TESTING COMPANY
NA-4 W2
Cumulative Water Volume (FT^3)
0
5
10
15
20
25
30
35
0
50
100
150
200
250
300
350
400
450
500
Time (Minutes)

Figure 2D-1

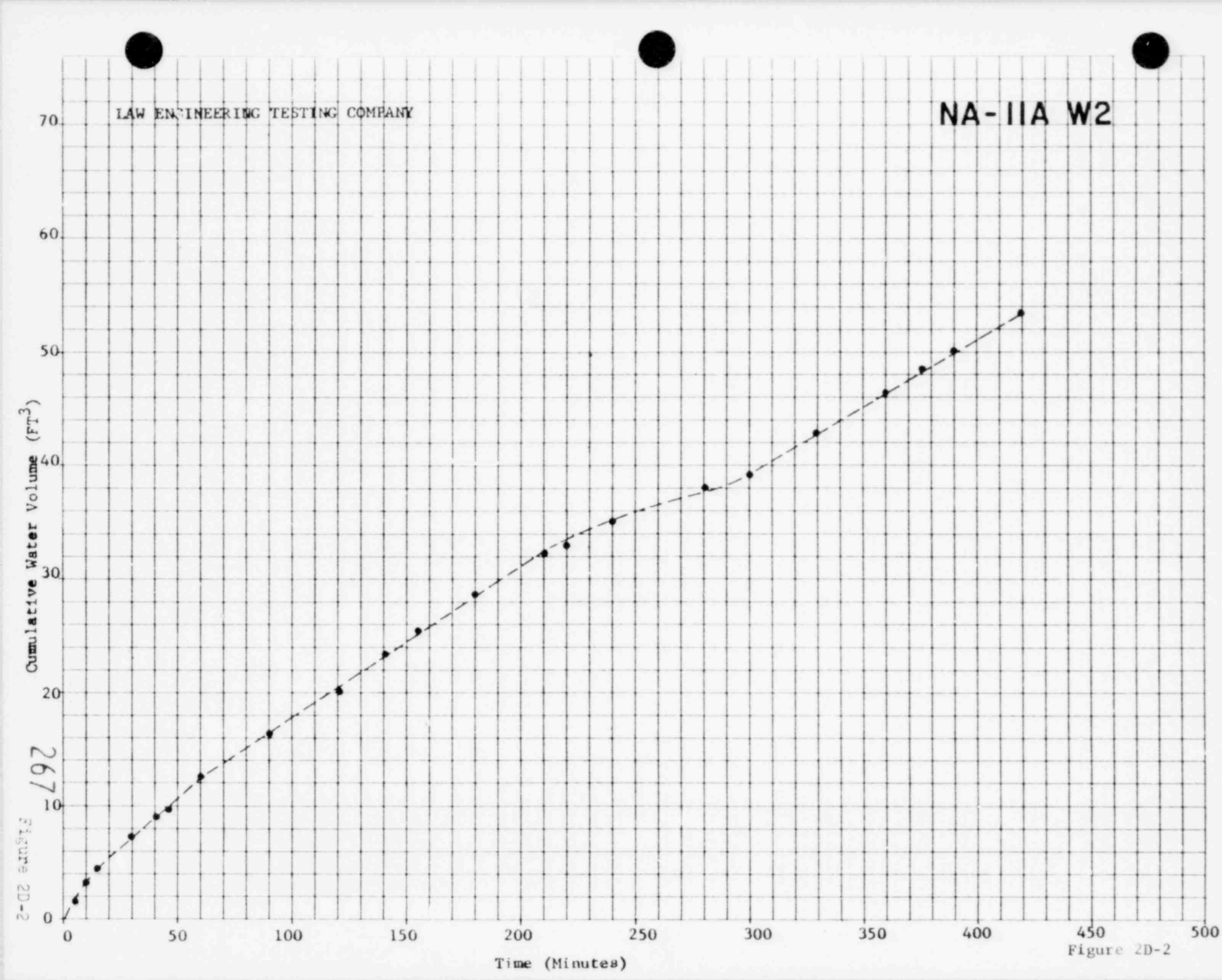

LAW ENGINEERING TESTING COMPANY
NA-IIA W2
Cumulative Water Volume (FT3)
0
10
20
30
40
50
60
70
0
50
100
150
200
250
300
350
400
450
500
Time (Minutes)

Figure 2D-2

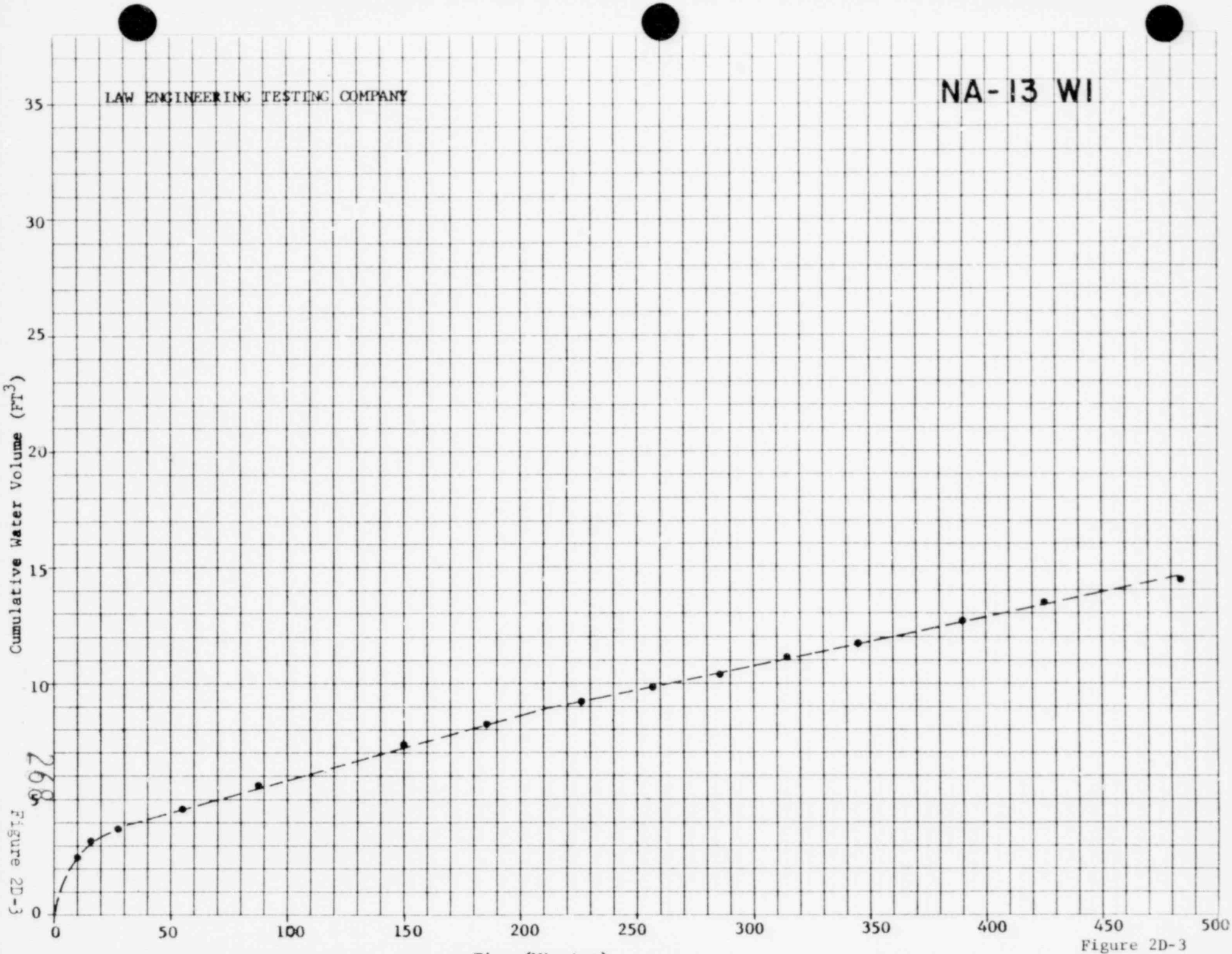

LAW ENGINEERING TESTING COMPANY
NA-13 WI
Cumulative Water Volume (FT^3)
0
5
10
15
20
25
30
35
0
50
100
150
200
250
300
350
400
450
500
Time (Minutes)

Figure 2D-3

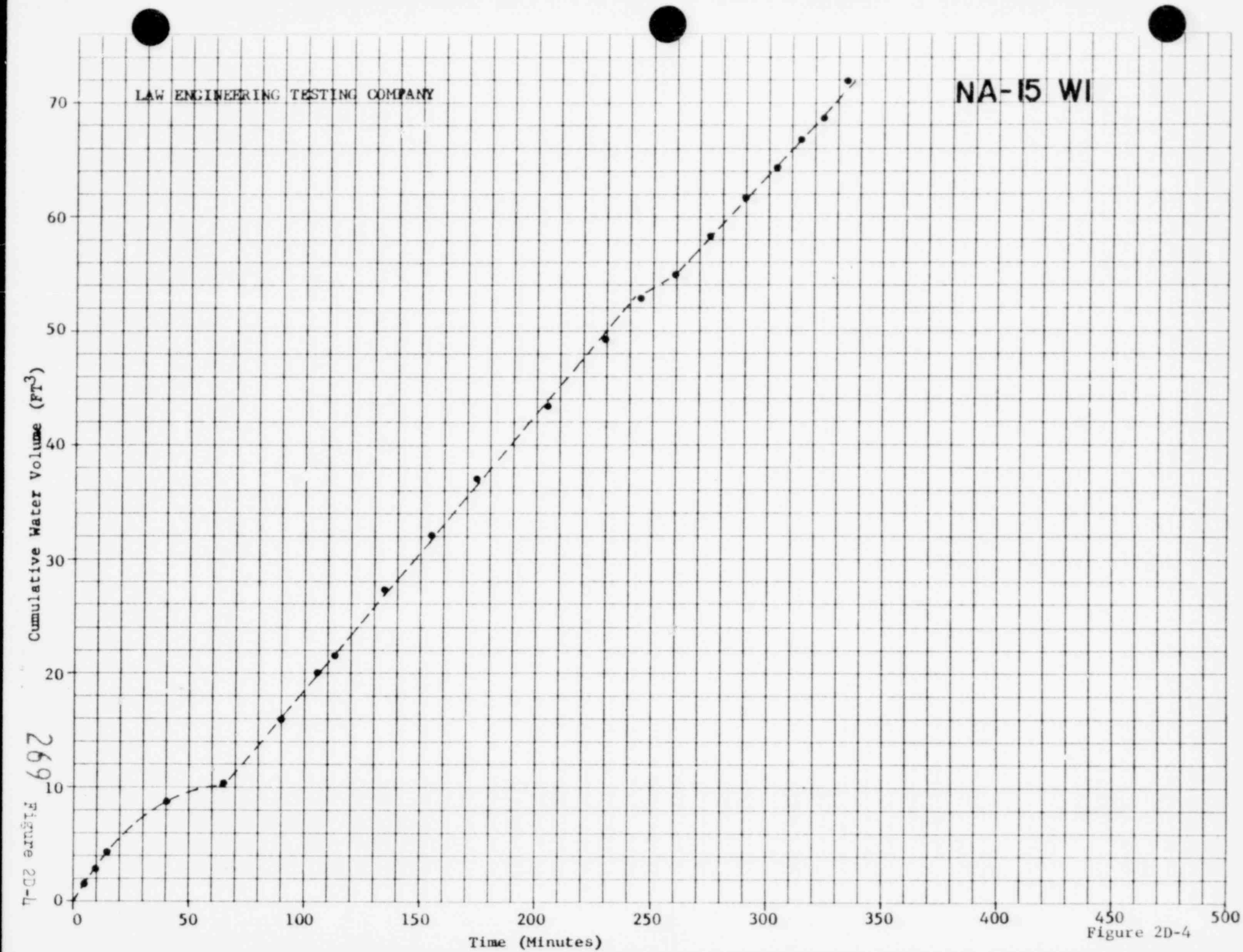


Figure 2D-4

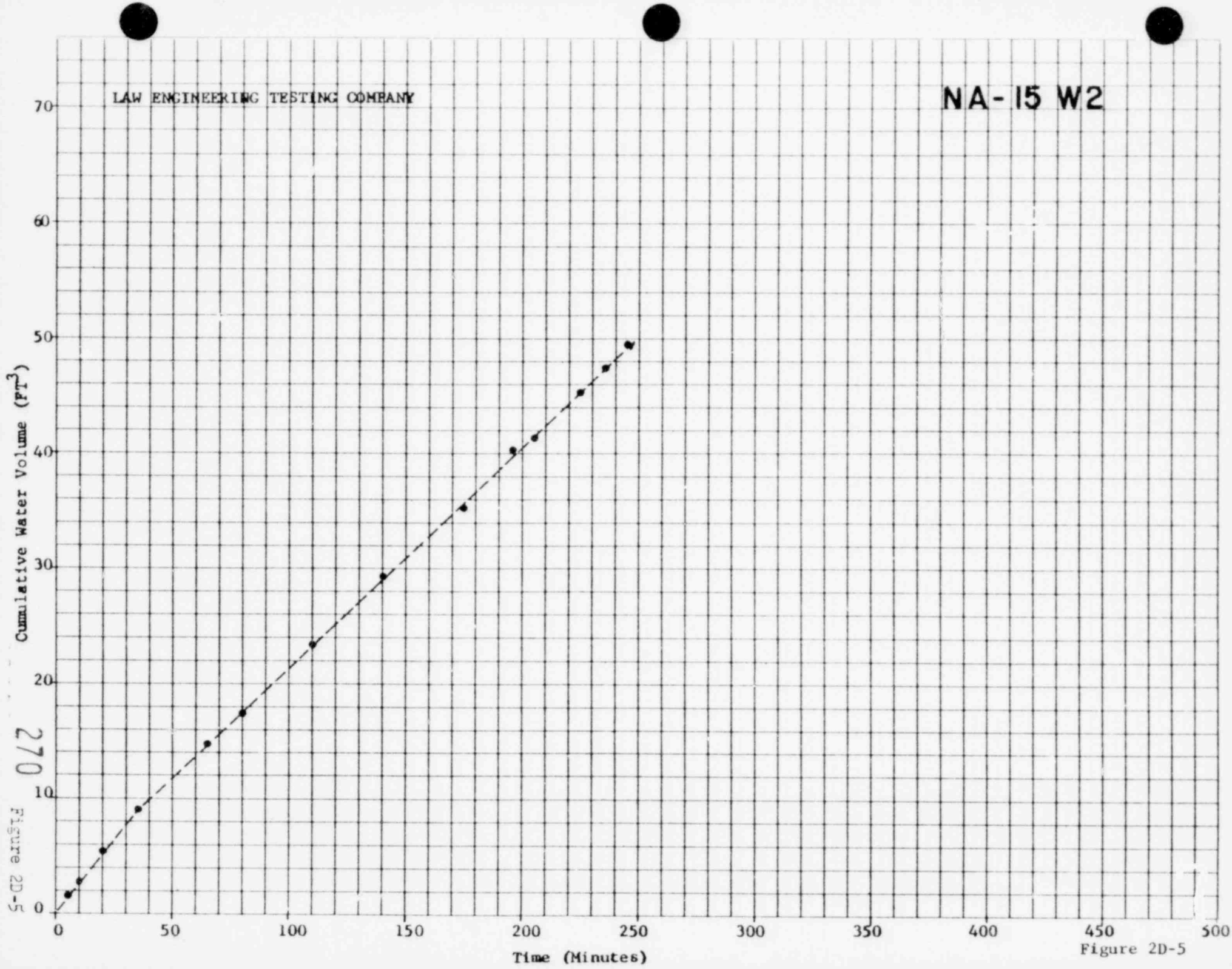
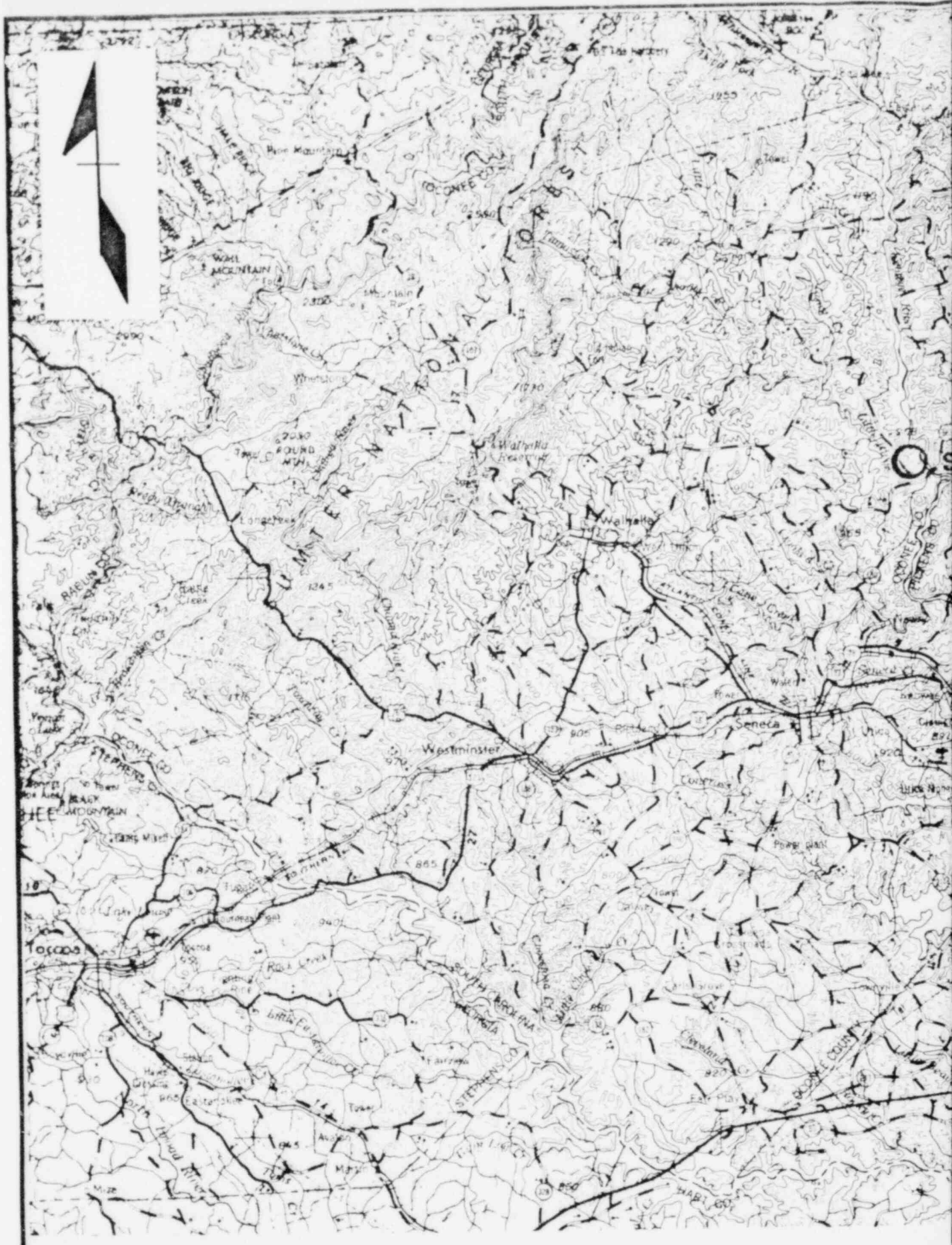
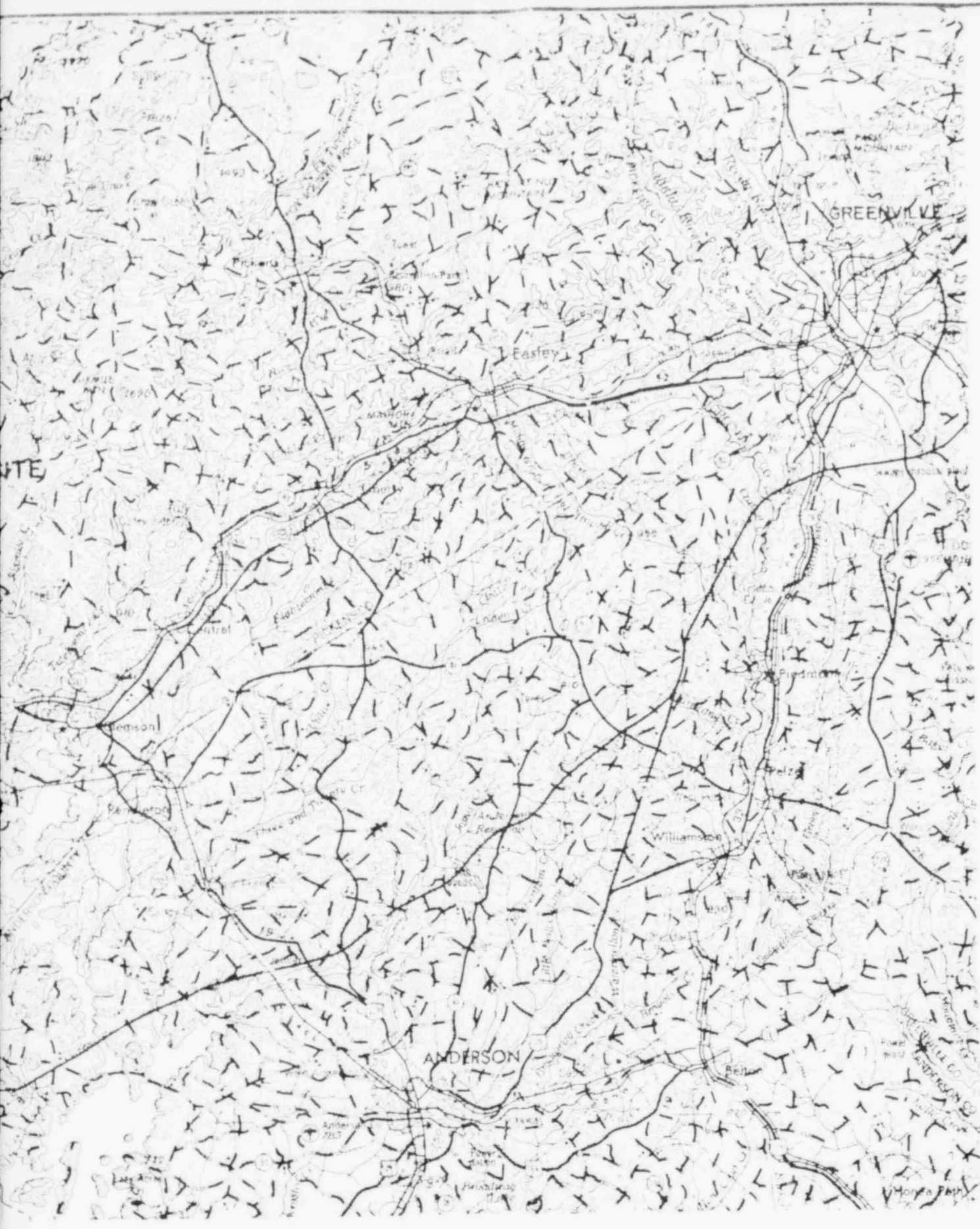


Figure 2D-5


SCALE: 5 0 5 10 Statute Miles
REFERENCE: AMS NI-17-4, GREENVILLE, S.C.
Walhalla
Westminster
Seneca
Toccoa
NANTAHALA NATIONAL FOREST
OCONEE CO
STEPHENS CO
RABUN CO
FANNIN CO
SOUTH CAROLINA
GEORGIA



MAP OF AREA

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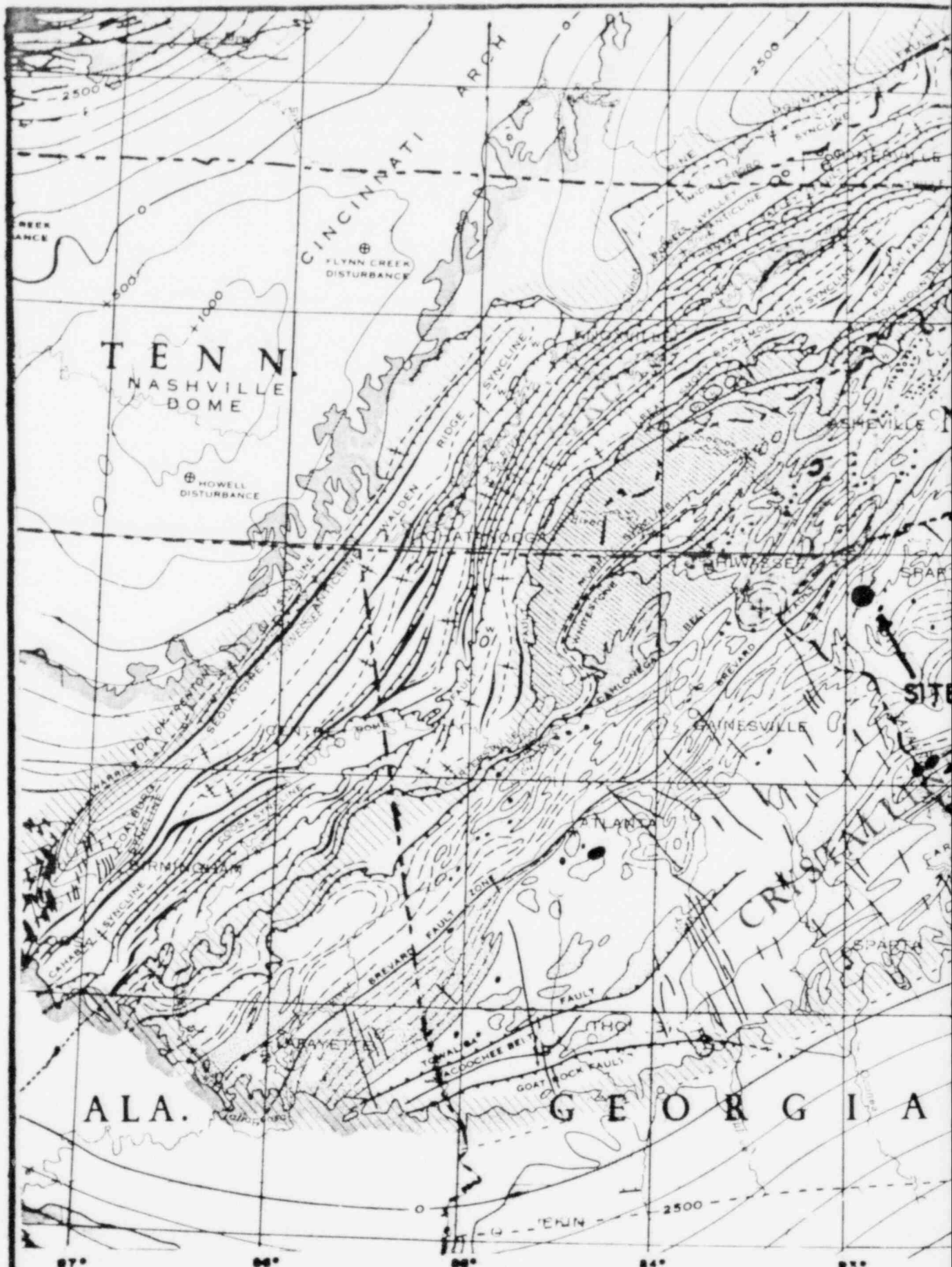
PLATE I-1



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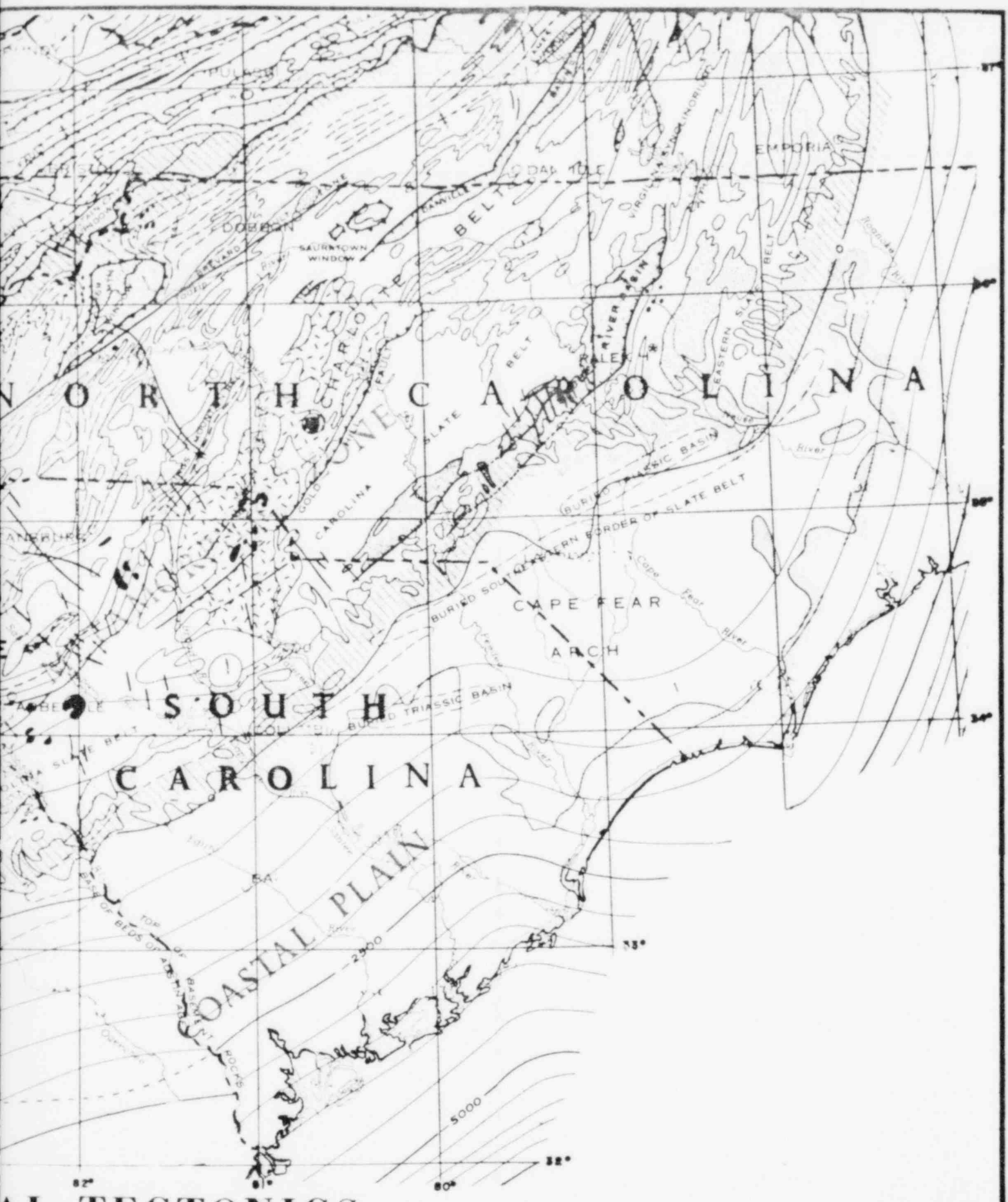
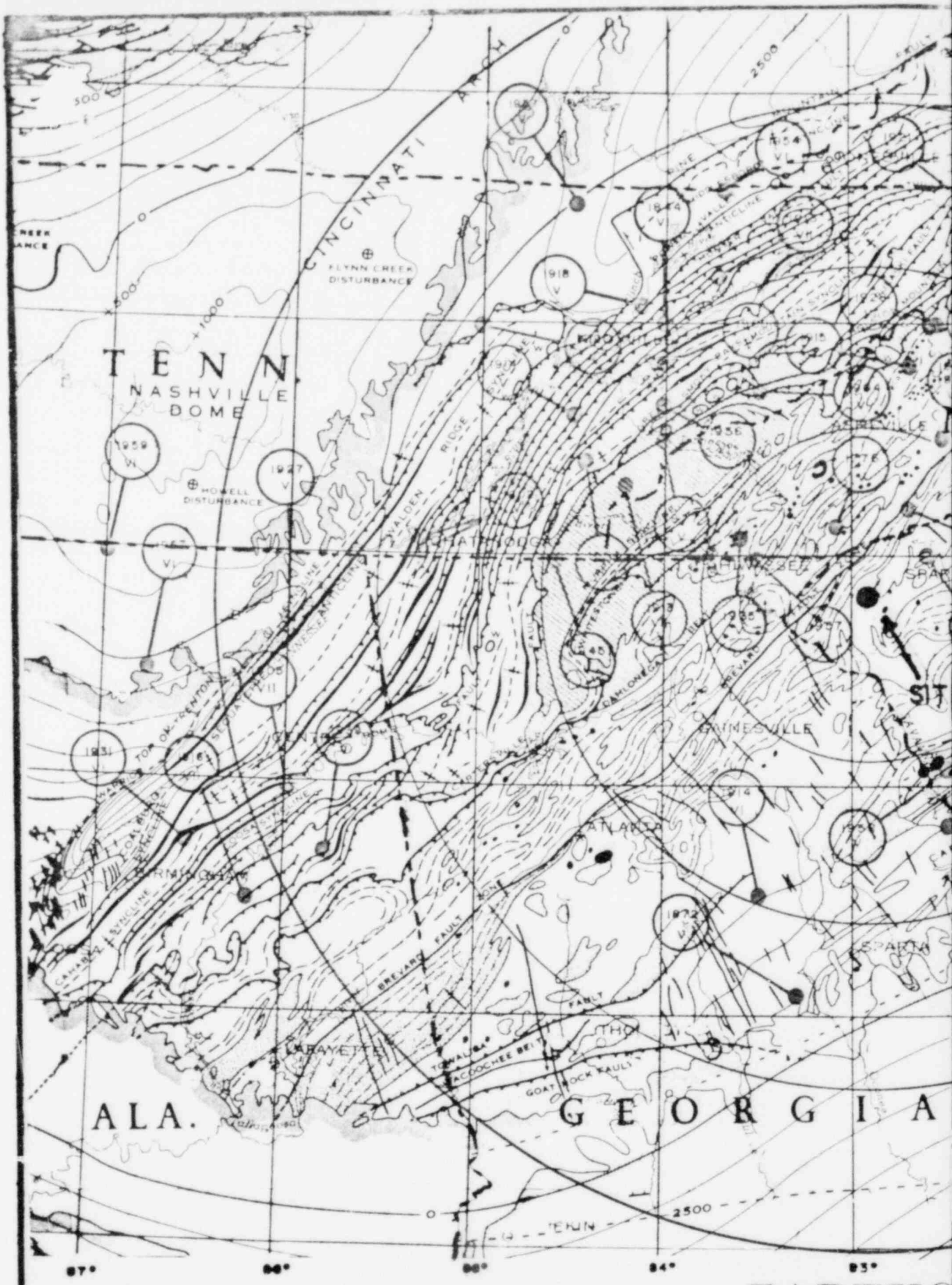
REFERENCE: TECTONIC MAP OF THE UNITED STATES BY U.S.G.S. & A.A.P.G.,

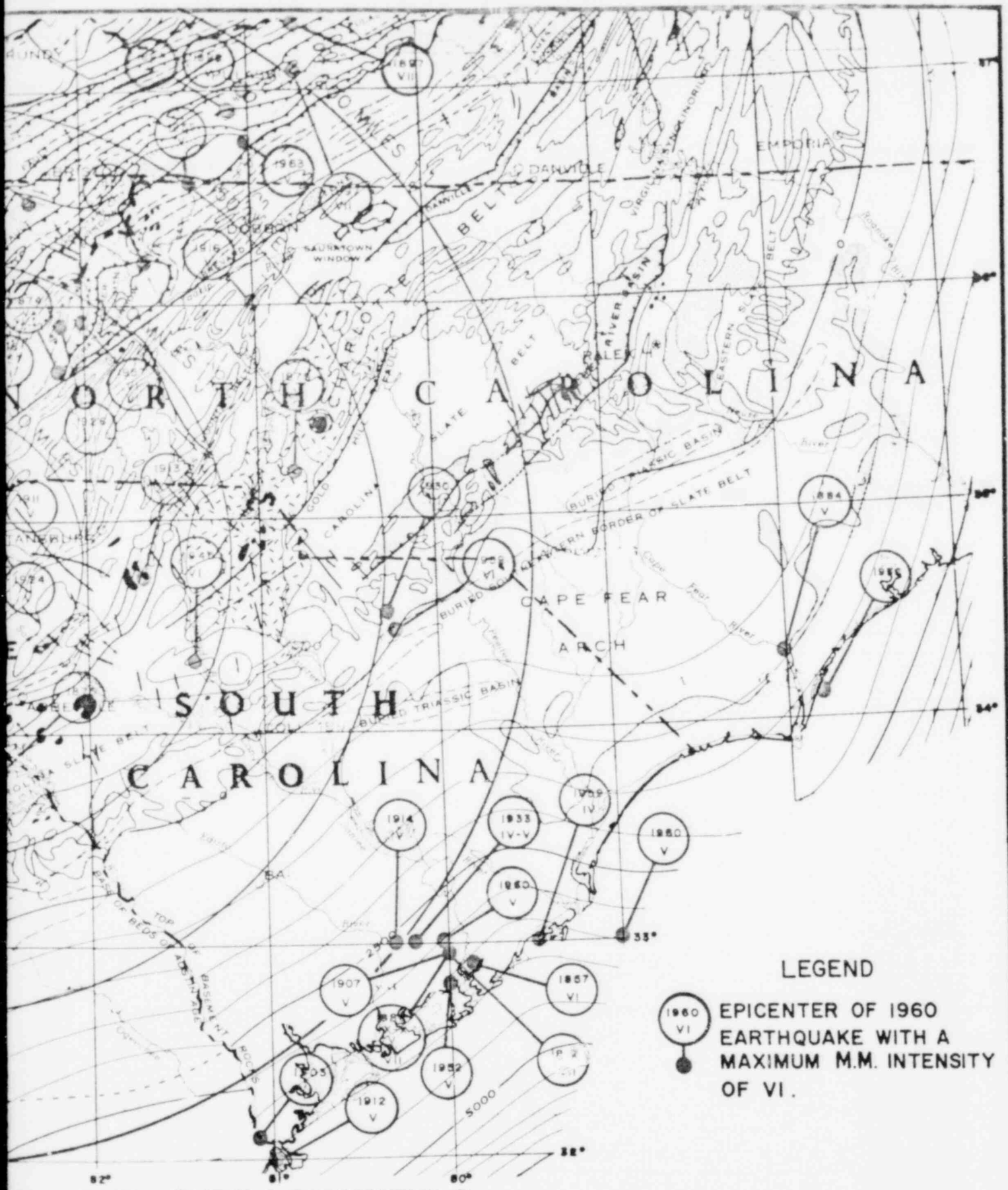


AL TECTONICS

962.

DAMES & MOORE


CINCINNATI ARCH
FLYNN CREEK DISTURBANCE
TENN.
NASHVILLE DOME
HOWELL DISTURBANCE
RIDGE
CHATTANOOGA
GAINESVILLE
ATLANTA
SPARTA
LAFAYETTE
ALA.
GEORGIA
TENN
2500
SCALE: 25 0 25 50 75 100
Approximately 1 inch to 40 miles
EARTHQ
REFERENCE: TECTONIC MAP OF THE UNITED STATES BY U.S.G.S. & A.A.P.G.



UAKE EPICENTERS

1962.

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PLATE II-2

946.7 (REV. 6-61)

BY GWC DATE 11-4

CHECKED BY

FILE

REVISIONS

BY DATE

RECOMMENDED GROUND MOTION SPECTRUM

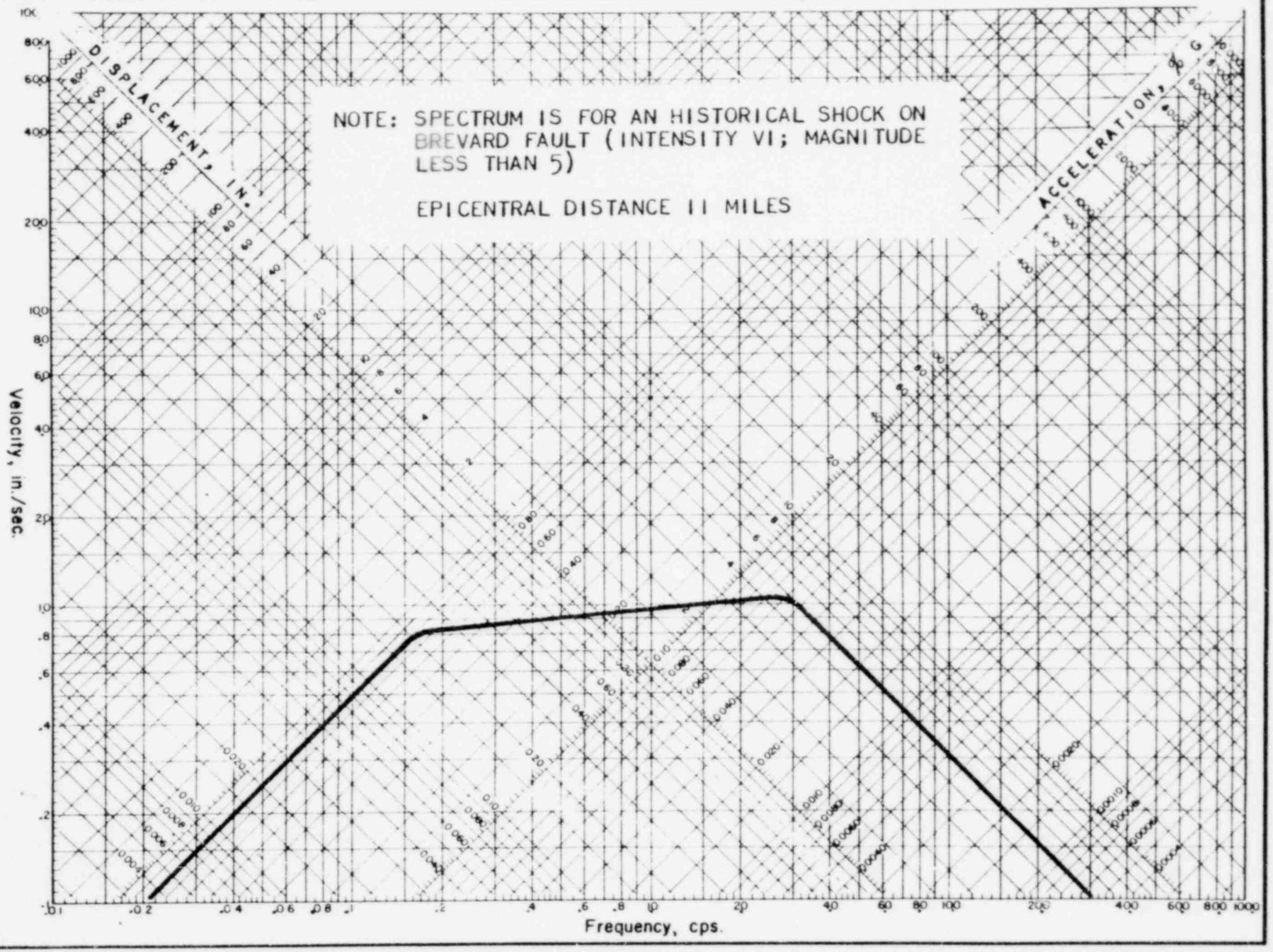

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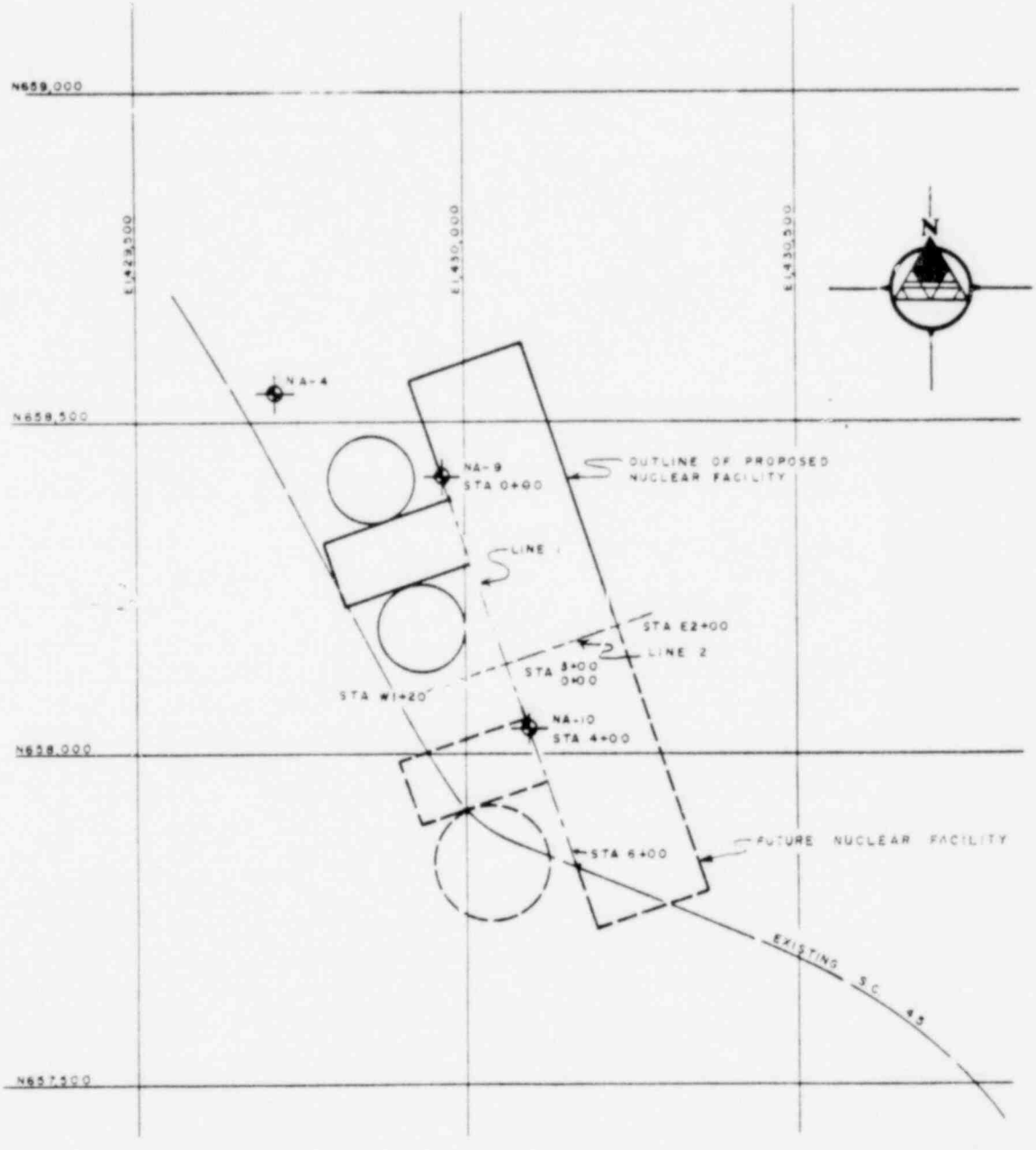
PLATE II-3



LEGEND

FOUNDATION BORING BY LAW ENGINEERING TESTING CO.

SEISMIC REFRACTION LINE

NOTE:

UPHOLE VELOCITY SURVEY PERFORMED IN BORING NA-9

STATIONING REFERS TO SEISMIC LINES ONLY

LOCATION MAP
SEISMIC FIELD WORK

REF: DUKE POWER COMPANY DWG. NO. PN 1
NUCLEAR STATION
PRELIMINARY BORING LOCATIONS

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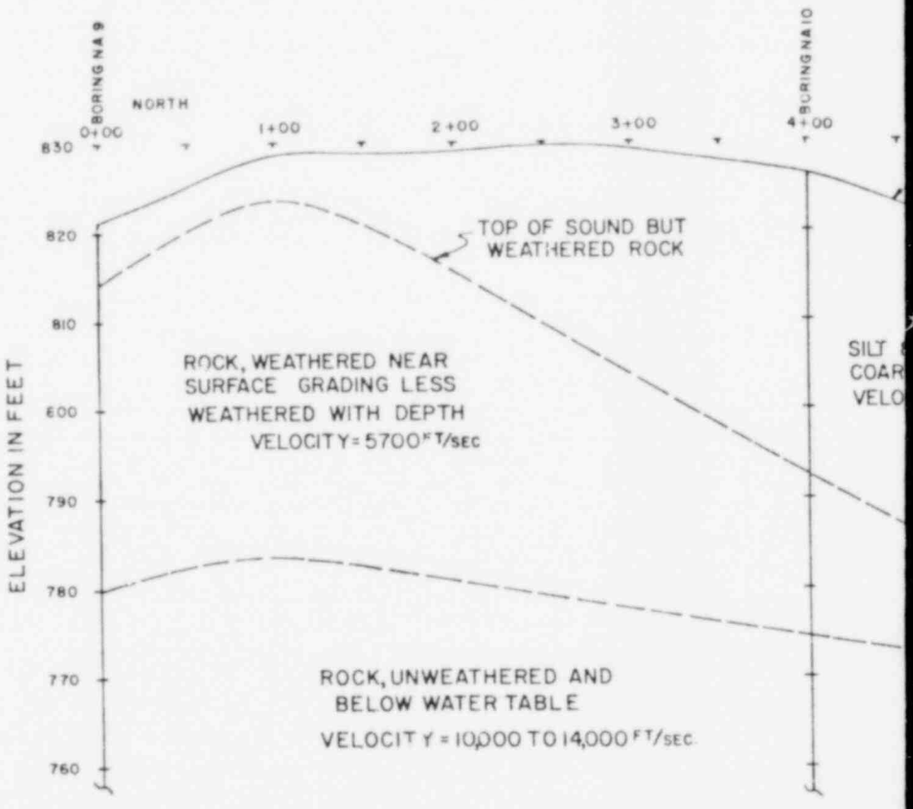
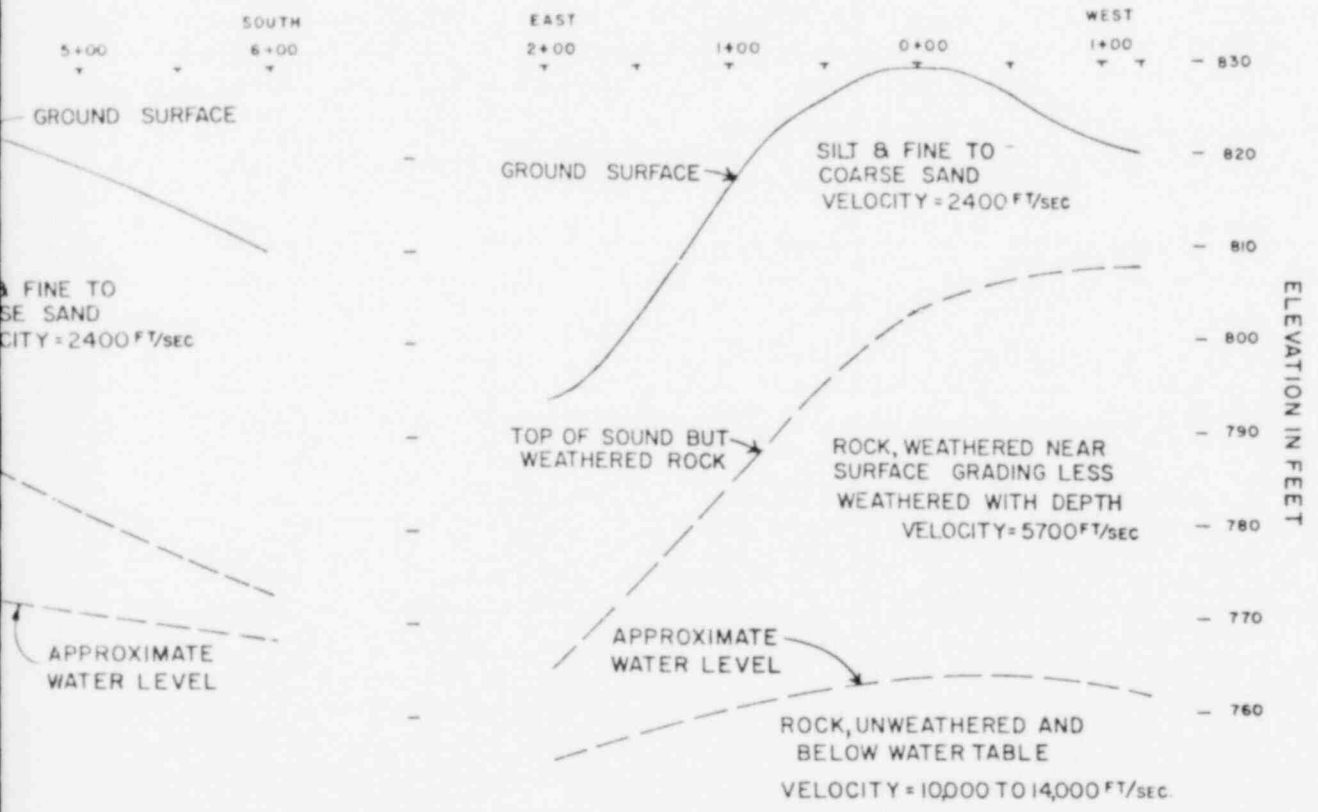
PLATE II - A1

LINE I



DIAGRAMMATIC CROSS

LINE 2



SECTIONS THROUGH SEISMIC LINES

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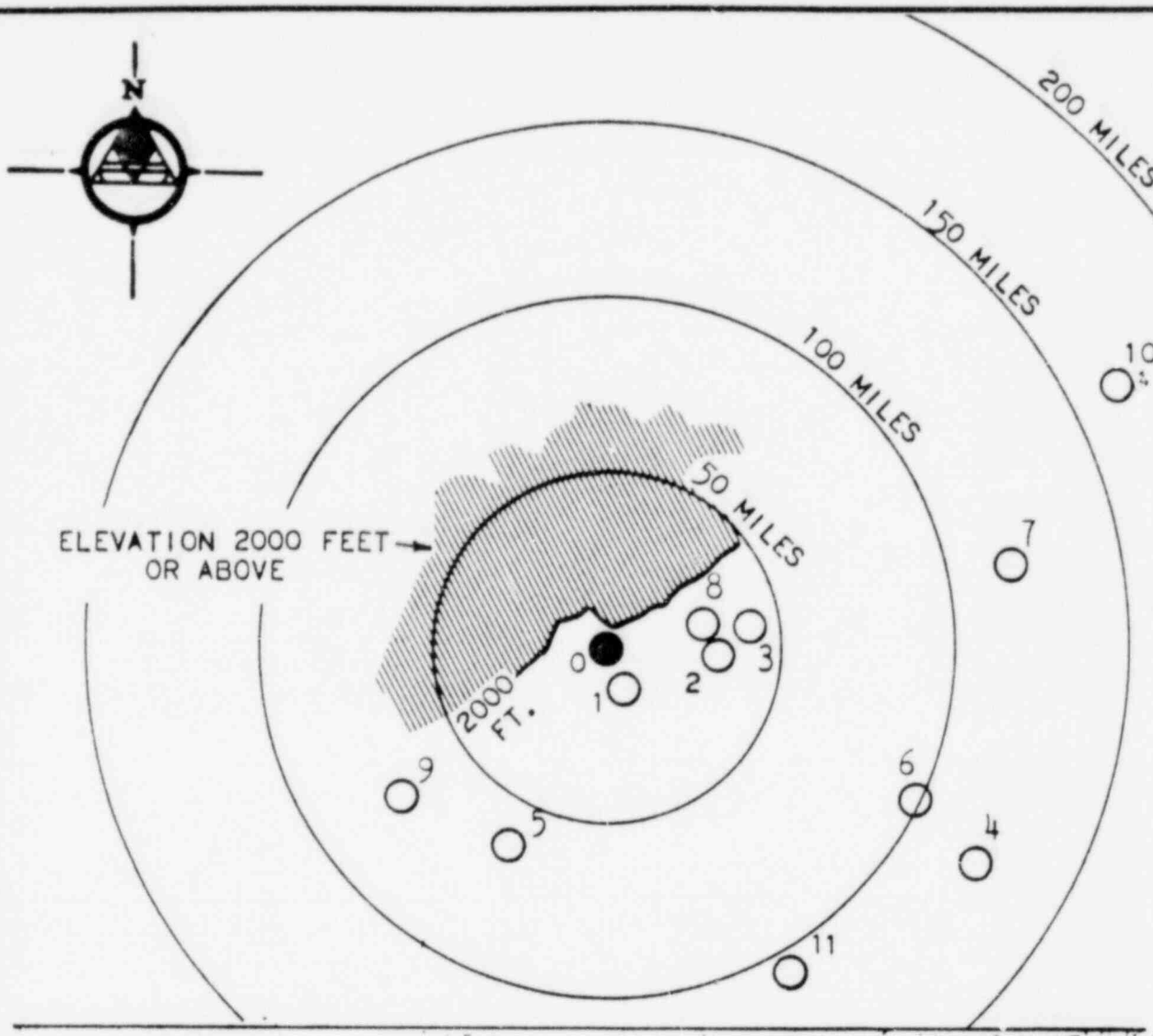
PLATE II - A2



REFERENCE NUMBER	STATION	DISTANCE FROM NUCLEAR SITE (MILES)	ELEVATION ABOVE MSL (FEET)
0	NUCLEAR SITE	0	790
1	CLEMSON	12	850
2	GREENVILLE WBAS	32	1018
3	GREENVILLE-SPARTANBURG WBAS	43	1047
4	COLUMBIA WBAS	125	217
5	ATHENS WBAS	64	807
6	PARR, S.C.	100	258
7	CHARLOTTE WBAS	122	748
8	PARIS MOUNTAIN FIRE TOWER	31	2047
9	DAWSONVILLE, GA.	78	1121
10	WINSTON-SALEM WBAS	168	969
11	AUGUSTA WBAS	107	142

WEATHER STATION LOCATION CHART

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PLATE III-1

REVISIONS BY DATE

BY DATE

CHECKED BY DATE

FILE Coal Creek

946.7 (REV. 6-61)