APPENDIX 2B

GROUNDWATER HYDROLOGY

McGUIRE NUCLEAR STATION

FSAR

DUKE POWER COMPANY

PREPARED BY
LAW ENGINEERING TESTING COMPANY
CHARLOTTE, NORTH CAROLINA
NOVEMBER, 1973

GROUNDWATER HYDROLOGY

LIST OF FIGURES

FIGURES

GROUNDWATER HYDROLOGY

OF

McGUIRE NUCLEAR STATION

1 REGIONAL GROUNDWATER HYDROLOGY

The plant site lies within the groundwater region known as the Charlotte area, which is part of the Piedmont Groundwater Province. Groundwater in this area is derived entirely from local precipitation. The surface materials in many locations are relatively impermeable with the result that only 10 to 15 inches of the average 43 inches of precipitation percolates to the water table.

Groundwater is contained in the pores that occur in the weathered material (residual soil-saprolite) above the relatively unweathered rock and in the fractures in the igneous and metamosphic rock. Although generally the depth to the water table depends on climate, topography and rock type, in the Charlotte are the depth depends primarily on topography and rock weathering because there is little variation in the hydrologic properties of rock types within the area. The water table varies from ground surface elevation in valleys to more than 100 feet below the surface on sharply rising hills. The groundwater level normally declines during the late spring, summer and early fall months as a result of evaporation and transpiration by plants, and, in the fall, when rainfall is low. The groundwater level rises in the late fall and winter when the evaporation potential is reduced.

Shallow dug wells are supplied from surface deposits or from the upper decomposed parts of the bedrock. Many drilled wells of moderate depth are supplied from joints in the crystalline rocks. The water quality is excellent, generally low in minerals, except iron. The quantities available are generally small.

1.1 WELL SURVEY

To determine the general groundwater environment surrounding the site, a survey was made of the wells which provide domestic water supplies in the general site area. The locations of existing wells are shown on Figure 2B-1, and data on these wells are given in Table 2B-1. The wells surveyed range from 3 to 6-1/4 inches in diameter, and depths range from 80 to 325 feet. The maximum discharge is about 10 gallons per minute.

2 SITE GROUNDWATER HYDROLOGY

The occurrence, location and movement of groundwater at the site is controlled primarily by the water level in Lake Norman, which borders the site on the north. Permeability is controlled by the distributions of fractures in the bedrock and by the size and distribution of the pores in the material above bedrock. Gradients are controlled by topography, fractures and by the elevation of the water in Lake Norman.

2.1 GROUNDWATER LEVELS

2.1.1 PRECONSTRUCTION

Observations of preconstruction groundwater elevations were made at approximately 100 locations in the immediate vicinity of the site. Based on these observations a contour map showing the water table was prepared (see Figure 2B-2). This map shows that the preconstruction elevation of the groundwater along the northern boundary of the site coincides with the elevation of the surface of Lake Norman, and that the movement of the groundwater is generally to the south and southwest. Thus, groundwater moved from the plant site toward the Catawba River or toward the small branches that drain into the Catawba. A cross-section through the site illustrates the relation between the topography, preconstruction groundwater elevation and geology (see Figure 2B-3).

A water level recorder was installed on boring H-11 in order to monitor fluctuations of the groundwater elevation. The record of this variation of H-11 water level versus Lake Norman pond Elevation is shown in Fig. 2B-7.

2.1.2 CONSTRUCTION EFFECTS

The groundwater environment in the immediate vicinity of the site will be substantially changed by the construction; however, the effects of changes will be to decrease the slope of the water table and thus to increase the transit time of contaminants moving from the site to any discharge point. Since the bottom elevations of the structures are below the natural water table, an underdrain system has been installed to lower the water table. This underdrain system will remain in service after construction. This will result in a minimum groundwater level of about elevation 712 in the Reactor Building area and a depression of the water table with groundwater flow toward the Reactor Building area from all directions. Under normal condition, the flow from the underdrain system will be discharged into the surface water drainage system.

Groundwater elevations measured during construction, are shown in Figure 2B-2A. Contours shown on Figure 2B-2A are based on groundwater elevations measured on May 7, 1975 and show the effects of various dewatering projects at the site as well as the presence of the Standby Nuclear Service Water Pond. Discharge from the three sumps used to drain the Auxiliary Building were monitored during the period March 5, 1975 to April 1, 1975. The average flow from the north sump was 3.6 gpm and the maximum flow during any 24 hour period was 3.8 gpm. The discharge from this sump on May 7, 1975 was 3.64 gpm. The two south drainage sumps each have an average flow of 6 gallons per day. The well point system at the Intake Structure discharges approximately 65.9 gpm directly into Lake Norman. It is scheduled for removal on or about September 1, 1975. The Discharge Canal was unwatered to about elevation 725 feet at the time the water elevations shown on Figure 2B-2A were measured.

Figure 2B-2A provides data for the site groundwater situation with all underdrain systems installed and functioning. Construction dewatering by eductor wells was in progress at the intake excavation northwest of the plant. The discharge canal was not full of water. Otherwise. conditions on May 7, 1975 were similar to those that will exist after all construction is complete. Therefore, Figure 2B-2A provides a basis for estimating the extent of the zone of influence of groundwater and the amount of drawdown at the site boundary.

Figure 2B-2A shows the groundwater aquifier at the site can only be affected locally by the drainage system, since it is bounded on the north by Lake Norman, on the west by the Catawba River, on the south by the NSNW Pond and on the east by a ridge where the groundwater elevation has not been significantly affected by dewatering. The contours also indicate that offsite groundwater users will not be affected by the lowered groundwater table in the plant vicinity.

A groundwater level monitoring program in the vicinity of the Reactor, Diesel Generator, and Auxiliary Building areas has been initiated to determine any further changes when construction dewatering is discontinued. This program is defined in the plant technical specifications, and Selected Licensee Commitment 16.9-8, Groundwater Level Monitoring System.

2.2 SPRINGS AND SURFACE DRAINAGE

A number of small springs are present in the vicinity of the site. These springs occur where the groundwater table or water bearing joints intersect the ground surface. The springs generally occur at the head of the small streams which drain the site. These streams are defined by the topographic map of the site (see Figure 2B-4), and the location and elevation of six of the springs are also shown on this map. Discharge measurements were made at several points along the branches in order to obtain an estimate of the quantity of flow produced by the springs. The locations of the discharge measurements are also shown on Figure 2B-4.

2.3 PERMEABILITY

The permeability of a material is its relative ability to transmit water. The permeability, along with the water table gradient, determines the rate of water movement in the soil or weathered rock pores, and in cracked zones in the rock. The permeability was measured at fifteen locations across the site. Single and double packer systems were used to determine the permeability of the bedrock, and constant head tests in sealed piezometers were employed to measure the permeability of the weathered materials. Figures 2B-5 and 2B-6 show the arrangement of the equipment along with a brief description of the procedure used in determining the rock and soil permeabilities. Table 2B-2 presents the rock permeability test results, and Table 2B-3 presents the soil permeability test results.

The permeabilities in the rock were found to be very low, ranging from 0.0 to about 160 feet per year. The highest permeabilities were found in material described as "very soft diorite" and "very soft granite." This is some indication that the very soft coarse grained diorite is more permeable than very soft fine grained diorite. Material classified as "hard diorite" or as "hard granite" had permeabilities that ranged from 0.0 to less than 30 feet per year with values in the lower end of this range occurring more frequently.

The soil permeability measurements were generally conducted in the most permeable zone of the weathered material-residual soil or saprolite. This is texturally described in the drilling logs as "silty fine to coarse sand."

The results of four tests in widely separated holes showed a remarkable consistency. The values ranged from about 200 to 300 feet per year. The permeability measured in boring H-5, which is much lower than that measured in other locations, is discounted because the water table at this location is very near the surface and a head sufficient to produce good results could not be attained. Permeability tests performed on soils for Cowans Ford dam at a depth of 7 to 8 feet below the surface indicate a relatively impermeable soil at this level. Permeability as determined from such tests was 16 feet per year.

2.4 MOVEMENT OF GROUNDWATER

In general, flow of groundwater is normal to groundwater contours. The quantity of groundwater movement is controlled by the slope or gradient of the water table and the permeability of the area through which it moves. The velocity of flow is controlled by the gradient, the permeability and the porosity. The shortest groundwater path between the site and the river is by way of springs in the vicinity of the point marked S-1 on Figure 2B-4. The time of travel can be estimated as approximately 60 to 8 years based on a permeability of 300 feet per year and a porosity of 0.10. The rate of movements in the joints is probably greater.

2.5 QUALITY OF GROUNDWATER

The quality of the groundwater in the vicinity of the site is high and satisfactory for domestic use without treatment. Chemical and physical tests were conducted on water from six wells located around the site. The analysis showed the water to be low in mineral content and slightly alkaline. The mineral content in these wells is as low or lower than average values found in the surrounding area. The results of the chemical and physical tests are shown in Table 2B-4. The locations of the wells from which the samples were taken are shown on Figure 2B-1.

2.6 ION EXCHANGE POTENTIAL OF SOIL

Standard methods of chemical analysis were used to determine the cation exchange capacity of the soil at the site. Several samples were selected from borings near the center of the site and tested for their ion exchange capacity relative to ions of cesium and strontium. The results of these tests are presented in Table 2B-4.

The ion exchange capacity of soil affects the rate at which a radioactive groundwater containment moves through the soil. The rate of movement of the contaminant depends on the composition of the waste, composition of the soil, and the rate of movement of groundwater. The radioactive contaminant will move less rapidly than the groundwater because it will be absorbed, to some degree, by soil particles. A relationship has been developed[1] which provides

---

[1] Iome, Y., and Kaufman, W. J., "Studies of Injection Disposal," Proceedings of Second Ground Disposal of Radioactive Wastes Conference, Chalk River, Canada, 1961, pp. 303-321.

an estimate of the effect of ion adsorption on the travel time of a radioactive contaminant. This relationship may be expressed as

$$t_c = [1\pm + B \frac{(1-P)}{P} K_d] t_w$$

where

t_c = time of travel for contaminant

B = bulk density (g/ml)

P = porosity

K_d = distribution coefficient (ml/g)

t_w = time of travel for groundwater

The distribution coefficient provides a measure of the exchange characteristics of the soil. It has been shown[2] that the distribution coefficient depends on the concentration of the contaminant, the pH of the transporting solution, and on the presence of additional ions in the transporting solution. Comparison of the ion exchange capacity of the soil and the chemical characteristics of the groundwater at the site with values obtained from laboratory tests (see Prout) suggest a value of K_d for the site in the range 10-100 ml/g for strontium.

A conservative travel time for strontium is estimated to be approximately

$$t_c = [1 + 1.925 \frac{(1-.3)}{.3} 10] t_w$$

$$t_c = [1 + 45] t_w$$

i.e., the conservative travel time for strontium is about 46 times the travel time for water. If the larger value of the distribution coefficient were to be used, the travel time would be increased by a factor of 460 instead of 46. These calculations are based on a value of density equal to 1.925 g/ml (120 lbs/ft^3) and a porosity of 0.3. Strontium was used in these calculations because it frequently represents the most critical contaminant.

The distribution coefficient for cesium, like that for strontium, varies with pH and the concentration of the isotope solution. At a molal concentration of 5×10^{-8}, the soil tested by Prout had a distribution coefficient for strontium that varied from about 10 (pH=3) to a value of approximately 900 (pH=7). For the same concentration and range of pH, the distribution coefficient for cesium varied from about 200 to over 1,600. Therefore, the adsorption of cesium at low values of pH can be predicted to be considerably greater than that for strontium. As a result, the travel time for cesium will also be greater, possibly in the range of about two time to as much as twenty times as long.

[2] Prout, W. E., "Adsorption of Radioactive Wastes by Savannah River PLANT Soil," Soil Science, Vol. 86, No. 1, July 1958, pp. 13-17.

2.7 GROUNDWATER RISE FOLLOWING POSTULATED UNDERDRAIN FAILURE

In order to estimate the response characteristics of the aquifer, should a failure of the Category 1 underdrain system occur, the underdrain system was modeled by using a two-dimensional finite difference solution to the unsteady flow equations.[3] Aquifer parameters were assumed based upon the results of the field investigation. Simulations were made with a permeability equal to 300 feet per year, and an aquifer storage coefficient equal to 0.1. The bottom of the aquifer was assumed to be at elevation 712 feet msl, the elevation of the underdrain system. An infiltration rate was estimated by assuming that 32 percent of the maximum monthly rainfall (March, 1973 Mr. Holly, North Carolina) infiltrates to the groundwater system, and that this recharge is uniformly distributed in time. These assumptions yield a recharge rate of 0.0598 gpd/sq. ft.

Initial conditions for the simulation were derived by assuming that the water table was at steady state at time t=o (the time of underdrain failure). The edge of the structure was assumed to represent an impermeable boundary, and Lake Norman was assumed to act as a line source at a distance of 300 feet from the structure. The elevation of the water surface in Lake Norman was held at 760 feet throughout the simulation.

The results of these simulations are presented in Figure 2B-8 which shows water level at the structure as a function of time after underdrain failure. These curves neglect all storage in the underdrain system, and consider only storage in the aquifer.

3 CONCLUSIONS

The depth of groundwater below the ground surface, the direction of groundwater movement, and the rate of movement are, to a great extent, controlled by the water surface elevation in Lake Norman. Other important factors which influence the groundwater characteristics are the topography and the permeability of the soil and rock. Water which moves through the soil and rock beneath the site is discharged through a number of small springs and seeps along the small streams which drain the site. Measurement of the flow in these streams indicates a discharge 10 to 20 times larger than would be computed from the soil and rock permeabilities and from the groundwater gradients. This shows that the greatest part of the seepage is through rock joints.

Although radioactive materials are not expected to enter the groundwater except as the result of an extraordinary accident, the results of this study show that these materials would not readily be dispersed to the environment where people could be exposed.

---

[3] Prickett, T. A. and Lonnquist, D. G., "Selected Digital Computer Techniques for Groundwater Resource Evaluation," Illinois State Water Survey, Urbana, Illinois, Bulletin 55, 1971.

TABLE 2B-1

WELL SURVEY DATA

WELL NUMBER (From Fig. 2B-1)	LOCATION	DIAMETER	DEPTH	DEPTH TO WATER	FLOW RATE	SURFACE ELEVATION	REMARKS
1	Elmore Stinson Residence (Relocated) Hager Ferry Road		133' 33" Into Rock	*	*	825	Jack Robins, Driller
2	Walter Johnson Residence Hager Ferry Road	3"	80'	*	4gpm	825	McCall Bros., Drillers
3	J. Waller Residence Twin Coves	5"	150'	*	10 gpm	775	McCall Bros., Drillers
4	Mr. William Van Every Twin Coves	6-1/4"	100'	*	5 gpm	775	McCall Bros., Drillers
5	Harold Junker Twin Coves	*	*	*	*	790	John Venokal, Driller
6	Mr. Wilhelm Residence Twin Coves	6"	325	18'	1-1/2 gpm	780	Paul Stewart, Driller Present Well Have Been Dry Twice
7	Mr. M. J. Groves Residence Twin Coves	2"	90' 60' Into Rock	15' To 20'	10 gpm	770	Cotton Baker, Driller This Well is Not Being Used At Present Due to Mud & Sand in Water
8	Mr. M. J. Groves Twin Coves	2"	80'	10'	5 gpm	770	Cotton Driller

TABLE 2B-1 (Continued)

WELL SURVEY DATA

WELL NUMBER (From Fig. 2B-1)	LOCATION	DIAMETER	DEPTH	DEPTH TO WATER	FLOW RATE	SURFACE ELEVATION	REMARKS
9	Mr. Earnhardt's Boatdock Twin Coves	2"	124	*	3 gpm	765	
10	Kenneth Hastings Residence N. C. 73	*	*	*	*	810	
11	Mr. Williams Residence N. C. 73	*	*	*	*	775	
12	Mr. Hubbard Residence N. C. 73	*	*	*	*	780	Cotton Baker, Driller
13	Mr. McAllister Residence N. C. 73	*	*	*	*	770	Cotton Baker, Driller

* Data Not Available

TABLE 2B-2

ROCK PERMEABILITY TEST RESULTS

HOLE NUMBER (From Fig. 2B-2)	DEPTH OF TEST SECTION (ft)	h(ft)	Q(gpm)	k_h(ft/yr)
H-8	40.0 - 46.15	151.8	1.80	84.3
H-8	61.0 - 67.15	195.7	4.10	148.0
H-68	59.0 - 65.15	191.2	0.00	0.0
H-5	82.4 - 92.0	203.0	0.40	10.0
H-14	115.4 - 169.5	257.0	5.50	26.7
H-14	110.4 - 169.5	239.0	5.50	26.9
H-14	95.0 - 169.5	243.0	2.70	10.6
H-69	65.0 - 71.15	187.0	0.00	0.0
H-43	63.0 - 69.15	182.0	0.35	13.6
H-43	77.0 - 82.3	221.0	0.03	1.1
H-13	95.0 - 101.15	255.0	0.00	0.0
H-13	75.0 - 81.1	209.0	0.60	2.0
H-20	60.0 - 66.1	164.0	0.00	0.0
H-20	36.0 - 42.1	115.0	2.60	160.0
H-58	90.0 - 104.5	244.0	0.00	0.0

h = Applied Water Pressure Head in Feet

Q = Flow Rate in Gallons Per Minute

k_h = Horizontal Permeability in Feet Per Year

TABLE 2B-3

SOIL PERMEABILITY TEST RESULTS

HOLE NUMBER (From Fig. 2D-2)	DEPTH OF TEST SECTION (ft)	h(ft)	Q(gpm)	k_h(ft/yr)
H-32	33.5 - 38.5	11.17	.30	205
H-18	41.5 - 46.5	20.20	.73	274
H-21	16.0 - 21.0	13.00	.56	328
H-5	56.0 - 66.0	3.80	.01	15
W-8 (H-55)	34.0 - 39.0	17.00	.73	328

h_c = Constant Applied Water Head Above Static Water Table

Q = Flow Rate in Gallons Per Minute

k_h = Horizontal Permeability in Feet Per Year

TABLE 2B-4

RESULTS OF PHYSICAL AND CHEMICAL TESTS ON GROUNDWATER

WELL NUMBER: (From Fig. 2B-1)	1	7	11	10	3	2
pH VALUE	8.3	8.3	8.3	8.4	8.1	8.2
			Parts Per Million			
TOTAL DISSOLVED SOLIDS	66	39	55	47	203	86
TOTAL ALKALINITY AS $CaCO_3$						
Carbonate	0	0	0	0	0	0
Bicarbonate	38	21	30	23	126	47
TOTAL HARDNESS AS $CaCO_3$	27	18	25	15	41	40
SILICA	1.30	0.75	0.73	0.74	1.12	0.71
IRON	0.10	0.10	0.10	0.20	0.50	0.15
CALCIUM	7.50	3.20	4.60	3.20	8.60	8.90
MAGNESIUM	1.90	2.40	3.20	1.70	4.80	4.30
CHLORIDES	11.20	14.90	11.20	11.20	26.10	18.70
SULFATES	26	7	10	8	20	12
SPECIFIC CONDUCTANCE (MICROMHOS)	14250	8500	12000	10500	43000	19000
TURBIDITY, ppm	6	5	3	2	12	11

CATION EXCHANGE CAPACITY OF SOILS
EXPRESSED AS MILLEQUIVALENT WEIGHT PER 100 GRAMS SOIL (a)

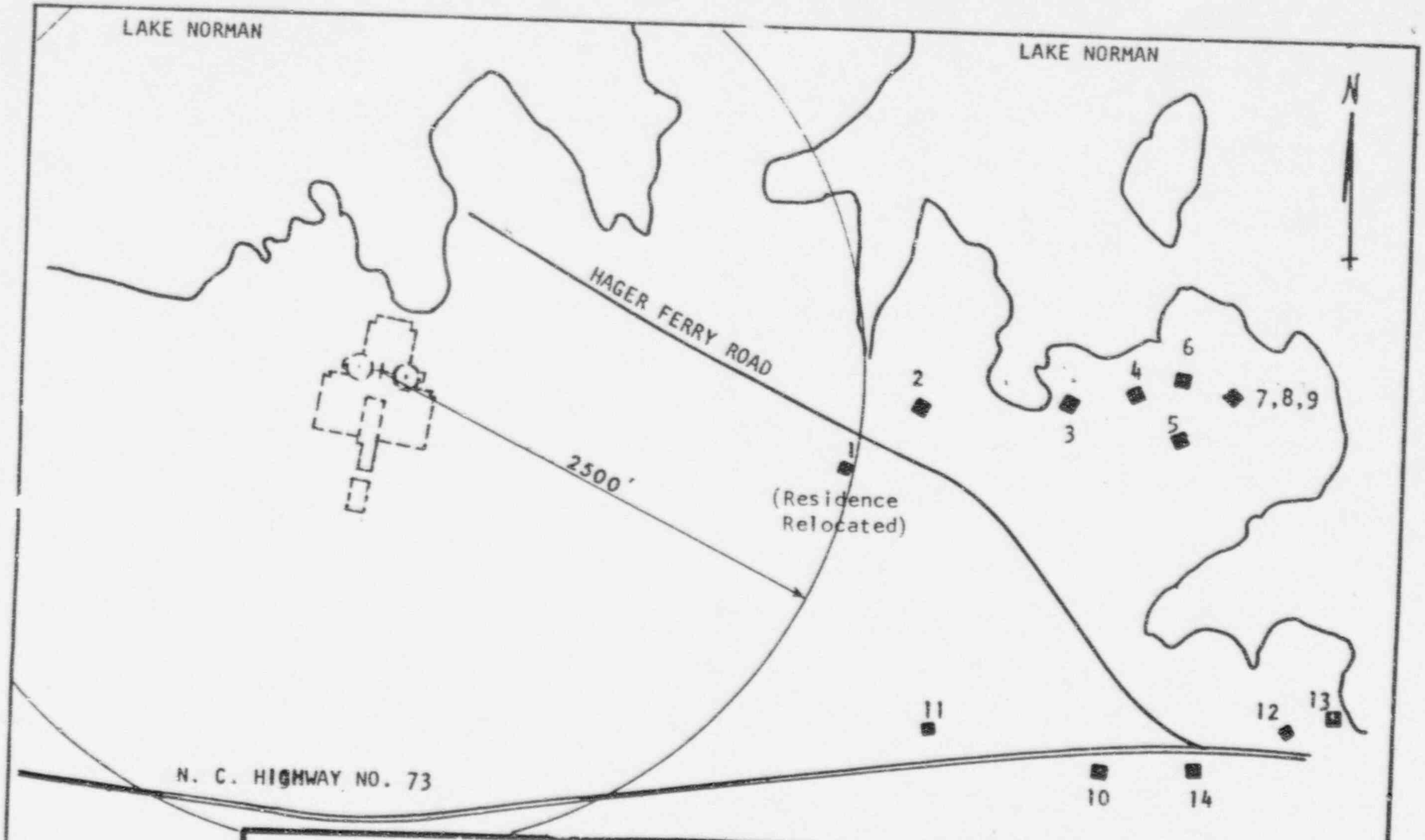
BORING NUMBER (From Figure 2D-2)	DEPTH (FEET)	CESIUM	STRONTIUM
H-41	16	0.622	0.410
	26	0.350	0.230
	36	0.338	0.223
	47	0.761	0.502
	56	0.780	0.514

TABLE 2B-4 (Continued)

CATION EXCHANGE CAPACITY OF SOILS
EXPRESSED AS MILLEQUIVALENT WEIGHT PER 100 GRAMS SOIL (a)

BORING NUMBER (From Figure 2D-2)	DEPTH (FEET)	CESIUM	STRONTIUM
H-49	6	0.732	0.483
	16	0.532	0.351
	26	0.523	0.345
	36	0.500	0.330
	51	0.542	0.357

a) Millequivalent Weight - one of the comparative weights of different compounds, elements, or radicals (in this case the elements cesium and strontium) which possess the same chemical value for reaction when compared by reference to the same standard (in this case chlorine).

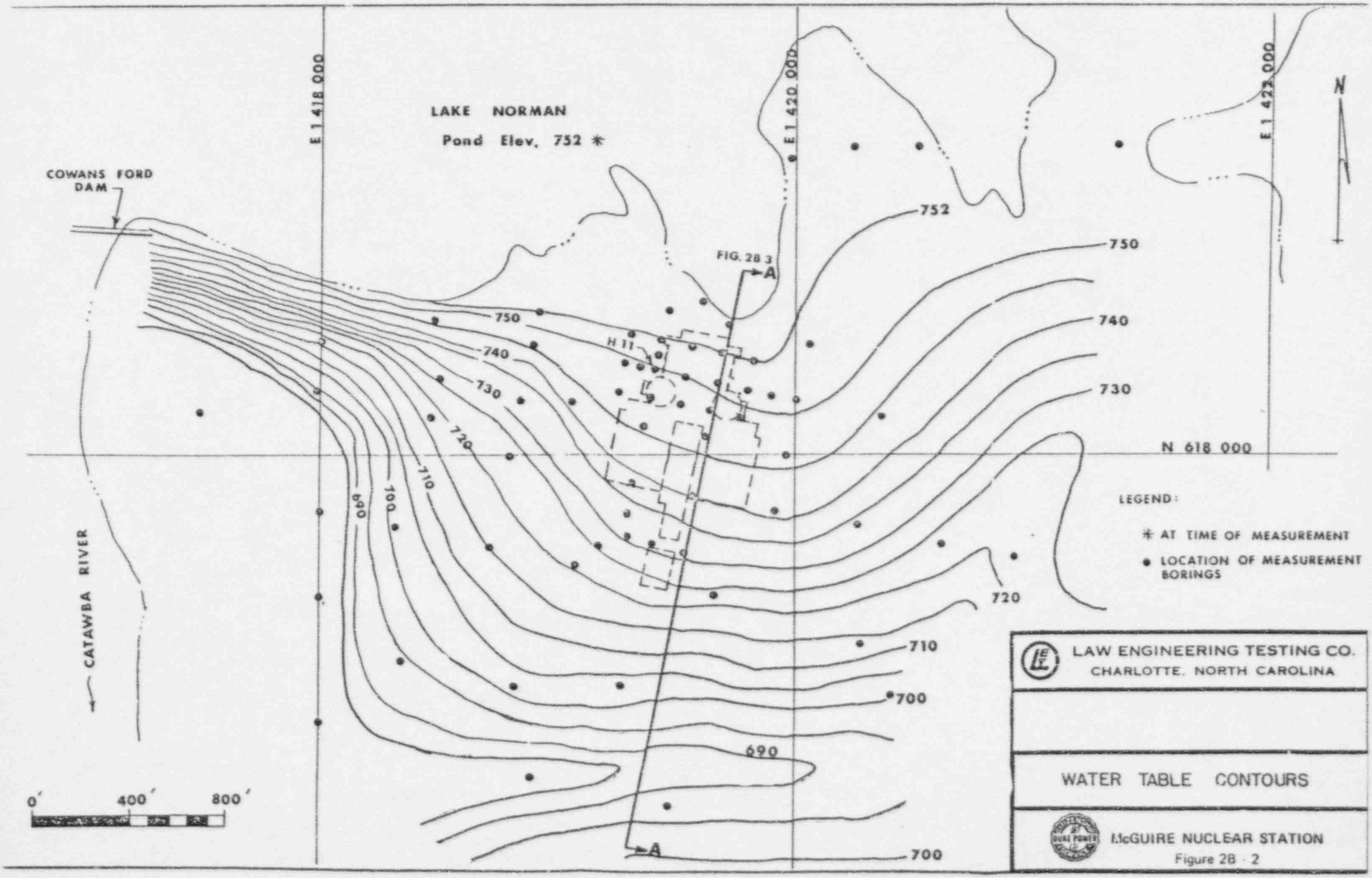


LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

MAP SHOWING WELLS SURVEYED

Scale 1" = 800'

McGUIRE NUCLEAR STATION
Figure 2B - 1

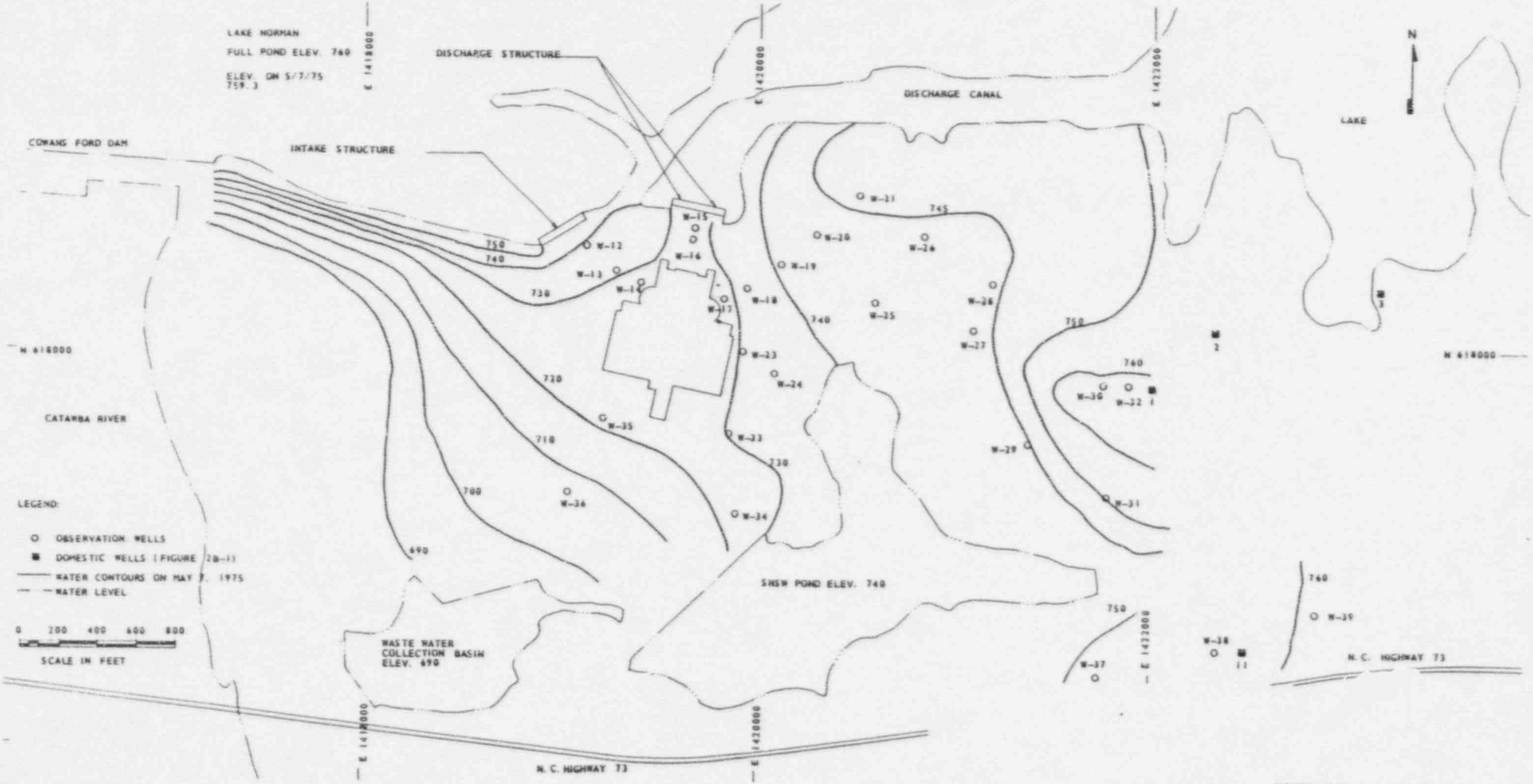


LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

WATER TABLE CONTOURS

McGUIRE NUCLEAR STATION

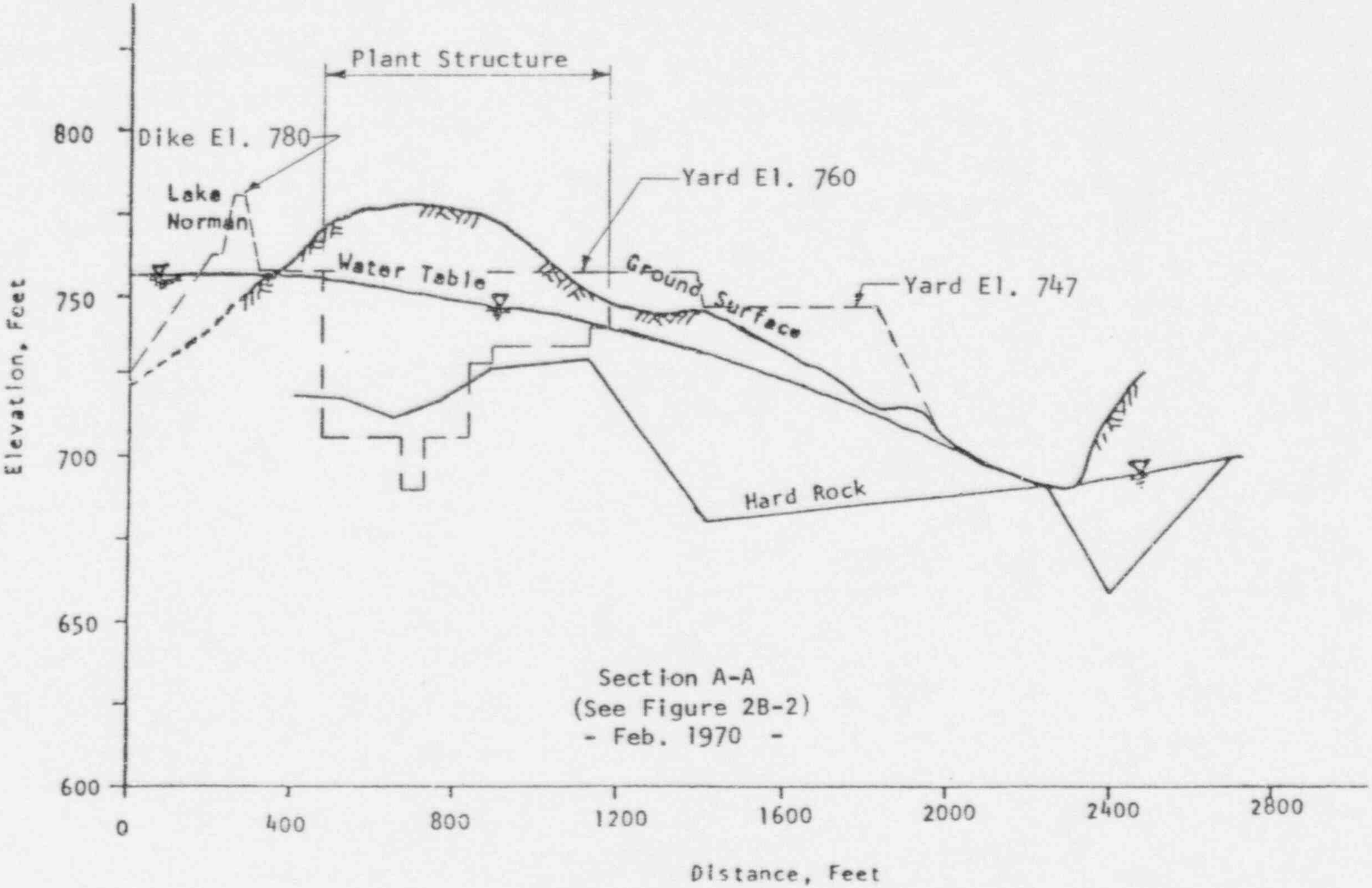
Figure 2B - 2



WATER TABLE CONTOURS ON
MAY 7, 1975

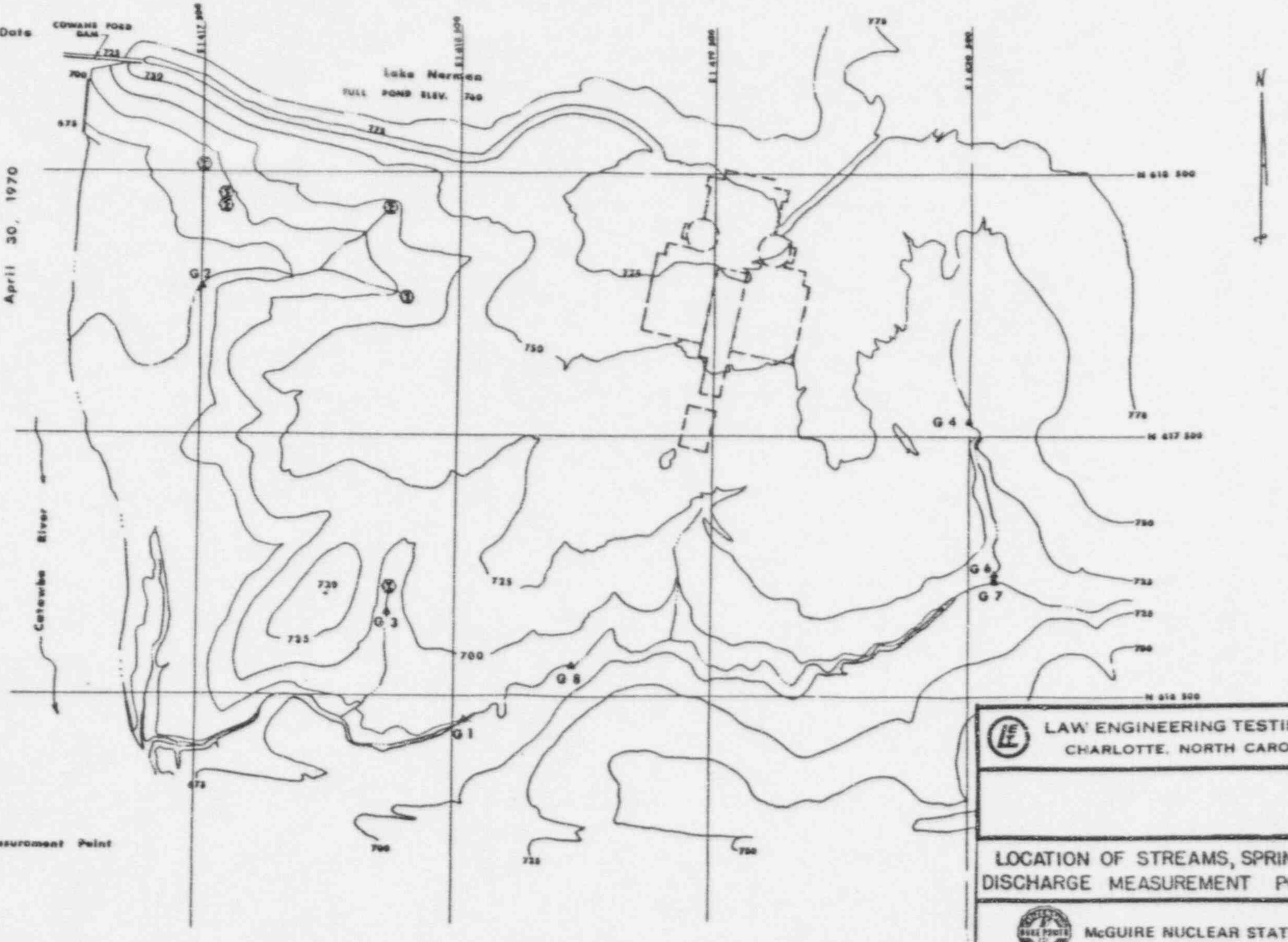
McGUIRE NUCLEAR STATION

Figure 2B-2A



TYPICAL GROUNDWATER SECTION AA
McGUIRE NUCLEAR STATION
Figure 2B-3

Measurement Point	Flow, Gallons per Minute	Date
G-1	No Measurement	April 30, 1970
G-2	75.0	
G-3	1.0	
G-4	8.1	
G-6	1.4	
G-7	14.0	
G-8	43.0	



LEGEND:

⊕ Spring

▲ Discharge Measurement Point

~ Stream

0' 200' 400'

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

LOCATION OF STREAMS, SPRINGS, & DISCHARGE MEASUREMENT POINTS

McGUIRE NUCLEAR STATION
Figure 2B - 4

Rock Permeability (Packer) Testing

Double packers inflated by pressure from a nitrogen tank were used to seal off the section of rock within the NX drill holes to be tested. An occasional single packer test was performed with the test section being the length of drill hole below the single packer.

Water pressure was applied to the test section by means of a Homelite centrifugal pump pumping clean lake water from the supply tank through 1" brass pipe and 1" rubber hose through the A drill rod to the 3/4" perforated pipe sealed between the packers. A surge tank, water meter (city water department meter accurate to 0.1 gal), and pressure gauge (200 psi with 5 psi increments), quick acting cut-off valve, and by-pass valve were in the line between the pump and the A drill rod.

Upon moving the rig to a designated drillhole the groundwater level and temperature were determined. The groundwater temperature was in all cases lower than that of the lake water used as the test water. The drillhole was then cased with steel NX casing to the top of rock and the entire drill hole flushed with clean water until the return became clear. The packers were then lowered into the drill hole for testing of the deepest rock section. The height from ground surface to the top of the swivel connecting the A drill rod and the metering section was measured and recorded. The drill hole was flushed until all entrapped air was removed at which time the pump was cut back and the packers inflated to between 60 and 80 psi depending on test section depth. The pump was then speeded up and regulated in unison with the by-pass valve until the desired test pressure was reached (1 psi per foot of depth below ground surface to middle of test section). The test pressure was maintained constant and the flow in gallons was recorded at 1 minute intervals for 15 to 20 minutes.

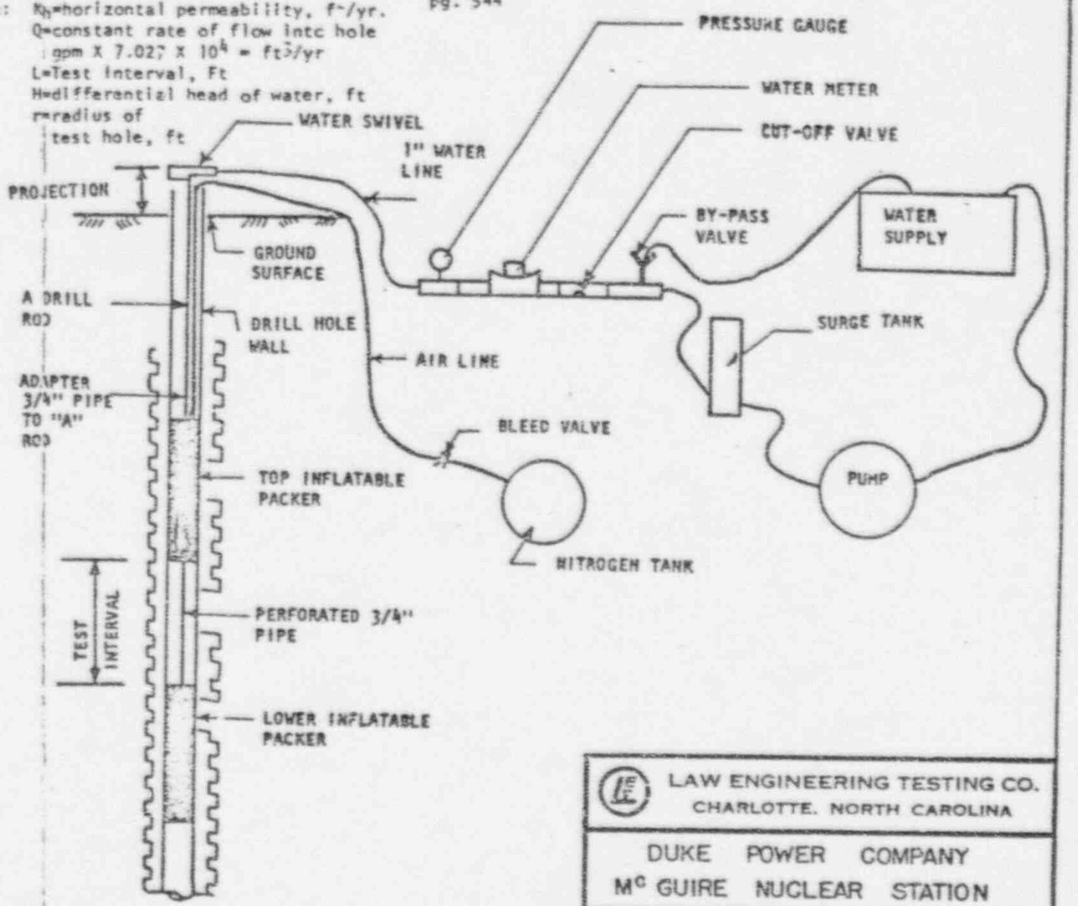
At completion of the test the quick acting cut-off valve was closed and pressure and time readings were recorded for the closed system. These readings were designated as holding test readings.

After performing the holding test, the packers were deflated and the packer assembly moved up the drill hole to the next test level. The drill hole was flushed again to remove air in the line and the packers re-inflated for the next test.

$$* \quad K_h = \frac{Q}{2\pi LH} \log_e \frac{L}{r}$$

where:
K_h=horizontal permeability, ft/yr.
Q=constant rate of flow into hole gpm X 7.027 X 10^4 = ft^3/yr
L=Test interval, Ft
H=differential head of water, ft
r=radius of test hole, ft

* Earth Manual, USDI Bureau of Reclamation, pg. 544

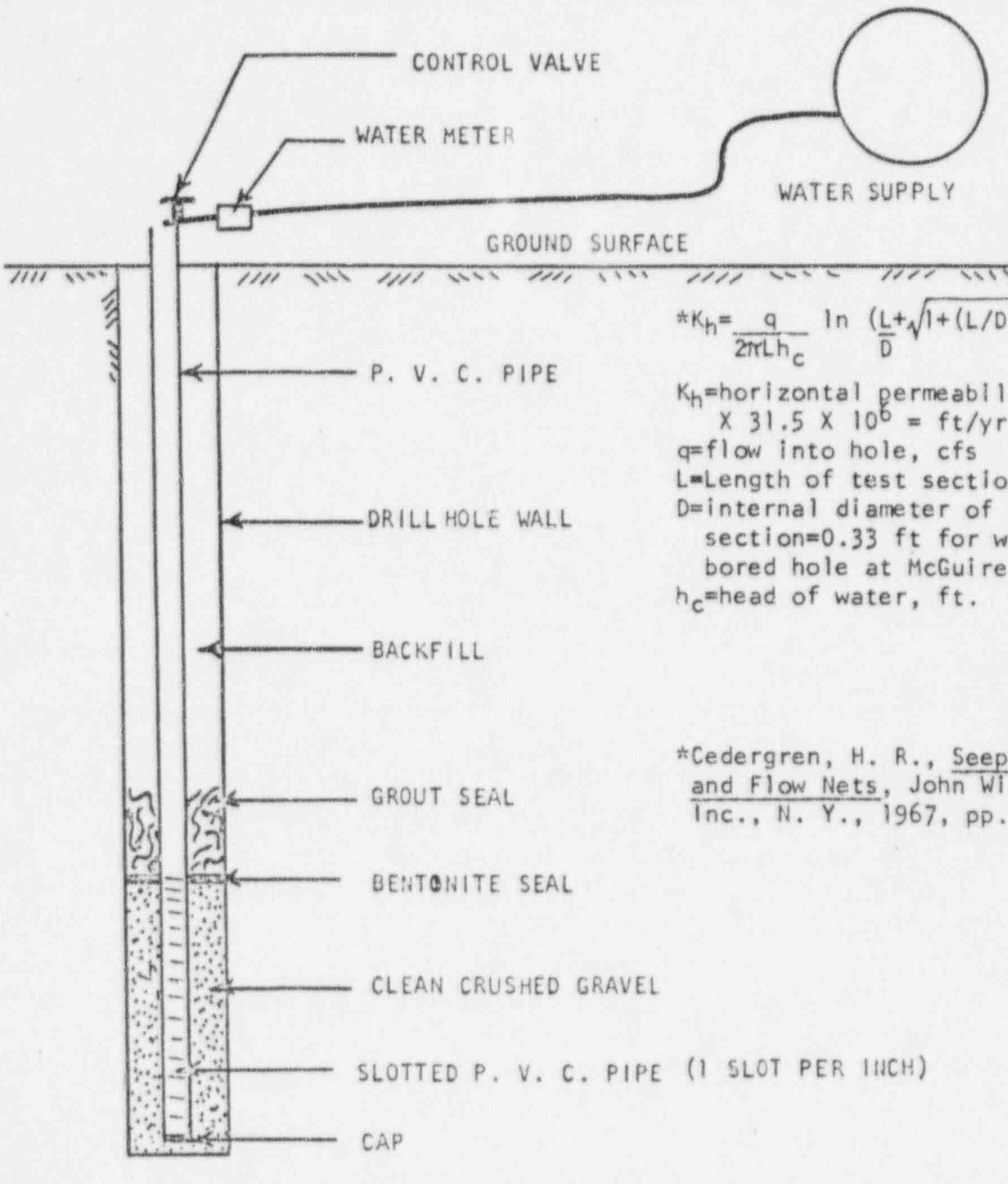


LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

DUKE POWER COMPANY
MC GUIRE NUCLEAR STATION

SCHEMATIC OF EQUIPMENT LAYOUT & DESCRIPTION OF PROCEDURE FOR ROCK PERMEABILITY TESTING

DWN. BY	JAH		SCALE:
CKD. BY	SEB		DRAWING NO.
APPR'D.	SEB		FIGURE 2B-5



$$^{*}K_h = \frac{q}{2\pi L h_c} \ln\left(\frac{L}{D} + \sqrt{1+(L/D)^2}\right), \text{ fps}$$

K_h=horizontal permeability, fps
X 31.5 X 10^6 = ft/yr
q=flow into hole, cfs
L=Length of test section
D=internal diameter of test section=0.33 ft for wash bored hole at McGuire 1 and 2
h_c=head of water, ft.

*Cedergren, H. R., Seepage, Drainage and Flow Nets, John Wiley & Sons, Inc., N. Y., 1967, pp. 87-89

Soil Permeability Testing

Constant head testing was performed in piezometers due to the inability of obtaining a good seal in the soil with the packer equipment. A five foot section of slotted (one slot per inch on two sides) p.v.c. pipe was sealed within the soil stratum to be tested. The groundwater level was recorded to establish the head applied during the test. The water head was maintained at the top of the p.v.c. pipe above ground level by adjusting a needle valve connected in line with a water meter and the water supply tank. Water meter and time readings were recorded during the test.

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

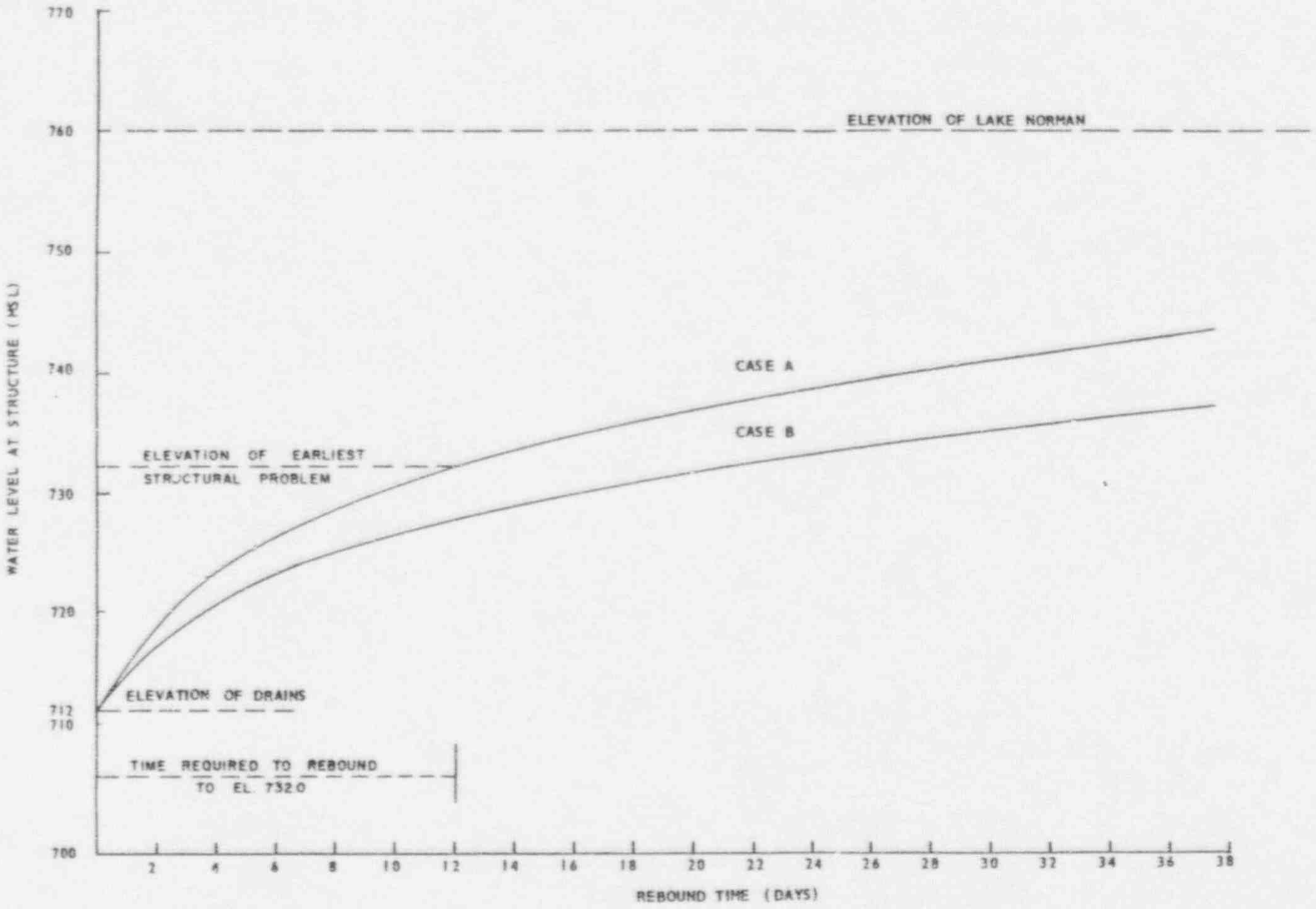
SCHEMATIC OF EQUIPMENT LAYOUT & DESCRIPTION OF PROCEDURE FOR SOIL PERMEABILITY TESTING

McGUIRE NUCLEAR STATION
FIGURE 2B-6

TIME PLOT OF LAKE LEVEL,
TAILWATER LEVEL, GROUND WATER
LEVEL AND RAINFALL

McGUIRE NU R STATION

Figure [illegible]



CASE	K ft/yr	S	E gpd/ft^2
A	300	0.1	0.0598
B	300	0.1	0

K = PERMEABILITY
S = STORAGE COEFFICIENT
E = INFILTRATION

PLOT OF WATER LEVEL AT STRUCTURE VERSUS REBOUND TIME

McGUIRE NUCLEAR STATION

Figure 2B-8

OVERSIZE DOCUMENT PAGE PULLED

SEE APERTURE CARDS

NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARDS 1

APERTURE CARD/HARD COPY AVAILABLE FROM

RECORDS AND REPORTS MANAGEMENT BRANCH

OVERSIZE

DOCUMENT

PAGE(S) PULLED

SEE APERTURE CARD FILES

APERTURE CARD/PAPER COPY AVAILABLE THROUGH NRC FILE CENTER

NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARD(S) 1

ACCESSION NUMBERS OF OVERSIZE PAGES:

9706190420