Docket STN-50488--88
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DUKE POWER COMPANY

POWER BUILDING, BOX 2178, CHARLOTTE, N. C. 28242

W. H. OWEN
VICE PRESIDENT,
DESIGN ENGINEERING

October 13, 1975

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Division of Reactor Licensing
United States Nuclear Regulatory Commission
Washington, D.C. 20555

RE: Project 71
Perkins Nuclear Station
Docket Nos. STN-488, -489, -490
Duke File No. PK-1444.00

Dear Mr. Muller:

Duke Power Company is filing herewith three (3) signed originals and one-hundred-ninety-seven (197) copies of Amendment 4 to the Project 81 Perkins Nuclear Station Environmental Report.

As required by Section 2.101 of the Commission's Regulations, a copy of this amendment is being served on Mr. Ronald H. Vogler, County Manager of Davie County, North Carolina.

Yours very truly,

s/W.H. Owen

W. H. Owen

W. H. Owen being duly sworn states that he is Vice-President of Duke Power Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this amendment to its Application and documents appended thereto; and that all statements and matters set forth therein are true and correct to the best of his knowledge.

s/W.H. Owen
W. H. Owen
Vice-President, Design Engineering

ATTEST:

s/George W. Ferguson, Jr.
George W. Ferguson, Jr., Associate
General Counsel & Secretary

Subscribed and sworn to before
me this day of October, 1975

s/ Carol D. Denton
Notary Public

My commission expires: 9-16-79

PERKINS NUCLEAR STATION
ENVIRONMENTAL REPORT
DOCKET NOS. 50-488,-489,-490

ENVIRONMENTAL REPORT
Amendment No. 4
October 13, 1975

The following listed pages, tables, and figures are to be inserted as replacements for existin_ pages, tables, and figures. Also insert additional material marked "New" where appropriate.

Remove the following sheets:	Insert the following sheets:
Chapter 1-Vol. 1	
ER-iii	ER-iii
ER-xxi	ER-xxi
ER-xxvi	ER-xxvi
1.1-1,-2,-3,-4	1.1-1,-2,-3,-4
Tables: 1.1.1-3,-4	Tables: 1.1.1-3,-4
Chapter 2-Vol. 1	
2-xv	2-xv
2.1-1	2.1-1,-1a,-2
2.2-3	2.2-3,-3a
2.2-4,-5	2.2-4,-5
2.5-15	2.5-15
2.6-3,-4	2.6-3,-4
Tables: 2.6.2-5	Tables: 2.6.2-5
Figures: 2.1-6,-7	Figures: 2.1-6,-7 2.1-8(1 of 4 thru 4 of 4)
Chapter 3-Vol. 1	
3-v	3-v
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3.3-2,-3	3.3-2,-3
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Tables: 3.3.0-3 3.4.0-1 3.5.1-3 3.5.2-1	Tables: 3.3.0-3 3.4.0-1 3.5.1-3 3.5.2-1
Figures: 3.1.0-5 3.4.0-2,-3 3.6.1-1	Figures: 3.1.0-5 3.4.0-2,-3 3.6.1-1

Remove the following sheets:	Insert the following sheets:
Chapter 4-Vol. I	
4.1-3,-10	4.1-9,-10
Figures: 4.1.1-4	Figures: 4.1.1-4
Chapter 5-Vol. II	
5-i	5-i
5-iii	5-iii
5.1-3,-4	5.1-3,-4
5.1-4e,-4f,-4g,-4h	5.1-4e,-4f,-4g,-4h
5.1-6a,-7	5.1-6a,-7
5.2-1,-2	5.2-1,-2
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1.1 NEED FOR POWER

Information is presented in this section relative to the need for power on the Duke system based on past and projected load growth, reserve margins, and the reliability of the bulk power supply. Both the Duke system and the other power systems in the same geographic region are considered in the evaluation. Detailed statistical information relative to the Duke system may be found in "Uniform Statistical Report - Year Ended December 31, 1974". Q1.1.8

1.1.1 LOAD CHARACTERISTICS

Table 1.1.1-1 lists the actual territorial peak loads and annual energy requirement for the Duke system from 1964 through 1974, and the forecast values from 1975 through 1988. The corresponding values for the Virginia-Carolinas (VACAR) subregion of the Southeastern Electric Reliability Council (SERC), of which Duke is a part, are tabulated in Table 1.1.1-2. The Council and its subregions are described in Section 1.1.2. Q1.1.2

A breakdown of annual peaks and energy production for the Duke system by months for the years 1965, 1970, 1973, and 1974 appears in Table 1.1.1-3. Although no specific trend in demand or energy growth is discernible from this table, a comparison of the monthly demand and energy values of 1974 with the corresponding values of 1973 yields a significant indicator. Q 1.1.4c

Comparison of Duke System Monthly Demand and Energy Values

Maximum Hourly Demand - MW

	Month	1972	1973	1973/72 % Inc.	1974	1974/73 % Inc.
	January		7185.7		7264.7	1.10
	February		7247.0		7492.0	3.38
	March		6740.5		7104.3	5.40
	April		6663.9		6707.7	0.66
	May		6431.8		7008.3	8.96
4	June		7238.6		7606.4	5.08
	July	7449.5	7763.7	4.22	7921.3	2.03
	August	7177.3	8235.6	14.75	8057.6	-2.16
	September	6847.5	7601.0	11.00	7567.7	-0.44
4	October	6447.1	6753.3	4.75	6974.7	3.28
	November	6829.5	6894.0	0.94	7064.7	2.48
	December	7258.7	7292.6	0.47	7581.0	3.95

Territorial Load - GWH

	Month	1972	1973	1973/72 % Inc.	1974	1974/73 % Inc.
4	January		4116.0		3857.8	-6.27
	February		3746.2		3621.9	-3.32
	March		3769.6		3696.5	-1.94
	April		3509.2		3499.9	-0.26
	May		3645.2		3802.4	4.31
	June		3886.0		3746.3	-3.59
4	July	3644.2	4049.8	11.13	4085.0	0.87
	August	3974.1	4318.3	8.66	4156.3	-3.75
	September	3556.8	3882.7	9.16	3637.4	-6.32
	October	3554.6	3800.8	6.93	3691.4	-2.88
	November	3693.6	3691.8	-0.05	3625.4	-1.80
	December	3788.8	3867.3	2.07	3819.8	-1.23

It must be inferred from this comparison that energy conservation measures recently employed in the wake of the Arab oil embargo have had considerable impact on the Duke system load. It will be noticed, however, that although the energy production in 1974 has consistently fallen behind the corresponding values of 1973, the maximum monthly demand figures for 1974 show a consistent increase over the 1973 values. The net effect of energy conservation, therefore, is to reduce the energy consumed over a period of time, but not to reduce materially the demand at time of peak. It is anticipated that any elasticity in the consumption of electric energy with price would bear a similar relationship. It is not possible at this time to determine the long-range impact of energy conservation or rate increases, but the peak demand and annual energy forecasts shown in Table 1.1.1-1 do reflect a decreasing rate of growth as well as a decreasing load factor. The forecast is discussed later in this section. Q 1.1.1g

Prior to June, 1971, Duke Power Company's advertising was directed toward promoting those uses of electricity which tended to improve the load factor of the plant in service, with particular emphasis on the electric heating concept. No promotion of air-conditioning load was made in either regular marketing advertising or Medallion advertising during this time.

In June, 1971, all marketing advertising except Medallion advertising was discontinued. Medallion advertising was retained in an effort to improve the system load factor by offsetting the normal growth in summer load with an increased winter heating load. No new commitments for Medallion advertising were made, however, after October, 1972. Commitments which had already been made were honored through March, 1973, at which time all Medallion advertising was discontinued. This action resulted in a complete cessation of all marketing advertising. Q 1.1.1a

Since March, 1973, all Duke Power advertising has been of an informational (institutional) nature. This advertising has been directed toward acquainting customers with company activities which affect them -- environmental protection, reasons for rate increases, energy conservation, the need for additional generating capability, etc. Public understanding of the company's efforts in these areas is considered essential if the company is to carry out its responsibility to provide reliable electric service to the area it serves. Q 1.1.1b

There are, of course, a number of ways to gauge the intensity of advertising. Total dollar amounts are relative only when applied to the market area in which the advertising is being done. For example, a million-dollar advertising campaign in a single television market would give intensive exposure to the advertising message, while the same amount spent in a regional market would be substantially less intensive. The most accurate yardstick, and the one most often used by electric utilities, is that which relates advertising expenditures to the number of customers the advertising is intended to reach -- advertising cost per customer. Since most of Duke Power advertising has been directed toward residential customers, advertising expenditure for each of the three years, 1971 through 1973, are shown in the following tabulation as "costs per customer".

DUKE POWER COMPANY
Advertising Expenses - $

		Institutional	Medallion	Marketing	Total
1971:	Total cost	471 815	319 771	247 463	1 039 049
	Cost per customer	0.55	0.31	0.24	1.10
1972:	Total cost	478 911	250 277	24 245	753 433
	Cost per customer	0.53	0.28	0.03	0.84
1973:	Total cost	791 441	*141 462	None	932 903
	Cost per customer	0.85	0.15	--	1.00

*Discontinued March 31, 1973

Q 1.1.1a

It is pertinent to compare the rates of growth of the various load classifications on the Duke system. The largest single load classification on the Duke system is textiles, comprising 18.4 percent of the total annual energy sales in 1974. This industry, which is highly sensitive to a number of economic factors, has historically grown at an average annual rate of approximately 6.2 percent; all other industry, representing some 15.9 percent of the total energy sales in 1974, has grown at a rate of approximately 11 percent annually. Q 1.0.1

Residential use, which constituted approximately 31.2 percent of the energy sold in 1974, has been growing at roughly 8.5 percent per year. It should be pointed out, however, that the rate of growth of energy sales to all-electric residences, roughly one half of all residential sales in 1974, has been at better than 12 percent per year. This trend is expected to continue, or possibly to increase, if the cost of fossil fuels to the residential consumer continues to climb, or if he is threatened with possible shortages of fossil fuels for heating his home. Sales to municipal systems and cooperatives, which constitute the major portion of the remaining energy sales on the Duke system, are growing at rates comparable with Duke's residential sales. The regulatory commissions that regulate the retail price of electricity in the Duke service area are the North Carolina Utilities Commission and the South Carolina Public Service Commission. Q 1.0.2 Q 1.1.1c

The effect of energy conservation measures on various classifications of energy sales in 1973 and 1974 is demonstrated in the following table:

Energy Sales by Load Classifications - MWH

Month	Residential			Industrial		
	1973	1974	% Inc.	1973	1974	% Inc.
January	1065.4	1096.3	2.90	1333.3	1449.6	8.72
February	1045.3	898.9	-14.00	1545.1	1385.1	-10.35
March	922.0	899.7	- 2.42	1509.3	1387.8	- 8.05
April	789.8	856.8	8.48	1537.6	1493.4	- 2.87
May	706.5	720.7	2.00	1568.7	1646.7	4.97
June	694.8	730.3	5.11	1661.3	1601.8	- 3.58
July	835.8	805.0	- 3.69	1520.1	1473.7	- 3.05

Q 1.1.1g

Energy Sales by Load Classifications - MWH (cont.)

Month	Residential 1973	Residential 1974	Residential % Inc.	Industrial 1973	Industrial 1974	Industrial % Inc.
August	872.1	864.3	- 0.89	1776.9	1731.1	- 2.58
September	890.1	846.1	- 4.94	1689.7	1572.3	- 6.95
October	725.2	740.1	2.05	1619.3	1506.8	- 6.95
November	740.0	777.5	5.07	1621.8	1435.3	-11.50
December	898.9	1088.9	21.14	1465.1	1197.0	-18.30

Month	General Services 1973	General Services 1974	General Services % Inc.	Resale 1973	Resale 1974	Resale % Inc.
January	585.8	570.9	- 2.54	503.5	569.2	13.05
February	612.0	555.2	- 9.28	558.2	469.1	-15.96
March	575.5	538.8	- 6.38	469.8	446.8	- 4.89
April	555.0	543.1	- 2.14	457.7	465.8	1.77
May	550.8	553.1	0.42	432.9	490.1	13.21
June	581.1	597.2	2.77	468.5	461.7	- 1.45
July	653.7	619.6	- 5.22	521.5	528.8	1.40
August	678.4	648.2	- 4.45	597.3	580.1	- 2.88
September	691.3	655.5	- 5.18	536.2	517.2	- 3.54
October	637.8	585.2	- 8.25	457.8	475.6	3.89
November	595.8	574.5	- 3.58	515.3	526.8	2.23
December	569.9	612.2	7.42	506.7	559.7	10.46

Q 1.1.1g

No maximum monthly demand figures by classification are available, but it is evident that energy consumption was curtailed sharply in all classifications during most of 1974. By the end of the year, however, growth is noted in all classifications except the industrial, which is most sensitive to the economic recession. Also, a number of industrial plants have had considerable success in reducing both the demand and energy consumed in their operations. The forecast shown in Table 1.1.1-1, therefore, is predicated on the assumption that the growth in annual peak demand will not be affected greatly by energy conservation measures, but that growth in energy sales may decline, hence, the load factor projected for future years is below that historically experienced on the Duke system.

It is evident that the reduction in energy consumption occurs in the base load portion of the load curve because there is essentially no change in the shape of the load duration curve itself other than a displacement downward by an amount equivalent to the change in load factor. Hence the effect of energy conservation is felt equally throughout the year, and does not appear seasonally or solely in the peak.

In making the forecast, two trends are included: That of the base portion of the load, and that of the temperature responsive component of load. The base load portion of the forecast is trended from historical base loads determined by correlating daily peak loads with temperature variables as expressed in the equation

ER TABLE 1.1.1-3

Perkins Nuclear Station

Monthly Peak Demands and Energy

Duke System

Month	1965 MW	1965 MWH	1970 MW	1970 MWH	1973 MW	1973 MWH	1974 MW	1974 MWH
January	3 498.1	1 864 044	6 031.5	3 260 946	7 185.7	4 116 007	7 264.7	3 857 812
February	3 470.4	1 719 482	5 743.7	2 829 286	7 247.0	3 746 230	7 492.0	3 621 858
March	3 370.7	1 383 359	5 460.6	2 953 837	6 740.5	3 769 611	7 104.3	3 696 541
April	3 245.0	1 750 121	5 145.8	2 808 823	6 663.9	3 509 236	6 707.7	3 499 935
May	3 508.2	1 854 272	5 449.8	2 932 494	6 431.8	3 645 187	7 008.3	3 802 388
June	3 605.2	1 855 521	5 998.0	2 997 383	7 238.6	3 886 018	7 606.4	3 746 326
July	3 664.9	1 849 648	*6 283.9	3 240 911	7 763.7	4 049 765	7 921.3	4 084 987
August	*3 826.4	2 017 759	6 225.6	3 281 072	*8 235.6	4 318 279	*8 057.6	4 156 306
September	3 694.4	1 937 428	6 089.2	3 151 262	7 601.0	3 882 671	7 567.7	3 637 361
4 October	3 487.2	1 930 087	5319.0	2 995 974	6 753.3	3 800 767	6 974.7	3 691 440
November	3 723.0	1 929 256	6 147.6	3 000 678	6 894.0	3 691 807	7 064.7	3 625 423
December	3 702.1	2 057 446	6 050.5	3 188 533	7 292.6	3 867 340	7 581.0	3 819 784
Total energy put on lines		22 648 423		36 641 199		46 282 918		45 240 161
Annual Load Factor		67.6%		67.6%		64.2%		64.1%

*Peak for year

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ER TABLE 1.1.1-4
Perkins Nuclear Station

Duke System Energy Dispatch for Year 1988

UNIT		UNIT CAPACITY (MW)	UNIT ENERGY (MWH x 1000)
Oconee	1	871	5 985.3
	2	871	6 004.3
	3	871	6 021.1
McGuire	1	1180	6 356.3
	2	1180	6 492.2
Catawba	1	1153	6 591.1
	2	1153	6 767.1
Perkins	1	1280	8 492.4
	2	1280	7 801.7
	3	1280	6 938.7
Cherokee	1	1280	8 310.1
	2	1280	7 742.2
	3	1280	7 074.6
Total Nuclear Energy			90 577.1

Nuclear Energy	90 577.1
Conventional Steam	28 849.8
Hydro, Purchase, Misc.	1 726.6
Total Energy Input	121 153.5
-Pumped Hydro Losses	-1 524.5
Net Load Requirements	119 629.0

UNIT		UNIT CAPACITY (MW)	UNIT ENERGY (MWH x 1000)
Allen	1	165	272.9
	2	165	239.4
	3	265	679.7
	4	265	615.0
	5	254	735.0
Buck	5	128	174.6
	6	128	136.2
Cliffside	3	61	39.4
	4	61	40.9
	5	572	3 341.0
Dan River	1	71	45.8
	2	71	43.4
	3	142	149.4
Lee	1	84	67.3
	2	84	67.3
	3	155	195.1
Marshall	1	385	1 878.2
	2	380	1 814.3
	3	550	2 968.6
	4	550	3 267.8
Riverbend	4	94	78.1
	5	94	74.5
	6	133	120.8
	7	133	120.6
Belews Creek	1	1060	5 775.5
	2	1060	5 909.0
Total Conventional Steam			28 849.8

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2.1 SITE LOCATION AND LAYOUT

Perkins Nuclear Station is located in Davie County, North Carolina on the Yadkin River, approximately seven miles east-southeast of Mocksville, North Carolina. The plant site is approximately 2,200 yards north of the Yadkin River channel, as shown on Figure 2.1-1.

The plant site, as shown on Figure 2.1-2, is bounded on the north, east and west by private property and on the south by the Yadkin River. The center line of Reactor Building number two is located at latitude 35 degrees - 50 minutes - 53 seconds north and longitude 80 degrees - 27 minutes
3 - 10 seconds west. The corresponding Universal Traverse Mercator Grid Coordinates are N 3,967,030.34 and E 549,408.65, zone 17. Q2.0.1

The Exclusion Area is the area within a 2,500 foot radius centered at the unit two Reactor Building. The Low Population Zone is the area within a five mile radius centered at the unit two Reactor Building. A security fence will be erected around the immediate station area.

Of the property within a two mile radius of the site, two percent is water surface, 18 percent is owned by Duke Power Company (as of May, 1975) and the remaining 80 percent is privately owned. Figure 2.1-3 shows existing Q Q
3 land use (as of June 30, 1974) within a two mile radius of the Perkins 1.1.11 2.0.4
station and residences anticipated to be removed before the plant becomes 1.1.12
operational.

In order to use condemnation procedures for acquiring land, a Utility is Q
required by law to obtain a Certificate of Public Convenience and Necessity 1.1.8
from the North Carolina Public Utilities Commission. Therefore, eminent domain proceedings cannot be initiated until the certificate is received by Duke.

As of June 30, 1974, four families have been displaced as a result of Duke Q
Power Company acquiring the site. It is estimated that an additional 22 1.1.9
families will be displaced before the plant becomes operational. Figure 2.1-4 shows property adjacent to the site, and property at the site which has been acquired as of June 15, 1975. Also shown on the figure are the
4 | 3 parcels remaining to be acquired. Duke originally intended to acquire all property inside the area zoned heavy industrial.

Survey work for the railroad right-of-way is in progress. Final alignment Q
of the route is in design stage and property information is not available 1.1.7
as yet.

The proposed transmission corridors have tentatively been laid out, but the routes have not been finalized. Acquisition of right of way will not begin until the routes have been finalized and surveying has begun. At the present time, no right of way has been acquired from any private landowners in the Perkins area, and the number of parcels in the rights of way has not been determined.

Figure 2.1-5 is an aerial photograph of the site and vicinity.

4

4 Figure 2.1-6 shows the area topography by sector within a 10 mile radius of the site. Figure 2.1-7 shows site topographical features as modified by the plant site. A plot of the maximum topographic elevation versus distance from the center of the plant in each of the 16 22½ degree cardinal compass point sectors, to a distance of 10 miles is shown in Figure 2.1-8. Q3

Activities within the Exclusion Area will be limited to those associated with the nuclear station.

There will be no recreational or agricultural land uses allowed within the site area. Q 5.7.1

2.1.1 PROPOSED CARTER CREEK RESERVOIR LOCATION AND LAYOUT

The proposed Carter Creek reservoir is located in Davie County, North Carolina, approximately four miles north-northeast of Perkins Nuclear Station (Figure 2.1.1-1). The reservoir dam site is located on Carter Creek approximately 2,000 feet upstream of the Carter Creek, Yadkin River confluence, as shown on Figure 2.1.1-2.

The reservoir site is bounded by private property and lies within an area bounded by North Carolina Highway 801 to the south and east, County Road 1616 to the north, and County Road 1611 to the west. Current (March, 1975) land usage in the 1400 acre site area is composed of approximately 64 per- Q18
cent wooded, 19 percent pasture, 10 percent cropland, and 7 percent cleared
3 or idle. Figures 2.1.1-2 and 2.1.1-3 are a topographical map and an aerial Q4
photograph, respectively, outlining the reservoir and land anticipated to be owned by Duke surrounding the proposed reservoir.

An estimated 18 buildings will be affected by the creation of the reservoir. Of the 18 buildings, 13 are houses, 3 are mobile homes, and 2 are farm buildings. Q15

Duke plans to close the portions of County Roads 1617 and 1618 which will be inundated. Duke will coordinate with the North Carolina State Highway Department the closing of these roads to minimize the impact to local residents. Q16 Q18

A 44 KV line, to be constructed, will supply power for the reservoir pumps. As of May, 1975, the final route of this line has not been determined.

The Carter Creek reservoir will be constructed and operated to assure the continued operation of Perkins Nuclear Station during periods of low flow in the Yadkin River. For this reason, water levels in the reservoir may fluctuate more than is desirable for a recreational impoundment. Duke does Q5
not plan to encourage such usage. Any recreational patterns that may be established on the reservoir or surrounding area will be subject to Duke's use of the reservoir for its intended purpose.

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within five miles of the site. U. S. Highway 64, located approximately 2.4 miles north of the site, and N. C. Highway 801, located approximately .6 miles north and 1.5 miles west of the site, are the major transportation arteries in the vicinity of the site. Figure 2.2.2-1 shows the closest Q2.2.1
1 school, church, hospital, dairy, farm, rest home, residence and animal producing milk for human consumption within a 10 mile radius of the site. Table Q5
4 2.2.2-1a details distance and direction for Figure 2.2.2-1.

Figure 2.2.2-1a shows locations of dairy herds and individual cows and goats producing milk for human consumption within five miles and from five to ten miles of the Perkins power block. Q 2.2.2.1.1 Q5

2.2.2.1 Agriculture

Figure 2.2.2-2 shows concentrations of major farm products within five miles of the site. Farm products generally found within five miles of the site are wheat, corn, tobacco, milo, barley, and soybeans with concentrations of corn to the north and west and tobacco to the south. Some cattle and swine are raised throughout the area. Q 2.2.2.1.3

1 Despite its small area, Davie ranks near the top in Dairying, and has led the state several times. Dairy products amount to about $3,000,000 annually. Beef cattle and poultry are also important products.[9]

Davie is blessed with fine farming land, abundant natural water and mild climate enabling cows graze on pasture 12 months per year with supplements to their diet for approximately three months in mid-winter. Feed supplements normally consist of local hay and silage and some feed grains. Q 5.3.3.2

There is substantial cultivation of tobacco and various truck crops, but most emphasis is on small grain. Figure 2.2.2-2a shows the location, acreages and estimated annual income of tobacco fields within a 3 mile radius of the plant site. Total acreage of forest land is 78,788 acres.[9] Q 2.2.2.1.2

2.2.2.2 Transportation and Industry

Figure 2.2.2-3 shows routes, locations, and industries in the vicinity of the site. Table 2.2.2.1 gives details for this figure.

Transportation facilities have been a major factor in determining non-agricultural land uses. The heaviest concentrations of development occur in and around the town of Mocksville, the city of Lexington, unincorporated Cooleemee, and the city of Salisbury. Located approximately seven miles west-northwest of the site is the town of Mocksville.

Mocksville is an important center for highway transportation, with U. S. Highways 158, 64, and 601 meeting there. These highways join interstate 40 which is approximately nine miles to the northwest of the site. In addition, rail service by Southern Railway and bus service by Greyhound are available. Air service is conveniently near in Winston-Salem.

In addition to its attractive residential area, Mocksville is the industrial center for Davie, embracing a thriving, diversified family of manufacturers. There is an active social and civic life; the town is widely known for its

Masonic Picnic, which attracts upward of 10,000 people every August.

Mocksville's industrial family, healthily diversified, effectively balances the county's agricultural economy. It includes the Heritage Furniture

Plant, the Ingersol Rand plant, five garment plants, a belt factory, numerous feed mills, and lumber plants. Located in the county are a finishing mill in Cooleemee and a lary. R. J. Reynolds Tobacco Company storage facility. 1 Just outside Mocksville is a new Baker Company furniture manufacturing plant and a new B.V.D. manufacturing plant.[9]

Located approximately ten miles east of the site is the city of Lexington. Lexington is primarily an industrial community with over 12,000 persons working in manufacturing and processing. About 60 industrial firms inject 1 over $50,000,000 a year into the area's economy through their employees.[10]

Furniture and textile industries employ the largest number of persons. Other types of industry include machinery and machine parts, electronics, food products, ceramics, and veneer and plywood. A partial list of products 1 manufactured in Lexington include: household furniture, fiber glass, molded plastics, jams and jellies, campers, dehydrated sauce mixes, industrial dryers, mercury batteries, boxes, mattresses and clothing.[10]

Salisbury, located approximately 10.5 miles south of the site is served by U. S. Highways 29, 52, 70 and 601, Interstate Highway 85 and North Carolina Highway 150. Salisbury is served by one railroad and 41 motor freight 1 lines.[11]

Sixty-three percent of all plant workers in Rowan County are employed in either food processing, apparel, textile or wood products industries, all 1 of which are labor intensive.[11]

The portions of Davie, Davidson and Rowan Counties that are within a ten mile radius of the site are rural residential with commercial development bordering rural roads and clustering around churches or at road intersections.

2.2.2.3 Wildlife Preserves

Cooleemee Plantation Game Land is located on the Yadkin River in Davie and Davidson Counties. Its nearest boundary is 1.3 miles to the east-northeast of the site (Figure 2.2.2-4). The 4,000 acre gameland which is managed and maintained by the N. C. Wildlife Resources Commission is open to seasonal hunting for all game species (with a few exceptions), with hunting limited to Mondays, Wednesdays, Saturdays and Federal holi-1 days.[12] There are no other hunting areas or refuge areas within five miles of the site except as allowed by local land owners.

2.2.2.4 Zoning

Figure 2.2.2-5 presents detailed zoning information for Davie and Davidson Counties within the five mile radius of the site.

Davidson County has recently adopted a zoning ordinance. The area south of N. C. Highway 64 has not yet been zoned. The area to the north of Highway 64 within five miles of the site is zoned Residential-Agricultural.

	Minimum	Average	Maximum
6) Station service water	-	1	5
7) Flood discharge (PMP)	-	-	5625

The Auxiliary Holding Pond is located west of the powerhouse yard. The dam that forms the pond has a crest elevation of 685 feet msl. The pond capacity curve is shown on Figure 2.5.5-2.

2.5.6 WATER QUALITY STANDARDS

Compliance with all applicable water quality standards and requirements is a criterion for the construction and operation of Perkins Nuclear Station. Relevant regulations and requirements are contained in Appendix I. The status of all applications and permits affecting plant construction and operation is discussed in Section 12.1.

2.2.2.5 Water Use

Figures 2.2.2-6 and 2.2.2-7 show present water usage within a 20 mile radius of the site and 50 miles downstream of Perkins Nuclear Station.

Present groundwater usage within 20 miles of Perkins Nuclear Station is shown on Figure 2.2.2-6. Surface water usage within 20 miles of the site and 50 miles downstream is shown on Figure 2.2.2-7. Tables 2.2.2-2 and 2.2.2-3 respectively show details of Figures 2.2.2-6 and 2.2.2-7.

LeGrand[13] indicates that the radius of influence of wells in the area are in the order of a few hundred feet. In particular, wells placed closer than 200 feet apart will probably interfere with each other, and wells spaced further than 1000 feet apart may not interfere with each other appreciably. These statements indicate a typical radius of influence of between 100 and 500 feet.

2 Computations using measured values of permeability at the site, and using Q
the formula[4] 2.2.2.5.3

4 $$R = C' (H-h_w) \sqrt{k}$$

indicate that for a well depth of 225' and a drawdown of 75' (average values for domestic wells reported by LeGrand, the radius of influence for a typical domestic well would be 300 feet for average permeabilities of 200 feet/year, and only 700 feet for average permeabilities of 1000 feet/year. Field tests and computations using measured spring discharges indicate that the average permeability at the site is on the order of 200 feet/year, and thus pumping from wells in the area should not influence groundwater levels beyond 300 feet from the wells. No wells are located closer than 300 feet to any significant plant structure.

Due to the relatively impermeable nature of the soils and rock at the site,
the radius of influence of wells in the immediate vicinity of the site is Q
only a few hundred feet with continuous pumping. Since the wells surrounding 2.2.2.5.4
the site are used for domestic purposes, it is unlikely that these wells would be subjected to continuous high-volume pumping, and thus drawdowns are expected to be small even near the wells. Thus, these drawdowns are not expected to induce flow reversals even under extreme conditions.

The minimum daily average flow of record at the Yadkin College gage of
1 330 cfs is assumed to be the minimum dilution flow. Accordingly, the Q
maximum dilution flow is assumed to be the maximum daily average flow 2.2.2
of 64,100 cfs. The dilution flows for chemical, biocide and liquid
radwaste are detailed in Table 2.2.2-4. The transient times to downstream Q
2 surface water intakes are detailed in Table 2.2.2-5. Figure 2.2.2-7 gives 2.2.2.5.2
locations for Table 2.2.2.5. Water velocity estimates are conservatively Q
based on a discharge-velocity curve (Figure 2.2.2-8) for the Yadkin 2.2.2.5.2
College gage.

The first downstream water user on the Yadkin River is the City of Salisbury
2 (Key number 8 on Table 2.2.2-5), located eleven River Miles from the station
discharge. The average transient time to the intake from the station dis- Q
charge is 5.2 hours. 2.2.2.5.1

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2.6.2.2 Results

4 Table 2.6.2-1 (Sheets 1-7) displays the joint frequencies of wind direction and speed by atmospheric stability type as they were observed onsite at the 30 foot level. Calms are defined for this table as wind speeds less than one mile per hour. The recovery of joint wind speed, direction, and stability data for this one year period was 89.81 percent of the total possible hourly observations. This distribution is the basis for all onsite X/Q estimates. A more detailed discussion of the wind and stability characteristics observed during the field measurement period follows the presentation of long-term diffusion estimates in Section 2.6.3. Q4

Figures 2.6.2-1 and 2.6.2-2 represent the distributions of hourly dispersion factors at the exclusion area boundary (2500 feet) and the low population zone boundary (26,400 feet) respectively for the period of record. The distributions are calculated for the shortest distance between the boundary of interest and the nearest reactor vent; that is, 1960 feet at the exclusion area boundary and 25,860 feet at the low population zone boundary. The locations of the vents with respect to the center of the exclusion area boundary is shown on Figure 3.1.0-4. The 95 percentile X/Q value at the exclusion area boundary is noted as 2.5×10^{-3} sec/m^3, and the corresponding 50 percentile X/Q value is noted as 1.7×10^{-4} sec/m^3. At the low population zone boundary the indicated 95 percentile X/Q value is 1.4×10^{-4} sec/m^3, and the 50 percentile X/Q value at this distance is 6.0×10^{-6} sec/m^3.

Estimates of the dispersion factors for intermediate averaging times (greater than hourly but not more than 30 days) at the low population zone boundary are required for the worst value (100 percentile) and the 95 percentile and 50 percentile levels. Table 2.6.2-4 (Sheets 1-4) include the cumulative frequency distributions for averaging times or "windows" of 8 hours, 16 hours, 72 hours, and 624 hours. These distributions correspond to times of 8 hours, 24 hours, 4 days, and 30 days following an accidental release.

The 100, 95, and 50 percentile X/Q values have been estracted from the frequency distributions and summarized in Table 2.6.2-5 for convenience.

2.6.3 LONG TERM (ROUTINE) DIFFUSION ESTIMATES

2.6.3.1 Objectives

Realistic estimates of annual average onsite atmospheric dispersion factors are provided in this section. Three separate analyses comprise this section:

1) A spatial distribution of annual average X/Q values is generated assuming advection and diffusion are the primary plume dispersion and transport processes.

2) A value for Man-X/Q is calculated as a population weighted annual average value within a 50 mile radius of the site.

3) Annual average X/Q values for computing radioiodine dosage through milk and leafy vegetables is produced considering the role of dry deposition in plume depletion in addition to the advection and diffusion of the plume.

Onsite data from October 12, 1973, through October 11, 1974, provides the basis for the disperison estimates. These estimates are assumed to be representative of long term X/Q values anticipated for an extended time period.

The wind and stability characteristics of the site and the relationship of these parameters to corresponding regional airport parameters are discussed with respect to their effect on the resulting X/Q values.

2.6.3.2 Results

The areal distribution of annual average normalized concentrations is presented in Table 2.6.3-1 (Sheets 1-10) and in Figure 2.6.3-1 (Sheets 1-3). The highest X/Q value occurs at the exlcusion area boundary (radius of 600 m) at a receptor located west-southwest of the plant (angle = 245°). The X/Q value at this receptor is 1.9 X 10^{-5} sec/m^3.

The Man-X/Q value for the entire area within 50 miles of the Perkins site is 6.9 X 10^{-8} sec/m^3. As a basis for estimating the effects of radioiodine through the milk pathway and the vegetable pathway, annual average dispersion factors were computed for farms and cow pastures in the vicinity of the site. The X/Q values for the farm and the cow with the highest expected dosage potential were computed from the X/Q distribution and from a survey of land usage in the vicinity of the plant. The highest farm X/Q value, referring
3 to the vegetable pathway, is 2.0 X 10^{-6} sec/m^3. The highest cow and goat X/Q values, referring to milk pathway, are 1.0 X 10^{-6} sec/m^3 and 5.o x 10^{-8} sec/m^3, respectively.

The results of each of the above long term dispersion analyses appear in Table 2.6.2-5.

As has been stated the distribution of wind direction and speed at the site is affected by site topography. Figure 2.1-1 and the site plot plan indicate (Q 2.6.7) the large scale topographical features, the existing features of the immediate plant environs before construction, and proposed excavation, and structures after construction. The existing meteorological towers are approximately 1600 feet from the nearest reactor vent. Because of the proximity of the existing towers to the reactor site, we expect existing 10 meter wind (Q 2.6.3) conditions to be similar over the distance between the tower and the reactor vents.

The present towers are located on a gentle slope with a basically north-south orientation toward the Yadkin River level. This gentle slope will be replaced by several plateaus: a uniform 710 feet above MSL reactor (Q 2.6.13) yard, a 740 feet MSL switch yard complex, and a 730 feet MSL cooling tower base level. In addition, the land immediately south of the towers will be flooded to 695 feet MSL for the nuclear service water pond. The overall orientation of the Yadkin River in the vicinity of the site is east-northeast to west-southwest. It is likely that small changes in wind speed and direction distributions will be experienced due to slight alterations


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Table 2.6.2-5
Perkins Nuclear Station
Dilution Factors
for Accident and Routine Releases

Type of Release	Distance to Receptor (m)	Dilution Factor (X/Q sec m^{-3})	Percentile Value
0-2 hr	762	2.5×10^{-3}	95
0-2 hr	762	1.7×10^{-4}	50
0-2 hr	8048	1.4×10^{-4}	95
0-2 hr	8048	6.0×10^{-6}	50
0-8 hr	8048	6.0×10^{-5}	100
0-8 hr	8048	2.9×10^{-5}	95
0-8 hr	8048	5.6×10^{-6}	50
8-24 hr	8048	3.7×10^{-5}	100
8-24 hr	8048	1.8×10^{-5}	95
8-24 hr	8048	7.2×10^{-6}	50
1-4 day	8048	1.2×10^{-5}	100
1-4 day	8048	8.0×10^{-6}	95
1-4 day	8048	3.6×10^{-6}	50
4-30 day	8048	3.1×10^{-6}	100
4-30 day	8048	2.5×10^{-6}	95
4-30 day	8048	1.3×10^{-6}	50
1 year	762 (245°)	1.9×10^{-5}	100
1 year (cow)	1770 (W)	1.0×10^{-6}	100
1 year (goat)	10463 (NE)	5.0×10^{-8}	100
1 year (farm)	1127 (NE)	2.0×10^{-6}	100

3 Exclusion Area Boundary 762 m
4 Low Population Zone Boundary 8048 m
Distance to Highest Dosage Milked Cow 1770 m
Distance to Highest Dosage Milked Goat 10463 m
Distance to Highest Dosage Farm 1127 m

Mean Annual Average X/Q for Total Population to 50 Miles (based on 1980 population estimates) - 6.9×10^{-8} sec/m^3.

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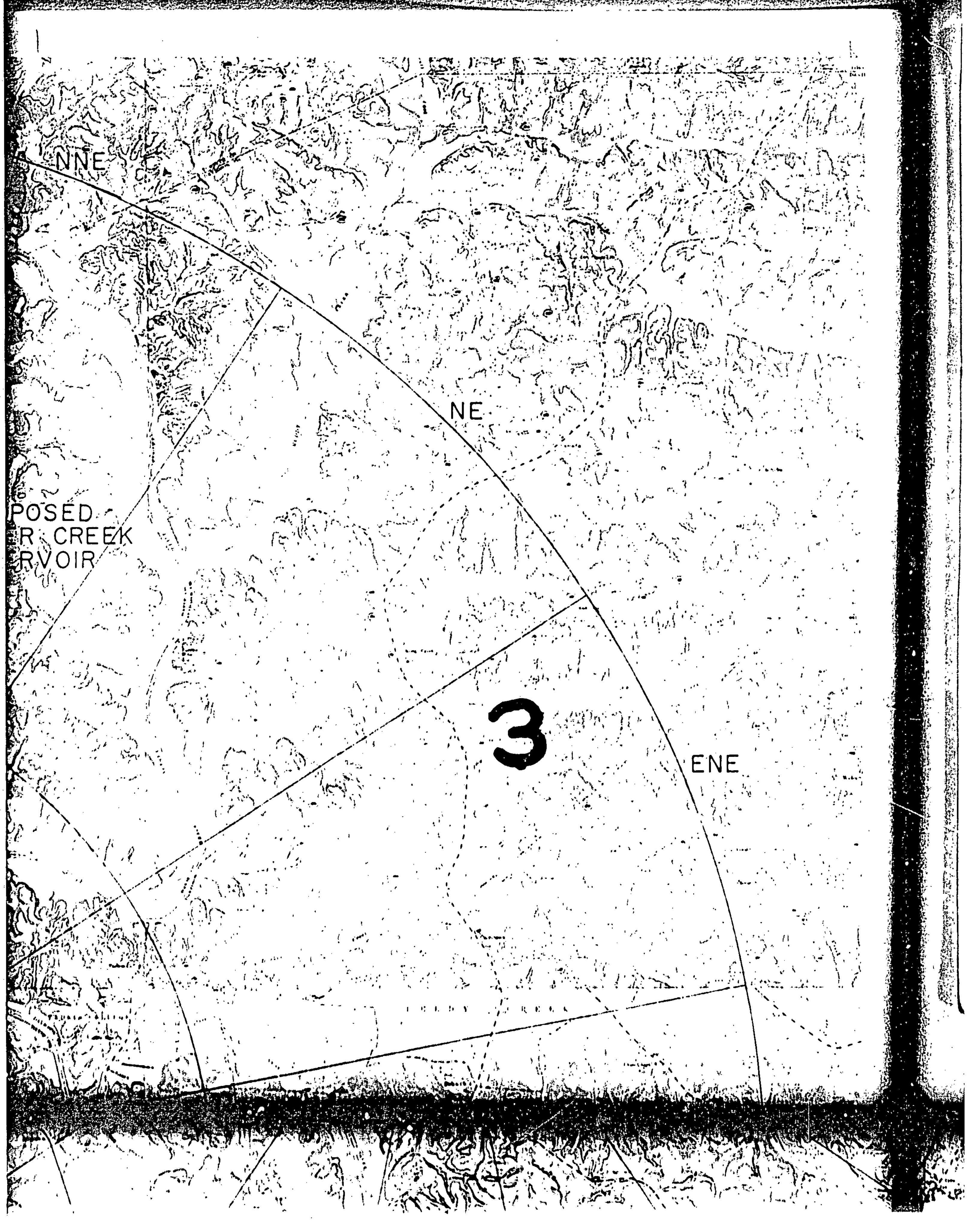
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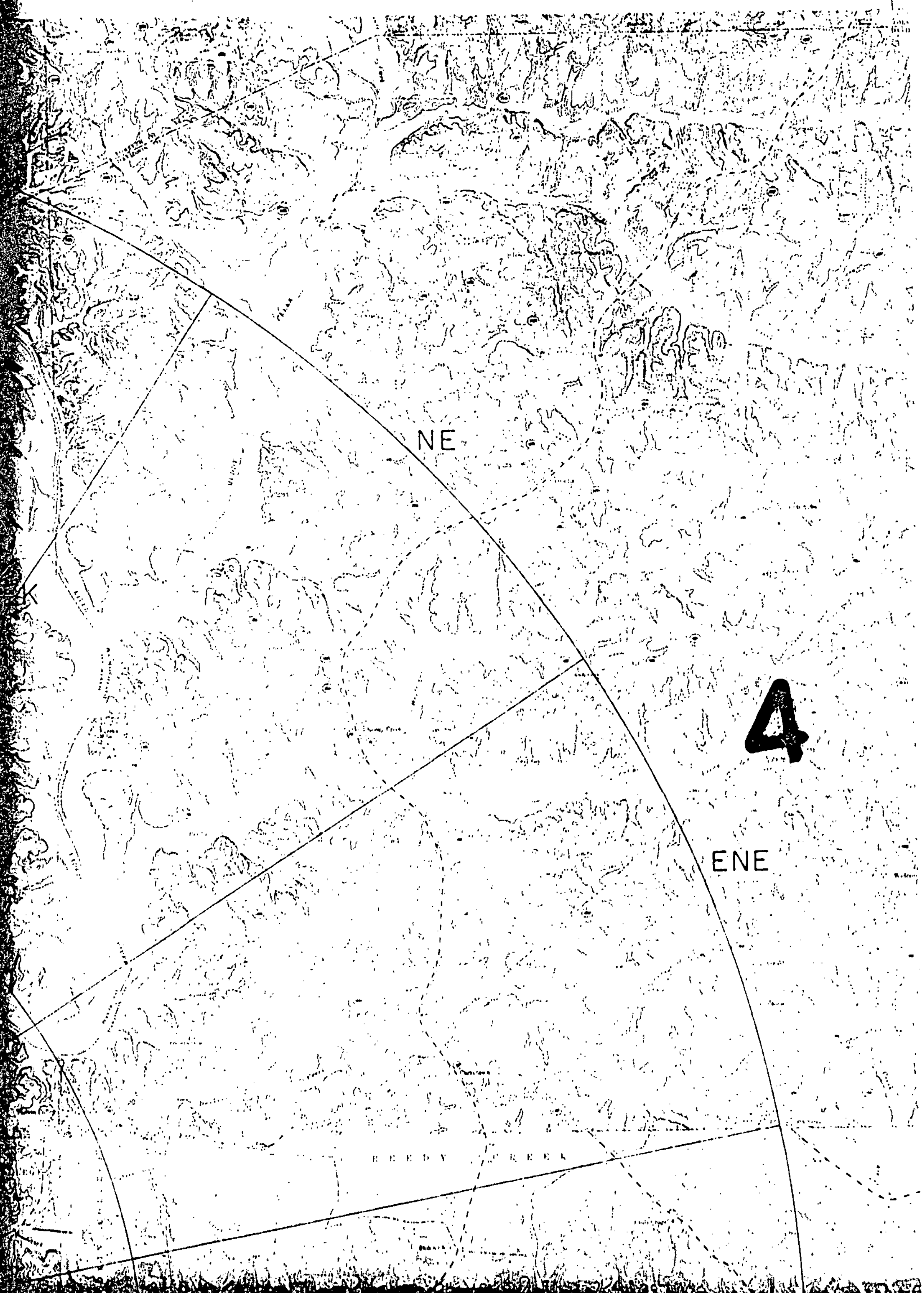
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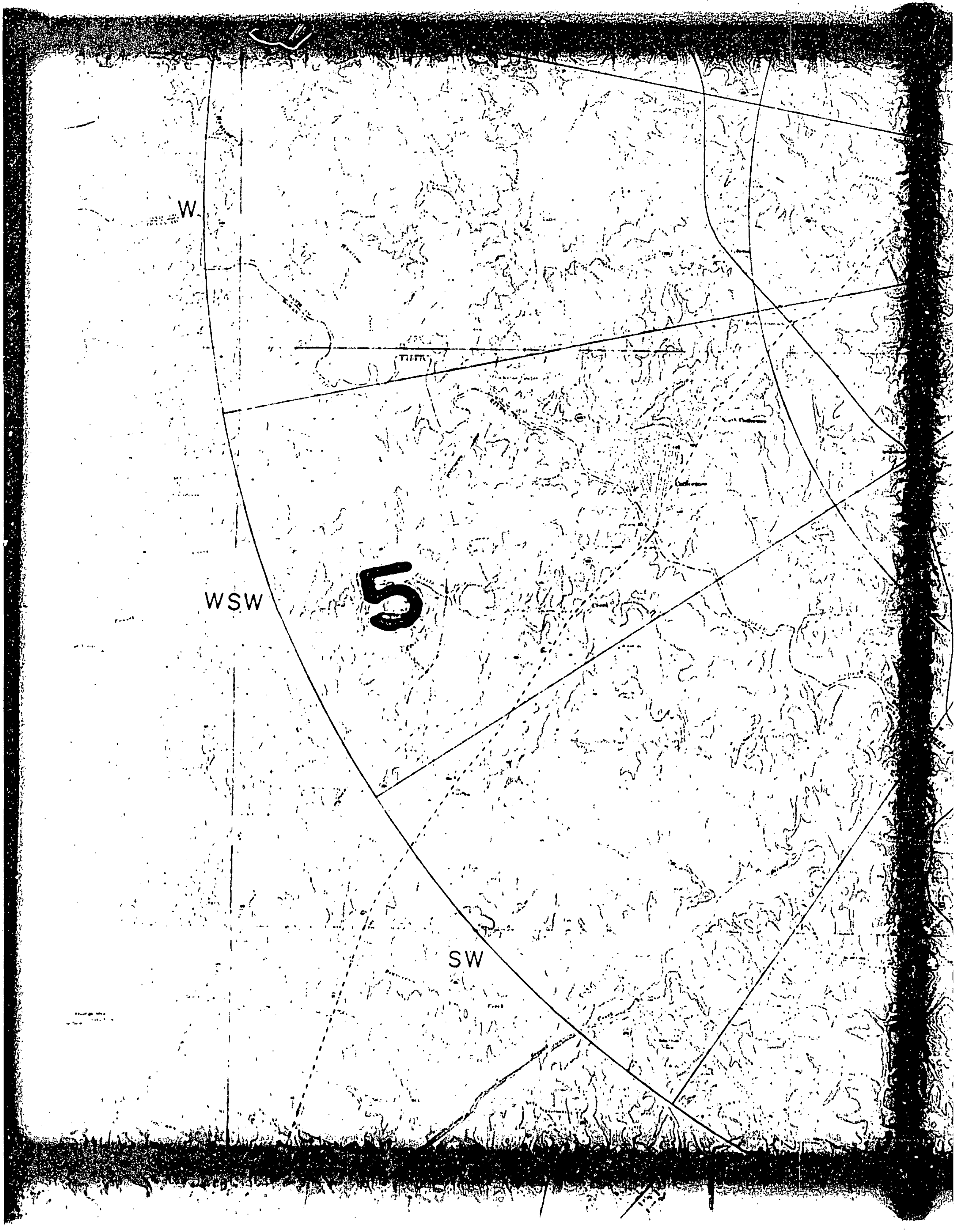

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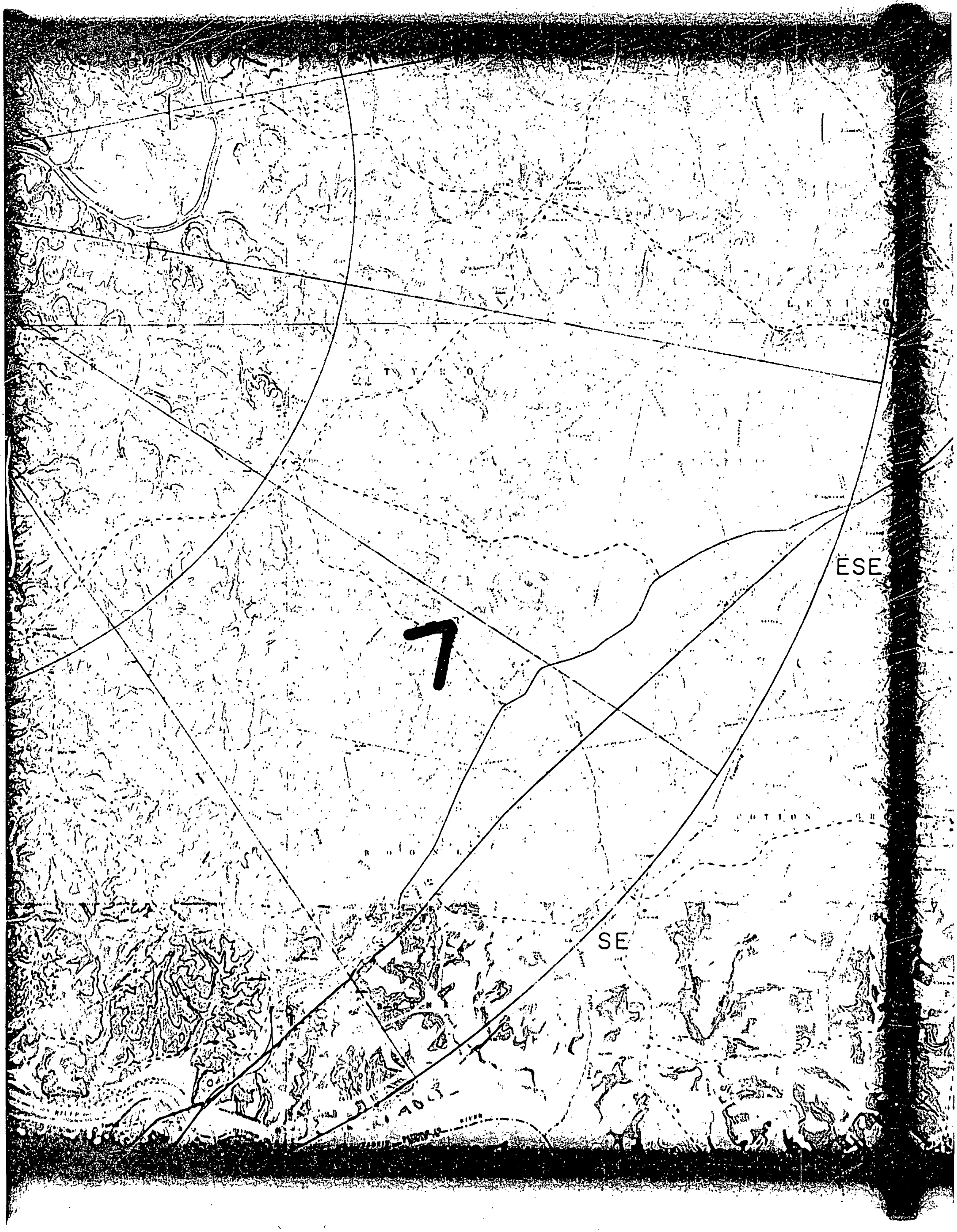
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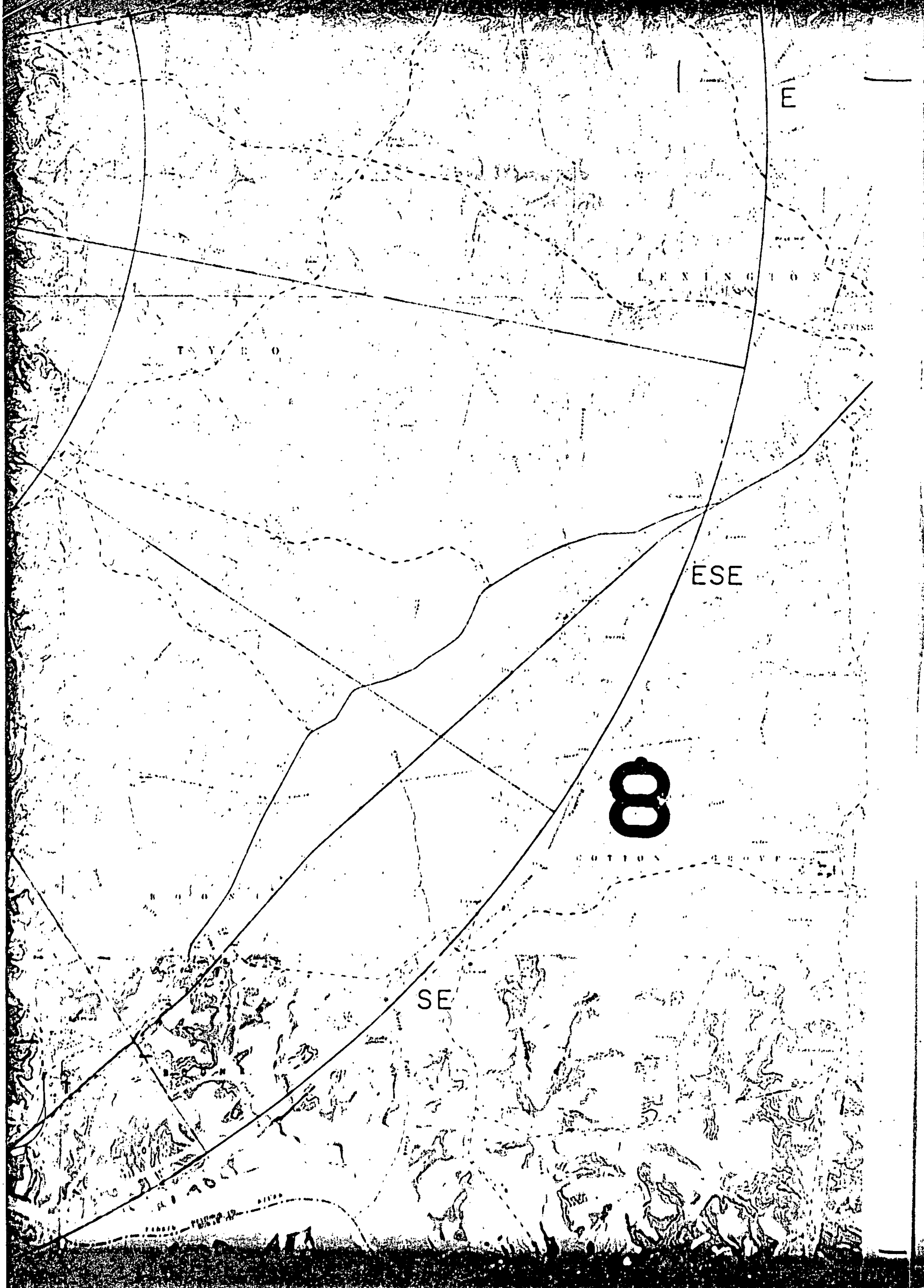

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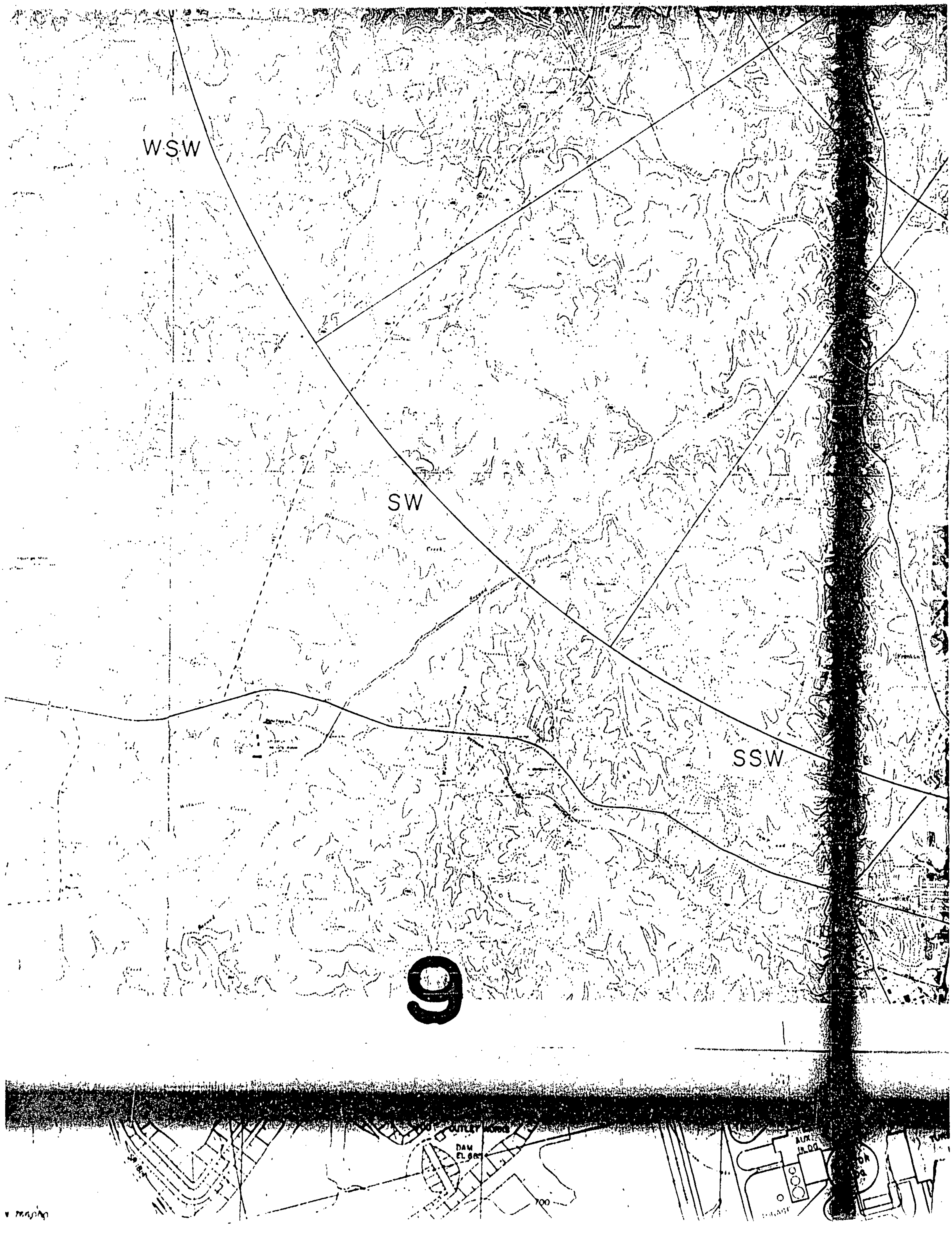
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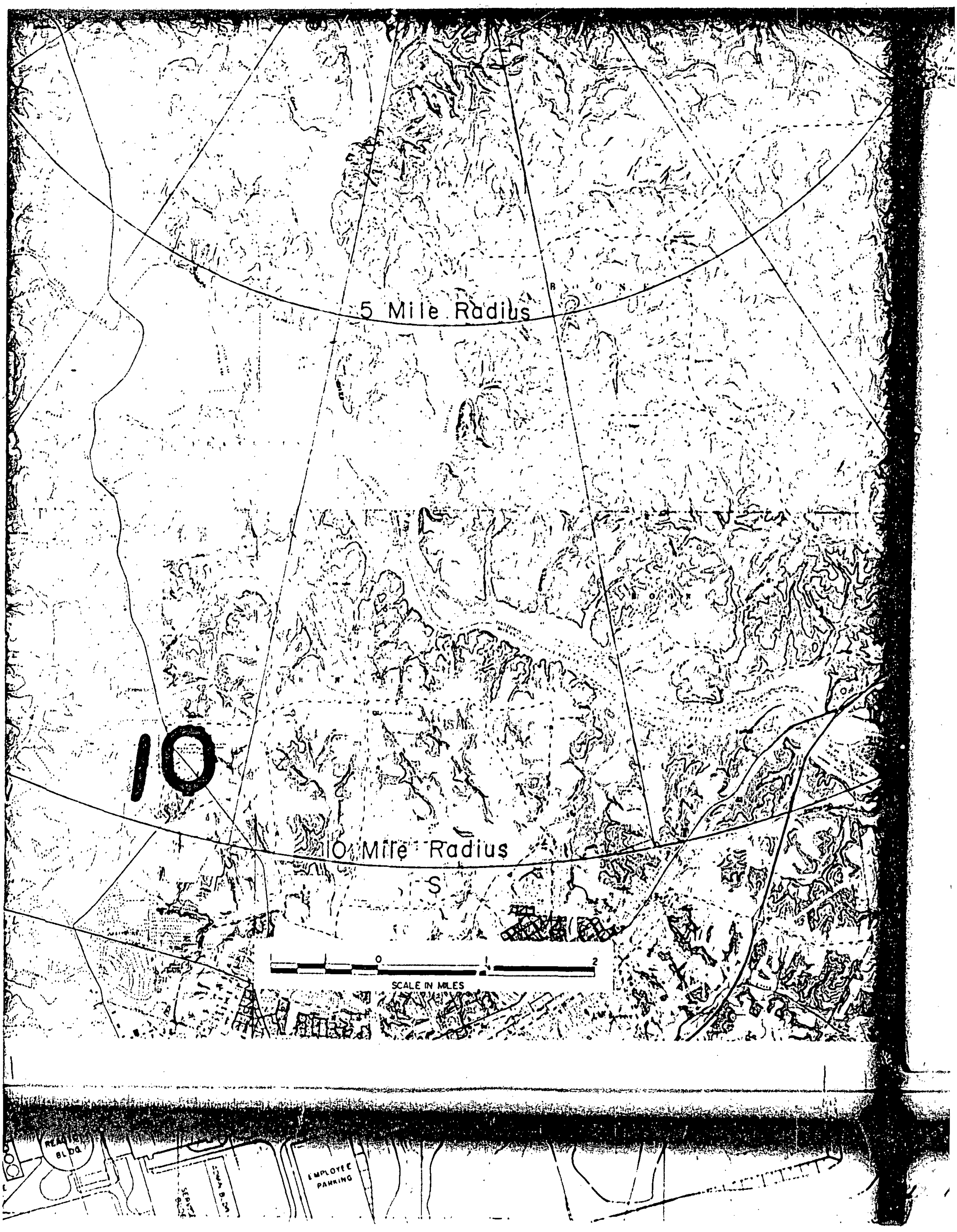
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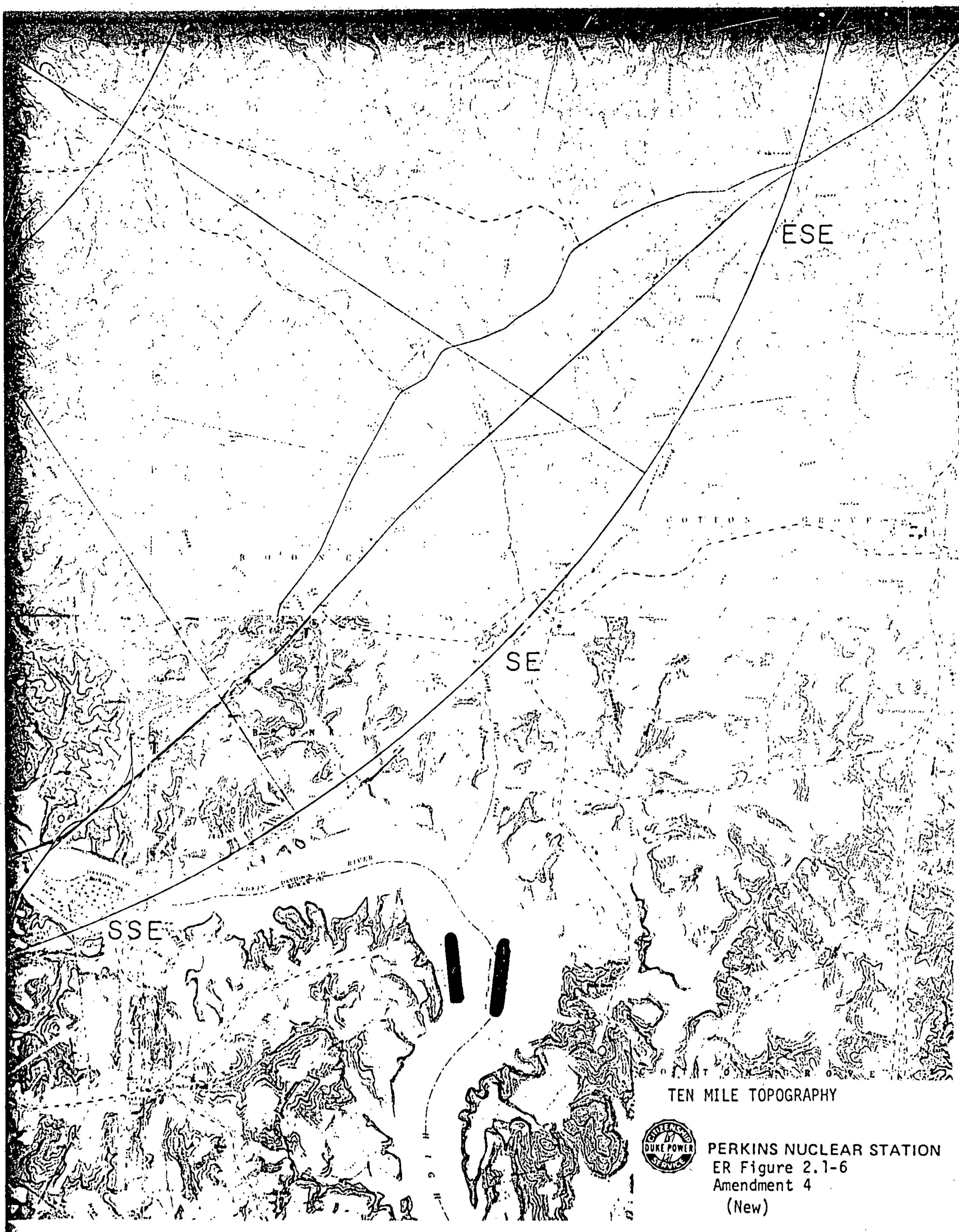

TEN MILE TOPOGRAPHY

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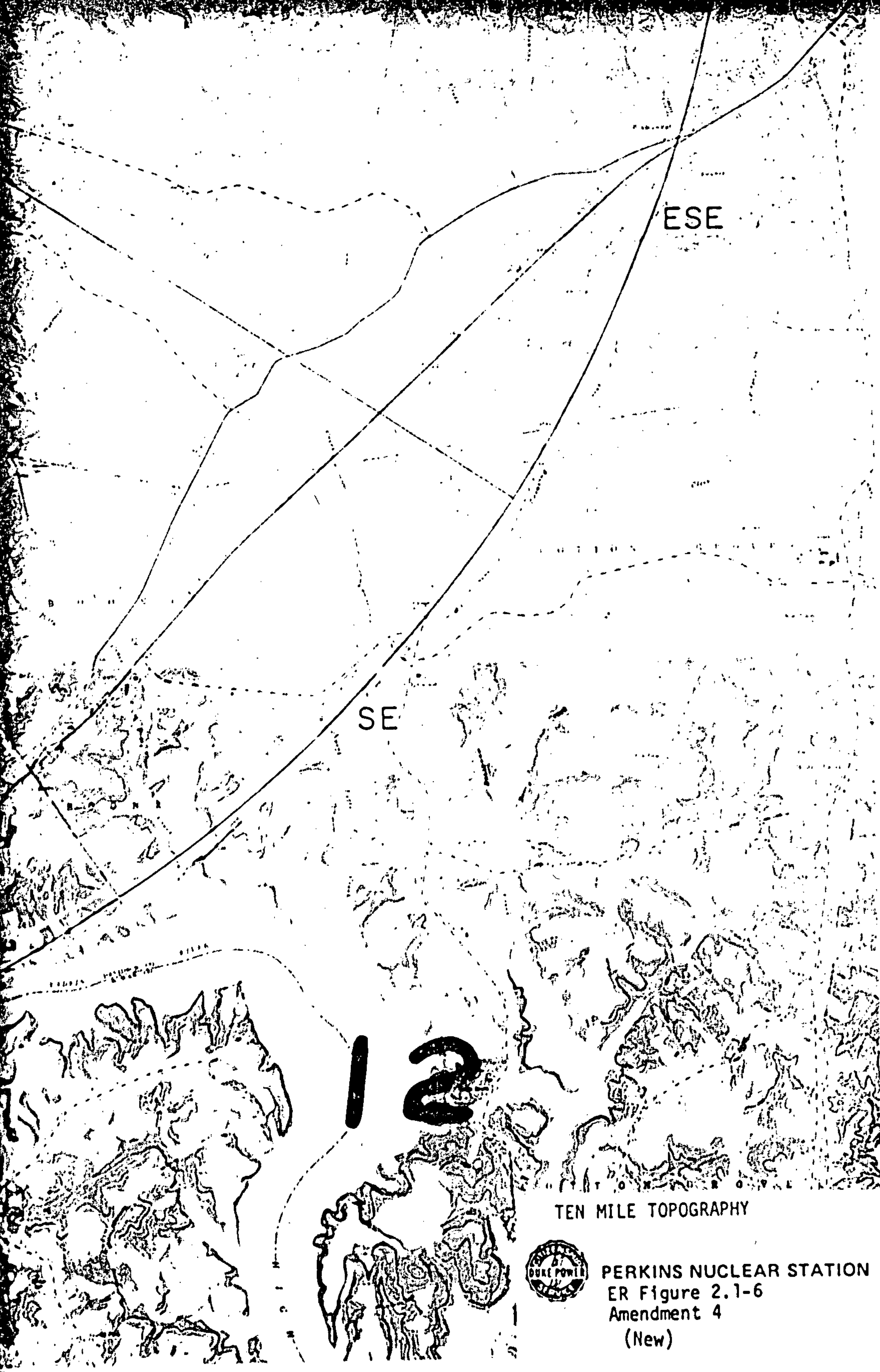

TEN MILE TOPOGRAPHY

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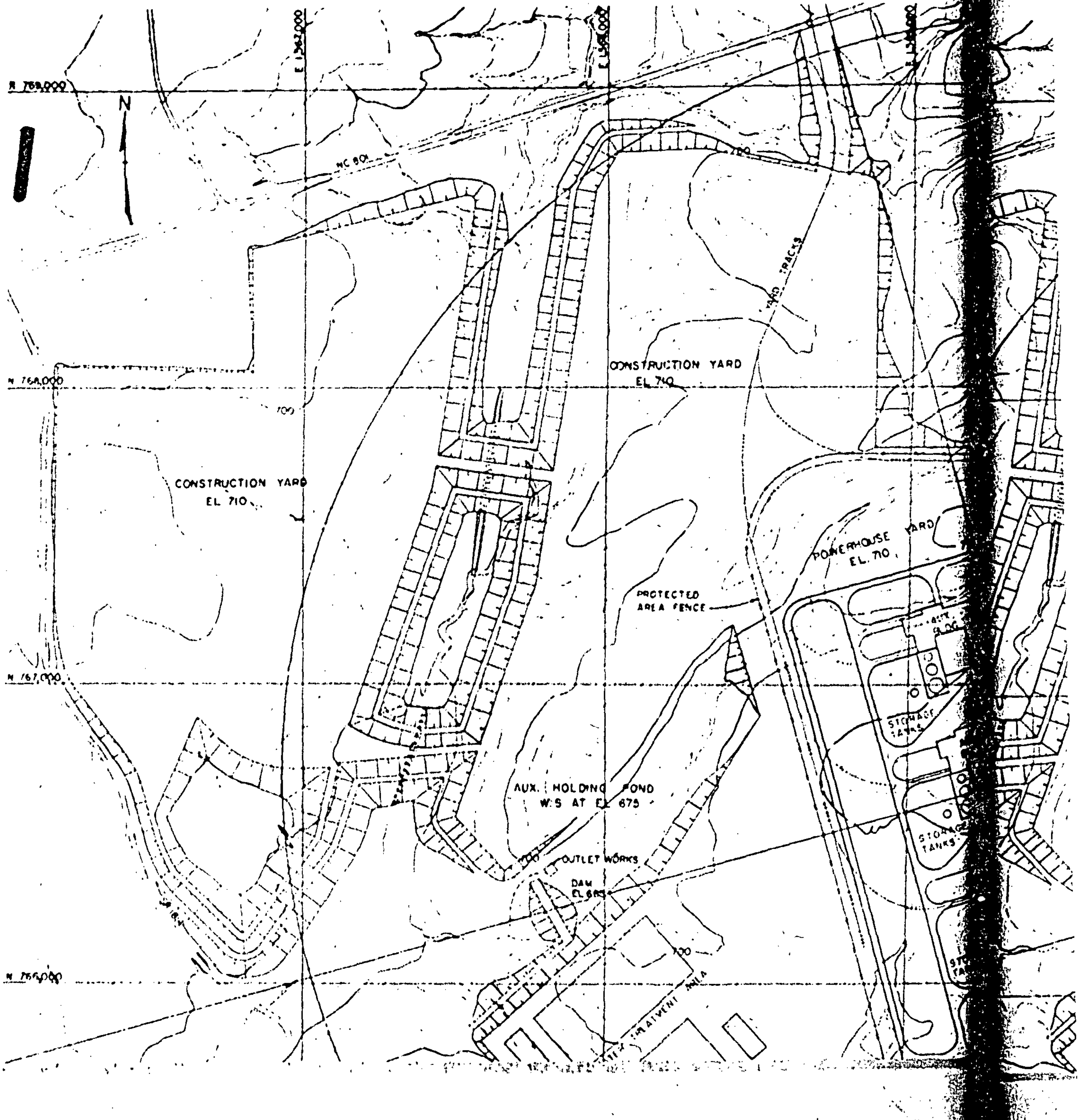
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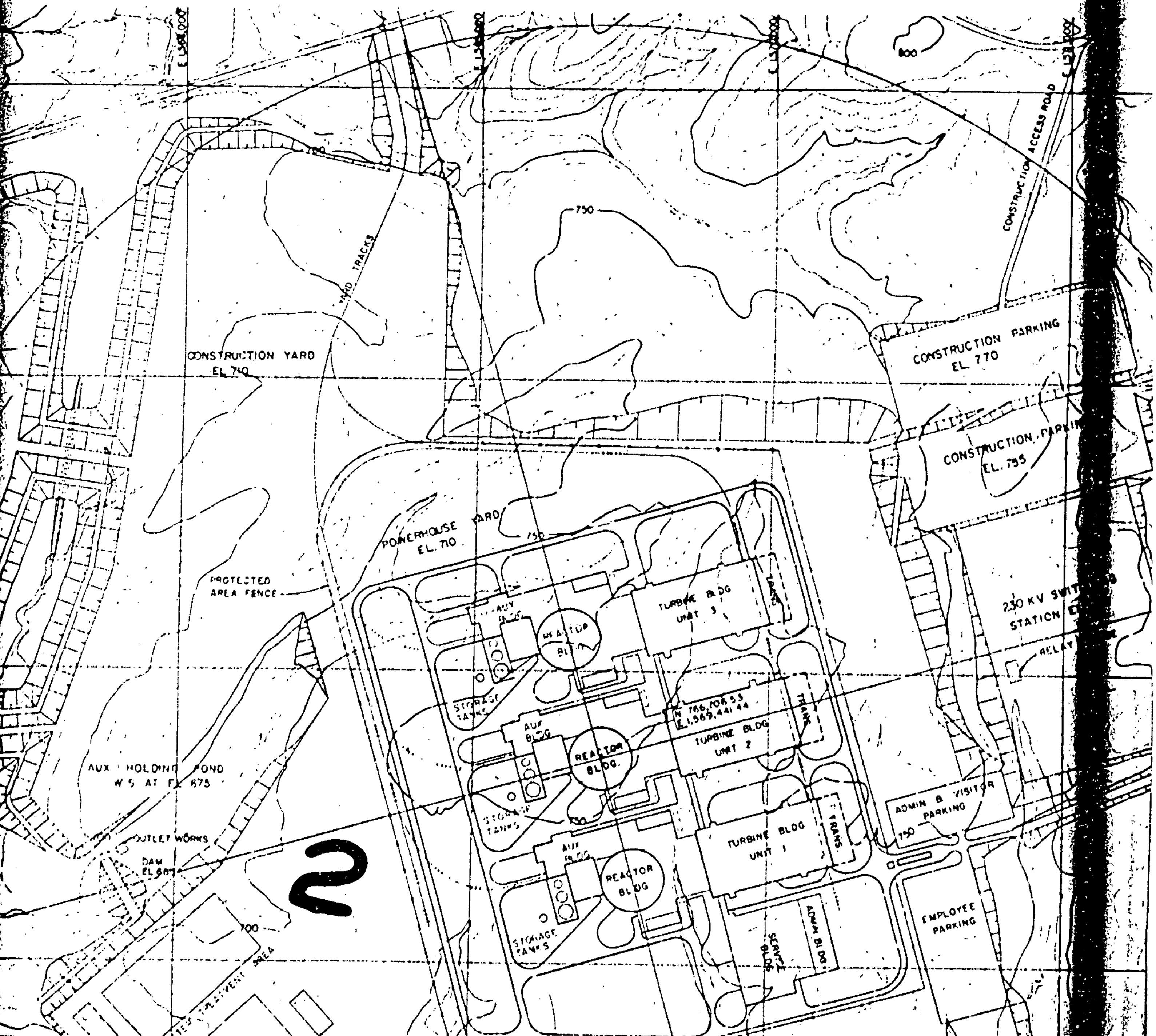

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EL. 770
CONSTRUCTION PARKING
EL. 755
POWERHOUSE YARD
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PROTECTED
AREA FENCE
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UNIT 3
REACTOR BLDG
AUX BLDG
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UNIT 2
REACTOR BLDG
TURBINE BLDG
UNIT 1
TRANS.
REACTOR BLDG
SERVICE BLDG
ADMIN BLDG
ADMIN & VISITOR
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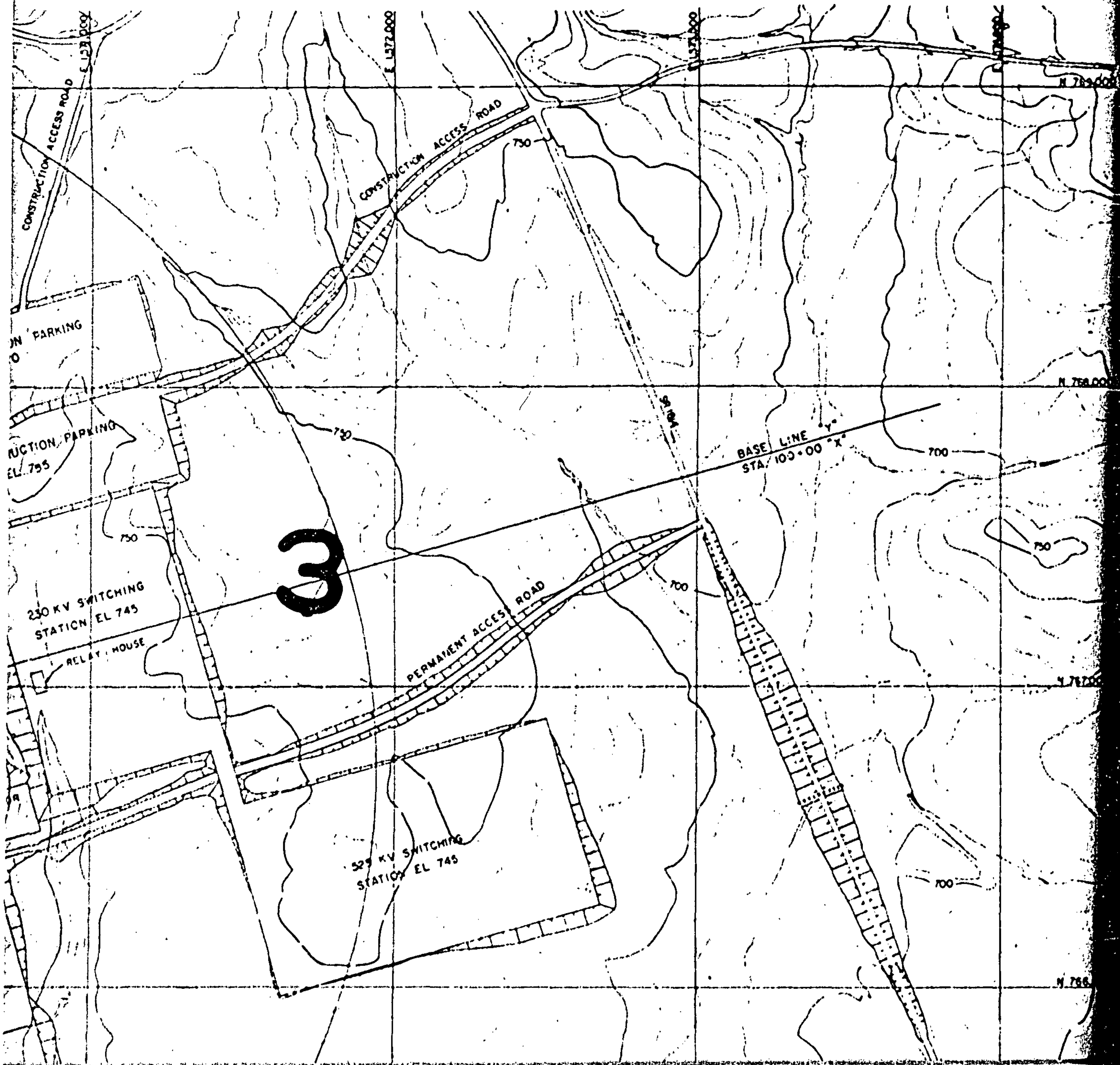

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525 KV SWITCHING
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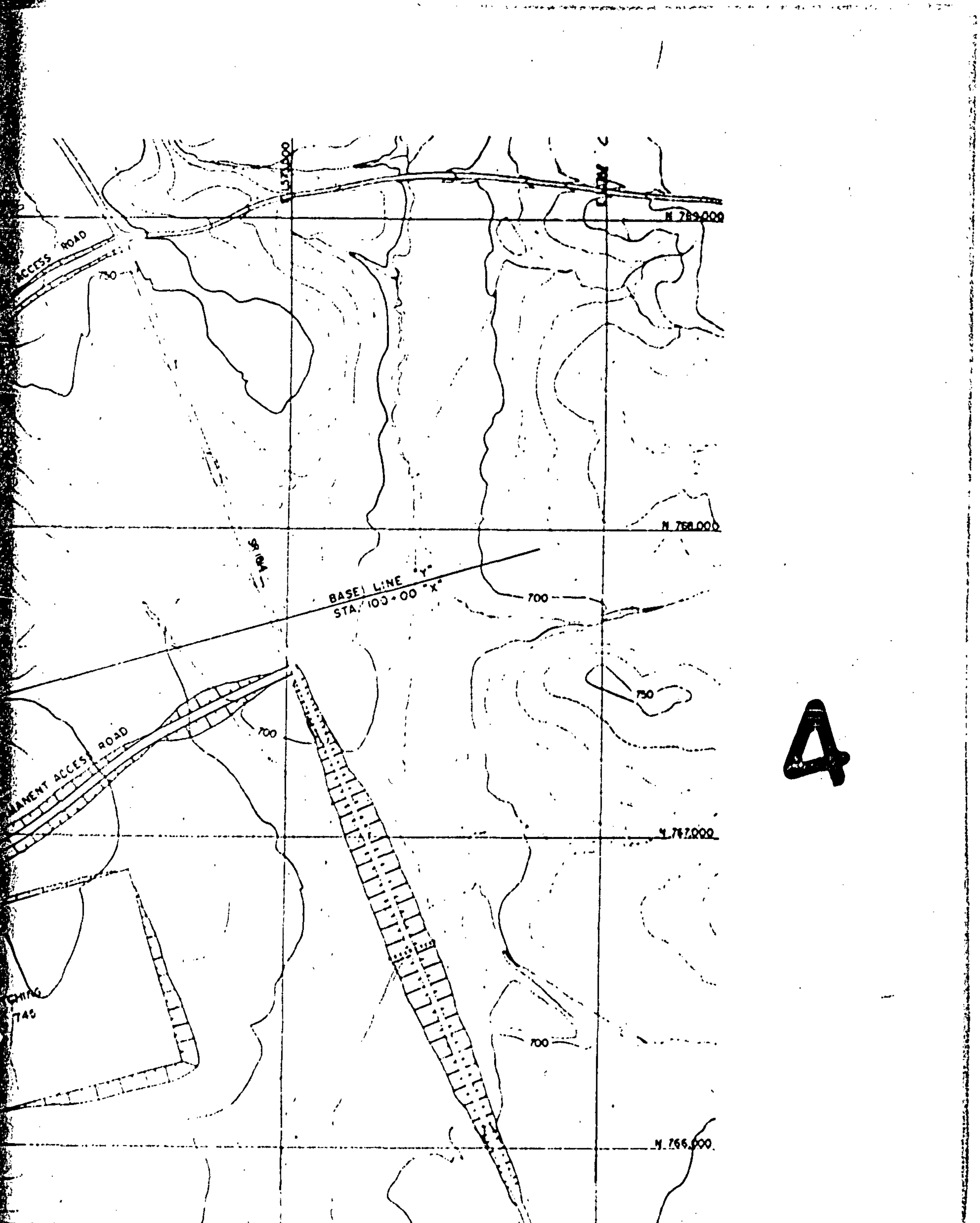
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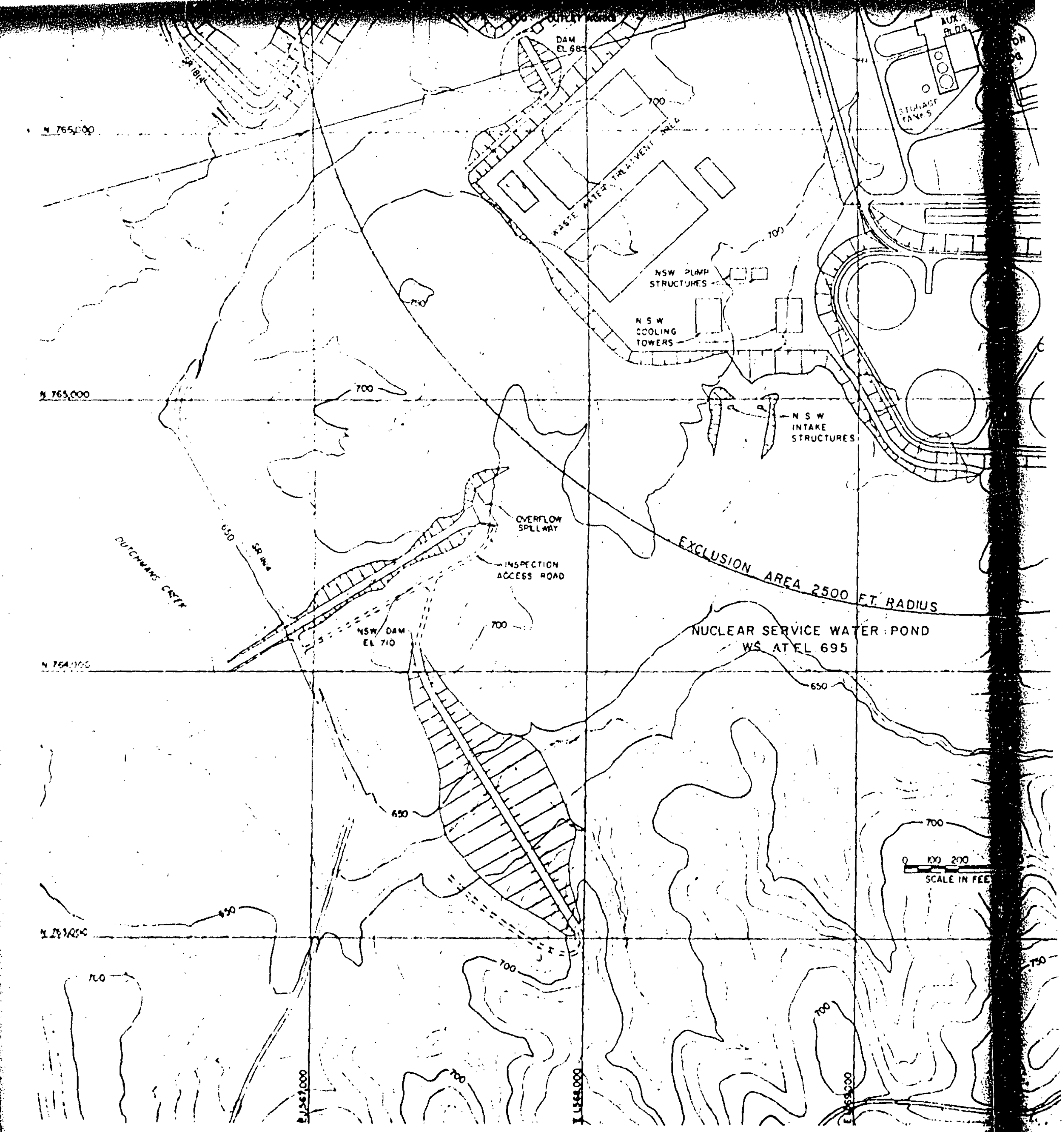
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N S W COOLING TOWERS
N S W INTAKE STRUCTURES
OVERFLOW SPILLWAY
INSPECTION ACCESS ROAD
NSW DAM EL 710
DUTCHMANS CREEK
EXCLUSION AREA 2500 FT. RADIUS
NUCLEAR SERVICE WATER POND
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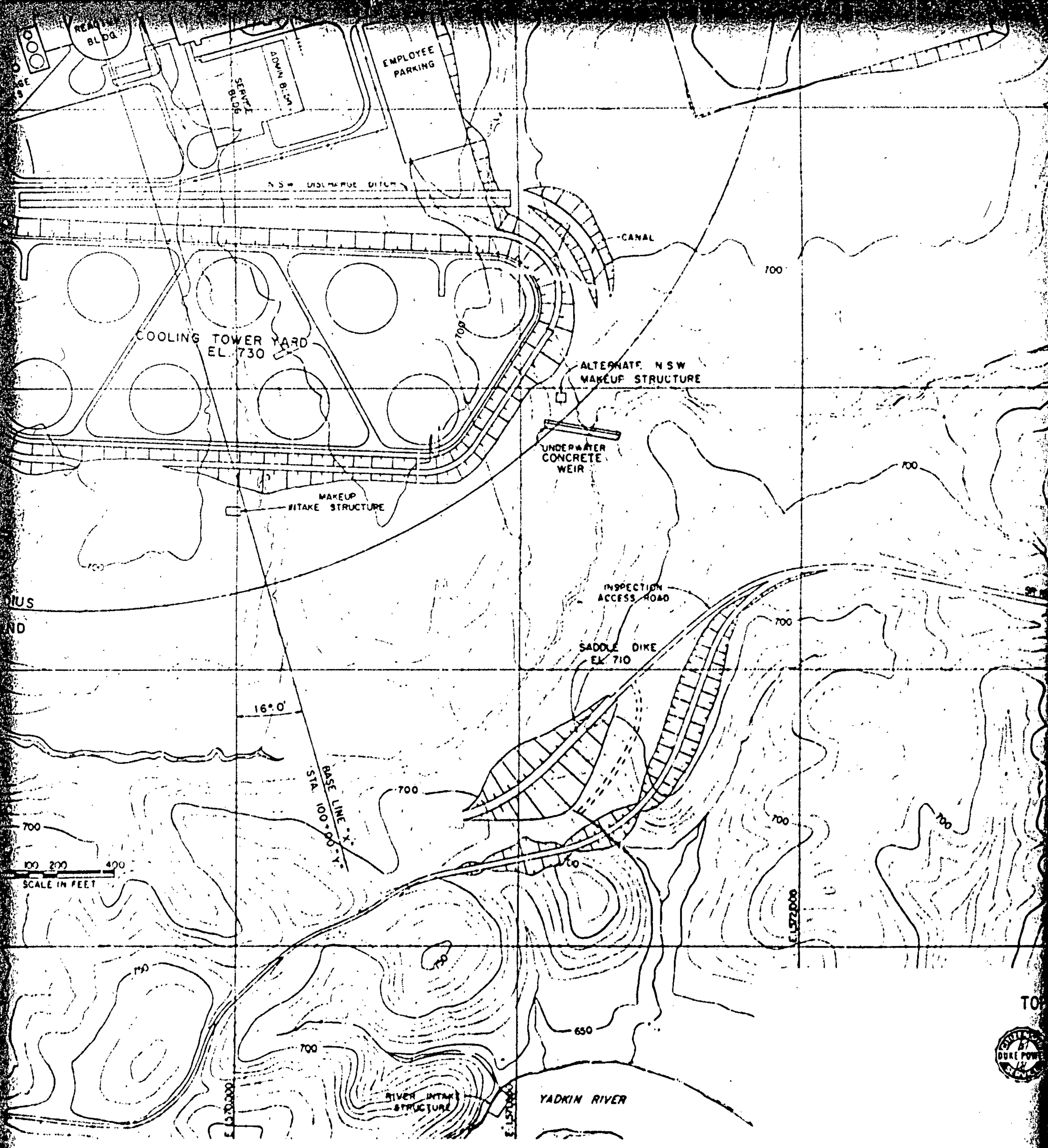
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CANAL
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ALTERNATE N.S.W MAKEUP STRUCTURE
UNDERWATER CONCRETE WEIR
MAKEUP INTAKE STRUCTURE
INSPECTION ACCESS ROAD
SADDLE DIKE EL. 710
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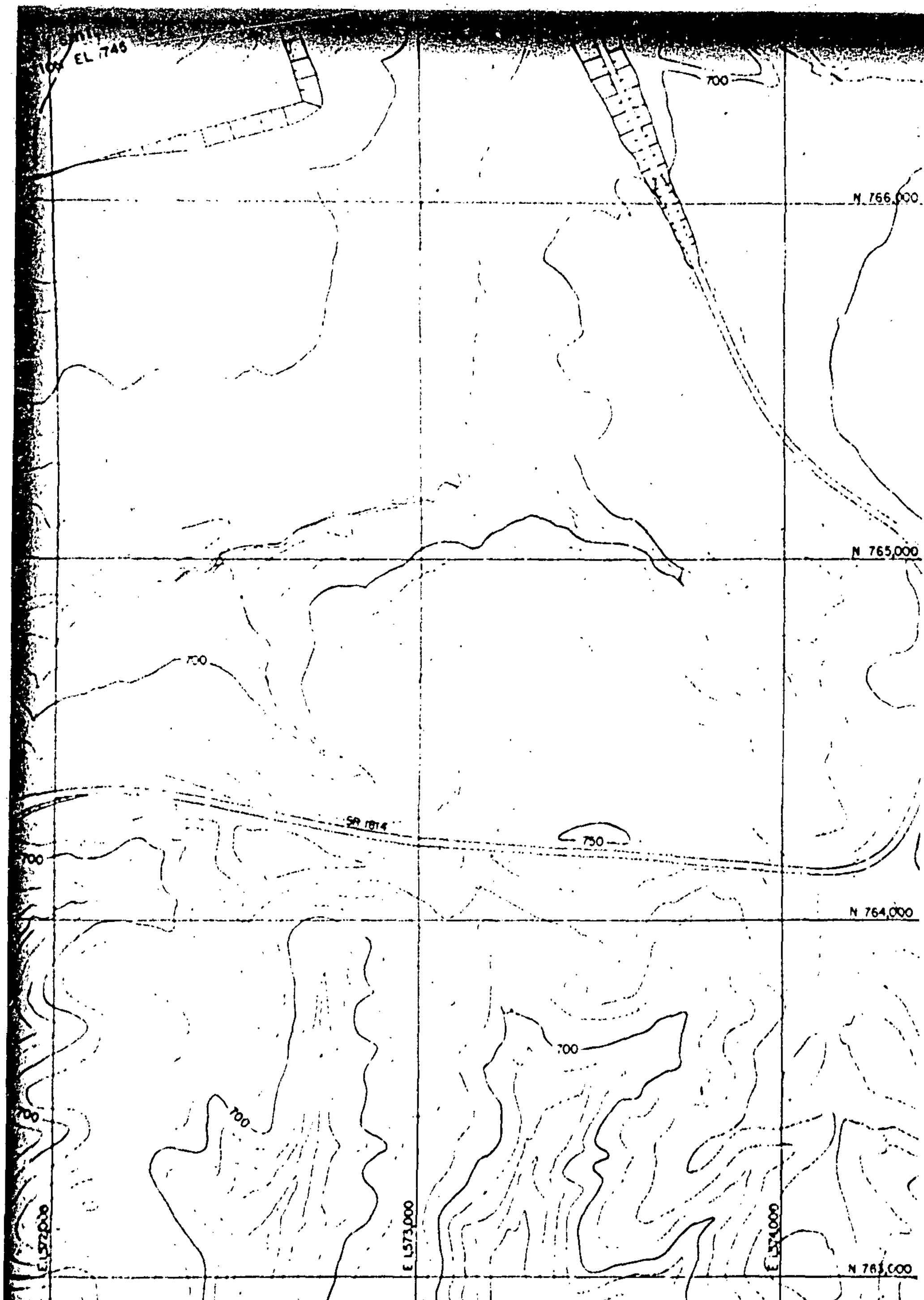

TOPOGRAPHIC MAP - SITE AREA

PERKINS NUCLEAR STATION
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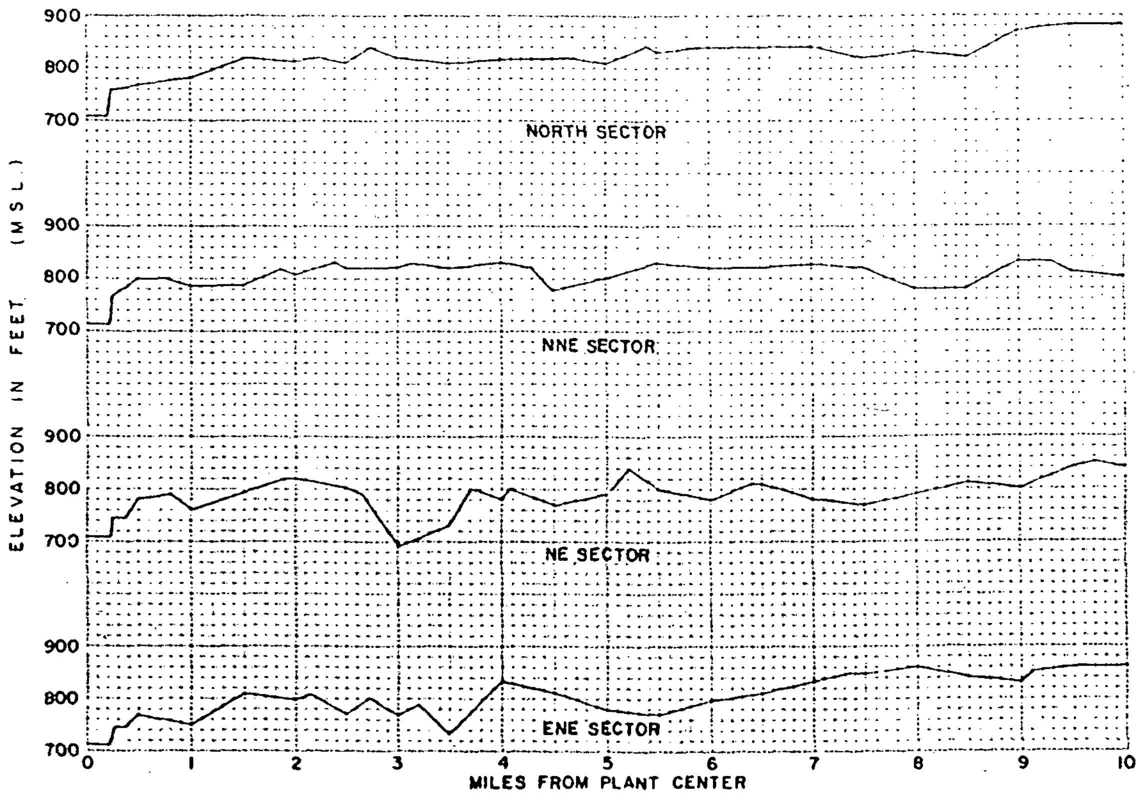

MAXIMUM TOPOGRAPHIC ELEVATION VERSUS DISTANCE

PERKINS NUCLEAR STATION

ER Figure 2.1-8 (1 of 4)

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MAXIMUM TOPOGRAPHIC ELEVATION
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PERKINS NUCLEAR STATION
ER Figure 2.1-8 (2 of 4)
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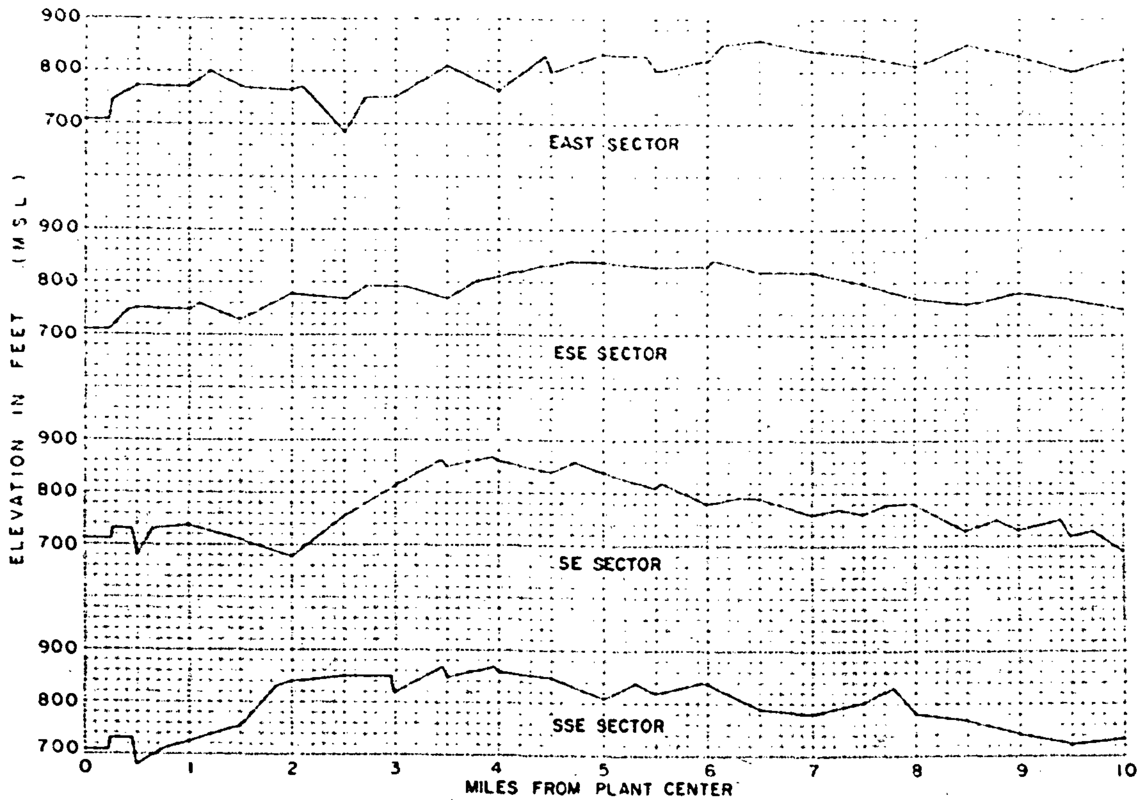

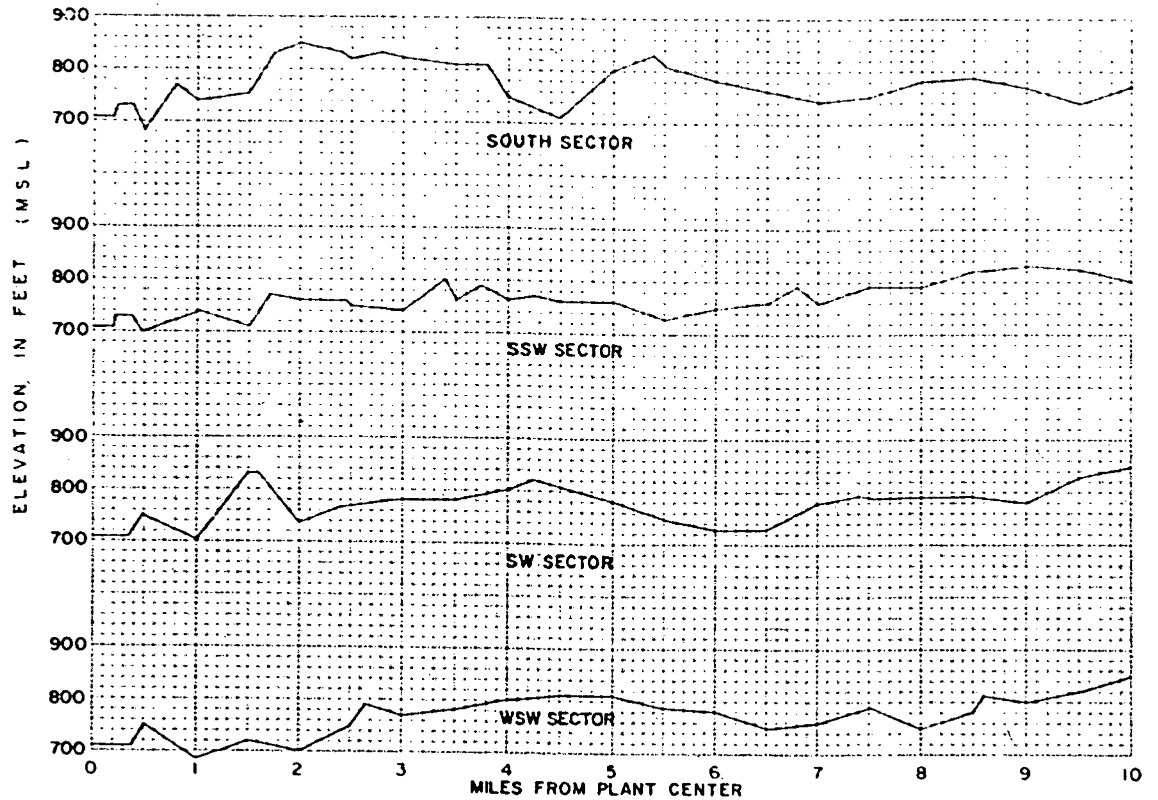

MAXIMUM TOPOGRAPHIC ELEVATION
VERSUS DISTANCE

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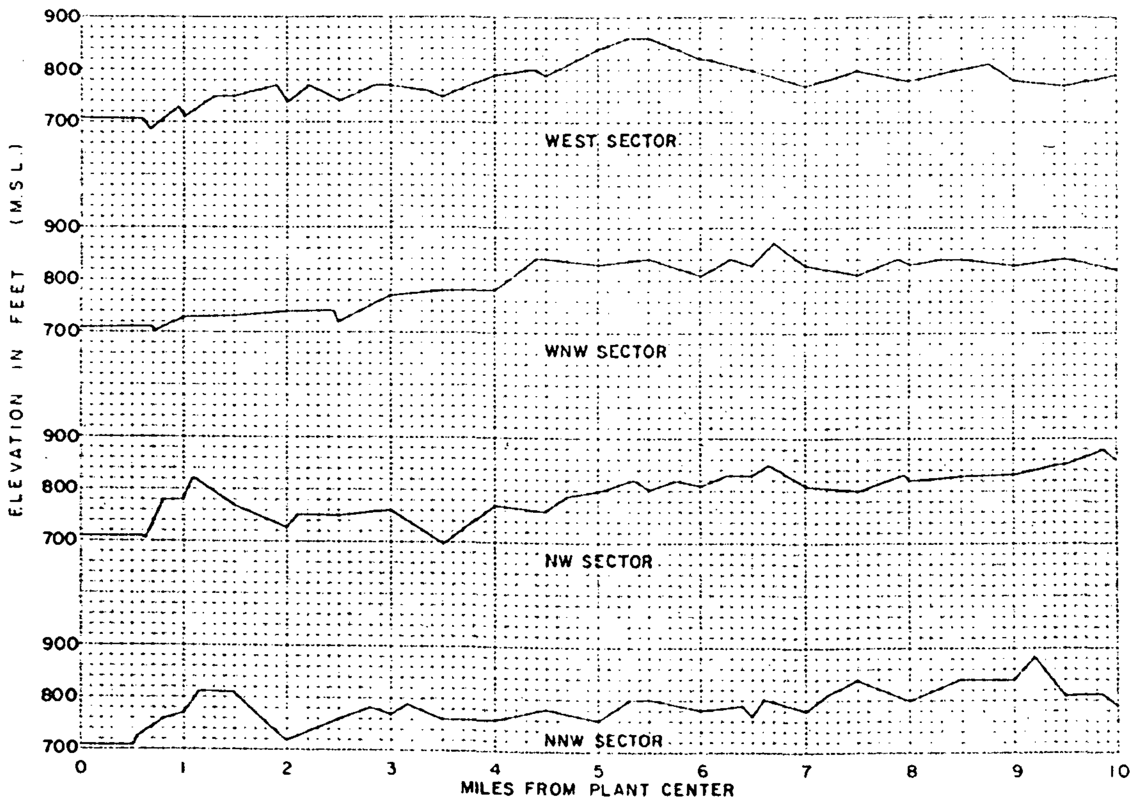

MAXIMUM TOPOGRAPHIC ELEVATION VERSUS DISTANCE

PERKINS NUCLEAR STATION
ER Figure 2.1-8 (4 of 4)
Amendment 4
(New)

LIST OF FIGURES

3.1 EXTERNAL APPEARANCE

1 The Perkins Nuclear Station facilities are to be located in the area shown on Figure 3.1.0-1. Perkins Nuclear Station will consist of three reactor buildings, three auxiliary buildings, three turbine buildings, one shared equipment building and one administration building. There are no plans for a visitors center on or near the site. Q3.1

The station layout and perimeter for Perkins Nuclear Station is illustrated on the site plan shown in Figure 3.1.0-2 and also on the site maps presented in Section 2.1. A perspective of the station in relation to the site is shown in Figure 3.1.0-3.

The architectural design of Perkins incorporates various materials with contemporary design to create an aesthetically pleasing appearance. The reactor building is constructed of concrete. In the turbine building a masonry wainscot wall is used at ground level, topped with colored siding. The auxiliary building is constructed primarily of concrete; the service and administration buildings are each primarily masonry constructions.

Care is exercised to effectively coordinate building materials and color selections in the overall design development of Perkins to provide an aesthetically pleasing effect.

Landscaping is planned for the site, areas adjacent to the structures and in the parking areas to complement and blend with the natural surroundings. Landscaping materials used are mostly those which occur naturally in the locality.

2 | 1 The location and elevation of release points for liquid and gaseous wastes are shown in Figure 3.1.0-4. The top elevation of the unit vent (gaseous waste release point) in respect to the top elevation of the other buildings is shown in Figure 3.1.0-5. Q3.5.1

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3.2 REACTOR AND STEAM-ELECTRIC SYSTEM

The Perkins Nuclear Station consists of three units. The Nuclear Steam Supply System (NSSS) for each unit is a pressurized water reactor manufactured by Combustion Engineering, Inc. The reactor fuel is zircaloy clad uranium
4 dioxide with a maximum enrichment of 3.6 wt. percent. The NSSS has a guaranteed main steam flow of 17,185,000 lbs./hr., a warranted output of 3817 MWt, and a design point of 4018 MWt.

The turbine generators are manufactured by General Electric. Each has a gross rated electrical output of 1,345 MW and a gross valves-wide-open (VWO) electrical output of 1,387 MW. Auxiliary losses (in-plant electrical consumption) amount to 58 MW. The cycle net heat rate is approximately 9,683 Btu/KW-HR.

Where:

T_1 = Temperature of warm entering water.

T_2 = Temperature of cold water leaving tower.

$T_{A_{out}}$ = Approximated exit vapor temperature.

$$(S.H.)_{out} = \frac{(Pv)_{exit} * .622}{14.7 - Pv_{exit}}$$

Where:

$(S.H.)_{out}$ = the exit specific humidity.

$(P_v)_{exit}$ = the saturated vapor pressure corresponding to $T_{A_{out}}$, PSIA.

The energy balance on the tower is:

4 $$M_w h_{f_{in}} + M_a h_{a_{in}} + M_a \{(S.H.)_{in} (h_v)_{in}\} =$$

$$\{M_w - M_a (S.H._{out} - S.H._{in})\} h_{f_{out}} + M_a h_{a_{out}} + M_a \{(S.H.)_{out} (h_{v_{out}})\}$$

Where:

M_w = Mass flow rate of entering water, GPM. Q 3.3.1

M_a = Mass flow rate of dry air, lb/hr.

h_f = Enthalpy of saturated liquid, BTU/lb.

h_v = Enthalpy of saturated vapor, BTU/lb.

h_a = Enthalpy of air, BTU/lb.

Re-arranging and dividing by M_a the ratio of water flow rate to air flow rate, M_w/M_a is obtained.

$$\frac{M_w}{M_a} = \frac{\{(h_{a_{out}} - h_{a_{in}}) + (S.H._{out} * h_{v_{out}} - S.H._{in} * h_{v_{in}}) - (S.H._{out} - S.H._{in}) * h_{f_{out}}\}}{(h_{f_{in}} - h_{f_{out}})}$$ 3

$$M_w = \frac{Q}{(500)\ (Range)}$$

Where:

Q = Heat rejected to condenser, BTU/hr.

Range = Range of the tower, ^{o}F.

M_w = Flow rate of water, GPM.

$$M_a = \frac{(M_w)\ (500)}{(M_w/M_a)}$$

Where:

M_a = Flow rate of air, lb/hr.

$$W_{evap} = (M_a)\ (S.H._{out} - S.H._{in})$$ Q 3.3.1

Where:

W_{evap} = Water evaporated, lbs/hr.

$$W_{evap_{gpm}} = \frac{W_{evap}}{500}$$

Where:

$Q_{evap_{gpm}}$ = Water evaporated, gallons per minute.

$$W_{evap_{cps}} = \frac{W_{evap_{gpm}}}{450}$$

Where:

$W_{evap_{cps}}$ = Water evaporated, cubic feet per second.

The drift value of 0.005% is an empirical value determined by the cooling tower manufacturer based on the performance of similar towers.

Filtered water for station use will be obtained from conventional treatment of water withdrawn from the Nuclear Service Water Pond. The water will be treated with biocides and coagulants. This will be followed by filtration through high rate filters. Waste materials from the coagulation and filtration will be flushed to the Waste Water Treatment System (Section 3.6). The filtered water is the supply source for sanitary and potable water, laundry and hot showers, and demineralizer make-up.

Two 700-gallon per minute mixed-bed demineralizers will provide high purity
water for make-up to the primary and secondary systems and for lab usage. At
3 normal operation, regeneration of one demineralizer will be required approxi-
mately every three days. One demineralizer will normally be in use while the
other is being regenerated or is on standby. Sodium hydroxide and sulfuric
acid will be used for regeneration of the demineralizers, and the regenerant
wastes will be flushed to the Waste Water Treatment System. Further detail on
the quantity and disposal of these chemicals is presented in Section 3.6.

As indicated on Figure 3.3.0-1 the remaining nonradioactive waste water from the station will flow to the Waste Water Treatment System for treatment and disposal (Section 3.6) while low-level radioactive liquid wastes will be pro-

3.4 HEAT DISSIPATION SYSTEM

The Perkins Nuclear Station is designed to convert about 35 percent of the thermal energy generated by nuclear fission into electrical energy. The remaining low grade thermal energy is dissipated in the form of heat. Several alternative methods of heat dissipation are discussed in Section 10.1. The selected system uses closed-cycle cooling towers.

The Heat Dissipation System includes the Main Condenser Cooling Water System, the Nuclear Service Water System, the Conventional Service Water System, and the Makeup Water System.

Pertinent system characteristics are presented in Table 3.4.0-1. Layouts of the piping for the various heat dissipation systems are presented in Figure 3.4.0-1. The layout of condenser cooling towers and noise levels are shown in Figures 3.4.0-2 and 3.4.0-3. Q 3.4.7

3.4.1 CONDENSER COOLING WATER SYSTEM

The Condenser Cooling Water (CCW) System includes the main steam condenser cooling towers, pumps, valves, and piping. The flow enters the tubes of
4 the three pass condenser under gravity head from the cooling tower basins. After receiving the plant heat load, the flow is pumped to the closed-cycle wet cooling towers, where it is distributed to the hot water basins at the top of each of the tower cells. Within the towers, nozzles and fill break the water flow to droplet size as it passes to the lower receiving basin. A current of air flow permits surface cooling of the warmed water, partly by evaporation and partly by conduction. The design and performance data for both summer and winter conditions for the cooling towers proposed for Perkins Station, is presented in Table 3.4.0-2. Q 3.4.8

4 The cooled water is collected in the cooling tower basin and piped through the condenser to the condenser cooling water pumps. Circulation of flow for each unit is maintained by three vertical wet pit pumps. The cooling
4 water is then pumped to the cooling towers; then it enters the condenser tubes and completes the circulation loop.

During normal system operation, the cooling water temperature is raised 24° F as it passes through the condenser. A temperature drop equal to the temperature rise of the total flow is experienced in the cooling towers.

A cooling water blowdown release is maintained continuously to prevent dissolved solids buildup and consequent scaling in the cooling water system. Dissolved solids concentrations in the cooling water are maintained at a level approximately ten times greater than that of the makeup water. Blow-
4 down of the cooling water flow is extracted from the cooling tower basins and flows to the river. A blowdown discharge structure, which consists of a bankside single port discharge pipe emptying into the Yadkin River through a headwall, is located approximately 300 feet downstream of the intake structure. The five fps discharge flow is oriented perpendicular to the river flow. Preliminary studies of the discharge area indicate that scouring will not be a problem due to the rocky river bottom. If further studies in the area indicate that such is not the case, the bottom will be stabilized to prevent detrimental scouring by the use of concrete Q 3.4.6

or rock riprap. Figures 3.4.1-1 and 3.4.1-2, respectively, show location and details of the discharge structure. Q 3.4.6

The flow paths of all water systems within the Perkins plant are shown schematically in Figure 3.3.0-1. The flow paths for these systems will not be seasonally dependent. The flow rates, frequency of flows, and dilution for all systems are incorporated into Figure 3.3.0-1. Q 3.4.5

The temperatures of all water systems, except cooling tower blowdown, will closely reflect ambient conditions. The rate of blowdown varies depending on the rate of solids accumulation which is a function of evaporation in the cooling tower system. Blowdown temperatures and volumes are estimated on a monthly basis as follows: Q 3.4.2

Month	Temperature (°F)	Volume (CFS)*
January	70.2	8.1
February	71.2	8.1
March	73.1	8.4
April	77.0	8.5
May	81.0	8.7
June	83.7	8.9
July	85.5	8.8
August	84.9	8.9
September	82.6	8.9
October	77.9	8.7
November	74.3	8.5
December	70.8	8.4

* Volumes are based on 76 percent plant capacity factor.

Blowdown releases, evaporative losses, and drift losses are replaced by makeup water intoduced into the system upstream of the pumps.

3.4.2 NUCLEAR SERVICE WATER SYSTEM

The Nuclear Service Water (NSW) System supplies cooling water to various heat loads in both the primary and secondary portions of each unit. The maximum flow of 151 cfs per unit is pumped by the NSW pump structure through the systems requiring cooling. The heat gained in this process is dissipated in a dedicated closed cycle wet mechanical draft cooling tower. Makeup for the NSW system is provided by the NSW Pond.

The primary reason for creating the Nuclear Service Water Pond at the Perkins station is to fulfill the requirements for the reliable ultimate heat sink, as discussed in Regulatory Guide 1.27. A multipurpose reservoir, the NSW Pond also functions as a sedimentation basin and a storage facility for makeup water for plant uses. The first requirement is most easily satisfied by the construction of a pond. By providing sufficient volume in the pond, all of the above requirements can be accommodated. Q 3.4.3

Alternatively, several smaller separate facilities would have to be constructed to fulfill the above requirements. Since the site readily lends itself to the construction of a pond, the development of this single

3.5 RADWASTE SYSTEMS

There are four systems for each unit that process radioactive or potentially radioactive wastes. No radwaste components or subsystems are shared by, or interconnected between the units. The four systems are designated:

a) Miscellaneous Liquid Waste Management System (MLWMS)
b) Gaseous Waste Management System (GWMS)
c) Solid Waste System (SWS)
d) Steam Generator Blowdown System (SGBS)

The term waste denotes a product that is not practical to recover. The basic design criterion for all the above systems is to reduce the volume and specific activity of the total system input to a minimal amount prior to disposal or discharge. The reduction steps include recovery and recycle of uncontaminated water, separation and removal of non-radioactive gases, filtration and ion exchange, dewatering of resins, and concentration of liquid wastes by evaporation.

3 3.5.1 MISCELLANEOUS LIQUID WASTE MANAGEMENT SYSTEM

The Miscellaneous Liquid Waste Management System flow diagram is shown in Figure 3.5.1-1 and 3.5.1-2. Table 3.5.1-1 lists the estimated quantity, flow rates and sources of input wastes to the MLWMS. Table 3.5.1-2 gives the expected decontamination factors for MLWMS components and the variations that are anticipated in waste quantities during normal plant operation. Table 3.5.1-3 lists the radionuclides, their half-lives, and their annual average discharge concentration prior to dilution.

3 Radioactive liquids are discharged from the MLWMS to the river via the blowdown and radwaste discharge structure (Figures 3.4.1-1 and 3.4.1-2). Radioactive liquid wastes from the station will be mixed with the 150 cfs flow provided by the radwaste dilution water pumps prior to discharge to the river. 4 The concentrations of radioactive nuclides in the radwaste discharge pipe, prior to entering the river will be at or below the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2. The MLWMS discharges a monitored effluent at the rate of 250 gpm; however, there will be variations in the intermittent frequency of the discharges pending on variations in the input to the MLWMS. The frequency of discharges may vary from every day to 30 days.

3.5.1.1 System Description

The Miscellaneous Liquid Waste Management System processes contaminated liquid waste from the laundry, showers, building sumps, lab and sample sink drains, and condensate from the containment coolers. All these sources are potentially radioactive and are generally not suited for cleanup and reuse as 3 reactor coolant. Steam generator blowdown concentrate is not processed in the MLWMS.

The system is designed so that all radioactive liquid wastes that are to be discharged from a unit can be released to the environment only via the release point in the MLWMS. No other systems have release points for radioactive liquid wastes.

The system is designed to operate on a batch basis. Chemically contaminated radioactive and potentially radioactive liquid wastes are directed to the MLWMS via the Equipment and Floor Drainage System. Here the liquid waste is monitored and processed prior to discharge to the environment. The processing selected for the liquid collected in this system is dependent upon its chemical and radionuclide contamination level. Numerous recirculation lines are provided to insure that the required processing is accomplished.

3.5.1.1.1 Liquid Waste From Laundry Operations

Laundry operation liquid wastes which are potentially radioactive and may contain large diameter particles, such as lint, are collected and sampled in the laundry tanks. Because of the expected low radioactivity level, processing of the laundry tank contents generally requires that only filtration be applied prior to discharge to remove any organic material and suspended solids. If the specific activity of the tank contents exceeds a level where direct or diluted discharge is allowed, the flow will be diverted to the waste concentrator to obtain the required processing. Both the flow rate and the activity level of the waste condensate pump discharge line is recorded and flow is automatically terminated if activity reaches a predetermined level.

3.5.1.1.2 Liquid Waste From Sumps and Drains

Liquid wastes which are radioactive and contain both suspended and dissolved solids from various drains, valve leakoffs and sumps are collected and sampled in the waste tanks. Sources, volumes and activities of waste tank
3 inputs are given in Table 3.5.1-1. Four waste tanks are provided to preclude the possibility of having contaminated liquids entering a previously sampled tank while its contents are being discharged. After sampling the contents of the waste tanks, it is necessary to render the liquid suitable for discharge. The waste tank liquid is first filtered to reduce suspended solids concentrations and remove organic material in order to reduce fouling of downstream system equipment. The application of an evaporator to process the filtered liquid provides an established means of reducing dissolved solids concentration as well as radioactivity levels with high decontamination factors. A mixed bed (H-OH form) ion exchanger is provided in the condensate path from each concentrator to further reduce any volatile species which carry over with the dis-
3 tillate. The distillate is collected in one of four waste condensate tanks for sampling and analysis prior to discharge. The concentrate from the evaporators is sent to the Solid Waste System for disposal.

3.5.1.1.3 Liquid Waste From Steam Generator Blowdown

Steam generator blowdown is not introduced into the MLWMS. Any radioactive
3 contamination of the blowdown is removed in the condensate polishers, as dis-
4 cussed in Subdivision 3.6.1.5. Anticipated steam generator blowdown mass flow Q 2a
rate is 172,000 lb/hr.

3.5.1.1.4 Liquid Waste From Containment Cooling Units

The MLWMS is designed to accept the condensate from the four containment cooling units when activity is detected by sampling. The condensate is collected in one of two tanks which provides sampling capability. When there is airborne radioactivity in the containment air due to leakage from systems that contain radioactive liquids, some of the airborne activity will condense with the water vapor that collects in the drip pans on the containment coolers. If the sample of the condensate tank contents contains significant amounts of radioactivity, the tank contents will be pumped to the waste concentrator for processing. If the sample contains no or insignificant amounts of activity, the tank contents may be routed to either the reactor makeup water tank or the discharge canal depending on its water quality. Volumes and activities are presented in Table 3.5.1-1.

3.5.2 GASEOUS WASTE MANAGEMENT SYSTEM

The Gaseous Waste Management System flow diagram is shown in Figure 3.5.2-1. Table 3.5.2-1 lists the estimated quantities, flow rates and sources of gases directed to the GWMS. Table 3.5.2-2 gives the specific activity of the radioactive gases discharged from the GWMS as well as the holdup time and its variation that is anticipated during normal plant operation. Releases from
4 the GWMS are made via the unit vent stack. The stack is approximately 180 Q1b
feet high and has an inside diameter of 12 feet. The stack is cylindrical in shape and has a normal flow rate of approximately 170,000 SCFM at 115 F. The relative height of the stack with respect to the surrounding buildings
2 1 is shown on Figure 3.1.0-5. (Amendment 1, New). Q3.5.1

4 The duration and frequency of containment building purge are described in PSAR Subdivision 9.4.5.3 and PSAR Subsection 11.3.6. Q1c

3.5.2.1 <u>System Description</u>

The GWMS is designed to collect, store and monitor the maximum amount of gas generated from all the systems input streams. The primary constituent of the total volume generated is from gas stripping operations in the CVCS. The system is designed to process and hold this volume plus the volume from shutdown degasings as well as normal volumes from the other components served. 4

The waste gases, primarily composed of hydrogen and fission gases, are routed to the GWMS via the gas collection header (GCH), the containment vent header (CVH), and the gas surge header (GSH).

The CVH collects hydrogenated, potentially radioactive gases from the reactor drain tank and refueling failed fuel detector inside containment and connects with the gas surge header outside containment. The GSH collects the hydrogenated, radioactive gases with negligible oxygen from the CVH, the volume control tank and the gas stripper.

The GCH receives low activity gases containing oxygen from aerated tanks, ion exchangers and concentrators. These gases are then directed to the unit vent for monitoring and discharge.

Gases flow from the GSH to the gas surge tank where they are collected prior to being compressed. The gases remain in the surge tank until the pressure increases to a point where the waste gas compressors are started automatically.

The compressed gases then flow into one of the three gas decay tanks where they are analyzed. The analysis is done automatically by the gas analyzer which determines the oxygen and hydrogen concentration. The gas analyzer returns the sampled oxygenated gas to the GCH and the sampled hydrogenated gas to the GSH. After the contents of the tank have been identified, one of the following actions will be taken:

a) If no significant activity is present, the tank contents may be discharged to the atmosphere via the unit vent.

b) If there are significant quantities of hydrogen or oxygen present, the tank contents are passed through the catalytic type hydrogen recombiner to remove hydrogen and oxygen before returning the gas to another decay tank for long term storage.

c) If there is essentially only radioactive gas present, the tank will be filled to capacity and be allowed to decay by long term storage.

All discharges from the gas decay tanks to the unit vent are monitored with a radiation detector which will alarm if any residual activity is present and automatically close the discharge control valve. The only process flow bypass line that exists in the GWMS leads from the gas surge tank directly to the gas discharge header and bypasses the waste gas compressor and gas decay tanks. This flow path is used mainly to purge air from components after maintenance operations, at which time the vented gas contains essentially no radioactivity. The valve on this bypass line is locked closed to facilitate administrative control.

The system is designed so that all radioactive gases that are collected can be released only via the one discharge point in the GWMS. There are no other systems that have controlled discharge points for radioactive gases.

4 Ventilation systems that exhaust potentially contaminated areas are filtered to conform to requirements in 10 CFR 50. A complete description of these systems, i.e. systems for the auxiliary and reactor buildings, can be found in the PSAR Sections 9.4.2, 9.4.5, and 9.4.7. Q1a

3.5.3 SOLID WASTE SYSTEM

The Solid Waste System flow diagram is shown in Figures 3.5.3-1 and 3.5.3-2. Table 3.5.3-1 lists the estimated quantities and sources of input to the SWS. Table 3.5.3-2 gives the expected activity of the solids that are being shipped off site.

3.5.3.1 <u>System Description</u>

The Solid Waste System is best described as a series of process operations involving the drumming of waste concentrator bottoms, spent resins, filter cartridges, chemical wastes and low activity solids.

3.5.3.1.1 Processing Waste Concentrator Bottoms

The concentrator bottoms drumming process is handled remotely from a control panel located behind a shield wall. The shield wall is fitted with lead glass windows for observation. A drum is moved to the fill station via a motorized conveyor. The drumming header nozzle is forced down tightly over the drum fill nozzle. Concentrate may then be pumped to the drumming header where it is blended with the solidification chemicals and catalyst before flowing into the drum. When the drum is filled to a preset level, drumming is automatically stopped. Concentrates remaining in the drumming header are flushed into the drum with demineralized water. The drum is then capped and moved into a storage position with the motorized conveyor. The drumming header may then be isolated. All of the above operations are observed and controlled from the shielded remote control panel.

3.5.3.1.2 Processing Spent Resins

The spent resin sluice pump provides 35 gpm of sluice water flow to flush spent resins from plant ion exchangers into the spent resin storage tanks. The spent resin sluice pump suction lines are connected to the 5000-gallon spent resin storage tanks above the maximum expected spent resin level to assure that the recirculated sluice water is relatively free of spent resins. Johnson screens fitted to the ends of the suction lines and a filter in the discharge piping of the spent resin sluice pump provide additional assurance that the recirculated sluice water is free of resins. In the sluicing process, sluice water is pumped through an ion exchanger from the bottom, thereby breaking up the resin bed, mixing with it, and flushing the spent resins into one of the spent resin storage tanks. When stored resins in a spent resin storage tank have reached a maximum level, that tank is isolated and sluicing flow is then directed to the alternate tank. 4

In preparation for drumming stored spent resins, the resins may be loosened up by using the spent resin sluice pump to recirculate sluice water from the top of the tank into the bottom. All connections to the tank are then valved off except those required in the drumming process. At the drumming station in the waste shipping area, the drumming header nozzle is manually connected to a truck-mounted, shielded cask.

The remainder of the drumming process is controlled from a remote panel. The spent resin and sluice water mixture is forced through the spent resin feed line to the drumming station at approximately 35 gpm by pressurizing the spent resin storage tank with nitrogen. The spent resins are blended with solidification chemicals and catalyst as in the concentrator bottoms drumming process. When the cask is filled to a preset level, drumming is automatically stopped. The drumming header is flushed, the drumming header nozzle is disconnected, and the cask is sealed. The drumming header is then isolated and residue remaining in the spent resin feed line is flushed back into the spent resin storage tank.

3.5.3.1.3 Processing Spent Filter Cartridges

All potentially radioactive filters are located with access hatches directly above each filter. Once a hatch is removed, the filter transfer vehicle, with associated tools and filter transfer shield, is moved over the hatchway. The filter below is remotely removed from its housing and drawn up into the transfer shield. The vehicle is then transported to the waste drumming area where the transfer shield with filter is removed from the cart and positioned over a bunker containing filter storage drums. The filter is lowered into a drum for storage. The transfer shield is removed, the drum is capped, and the bunker doors are closed.

3.5.3.1.4 Processing Chemical Reagent Wastes

Waste liquids from the chemical drain tank are disposed of in the same manner as concentrator bottoms.

3.5.3.1.5 Processing Miscellaneous Low-Activity Solids

Low activity solid wastes, such as rags, are compressed into 55-gallon drums by a hydraulic compactor. The drums are then stored in a shielded room within the waste shipping area to await shipment.

3.5.4 STEAM GENERATOR BLOWDOWN SYSTEM

4 The Steam Generator Blowdown System flow diagram is shown in Figure 3.5.4-1. The system is designed to maintain steam generator blowdown during startup and periods of primary-to-secondary leakage and condenser leakage. Q2e

3.5.4.1 System Description

The Steam Generator Blowdown System consists of the lines and associated valves connecting each steam generator blowdown nozzle with the main condenser. Impurities in the blowdown are removed in powdered resin type condensate polishers located downstream of the hotwell pumps. The polishers are described in Subdivision 3.6.1.5.

A Steam Generator Blowdown System is provided for each unit. Steam generator blowdown is performed as required to maintain acceptable secondary side water chemistry. Essentially all of the blowdown liquid is treated and returned as condensate.

Sampling of the steam generator secondary water is the primary means of detecting either a condenser or a primary to secondary leak. A radiation monitor is provided in the Steam Generator Blowdown System as a backup to the sampling technique.

3.6 CHEMICAL AND BIOCIDE WASTES

Chemical and biocide usage at Perkins Nuclear Station will be at the lowest level that is consistent with reliable operating practices. Treatment and discharge of wastes will be controlled so as to meet all applicable effluent limitations and water quality standards.

3.6.1 CHEMICAL AND BIOCIDE WASTE SOURCES

Chemical and biocide wastes originate in several systems. The Schematic diagram of Figure 3.3.0-1 may be used with the following descriptions to relate the various systems identified as waste sources and to trace the disposal routes.

3.6.1.1. Circulating Cooling Water Systems

Unit condensers will have stainless steel tubes for corrosion resistance. A mechanical cleaning system will recirculate sponge rubber balls through the condenser to minimize chemical and biological deposits of scale and slime on heat exchange surfaces. The larger group of cooling towers provide water for condenser cooling and for conventional service water. Smaller cooling towers provide Nuclear Service Water through a separate system. Maximum evaporation of all cooling towers is estimated to total 50,400 gpm, maximum drift and blow-
4 down will approximate 114 gpm and 5300 gpm. Maximum cooling tower makeup of 55,820 gpm will be pumped from the Nuclear Service Water Pond where plain sedimentation is expected to remove 60 - 70% of the suspended solids. Remaining solids and incipient precipitates formed by concentrating makeup water will be stabilized in suspension as sols by substantative action of liquid organic corrosion and deposit inhibitor mixtures that may contain 10% of a short chain polyacrylate polymer and aminomethylenephosphonate equivalent to 8.6% as ortho-phosphate. Inhibitor product usage at 30 ppm concentration is expected to permit cooling system operation with water in the range of pH 7.8 to 8.25. Q
The addition of acid to control pH is not expected but will be used if found to 3.6.5
be necessary.

Chlorination of cooling systems sequentially, once a day is expected to control algae and slime forming microorganisms when a free chlorine residual is established and maintained for one hour, or longer, in each system at 0.5 ppm in cold weather and at 1 ppm during warm months. Typically an application of chlorine, 4 to 8 ppm, would be applied for 20 minutes to satisfy the initial chlorine demand of cooling water in each system and to establish the desired concentration Q
of free chlorine. Once established, the free chlorine residual will be maintained 3.6.4
for one hour or longer by feeding 1 to 3 ppm of chloride, or as required, to maintain the residual. The chlorine concentration at the cooling water outlet of the condenser will be monitored for control purposes. Three units may use 1600-3200 pounds of chlorine a day through a sodium hypochlorite solution feeder discharging to the cooling tower sumps. . As the treated water circulates through the cooling system, the warm water loses some chlorine to the atmosphere. Consequently, not all chlorine nor chlorine reaction products will remain in the water to be removed in the cooling tower blowdown as waste.

Since chlorination will be on an intermittent "slug" treatment basis, the free chlorine residual will disappear into the vapor phase or combine with the chlorine demand of makeup water to form chlorinated organics and mineral chloride salts. Sequential chlorination will cause different concentrations of chlorination products to be in the blowdown from each unit at any time and will result in a lower concentration in the receiving dilution water.

The cooling tower blowdown is expected to have an average total residual chlorine concentration of 0.14 ppm. When chlorine-resistent organisms appear, or the use of a non-oxidizing biocide is indicated for any reason the alternate organic control solution may contain dodecylquanidine hydrochloride as a 35% solution in 15% isopropanol. The product may be applied in the 10-30 ppm concentration range two times a week. The cooling system of each unit would be treated with 1,350 to 4,050 pounds of the active ingredient for each application. The diluted waste will have low toxicity and can be broken down by soil microorganisms. Q 5.1.14 Q 3.6.6

3.6.1.2 Filtered Water Treatment

River water will pass through the Nuclear Service Water Pond where plain sedimentation can decrease turbidity 60% and can lower suspended solids 70%. The presence of fine clay-type mineral colloids in the settled water makes use of a coagulant mandatory.

The coagulant will be a polyelectrolyte that is approved for use in potable water. These materials used in the concentration range of 1-4 ppm will replace about 40 ppm alum and 12 ppm sodium hydroxide. The use of polyelectrolytes avoids adding 51 ppm soluble sodium sulfate to filtered water. Also the difficult disposition of a voluminous residue of aluminum hydroxide in filter wash water is avoided. The polyelectrolyte coagulants are bridging agents of minimal volume. They collect particulate and colloidal matter from water into a more dense accretion that can be washed from filters and can be settled more effectively as a waste, resulting in a diminished environmental impact.

Three filters of the deep bed upflow type will have a combined output of 2,100 gallons per minute. The expected normal system capacity will be three (3) million gallons per day. Chemical usage of 1-4 ppm polyelectrolyte and 2-10 ppm chlorine will represent 25 to 100 pounds of polyelectrolyte, and 50 to 250 pounds of chlorine per day at design capacity. The average chemical requirements will be about 20-75 pounds per day of polyelectrolyte, 38-190 pounds per day of chlorine, and the waste water flow will be approximately 153,700 gallons per day. Waste water will flow to the Waste Water Treatment System for treatment.

The capacity of the water filtration system is designed to provide make-up water during startup periods and under other adverse conditions. During normal periods of operation the recycling of water through condensate polishing demineralizers will substantially reduce the make-up water requirements for the station.

Biocidal agents will be used to assure the bacteriological safety of the potable water supply. Various means of disinfecting water are under study as alternative processes to the use of chlorine. Alternate processes, among others, include the use of ozone and ultraviolet light.

3.6.1.3 Demineralized Water System

Filters containing granular activated carbon will remove organic compounds and chlorine from filtered water just ahead of two mixed bed demineralizers of 700 gpm capacity each. Periodically, the carbon filters will be backwashed and then steamed to remove suspended and adsorbed wastes that will flow to the Waste Water Treatment System.

Station requirements for demineralized Water may require operation of both ion exchange cells to produce 1,100 gpm at times. Average plant requirements are estimated to demand 115 regenerations a year of a mixed bed demineralizer.

Each regeneration of an ion exchange cell will use 1,871 pounds sodium hydroxide and 1,216 pounds of 66° Bé sulfuric acid. The acid will elute sulfates of metallic cations removed during water purification and sodium sulfate with the total being 1,638 pounds as sodium sulfate. The alkali will elute anions from the anion exchange resin, with sulfates from acid neutralization being the most abundant anion. Excess alkali in the waste stream will be 948 pounds as NaOH or 1,185 pounds as $CaCO_3$. The waste will flow to the Waste Water Treatment System and will be neutralized to a waste effluent not exceeding pH 9.0. Approximately 70,000 gallons of waste water result from each cell regeneration.

3.6.1.4 Reactor Coolant Chemicals

The daily usage of reactor coolant chemicals is estimated to include:

165 pounds boric acid for reactor shim management

0.1 pounds lithium hydroxide

3.6.1.5 Secondary Coolant Feedwater

Volatile treatment of water in the secondary system will use hydrazine as an oxygen scavenger and amines for pH control. Station annual usage of secondary feed water treatment chemicals will not exceed 18,000 lbs. hydrazine, 36,000 lbs. cyclo hexylamine or 180,000 lbs. of morpholine. Hydrazine reacts with oxygen or decomposes forming water, nitrogen or ammonia that may recirculate in the feed water system or leave the system by way of the air ejector. Other amines can follow the same waste routes as the hydrazine.

Corrosion protection of the secondary side of shut down units is provided by using a blanket of inert nitrogen and/or by filling steam generators partly or completely with condensate quality water containing 200 ppm hydrazine and 10-15 ppm ammonia to pH 10. When tanks are available, layup solutions will be stored and recycled to conserve materials. When tank storage is not available, wet layup solution will be treated in the Waste Water Treatment System. To illustrate a worst case effect of diluting wet layup solutions into the River (Table ER 3.6.2-1) the assumption was made that 4 wet layups per unit per year would drain 24 full steam generators a year into the WWTS. Daily average discharges and downstream effects are tabulated.

4 | Impurities in the secondary cycle are controlled by full flow powdered resin condensate polishing demineralizer cells (Figure 3.6.1-1) following the hotwell pumps. Steam generator blowdown aids in steam generator water chemistry control. Blowdown enters the cycle ahead of the demineralizers, which act as a filter and demineralizer allowing both suspended and dissolved solids removal before the condensate re-enters the steam generators. The system will include five condensate polishers per unit. Normally, four polishers per unit will be | Q2e

4 in operation with the fifth polisher on a standby. Anticipated mass flowrate of condensate through each cell in service is 2,225,647 lb/hr. When the resins become fouled, the polishers are precoated with fresh resins. Radioactively contaminated Q
4 resins are discharged from the condensate polishing demineralizer backwash tank to 2b,
the spent resin tanks in the solid waste system. In the absence of radioactivity c,
spent resins will be discharged to the Waste Water Treatment System for sedimentation d
and subsequent disposal to landfill. Typically, five polishers per week will require precoating. It is estimated that the maximum number of precoats will be one per day. A single precoat requires 310 lbs. of resins and 500 gallons of water (backwash) for
4 transport of the spent resins. The condensate polishers will remove approximately 400 pounds of iron oxides per unit per year and will provide some protection from condenser tube leakage.

3.6.1.6 Miscellaneous

During a construction phase of six years, the pipe fabricating shop area will use a total of 850 gallons of liquid detergents to spray-clean pipe assemblies before final assembly into each of three units. Waste water flushed and drained from pipe sub-assemblies will average containing 142 gallons of liquid detergent a year. The product is designated as a biodegradable formulation. The dilute waste will be piped from the component assembly area to temporary package sewage treatment units of the extended aeration type used on the job site. The shop waste will be mixed into a unit that receives mostly domestic type waste from employee toilets. A certified operator is employed and laboratory tests assure design level results in waste treatment. Finally, effluent from the package treatment unit flows through a lagoon before it flows into a receiving body of water.

The condenser-feed water system of each unit will be cleaned with a hot alkaline solution before startup at intervals of about a year apart for each unit. The divided condenser will be cleaned by sections in sequence using one batch of solution to minimize waste. About 30,000 pounds of commercial trisodium phosphate, $Na_3PO_4 \cdot 12H_2O$, and 138 gallons of liquid detergent will be used in about 720,000 gallons of water. The waste will flow to the Waste Water Treatment System for treatment and controlled release. The annual daily average weights of these startup cleaning materials are included in WWTS discharges and downstream incremental effects of Table ER 3.6.2-1.

3.7 SANITARY AND OTHER WASTE SYSTEMS

3.7.1 SUMMARY

In addition to the potentially radioactive wastes and chemical wastes described in the previous subsections, there are other miscellaneous liquid and gaseous wastes which will not be radioactive but which may require treatment from a public health standpoint. These liquid wastes include domestic sewage, small quantities of industrial chemicals, ordinary floor and yard drains, and air conditioning condensate. These sources of waste water will be treated as required to make them suitable for disposal, as described by the following subsections.

During plant operation, normal disposition of garbage and other non-radioactive trash will be to landfill.

Gaseous wastes include exhaust emissions from the auxiliary boiler and diesel generator engines.

3.7.2 SEWAGE TREATMENT SYSTEMS 2

During the period of plant construction, all domestic sewage from the field toilets, field office toilets, and mess hall will amount to a maximum total flow of 35,000 gallons per day. The average flow of effluent from the temporary system will increase to a maximum in 1978 and remain constant until 1981. It will then decrease until construction activities terminate several months following the startup of Unit 3, when the flow of effluent will be zero. These wastes will be treated in prefabricated extended aeration type sewage treatment plants having a combined capacity of 36,000 gallons per day. Up to 6 pounds of hypo-chlorite per day (12-25 ppm) will be used in chlorite contact chambers with 30-40 minutes retention. Sewage solids will be digested completely by extended aeration treatment, leaving a liquid effluent with a minimum free chlorite residual of 0.5-1.0 ppm. The effluent will then be pumped to a 2
holding pond and ultimately to the river.

After the construction period, domestic sewage will total an estimated 8,000
4 gallons per day. This sewage will be treated by extended aeration with tertiary treatment with a capacity of 8,000 gallons per day. The effluent will be treated in a contact chamber that will apply up to 2 pounds of hypo-chlorite per day (12-25 ppm). The effluent will have a minimum residual of 0.5-1.0 ppm free chlorite and will be pumped to the station's holding pond and then ultimately to the river. Suspended solid removal will vary between 60 and 85 percent, and the biochemical oxygen demand (B. O. D.) reduction will
2 be 90 percent.

Residual combined chlorite in the effluent of both temporary and permanent sewage treatment systems will be determined by daily tests using a procedure outlined in Standards Methods. The sewage treatment facilities will be operated under the supervision of a trained waste treatment plant operator who is certified by the State of North Carolina.

3.7.3 CHEMICAL LABORATORIES

Miscellaneous chemical reagents in very small quantities will be used in the chemical laboratories, and no special chemical waste treatment will be necessary.

Because drains from the "Hot Lab" may contain small quantities of radioactivity, all drains from this lab will be processed through the radioactive liquid waste disposal system described in Section 3.5.

3.7.4 LAUNDRY WASTES

Normally, laundry wastes should require no special chemical treatment. If testing shows that the laundry wastes contain unacceptable quantities of radioactivity, they will be processed through the radioactive liquid waste disposal system described in Section 3.5.

3.7.5 DRINKING WATER

Drinking water disinfection and sanitary waste water post-treatment will utilize
4 hypo-chlorite. No disposal considerations will be involved.

3.7.6 PLANT HEATING BOILER

This boiler will be used for plant heating purposes for a period of approximately one year prior to Unit startup. After that, heat will be provided by the
2 1 Auxiliary Steam System. The boiler will be electric fired; there will be no emissions. Q. 3.7

3.7.7 DIESEL ENGINES

The diesel generators will provide emergency power during an accident. They will be started and tested no less than once every two weeks and operate each time for about an hour. The diesels will run on fuel oil having a cetane rating of 37-47. The fuel oil will consist of 0.15 percent weight carbon residue, 0.60 percent weight sulphur, and 0.01 percent weight ash.

Exhaust gases will pass through an exhaust silencer before discharging into
2 1 the atmosphere. Sulphur dioxide content is expected to be 550 lb/yr. Nitrous oxide content is expected to be 3090 lb/yr. Q. 3.7

ER Table 3.3.0-2

Perkins Nuclear Station

Cooling Tower Evaporation[1]

Not Including Drift[2]

Month	3 Units 100% Load CFS	3 Units 76% Load CFS
January	100	76
February	102	78
March	105	80
April	107	81
May	110	84
June	112	85
July	110	84
August	110	84
September	112	85
October	110	84
November	109	83
December	103	78
Average	107	82

Maximum evaporation will occur when three units operate at 100% load factor.

Average evaporation will occur at 76% load factor.

[1] ER Table 3.3.0-2 includes CCW and NSW cooling towers.

[2] Drift at 0.005% will cause an additional loss of 0.25 CFS at

Amendment 2
(Entire Page Revised)

ER Table 3.4.0-1
Perkins Nuclear Station
<u>Heat Dissipation System</u>

Heat Load		
Main Condenser (100% Load)	8.7×10^9	BTU/hr/unit
Service Water (Normal Conditions)	5.5×10^6	BTU/hr/unit
Nuclear Service Water (Normal Conditions)	$80. \times 10^6$	BTU/hr/unit
Circulating Water Flow		
Condenser	2,175,000	gpm/station
Conventional Service Water	6,900	gpm/station
NSW	105,000	gpm/station
Cooling Towers (CCW)		
Design Wet Bulb	76° F	
Range	24° F	
Approach	12° F	
4 Exit Air Velocity	35.5 fps	
Exit Air Temperature	101.2° F	
Maximum Drift Rate	.005%	
Condenser		
Delta T	24° F	
Surface Area	1,100,000 square feet	
Tube Material	Stainless Steel	
Tube Length	39 Feet	
Tube Diameter	1-1/4 Inch	

Amendment 2
(Entire Page Revised)
Amendment 4

ER Table 3.5.2-1
Perkins Nuclear Station

Sources, Volumes and Flow Rates of
GWMS Waste Gas Inputs per Unit
Gas Collection Header (GCH)

Sources	Annual Volume (SCF)	Flow Rate (SCFM)
a. Blowdown Recycle IX	56	16
b. PCPS Pool IX's	112	16
c. Purification IX	112	16
d. Deborating IX	56	16
e. Waste Condensate IX	102	16
f. Boric Acid Condensate IX	102	16
g. Preholdup IX	56	16
h. Waste Concentrator	987	1
i. Boric Acid Concentrator	2,626	1
j. Laundry Tanks	17,567	7
k. Waste Tanks	53,325	7
l. Waste Condensate Tanks	53,325	7
m. Spent Resin Tanks	1,337	22
n. Reactor Makeup Water Tank	127,480	22
o. Holdup Tank	141,644	16
p. Refueling Water Tank	14,164	22
q. Equipment Drain Tanks	1,952	16
r. Concentrate Tanks	4,438	1
TOTAL	419,441	

Gas Surge Header (GSH)

Sources	Annual Volume (SCF)	Flow Rate (SCFM)
Reactor Drain Tank(2)	7,759	.02
Volume Control Tank	1,624	.004
Gas Stripper	145,000	.32
Refueling Failed Fuel Detector(2)	1,673	.004
TOTAL	156,056	

(1) Flow rates are estimated maximums, not continuous. Volumes include anticipated operational occurrences.

(2) Inputs that enter the GSH via the containment vent header.

ER Table 3.5.1-3
Perkins Nuclear Station

Annual Average Discharges from the MLWMS of One Unit

Nuclide	Half-life (Hours)	Annual Discharge Curies/year
I 131	1.9(2)	1.3(-2)*
I 132	2.3(1)	1.0(-4)
I 133	2.1(1)	1.4(-2)
I 135	6.7(1)	3.3(-3)
Mo 99	6.7(1)	9.2(-2)
Cs 134	18.(4)	1.1(-3)
Cs 136	3.1(2)	1.2(-3)
Cs 137	2.6(5)	4.6(-3)
Co 58	1.7(3)	4.4(-3)
Co 60	4.6(4)	4.8(-4)
TOTAL**		1.4(-1)
H 3	1.1(5)	4.5(+1)

4

* ( ) indicates power of ten

** The sum of all other nuclides comprise less than 1 percent of the total

Amendment 1
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Amendment 3
(Entire page revised)
Amendment 4

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ER Table 3.5.2-2
Perkins Nuclear Station

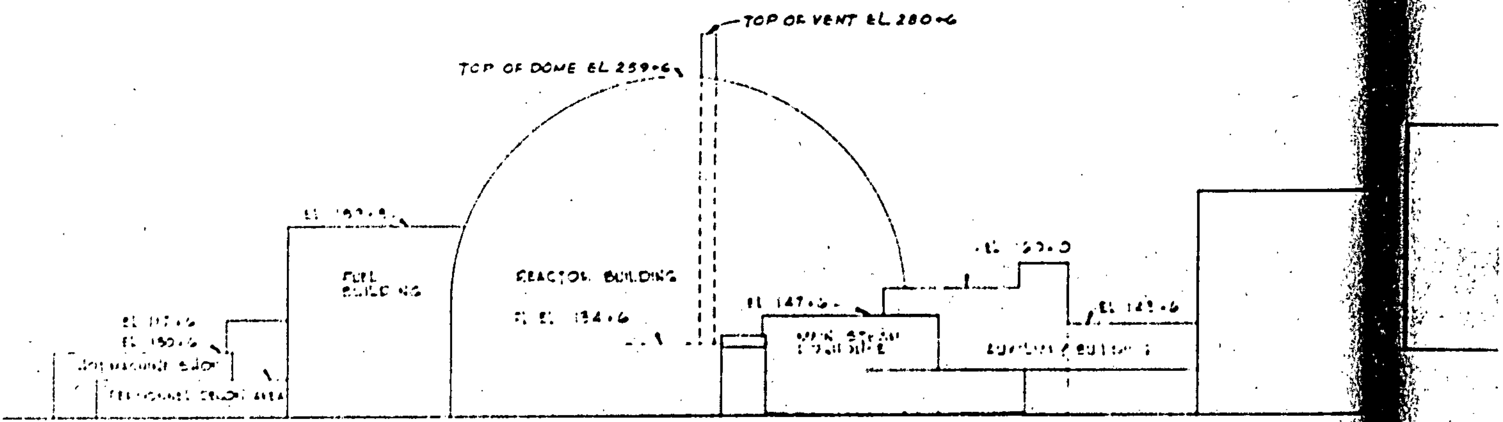
Annual Average Discharge from GWMS

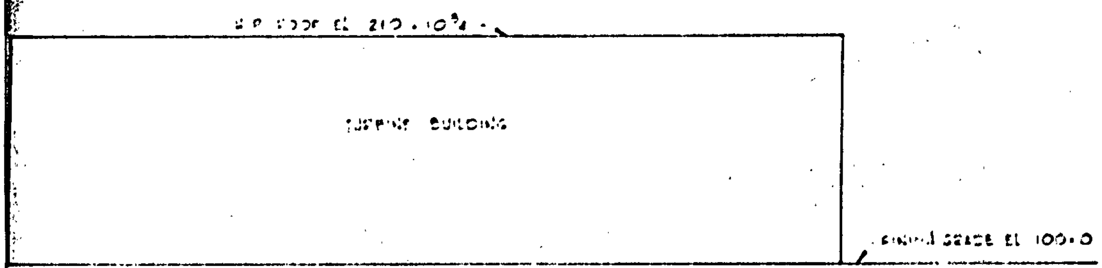
	Nuclide	Half-life, Hours	Discharge per unit, Curies/year
	Kr-85M	4.4E+00	5.8
	Kr-85	9.4E+04	3.7(+2)
	Kr-87	1.3E+00	3.7
	Kr-88	2.8E+00	1.0(+1)*
	Xe-131m	2.8E+02	6.5(-1)
4	Xe-133	1.3E+02	1.0(+2)
	Xe-135	9.3E+00	2.2(+1)
	Xe-138	2.8E-01	2.4
	I-129	1.5E+11	1.2(-11)
	I-131	1.9E+02	9.8(-4)
	I-132	2.3E+00	1.2(-4)
	I-133	2.1E+01	1.0(-3)
	I-134	8.7E-01	7.6(-5)
	I-135	6.7E+00	4.2(-4)

Note: Credit taken for one year holdup of the nuclides in the gas decay tanks prior to discharge.

*( ) Indicates power of ten.

Amendment 3
(Entire page revised)
Amendment 4


TOP OF VENT EL 280-6
TOP OF DOME EL 259-6
FUEL BUILDING
REACTOR BUILDING
EL 147-6



SCHEMATIC ELEVATION

PERKINS NUCLEAR STATION
ER Figure 3.1.0-5
Amendment 1
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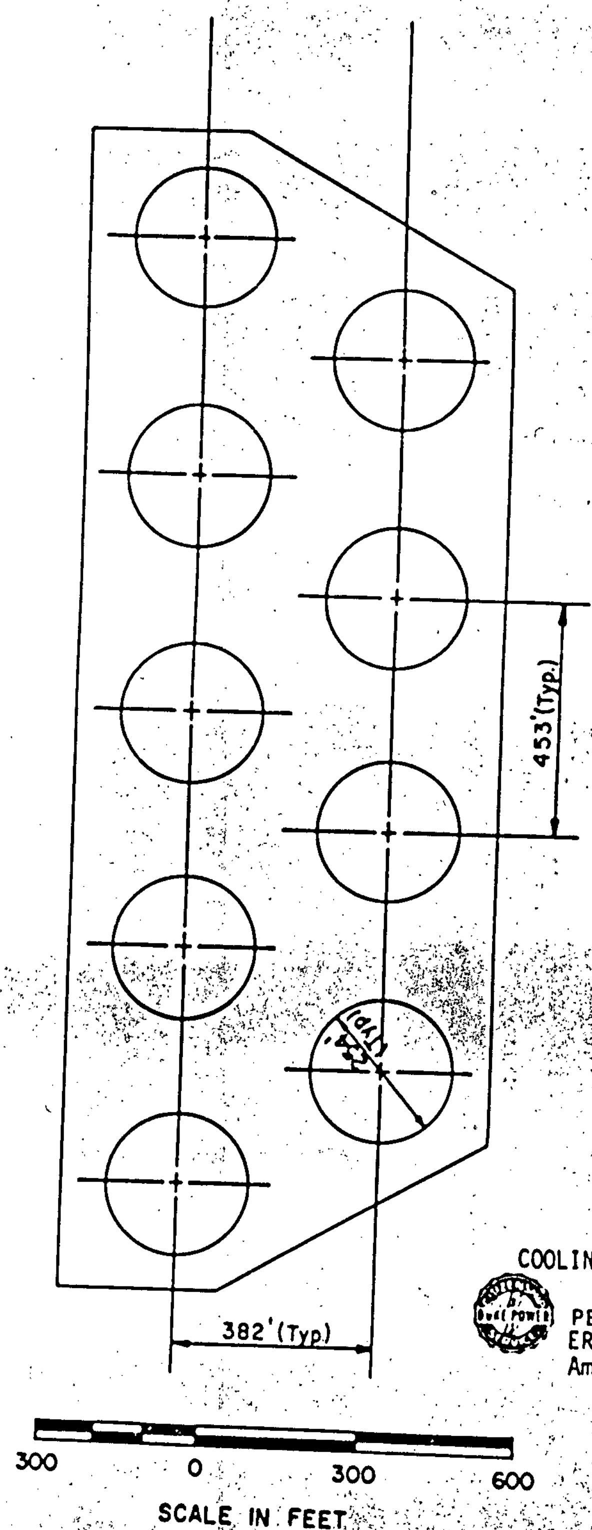
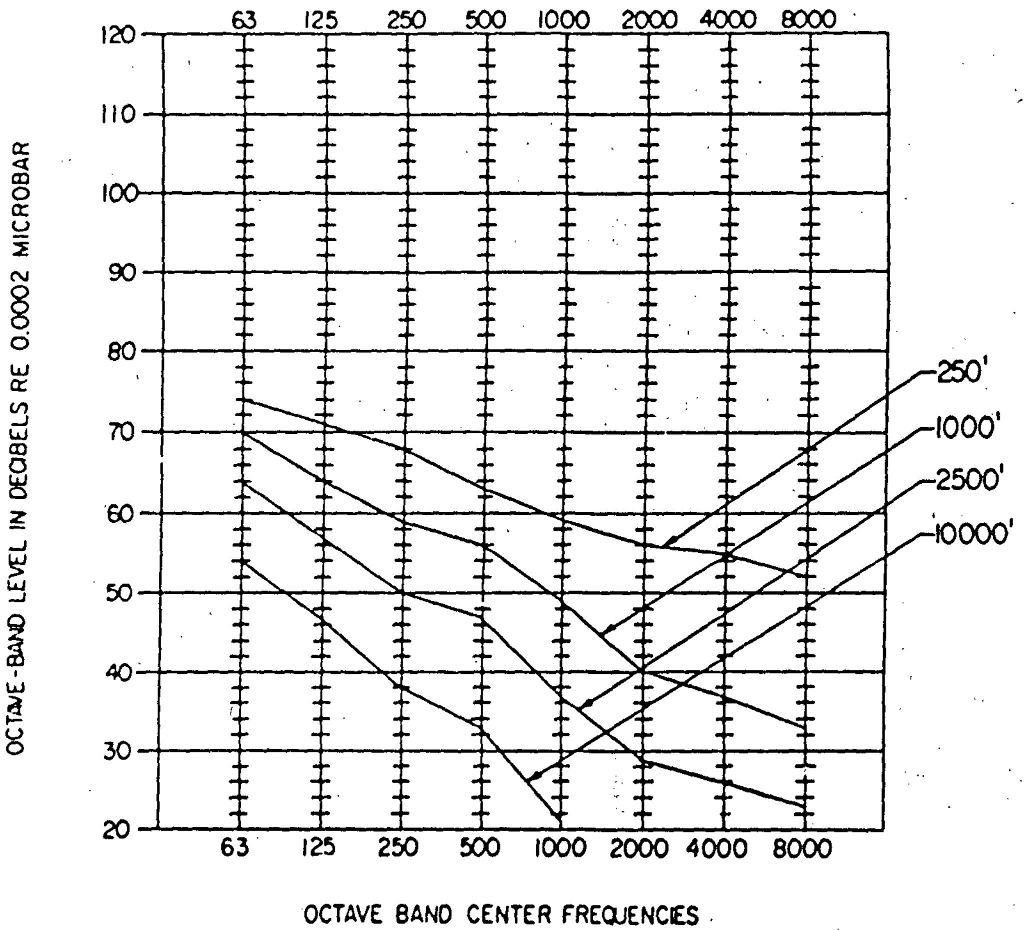


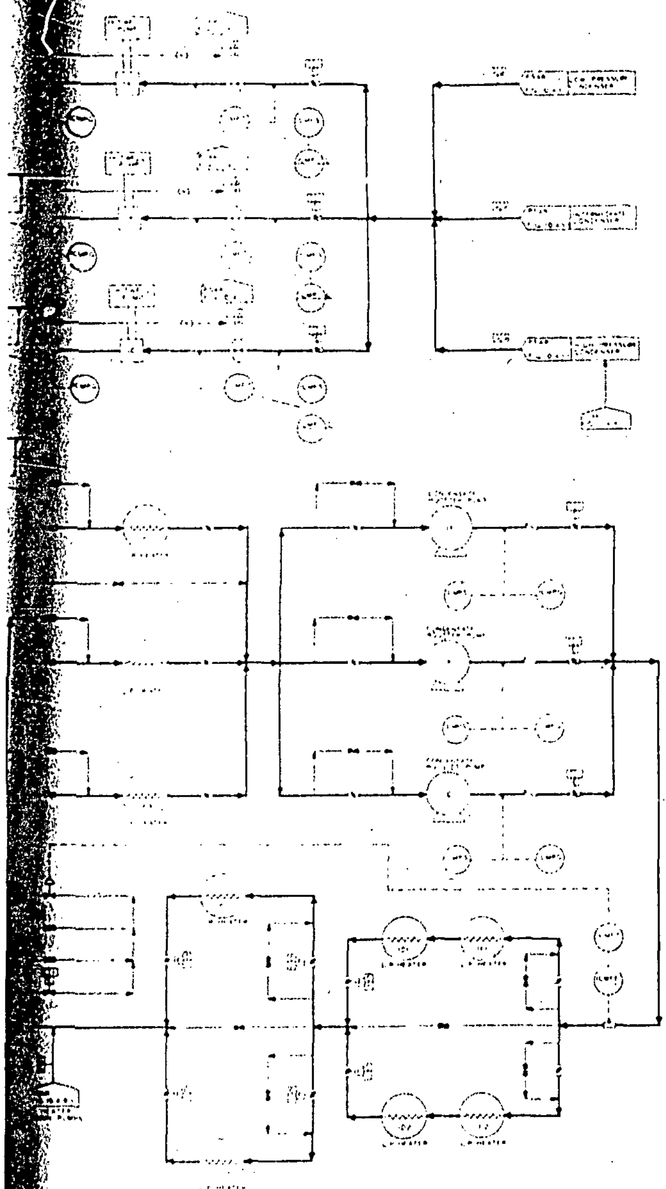
COOLING TOWER ARRANGEMENT

PERKINS NUCLEAR STATION
ER Figure 3.4.0-2
Amendment 4
(New)



PREDICTED NOISE LEVELS

PERKINS NUCLEAR STATION
ER Figure 3.4.0-3
Amendment 4
(New)



FLOW DIAGRAM OF CONDENSATE SYSTEM

PERKINS NUCLEAR STATION

ER Figure 3.6.1-1

Amendment 4

(New)

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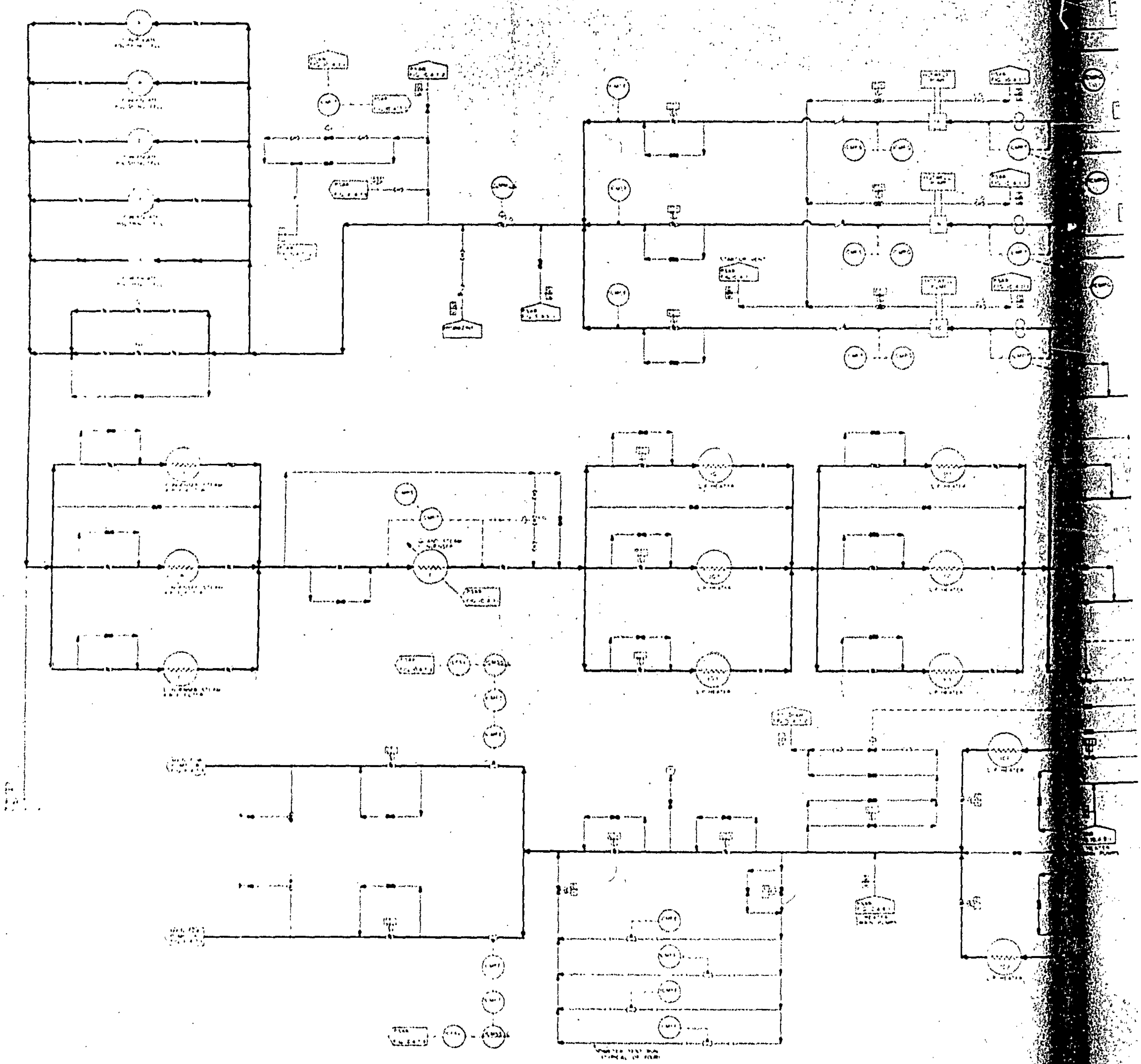


Organic wastes from construction personnel are to be controlled by the use of portable chemical toilets until temporary waste treatment facilities are installed. These toilets are periodically emptied into closed tank trucks and the wastes transported offsite for proper disposal.

The effects on water quality and water supply in the Yadkin River, due to the construction of the intake and discharge structure, are detailed in Sections 10.2 and 10.3. The bankside structures will have minimal land requirements (1 acre). Chemical, biocide, and mineral quality of the water
1 will remain unchanged. The turbidity of the water, described in Subdivi- Q4.1.7
sion 2.5.1.5, is primarily a function of upbasin rainfall runoff and is not Q4.0.9
expected to be affected by construction. The water supply available in the
river will not be affected by construction Q4.0.11

4.1.4.2 Effects on Groundwater

The proposed facilities require several excavations of considerable size. The dewatering of the structure excavations will not lower the groundwater table beyond the site area since the most conservatively calculated radius of influence extends less than 1000 feet beyond the excavations. The site boundary is at least 2,000 feet away from any excavation as shown by Figure 2.1-2. Computations are based on the following empirical equation:

4 $$R = C' \; (H-h_w) \; \sqrt{k}$$ [1]

Where R = radius of influence (ft)

$(H-h_w)$ = drawdown at well (ft) Q4.0.10

k = permeability of soil (10^{-4} cm per sec.)

C' = dimensionless constant

Values for soil permeability for the site are given in PSAR Appendix 2B, and the value of C' used in computations is 3.0 as discussed by Leonards.[2] When construction is complete, the groundwater table is expected to return to its previous level, resulting in no adverse impact on the aquifer.

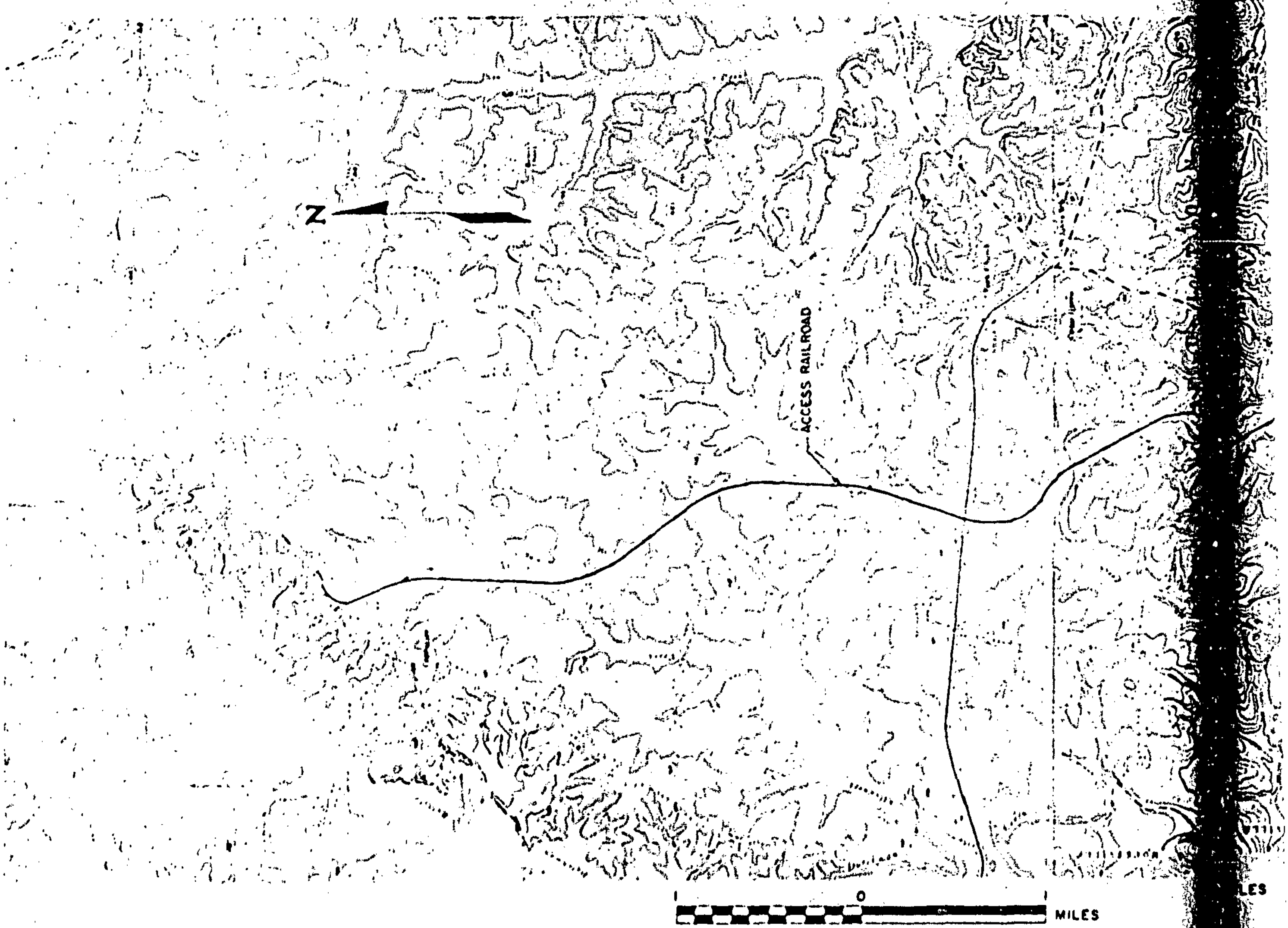
Nearby groundwater users will not be affected by dewatering for excavation or the construction of impoundments on the site as discussed above and in Section 2.5. Small creeks adjacent to the site will furnish sources of
water for fire protection and concrete batch mixing. Wells with a maximum Q4.0.11
total usage of 60 gpm will provide water for other construction uses.

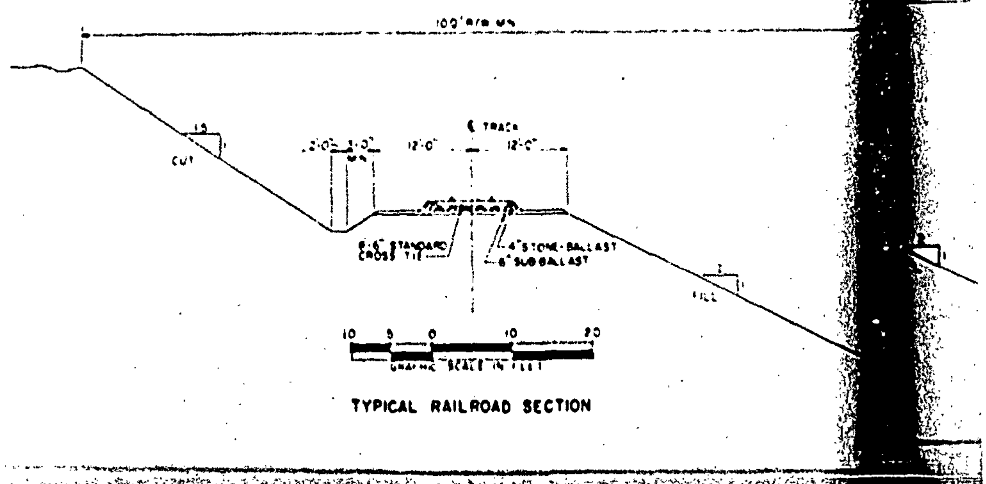
4.1.4.3 Effects on Aquatic Life

Site preparation and station construction is expected to affect the aquatic organisms inhabiting the local site in several ways. These impacts include the loss of space and habitat and increased turbidity and siltation in the river. Direct loss of habitat due to the intake, discharge, and embankment facilities construction may effect the macroinvertebrate population, but is not expected to have as important an impact on the plankton and fish populations in these areas. The effect on plankton and fish is a function of the reduction in space equal to the volume of the facilities. Although this is a permanent impact on the population of aquatic fauna, it is not considered as a significant impact since the area to be occupied by the facilities is a negligible portion of the total water flow line.

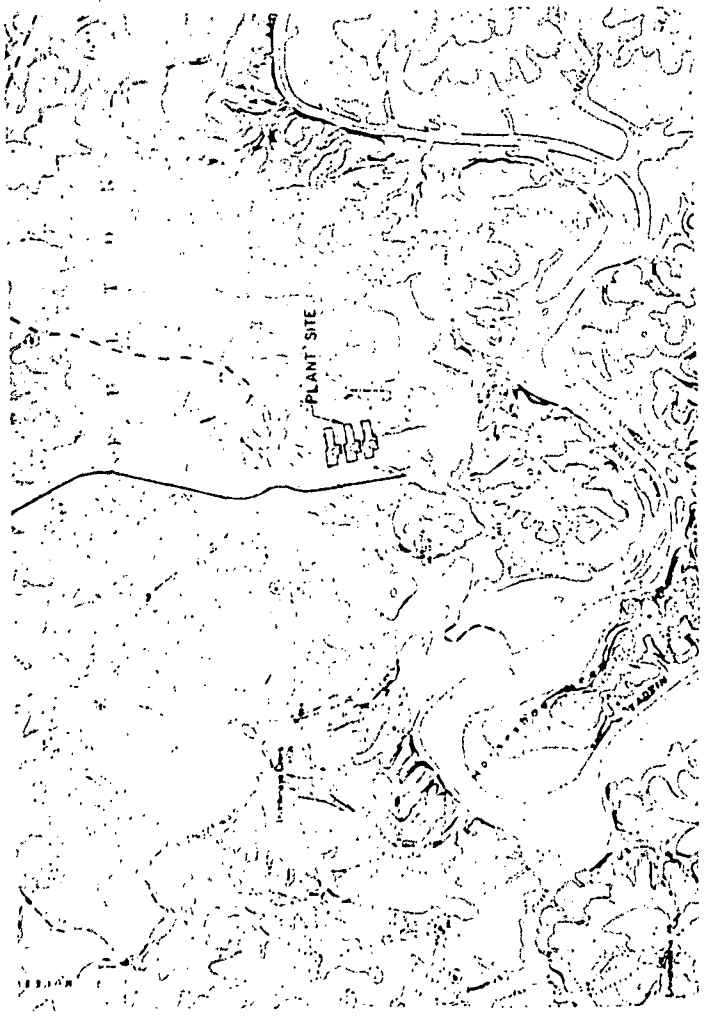
The suspended solids resulting from erosion during construction are expected to have a temporary impact on all forms of aquatic life. The area affected
1 by increased turbidity depends on weather and physical conditions at the river at that time, as shown in Section 2.5.

Deposition of silt in the river may affect benthic flora and fauna and fish populations in the immediate area. Reductions in aquatic plants and macro-invertebrate population can occur through physical smothering of organisms. The presence of silt is also known to change the species composition of benthic populations. Estimation of the time required for repopulation and stable community development is not possible until the complete background ecological study is completed. Siltation affects fish through possible loss of spawning habitat, smothering of demersal or adhesive eggs, and depletion or elimination of benthic food organisms.





TYPICAL RAILROAD SECTION



2

ACCESS RAILROAD

PERKINS NUCLEAR STATION
ER Figure 4.1.1-4
Amendment 4

3
2

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5.1.2.2 Effect of Heated Discharge on Aquatic Life

As explained in Subdivision 5.1.2.1, the thermal plume caused by discharge of blowdown water to the river will be very small. It is not expected to extend across the entire river at any time. Under winter conditions, which tend to maximize plume size, the 5 F isotherm will extend across only 1/2 of the river's width (Figure 5.1.2-2). This is not expected to restrict passage of fish in either direction.

The effects of this plume on the fish population of this reach of the river are not expected to be appreciable for these reasons:

2 1. Fish will be able to swim around and under the plume (Figures 5.1.2-1 and 5.1.2-2).

2. The density of fish in the region of the discharge (Station 27) is low, as shown in Table 2.7.2-17 and Figure 6.1.1-2. A detailed de-
2 scription of the distribution of fish in this section of the Yadkin River is presented in Section 2.7.2.6. Q5.1.15

3. The most severe effects which may be expected from the thermal discharge may be evaluated in the case of the bluegill (<u>Lepomis macrochirus</u>) using the data of C.C. Coutant as cited in the AEC's <u>Final Environmental Statement</u> on the William B. McGuire Nuclear Station (1972). Assuming an ambient summer temperature of 77 F (acclimation temperature) an upper lethal threshold temperature for this species may be expected at 91.4 F. The maximum discharge temperature is calculated as 90 F (Subdivision 5.1.2.2). Therefore, at no time will the discharge temperature exceed the lethal threshold temperature for this species. Furthermore even this 90 F temperature will dissipate rapidly downstream. (Figure 5.1.2-1)

   The ambient temperature for the winter months is expected to be 40-45 F (Figure 2.5.1-6). Coutant does not provide an estimated upper lethal threshold for the bluegill at this acclimation temperature. However, bluegills exposed to an ambient temperature of 59 F are reported to reach threshold at 87 F.

   Ambient river temperatures in the neighborhood of 59 F generally occur in the months of November and March (Figure 2.5.1-6). Average wet bulb temperatures for these months are 51 F and 48 F (Charlotte Airport data 1955-64). Therefore the cooling tower performance curves predict blowdown temperatures of 75F and 74 F, respectively. These figures are well below the lethal threshold temperature for the bluegill.

   In predicting the possible environmental effects of the 30 F Δt in winter, and in viewing Figure 5.1.2-2, it is important to keep in mind
2 that the average flow of the Yadkin River is 2850 cfs and that late fall, winter and early spring are, historically, periods of high flow (Figure 2.5.1-6). The range of the discharge will be 8-12 cfs.

The thermal discharge plume is primarily a surface phenomenon and is therefore not expected to have an appreciable effect on the benthos downstream from the discharge. Planktonic organisms will only be exposed to the heated discharge for a brief amount of time. The worst effects would be to those plankton passing through the immediate area of the discharge. In the winter especially this will be a small portion of an already small population (Sections 2.7.2.1 and 2.7.2.2).

5.1.2.3 Impingement and Entrainment by Cooling Water Intake Structures

Operation of the Perkins Nuclear Station requires a maximum of 272 cfs
4 makeup water from the Yadkin River. Of this, a maximum of 122 cfs (112 cfs consumed) will be used for various purposes in the plant, and a maximum of 150 cfs will be used on an intermittent basis for dilution of radioactive wastes and returned directly to the river. The intake structure is described in Section 3.4. Maximum intake velocities will occur at the screens and will be approximately 0.5 feet per second.

Velocities on the Yadkin River in the vicinity of the intake (Figure 3.4.0-1) are about 2.5 feet per second (Section 2.5). Adult fish are acclimated to this velocity, which is many times that expected in the immediate area of the intake. Swim speeds of selected fish species from the Piedmont Carolinas are discussed at length in Appendix IV. Q2.7.9 All adult fish tested exhibited the ability to swim at speeds greater than 0.5 fps. Since the intake is sized such that the maximum intake velocity is less than 0.5 feet per second even at lowest river flow, low flows will not increase fish impingement due to velocity considerations. However, assuming the numbers of fish in the vicinity of the intake remain the same at low flows, the decreased quantity of water could cause overcrowding and stress causing the fish to become weaker. In this respect increased impingement, though unlikely, could occur due to low flows. Q5.1.11

The intake will be protected by a 3/8 inch mesh traveling screen (Section 10.2). Therefore, no fish with a diameter larger than 3/8 inch can pass through, and no healthy adult fish will be impinged. Furthermore, fish population are low in the area of the intake (Table 2.7.2-17). Fish eggs and ichthyoplankton are not expected to reach high levels in the turbid and swift flowing reach of the Yadkin where the intake structure is to be located. The fish populations of the Yadkin River are discussed at greater length in Subdivision 2.7.2.6.

4

Q5.1.17

4 The proposed bankside intake structure (Subdivision 10.2.2.1) incorporates the "best available technology" for a conventional cooling water intake structure as proposed by the U.S. Environmental Protection Agency.

of an emergency need for cooling water, pond level is not expected to fluctuate appreciably.

The principal environmental effect of the construction of the pond will be the replacement of about 1 1/2 miles of creek habitat and some 190 acres of terrestrial vegetation (which will be cleared prior to flooding) with the pond, which will hold 3600 acre-feet and reach a depth of 40 feet just behind the dam. The site creek has a drainage area of 1469 acres. In the portion which will be affected it ranges from two to three meters in width and is never more than 1.0 meter deep. Most of the substrate is hard packed sand.

Aquatic sampling station 3 (Figure 6.1.1-2) is located on the creek. Data for water quality measurements are given in Table 2.5.0-1. Information concerning the biota collected at Station 3 is presented in Subsection 2.7.2. Fish sampling by electroshocking has yielded very low numbers (Table 2.7.2-32), mostly the creek chub (Semotilus atromaculatus) and the green sunfish (Lepomis cyanellus). Lepomis cyanellus will, in all likelihood, become established in the pond; Semotilus atromaculatus may survive in small numbers in what remains of the creek environment above the influence of the impoundment. It is also expected that the settling of silt from the Yadkin intake will result in the establishment of a chironomid/oligochate/Chaoborus bottom community typical of ponds. Q5.1.1

The area flooded by the Nuclear Service Water Pond presently consists of approximately 50 acres of mixed mesic hardwood forest, 26 acres of mesic pine forest, 25 acres of pine plantation, 21 acres of oak-hickory forest, 18 acres of alluvial fields, 18 acres of upland fields, 16 acres of alluvial forest, 10 acres of upland abandoned fields, and 7 acres of upland thicket (Figures 2.7.1-2 and 3.1.0-2). In addition, approximately three acres of alluvial field and two acres of mixed mesic hardwood forest will be destroyed in construction of the NSW Pond dam.

It is expected that the half mile of creek bed below the dam will essentially be lost as a habitat for stream organisms, although overflow from the dam will be fed back into it during high and average flows. As noted above, this site creek has a drainage area of slightly over two square miles. Since the drainage area of Dutchman Creek is approximately 130 square miles, loss of the discharge from this creek is not expected to have a marked effect on Dutchman Creek, even at low flows. It is the last creek to enter Dutchman before the latter reaches the Yadkin River.

There are at present no plans to use biocides in the NSW pond. Aquatic macrophytes would be removed mechanically should they develop in any numbers along the shore. High populations (e.g. Dorosoma spp.) of trash fish, if they should develop to nuisance levels, could be removed by extensive shocking and netting. Biocides will be used to keep condenser tubes and cooling towers free of growths, but blowdown will be treated before release to the Yadkin, and in no event will it be returned to the NSW pond. Q2.7.5

5.1.4.2 Carter Creek Reservoir

The Carter Creek impoundment (Figure 2.1.1-1) is designated to the sole function of providing makeup water to allow continuous operation of the Perkins Nuclear Station, during low flow periods, when the Yadkin River flow is below the minimum flow established by North Carolina Department of Natural and Economic Resources (Subdivision 5.1.4.2.2). A comparison of the proposed impoundment required for three minimum flow restrictions is given in Table 5.1.4-1. Q 10a

5.1.4.2.1 Alternate Sites

Between Muddy Creek and Dutchman Creek, numerous rivulets and intermittent streams enter the Yadkin River from either bank above the proposed location of the intake structures for the Perkins Nuclear Station. Of these, only seven are large enough to be named on USGS topographic maps. Going downstream from Muddy Creek, they are: Peoples Creek, Reedy Creek, Carter Creek, Dykers Creek, Gobble Creek, Mill Creek, and Lick Run. Carter Creek is one of the longest and has one of the largest drainage areas (8.1 sq. mi). A remarkable feature about it is that it is very straight over most of its length. Its possible importance as a site for fish spawning will be evaluated in the special sampling effort which began in March, 1975.

In selecting the Carter Creek impoundment site, alternate creeks along the Yadkin River were considered. Carter Creek was selected over the others as the most acceptable, based on hydrologic, economic, social, and environmental considerations. Alternate creek sites considered which are closer to the plant site are Dutchman Creek and Mill Creek.

Dutchman Creek is located west of the plant site and joins the Yadkin River about two miles downstream of the station intake structure. Mill Creek is located east of the Yadkin River in Davidson County and joins the Yadkin River about one mile upstream of the Perkins intake.

The Carter Creek site is preferred over the Dutchman Creek site because the land requirement to store an equal volume of water on Dutchman Creek is about twice that of the land requirement at Carter Creek. Also, the Dutchman Creek site is more heavily populated and construction of an impoundment on it will have a greater impact on the local population. The larger surface area of Dutchman Creek would also increase evaporation losses from the pond. The impoundment of the Dutchman Creek site would require road and railroad relocations, increasing the cost of the impoundment by about 35 percent. Q 12

The Carter Creek site is considered a better choice than the Mill Creek site in Davidson County based on economic and environmental considerations. The construction cost of the Mill Creek impoundment is about 10 percent greater than that of the proposed Carter Creek impoundment. The impoundment of Mill Creek would require inundation of over 200 acres of the Cooleemee gameland which is currently under management of the North Carolina Wildlife Commission.

5.1.4.2.2 Reservoir Operation

Based on tentative agreement reached between Duke and NCDNER on January 20, 1975, river flow above which pumping will be allowed is 880 cfs (measured at the Yadkin College gage). All flow above 880 cfs can be withdrawn from the river subject to a maximum of 25 percent of the total stream flow. The average flow of the Yadkin River is 2853 cfs. Since the operation of the W. Kerr Scott Reservoir began in 1962, the flow of the Yadkin River has been above 880 cfs 98 percent of the time.

During normal filling operations, one to four of the 50 cfs capacity intake pumps will operate at full capacity to bring the reservoirs to full pond. The number of pumps operating is a function of streamflow available for pumping. Q 10 c, e, f The pumping rate into the Carter Creek Reservoir will be limited to the excess river flow above 880 cfs minus any consumptive withdrawals being made at the Perkins intake. The historical river flow since W. Kerr Scott began operation has exceeded 1,248 cfs 93 percent of the time. At this level of flow, the maximum plant consumptive requirement plus the maximum pumping capacity (200 cfs) into the Carter Creek Reservoir may be withdrawn from the river without violating the tentative agreement restricting withdrawals to 25 percent of the total river flow.

The expected drawdown, based on Yadkin River historical flow records, of the Carter Creek Reservoir once in 10 years is 20.5. The reservoir will be refilled by pumping available river flow (based on State of North Carolina restrictions) up to 200 cfs, into the reservoir. The area capacity curves for the reservoir are shown in Figure 5.1.4-1 and other Q 14
4 design basis are given in Table 5.1.4-2.

The average annual estimated operating cost of the Carter Creek Reservoir is $8,000 which will have only minimal effect on the cost of producing power at Perkins. Q 17

Releasing impounded water from Carter Creek to Yadkin River during periods of low flow will not only maintain a larger flow rate in the river, it should improve the average quality of water flowing downstream into High Rock Lake. Improvement in the average quality of water by flow augmentation involves several factors.

Reduced stream flow at Yadkin College Gaging Station reduces the dilution factor for wastes discharged by Winston-Salem's waste treatment plants through Salem Creek, Town Creek and Muddy Creek.

The lowered stream flow carries a smaller amount of dissolved oxygen. Consequently both the assimilative capacity of the river and the dilution capability of the stream are smaller at a time when wastes from the metropolitan area continue at a relatively constant level of Biochemical Oxygen Demand. In fact, waste discharges tend to become more concentrated because of the absence of dilution water in storm sewers and because of the smaller amount of infiltration of ground water into a sewer collection system during drought periods.

The quality of water released from storage will be better than the quality of water in the river. Sedimentation and biological stabilization during storage will remove suspended solids and break down nutrients. The bio-chemical oxygen demand of the stored water will be lowered and the dis-
4 solved oxygen content of the water will tend to increase. The release of 112 cfs to maintain a river flow of 880 cfs downstream at Perkins Nuclear Station would result in more than 12 percent of the stream flow being improved by impoundment. At the 7Q10 river flow of 625 cfs, a release of 82 cfs from storage improves 13 percent of the flow by storage. A release of 108 cfs from storage to a 7Q10 flow of 625 cfs is more than 17 percent of river flow.

Flow augmentation from the Carter Creek impoundment to Yadkin River should improve the capability of the stream to assimilate the impact of wastes that enters the river at upstream point sources. The environmental improvement will extend downstream into High Rock Lake.

5.1.4.2.3 Intake Discharge Structure for Carter Creek

The preliminary layout of the Carter Creek impoundment, the reservoir discharge structure, and the river intake discharge structure are shown in Figure 2.1.1-2.

The bankside intake discharge structure will have four vertical pumps of 50 cfs capacity each. The structure (Figure 5.1.4-2) will include a skimmer wall to prevent floating objects from entering the intake, trash racks to prevent larger submerged objects from entering the screen well and traveling screens to protect larger fish and to keep larger debris from entering the pump well. The geometry of the inlet and screen will provide a velocity equal to or less than 0.5 fps for all stages of the river. Q 10b, g Q 10d

The traveling screens will be 3/8 inch mesh wire panels attached to an endless belt. The screen would travel vertically and pass through a backwash jet spray for cleaning. Debris washed from the screens will be transported to the end of the structure and removed for proper disposal. 4

The intake discharge structure will be equipped with remote controls and operated by personnel at the Perkins Nuclear Station. Operation of the structure will be initiated by plant personnel monitoring the flow at the Yadkin College gage and plant water requirements.

A dual port discharge structure, shown in Figure 5.1.4-3, will be located inside the reservoir (Figure 2.1.1-1) for the release of water to the Yadkin River. This structure will have a high level and a low level sluice gate, each of sufficient size to pass the maximum release of 112 cfs required to replenish consumptive plant loss during low flow periods. Q 11

The reservoir discharge structure will be provided with an overflow inlet at elevation 723.0 ft. to maintain the water level at full pond.

For previous analyses, estimates of drift anticipated from the cooling towers were based on extremely conservative estimates of percentage drift loss and particle size distribution. The specifications of the towers planned for the Perkins station are now known in much more detail. These revised specifications have been used to generate isopleths of drift deposition on an annual basis around the towers. These isopleths are presented on Figure 5.1.5-2.

Deposition was computed solely from trajectory considerations as per nomograms by Hosler, Pena and Pena.[7] In the prediction techniques the following parameters and assumptions have been used:

1. The drift droplet size distribution reflect data taken by the Marley Company applicable to their circular mechanical draft towers.[8]

Distribution of Drift Mass (drift rate - 0.005%)

Droplet Diameter (microns)	Percent of Total Mass
0-60	50
60-125	22
125-180	5
180-225	4
225-325	8
325-425	6
425-525	5

2. Drift loss has been assessed at .005%[8] of circulating water and the solids content of the drift is assumed to be 1150 ppm.[9]

4 3. The profile of exhaust air vertical speeds assumes a linear decrease from tower exit to 925 feet above ground level with an exit speed of 35.5 feet/sec. The final plume height is based on recommendations of Briggs (174)[10] for multiple stack sources.

4. In the interest of conservatism, no evaporation is assumed. Calculations done with evaporation show no substantial difference within 1000 feet of the towers, and only slightly lower deposition rates beyond 1000 feet.

5. Meteorological parameters used are average wind speed by 22.5° sector and wind direction frequency by 22.5° sector. This data is derived from one year of onsite wind observations at the 130 foot level.

As can be seen from Figure 5.1.5-2, the maximum salt deposition rate is about 40 lb/acre-month. The deposition rate decreases rapidly with distance from the tower. The figure also indicates the vegetation occurring in the drift field.

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5.1.12
5.4.2
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5.1.6 OTHER ENVIRONMENTAL EFFECTS OF OPERATION OF THE COOLING WATER SYSTEM

The mechanical draft cooling towers will have a certain level of noise associated with their operation. Maximum noise levels which the cooling tower manufacturer must meet are as follows:

1) The sound levels at any location on the fan deck or any cell (near field) shall not exceed 90 db when measured on the "A" scale of a standard sound level meter at slow response with all fans in operation.

2) The combined sound pressure levels measured at a distance of 250 feet from any point on the outer casing in any direction shall not exceed the following values:

Octave Band Center Frequency, Hz	63	125	250	500	1000	2000	4000	8000
SPL, db, re 0.0002 Microbars	84	77	72	69	69	65	65	65

The site boundary is approximately 3000 feet from the cooling tower at the closest place.

The levels presented above are maximums; actual noise levels are expected to be considerably lower. Vegetative screening should further reduce noise levels so that offsite noise will not be a problem.

Restrictions as to water use and resultant flow conditions is regulated only to the extent that compliance with water quality standards are maintained. Section III Rule 6-d, "Rules Applicable to All Classes and Standards", states that "The criteria are applicable to any fresh water stream when the flowrate is equal to or greater than the minimum seven-day average flowrate that occurs with an average frequency of once in ten years".

The discharge of cooling tower blowdown into the Yadkin River while maintaining the 7Q10 is not expected to cause contravention of the State of North Carolina water quality standards at Perkins Nuclear Station.

Emissions from cooling towers at Perkins Nuclear Station are expected to meet any applicable ambient air quality standards of the State of North Carolina that may be promulgated. There are no standards at the present time for cooling tower emissions pursuant to the "Rules, Regulations, and Standards Governing the Control of Air Pollution" for the State of North Carolina, adopted January 21, 1972.

The behavior of cooling tower plumes under varying areal meteorological conditions is described in Subsection 5.1.5.

5.2 RADIOLOGICAL IMPACT ON BIOTA OTHER THAN MAN

The low-level releases of radioactivity that is normally present in the gaseous and liquid effluents from Perkins Nuclear Station expose all living species in the environment to some small amount of radiation, which results in doses whose magnitude depends upon the habitat and feeding characteristics of the species of interest. This section presents quantitative estimates of annual doses for a broad category of organisms which encompass the "important" biota identified in Section 2.7.

5.2.1 EXPOSURE PATHWAYS

Important local flora and migratory fauna are discussed in Section 2.7. Subsection 5.2.1 considers only those important species whose aquatic and terrestrial habitats provide the highest potential for radiation exposure, and the maximum potential doses have been calculated for these organisms. It is expected that the actual doses received by these organisms from the operation of the station will be much less.

The most important exposure pathways to biota other than man from radioactive materials released to the aquatic or terrestrial environment are shown in Figure 5.2.1-1; however, in the case of the Perkins Nuclear Station, many potential Significant pathways are not available because of the water and land usage, and the nature of the releases. (This statement on water and land use refers to ecological considerations; that various "important" plant and animal species are not present or are present in limited numbers, due to the agricultural use of the land, and the condition and use of the river.) The major pathway for exposure from gaseous waste effluents is direct external radiation from the airborne radioactive material itself as it is dispersed in the environment of the station by the wind. Very small quantities of radioactive iodine are also released in gaseous effluents. This material deposits on vegetation and ingestion is therefore another exposure pathway for grazing animals. Radioactive materials are also released in liquid form in dilution water to the river. Direct radiation exposure from immersion, as well as ingestion and assimilation of the waterborne activity, are the pathways for exposure of aquatic biota.

2 Q 5.2.1

The significant exposure pathways for biota other than man from gaseous waste releases at the Perkins Nuclear Station are determined to be

1. the iodine dose to the thyroids of grazing animals, i.e., cows, from ingestion of contaminated grass; and
2. the external exposure of terrestrial organisms from the radioactive materials in the gaseous waste plume.

For liquid waste releases, the significant pathways for exposure affecting aquatic plants, invertebrates, fish, and ducks are

1. the external exposure due to submersion in water containing dissolved radioactive materials;
2. the external exposure to organisms living in or on shoreline or bottom sediment containing deposited radioactive materials; and
3. the internal exposure due to ingestion and assimilation of dissolved radioactive materials from the water.

5.2.2 RADIOACTIVITY IN THE ENVIRONMENT

4 Estimates of radionuclide releases from the MLWMS and the GWMS from one unit appear in Tables 3.5.1-3 and 3.5.2-2 respectively.

Radioactivity concentrations in the waters downstream of Perkins Nuclear
Station are calculated from the annual release from three units Q5.3.1
4 diluted by the annual average river flow of 2853 cfs (Subdivision 2.5.1.2).
Results are presented in Table 5.3.2-1. Q5.3.2

4 Estimates of radioactivity in sediments have been made for areas downstream of Perkins Nuclear Station. Concentrations listed in Table 5.2.2-1 are calculated from the following relationship.[1]

S_i = $100. \text{ X } Ti \text{ X } Ci \text{ X } W \text{ X} (1-e^{-\lambda_i TL})$

Ti = Half life of isotope i

Ci = River concentration of siotope i at the concentration listed in Table 5.3.2-1. Q5.2.3

W = 0.2 = Shore width factor

λ_i = Decay constant for isotope i

TL = Life of the plant

3 Si = Sediment concentration for isotope i

A discussion of the distribution of gaseous effluents in the environment appears in Subsection 5.3.3.

5.2.3 DOSE RATE ESTIMATES

4 In order to evaluate the dose to the important terrestrial and aquatic biota, certain simplifying assumptions were made, i.e., representative organisms were chosen and the maximum hypothetical doses to such organism
4 were calculated. For example, radionuclide concentrations in aquatic biota (fish, invertebrates and vegetation) have been determined by multiplying the average concentrations of radionuclide expected in the Yadkin River by appropriate biological concentration factors for each radionuclide. It was
3 also assumed that waterfowl (ducks) consumed only aquatic plants containing the above concentrations of Radionuclides. Dose estimates are summarized in Table 5.2.3-1.

The models used for calculation of the doses are presented in Attachment 5A. Q5.2.5
The assumptions are included in this section.

The dose to the thyroid of a representative important grazing animal was calculated through the iodine-atmosphere-grass pathway to the nearest dairy cow.

5.3.4 DIRECT RADIATION

5.3.4.1 Radiation From Facility

Direct radiation exposure due to the Perkins Nuclear Station is expected to be well within applicable regulations for the operating staff and maintenance personnel, and negligible for the population living in the vicinity of the station in comparison with the exposure due to natural background radiation. Exposure to the population residing near the station is conservatively estimated at less than 0.03 man-rems/year. For the period of time when one unit or two units are in operation and construction of the remaining unit(s) is being completed, it is estimated that construction personnel receive an exposure of 76 man-rem, assuming the exposure times shown in Table 5.3.4-2. The dose rates from Unit 1 are 9.0×10^{-6} rem/hr and 1.2×10^{-6} rem/hr at Unit 2 and Unit 3 respectively. The dose rate at Unit 3 resulting from operation of Units 1 and 2 is 1.02×10^{-5} rem/hr. Dose rates at selected offsite locations are estimated as follows:

4

Location	Dose Rate (rem/year)
Exclusion area boundary	1.8×10^{-4}
Nearest residence	1.2×10^{-4}
Nearest school	$\ll 10^{-10}$
Nearest hospital	$\ll 10^{-10}$

The nearest residence (2625 feet north of the station), school, and hospital are indicated on Figure 2.2.2-1.

Direct radiation is taken to be that from the outside tanks (Refueling Water Tank, Holdup Tank, and Reactor Makeup Water Tank). These tanks (shown on Figure 5.3.4-1) were assumed to be 'square' cylinders containing the Q5.3.4.1
volume and radionuclide concentrations (average values for shielding) listed in PSAR Section 12.1.3. Q5.3.5.3
Direct radiation does not include any external component from radioactive effluents. The point kernel method is used to calculate offsite dose rates. Reduction by distance and air shielding is considered. No credit is taken for attenuation by offsite structures or terrain. Population projections for 1983 are used in the man-rem calculation.

5.3.4.2 Transportation of Radioactive Materials

Radioactive materials to be shipped to and from the station during operation are discussed in Section 3.8. Additional information is provided below to address specifically the radiological effects of these shipments. A summary is presented in Table 5.3.4-1.

Fresh fuel is supplied from the Combustion Engineering fabrication plant in Windsor, Connecticut. Irradiated fuel is transported by Allied-Gulf Nuclear Service to their facility at Barnwell, South Carolina. The specific AEC or Agreement State-licensed disposal site for solid radwastes has not been selected. Detailed routes for shipments of fuel and radwaste have not been defined; it should be noted that safety standards do not rely on restriction of routing for assuring safety in transport. It is expected that truck shipments will be routed to avoid congested areas and to reduce shipping time and accident probability. Except for spurs leading to the station site and to the reprocessing plant, rail shipments could be expected to travel via regular main line routes.

Radiological requirements of the fresh fuel container are minimal; the principal objectives are to prevent nuclear criticality and to protect the fuel from damage in transport. Design and licensing of the irradiated fuel shipping casks are not complete. The most likely design incorporates a dry fuel cavity and layered shield materials. A fuel assembly having clad defects through which fission products are leaking is placed in a can prior to loading into the transport cask.

Federal regulations governing the packaging and transportation or radioactive materials can be found in the Code of Federal Regulations, Title 49, Parts 170 to 199; Title 14, Part 103; Title 10, Part 71; Title 39, Parts 124.2 (d) and 125.2 (d); Title 46, Parts 146 and 149. These Federal regulations are administered by the U. S. Atomic Energy Commission and the Department of Transportation. The limitations imposed by these regulations on both quantity and method of packaging assure that any significant effects resulting from a severe transportation accident would be confined to the immediate area.

Because of the care and concern taken by shippers to comply with these Federal regulations, the record of safety in the transportation of radioactive materials has been excellent. It is estimated that more than 800,000 packages of radioactive materials are now being shipped annually throughout the United States. Some transportation accidents have occurred; but to date there have been no known deaths or injuries due to radiation from fissile or radioactive materials in the transportation environment.

5.4 EFFECTS OF CHEMICAL AND BIOCIDE DISCHARGES

5.4.1 APPLICABLE WATER STANDARDS

Effluent limitations for steam electric power plant discharges have not yet been promulgated for the State of North Carolina. Any discharge into the Yadkin River must meet the currently applicable State Water Quality
4 Standards for class A-II waters and the appropriate EPA standards. The Perkins Nuclear Station is designed so that chemical and biocide discharges will meet the current stream standards. Duke will comply with these standards and federally approved effluent limitations.

5.4.2 EFFECTS ON RECEIVING WATERS

The effluent concentrations of chemical and biocide discharges and the ambient river concentrations of these chemicals are given in Table 3.6.2-1. This table also gives the expected incremental increase in concentration in the river assuming instantaneous mixing with the 7 day - 10 year low flow and with the yearly average stream flow. Table 5.4.2-1 lists Public Drinking Standards which can be compared with the discharge concentrations listed in Table 3.6.2-1. The incremental increase in chemical concentration due to discharge is only a fraction of the existing river concentration. In most cases the incremental increase added to the average river concentration gives values well below even drinking water standards. North Carolina water quality standards for Class II-A waters do not give maximum concentrations for any of the chemical effluents listed in Table 3.6.2-1 except total hardness, which is not to exceed 100 mg/l. The average discharge concentration for total hardness given in Table 3.6.2-1 is 130 mg/l.

As mentioned above, the expected river concentrations presented in Table 3.6.2-1 assume instantaneous mixing with river flow. Actually a small chemical plume similar to the thermal plume described in Section 5.1 will exist. The computer program described in Subsection 5.1.2.1 was modified to calculate chemical concentrations in the river as a function of discharge concentration, discharge flow characteristics and river channel characteristics. The program computes chemical concentration at various distances downstream using the following equation:

$$C_1/C_2 = 1 + (N-1)\,\frac{(T_1-T_2)}{(T_{1_0}-T_2)}$$

where

C_1 = concentration at some point in the plume
C_2 = ambient concentration in the river
N = number of times discharge concentration is greater than ambient
T_1 = temperature of plume at some point
T_2 = ambient temperature of river
T_{1_0} = initial plume temperature

By applying this equation to the temperature prediction program, the isotherms of Figure 5.1.2-1 become lines of equal chemical contentration. Each isotherm represents chemical concentration in the river as a percent of discharge concentration according to the following translation:

Isotherm	Percent of Initial Concentrations
2°	15%
5°	25%
10°	40%
15°	55%

As an example, in order to dilute the discharge concentration of total hardness mentioned above from 130 mg/l to the state standard of 100 mg/l, a dilution to approximately 77% of the discharge concentration is required. The 15°
2 isotherm in figure 5.1.2-2 represents a dilution to 55% of initial concentration, so that the area required for dilution to only 77% would be somewhat less than that represented by the 15° isotherm and the distance from the discharge point would be less than 150 feet.

Figure 5.1.2-2 represents the case of discharge into the 7 day - 10 year low river flow and winter ambient and discharge temperatures. The 7 day - 10 year low river flow is used since it represents hydraulic conditions in which mixing would be minimized. The winter temperatures are used because they represent the greatest difference between discharge temperature and ambient river temperature and thus require a larger mixing area to dilute the discharge plume. This can be seen by comparing Figure 5.1.2-2 (winter conditions) with Figure 5.1.2-1 (summer conditions). These two conditions thus tend to maximize the size of the discharge plume. As can be seen from figure 5.1.2-2, the chemical concentrations are diluted to near ambient levels within a few hundred feet of the discharge. Other streamflow and temperature combinations clearly would produce a smaller discharge plume.

2

ER TABLE 5.1.4-1 (Sheet 1 of 4)
PERKINS NUCLEAR STATION
COMPARISON OF CARTER CREEK RESERVOIR FOR
THREE YADKIN RIVER FLOW RESTRICTIONS

Item	Units	Flow Restrictions 625 cfs	880 cfs	1000 cfs
		Magnitude		
HYDROLOGIC FEATURES				
1. Yadkin River				
a) Flow exceeds restriction	% of Time			
	(1929-1961)	99	95	93
	(1962-1971)	100	98	96
b) Flow Restriction	% of Average Flow, 2853 cfs	22	31	35
c) Flow Restriction	% of 7Q10 Flow			
7Q10, (1929-62, 597 cfs		104	147	167
7Q10, (1962-73), 760 cfs		82	115	131
2. Reservoir Design Criteria				
a) Live storage required for drought of record.	Ac-ft.	8,200	15,502	32,888
3. Carter Creek Reservoir				
a) Full Pond Elevation	ft, msl	713	723	740
b) Area at Full Pond	Acres	605	860	1,400
c) Volume at Full Pond	Ac-ft.	11,500	18,800	38,000
d) Maximum Drawdown Elevation	ft, msl	693	693.5	697

Amendment 4
(Entire Page Revised)

ER TABLE 5.1.4-1 (Sheet 2 of 4)
PERKINS NUCLEAR STATION

ER TABLE 5.1.4-1 (Sheet 2 of 4)
PERKINS NUCLEAR STATION
COMPARISON OF CARTER CREEK RESERVOIR FOR
THREE YADKIN RIVER FLOW RESTRICTIONS

Item	Units	Flow Restrictions 625 cfs	880 cfs	1000 cfs
		Magnitude		
3. Carter Creek Reservoir (Cont'd.)				
e) Maximum Drawdown	ft.	20	29.5	43
f) Area at Maximum Drawdown	Acres	245	250	305
g) Volume at Maximum Drawdown Elev.	Ac-ft.	3,300	3,298	5,112
h) Volume in Maximum Drawdown	Ac-ft.	8,200	15,502	32,888
i) 1-in-10yr Drawdown Elevation	ft. msl	703	702.5	717
j) 1-in-10yr Drawdown	ft.	10	20.5	23
k) Area at 1-in-10yr Drawdown	Acres	400	390	705
l) Volume at 1-in-10yr Drawdown Elev.	Ac-ft	6,500	6,358	14,000
m) Volume in 1-in-10yr Drawdown	Ac-ft	5,000	12,442	24,000
4. Dam				
a) Crest length	ft.	1,800	1,900	3,400
b) Maximum height	ft.	90	100	105
c) Volume	Million cu. yd.	.9	1.1	1.6

ER TABLE 5.1.4-1 (Sheet 3 of 4)
PERKINS NUCLEAR STATION
COMPARISON OF CARTER CREEK RESERVOIR FOR
THREE YADKIN RIVER FLOW RESTRICTIONS

Item	Units	Flow Restrictions 625 cfs	880 cfs	1000 cfs
		Magnitude		
ENVIRONMENTAL EFFECTS				
1. Land Usage within reservoir	Acres at contours of 713, 720, and 740 ft. respectively			
a) Hardwood Forest		315	414	653
b) Mixed Pine - Hardwood Forest		24	31	95
c) Pine Forest		71	82	137
d) Pine Scrub		2	3	11
e) Pastures, Cropland and other cleared land.		191	256	497
f) Ponds		2	2	8
g) Total Forrested Acreage		412	530	896
h) Total Acreage		605	780	1401
2. Buildings Affected				
a) Homes	Number	4	11	13
b) Mobile Homes	Number	0	0	3
c) Farm Buildings	Number	1	2	2

ER TABLE 5.1.4-1 (Sheet 4 of 4)
PERKINS NUCLEAR STATION
COMPARISON OF CARTER CREEK RESERVOIR FOR
THREE YADKIN RIVER FLOW RESTRICTIONS

Item	Units	625 cfs	880 cfs	1000 cfs
		Flow Restrictions		
		Magnitude		
3. Relocations				
a) Roads (New)	Miles	0	1.2	1.2
b) Roads (Abandoned)		0	1	1
COSTS				
1. Capital Cost	Million $, 1983	12.0	14.0	22.0
2. Annual Fixed Charges	Million $, 1983	2.1	2.4	3.8

ER Table 5.1.4-2
Perkins Nuclear Station
Design Basis for Carter Creek Reservoir

Design Basis	Elevation (ft. msl)	Volume (ac. ft.)	Area (ac.)
Project Design Flood (SPF) Level	728.5	24,112	1,014
Full Pond	723.0	18,800	860
1 in 10 Yr. Drawdown	702.5	6,358	390
Maximum Drawdown	693.5	3,298	250

ER Table 5.2.2-1

Perkins Nuclear Station

Estimates of Radionuclide Concentrations in Shoreline Sediments

	Isotope	Concentration (pCi/m^2)
3	I129	4.1×10^{-05}
	I131	2.7
	I132	2.8×10^{-04}
	I133	3.0×10^{-01}
	I134	6.1×10^{-06}
	I135	2.2×10^{-02}
	BR84	1.3×10^{-7}
	RB88	2.9×10^{-6}
	RB89	6.7×10^{-8}
	SR89	2.2×10^{-02}
	SR90	1.3×10^{-01}
	SR91	7.8×10^{-05}
	Y90	1.3×10^{-03}
	Y91	1.2×10^{-1}
	ZR95	4.0×10^{-02}
	MO99	6.1
	TE129	2.6×10^{-7}
4 3	TE132	1.0×10^{-01}
	TE134	2.8×10^{-7}
	CS134	2.1×10^{1}
	CS136	3.9×10^{-01}
	CS137	$7.6 \times 10^{+2}$
	CS138	4.3×10^{-6}
	BA140	9.8×10^{-03}
	LA140	9.9×10^{-04}
	RU103	3.0×10^{-02}
	RU106	5.7×10^{-02}
	PR143	7.7×10^{-03}
	CE144	1.1×10^{-01}
	MN54	9.2×10^{-01}
	CO58	1.1×10^{1}
	CO60	1.1×10^{2}
	FE59	3.7×10^{-02}
3	CR51	1.8
	ZR95	5.0×10^{-02}

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ER Table 5.2.3-1

Perkins Nuclear Station

Estimate of Maximum Doses to Biota Other than Man

	Dose Estimates (millirad/yr)
Liquid Waste Releases	
External Exposure*	
4 in water from submersion	1.2×10^{-3}
3 in air from shoreline sediments	3.7×10^{-2}
Internal Exposure:	
to aquatic plants	1.2
to invertebrates	0.38
4 to fish	0.43
to duck	0.42
Gaseous Waste Releases	
4 3 *Dose to cow's thyroid	0.7

*Continuous exposure

Amendment 2
(Entire Page Revised
Amendment 3
Amendment 4

ER Table 5.2.3-2

Perkins Nuclear Station

Bioaccumulation Factors for Fresh Water Organisms

ELEMENT	FISH	INVERTEBRATES	ALGAE
BR	417	333	50
RB	2000	1000	1000
SR	30	100	500
Y	25	1000	5000
ZR	3.33	6.67	1000
NB	30000	100	800
MO	10	10	1000
I	15	5	40
TE	400	75	100
CS	2000	100	500
BA	4	200	500
LA	25	1000	5000
CE	25	1000	5000
PR	25	1000	5000
MN	400	90000	10000
CO	50	200	200
FE	100	3200	1000
CR	200	2000	4000
TRITIUM	0.9	0.9	0.9

*Data is lacking. A value of 100000 was used in these cases.

ER Table 5.2.3-2

Perkins Nuclear Station

Bioaccumulation Factors for Fresh Water Organisms

ELEMENT	FISH	INVERTEBRATES	ALGAE
BR	417	333	.50
RB	2000	1000	1000
SR	30	100	500
Y	25	1000	5000
ZR	3.33	6.67	1000
NB	30000	100	800
MO	10	10	1000
I	15	5	40
TE	400	75	100
CS	2000	100	500
BA	4	200	500
LA	25	1000	5000
CE	25	1000	5000
PR	25	1000	5000
MN	400	90000	10000
CO	50	200	200
FE	100	3200	1000
CR	200	2000	4000
TRITIUM	0.9	0.9	0.9

*Data is lacking. A value of 100000 was used in these cases.

ER Table 5.3.2-1

Perkins Nuclear Station

Radionuclide Concentrations in the Yadkin River Downstream Station Discharge

Nuclide	Concentration µCi/ml	Fraction of 10CFR20
I 131	1.7×10^{-11}	5.5×10^{-05}
I 133	1.7×10^{-11}	1.7×10^{-05}
I 135	4.0×10^{-12}	9.9×10^{-07}
Mo 99	1.1×10^{-10}	2.7×10^{-06}
Cs134	1.4×10^{-12}	1.6×10^{-07}
Cs137	5.8×10^{-12}	2.9×10^{-07}
H 3	5.1×10^{-08}	1.7×10^{-05}
Total*	5.1×10^{-08}	9.4×10^{-05}

*The sum of all other nuclides comprise less than 1 percent of the total.

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ER Table 5.3.2-2

Perkins Nuclear Station
Estimated Doses to Man from Liquid Releases

		Drinking Water	Eating Fish	
3	Total Body (mrem/yr)	5.5×10^{-3}	1.4×10^{-2}	
4	GI Tract (mrem/yr)	5.8×10^{-3}	.28	4
	Bone (mrem/yr)	6.3×10^{-5}	7.8×10^{-3}	
	Thyroid (mrem/yr)	3.3×10^{-2}	1.6×10^{-2}	

Aquatic Recreation Whole Body Doses

	Swimming	1.4×10^{-5} mrem/yr	
4	Boating	6.9×10^{-6} mrem/yr	4
	Shoreline	2.1×10^{-3} mrem/yr	

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Amendment 4

ER Table 5.3.3-1

Perkins Nuclear Station

Estimated Doses to Man From Gaseous Releases

		Dose to Man
	Total Body (mrem/yr)	0.5
4	Skin (mrem/yr)	1.9
	Thyroid (mrem/yr)	0.03

3

Estimated Dose to an Individual Child

4 3	Thyroid Dose Via. Milk Pathway	0.3 mrem/yr
	Thyroid Dose Via. Vegetable Pathway	.01 mrem/yr

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ER Table 5.3.5-1

Perkins Nuclear Station

Estimated Population Doses from Liquid and Gaseous Effluents

	Dose to Population Within 50 Miles (man-rem)
Liquid Effluents	1.8
Gaseous Effluents	3.2

4

Amendment 1
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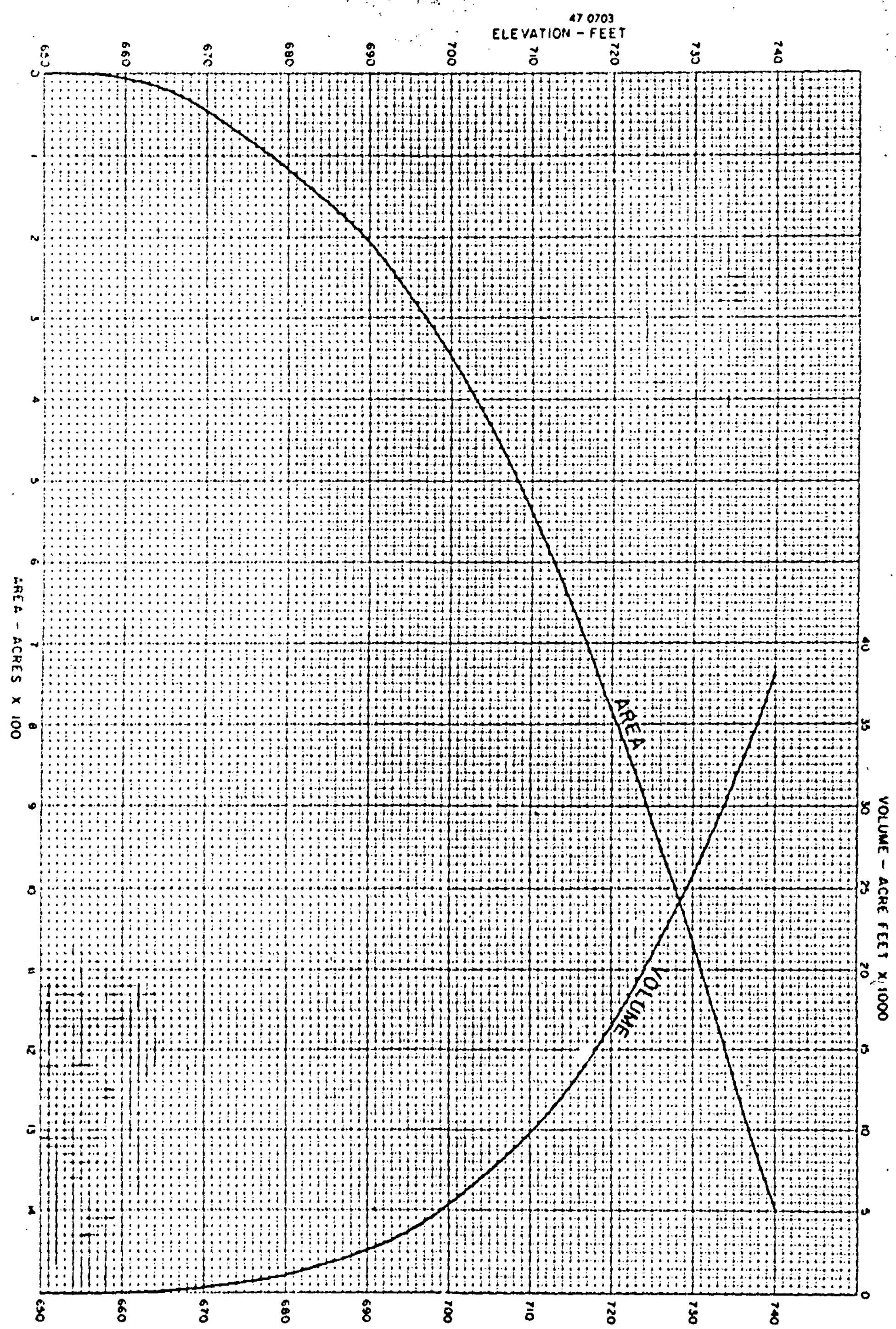
ER Table 5.4.2-1
Perkins Nuclear Station

Public Drinking Water Standards

		Public Drinking Water Standards (1)
		mg/l
pH		(6-8.5)
Color Pt-Co Mg/l		75
Turbidity JTU		Not established
Conductivity Micro Mho		Not established
B O D		Not established
M B A^5S		0.5
Alkalinity as Ca CO_3		400
Hardness as Ca CO_3		300
Calcium	Ca	Not established
Magnesium	Mg	Not established
Sodium	Na	Not established
Potassium	K	Not established
Iron	Fe	0.3
Manganese	Mn	0.05
Ammonia	NH	0.5 (as N)
Nitrate	NO^3	10
Phosphate	PO^3	Not established
Chloride	Cl^4	250
Fluoride	F	(0.8-1.7)
Silica	$Si O_2$	Not established
Sulfate	SO_4	250
Suspended Solids		Not established
Dissolved Solids		500
Polyacrylate Polymer		---
Aminomethylene Phosphonate as PO_4		---
Boron		1.0
Hydrazine		Not established
Ammonia		0.5 (as N)
Organic Biocide (Alternative)		---

(1) From Water Quality Criteria, Table II-1, FWPCA, 1968.



AREA CAPACITY CURVES
CARTER CREEK RESERVOIR

PERKINS NUCLEAR STATION

ER Figure 5.1.4-1
Amendment 3
(New)

4 | 3 | The investment of $2,369,587,000 (detailed on Table 8.1.2-3) in generating and transmission facilities at Perkins creates approximately $133-million annually in new tax revenues, according to the formula used by the Federal Power Commission.

The Federal Power Commission in Hydroelectric Power Evaluation, U.S. Government Printing Office, FPC P-35, sets forth economic data "considered appropriate for use in power evaluation studies. Updated data appears in Hydroelectric Power Evaluation, Supplement No. 1, U. S. Government Printing Office, FPC P-38. Q8.1.5

The "formula" applied by Duke in determing state and local taxes is estimated plant cost times the percentage, 2.59, shown in Table 36, column 7, Supplement No. 1, for Duke Power Company.

The justification for using this method of determing tax amounts is that stated in the FPC publications. Experience has shown a significant correlation between the amount of plant investment and the amount of state and local taxes. Use of Duke's own experience, as reflected in the FPC data, is appropriate. Use of data derived from operation of Duke's entire system rather than of data relating to specific localities is justified in that the tax situation of a locality can change drastically for a number of reasons while the tax situation of an entire region over an extended period tends to be stable.

The balance of state and local taxes after deduction of property taxes would go to the State of North Carolina in the form of franchise tax, income tax and several minor taxes. On the basis of the formula described above the total would be as follows:

4	Plant investment	$2,369,587,000
	Formula percentage	2.59
3		$ 61,372,000
3	Property tax portion of amount above	11,223,000
	Balance to North Carolina	$ 50,149,000

Q8.1.8

In addition, operation of Perkins would be expected to give rise to Federal income tax. Hydroelectric Power Evaluation, FPC-35, and Hydroelectric Power Evaluation, Supplement No. 1, FPC-38 provide the basis for calculation of the tax amount. Table 35, Supplement No. 1, indicates Federal income tax equal to 3.03% of plant investment.

4	Plant investment	$2,469,587,000
	Formula percentage	3.03
4 | 3	Tax amount	$ 71,798,000

The justification for using this method of determining tax amounts is that stated in the FPC publications. Experience has shown a significant correlation between the amount of plant investment and the amount of Federal income

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taxes. Use of Duke's own experience, as reflected in the FPC data, is appropriate. Q8.1.8

Assuming that 1972 procedures, regulations, and rates are in effect, the assessed valuation of the Perkins Nuclear Station would be $1,020,275,000. The amount of taxes, based on the assessed value, would be $11,223,000, all of which goes to local governmental units. Q8.1.6 Q8.1.7

Effects due to the change that the Perkins station will have on the Davie County tax base must center on the total valuation of Davie County in 1972 which was $110,247,329.

The assessed value of the Perkins units, based upon rules applicable in the County by 1972 is $1,020,275,000 or approximately 9.25 times the total county valuation in 1972.

There could be many primary and secondary effects of the large increase in the tax base, all of which are speculative, including the following: Q8.1.16

1) Lowering of tax rates may accelerate industrialization of Davie County in preference to surrounding counties; decrease tax burden on current property owners; cause influx of population from other counties; and effect the total tax revenues of the county.

2) Increase the tax revenues, which: may allow for additional public facilities construction, such as roads, schools, water and sewage systems, etc.; may allow for higher wages for local government employees; may allow for more local studies for planning; and may cause influx of population seeking better public facilities and services.

3) Any combination of the two above, which could cause any or all of the previously stated effects or others.

The effects on the tax base and tax rates in Davie County due to the construction and operation of Perkins will depend in whole upon the decisions made by county officials at some future time. It is not possible for Duke to predict with any reasonable level of accuracy as to what changes in their tax structure county officials may elect in the 1980s.

The Perkins station is expected to be an unusual asset to the county as it will be practically free of demands on the tax supported agencies of the county. No tax-paid police or fire staffs, publicly supported water, sewer or trash disposal services are required.

In summary, the construction and operation of the Perkins units is expected to allow Davie County to plan on a rapidly increasing source of tax revenue into the 1980s.

8.1.2.3 Employment

Duke's construction and operating experience provides the necessary background information needed to estimate the benefits associated with increased employment for the Perkins Nuclear Station

LIST OF FIGURES

9.2 ALTERNATIVES REQUIRING THE CREATION OF NEW GENERATING CAPACITY

As described in Section 1.1, system planning studies have shown that substantial amounts of additional generation are required in the 1983-1988 period in order to meet predicted future load requirements and maintain adequate reserve margins. This capacity is provided by installing six base-load units of approximately 1280 MW each.

The following tabulation shows the system load each hour of August 29, 1973, which was the day of peak demand. The tabulation also shows corresponding hourly loads estimated for the 1981 peak day (Figure 9.2.0-1):

Time EDT	August 29, 1973 MW Load	Estimated 1981 Peak Day Load-MW
1 AM	5,434	10,294
2	5,153	9,760
3	4,951	9,377
4	4,866	9,218
5	4,833	9,154
6	4,934	9,346
7	5,474	10,368
8	6,143	11,636
9	6,552	12,410
10	6,921	13,109
11	7,291	13,810
12N	7,550	14,301
1 PM	7,663	14,515
2	7,855	14,878
3	7,939	15,037
4	7,983	15,121
5	8,203	15,537
6	8,236	15,600
7	8,027	15,204
8	7,824	14,820
9	7,841	14,852
10	7,608	14,410
11	6,995	13,249
12	6,078	11,512

Q 9.3.3

Preliminary engineering and construction estimates, made in 1972, showed that in order to license, construct, and place into service these six units within the required period, several potential sites would have to be identified and evaluated and the selected sites known by early 1973 in order that more detailed site data could be available prior to license application. The preliminary estimates resulted in the decision, made in early 1973, to initiate design for Project 81, consisting of two 3-unit plant sites, with facilities identical in so far as possible. The candidate areas studied are discussed in Subsection 9.2.1 and the ten site-plant alternatives evaluated for Project 81 are described in Subsection 9.2.2.

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9.2.1 SELECTION OF CANDIDATE AREAS

Duke and neighboring utilities are experiencing rapid growth and having to install new generating facilities to serve their customers. There is no justifiable reason or advantage for Duke to consider sites outside of its service area for Project 81 since neither the economics nor the environmental impact of the project would be improved.

As shown in Figure 9.2.1-1, the Duke Power Company Service Area covers approximately 20,000 square miles in the Piedmont sections of North and South Carolina. The major power loads are served by a transmission network throughout this total area. Whenever the generalized location or region within the service area is considered for a possible power plant site, a major criterion is the relationship of the site to the transmission network. In order to minimize environmental effects and capital costs of required new transmission lines, the future capacity, together with that in operation and under construction, is analyzed in detail with relation to the existing and predicted loads. Also, since all modern base-load generation requires large supplies of cooling water, a second major criterion for initial location of potential sites for further study is the availability of cooling water. For this purpose, the entire service area is considered as being divided into the following four "Load-Generation Regions":

I.	Greenville-Anderson	(Savannah River)
II.	Spartanburg-Shelby	(Broad River)
III.	Hickory-Charlotte	(Catawba River)
IV.	Winston-Salem-Durham	(Yadkin River)

Approximate boundaries for geographical areas comprising these regions generally correspond with the four major river basins in the service area as shown on Figure 9.2.1-1. The existing Duke transmission network and major interties with neighboring utilities and the locations of the various Duke generating stations are shown on Figure 9.2.1-2.

Duke's transmission system has been developed to allow installation of new generation on an economic basis considering the entire load area. To realize the economic advantages of continuous construction at any given new site, may therefore require any of the four candidate areas to become a net exporter or importer of power for reasonable periods of time. Overbuilding in any of the areas as a continuous practice, however, would be uneconomic because transmission facilities would have to be increased to maintain the same degree of system reliability. Q 9.2.1

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The following is a brief description of the composition and extent of each region including their relative location, major water resources, the nearby load centers considered to be served within their designated area, and the primary generation capacity located in the area:

I. Greenville-Anderson Region - (Savannah River) - The area on the south-western end of the service area comprising portions of the Savannah, Keowee, and Saluda River basins. Major load centers are Anderson, Seneca, Greenville, Greenwood, and Laurens, S. C. Existing or under construction primary generation plants in this region are:

	Lee Steam Station (Fossil)		323 MW
	Keowee Hydro Station		140 MW
1	Oconee Nuclear Station	1973-74	2,628 MW
	Jocassee Pumped Storage Station	1973-74	610 MW
1		Total	3,701 MW (by 1981)

II. Spartanburg - Shelby Region - (Broad River) - Adjacent on the east to the Greenville Region. Includes drainage basin areas in Green, Broad, and Pacolet Rivers. Major centers served are Hendersonville and Shelby, N. C., and Spartanburg, Gaffney, Union, and Chester, S. C.
4 Thermal generation in this region consists of the following:

Cliffside Steam Station (Fossil)		770 MW
	Total	770 MW (by 1981)

III. Hickory-Charlotte Region (Catawba River - A sprawling, highly populated industrial and commercialized complex near the center of the service area which approximately coincides with the Catawba River drainage basin in both North Carolina and South Carolina. Major region load centers are Marion, Morganton, Hickory, Statesville, Concord-Kannapolis, Monroe, Gastonia, and Charlotte, N. C., and Rock Hill and Lancaster, S. C. The major portion of Duke's generation capacity is located in this Region.

Marshall Steam Station (Fossil)		2,025 MW
Allen Steam Station (Fossil)		1,140 MW
Riverbend Steam Station (Fossil)		610 MW
McGuire Nuclear Station 1976-77		2,360 MW
Catawba Nuclear Station 1979-80		2,306 MW
Cowans Ford Hydro Station		372 MW 4
	Total	8,813 MW (by 1981)

IV. Winston-Salem-Durham Region - (Yadkin River) - Northernmost and largest of the four regions, with heavy industrial, commercial, and residential loads. Main river basins are the Yadkin and Dan Rivers with only upper portions of the Neuse and Cape Fear basins within Duke Service area. The major load centers scattered through the region include Elkin, Mount Airy, Salisbury, Albermarle,
4 Lexington, Winston-Salem, High Point - Greensboro, Reidsville, Leaksville, Burlington and Durham, North Carolina.

The primary generation stations in this Region are:

Buck Steam Station	(Fossil)		426 MW
Dan River Steam Station	(Fossil)		284 MW
3 Belews Creek Steam Station	(Fossil)	1974-75	2120 MW
	Total		2830 MW (by 1981)

The two proposed three-unit plants for Project 81, now known as the Perkins and Cherokee Nuclear Stations, could be located in any of the four described "Load-Generation Regions" since potential sites with adequate water availability exist in each portion of the Duke service area. However, there are three basic reasons for selecting the Broad River and Yadkin River Regions as the primary candidate areas over the other two regions. These are:

(1) Improved system reliability and operation with substantially less new transmission line mileage.

(2) Availability of sites for closed-cycle cooling operation with minimum land requirements.

(3) Desire to reserve existing lake sites in Savannah and upper Catawba regions until effective EPA guidelines are established. (Resulting from Duke's Catawba licensing experience.)

Additionally, since Wateree Reservoir, located at the remote southern end of the Catawba River Region, has been considered in previous site studies it is also included as a candidate area for one of the plants.

In the Duke service area, fossil fuel is the only viable alternative to nuclear fuel which can now be considered for a base-load station.[1]

On a practical basis, hydroelectric capacity could not be considered. Duke's total existing hydro capacity of about 1,002,000 kw built in 27 plants over a period of nearly 70 years is less than one-seventh of the total present capacity at Perkins. The characteristically low flows
4 of streams in the Duke territory further limit the usefulness of Q
hydro capacity to short term peaking service. There remain only a very 9.1.5
3 few hydro sites suitable for development for peaking service, and none in the Duke territory for base load service. For example, the Federal Power Commission lists[2] 30 locations in Duke's service area where undeveloped hydroelectric potential exists indicating 2.0 billion kilowatt hours to be the total annual energy potential of all 30 sites combined.

9.3 COST EFFECTIVENESS COMPARISON OF CANDIDATE SITE-PLANT ALTERNATIVES

Section 9.1 discusses in detail why purchased power, upgrading of older plants, and the baseload operation of existing peaking facilities are not viable alternatives to the creation of new capacity on the Duke System to meet the forecasted load growth detailed in Chapter 1. Section 9.2 discusses the ten site-plant alternatives for the proposed Project 81 units. This section examines the cost-effectiveness of the alternatives in terms of both economic and environmental costs.

Subsection 9.2.2 lists the preliminary siting criteria used as a basis for selection of the site-plant alternatives listed in Table 9.3.0-1.

After candidate site-plant selection with preliminary criteria, detailed analysis of candidate site-plant alternatives is performed. Criterion for final selection of the Project 81 site-plant alternatives are given in Table 9.3.0-2. Many of the criteria are subjective and nonquantifiable.

9.3.1 SITE ALTERNATIVES

The separation of site alternatives from plant alternatives is impractical. A coal-fired facility at any given site is very different from a nuclear fueled facility at that same site. Likewise, the use of a closed cycle cooling pond, surface cooling in a large lake, cooling towers taking their makeup from a river, and cooling towers utilizing a large body of impounded water for makeup for waste heat dissipation are very different in their economic and environmental costs. The economic comparison of capital costs for each site-plant alternative is detailed in Table 9.3.1-1. The environmental comparison of each alternative is given in Table 9.3.1-2. Bases for the economic comparisons are given in Subsection 9.3.4.

9.3.2 FUEL ALTERNATIVES

As discussed in Subsection 9.2.1, coal is the only viable alternative to uranium as a fuel for the Project 81 units. Neither natural gas nor oil is presently in abundant supply from local sources within the Duke service area. Almost three-fourths of the natural gas produced in the United States comes from sources in Texas and Louisiana. About one-third of the natural gas domestically produced is consumed by industry in Oklahoma, Arkansas, Texas, and Louisiana. A large natural gas pipeline from principal continental sources by interstate delivery is not a reasonable economic choice for even one large power plant. Similarly, fuel oil is not an economic alternative to coal or uranium as a fuel choice. Since the domestic consumption of oil exceeds the total combined production of the United States and Canada, transportation of oil from overseas is necessary. The use of oil or gas as a fuel alternative is not considered a viable alternative.

Exotic sources of energy for bulk power production, or even those not so exotic, do not yet have the technical capability for the Project 81 capacity needs.

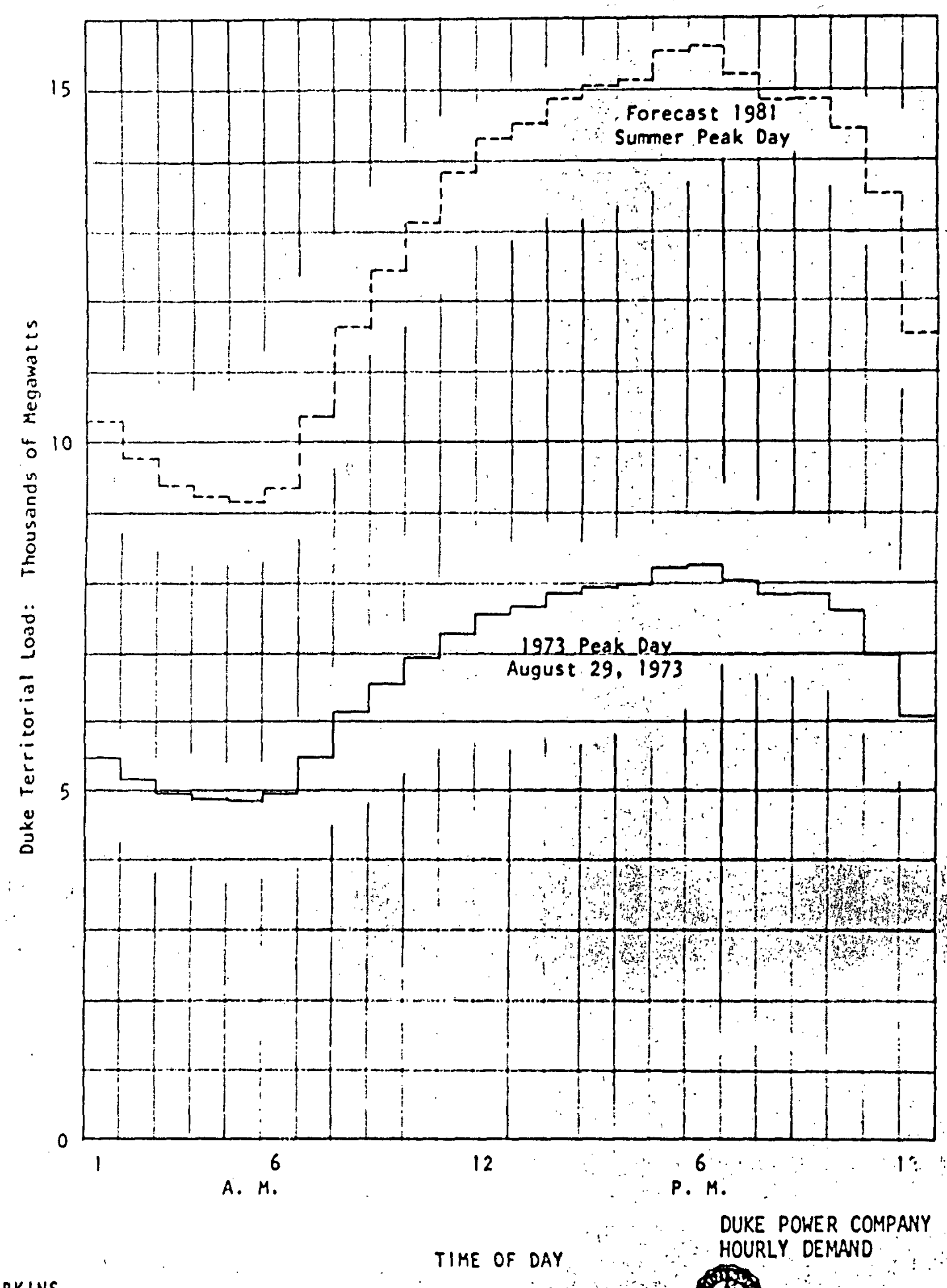
For the Duke system, therefore, coal and uranium are the only viable fuel alternatives. When compared to the coal-fired alternative, a nuclear plant offers several environmental advantages.

Since combustion of fossil fuels is not involved, the nuclear plant offers no air pollution. Air pollution control equipment for the Project 81 coal-fired alternatives is a paramount factor. Fortunately, the coal Duke now burns contains less than one percent sulphur. Whereas, the low sulphur content helps Duke meet applicable state air quality standards, it also makes particulate collection difficult. Duke plans to continue burning low sulphur coal; however, if high sulphur coal burning becomes necessary,
4 even where stringent requirements are not applicable, additional capital and operating costs are expected.

The nuclear stations require about 21 truck shipments of new fuel per year. The coal-fired alternatives require about 400 train cars of fuel per day. Put another way, a coal-fired alternative consumes, in about 15 minutes, a weight of coal equal to the weight of one year's supply of nuclear fuel for the equivalent station. The nuclear alternative generates about 300 cubic feet of highly radioactive waste per year that must be stored and isolated from the environment for hundreds of years. The coal-fired alternative generates about 74 million cubic feet of virtually useless ash per year whose storage conflicts with other beneficial land uses.

Studies by the United States Public Health Service, Bureau of Radiological Health show that a pressured water nuclear plant results in less radiation exposure to the public due to radioactivity in gaseous effluents than does a modern coal-fired plant.[1, 2] This fact is explained in the summary report of the hearings on the Environmental Effects of Producing Electric Power by the Joint Committee on Atomic Energy of the Congress of the United States, as follows:

"An interesting corollary to the air pollution problem from fossil fuel power plants concerns the radiochemical analyses of flyash samples which were obtained from the combustion of pulverized coal and fuel oil. From these analyses, estimates were made of the quantities of radium-226 and radium-228 which would be discharged from a 1,000 megawatt coal-burning power plant. Comparisons of these data on the release of fission products such as iodine and Kr 85 from nuclear power generating stations shows that when the physical and biological properties of these radionuclides are taken into consideration, the conventional fossil-fueled plants discharge relatively greater quantities of radioactive material into the atmosphere than nuclear power plants of comparable size. While no one would suggest that the amount of radium being discharged into the atmosphere of our large cities is a health hazard, the above example does emphasize the 'clean air' which is being discharged from our nuclear power plant facilities."



DUKE POWER COMPANY
HOURLY DEMAND

PERKINS

PERKINS NUCLEAR STATION
ER Figure 9.2.0-1
Amendment 4
(New)

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PERKINS NUCLEAR STATION

Figure 9.3.1-1

10.1 COOLING SYSTEMS

1 Because of the nature of the site selected for this station, only a limited number of cooling system alternatives are feasible. The relatively small flow in the Yadkin River prohibits the use of a once through cooling system. The only cooling system alternatives are a cooling pond, closed cycle cooling towers, or a closed cycle spray system. A cooling pond is not considered feasible at the present site because the topography surrounding the site does not lend itself to construction of a pond of adequate size to dissipate the waste heat from these units. Therefore, cooling system alternatives limited to closed cycle cooling towers or spray system with makeup from the from the river. Q10.1.1

Three alternative closed cycle systems were evaluated in order to select the most economical in terms of monetary and environmental costs associated with each. These systems are conventional rectangular mechanical draft cooling towers, natural draft cooling towers and circular mechanical draft cooling towers. Wet-dry towers, dry towers, and spray systems are presented but for reasons discussed they are not considered viable alternatives. Tables 10.1.0-1 and 10.1.0-3 detail the cost comparisons of the alternatives. Q10.1.4 Q10.1.3

Effects of icing and salt buildup from cooling tower operation are identified as potential problems with respect to operation of electrical equipment on the station yard. Electrical components have been situated at nominally 1000 feet from the cooling towers; this distance was recommended as a working number in layout considerations. Discussion in Section 5.1.4, however, specifies limitations on estimates of condensate plume effects in this regard. A physical modeling effort is presently underway aimed at further delineation of plume behavior at or near the ground. The Morley Company has been engaged both for use of their facility and for modelling services. Q10.1.2 Results should be forthcoming in the spring of 1975. As to contributions from cooling tower drift with regard to possible icing or salt buildup, deposition rates have been calculated in Section 5.1.4. Highest rates are on the order of 40 pounds/ac. mo. This does not present a buildup problem. For a postulated wind direction frequency of one percent, this translates
4 to a water accumulation rate of 0.6 inch in 24 hours. This does not present an icing problem.

10.1.1 CIRCULAR MECHANICAL DRAFT COOLING TOWERS (PROPOSED SYSTEM)

The proposed cooling system as described in Section 3.4 is circular mechanical draft towers. These are induced draft, crossflow type towers. Twelve towers with 42 bays per tower would be needed. Optimum design dictates a 24 F range and 12 F approach to a 76 F wet bulb. A plant layout showing the circular mechanical draft towers is shown in Figure 3.1.0-2.

10.1.1.1 Economics of Circular Mechanical Draft Tower

Table 10.1.0-1 gives a cost comparison for the three alternate closed cycle cooling systems. Costs include major equipment costs, construction costs, and performance and pumping penalties.

10.1.1.2 Environmental Costs of Circular Mechanical Draft Towers

Environmental costs associated with the circular mechanical draft towers are tabulated in Table 10.1.0-2 and supporting details are presented below.

NATURAL SURFACE WATER BODY

Impingement or Entrapment by Cooling Water Intake Structure (1.1)

Makeup water intake velocities will be held less than 0.5 feet per second. At these velocities, entrapment or impingement of fish is not expected to occur. A full discussion of impingement and entrapment is given in Subdivision 5.1.2.3.

Passage Through or Retention in Cooling Systems (1.2)

Entrainment of aquatic organisms with the makeup water will occur. Since the cooling system is a closed cycle, 100 percent mortality of entrained organisms is assumed. An analysis of the effects on the river of loss of these organisms, which will be the same for all alternatives, is given in Subdivision 5.1.2.3.

Discharge Area and Thermal Plume (1.3)

The maximum thermal plumes expected to occur due to discharge of cooling tower blowdown are shown in Figures 5.1.2-1 and 5.1.2-2 for summer and winter conditions. The areas bounded by the 1 F and 3 F isotherms under summer conditions are .05 and .02 acres, respectively. The isotherms will be larger in winter due to the greater temperature difference between blowdown and ambient river water. The 2 F, 3 F and 5 F isotherms encompass 1.3, 1.0 and .5 acres, respectively. Environmental effects of thermal discharge are presented in Subdivision 5.1.2.2.

Chemical Effluents (1.4)

As discussed in Section 5.4, the chemical discharge plume will closely resemble the thermal plume. Chemical concentrations will be diluted to near ambient levels within a few hundred feet of the discharge point. Discharged chemicals are not expected to be harmful to fish since concentration levels even in the discharge canal are much lower than toxic levels recorded in the literature. Subsection 5.4.3 contains a detailed description of blowdown effects on aquatic biota.

Consumptive Use (1.6)

Maximum consumptive use of the river water will include 108 cfs evaporated during cooling tower operation. This quantity represents about four percent of the average river flow (2850 cfs) at the site. The nearest major industrial water user downstream is N. C. Finishing Company, about 15 river miles downstream. Its intake, however, is located on the backwaters of High Rock Lake and should not be affected by low flows in the river. 4

vegetation so that noise levels offsite are not expected to be a problem. The visual impact of circular mechanical draft towers will be small due to their low profile and surrounding vegetation. However, plumes will be visible for several miles at times of high humidity and low temperatures. Frequency of occurrence of visible plumes is shown in Figures 5.1.4-1 and 5.1.4-2.

Salts Discharged from Cooling Towers

4 Assuming a conservative drift rate of 0.005 percent of the circulating water volume, salt deposition rates were calculated using the method described in Subsection 5.1.4. Maximum deposition rate for the proposed system is 40 lb/acre-month. At the nearest site boundary (approximately 2000 feet) this rate would drop to 2 lb/acre-month. Salt tolerances of area vegetation are not known, therefore, effects have not been quantified.

10.1.2 RECTANGULAR MECHANICAL DRAFT COOLING TOWERS

The closed-loop cooling system described in Section 3.4 could use rectangular mechanical draft cooling towers as an alternative. Mechanical draft towers of the size needed to cool 2,274,000 gpm of cooling water would be induced draft design using one or more fans to force air movement over a counterflow fill arrangement. Twelve towers are necessary with 8 cells per tower. Each tower is 522 feet long by 72 feet wide by 57 feet high.

Optimum design dictates a 24 F range and 12 F approach to a 76 F wet bulb. A plant layout for Perkins Station with rectangular mechanical draft towers is shown in Figure 10.1.2-1.

10.1.2.1 Economics of Rectangular Mechanical Draft Towers

Table 10.1.0-1 gives a cost comparison for the three alternative closed cycle cooling systems. Costs include major equipment costs, construction costs, and performance and pumping penalties.

10.1.2.2 Environmental Costs of Rectangular Mechanical Draft Towers

Environmental costs associated with the rectangular mechanical draft towers are tabulated in Table 10.1.0-2 and supporting details are presented below.

NATURAL SURFACE WATER BODY

Impingement or Entrapment by Cooling Water Intake Structure (1.1)

Maximum make-up flow for the rectangular mechanical draft alternative is approximately 52,300 gpm or 116 cfs compared to 120 cfs for the proposed system. The intake structure for this alternative is the same as that described in Section 3.4. Since make-up requirements and intake velocities (<0.5 fps) are approximately the same as for the proposed cooling system, neither impingement nor entrapment of fish will be a problem as explained in Section 5.1.

Passage Through or Retention in Cooling Systems (1.2)

With make-up flow and intake design the same as for the proposed cooling system, the effects of entrainment of organisms would be the same as described in Section 5.1.2.3.

Discharge Area and Thermal Plume (1.3)

Blowdown requirements for rectangular mechanical draft towers would be similar to those for the proposed cooling system. Also since the rectangular towers would also have a guaranteed 12 F approach, blowdown temperatures would be the same as for the proposed system. Therefore, discharge area and thermal plume considerations would be the same as for the proposed system.

Chemical Effluents (1.4)

Chemical concentration of blowdown water would be the same for rectangular mechanical draft towers as for the proposed system.

10.6 SANITARY WASTE SYSTEM

An alternate system for the temporary treatment system used during construction is the use of sand filters instead of prefabricated extended areation type sewage treatment plants. Sand filters will not be used for the construction period as they require much more land area for the high flow rate given in Section 3.7.

An alternate system for the permanent treatment system used after construction is sewage lagoons, where waste water will be disposed of by evaporation.
4 The evaporation rate for this area is expected to be 46 in. per year. If the evaporation rate cannot meet the demand, other means of disposal must be provided.

10.7 LIQUID RADWASTE SYSTEMS

Design objectives and technical specifications are in accordance with "as low as practical" requirement of 10CFR20 and 10CFR50. Since these conditions are met, no further consideration was given to the reduction of radiological impacts by formulating alternative plant designs. All releases from liquid radwaste systems require deliberate operator action.

Reference List of Questions

In Response To

Nuclear Regulatory Commission's Letter of September 12, 1975

Project 81
Perkins Nuclear Station
Environmental Report

ADDITIONAL INFORMATION NEEDED FROM APPLICANTS FOLLOWING OPTION PROVIDED IN THE SEPTEMBER 4, 1975, AMENDMENT TO SECTION II.D. OF APPENDIX I

	Reference
1. For each building housing systems containing radioactive materials:	
a. Provide a description of the provisions incorporated to reduce radioactive releases (iodine and particulates) from ventilation exhaust systems.	3.5.2.1
b. Provide the location, height of release, inside dimensions of release point exit, effluent temperature and exit velocity.	3.5.2
c. For the containment building indicate the expected purge and venting frequencies and duration, and the continuous purge rate (if used).	3.5.2
2. For a pressurized water reactor having recirculating U-tube steam generators and employing all volatile treatment (AVT) to main secondary coolant chemistry, provide the following information:	
a. Expected blowdown rate (lb/hr) and method of processing blowdown.	3.5.1.1.3
b. Number and type of condensate demineralizers (if applicable) and flow rate of condensate through polishing demineralizers (lb/hr).	3.6.1.5
c. Expected frequency of resin regeneration or replacement, volumes and radioactivity of regenerant and rinse solutions, sluice water, or backwash water per batch of resin regenerated or replaced.	3.6.1.5
d. Method of collection, processing and disposal of liquid wastes, including decontamination factors assumed for process operations.	3.6.1.5
e. P&ID's and process flow diagrams for the steam generator blowdown system and condensate polishing system.	3.5.4 3.6.1.5
3. Provide a map showing the detailed topographical features (as modified by the plant) on a large scale within a 10-mile radius of the plant and a plot of the maximum topographic elevation versus distance from the center of the plant in each of the sixteen 22-1/2 degree cardinal compass point sectors (centered on true north), radiating from the center of the plant, to a distance of 10 miles.	2.1

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Reference

4. Provide representative annual and, if available, monthly summaries of wind speed and direction by atmospheric stability class, in joint frequency form from onsite data. If available, describe airflow trajectory regimes of importance in transporting effluents to a distance of 5 miles from the plant, including airflow reversals. 2.6.2.2

5. Tabulate, for each compass point sector radiating from the center of the plant, the location of the nearest existing milk producing animals (cows and goats) within 5 miles of the site. 2.2.2

NOTE: If you choose to provide site specific data in less detail than requested above, it will be necessary to use a less complex calculational procedure comparable in conservatism to that used in the past, to demonstrate compliance with the Appendix I guidelines. Thus, the depth and scope of the information you wish to provide will dictate the calculational procedures to be used to demonstrate compliance with the Appendix I design objectives, but the information provided should, as a minimum, be sufficient to support the analyses used in your assessments. In any event, the calculational procedures utilized to demonstrate compliance with Appendix I and the data to be used in those models must be such that the actual exposure of an individual is unlikely to be substantially underestimated.