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BRAIDWOOD NUCLEAR GENERATING STATION - UNITS 1 & 2

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

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CHAPTER 2.0 - THE SITE AND ENVIRONMENTAL INTERFACES

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 Site Location and Description

2.1.1.1 Specification of Location

The Braidwood Nuclear Generating Station - Units 1 and 2 (Braidwood Station) is located in Reed Township of Will County northeastern Illinois approximately 50 miles southwest of Chicago and 20 miles south-southwest of Joliet. It is adjacent at its northwest corner to the village of Godley and its western and southern borders lie adjacent to the Grundy and Kankakee County boundary lines, respectively. The site is in an area of flat agricultural farmland that has been scarred from coal strip mining, and the site itself is located principally on terrain that has been strip mined.

At its closest approach, the Kankakee River is approximately 3 miles east of the northeastern site boundary; this point is approximately 12 miles upstream of the headwaters of the Illinois River at the confluence of the Kankakee and Des Plaines Rivers. The Braidwood Station is located approximately 8 miles southwest of the Joliet Arsenal.

Figure 2.1-1 shows the location of the site within the State of Illinois, and Figure 2.1-2 outlines the site with respect to the Kankakee River and the county boundaries. The following coordinates of the center of containments are given in both latitude and longitude and Universal Transverse Mercator (UTM) Coordinates. Latitude and longitude are given to the nearest second and UTM Coordinates are given to the nearest 100 meters.

Nuclear Unit	Latitude and Longitude	UTM Coordinates
1	88° 13' 42" W x 41° 14' 38" N	4,565,300 N 397,000 E
2	88° 13' 42" W x 41° 14' 36" N	4,565,200 N 397,000 E

2.1.1.2 Site Area

The roughly rectangular site occupies approximately 4454 acres of
which 2537 acres comprise the cooling pond. The pond has an eleva- 1
tion of 595 feet above mean sea level (MSL) when filled to capac-
ity. The plant property lines and the site boundary lines are the
same. 1

The site boundary and the general outline of the pond are shown in Figure 2.1-3. As noted in this figure, the nuclear generating

facilities are located at the northwest corner of the site. Figure 2.1-4 shows the location and orientation of the principal plant structures. The makeup and blowdown lines are buried in the ground within a transmission line corridor and have their respective source and terminus at the Kankakee River as 1
shown in Figure 2.1-2.

The plant exclusion area, located within the site boundary, is illustrated in Figure 2.1-5. The minimum exclusion boundary distance from the gaseous release point is 1625 feet.

There are no industrial, commercial, institutional, recreational, or residential structures on the site. Illinois State Routes 53 and 129 are adjacent to the northwest boundary of the site. The Illinois Central Gulf Railroad (previously the Gulf Mobile & Ohio Railroad) runs parallel between State Routes 53 and 129 and provides spur track access from the site area to the main line. Interstate 55 is less than 2 miles west-northwest of the site and State Route 113 is approximately 2 miles north of the site. Figure 2.1-6 illustrates these transportation routes. The Kankakee River is approximately 3 miles east of the northeastern site boundary.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

It is required by Title 10 of the Code of Federal Regulations Section 20.106 (10 CFR 20.106) that "a licensee shall not possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in Appendix 'B', Table II of this part . . . "; it is further required by 10 CFR 50.34a that "in the case of an application filed on or after January 2, 1971, the application shall also identify the design objectives, and the means to be employed, for keeping levels of radioactive material in effluents to unrestricted areas as low as practicable."

The restricted area boundary, the boundary that separates the restricted area from the unrestricted by 10 CFR 20.106, is specified to be the plant property line for the Braidwood Station. Expected concentrations of radionuclides in effluents are shown in Sections 3.5 and 5.2 to be in compliance with 10 CFR 20.106 criteria.

2

The distances from the release point of gaseous effluents (the vent stack) to the restricted area boundary for each of the 16 directional segments are given in Table 2.1-1. The site boundary closest to the release point of gaseous effluents is in the northwestern direction at a distance of 1625 feet. Figure 2.1-3 illustrates the restricted area boundary. 2

Liquid effluents are discharged into the cooling pond blowdown line, which subsequently discharges into the Kankakee River. Radionuclides in liquid effluents, therefore, enter the unrestricted area at that point.

The restricted area boundary is posted conspicuously with "Private Property - No Trespassing" signs. In addition, administrative procedures include periodic patrolling to control access to the area.

2.1.2 Population Distribution

In order to assess the population distribution within a 10-mile radius of the Braidwood Station, a detailed analysis was performed. For this purpose, the region surrounding the station was divided into sixteen 22.5° azimuthal sectors centered on the centerline of the reactors with outer radial increments of 1, 2, 3, 4, 5, and 10 miles. The geographical locations of these sectors are identified in Figure 2.1-7. The 1980 population densities within these radial-azimuthal sectors were obtained by performing a house count utilizing a combination of data obtained from 1981 and 1982 aerial photographs, and a field survey conducted in 1981. To estimate the population, the number of houses was multiplied by the average number of people per household in each township as listed in Table 2.1-2A. These numbers are based on the number of housing units in the unincorporated areas of each township and the U.S. Census Bureau population statistics. 1 2 1

The Census Bureau 1980 population for all townships between 10 and 50 miles of the station was proportioned into each of the 16 directional sectors and 10 mile distance increments. The geographical locations of the population sectors are found in Figure 2.1-9. The proportion of the population assigned to each sector was based on the proportion of land area of each township falling in that sector. In order to ensure that the figures more accurately represent the population distribution of an area, the proportioning technique incorporated knowledge of the area, location of outstanding features such as parks and military bases, and location of large populations in cities.

Projected population distributions were made by a computer program using a modified "ratio technique." The ratio technique essentially involves calculating the future population of an area by projecting the ratio of the total population of that area to the total population of a larger area containing the

first, for which population projections have already been made. Projection of the ratio for this report included the following techniques: 1) the geographic units used for the ratio were state and township, 2) to determine the rate of change in the ratio for use in projection, the historical base period 1970 to 1980 was used, and 3) the rate of change in the ratio found during the base period was projected linearly for a few years, but was gradually decreased to zero--the ratio itself became constant after 20 years. The effect of the third technique is that the growth rate of the township may differ significantly from that of the state during the base period and for a few years thereafter, but after about 20 years the growth rates for the two areas will be the same. State projections required for use in the modified ratio technique were projected geometrically based on state growth during the base period.

2.1.2.1 Population Within 10 Miles

The 1980 and projected population distribution within 10 miles of the Braidwood Station is shown in Table 2.1-2. The total 1980 population is estimated at 27,482 with an average density of 87 persons per square mile within this area. The maximum population densities in the near vicinity of the station occur in the northern sectors, which includes the cities of Braidwood and Wilmington, and the village of Coal City.

Figure 2.1-8 shows the location of cities and villages within 10 miles and their 1980 population. Wilmington (1980 population 4,424), Braidwood (1980 population 3,429), and Coal City (1980 population 3,028) are the largest urbanized areas within 10 miles of the plant. The village of Godley (1980 population 373) located approximately 0.5 mile southwest of the station is 1 2
the closest village.

The total population within 10 miles is projected to be 35,411 by 2020 with average density projected to be 113 within this region.

The projected national age distribution for the year 2000 (midpoint of station operating life) is 17.0% in the 0 to 9 age group, 17.4% in the 10 to 19 age group, and 65.6% in the 20 and over age group (Bureau of the Census 1980). These percentages correspond to a projected 2000 population of 5,691 persons in the 0 to 9 age group, 5,825 persons in the 10 to 19 age group, and 21,960 persons in the 20 and over age group within 10 miles

of the site. The U.S. projected age distribution was used because the area within a 10-mile radius of the site (Will, Kankakee, and Grundy Counties) did not show a significant difference from the 1980 U.S. Census age distribution (Bureau of the Census 1977).

When applying the significance test described in Appendix D of Regulatory Guide 4.2, Will, Grundy and Kankakee Counties did not significantly differ from the U.S. distribution. The average age distribution for the three counties did not vary more than 10% from the 1980 U.S. Census age distribution. Thus, it is assumed that the area within a 10-mile radius of the site will have a projected age distribution similar to the U.S. projected age distribution.

2.1.2.2 Population between 10 and 50 Miles

The 1980 population distribution and the estimated projected population distributions through 2020 at 10-year intervals for the area between 10 and 50 miles are summarized in Table 2.1-3. The geographical locations of the population sectors are found in Figure 2.1-9. The total population within 50 miles was 4,580,641 in 1980 with an average population density of 583 persons per square mile. By 2020, the population is projected to grow to 5,124,734, which yields a population density of 653 persons per square mile. 1 2

The most heavily populated sectors within 50 miles of the site lie in the north-northeast and northeast directions, with 1980 populations of 1,178,378 and 2,201,145, respectively. The high populations in these sectors are due primarily to the inclusion of the City of Joliet (1980 population 77,956) and a portion of Chicago (1980 population 3,005,072). Also included in this area are some suburbs of Chicago and cities in Lake County, Indiana.

The nearest population center is Joliet, located approximately 20 miles north-northeast of the site. According to the 1970 population census, Joliet had a population of 80,378, and in 1980, 77,956, a decrease of 3.1% during the last decade. Its expected population is 82,501 by 2020. The city of Kankakee, located approximately 20 miles eastsoutheast of the site, had a 1970 population of 30,944, and in 1980, 30,141, and has an expected population of 31,065 by 2020. Table 2.1-4 lists the 25 population centers within 50 miles of the site and Figure

2.1-10 locates them. Most of these centers are located near the greater Chicago metropolitan area, 40 to 50 miles northeast of the site.

Table 2.1-5 lists the distance and approximate direction from 1
the site of all urban centers (those locations with a population greater than 2500) within a 30-mile radius of the site and gives their 1980 populations. It should be noted that there are only 22 such urban centers and that only two of these, Joliet and Kankakee, are population centers.

The projected national age distribution for the year 2000 (midpoint of station operating life) is 17.0% in the 0 to 9 age
group, 17.4% in the 10 to 19 age group, and 65.6% in the 20 and 2
over age group (Bureau of the Census 1980). These percentages correspond to a projected 2000 population of 820,375 persons in the 0 to 9 age group, 839,678 persons in the 10 to 19 age group, and 3,165,682 persons in the 20 and over age group within 50 miles of the site. The U.S. projected age distribution was used because the age distribution of Will County, the county in which the station is located, did not vary significantly from the 1980 U.S. Census age distribution described in Appendix D of Regulatory Guide 4.2.

2.1.2.3 Transient Population

The transient population within 10 miles of the site is composed of visitors to recreational facilities, students enrolled at and teaching staff employed by schools, and employees at industrial establishments.

As shown in Table 2.1-6, the state parks and conservation areas within a 10-mile radius of the site include the Des Plaines Conservation Area approximately 8 miles north of the site, the Goose Lake Prairie State Park approximately 9 miles northnorthwest of the site, the Kankakee River State Park approximately 9 miles east of the site, and the Illinois and Michigan Canal State Trail (Channahon Park Access) approximately 10 miles north of the site. In 1981, these four parks had a combined annual attendence of 1,634,875 persons (Illinois Department of
Conservation 1982). The estimated peak daily attendances for 2
these areas are respectively 1000, 2,706, 25,000, and 851 visitors.

The Des Plaines Conservation Area consists of 4253 acres and offers camping, picnicking, fishing, boating, and hunting (Illinois Department of Conservation 1976). The Goose Lake Prairie State Park consists of 2357 acres of which approximately 1513 acres are dedicated as an Illinois Nature Preserve. The park offers picnicking, hiking, and year-round nature study programs (Illinois Department of Conservation 1974). The Kankakee River State Park consists of 2968 acres extending along the Kankakee River and offers camping, picnicking, fishing, boating, hiking, horse trails, hunting, and a summer nature study program (Illinois Department of Conservation 1974). The Illinois and Michigan Canal State Trail is currently being developed for hiking, bicycling, and canoeing. The portion of the trail near the Channahon access is now completed and offers camping, canoeing, bicycling, and hiking (Illinois Department of Conservation 1975).

In addition to these state recreational facilities, there are several privately owned recreation areas within 10 miles of the Braidwood Station. Table 2.1-6 lists these recreation areas along with their location, their total membership, and their estimated peak daily attendance. These clubs and parks provide a variety of recreational activities and attract people from outside the 10-mile radius.

The estimated peak daily attendance figures in Table 2.1-6 indicate that on a short-term basis, the population within 10 miles of the station could increase by 50,417 persons due to both state and private facilities. Should all these visitors be from outside the 10-mile radius, the total population within the 10-mile area would increase by 183%. 2

As listed in Table 2.1-7, there are 10 industries within 10 miles of the station. Approximately 860 persons are employed at these industries. Even if all these people come from outside the 10-mile area, which is highly unlikely, the total population of this area would only increase during working hours by about 3%. 1

As shown in Table 2.1-8, the total of 16 schools within 10 miles of the site had a total 1981-1982 enrollment of 5625 students and a staff of 332 teachers. The great majority of students attending these schools reside within a 10-mile radius of the station.

The 1980 and projected population distributions within the 10-mile radius are given in Table 2.1-9. This table includes the residential population and the peak daily transient population resulting from recreational activities within the 10-mile area. 2

2.1.3 Uses of Adjacent Lands and Waters

2.1.3.1 Land Use

2.1.3.1.1 Land Use within 5 Miles

The area within a 5-mile radius of the station includes land in Will, Kankakee, and Grundy Counties. This area as well as the remainder of Will, Kankakee, and Grundy Counties is predominantly agricultural. According to the 1974 farm statistics in Table 2.1-10, 64.8%, 89.7%, and 82.9% of the total land acreage in Will, Kankakee, and Grundy Counties, respectively, is farmland. The percentage of the total county land under cultivation is: Will County--55.1%, Kankakee County--79.3% and Grundy County--71.1%.

The major crops grown in the three counties are corn and soybeans. Hay, oats, and wheat are also grown in the area. Table 2.1-11 gives the 1974 and 1975 acreage, yield, production, and dollar value of these crops for the three counties and the State of Illinois. In general, Grundy and Kankakee counties were more productive in 1975 than the state average, with the exception of corn yield in Kankakee County, which was slightly less than the state average. In 1975 Will County was less productive than the state average, with the exception of wheat yield, which was slightly higher than the state average. In general, the number of acres devoted to corn and soybeans in the three counties decreased between 1974 and 1975 while the number of acres devoted to wheat, oats, and hay increased.

Corn and soybeans are the major crops grown within a 5-mile radius of the site. A "pick your own" christmas tree, blueberry, and strawberry farm is located approximately 3.5 miles southeast of the station.

TABLE 2.1-1

DISTANCE FROM GASEOUS EFFLUENT RELEASE POINT TO NEAREST SITE BOUNDARY IN THE 16 MAJOR COMPASS DIRECTIONS

DIRECTION	APPROXIMATE DISTANCE (ft)
N	2,000
NNE	3,000
NE	2,600
ENE	2,300
E	3,400
ESE	8,900
SE	11,200
SSE	11,300
S	15,200
SSW	3,200
SW	2,050
WSW	1,750
W	1,700
WNW	1,650
NW	1,625
NNW	1,675

TABLE 2.1-2

1980 AND PROJECTED POPULATION DISTRIBUTIONS
WITHIN 10 MILES OF THE BRAIDWOOD STATION

Sector Designation	1980 RADIAL INTERVAL (miles)							
	0-1	1-2	2-3	3-4	4-5	5-10	0-5	0-10
N	34	690	389	15	2	309	1,130	1,439
NNE	75	823	960	294	70	234	2,222	2,456
NE	0	107	103	0	480	4,735	690	5,425
ENE	4	12	22	22	291	1,980	351	2,331
E	0	0	13	28	22	1,027	63	1,090
ESE	0	0	17	18	50	236	85	321
SE	0	0	4	9	8	156	21	177
SSE	0	0	60	9	235	358	304	662
S	0	0	0	3	3	686	6	692
SSW	0	8	17	29	173	849	227	1,076
SW	402	296	214	19	89	1,384	1,020	2,404
WSW	82	218	0	37	214	163	551	714
W	0	34	179	3	11	794	227	1,021
WNW	8	0	8	37	13	251	66	317
NW	4	25	42	1,499	1,340	928	2,910	3,838
NNW	6	256	119	1,692	526	920	2,599	3,519
Sum for Radial Interval	615	2,469	2,147	3,714	3,527	15,010	12,472	27,482
Cummulative Total to Outer Radius	615	3,084	5,231	8,945	12,472	27,482	12,472	27,482
Average Density (people/mi ^{2}) in Radial Region	196	262	137	169	125	64	159	87

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TABLE 2.1-2 (continued)

Sector Designation	1990 RADIAL INTERVAL (miles)							
	0-1	1-2	2-3	3-4	4-5	5-10	0-5	0-10
N	44	890	502	18	2	356	1,456	1,812
NNE	97	1,061	1,238	307	73	247	2,776	3,023
NE	0	138	133	0	501	5,037	772	5,809
ENE	5	15	26	25	327	2,084	398	2,482
E	0	0	15	31	25	1,105	71	1,176
ESE	0	0	20	20	56	269	96	365
SE	0	0	5	10	9	181	24	205
SSE	0	0	77	11	276	414	364	778
S	0	0	0	4	4	772	8	780
SSW	0	8	17	30	177	869	232	1,101
SW	478	304	220	20	94	1,473	1,116	2,589
WSW	104	224	0	38	221	167	587	754
W	0	35	184	3	12	857	234	1,091
WNW	8	0	8	38	14	297	68	365
NW	5	26	43	1,560	1,663	1,291	3,297	4,588
NNW	8	328	140	2,246	715	1,414	3,437	4,851
Sum for Radial Interval	749	3,029	2,628	4,361	4,169	16,833	14,936	31,769
Cummulative Total to Outer Radius	749	3,778	6,406	10,767	14,936	16,833	14,936	31,769
Average Density (people/mi ^{2}) in Radial Region	238	321	167	198	147	71	190	101

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TABLE 2.1-2 (continued)

Sector Designation	2000 RADIAL INTERVAL (miles) 0-1	1-2	2-3	3-4	4-5	5-10	0-5	0-10
N	47	956	539	19	2	375	1,563	1,938
NNE	104	1,140	1,330	317	75	255	2,966	3,221
NE	0	148	143	0	517	5,219	808	6,027
ENE	6	17	28	26	343	2,154	420	2,574
E	0	0	16	33	26	1,148	75	1,223
ESE	0	0	22	21	59	283	102	385
SE	0	0	6	11	10	191	27	218
SSE	0	0	83	12	291	436	386	822
S	0	0	0	4	4	809	8	817
SSW	0	8	18	31	181	893	238	1,131
SW	506	313	226	20	97	1,527	1,162	2,689
WSW	111	230	0	39	228	171	608	779
W	0	36	189	3	12	891	240	1,131
WNW	8	0	8	39	15	314	70	384
NW	6	26	44	1,608	1,776	1,405	3,460	4,865
NNW	8	352	148	2,426	776	1,561	3,710	5,271
Sum for Radial Interval	796	3,226	2,800	4,609	4,412	17,632	15,843	33,475
Cummulative Total to Outer Radius	796	4,022	6,822	11,431	15,843	33,475	15,843	33,475
Average Density (people/mi ^{2}) in Radial Region	253	342	178	210	156	75	202	107

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TABLE 2.1-2 (continued)

Sector Designation	2010 RADIAL INTERVAL (miles)							
	0-1	1-2	2-3	3-4	4-5	5-10	0-5	0-10
N	48	983	554	20	2	386	1,607	1,993
NNE	107	1,173	1,368	326	77	262	3,051	3,313
NE	0	152	147	0	532	5,368	831	6,199
ENE	6	17	29	27	352	2,216	431	2,647
E	0	0	17	34	27	1,180	78	1,258
ESE	0	0	22	22	61	291	105	396
SE	0	0	6	11	10	197	27	224
SSE	0	0	86	12	299	448	397	845
S	0	0	0	4	4	832	8	840
SSW	0	9	18	31	186	919	244	1,163
SW	520	322	233	21	100	1,570	1,196	2,766
WSW	114	237	0	40	234	176	625	801
W	0	37	195	3	13	917	248	1,165
WNW	9	0	9	40	15	323	73	396
NW	6	27	46	1,654	1,826	1,445	3,559	5,004
NNW	9	362	153	2,495	798	1,605	3,817	5,422
Sum for Radial Interval	819	3,319	2,883	4,740	4,536	18,135	16,297	34,432
Cummulative Total to Outer Radius	819	4,138	7,021	11,761	16,297	18,135	16,297	34,432
Average Density (people/mi^2) in Radial Region	261	352	184	216	160	77	207	110

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TABLE 2.1-2 (continued)

Sector Designation	2020 RADIAL INTERVAL (miles) 0-1	1-2	2-3	3-4	4-5	5-10	0-5	0-10
N	50	1,011	570	20	2	397	1,653	2,050
NNE	110	1,206	1,407	336	80	270	3,139	3,409
NE	0	157	151	0	547	5,520	855	6,375
ENE	6	18	30	27	363	2,279	444	2,723
E	0	0	17	35	27	1,214	79	1,293
ESE	0	0	23	22	62	299	107	406
SE	0	0	6	11	10	202	27	229
SSE	0	0	88	12	308	461	408	869
S	0	0	0	4	4	856	8	864
SSW	0	9	19	32	192	945	252	1,197
SW	535	331	239	21	103	1,615	1,229	2,844
WSW	117	244	0	42	241	181	644	825
W	0	38	200	4	13	943	255	1,198
WNW	9	0	9	42	16	332	76	408
NW	6	28	47	1,701	1,878	1,486	3,660	5,146
NNW	9	372	157	2,566	820	1,651	3,924	5,575
Sum for Radial Interval	842	3,414	2,963	4,875	4,666	18,651	16,760	35,411
Cummulative Total to Outer Radius	842	4,256	7,219	12,094	16,760	18,651	16,760	35,411
Average Density (people/mi^2) in Radial Region	268	362	189	222	165	79	213	113

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TABLE 2.1-2A

AVERAGE NUMBER OF PEOPLE PER HOUSEHOLD

IN TOWNSHIPS WITHIN 10 MILES OF SITE

COUNTIES (TOWNSHIPS)	AVERAGE NO. OF PEOPLE PER HOUSEHOLD[a]
Will County	
Channahon	2.7
Custer	3.1
Florence	3.6
Reed	2.0
Wesley	3.5
Wilmington	2.0
Grundy County	
Braceville	2.8
Felix	3.2
Garfield	3.4
Goodfarm	2.9
Goose Lake	3.8
Greenfield	2.6
Maine	3.3
Mazon	2.7
Wauponsee	3.1
Kankakee County	
Essex	2.7
Norton	2.9
Salina	3.1

[a] Numbers based on U.S. Census Bureau's 1980 population, statistics and the number of housing units in the unincorporated areas of each township.

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TABLE 2.1-3

1980 AND PROJECTED POPULATION DISTRIBUTIONS
WITHIN 10 TO 50 MILES OF THE BRAIDWOOD STATION

Sector Designation	1980 RADIAL INTERVAL (miles)				
	10-20	20-30	30-40	40-50	0-50
N	18,118	21,607	159,852	196,880	397,896
NNE	18,014	140,555	210,493	806,860	1,178,378
NE	4,170	31,037	328,860	1,831,653	2,201,145
ENE	1,252	7,008	135,725	251,879	398,195
E	1,875	7,055	6,972	16,999	33,991
ESE	25,876	45,742	9,524	3,854	85,317
SE	3,479	6,320	2,591	9,739	22,306
SSE	1,963	1,977	5,545	2,618	12,765
S	1,191	1,583	2,918	2,502	8,886
SSW	833	1,395	6,401	2,418	12,123
SW	4,926	2,012	14,651	6,144	30,137
WSW	711	2,612	21,515	5,561	31,113
W	1,075	2[illegible]	8,987	31,459	44,555
WNW	1,970	9,491	19,687	4,206	35,671
NW	11,138	3,675	12,042	4,979	35,672
NNW	1,840	6,195	29,119	11,818	52,491
Sum for Radial Interval	98,431	290,277	974,882	3,189,569	4,580,641
Cummulative Total to Outer Radius	125,913	416,190	1,391,072	4,580,641	4,580,641
Average Density (people/mi^2) in Radial Region	104	185	443	1,128	583

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TABLE 2.1-3 (continued)

Sector Designation	1990 RADIAL INTERVAL (miles) 10-20	20-30	30-40	40-50	0-50
N	24,174	27,526	187,765	247,373	488,650
NNE	18,675	150,493	268,507	790,971	1,231,669
NE	5,273	44,293	379,601	1,676,391	425,326
ENE	1,367	8,580	154,612	258,285	425,326
E	1,219	5,192	8,140	22,523	38,250
ESE	30,443	47,173	10,307	4,231	92,519
SE	3,821	6,630	2,636	9,663	22,955
SSE	2,140	2,005	5,524	2,388	12,835
S	1,313	1,577	2,730	2,247	8,647
SSW	849	1,368	6,436	2,083	11,837
SW	5,268	1,926	15,657	6,067	31,507
WSW	622	2,499	20,820	5,292	29,987
W	1,087	2,349	9,290	30,514	44,331
WNW	2,246	10,293	18,757	4,296	35,957
NW	11,881	4,141	14,168	4,814	39,592
NNW	2,127	7,868	34,744	14,888	64,478
Sum for Radial Interval	112,505	323,913	1,139,694	3,082,026	4,689,907
Cummulative Total to Outer Radius	144,274	468,187	1,607,881	4,689,907	4,689,907
Average Density (people/mi^2) in Radial Region	119	206	518	1,090	597

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TABLE 2.1-3 (continued)

Sector Designation	2000 RADIAL INTERVAL (miles) 10-20	20-30	30-40	40-50	0-50
N	26,127	29,520	198,444	264,664	520,693
NNE	19,241	156,133	288,030	804,612	1,271,237
NE	5,648	48,379	399,855	1,678,125	2,138,034
ENE	1,424	9,137	162,464	270,509	446,108
E	1,092	4,868	8,640	24,871	40,694
ESE	32,184	48,546	10,729	4,506	96,350
SE	3,985	6,849	2,704	9,862	23,618
SSE	2,228	2,056	5,640	2,387	13,133
S	1,370	1,610	2,746	2,236	8,779
SSW	871	1,392	6,585	2,051	12,030
SW	5,464	1,948	16,237	6,182	32,520
WSW	615	2,527	21,114	5,345	30,380
W	1,114	2,480	9,565	30,962	45,252
WNW	2,360	10,708	18,950	4,412	36,814
NW	12,317	4,342	14,978	4,881	41,385
NNW	2,241	8,433	36,828	15,936	68,709
Sum for Radial Interval	118,281	338,928	1,203,509	3,131,541	4,825,734
Cummulative Total to Outer Radius	151,756	490,684	1,694,193	4,825,734	4,825,734
Average Density (people/mi^2) in Radial Region	126	216	547	1,108	614

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TABLE 2.1-3 (continued)

Sector Designation	2010 RADIAL INTERVAL (miles) 10-20	20-30	30-40	40-50	0-50
N	26,871	30,361	204,093	272,197	535,515
NNE	19,788	160,577	296,228	827,514	1,307,420
NE	5,809	49,756	411,236	1,727,849	2,200,849
ENE	1,465	9,397	167,114	285,085	465,708
E	1,123	5,007	8,948	26,282	42,618
ESE	33,100	49,928	11,049	4,758	99,231
SE	4,098	7,043	2,781	10,150	24,296
SSE	2,292	2,114	5,801	2,455	13,507
S	1,409	1,656	2,824	2,300	9,029
SSW	896	1,431	6,772	2,109	12,371
SW	5,619	2,004	16,699	6,358	33,446
WSW	632	2,599	21,715	5,497	31,244
W	1,146	2,550	9,837	31,843	46,541
WNW	2,427	11,013	19,490	4,538	37,864
NW	12,668	4,465	15,404	5,019	42,560
NNW	2,304	8,673	37,876	16,389	70,664
Sum for Radial Interval	121,647	348,574	1,237,867	3,230,343	4,972,863
Cummulative Total to Outer Radius	156,079	504,653	1,742,520	4,972,863	4,972,863
Average Density (people/mi ^{2}) in Radial Region	129	222	563	1,143	633

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TABLE 2.1-3 (continued)

Sector Designation	2020 RADIAL INTERVAL (miles) 10-20	20-30	30-40	40-50	0-50
N	27,636	31,225	209,902	279,945	550,758
NNE	20,352	165,147	304,659	851,067	1,344,634
NE	5,974	51,172	422,941	1,779,099	2,265,561
ENE	1,507	9,665	171,899	300,466	486,260
E	1,155	5,149	9,267	27,773	44,637
ESE	34,042	51,349	11,379	5,025	102,201
SE	4,215	7,244	2,860	10,447	24,995
SSE	2,357	2,175	5,966	2,525	13,892
S	1,449	1,703	2,905	2,365	9,286
SSW	921	1,472	6,965	2,169	12,724
SW	5,779	2,061	17,175	6,539	34,398
WSW	650	2,673	22,333	5,654	32,135
W	1,178	2,623	10,117	32,749	47,865
WNW	2,497	11,326	20,044	4,667	38,942
NW	13,028	4,592	15,843	5,162	43,771
NNW	2,370	8,920	38,954	16,856	72,675
Sum for Radial Interval	125,110	358,496	1,273,209	3,332,508	5,124,734
Cummulative Total to Outer Radius	160,521	519,017	1,792,226	5,124,734	5,124,734
Average Density (people/mi^2) in Radial Region	133	228	579	1,179	653

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TABLE 2.1-4

POPULATION CENTERS WITHIN 50 MILES OF THE BRAIDWOOD STATION

Population Center	County	Distance & Direction From the Site	1980 Population
Joliet	Will (IL)	20 miles NNE	77,956
Kankakee	Kankakee (IL)	20 miles ESE	30,141
Park Forest	Will & Cook (IL)	32 miles ENE	26,222
Bolingbrook	Will & DuPage (IL)	34 miles NNE	37,261
Tinley Park	Cook (IL)	34 miles NE	26,171
Aurora	Kane (IL)	35 miles N	81,293
Chicago Heights	Cook (IL)	35 miles ENE	37,026
Naperville	DuPage & Will (IL)	37 miles N	42,330
Oak Forest	Cook (IL)	37 miles NE	26,096
Downers Grove	Dupage (IL)	39 miles NNE	42,572
Harvey	Cook (IL)	39 miles NE	35,810
Oak Lawn	Cook (IL)	42 miles NE	60,590
Burbank	Cook (IL)	43 miles NNE	28,462
Lansing	Cook (IL)	43 miles NE	29,039
Wheaton	DuPage (IL)	44 miles N	43,043
Calumet City	Cook (IL)	45 miles NE	39,697
Chicago (part)	Cook (IL)	45 miles NE	3,005,072
Lombard	DuPage (IL)	46 miles NNE	37,295
Hammond	Lake (IN)	47 miles ENE	93,714
Highland	Lake (IN)	47 miles ENE	25,935
Elmhurst	DuPage (IL)	48 miles NNE	44,276
Addison	DuPage (IL)	49 miles NNE	29,759
Berwyn	Cook (IL)	49 miles NNE	46,849
Cicero (part)	Cook (IL)	49 miles NNE	61,232
Maywood	Cook (IL)	49 miles NNE	27,998

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TABLE 2.1-5

URBAN CENTERS WITHIN 30 MILES OF THE BRAIDWOOD STATION

URBAN CENTER[a]	COUNTY[b]	DISTANCE & DIRECTION FROM THE SITE	1980 POPULATION
Braidwood	Will	1.5 miles NNE	3,429
Coal City	Grundy	3.5 miles NW	3,028
Wilmington	Will	6.0 miles NE	4,424
Morris	Grundy	13 miles NW	8,833
Channahon	Will	13 miles N	3,734
Dwight	Livingston	14 miles SW	4,146
Bourbonnais	Kankakee	19 miles ESE	13,280
Bradley	Kankakee	20 miles ESE	11,008
Joliet	Will	20 miles NNE	77,956
Kankakee	Kankakee	20 miles ESE	30,141
Shorewood	Will	20 miles N	4,714
Manteno	Kankakee	21 miles E	3,155
Crest Hill	Will	22 miles NNE	9,252
Peotone	Will	24 miles ENE	2,832
New Lenox	Will	24 miles NE	5,792
Frankfort	Will	26 miles NE	4,357
Lockport	Will	26 miles NNE	9,170
Marseilles	LaSalle	26 miles WNW	4,766
Plainfield	Will	26 miles N	3,767
Mokena	Will	27 miles NE	4,578
Romeoville	Will	29 miles NNE	15,519
Yorkville	Kendall	30 miles NNW	3,422

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[a]An urban center is defined as an incoporated or unincorporated place with a population of over 2500 according to the 1980 census. 1

[b]All counties are in Illinois.

TABLE 2.1-6

MAJOR RECREATIONAL AREAS WITHIN 10 MILES OF THE BRAIDWOOD STATION

RECREATIONAL AREA	DISTANCE & DIRECTION FROM SITE	1981 TOTAL ATTENDANCE[a]	ESTIMATED PEAK DAY ATTENDANCE	
State Facilities				
Des Plaines Conservation Area	8 miles N	243,977	1,000[b]	
Goose Lake Prairie State Park	9 miles NNW	107,282	2,706[c]	
Kankakee River State Park	9 miles E	1,165,807	25,000[d]	
Illinois and Michigan Canal State Trail (Channahon Park Access)	10 miles N	117,809	851[e]	
Will County Facilities[f]				
Braidwood Dunes and Savana Nature Preserve	2 miles NE	500	80	
Forsythe Woods	7 miles NE	1,250	250	
McKinley Woods	9 miles N	*	250	
		TOTAL MEMBERSHIP (families)		
Private Parks and Clubs				
Chicago Beagle Club[g]	0.5 miles SW	46	300	
Braidwood Recreation Club[h]	2 miles NE	2,350	600	
South Wilmington Sportsmen's Club[i]	3 miles SSE	1,850	800-1,000	
Area 1 Outdoor Club[j]	3.5 miles N	450	300	
Wilmington Recreation Club[k]	3.5 miles NNE	875	3,000	2
Ponderosa Sportsmen's Club[l]	4 miles S	206	60	
South Wilmington Fireman Beach and Park Club[m]	4 miles SSW	1,800	2,100	
Will County Sportsmen's Club[n]	4 miles NE	350	700	
Fossil Rock Recreation Club[o]	4.5 miles NNE	160	420	
CECo Employees Recreation Association, Inc.[p]	5 miles NNW	500	1,000	
Coal City Area Club[q]	5 miles NNW	1,934	6,000	
Sun Recreation Club[r]	5 miles S	40	100	
Shannon Shores[r]	6 miles S	181	1,000	
Dresden Lakes Sports Club (Public)[s]	7 miles NNW	300	*	
Rainbow Council Scout Reservation[t]	7 miles NW	3,800	1,000	
Goose Lake Club[u]	7.5 miles NNW	900	2,500	

Note: Asterisk (*) indicates information not available.

[a]Source: Illinois Department of Conservation (1982).
[b]Source: Pohl (1982).
[c]Source: Nyhoff (1982).
[d]Source: Fredrick (1982).
[e]Source: Warren (1982).
[f]Source: Racicot (1982).
[g]Source: Zidich (1982).
[h]Source: Chilman (1982).
[i]Source: Dvorak (1982).
[j]Source: Ray (1983).
[k]Source: Southall (1983).
[l]Source: Adams (1982).
[m]Source: Testa (1983).
[n]Source: Burdick (1982).
[o]Source: Ingersoll (1983).
[p]Source: Scott (1982).
[q]Source: Berta (1983).
[r]Source: Crescenzo (1983).
[s]Source: Reynolds (1982).
[t]Source: Wills (1982).
[u]Source: Johnson (1982).

TABLE 2.1-9

1980 AND PROJECTED POPULATION DISTRIBUTIONS BETWEEN 0 AND 10 MILES OF THE BRAIDWOOD STATION INCLUDING PEAK DAILY TRANSIENT POPULATION

SECTOR DESIGNATION	1980	1990	2000	2010	2020
N[a]	3,840 (1,439 + 2,401*)	4,213 (1,812 + 2,401*)	4,339 (1,938 + 2,401*)	4,394 (1,993 + 2,401*)	4,451 (2,050 + 2,401*)
NNE[b]	5,876 (2,456 + 3,420*)	6,443 (3,023 + 3,420*)	6,641 (3,221 + 3,420*)	6,733 (3,313 + 3,420*)	6,829 (3,409 + 3,420*)
NE[c]	7,055 (5,425 + 1,630*)	7,439 (5,809 + 1,630*)	7,657 (6,027 + 1,630*)	7,829 (6,199 + 1,630*)	8,005 (6,375 + 1,630*)
ENE	2,331	2,482	2,574	2,647	2,723
E[d]	26,090 (1,090 + 25,000*)	26,176 (1,176 + 25,000*)	26,223 (1,223 + 25,000*)	26,258 (1,258 + 25,000*)	26,293 (1,293 + 25,000*)
ESE	321	365	385	396	406
SE	177	205	218	224	229
SSE[e]	1,662 (662 + 1,000*)	1,778 (778 + 1,000*)	1,822 (822 + 1,000*)	1,845 (845 + 1,000*)	1,869 (869 + 1,000*)
S[f]	1,852 (692 + 1,160*)	1,940 (780 + 1,160*)	1,977 (817 + 1,160*)	2,000 (840 + 1,160*)	2,024 (864 + 1,160*)
SSW[g]	3,176 (1,076 + 2,100*)	3,201 (1,101 + 2,100*)	3,231 (1,131 + 2,100*)	3,263 (1,163 + 2,100*)	3,297 (1,197 + 2,100*)
SW[h]	2,904 (2,404 + 500*)	3,089 (2,589 + 500*)	3,189 (2,689 + 500*)	3,266 (2,766 + 500*)	3,344 (2,844 + 500*)
WSW	714	754	799	801	825
W	1,021	1,091	1,131	1,165	1,198
WNW	317	365	384	396	408
NW[i]	4,838 (3,838 + 1,000*)	5,588 (4,588 + 1,000*)	5,865 (4,865 + 1,000*)	6,004 (5,004 + 1,000*)	6,146 (5,146 + 1,000*)
NNW[j]	15,725 (3,519 + 12,206*)	17,057 (4,851 + 12,206*)	17,477 (5,271 + 12,206*)	17,628 (5,422 + 12,206*)	17,781 (5,575 + 12,206*)
Sum for 0-10 Mile Interval	77,899 (27,482 + 50,417*)	82,186 (31,769 + 50,417*)	83,892 (33,475 + 50,417*)	84,849 (34,432 + 50,417*)	85,828 (35,411 + 50,417*)
Average Density Persons/mi^2) in 0-10 Mile Interval	248	262	267	270	273

Note: Asterisk (*) indicates transient population part of total.

[a]Sector includes Des Plaines Conservation Area, Illinois Michigan Canal State Trail, McKinley Woods and Area 1 Outdoor Club.

[b]Sector includes Wilmington Recreation Area Club and Fossil Rock Recreation Club.

[c]Sector includes Braidwood Dunes and Savanna Nature Preserve, Forsythe Woods, Braidwood Recreation Club and Will County Sportsmen's Club.

[d]Sector includes Kankakee River State Park.

[e]Sector includes South Wilmington Sportsmen's Club.

[f]Sector includes Ponderosa Sportsman's Club, Sun Recreation Club and Shannon Shores.

[g]Sector includes South Wilmington Fireman Beach and Park Club.

[h]Sector includes Chicago Beagle Club.

[i]Sector includes Rainbow Council Scout Reservation.

[j]Sector includes Goose Lake Prairie State Park, CECo Employees Recreation Association, Inc., Coal City Area Club, Dresden Lakes Sports Club and Goose Lake Club.

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2

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TABLE 2.1-10

1974 FARM STATISTICS

APPROXIMATE LAND AREA	WILL COUNTY	GRUNDY COUNTY	KANKAKEE COUNTY	ILLINOIS
Total Land (acres)	542,336	276,224	434,176	35,679,936
Percentage in Farms	64.8	82.9	89.7	81.5
Land in Farms (acres)	351,486	228,990	389,262	29,094,794
Number of Farms	1,430	708	1,384	111,049
Average Size of Farms (acres)	246	323	281	262
LAND AREA IN FARMS BY USE				
Cropland Harvested (acres)	298,954	196,530	344,251	21,517,665
Cropland Pastured (acres)	10,584	3,451	8,668	1,855,810
Cropland Not Harvested and Not Pastured (acres)	9,658	5,306	8,848	1,026,083
Woodland Including Woodland Pasture (acres)	5,931	7,445	5,905	1,969,796
Other Lands (roads, homes, etc.) (acres)	26,359	16,258	21,590	2,725,440

Source: U.S. Bureau of the Census (1977).

TABLE 2.1-12

LIVESTOCK STATISTICS AND PRODUCTION

	GRUNDY COUNTY		KANKAKEE COUNTY		WILL COUNTY	
	1974	1975	1974	1975	1974	1975
All Cattle (no. of head)	9,200[a]	10,100[b]	14,400[a]	14,700[b]	20,300[a]	20,900[b]
Beef Cows (no. of head)	2,600[a]	2,500[b]	3,000[a]	2,700[b]	3,800[a]	3,300[b]
Milk Cows (no. of head)	1,400[a]	1,300[b]	2,300[a]	2,200[b]	4,800[a]	4,500[b]
Hogs and Pigs (no. of head)	8,900[c]	7,200[d]	20,500[c]	16,800[d]	21,000[c]	18,400[d]
Sheep (no. of head)	1,700[a]	1,500[b]	1,300[a]	1,100[b]	2,100[a]	1,800[b]
Egg Production (no. of eggs)	30,900	29,000	183,800	139,100	373,200	387,100

Source: Illinois Cooperative Crop Reporting Service et al. (1976b).

[a] As of January 1, 1975

[b] As of January 1, 1976

[c] As of December 1, 1974

[d] As of December 1, 1975

TABLE 2.1-13 2

1983 SURVEY OF MILK COWS AND GOATS

WITHIN A 5-MILE RADIUS OF THE BRAIDWOOD STATION

DIRECTION	MILK COWS, APPROXIMATE DISTANCE (miles)	USE	MILK COWS, APPROXIMATE DISTANCE (miles)	USE
N	--[a]		--	
NNE	--		--	
NE	--		--	
ENE	--		--	
E	2.2[b]	Grade A Milk	4.1	Pets
ESE	2.3[b]	Grade A Milk	4.3	Pets
SE	--		4.6[c]	Pets 2
SSE	--		--	
S	--		--	
SSW	--		--	
SW	--		--	
WSW	1.7	Not used for human milk consumption, used for raising calves.	--	
W	2.7	Not used for human milk consumption, used for raising calves.	--	
WWN	--		--	
NW	--		--	
NNW	--		--	

Source: Pilch (1977); Ruff (1977a); Wicklein (1977b).

[a]None within 5 miles in this direction.
[b]These two groups are in the same herd.
[c]Added June 23, 1983. New survey was conducted by A. Lewis on June 23, 1983. 2

TABLE 2.1-14

NEAREST RESIDENCE AND GARDEN

WITHIN 5 MILES OF THE BRAIDWOOD STATION

DIRECTION	NEAREST RESIDENCE, APPROXIMATE DISTANCE (miles)	NEAREST GARDEN APPROXIMATE DISTANCE (miles)	
N	0.5	0.5	
NNE	0.7	0.7	
NE	1.2	1.2	
ENE	1.1	1.1[a]	2
E	0.7	0.8	
ESE	2.2	2.3[a]	2
SE	2.8	2.8	
SSE	3.2	3.4	
S	3.9	3.9	
SSW	0.9	0.9	
SW	0.7	0.7	
WSW	0.4	0.4	
W	0.3	0.3	
WNW	0.4	0.4	
NW	0.3	0.3	
NNW	0.4	0.4	

Source: Ruff (1977b).

[a]Revised June 23,1983. New survey conducted by A. Lewis on June 23, 1983. 2

TABLE 2.1-15

OIL PIPELINES WITHIN 5 MILES OF THE BRAIDWOOD STATION

PIPELINE COMPANY	DISTANCE AND DIRECTION FROM SITE (closest approach)	SIZE (in.)	AGE (years)	BURIAL DEPTH (ft)	MAXIMUM OPERATING PRESSURE (psi)	LOCATION AND TYPE OF ISOLATION VALVES	PRODUCTS
Arco Pipeline Company[a]	3.3 miles NW	8	25 to 74	3	450	Manual block valves location depends upon terrain.	Refined products[b]
Midwestern Gas Transmission Line Company[c]	4.5 miles E	30	18	2.5 or more	700-800	*[d]	Natural gas
Natural Gas Pipeline Company of America[e]	4.1 miles E	36	24	3.5	Designed for 858 maximum. Normally does not operate at maximum.	Automatic valves located every 10 miles.	Natural gas
Northern Illinois Gas Company[f]	4.2 miles S	4	13	3	60	Manual valve located at least every 10 miles.	Natural gas
	2.4 miles W	6	6 to 9	3	Designed for 210. Operating at 150.	Manual valve located at least every 10 miles.	Natural gas
	2.8 miles NW	12	*[d]	3	60	Manual valve located at least every 10 miles.	Natural gas
	2.8 miles NW	36[g]	12	3	750	Manual valve located at least every 10 miles.	Natural gas
Texaco-Cities Service Pipeline Company[h]	2.8 miles SE	12	48	2 to 3	720	Manual valves located at pump stations and major streams.	Crude Oil
	2.8 miles SE	12	40	2 to 3	750	Manual valves located at pump stations and major streams.	Crude Oil
	4.8 miles ESE	18	28	2 to 3	850	Manual valves located at pump stations and major streams.	Crude Oil

[a]Source: Morel (1977).

[b]Refined products include gasoline, kerosene, LPG, and ammonia.

[c]Source: Howard (1977).

[d]Asterisk (*) indicates information is not available.

[e]Source: Harbach (1977).

[f]Source: Mores (1977).

[g]Source: Weirich (1977).

[h]Source: Miller (1977).

TABLE 2.1-17

ESTIMATED 1978* BEEF PRODUCTION WITHIN 50 MILES OF THE BRAIDWOOD STATION

(All Values in Thousand kg/yr)

DIRECTION	DISTANCE (Miles) 0 TO 1	1 TO 2	2 TO 3	3 TO 4	4 TO 5
N	0	0	0	0	0
NNE	0	0	0	0	0
NE	0	0	0	0	13
ENE	0	0	0	0	33
E	0	0	0	13	7
ESE	0	0	0	0	0
SE	0	0	0	0	0
SSE	0	0	0	0	0
S	0	0	0	0	0
SSW	0	0	0	0	0
SW	0	11	0	0	0
WSW	0	0	0	6	0
W	0	0	6	11	0
WNW	0	0	0	11	0
NW	0	0	0	0	0
NNW	0	0	0	0	0

2

DIRECTION	5 TO 10	10 TO 20	20 TO 30	30 TO 40	40 TO 50
N	0	252	689	342	545
NNE	13	167	167	29	46
NE	0	153	276	16	20
ENE	20	167	307	227	176
E	20	106	186	275	491
ESE	37	115	208	417	775
SE	100	115	386	606	849
SSE	12	181	442	596	850
S	25	211	373	490	750
SSW	0	172	295	395	681
SW	0	170	295	395	627
WSW	0	137	501	511	1,069
W	23	172	749	1,001	1,392
WNW	11	144	741	1,001	1,385
NW	0	162	1,020	2,046	5,749
NNW	0	456	1,468	2,285	4,299

*Production within 10 miles of the station derived from location of beef cattle farms in 1982.

Sources: 1. U.S. Department of Commerce, 1981.

2. R. Morgan and C. Meyer, 1983, Kankakee County ASCS Office.

3. T. Ward, 1983, Kankakee County Agriculture Extension Advisor.

4. A. Pilch, 1983, Grundy County Agriculture Extension Advisor.

5. A. May, 1983, Will County Soil Conservation Service.

TABLE 2.1-18

ESTIMATED 1978* PORK PRODUCTION WITHIN 50 MILES OF THE BRAIDWOOD STATION

(All Values in Thousand kg/yr)

DIRECTION	DISTANCE (miles) 0 TO 1	1 TO 2	2 TO 3	3 TO 4	4 TO 5
N	0	0	0	0	0
NNE	0	0	0	0	0
NE	0	0	0	0	0
ENE	0	0	0	0	0
E	0	0	0	0	0
ESE	0	0	0	0	0
SE	0	0	0	0	0
SSE	0	0	0	0	0
S	0	0	0	0	0
SSW	0	0	0	0	0
SW	0	0	0	0	0
WSW	0	0	0	0	0
W	0	0	0	0	0
WNW	0	0	0	0	0
NW	0	0	0	0	0
NNW	0	0	0	0	0

DIRECTION	5 TO 10	10 TO 20	20 TO 30	30 TO 40	40 TO 50
N	0	233	713	340	2,960
NNE	21	261	261	53	85
NE	0	240	421	41	52
ENE	0	261	479	341	195
E	21	239	401	515	541
ESE	57	259	462	655	1,091
SE	45	259	447	553	828
SSE	99	316	409	543	775
S	0	445	690	895	1,077
SSW	0	480	820	1,099	1,481
SW	0	450	820	1,099	1,682
WSW	0	303	782	1,056	1,660
W	24	305	646	864	1,308
WNW	24	328	702	864	1,195
NW	0	511	811	1,223	2,945
NNW	0	471	1,074	1,483	2,238

*Production within 10 miles of the station derived from location of pig farms in 1982.

Sources:
1. U.S. Department of Commerce, 1981.
2. R. Morgan and C. Meyer, 1983, Kankakee County ASCS Office.
3. T. Ward, 1983, Kankakee County Agriculture Extension Advisor.
4. A. Pilch, 1983, Grundy County Agriculture Extension Advisor.
5. A. May, 1983, Will County Soil Conservation Service.

TABLE 2.1-19

ESTIMATED 1974 MUTTON AND LAMB PRODUCTION WITHIN 50 MILES OF THE BRAIDWOOD STATION

(All Values in kg/yr)

DIRECTION	DISTANCE (miles) 0 TO 1	1 TO 2	2 TO 3	3 TO 4	4 TO 5
N	0	0	0	0	0
NNE	0	0	0	0	0
NE	0	0	0	0	0
ENE	0	0	0	0	0
E	0	0	0	0	120
ESE	0	0	0	0	0
SE	0	0	0	0	0
SSE	0	0	0	0	0
S	0	0	0	0	0
SSW	0	0	0	0	0
SW	0	0	0	0	0
WSW	0	0	0	0	0
W	0	0	0	0	0
WNW	0	0	0	0	0
NW	0	0	0	0	0
NNW	0	0	0	0	0

DIRECTION	5 TO 10	10 TO 20	20 TO 30	30 TO 40	40 TO 50
N	424	1,700	4,160	7,660	6,990
NNE	424	1,700	2,120	1,510	1,580
NE	424	1,700	1,770	220	968
ENE	424	1,270	1,700	2,520	2,990
E	424	2,710	3,610	4,280	4,800
ESE	424	1,800	3,610	7,200	6,600
SE	902	2,710	7,340	8,310	12,700
SSE	902	3,610	8,310	11,100	13,800
S	1,350	3,060	9,490	10,700	16,600
SSW	580	2,520	5,040	10,100	15,900
SW	580	3,100	5,040	7,560	27,900
WSW	580	2,320	14,700	14,400	42,400
W	580	1,160	24,400	24,400	40,700
WNW	580	2,320	16,900	32,600	33,900
NW	580	1,160	17,900	25,600	25,400
NNW	580	7,790	13,300	14,200	20,600

Source: Bureau of the Census (1977).

TABLE 2.1-20

ESTIMATED 1981* MILK PRODUCTION WITHIN 50 MILES OF THE BRAIDWOOD STATION

(All Values in Thousand liters/yr)

DIRECTION	DISTANCE (Miles) 0 TO 1	1 TO 2	2 TO 3	3 TO 4	4 TO 5
N	0	0	0	0	0
NNE	0	0	0	0	0
NE	0	0	0	0	0
ENE	0	0	0	0	0
E	0	0	135	0	0
ESE	0	0	0	0	0
SE	0	0	0	0	0
SSE	0	0	0	0	0
S	0	0	0	0	0
SSW	0	0	0	0	0
SW	0	0	0	0	0
WSW	0	0	0	0	0
W	0	0	194	0	0
WNW	0	0	0	0	0
NW	0	0	0	0	194
NNW	0	0	0	0	0

2

DIRECTION	5 TO 10	10 TO 20	20 TO 30	30 TO 40	40 TO 50
N	0	976	2,171	943	2,242
NNE	0	1,264	1,264	206	330
NE	0	1,159	2,011	133	166
ENE	135	1,264	2,317	1,745	1,489
E	0	670	1,212	1,791	2,517
ESE	145	727	1,305	1,912	539
SE	290	727	1,673	2,352	2,948
SSE	0	909	1,681	2,312	3,296
S	194	696	600	963	1,270
SSW	0	454	776	1,040	1,209
SW	0	450	776	1,040	1,174
WSW	0	354	784	1,018	1,018
W	582	356	687	918	1,373
WNW	0	389	759	918	1,270
NW	291	377	754	1,287	2,906
NNW	0	471	922	3,610	7,063

*Production within 10 miles of the station derived from location of dairy farms in 1982.

Sources:
1. Illinois Cooperative Crop Reporting Service, 1982.
2. Indiana Crop and Livestock Reporting Service, 1981.
3. R. Morgan and C. Meyer, 1983, Kankakee County ASCS Office.
4. T. Ward, 1983, Kankakee County Agriculture Extension Advisor.
5. A. Pilch, 1983, Grundy County Agriculture Extension Advisor.
6. A. May, 1983, Will County Soil Conservation Service.

TABLE 2.1-21

ESTIMATED 1978 LEAFY VEGETABLE PRODUCTION HARVESTED FOR SALE WITHIN 50 MILES OF THE BRAIDWOOD STATION

(All Values in Thousand kg/yr)

DIRECTION	DISTANCE (miles)				
	0 TO 1	1 TO 2	2 TO 3	3 TO 4	4 TO 5
N	0	0	0	0	0
NNE	0	0	0	0	0
NE	0	0	0	0	0
ENE	0	0	0	0	0
E	0	0	0	0	0
ESE	0	0	0	0	0
SE	0	0	0	0	0
SSE	0	0	0	0	0
S	0	0	0	0	0
SSW	0	0	0	0	0
SW	0	0	0	0	0
WSW	0	0	0	0	0
W	0	0	0	0	0
WNW	0	0	0	0	0
NW	0	0	0	0	0
NNW	0	0	0	0	0

2

DIRECTION	5 TO 10	10 TO 20	20 TO 30	30 TO 40	40 TO 50
N	0	99	222	88	45
NNE	0	148	148	230	454
NE	0	136	274	517	649
ENE	0	148	279	422	564
E	0	133	225	419	840
ESE	0	145	256	254	10
SE	0	145	123	66	81
SSE	0	140	46	64	92
S	0	89	-	7	15
SSW	0	-	-	-	-
SW	0	-	-	-	-
WSW	0	-	-	-	8
W	0	-	3	4	10
WNW	0	-	3	4	5
NW	0	-	-	31	123
NNW	0	-	-	33	118

Note: "-" indicates less than 1,000 kg produced.

Sources: 1. U.S. Department of Commerce, 1981.

2. Illinois Cooperative Crop Reporting Service, 1982.

3. Indiana Crop and Livestock Reporting Service, 1981.

TABLE 2.1-21A

ESTIMATED 1978 NON-LEAFY VEGETABLE PRODUCTION HARVESTED FOR SALE WITHIN 50 MILES OF THE BRAIDWOOD STATION

(All Values in Thousand kg/yr)

DIRECTION	DISTANCE (miles) 0 TO 1	1 TO 2	2 TO 3	3 TO 4	4 TO 5
N	0	0	0	0	0
NNE	0	0	0	0	0
NE	0	0	0	0	0
ENE	0	0	0	0	0
E	0	0	0	0	0
ESE	0	0	0	0	0
SE	0	0	0	0	0
SSE	0	0	0	0	0
S	0	0	0	0	0
SSW	0	0	0	0	0
SW	0	0	0	0	0
WSW	0	0	0	0	0
W	0	0	0	0	0
WNW	0	0	0	0	0
NW	0	0	0	0	0
NNW	0	0	0	0	0

2

DIRECTION	5 TO 10	10 TO 20	20 TO 30	30 TO 40	40 TO 50
N	0	244	556	354	532
NNE	0	330	330	532	987
NE	0	303	592	924	1,170
ENE	0	330	619	772	631
E	0	147	274	516	956
ESE	0	159	307	1,199	666
SE	0	159	1,662	3,001	3,758
SSE	0	497	2,174	2,949	4,206
S	0	385	932	1,258	2,674
SSW	0	23	39	52	736
SW	0	32	39	52	320
WSW	0	59	633	411	1,248
W	0	155	1,443	1,930	2,327
WNW	0	49	1,358	1,930	2,669
NW	0	49	565	3,108	8,318
NNW	0	81	202	966	4,585

Sources:
1. U.S. Department of Commerce, 1981.
2. Illinois Cooperative Crop Reporting Service, 1982.
3. Indiana Crop and Livestock Reporting Service, 1981.

TABLE 2.1-22

APPROXIMATE YIELDS FOR CROPS HARVESTED FOR FORAGE

WITHIN 50 MILES OF THE BRAIDWOOD STATION

CROP	APPROXIMATE YIELDS WITHIN A 50-MILE RADIUS (kg/m^2)[a]	1975 ILLINOIS YIELDS (kg/m^2)[b]
Oats (silage)	0.6	NA[c]
Oats (dry)	0.2	0.2
Alfalfa (silage)	1.6	NA
Alfalfa Hay (dry)	0.7	0.7
Sorghum/Sudex (silage)	3.4	2.7
Corn (silage)	4.5	3.7

[a]Source: Whitson (1977).

[b]Source: Illinois Cooperative Crop Reporting Service et al. (1976a).

[c]NA = Not Available.

TABLE 2.1-29

FACILITIES AT PUBLIC ACCESS AREAS TO THE KANKAKEE AND ILLINOIS RIVERS WITHIN 50 RADIAL MILES DOWNSTREAM FROM THE BRAIDWOOD STATION 2

AREA	LAUNCHING RAMP	PICNIC AREA	RESTROOMS	CAMPING
Des Plaines Fish and Wildlife Area(1)	X	X	X	X
Dresden Dam (2)				
Wm. G. Stratton State Park (3)	X	X	X	
Illini State Park (4)	X	X	X	X
Allen Park (5)	X	X	X	
Starved Rock State Park (6)	X	X	X	X

2

Source: Bertrand (1975).

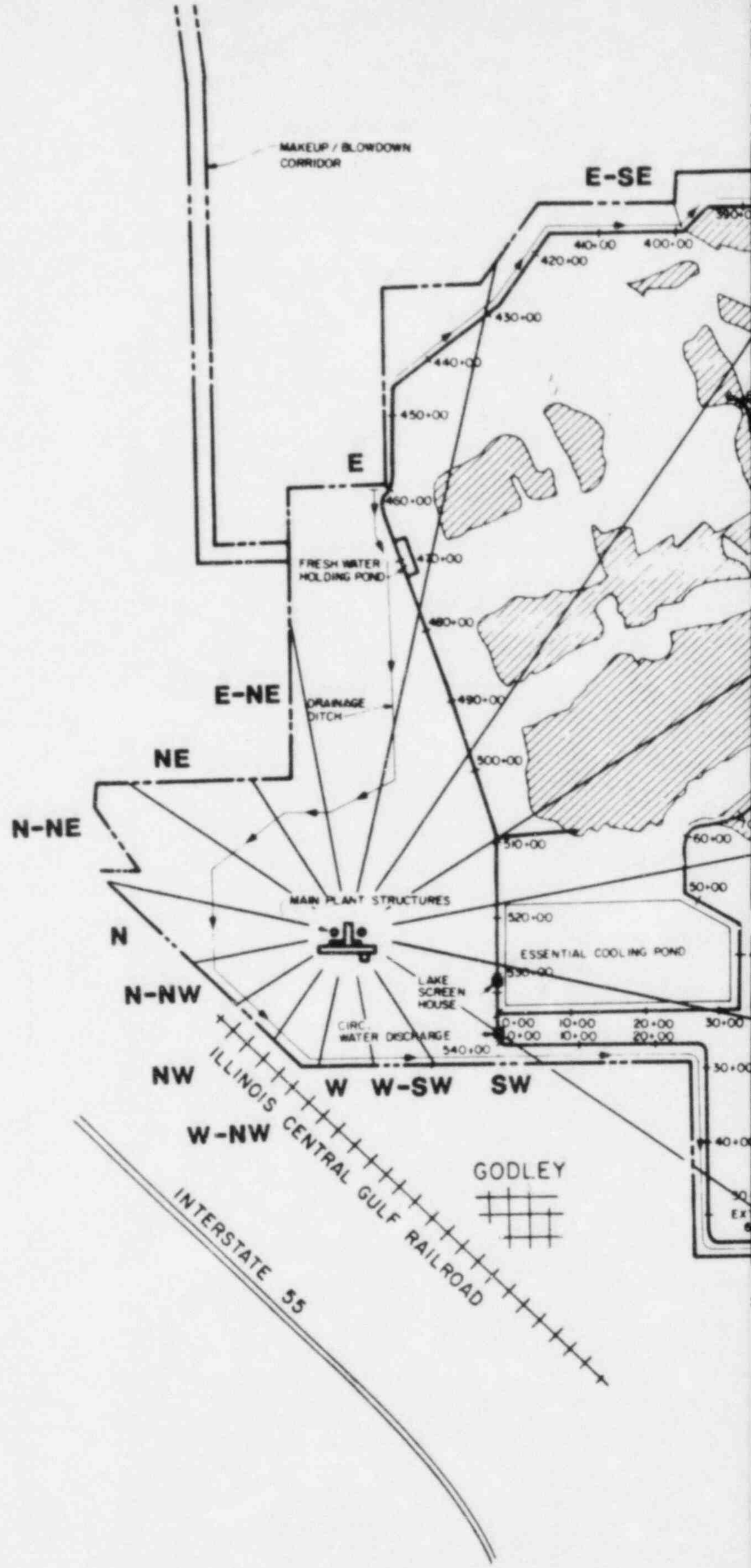
Note: Area numbers are keyed to Figure 2.1-13.

TABLE 2.1-30

POUNDAGE OF FISH TAKEN FROM ILLINOIS RIVER BY COMMERCIAL FISHERMEN

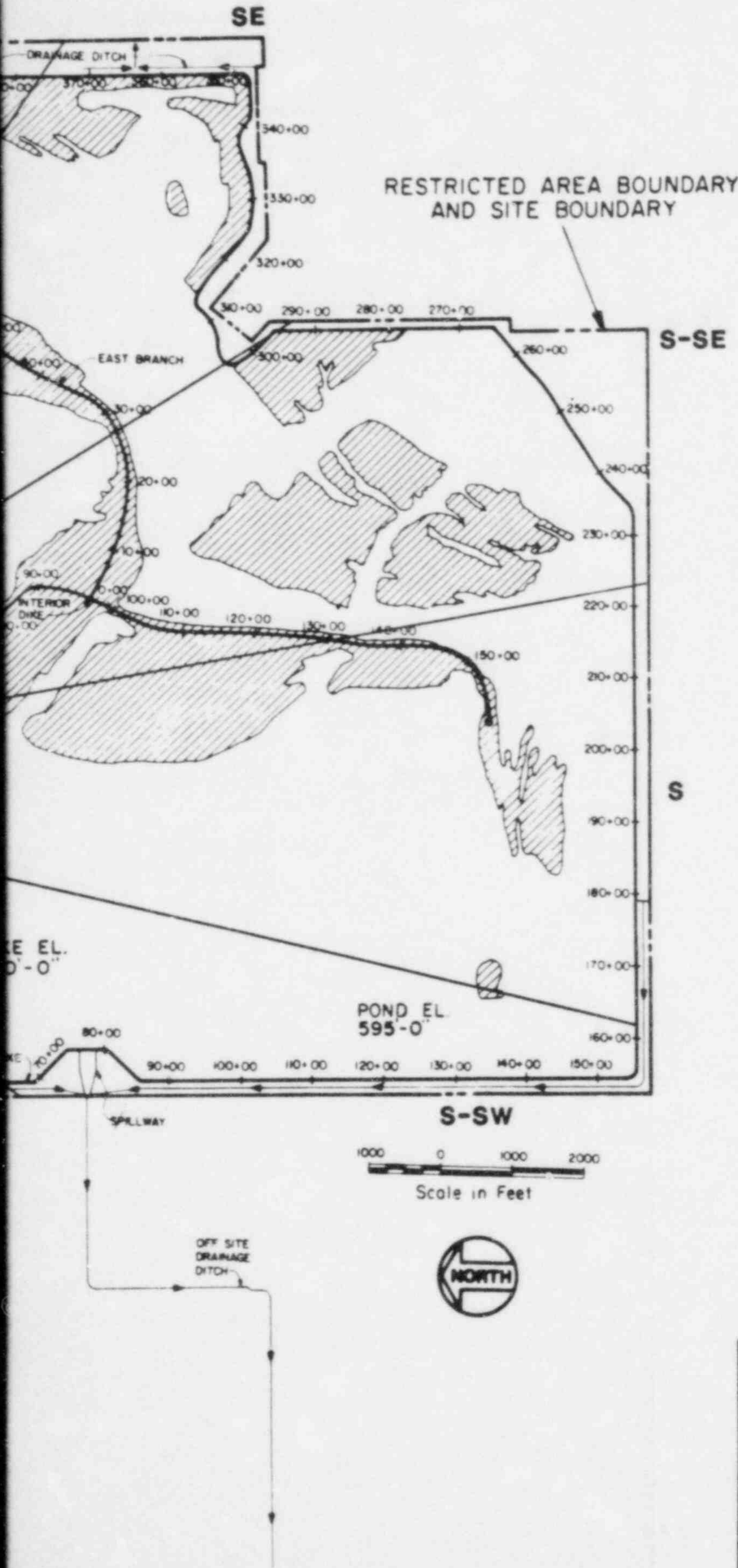
SPECIES	1970 (lb)	1971 (lb)	1972 (lb)	1973 (lb)	1974 (lb)	1975 (lb)
Carp	353,074	353,838	310,780	212,953	263,164	214,196
Buffalo	431,940	438,732	260,312	117,828	207,764	161,149
Drum	25,776	44,606	16,910	7,239	4,929	13,601
Catfish	71,663	50,443	54,261	45,429	53,675	54,972
Bullheads	21,666	15,276	6,620	15,113	25,036	14,358
Sturgeon	48	-	-	100	-	20
Paddlefish	6,094	1,210	3,123	807	16,365	3,438
White carp	330	500	600	600	190	5,550
Suckers	-	-	-	200	-	1,020
Gars	716	-	-	-	-	3,240
Bowfin	1,282	493	600	500	-	2,100
Mooneye & Goldeye	-	-	-	2	-	100
Eel	-	-	-	-	35	6
Crappies	-	-	-	-	-	135
Yellow perch	-	-	-	-	-	-
TOTAL	912,589	905,098	653,206	400,771	571,158	273,885

Source: Illinois Department of Conservation, Fisheries Division (1975).



MAKEUP / BLOWDOWN CORRIDOR
E-SE
E
FRESH WATER HOLDING POND
E-NE
DRAINAGE DITCH
NE
N-NE
MAIN PLANT STRUCTURES
N
N-NW
NW
W-NW
W
W-SW
SW
ESSENTIAL COOLING POND
LAKE SCREEN HOUSE
CIRC. WATER DISCHARGE
ILLINOIS CENTRAL GULF RAILROAD
INTERSTATE 55
GODLEY

AMENDMENT 1
FEBRUARY 1983
AMENDMENT 2
JULY 1983



PRC
APERTURE
CARD

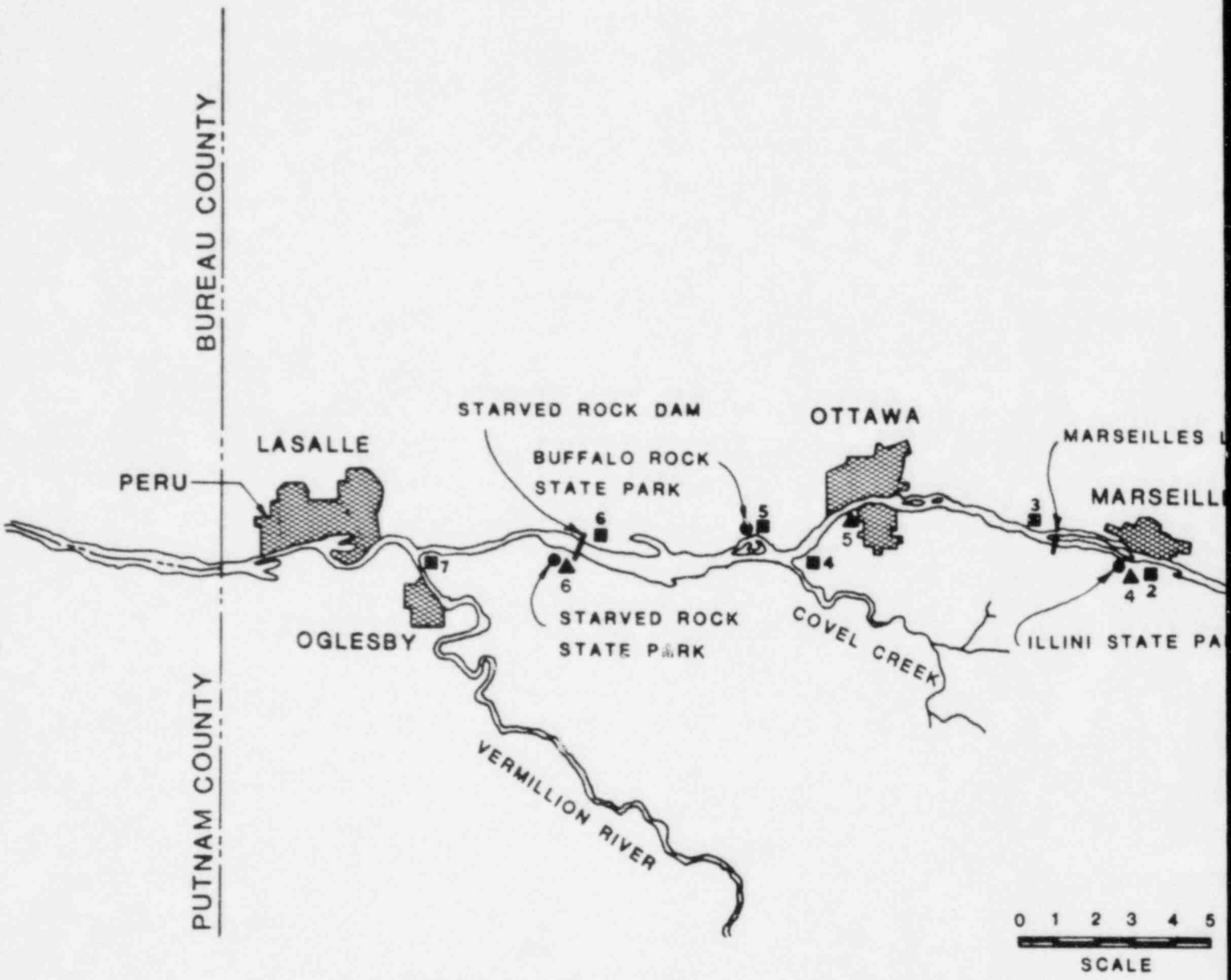
Also Available On
Aperture Card

BRAIDWOOD NUCLEAR GENERATING STATION
UNITS 1 & 2
ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

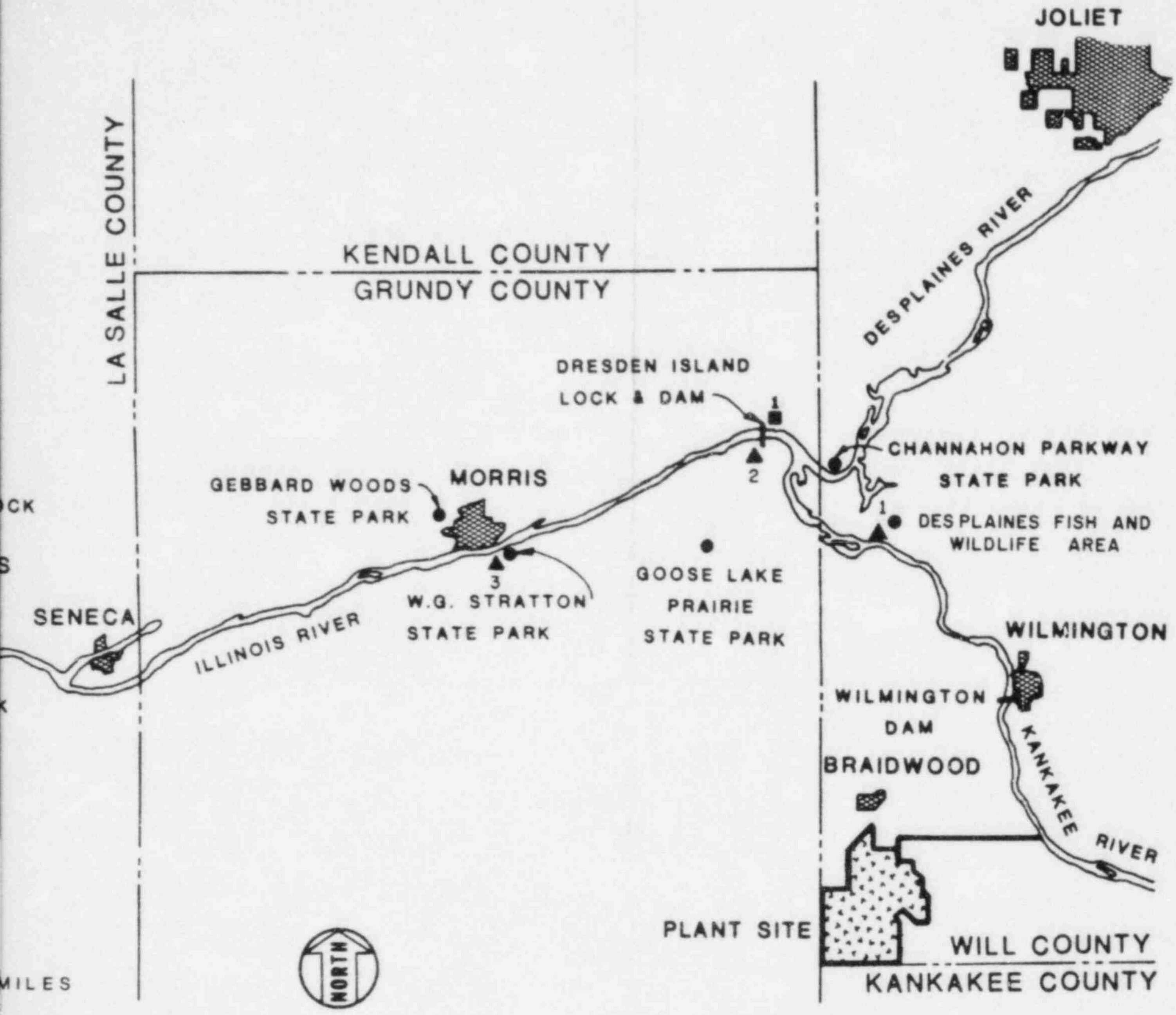
FIGURE 2.1-3

SITE BOUNDARY, RESTRICTED AREA
BOUNDARY, AND COOLING POND

8307200125 -01



- ● STATE PARKS (SEE TABLE 2.1-6)
- ■ FISHING AREAS (SEE TABLE 2.1 - 28)
- ▲ PUBLIC ACCESS AREAS (SEE TABLE 2.1 - 29)



Also Available On Aperture Card

BRAIDWOOD NUCLEAR GENERATING STATION UNITS 1 & 2 ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE
FIGURE 2.1-13 RIVER-ASSOCIATED RECREATION AREAS WITHIN A 50-MILE RADIUS DOWNSTREAM FROM THE STATION

8307200125 -02

Long-term joint frequency distributions of wind direction and wind speed for each Pasquill stability class at Peoria (1966-1975) are summarized in Table 2.3-30.

2.3.5.4 Inversions and High Air Pollution Potential

The 13 years of data (1952-1964) on vertical temperature gradients from Argonne (Moses and Bogner 1967) provide a measure of thermodynamic stability, or mixing potential. Weather records from many stations in United States have also been analyzed with the objective of characterizing atmospheric dispersion potential (Hosler 1961; Holzworth 1972).

The seasonal frequencies of inversions based below 500 feet for the Braidwood Station area are shown by Hosler as follows:

	Inversions Below 500 Feet	
Season	Percentage of Total Hours	Percentage of 24-Hour Periods With at Least One Hour of Inversion
Spring	30	68
Summer	31	81
Fall	38	72
Winter	28	48

1 2

Since northern Illinois has a primarily continental climate, inversion frequencies are closely related to the diurnal cycle. The less frequent occurrence of storms in summer produces a larger frequency of nights with short-duration inversion conditions.

Holzworth's data give estimates of the average depth of vigorous vertical mixing, which give an indication of the vertical depth of atmosphere available for mixing and dispersion of effluents. For the Braidwood Station region, the seasonal values of the mean daily mixing depths (in meters) are as follows:

	Mean Daily Mixing Depths	
Season	Morning	Afternoon
Spring	480	1500
Summer	320	1600
Fall	400	1200
Winter	470	610

When daytime (maximum) mixing depths are shallow, pollution potential is highest.

The following list presents Argonne data on the frequency of inversion conditions in the 5.5- to 144-foot layer above the ground expressed as a percentage of the total observations, and on the average duration of inversion conditions:

Month	Inversion Frequency	First Hour	Final Hour
Jan.	30.5%	5 p.m.	8 a.m.
Apr.	33.1%	6 p.m.	6 a.m.
Jul.	42.4%	6 p.m.	6 a.m.
Oct.	48.4%	5 p.m.	7 a.m.

Nocturnal inversions begin at dusk and normally continue until daylight the next day. The inversion frequency for January at Argonne compares well with Hosler's winter value, and the fall season shows a maximum in both Argonne and Hosler's data. Fall also has the longest period of inversion conditions.

Holzworth has also presented statistics on the frequency of episodes of high air-pollution potential, as indicated by low mixing depth and light winds (Holzworth 1972). His data indicate that, during the 5-year period from 1960 through 1964, the region including the Braidwood Station experienced no episodes of 2 days or longer with mixing depths less than 500 meters and winds less than 2 meters per second. There were two such episodes with winds remaining less than 4 meters per second. For mixing heights less than 1000 meters and winds less than 4 meters per second, there were about nine episodes in the 5-year period lasting 2 days or more, but no episodes lasting 5 days or more. Holzworth's data indicate that northern Illinois is in a relatively favorable dispersion regime with respect to the low frequency of extended periods of high air-pollution potential.

2.3.5.5 Topographical Description

Figure 2.3-22 is a topographic map showing the area surrounding the Braidwood Station. Figures 2.3-23 and 2.3-24 show topographic cross sections in each of the 16 compass-point directions radiating from the site. It can be seen that the station, at an elevation of approximately 600 feet above mean sea level (MSL) is at one of the highest points within a 5-mile radius. The lowest points within 5 miles of the site are about 550 feet above MSL. Terrain in the vicinity of the Braidwood Station falls off except in the northeast clockwise through the south-southeast directions (see Figure 2.3-24). The slope from the station site to the lower points is gradual.

The bottom contours in the discharge area (approximately 2000 feet downstream from the mouth of Horse Creek) indicate that this part of the river is narrower and shallower than any other section of the Kankakee River (see Figure 2.4-4). River velocities are higher in the region of the discharge canal than in other sections of the river because of the reduced cross-sectional area in this region.

See Section 2.1.3 for a discussion of water uses. Section 2.4.1.5 discusses surface-water quality characteristics.

2.4.1.3 Floods

2.4.1.3.1 Flood History

The information needed to describe the flood history of the Braidwood Station vicinity was obtained from several USGS sources (1947-1949, 1950-1960, 1950, 1961-1981; and 1964) and from 2
Mitchell (1954).

The peak discharge, corresponding gauge height, and maximum gauge height (if higher) for each water year (October through September) of record on the Kankakee River near Wilmington are entered in Table 2.4-1. The gauge is located in the northwest quarter of Section 15, T33N, R9E, 0.4 mile downstream from Prairie Creek and 8.78 miles downstream from the intake point. The intercepted drainage area is 5150 square miles. The datum, or zero point, of the waterstage recorder is at an elevation of 510.86 feet MSL (North American datum 1929). Peak discharges shown for the water years 1915 through 1933 were derived from Kankakee River gauging records at Custer Park, 0.25 mile upstream of Horse Creek. This gauge intercepted a drainage area of approximately 4870 square miles. The flow rates listed in the table were adjusted for the Wilmington site by multiplying the Custer Park discharge times the ratio of the square roots of the drainage areas.

The maximum known discharge near Wilmington was 75,900 cfs on July 13, 1957. The corresponding gauge height was 11.40 feet above datum. The maximum stage of 13.88 feet during the period of record was caused by ice jams. Ice jam floods in 1883 and 1887 reached a stage of 16.73 feet, but the corresponding discharge rates are unknown. All of the maximum stages that were greater than those caused by floods were caused by ice jams.

2.4.1.3.2 Ice Flooding

Ice flooding is common on the Kankakee River, but only the river screen house could be affected by ice flooding. In 17 of the 2
last 34 years of record at the Wilmington gauging station, the highest annual water levels were caused by ice jams. At such times, ice forms all along the Kankakee River in Illinois. Major ice jams (like those in 1866, 1883, and 1887) produced stages much higher than the stages created by flood discharges alone.

According to the Woermann profile of 1927, the 1866 ice jam generated a stage of 553.0 feet near Horse Creek. The 1883 ice jam destroyed the railroad bridge at Custer Park and displaced the approach embankments several feet downstream. It also completely destroyed the upper dam at Wilmington. Just before the Wilmington dam failure, the jam was reportedly 20 feet higher than the crest elevation of 545.0 feet (the present crest is at 530.5 feet) (Barker 1972). The maximum elevation upstream of Custer Park, 554.5 feet on February 15, 1959, was caused by an ice jam. Therefore, ice flooding is expected to raise the water surface near the intake to a maximum elevation of 555 feet.

2.4.1.4 Low Flows

2.4.1.4.1 Historical Low Flow

Monthly average flow rates for the Kankakee River at the intake for the period from 1941 to 1976 are given in Table 2.4-2. The drainage area at the intake is 5000 square miles. The drainage area at the Wilmington gauge is 5150 square miles. The flow rates at the intake were transposed from those at the Wilmington gauge using a ratio of the square roots of the appropriate drainage areas.

The lowest annual flow at the Wilmington gauge for the period of record from 1941 to 1976 occurred during the 1964 water year. During this year, the mean flow at the Wilmington gauge was 1407 cfs. Table 2.4-2 lists the monthly mean flows for 1964.

The lowest daily flow at the Wilmington gauge for the period of record was 204 cfs on August 1, 1936. The historical daily low flow at the intake was estimated at 198 cfs. The minimum daily flows for each month for the period from 1941 to 1976 are given in Table 2.4-3.

Low flow elevations in the Kankakee River at the Braidwood Station site are controlled by a rock ledge that lies across the river between the Resthaven and Lakewood shores, 7700 feet upstream of the Wilmington dam. The ledge acts as a dam, creating a pool of water that reaches upstream to Custer Park, approximately 1 mile upstream of the intake. Under low flow conditions, the rock ledge, which is at an elevation of 534 feet MSL, maintains a minimum water elevation of 534 feet.

Low flow rates and frequencies for the Kankakee River at the intake (see Table 2.4-4) were derived from the Wilmington gauge statistical summary based on the record from 1916 to 1976 (USGS 1977). The estimated 7-day, 10-year low flow at the intake is 440 cfs.

Future uses of Kankakee River water are not expected to significantly lower minimum flows. It is predicted that the urban Kankakee area will gradually increase its withdrawal rate for public and industrial water supply, but that most of the

supply will return to the river as wastewater. The city of Joliet may use the Kankakee River to supplement its water supply in the future (Barker et al. 1967). However, the withdrawal point would probably be downstream from the plant intake. Historical data indicate that low flow levels have increased irregularly since the lowest recorded flow at the Wilmington gauge occurred 39 years ago.

Based on an analysis with two units operating at 100% load factor for the period from 1949 to 1965, the concentration of total dissolved solids (TDS) in the pond and the pond drawdown would be within the required limits. The maximum TDS would be 1025 ppm compared with the limit of 1151 ppm. The maximum pond drawdown (minimum pond elevation) would be 593.6 feet MSL compared with the limit of elevation 592.8 feet MSL, which is the circulating water pump net positive suction head requirement. During low flow conditions, the makeup flow to the pond would be limited to 10% or less of the Kankakee River flow.

2.4.1.4.2 Plant Requirements

Makeup water for the cooling pond is withdrawn from the Kankakee River. Makeup is required to maintain pond water quality and to balance the amounts of water lost and gained through evaporation, seepage, blowdown, and rainfall. Table 3.3-1 shows the individual estimates for each of these parameters. The average water makeup requirement is 90.8 cfs. On the average, 56.8 cfs is lost through seepage and evaporation. Since 43.2 cfs are returned to the river as blowdown and approximately 9.3 cfs are added in rainfall, the average net usage rate is about 47.6 cfs. Actual usage rates may vary according to station power levels and seasonal changes in quantities of evaporation. Table 2.4-5 shows the percentage of Kankakee River low flows required to arrive at an average net use of 47.6 cfs. The sump invert in the river screen house is at an elevation of 526 feet MSL. This is well below the estimated minimum river water-surface elevation of 534 feet MSL

The cooling pond has a normal pool elevation of 595 feet MSL with a surface area of 2537 acres. The pond's normal volume is 22,300 acre-feet. Figure 2.4-5 presents the overall plan for the pond. The cooling pond reservoir storage-elevation curves are displayed in Figure 2.4-6.

The minumum required essential cooling water flow of 89 cfs is withdrawn from the essential cooling pond. The essential cooling pond is an excavated area within the cooling pond that was designed to provide sufficient water volume to permit the safe shutdown of the station for 30 days (minimum) without requiring the withdrawal of makeup water from the Kankakee River. It is estimated that the water loss caused by seepage and evaporation in the pond would amount to 178.5 acre-feet for such a 30-day period. The essential cooling pond is 99 acres in size and 6.0

feet deep at an elevation 590.0 feet MSL. The pond's area-capacity curve is presented in Figure 2.4-7.

Some storage capacity could be lost over the life of the station as a result of sedimentation in the essential cooling pond. Sediment can come from three sources: (a) runoff from the pond drainage area, (b) erosion of pond bottom material caused by pond water circulation, and (c) suspended solids flowing in makeup water from the Kankakee River. Since the amount of runoff into the pond is negligible and the velocity of the circulating flow is relatively slow, the first two sources' contributions can be dismissed as relatively insignificant compared to the portion of sediment load contributed by the third source.

Statistical analysis of 5 years of data (1957-1961) on the Kankakee River at the Wilmington gauge indicates that 50% of the time the turbidity was lower than 15 Jackson turbidity units (JTU) (Harmeson et al. 1969). Assuming that sediment load can be estimated from turbidity, sediment could be deposited in the essential cooling pond at a rate of 0.38 acre-feet per year. At this rate the total sediment deposition for a 40-year period would be 15.3 acre-feet or 2.7% of the essential cooling pond's capacity. This could raise the pond's bottom elevation to 584.17 feet MSL. However, it is probable that only a portion of the sediment will accumulate in the essential cooling pond. Whatever the case, periodic surveys will be made to detect any changes in the pond bottom elevation.

Studies were conducted to determine the quality of existing surface waters and the potential loading of substances from surface and subsurface soils. Based on an extensive pH and conductivity survey of the surface waters and soil extracts, the site was divided into the representative areas shown in Figure 2.4-8. Extractions made from incubated surface and subsurface soil samples yielded data on the potential for substances backing into an overlying column. These data were then used to predict pond water chemistry. Results of the investigations follow.

Tables 2.4-6 and 2.4-7 show a breakdown of leached soil components and their possible effects on water quality. The amount of salt added to the lake water through the leaching of soil constituents is likely to have an insignificant effect on the water quality of the Braidwood Station cooling pond (see Subsection 2.2.2).

The present phosphorus concentration in the Kankakee River is about 0.48 ppm. The phosphorus concentration in the cooling pond reflects this concentration. It is predicted that leaching will contribute an additional 0.03 ppm. Considering evaporation effects, the expected phosphorus concentration for the pond is 1.03 mg phosphorus/liter of cooling pond water.

TABLE 2.4-1

FLOODS ON THE KANKAKEE RIVER NEAR WILMINGTON

WATER YEAR	PEAK FLOOD DISCHARGE (cfs)	PEAK FLOOD STAGE (ft)	MAXIMUM GAUGE HEIGHT (ft)
1981	41,000	6.45	Same[a]
1980	24,800	5.88	Same
1979	48,000	--	12.07
1978	30,500	6.68	9.40
1977	16,200	4.54	Same
1976	32,600	6.95	Same
1975	27,100	6.24	Same
1974	49,100	8.49	12.78
1973	33,200	7.03	Same
1972	15,800	4.47	Same
1971	12,600	4.07	Same
1970	54,500	9.40	Same
1969	29,700	6.59	Same
1968	35,100	7.26	13.88
1967	19,400	5.18	10.08
1966	23,400	5.75	6.99
1965	19,500	5.20	Same
1964	10,800	3.70	Same
1963	22,000	--	9.72
1962	23,800	5.70	6.68
1961	17,000	4.86	Same
1960	19,500	5.25	9.13
1959	30,000	--	9.52
1958	30,600	6.72	9.92
1957	75,900	11.40	Same
1956	16,200	4.70	Same
1955	14,400	4.38	7.13
1954	15,000	4.53	Same
1953	19,500	5.17	Same
1952	29,000	6.46	9.43
1951	30,000	--	10.83
1950	37,800	7.61	11.39
1949	16,700	4.80	11.57
1948	23,000	5.67	6.00
1947	21,600	5.40	Same
1946	19,500	5.20	
1945	21,600	5.40	
1944	33,800	7.10	
1943	48,000	8.87	10.06
1942	46,600	8.70	
1941	8,290	3.30	
1940	11,100	3.95	
1939	24,600	6.00	
1938	19,600	5.30	
1937	15,100	4.65	
1936	17,500	5.00	
1935	17,500	5.00	
1934	7,000	--	
1933	35,300		
1932	10,600		
1931	6,510		
1930	17,200		
1929	24,800		
1928	24,000		
1927	29,100		
1926	20,900		
1925	14,100		
1924	18,900		
1923	16,400		
1922	34,300		
1921	7,270		
1920	26,200		
1919	22,800		
1918	26,600		
1917	15,600		
1916	14,500		
1915	22,400		
1887	--	--	16.73
1883	--	--	16.73

2

[a]Same = maximum gauge height is same as peak flood stage gauge height.

TABLE 2.4-2

KANKAKEE RIVER FLOW CHARACTERISTICS AT THE INTAKE

MONTH	AVERAGE FLOW (1941-1976) (cfs)	MONTHLY MEAN FLOW (1964) (cfs)
October	1836	500
November	2547	638
December	3379	618
January	4586	787
February	5579	885
March	6625	1610
April	7463	4357
May	6608	2371
June	4847	1997
July	3094	1609
August	1613	572
September	1353	483

TABLE 2.4-5

PERCENT OF KANKAKEE RIVER FLOW REQUIRED FOR AN AVERAGE NET USE OF 47.6 cfs 2

FLOW DURATION FREQUENCY	PERCENT
1-day 10-year low	12.5
3-day 10-year low	11.4
7-day 10-year low	10.8
30-day 10-year low	9.6
Average Annual Flow	1.2

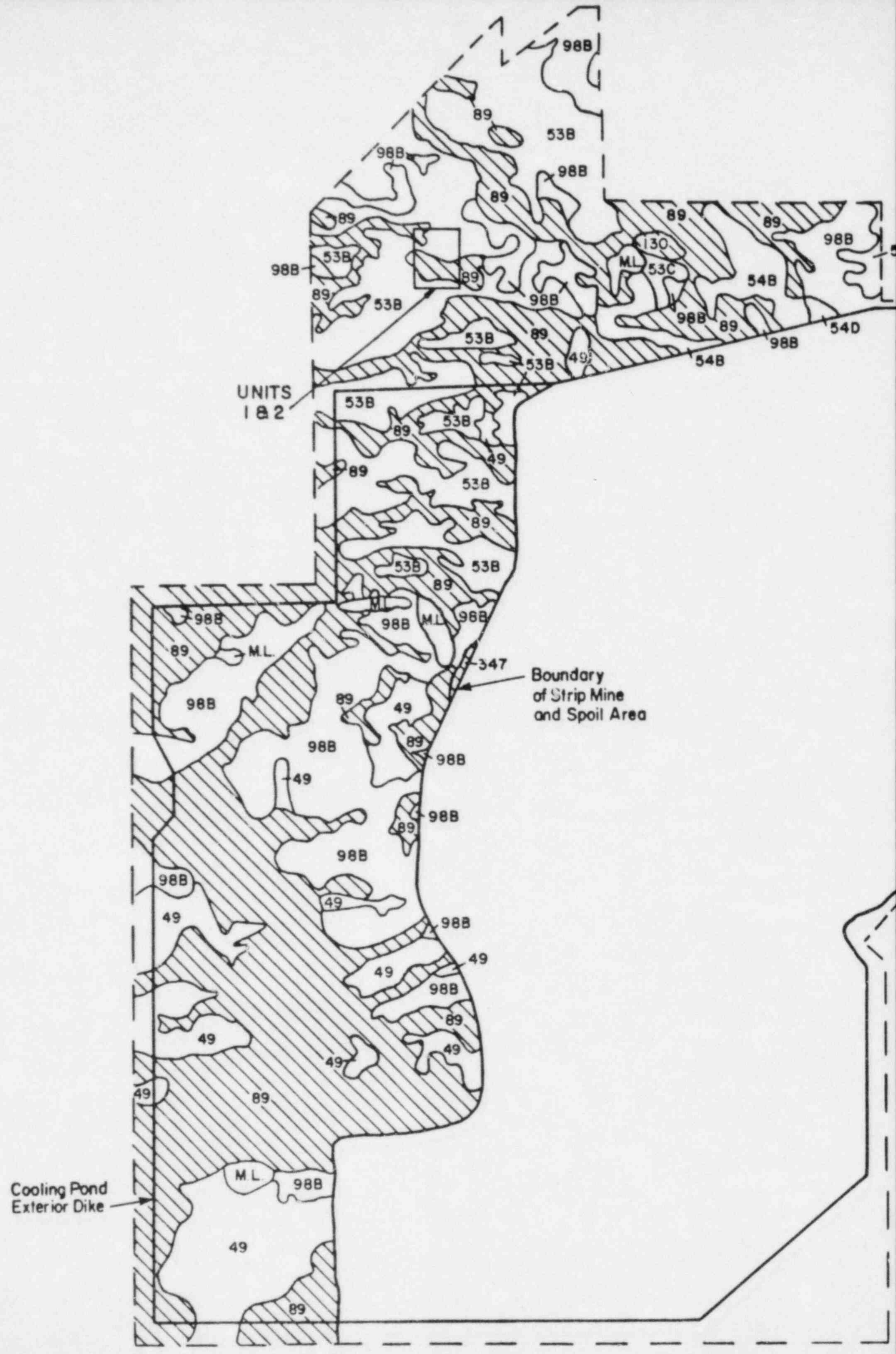
TABLE 2.4-6

EQUIVALENT CONCENTRATIONS OF THE MAJOR ALKALINE AND ACID FORMING COMPONENTS EXTRACTED FROM SOIL

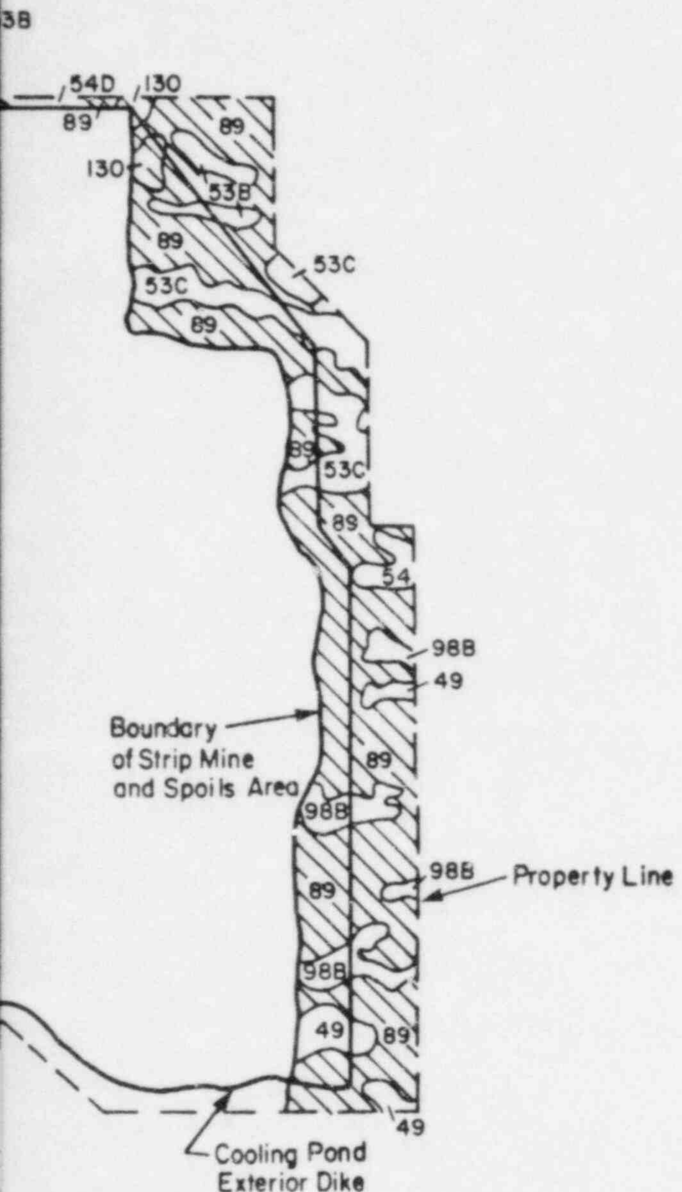
SAMPLE NO.	PROFILE DEPTH (in.)	DUPLICATE NUMBER	CATIONS[a]					ANIONS[a b]			CATION ANION RATIO
			CALCIUM (meq)	MAGNESIUM (meq)	SODIUM (meq)	POTASSIUM (meq)	TOTAL (meq)	SULFATE (meq)	CHLORIDE (meq)	TOTAL (meq)	
17	0-6	1	21.80	5.18	0.42	0.10	27.50	16.20	0.23	16.43	1.67
	0-6	2	1.25	3.16	0.66	0.06	5.13	12.91	0.18	13.09	0.39
	6-12	1	17.65	8.14	0.49	0.22	26.50	3.42	0.15	3.57	7.42
	6-12	2	22.77	5.60	0.34	0.11	28.82	15.57	0.28	15.85	1.82
9	0-6	1	9.32	10.21	0.62	0.22	20.37	0	0.19	0.19	107.21
	0-6	2	7.65	8.41	0.51	0.17	16.74	1.42	0.15	1.57	10.66
	6-12	1	16.45	39.08	0.44	0.05	56.02	5.78	0.23	6.01	9.32
	6-12	2	15.99	39.69	0.37	0.06	55.11	0	0.27	0.27	207.82
29	0-6	1	13.74	29.39	1.80	0.45	45.38	37.56	0.17	37.73	1.20
	0-6	2	12.44	32.76	1.90	0.41	47.51	7.85	0.15	8.00	5.96
	6-12	1	10.19	30.60	1.99	0.27	43.05	5.85	0.14	5.99	7.19
	6-12	2	15.90	30.50	1.95	0.29	48.64	9.24	0.16	9.40	5.17
5	0-6	1	0.72	4.85	0.37	0.08	6.02	0	0.16	0.16	37.63
	0-6	2	0.70	4.47	0.54	0.11	5.82	0	0.15	0.15	38.80
	6-12	1	7.32	19.21	0.98	0.19	27.70	11.64	0.14	11.78	2.35
	6-12	2	8.86	23.63	1.26	0.26	34.01	0	0.16	0.16	212.56

[a] Milliequivalent (meq) concentrations are calculated from undiluted soil extracts.

[b] The bicarbonate anion is not included.



UNITS
1 & 2
Boundary
of Strip Mine
and Spoil Area
Cooling Pond
Exterior Dike
98B
53B
89
49
53C
54B
54D
130
M.L.
347



LEGEND

Soil Series

49 Watseka loamy fine sand
53B, 53C Bloomfield fine sand
54B, 54D Plainfield sand
89 Maumee fine sandy loam
98B Ade loamy fine sand
130 Pittwood fine sandy loam
347 Canisteo loam
M.L. Mined Land
▨ Prime Farmland

NOTES

1. From Wascher, H.L., Veal, P.T., and Odell, R.T., 1962.
2. From May, A.D., 1983.

0 1000 2000
Scale in feet

NORTH

BRAIDWOOD NUCLEAR GENERATING STATION
UNITS 1 & 2
ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

FIGURE 2.5-2

SITE AGRICULTURAL SOILS MAP

BRAIDWOOD NUCLEAR GENERATING STATION - UNITS 1 & 2

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CONTENTS

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CHAPTER 3.0 - THE STATION

3.1 EXTERNAL APPEARANCE

3.1.1 Structures

The principal structures at the Braidwood Nuclear Generating Station - Units 1 & 2 (Braidwood Station), shown in the artist's conception in the frontispiece, consist of:

a. the turbine building (containing two steam turbine-generators and associated equipment);

b. two reactor containment buildings (each housing a pressurized water reactor and associated reactor coolant system);

c. the service and solid radioactive waste storage building (for office use and other related service functions);

d. the auxiliary building (containing auxiliary systems and equipment);

e. the fuel storage and handling building; and

f. an electrical switchyard.

Additional facilities include two vent stacks associated with the auxiliary building, a train washdown shed associated with the fuel storage and handling building, transmission lines, a pond screenhouse, and a river screenhouse and blowdown discharge structure on the Kankakee River, and a 2537-acre cooling pond. | 1

3.1.2 Arrangement of Structures

The arrangement of the principal structures is illustrated in the frontispiece. Further details of the layout, including the locations of the plant perimeter and exclusion boundary, are presented in Figure 2.1-4. The switchyard is located near a central group of buildings. This group includes the turbine building, the auxiliary building, the fuel storage and handling building, and the two reactor containment buildings.

The turbine building, auxiliary building, and fuel storage and handling building form a "T" shape. The turbine building is at one end of the "T" and the fuel storage and handling building is at the other. The auxiliary building connects these two buildings and is flanked by the two reactor containment buildings. The train car washdown shed extends from the end of the fuel storage and handling building. Adjoining the turbine building is the service and solid radioactive waste storage building.

3.1.3 Architectural Features and Aesthetic Considerations

Although the facility is obviously an industrial facility, much effort has been expended to develop a functional design that is aesthetically pleasing. For example, while the major materials of construction are concrete and steel, colored metal siding is employed as part of the architectural treatment to provide variety of texture as well as color. The siding is used on the entire turbine building and on the tendon enclosures of the reactor buildings. The structures are physically contiguous to each other; the grouping provides a balance and symmetry of design and a pleasing variety of roof and corner lines. The river screenhouse has as low a profile as possible, a screen wall hides the trash rack cleaning machinery from view and the screen house area was extensively landscaped. 2

3.1.4 Release Points

The release points for gaseous effluents are through vent stacks located on the auxiliary building roof. The vent stacks, described further in Section 3.5, extend above the turbine building to about 200 feet above the plant grade. The Unit 1 vent stack is located at Universal Transverse Mercator (UTM) coordinates 4,565,265 meters north and 396,950 meters east. The Unit 2 vent stack is located at UTM coordinates 4,565,250 meters north and 396,950 meters east.

The release point for liquid effluents is the blowdown discharge structure on the west bank of the Kankakee River at an elevation of 536 feet above mean sea level at UTM coordinates 4,565,887 meters north and 403,568 meters east.

3.3 STATION WATER USE

This section describes the expected uses of water at the Braidwood Nuclear Generating Station - Units 1 & 2 (Braidwood Station). The plant systems that require water are the circulating water system, the service water systems, the steam cycle makeup system, and the potable water supply system. An initial supply of water is provided for the primary water makeup system, the reactor auxiliary systems, and the refueling water and spent fuel pool systems. Since most of the water from these systems is recycled, only a small amount of makeup water is required to compensate for evaporative losses. A flow chart that details the predicted quantitative uses is depicted in Figure 3.3-1. Chemical, thermal, and radiological discharges are discussed in subsequent sections. Water quality implications of pond formation and blowdown are discussed in Subsection 2.4.1.

Water for the continuous operation of the Braidwood Station is obtained from the Kankakee River. Data pertaining to flow parameters of the Kankakee River and the groundwater hydrology of the area are discussed in Section 2.4. The quantity of makeup water is dependent primarily upon the following factors:

a. the amount of cooling pond blowdown necessary to prevent the total dissolved solids content from increasing to a level in excess of that desirable for operating purposes or permitted by state of Illinois effluent requirements;

b. the amount of water lost due to evaporation and seepage across the cooling pond;

c. the amount of water lost due to transpiration by aquatic plants; and

d. the amount of water gained by rainfall and other forms of precipitation.

The predicted quantitative uses depicted in Figure 3.3-1 present the best estimate based on engineering judgment. Seepage estimates are discussed in Subsection 3.3.6.

By noting that aquatic plant growth is expected to be limited to the marginal, shallow water (1 to 18 inches) areas of the cooling pond, it was determined that transpiration would result in only a small water loss.

Compared to the amount of water lost by evaporation and seepage, the amount lost by transpiration will be very small. Since cattails (*Typha latifolia*) have been observed on several occasions as the dominant aquatic plant along the banks of ponds within the area inundated by the cooling pond, it is expected that shoreline areas of the cooling pond can also support significant populations of this plant. Because *T. latifolia* has

one of the highest rates of transpiration of aquatic plants studied (115 acre-inches/acre per year) and is also expected to be the dominant vegetative constituent of the pond, this aquatic plant was selected for obtaining conservative estimates of pond water loss due to plant transpiration (Curtis and Clark 1950). Assuming a total shoreline length of 38.45 miles (see Subsection 4.1.4) and a width of 10 feet as an upper boundary of the area in which cattails would grow (46.6 acres), the water loss due to transpiration is about 0.15 x 10^9 gallons/year. Table 3.3-1 indicates that the annual average water loss from natural and forced evaporation is about 12 x 10^9 gallons/year. Thus, even on the basis of very conservative assumptions, transpiration from aquatic plants could increase pond water loss by only 1.3% above that associated with physical evaporation alone.

3.3.1 Circulating Water System

The station circulating water system is a closed-cycle cooling water system used to dissipate the heat gained from the condensation of steam formed in the secondary cycle by the steam generators. The cooling system consists of a cooling pond that dissipates the excess process heat to the atmosphere. The condenser cooling water is pumped to the cooling pond at a rate of approximately 3250 cfs for two units. At 100% load factor, the temperature rise of the water passing through the condenser is about 22° F, and the water temperature is reduced in the cooling pond through the evaporation of a portion of the water and through conductive and convective sensible heat transfer mechanisms.

Calculations have been made of the anticipated volumetric consumption of water by the plant (i.e., the loss by evaporation and seepage from the cooling pond). An analysis was made of the amount of river makeup needed to replace these losses and the amount of cooling pond blowdown necessary to control the chemistry of the circulating water system.

The evaporation rate from the cooling pond varies with weather conditions and the plant load factor. Evaporation is estimated to range seasonally between 31.8 and 71.1 cfs, with the average 51.8 cfs, based on 100% load factor. Rainfall, at an estimated average rate of 9.3 cfs, compensates for part of this evaporative loss. The loss due to seepage from the pond is about 5 cfs. The blowdown necessary to maintain water chemistry was calculated using the net evaporative and seepage losses. A blowdown averaging 43.2 cfs can maintain an average total dissolved solids (TDS) level of 900 mg/liter in the pond. To compensate for the evaporation, seepage, and blowdown, the makeup taken from the Kankakee River averages 90.8 cfs. These figures are based on 100% load factor. Table 3.3-1 shows the seasonal variations of the water usage. 2

Under most circumstances, the two-unit Braidwood Station will be capable of operation at full load with cooling pond consumptive losses supplied by a net withdrawal rate no greater than 10% of the Kankakee River flow. During the simultaneous occurrence of abnormally adverse weather and low river flow, however, cooling pond consumptive demand at full load may exceed 10% of the river flow. In this instance, the net withdrawal from the river will be maintained at a level acceptable to the Illinois Department of Conservation with the remainder of the pond consumptive demand being satisfied by drawing down the level of the pond. Following a cessation of the adverse weather, or a reduction in system load demand enabling a reduction in plant power level, the net river withdrawal rate will be maintained at no greater than 10% until the normal pond level is restored.

3.3.2 Service Water Systems

Service water is used to cool plant and auxiliary equipment. There are two service water systems provided for the plant, the nonessential service water and the essential service water systems.

3.3.2.1 Nonessential Service Water System

The nonessential service water cools equipment that is not safety-related and not essential for the safe shutdown of the reactor. The water is taken from the circulating water system. After its use the nonessential service water returns to the cooling pond along with the condenser cooling water. The nonessential service water circulation rate is about 78 cfs per unit. Makeup and blowdown are sent to and taken from the cooling pond as was discussed in Subsection 3.3.1.

3.3.2.2 Essential Service Water System

The essential service water cools the equipment that is safety-related. The design provides for two identical, full-capacity systems for each unit. Each unit has two full-capacity pumps, each of which takes suction from a separate supply line. This system supplies water to the reactor containment fan coolers, the diesel generator coolers, the component cooling heat exchangers, and the other equipment necessary for the safe shutdown of the reactor. The total required circulation rate for the essential service water system is approximately 54 cfs per unit. A small cooling pond, which also serves as the ultimate heat sink, is located within the cooling pond to maintain a 30-day supply of water for the essential service water system. This pond, which will remain intact even if the larger pond fails, was formed by excavating an area of 93.5 acres to a depth of 6 feet below the existing grade. The bottom elevation is 584 feet MSL.

3.3.3 Potable Water Supply System

The plant potable water treating system provides water from the Kankakee River for sanitary purposes. The makeup water is pumped from the river into the freshwater holding pond which overflows into the cooling pond. The potable water is taken from this freshwater holding pond. Approximately 15,000 gallons per day are required for normal operation. The withdrawal of the water complies with the applicable federal, state, and local regulations. Further information on sanitary water and its disposal is contained in Section 3.7. 2

3.3.4 Makeup Demineralizer System

Surface water from either the Kankakee River or the cooling pond is used as raw water for demineralizer makeup. There are two identical demineralizer trains, each capable of producing the total daily requirements averaging 150 gpm. The details of the makeup water system are discussed in Subsection 3.6.3.

3.3.5 Seepage

The method of seepage control consists of a slurry cutoff trench made up of, depending on conditions, soil bentonite or cement bentonite around the entire perimeter of the exterior dike. The slurry trench was constructed to an impermeable layer below the dike, creating an impervious barrier to impede water flow. The material underneath the slurry trench has been tested both in the laboratory and field to determine its average permeability. The permeability value of the slurry trench back fill was determined from research, past case histories, and laboratory and field-determined values for the test section. Based on the measured and assumed values for permeability, the amount of total seepage was calculated using finite element techniques.

The following data were used in a computer program developed to determine seepage at a section considered to be representative of the pond dike:

a. geometry of the dike section and foundation;

b. maximum probable head;

c. material properties of the dike and foundation materials; and

d. boundary conditions related to the site conditions.

Based on these computations, the total water loss from the dike structure is less than 5 cfs.

The estimated rate of seepage is not sufficient to cause any significant effect on underground features. Based on an evaluation of coal mining records (see Subsection 2.5.1.9 of the Preliminary Safety Analysis Report), boring logs, and geological data, the existing underground mines as affected by the head imposed by the cooling pond have no significant detrimental effect on the groundwater regime.

Coal mining occurred in the Pennsylvanian bedrock and did not penetrate the underlying Maquoketa formation. The Pennsylvanian bedrock, which underlies about 50 feet of Quaternary drift, is about 150 feet thick in the area, and the mines are on the order of 125 feet deep or less. Underlying the Pennsylvanian rock (and possibly a thin Silurian dolomite), the Maquoketa shale is approximately 120 feet thick. The Maquoketa shale is an effective aquiclude or aquitard that confines and protects the underlying Cambrian-Ordovician aquifer.

The mines and mine shafts are located in the west and northwest part of the cooling pond. The mines beneath the pond are not directly connected to those to the west, and the vertical access shafts within the cooling pond area were sealed with compacted clay during the earthwork for the cooling pond. Since no fracture zones have been identified in the area and the permeability of the Maquoketa shale is low, the slightly increased groundwater velocity due to the head imposed by the cooling pond should have no significant effect.

The potential for dike failure is minimized by the detailed investigations of the underlying soil, the use of the slurry wall trench to preclude a failure, and the detailed inspections of the dike work during construction. The slurry wall trench extends into the till and acts as an impervious barrier to localized large scale seepage through soils underlying the dike. In addition, the dikes are designed as extremely stable structures and are protected against the effects of wave runup where appropriate. The potential for a dike failure is therefore considered negligible.

3.3.6 Variations in Plant Water Use

Variations in plant water consumption, for 100% operation, 50% operation, hot standby, and cold shutdown conditions are given in Table 3.3-2.

TABLE 3.3-1

AVERAGE SEASONAL VARIATIONS OF COOLING POND SYSTEM

(at 100% load factor)

	WINTER	SPRING	SUMMER	FALL	AVERAGE
Makeup (cfs)	76.6	92.0	105.2	89.3	90.8
Evaporation (cfs)	31.8	52.3	71.1	52.2	51.8
Seepage (cfs)	5	5	5	5	5
Rainfall (cfs)	6.2	11.3	11.7	8.0	9.3
Blowdown (cfs)	46	46	40.8	40.1	43.2
TDS of Blowdown (mg/liter)	750	899	1048	976	906

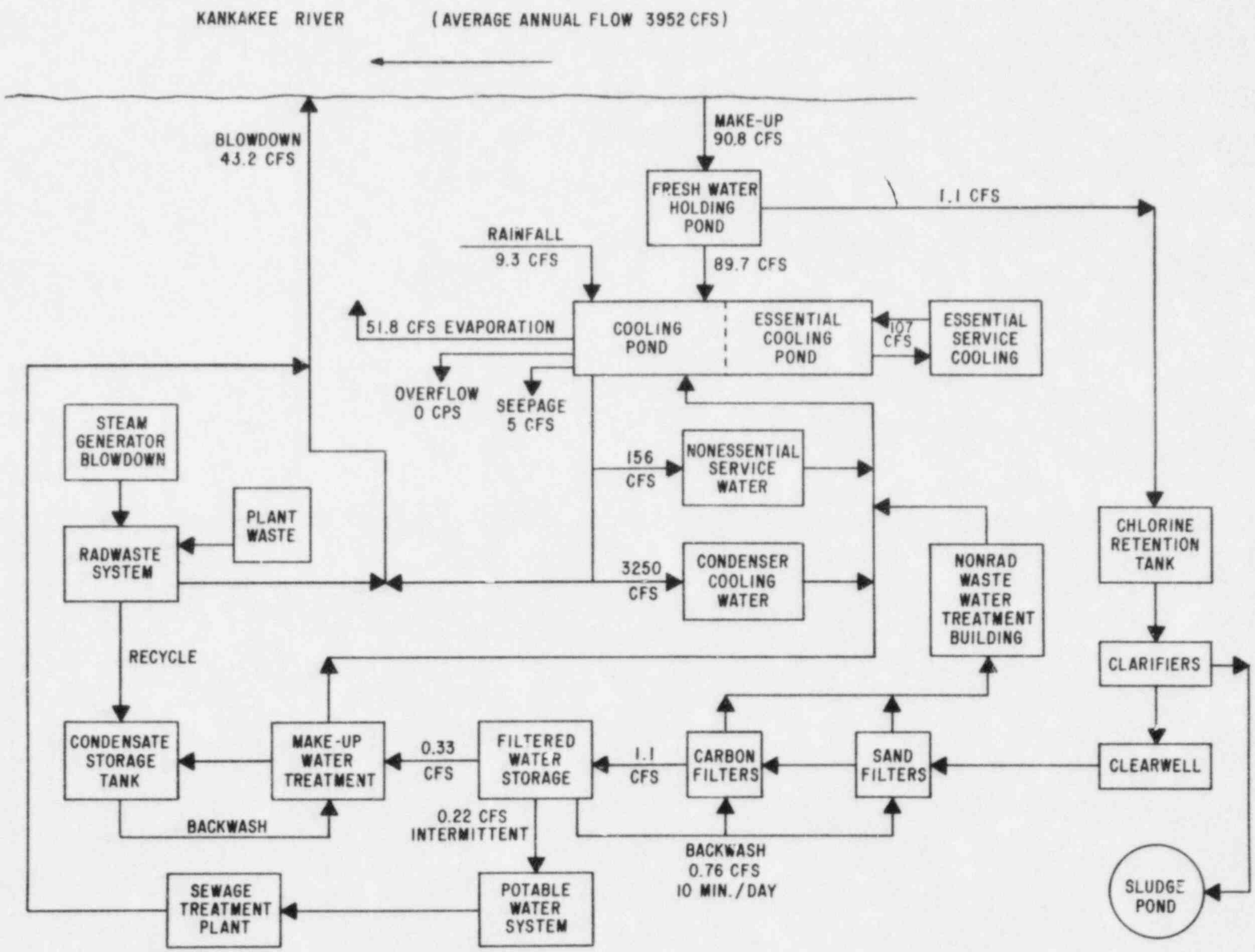

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FIGURE 3.3-1

WATER USAGE FLOW DIAGRAM

AMENDMENT 1
FEBRUARY 1983

AMENDMENT 2
JULY 1983

3.4 HEAT DISSIPATION SYSTEM

During the operation of the Braidwood Nuclear Generating Station - Units 1 & 2 (Braidwood Station), the condensers and other heat exchange equipment require cooling water. This water is taken from the cooling pond shown in Figure 3.4-1 and circulated through the various cooling equipment; the heated effluent is then returned to the cooling pond. This closed-cycle cooling pond serves as the heat sink to dissipate most of the waste heat to the atomosphere. This heat is dissipated by evaporation and by convective, reflective, and sensible heat transfer mechanisms.

The cooling pond has an overall area of about 3540 acres, with a water surface area of 2537 acres. Approximately 30% of the total pond area is occupied by islands. The maximum depth of the pond is about 15 feet, and it has an average depth of about 9 feet. Figure 3.4-1 indicates the general layout of the pond. | 1

Earthen dikes having a width of 14 feet at the top form the boundary of the pond. The top elevation and most of the dikes is 600 feet above mean sea level (MSL), 5 feet above the normal pond pool level of 595 feet MSL; the only exception, a portion of the dikes just south of the plant, has a top elevation of 602.5 feet MSL. Interior dikes have been included in the design of the Braidwood Pond in order to assure that the maximum utilization of the pond cooling surface is attained. With the interior dikes, the possibility of channeling or short circuiting of the warm water through portions of the pond is reduced to a minimum, and the cooling performance of the pond is improved. The layout of these internal dikes is shown in Figure 3.4-1. With the arrangement of the pond, no recirculation effects that would be detrimental to the performance of the pond are anticipated.

Channeling does occur in the Braidwood pond due to stagnant water in deep or side-arm regions, thus shortening the residence time of heated water in the pond. This channeling was considered in the pond performance analysis by using only the effective area and volume instead of total area and volume. The residence time for heated water in the pond is estimated at 2.9 days based on a volumetric efficiency of 83 percent. | 2

Significant vertical stratification of temperatures and velocities in the pond is expected to occur only in those regions that are deeper than the 10-foot depth of discharge.

The cooling pond is supplied with makeup water from the Kankakee River to compensate for losses due to evaporation, seepage, and blowdown. This makeup water is withdrawn from the river at an expected rate of 90.8 cubic feet per second (cfs) by means of a river intake structure illustrated in Figure 3.4-2. The intake structure operating floor is located at elevation 557 feet above mean sea level (MSL), which is above the 1975 flood (flood of record) elevation of 552 feet MSL. The average flow and 1-day low flow 2
of the Kankakee River at the intake are 3952 cfs and

487 cfs, and the corresponding water surface elevations are 538 and 534 feet MSL.

The intake structure houses three intake pumps; two pumps of 53.5 cfs capacity are used to supply water for normal operation and a third pump of the same capacity serves as a standby and is used for pond filling. The velocity at the river intake structure is between 0.32 and 0.48 feet per second (fps) based on two-unit operation.

At the river intake structure the water flows through bar grills and vertical traveling screens to remove debris from the intake water. The debris removed from the screens is disposed of off the site by an independent contractor.

The blowdown from the cooling pond is released to the Kankakee River from a discharge structure illustrated in Figure 3.4-3. Flow control is provided on the blowdown line so that flow may be terminated when both units are shut down or are being refueled. The location and orientation of the blowdown discharge and the river intake structures are shown in Figure 3.4-4. The orientation of the discharge is approximately perpendicular to the river shoreline. The river intake structure is approximately 2000 feet below the confluence of Horse Creek with the Kankakee River, and the discharge structure is about 500 feet below the intake structure. The discharge is returned to the river at a maximum velocity of 4.3 fps and at an increased temperature, which varies seasonally. Table 3.4-1 shows the median monthly temperatures for the blowdown with both units operating at 100% load factor. The predicted blowdown temperature ranges from 49° F in January to 88° F in July.

As a result of the discharge of the blowdown into the flowing Kankakee River, a thermal plume is established downstream whose detailed temperature profile depends on river conditions and the blowdown characteristics. A discussion of the extent and effect of this plume is in Section 5.1; a description of the model used to estimate these parameters is in Appendix 5.1A.

Three vertical dry pit circulating water pumps per unit draw water from the cooling pond through a pond screen house near the pumps (see Figure 3.4-5). At the pond screen house the water flows through bar grills and vertical traveling screens that remove debris from the intake water. The debris removed from the screens is disposed of off the site by an independent contractor. The water is pumped through a 16-foot diameter pipeline to the condensers, then through another 16-foot diameter pipeline to the discharge outfall structure and back into the pond. The Braidwood Station condenser cooling water requires a continuous flow of about 3250 cfs for the two units. This water is withdrawn from the cooling pond and returned there with a temperature rise of about 22° F. The total heat dissipated to the condenser cooling water is approximately 1.6×10^{10} Btu/hr for the two units.

Nonessential cooling water is withdrawn similarly from the cooling pond. Essential service water, at a flow rate of 108 cfs for two units, is cycled through an essential cooling pond that is contained within the larger cooling pond.

The temperature of the larger cooling pond varies depending on the distance from the point of the discharge of the heated effluent. As shown in Table 3.4-2, the evaporation from the pond varies between 30.9 cfs and 72.2 cfs with two units operating at 100% load factor. This evaporation includes both natural and forced evaporation. Rainfall to the pond compensates in part for the evaporation. The annual average precipitation is 35.1 inches (see Table 2.3-1). The monthly precipitation ranges between 13.1 and 0.03 inches per month with an average of 2.92 inches per month. This rainfall results in adding about 6.2 to 11.7 cfs of rain to the pond or an average of 9.3 cfs for the year. Since this pond is perched, the runoff to the pond is negligible.

The losses due to seepage are expected to be approximately 5 cfs. The blowdown necessary to maintain water chemistry is calculated using these evaporative and seepage losses and gains from rainfall. An average blowdown of about 43.2 cfs can maintain a total dissolved solids (TDS) level in the cooling pond of about 900 mg/liter. The TDS level varies depending on the river water quality and evaporation rate. The average overall water consumption from the Kankakee River, which is the difference between makeup and blowdown, is approximately 47.6 cfs. Studies have been done to determine any effect on pond water chemistry from leaching of substances from surface and subsurface soils (see Subsection 2.4.1.4.2 and Section 5.4). | 2

TABLE 3.4-1

ESTIMATED MONTHLY VARIATION IN DISCHARGE

TEMPERATURE COOLING POND BLOWDOWN

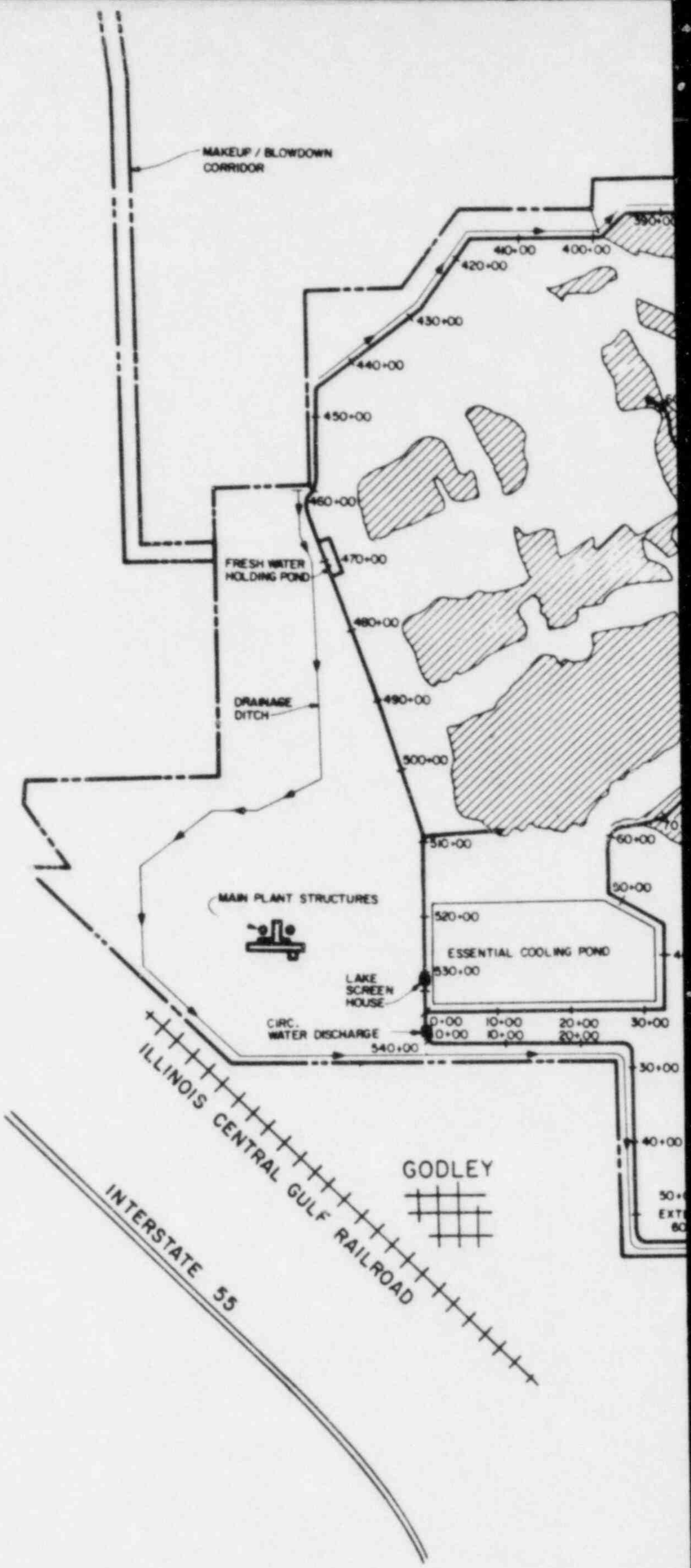
MONTH	DISCHARGE TEMPERATURE (°F)
Jan.	49
Feb.	52
Mar.	57
Apr.	66
May	77
June	85
July	88
Aug.	86
Sept.	80
Oct.	71
Nov.	59
Dec.	51

TABLE 3.4-2

BRAIDWOOD STATION COOLING POND EVAPORATION RATE

MONTH	POND EVAPORATION (cfs)		
	NATURAL	FORCED	TOTAL
Jan.	5.19	25.73	30.92
Feb.	4.51	28.95	33.46
Mar.	5.89	34.45	40.34
Apr.	11.67	40.36	52.03
May	19.29	45.19	64.46
June	23.41	48.79	72.20
July	22.72	49.22	71.94
Aug.	20.63	48.45	69.08
Sept.	17.62	45.45	63.07
Oct.	11.45	40.98	52.44
Nov.	6.94	34.19	41.13
Dec.	4.32	26.72	31.04

NOTE: Evaporation calculated on the basis of the following conditions:
Operating Condition = two 1120 MW nuclear units at 100% capacity
Circulating water rate = 3250 cfs
Condenser temperature rise = 22° F 2


MAKEUP / BLOWDOWN CORRIDOR
390+00
400+00
410+00
420+00
430+00
440+00
450+00
460+00
470+00
FRESH WATER HOLDING POND
480+00
DRAINAGE DITCH
490+00
500+00
510+00
60+00
50+00
MAIN PLANT STRUCTURES
520+00
ESSENTIAL COOLING POND
LAKE SCREEN HOUSE
530+00
CIRC. WATER DISCHARGE
0+00
10+00
20+00
30+00
540+00
40+00
ILLINOIS CENTRAL GULF RAILROAD
GODLEY
INTERSTATE 55

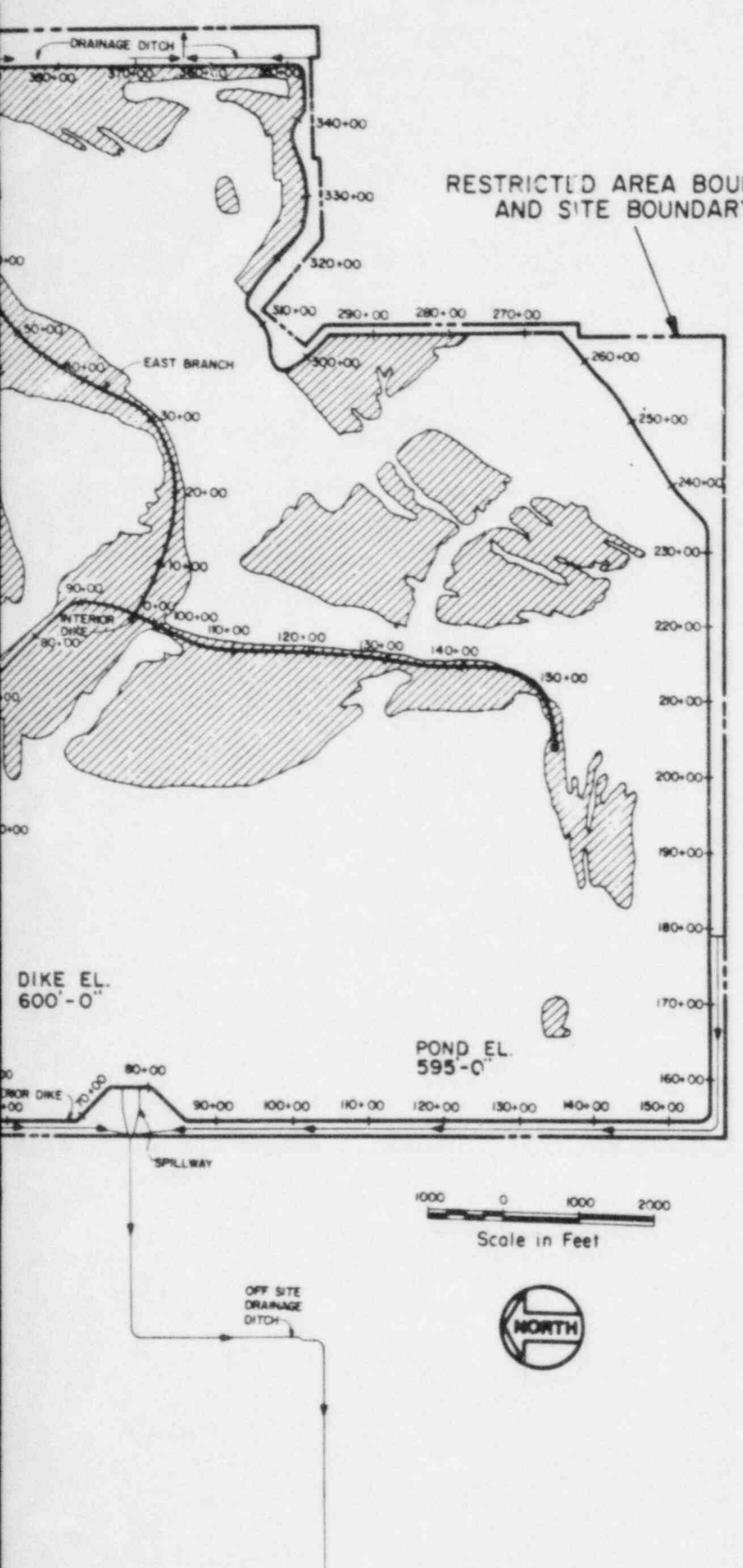


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FIGURE 3.4-1

GENERAL LAYOUT OF BRAIDWOOD
COOLING POND

blowdown demineralizers. These wastes are pumped to a 10,000 gallon tank for collection and sampling.

The recycle evaporator condensate demineralizer, which is shared by both units, is expected to be regenerated three times per calendar year, producing about 4,000 gallons of wastes per regeneration. The radwaste mixed-bed demineralizers which are shared by both units, are regenerated as often as required to maintain a decontamination factor of 10 for soluble ions. Each radwaste mixed bed demineralizer requires regeneration every 1 to 2 weeks depending on usage, and produces about 1800 gallons of waste per regeneration.

Expected source terms are given in Table 11.1-6 of the FSAR. 1 2

3.5.2.2.4 Turbine Building Floor Drains

The turbine building floor drains are shared by two units. The expected flow rates are an average of 4,200 gal/day, with a maximum of 12,000 gal/ day. The two turbine building floor drain tanks have a capacity of 12,000 gallons each. Turbine building floor drains, which are normally non-radioactive, may be released from the plant without treatment other than filtration after sampling. If sampling indicates that the wastes are not suitable for release, they will be processed through the radwaste evaporators and recycled. The expected source terms 2
are given in Table 11.1-6 of the FSAR.

3.5.2.2.5 Turbine Building Equipment Drains

The turbine building equipment drains are shared by both units. The expected flow rates are an average of 4,200 gal/ day, with a maximum of 12,000 gal/day. The two turbine building equipment drain tanks have a capacity of 12,000 gallons each.

After sampling, the turbine building equipment drains are normally processed through one of the blowdown mixed bed demineralizer and recycled.

Expected source terms are given in Table 11.1-6 of the FSAR. 2

3.5.2.2.6 Auxiliary Building Equipment Drains

The auxiliary building equipment drains collect an average 5,600 gal/day and a maximum of 16,000 gal/day. The expected

source terms are given in Table 11.1-6 of the FSAR. Since all equipment in the auxiliary building containing potentially radioactive liquid is periodically drained into this subsystem, the volume and activity on any given day varies according to the operations in progress, such as replacing filter elements, draining ion exchange vessels, and flushing and cleaning tanks and equipment. 2

These equipment drains are collected in two 8,000-gallon tanks, which are shared by both units. After sampling, the wastes are processed through filters and the radwaste evaporator.

3.5.2.2.7 Auxiliary Building Floor Drains

The auxiliary building floor drains collect an average of 5,600 gal/day and a maximum of 16,000 gal/day. The expected sources are given in Table 11.1-6 of the FSAR. These drains include pump baseplate drains in the auxiliary building, reactor coolant leakages, pump seal and stuffing box leakages, valve stem packing leakages, and other equipment overflows or spills. Inputs also include waste from operations such as washdown and equipment maintenance. These floor drains collect in two 8000-gallon tanks that are shared by both units. After sampling, the waste is filtered and evaporated.

3.5.2.2.8 Laundry Drains

Laundry wastes are collected directly from the laundry facilities of the two units. The expected average daily flow for this subsystem is 1400 gallons, with a maximum daily flow of 4000 gallons for both units. The expected activities are given in Table 11.1-6 of the FSAR. The laundry wastes are collected in one 4000-gallon tank and two 2000-gallon tanks. After sampling, the waste is filtered and evaporated. Because of potentially high carryover due to the detergent, the laundry waste will be processed separately from other wastes.

3.5.2.3 Liquid Radwaste Discharges

All liquid wastes to be released are analyzed for gross beta, gamma, and tritium activity in one of the five 20,000-gallon monitor tanks after thorough mixing by recirculation. The liquid is then pumped to the 30,000-gallon release tank where a sample is again analyzed for gross beta, gamma, and tritium activity. Based on this analysis, a discharge rate is determined so that, when mixed with circulating water blowdown, the water leaving the plant has a radioactivity level less than the applicable MPC as stated in 10 CFR 20. A key-locked switch may then be manually opened so that water can be discharged. The key for the valve lock is controlled by administrative procedures.

As a further backup, a radiation detector monitors the discharge line before the discharge is mixed with the cooling pond blowdown line. Upon detecting an abnormal level of radiation, a valve on the release tank line immediately ahead of the mixing point closes and an alarm signal is relayed to the control room. Records are maintained of all radioactive wastes discharged to the environs to verify that radioactive releases conform with the requirements of 10 CFR 20 and 10 CFR 50.

Liquid radwaste releases were calculated using the PWR-GALE computer program and the parameters listed in Table 3.5-5. Expected annual activity releases to the discharge canal are given in Table 3.5-3. The radiological impact of these releases is discussed in Section 5.2.

condensers. All radioactive noble gases entering the main condenser are assumed to be removed from the system by the SJAE. The SJAE exhaust exhausts through the plant vent. In the event of high radioiodine activity in the SJAE exhaust, off-gases are released through both HEPA filters and a charcoal filter system affording a DF of 10 for iodine.

3.5.3.4 Gaseous Releases

Releases of radionuclides in gaseous effluents were calculated using the PWR-GALE computer program and the parameters listed in Table 3.5-5. Expected annual releases of radioactive noble gases and particulates are given in Table 3.5-7. The radiological impact of these releases is discussed in Section 5.2.

3.5.3.5 Ventilation Stacks

Two ventilation stacks exhaust air emissions to the atmosphere. Each rectangular stack has inside dimensions of 13 feet 3-3/8 inches by 5 feet 0 inches. The stacks terminate 200 feet above grade at an elevation of 800 feet above sea level.

Each stack (one for each unit) handles the exhaust air from the following:

a. auxiliary building ventilation system exhaust;

b. solid radwaste ventilation system exhaust;

c. normal containment purge system exhaust; and

d. miscellaneous vents collected from various sources such as battery rooms, laboratory facilities, waste-gas decay tank vents, air ejector, and decontamination room.

The following is a list of the approximate ventilation exhaust rates through the vent stack.

a. auxiliary building ventilation exhaust air - 150,000 cfm;

b. solid radwaste ventilation system - 15,000 cfm;

c. normal containment purge system exhaust air - 40,000 cfm; and

d. miscellaneous vents collected from various sources such as battery rooms, laboratory facilities, waste-gas decay tank vents, air ejector, and decontamination room - 8,140 cfm.

Total air capacity exhausted through the exhaust vent is approximately 214,000 cfm, which corresponds to 2,800 ft/min face velocity.

Under all plant operating conditions, a radiation detector in the exhaust vent continuously monitors the radioactivity level of the exhaust air before its release to the atmosphere. At high radioactivity levels, this detector sounds an alarm in the main control room and alerts the operator to initiate corrective action.

Figure 3.5-3 depicts the general arrangement of the plant's roof and shows the location of the vent stacks.

3.5.4 Solid Radwaste System

3.5.4.1 Objectives and Design Basis

The Braidwood Station solid radwaste system is designed to receive, dewater, solidify with cement, seal in a 55-gallon drum, and temporarily store the following wastes: demineralizer bead resins, evaporator concentrates, and spent filter cartridges. The system also receives, compacts, and temporarily stores radioactive dry wastes produced during station operation and maintenance. Evaporator concentrates and dry active waste (DAW) residue can also be solidified by polymer after being processed by the volume reduction system. Closed-top 1
drums approved by the U.S. Department of Transportation (DOT) are used for packaging solidified wastes, and DOT approved open-top drums are used for packaging dry solid wastes. The expected annual weight, volume, and activity of solid radwaste shipped from the Braidwood Station appear in Table 3.5-8, which gives values both with and without the use of a volume reduc- 1
tion system. Packaged radioactive solid wastes are shipped off the site and buried in accordance with applicable Nuclear Regulatory Commission (NRC) and DOT reguations. The system is designed specifically for a 40-year service life, maximum reliability, minimum maintenance, and minimum exposure to station personnel and the general public. The expected solid radwaste system output is 5760 to 6910 drums per year if the volume reduction system is not operational and 900 to 940 drums if it 1
is.

3.5.4.2 System Description

Operation of the solid radwaste system is indicated in Figure 3.5-4 of the ER and Figure 11.4-7 of the FSAR. Table 11.4-1 of 1

the FSAR lists the process equipment and storage design capacities. A more detailed system description is given in the Braidwood Final Safety Analysis Report (FSAR) Subsections 11.4.2 and 11.4.3. The solid radwaste system is comprised of the following eight components: 1

a. drum preparation station,

b. decanting station,

c. drumming station,

d. drum handling equipment,

e. smear test and label station

f. dry waste compactor,

g. radwaste drum storage areas, and 1 2

h. control station.

Each is discussed separately in the following subsections.

3.5.4.2.1 <u>Drum Preparation Station</u>

This station consists of cement unloading, storing, feeding, weighing, and conveying equipment used to load 55-gallon drums. A mixing weight is added to the drum to ensure uniform mixing when the drum is tumbled. The unit is designed for dust-free operation, with an exhaust-air filter assembly attached to the side of the fixing material storage tank to capture dust generated within the tank.

3.5.4.2.2 <u>Decanting Station</u>

This station consists of a stainless steel decanting tank that receives spent resins, a progressive cavity decanting pump that removes excess liquid, a piston-type metering pump that transports accurate quantities of waste from the decanting tank to the drum, and all associated valves and instrumentation to provide remote manual operation of the unit. Processing equipment in contact with radioactive materials is located on the radioactive side of a thick machined-steel shield wall. Most drives, limit switches, and instrumentation are located on the low radiation side of the shield wall to minimize the dose to maintenance personnel.

3.5.4.2.3 Drumming Station

This station consists of a drum processing-unit and a heat-traced, pistontype metering pump. The pump transports accurate quantities of waste from the concentrated waste tank to the drum. The drum processing-unit is essentially a stainless steel box with an aircylinder actuated hatch in the top. The following remotely-performed operations occur within the drum processing-unit: cap removal, drum filling, cap reinsertion, tumbling of the drum for drum for mixing, and washing the exterior of the drum if required. Two separate fill nozzles are provided, one for spent resins and one for concentrated waste.

A scale and a radiation monitor provide drum weight and activity level readouts on the control console after removal from the drum processing-unit.

3.5.4.2.4 Drum Handling Equipment

This equipment includes three remotely operated cranes with television cameras for visual surveillance, two drum transfer cars, and a filter-cartridge transfer vehicle. The cranes are used to transport preloaded drums to the drumming station, remove and position drums on a scale, transport and position sealed drums in either high or low-level storage, and retrieve and transport them to trucks for offsite disposal. The drum transfer cars transport drums between the process units and the storage area. The filter cartridge transfer vehicle transports drums containing spent filter cartridges from the filter area to a place where the drums may be placed on the drum transfer car.

3.5.4.2.5 Smear Test and Label Station

This station consists of a motor-operated turntable setdown position for drums behind a small shield wall equipped with access plugs and working tools to accomplish remote labeling, smear testing, and radiation monitoring of all external surfaces of sealed drums before offsite disposal.

3.5.4.2.6 Dry Waste Compactor

The dry waste compactor compresses paper, fabrics, plastics, and other wastes into 55-gallon drums. A large-diameter, pneumatically-powered ram drives the platen down into the drum. During compaction, a safety shield encloses the loading areas

above the drum and protects the operator from debris that might escape. An air filtration assembly maintains control of contaminated particles during compactor operation. Radioactive dust is captured by means of a roughing filter and two HEPA filters operating in parallel. The filtration system is interconnected to the plant radioactive vent system. The radioactivity of most of the dry waste is low enough to permit manual handling.

3.5.4.2.7 Radwaste Drum Storage Areas 1 2

Shielded areas are provided for the storage of low-activity and intermediate-activity waste drums and of compacted dry-waste drums according to the requirements noted in Table 11.4-1 of the FSAR. Storage space is designed to accommodate approximately 20% of the normal yearly output of packaged waste (i.e., without VRS) or 1.3 years of output from the volume reduction system. 1 Visual surveillance for the low-activity and intermediate-activity waste storage areas is provided by the drum handling system television cameras. The intermediate-activity waste storage area capacity is sufficient to allow a decay of 60 days when used on a rotating basis.

3.5.4.2.8 Control Room 2

This room houses equipment for the remote visual monitoring and 1
control of the solid radwaste building system. A liquid/solid interface control panel is provided for transferring waste to the solid radwaste system from the liquid radwaste system.

3.5.4.3 Volume Reduction System 2

The major components of this system are a fluidized bed dryer, a dry waste processer, a gas-solids separator, a condenser, two scrubbers, and an air filtration unit. The system eliminates the water from the evaporator concentrates and reduces combustible material to ash. 1 The remaining salts and ash are solidified in polymer in 55 gallon drums using a specially designed drumming station. 2 The air exhausted from this system is passed through two HEPA and one charcoal filter before entering the auxiliary building filtered vent exhaust system.

3.5.4.4 Interconnections with Liquid Radwaste Systems 2

The solid radwaste system is interconnected with the liquid radwaste systems via the spent resin and concentrated waste system comprised of the following tanks:

a. concentrates holding tank, and

b. spent resin tank.

Tank capacities are given in Table 11.2-5 of the FSAR. 1

Spent resins are discharged to the decanting station, dewatered, and then routed to the drumming station for solidification. Concentrates are pumped from the concentrates holding tank directly to the drumming station.

3.5.4.5 Shipment 2

All wastes are shipped from the site by truck after solidification (compacting for dry compressible wastes). The empty drum storage area for shipping containers is shown on Figure 11.4-3 of the FSAR. 1

Intermediate-level wastes will be shipped with sufficient shielding to meet the regulation governing radioactive shipments.

3.5.5 Process and Effluent Monitoring

The release points described in Subsection 3.1.4 are monitored for potentially radioactive effluents in the following manner:

a. Continuous radiation monitoring of gaseous effluents is provided for each of the two auxiliary building vent stacks. No automatic control action occurs at high radioactivity levels, but alarms alert operating personnel to take corrective action.

b. Potential radioactive release to the circulating water blowdown line is continuously monitored at the injection point from the radwaste system release tank into the blowdown line. If high radioactivity-level setpoints are reached, the monitor automatically closes the release pump discharge valve.

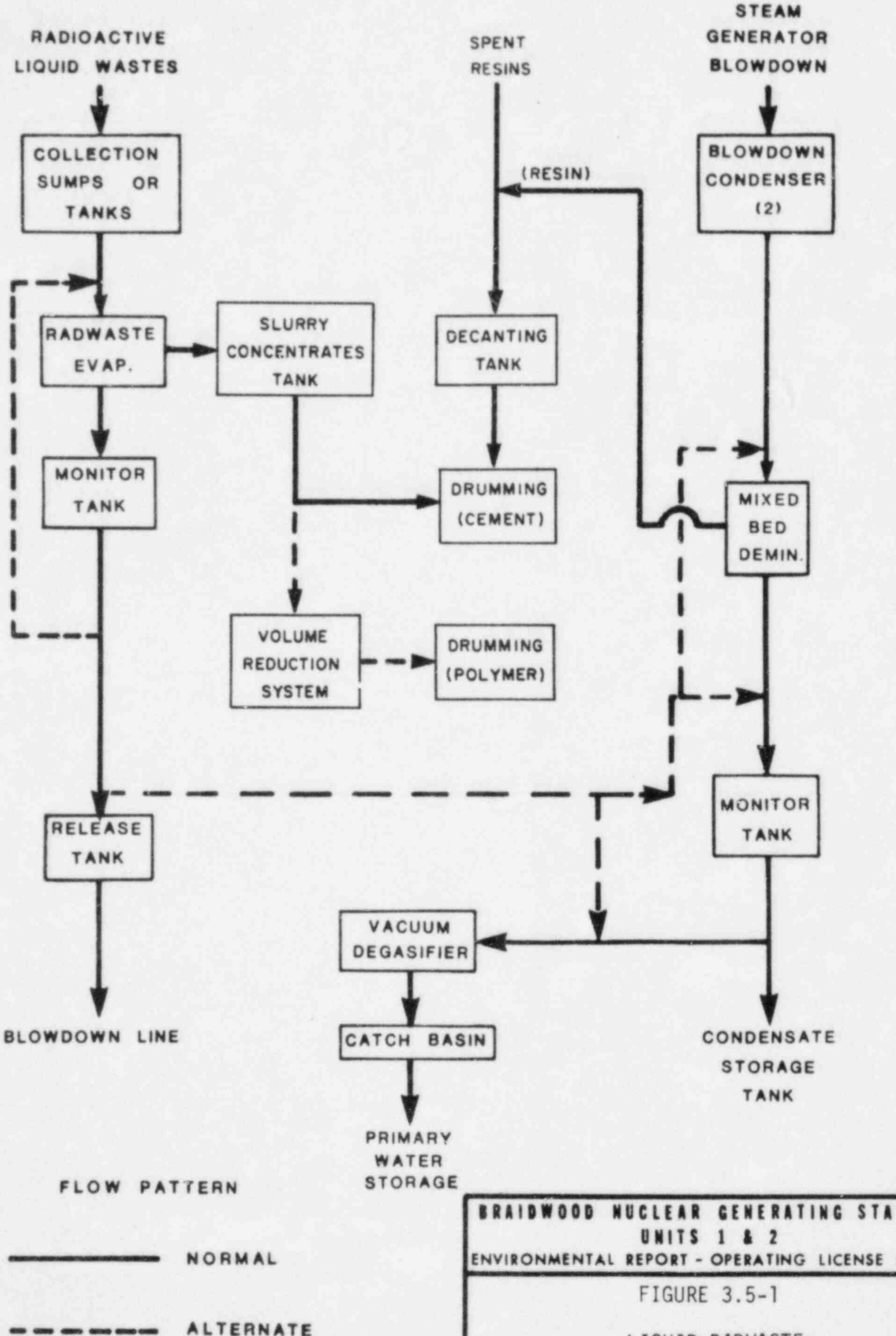
A detailed description of process and effluent radiation monitors is presented in Section 11.5 of the Braidwood Station FSAR.

TABLE 3.5-1

PARAMETERS USED IN THE CALCULATION OF THE INVENTORY OF RADIONUCLIDES IN THE SECONDARY COOLANT

PARAMETER	VALUE
Steam flow rate per steam generator	3.79×10^6 lb/hr
Number of condensate polishers used	none
Mass of water in four steam generators	3.82×10^5 lb
Primary water isotope activities	(see Table 3.5-1)
Carry-over factor from water to steam	
noble gases	1.0
iodines	0.01
all other isotopes	0.001
Primary to secondary leak rate	
design basis	1 gpm for 14 days
expected normal	110 lb/day
Blowdown flow rate	
design basis	135 gpm per unit
expected normal	20 to 60 gpm per unit

AMENDMENT 1 AMENDMENT 2
FEBRUARY 1983 JULY 1983



BRAIDWOOD NUCLEAR GENERATING STATION
UNITS 1 & 2
ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

FIGURE 3.5-1

LIQUID RADWASTE FLOW DIAGRAM

reduce airborne concentration of this isotope to approximately 1×10^{-10} Ci/cm^3. The containment internal recirculation system will operate approximately 18 hours before purging. The containment is purged at a rate of 40,000 cfm before the admission of workers for refueling, maintenance, or repair of equipment. The design purge frequency is 10 purges/year per unit. The expected purge frequency is approximately 6 purges/year per unit. The containment is purged continuously, however, at a rate of 3000 cfm.

3.5A.7 SOLID WASTE PROCESSING SYSTEMS

Request:

1. In tabular form, provide the following information concerning all inputs to the solid waste processing system: source, volume (ft^3/yr per reactor), and activity (Ci/yr per reactor) of principal radionuclides, along with bases for valves used.

Response:

Information concerning inputs to the solid waste processing system are given in Table 3.5-8.

Request:

2. Provide information on onsite storage provisions (location and capacity) and expected onsite storage times for all solid wastes prior to shipment.

Response:

Solid wastes will be stored in the Radwaste Building before shipment (see B/B FSAR Figure 11.4-3). Storage space is designed to accommodate approximately 25% of the normal yearly output of packaged waste. This amount was selected to allow for some decay of drummed material, startups, trucking strikes, unavailability of burial sites, and other contingencies. Information on the solid waste storage area is given in the following list. For other information refer to Section 11.4 of the B/B FSAR.

Storage Area	Number of Storage Areas	Design Capacity Per Storage Area	
Low Level	1	500 drums	2
Intermediate level	1	640 drums	
Dry compacted waste	1	70 drums	1
Dry uncompacted waste	1	90 ft^3	
Empty drum	2	100 drums (total)	1

Request:

3. Provide piping and instrumentation diagrams (P&IDs) for the solid radwaste system.

Response:

The P&ID drawings of the solid radwaste system are shown on B/B FSAR Figures 11.4-5 and 11.4-6. 1

3.6 CHEMICAL AND BIOCIDE SYSTEMS

The source of water for the Braidwood Nuclear Generating Station - Units 1 & 2 (Braidwood Station) is the Kankakee River, which supplies water for the initial pond filling and for the pond makeup water. Table 3.6-1 shows the expected seasonal composition of the river water. The flow path and ultimate disposition of the plant's various water systems are shown in Figure 3.3-1. Tables 3.6-2 and 3.6-3 list the average and maximum chemical compositions of the discharge to the Kankakee River, which is made up of the following major components: cooling pond blowdown, sewage treatment plant effluent, and wastewater treatment systems effluent.

3.6.1 Cooling Water Systems

3.6.1.1. Circulating Water System

As discussed in Subsection 3.3.1, each steam turbine unit has a closed-cycle, once-through cooling water system to remove the heat released during condensation of the turbine exhaust steam.

The dissolved solids content of the water in the cooling pond is maintained at the level necessary for operation such that the blowdown meets the applicable State of Illinois water quality standards. Table 3.6-2 lists the expected chemical composition of the blowdown, which is controlled to limit the average total dissolved solids (TDS) to 900 mg/liter. The blowdown contains the same chemical constituents as the river, but in higher concentrations due to evaporation. Chemical analysis of the blowdown may vary depending on the seasonal variations in the concentration of dissolved solids in the Kankakee River water.

Scale buildup in the main condensers is controlled by carbon dioxide (CO_2) feed to the circulating water. Carbon dioxide is injected into the plant intake water forming carbonic acid (H_2CO_3) before it is sucked through the circulating and service water pumps. The location of the diffusers allows maximum mixing before the treated stream reaches the pumps and ensures even acid distribution between the pumps. The total average carbon dioxide feed rate is 3500 lbs. per hour. 2

Biological growth and slime buildup in the main condensers are controlled through the use of mechanical cleaning, which greatly reduces the quantity of hypochlorite needed in the plant. The Amertap system at the Braidwood Station uses two

types of small, sponge-rubber balls sized to the inside diameter of the condenser tubes, a plain, sponge-rubber ball and a similar ball with an abrasive band bonded to it. During operation, these balls are injected into the circulating water piping at the inlet to the condenser. The balls, with a submerged density nearly equal to the density of water, are dispersed in the circulating water stream and forced through the condenser tubes by the pressure of the flowing water. As the balls pass through the tubes, they wipe them clean. A system of baffles and screens in the

| 2

circulating piping at the outlet of the condenser collects the balls as they flow out of the condenser. The balls are removed from the circulating water stream and reinjected at the condenser inlet or stored for later use.

It is also necessary to add small amounts of chlorine derivatives to the circulating water system to control algal growth. Hypochlorite is injected intermittently into the circulating-water line before the main condensers but after the blowdown take-off point. The chlorine dosage is controlled to satisfy the chlorine demand of the cooling water and provide a free residual chlorine concentration of 0.1 ppm. Since the free residual chlorine is dissipated in the cooling pond, the blowdown from the circulating water system has no chlorine residual.

3.6.1.2 Service Water System

Service water is used to cool plant and auxiliary equipment. The service water is taken from the circulating cooling water system, pumped through the power plant equipment, and then returned to the cooling pond.

The service water is hypochlorinated to prevent biological growth in the cooling equipment. The hypochlorination method requires controlled addition of hypochlorite solution three times a day for half-hour periods. The service water is chlorinated with a 15% solution of sodium hypochlorite (NaOCl). The essential and nonessential service water systems of each unit are chlorinated separately. Each day an average of 1840 pounds of 15% NaOCl is added to the nonessential service water, and an average of 1275 pounds of 15% NaOCl is added to the essential service water.

When sodium hypochlorite is added to water the following reactions occur:

$$NaOCl + H_2O \longrightarrow HOCl + NaOH \qquad (3.6\text{-}1)$$

$$HOCl \longrightarrow H^+ + OCl^- \qquad (3.6\text{-}2)$$

The rate at which hypochlorous acid and hypochlorite ion are formed varies depending on the pH; the two are present in approximately equal concentrations at pH 7.5. The hypochlorous acid is the active disinfectant compound formed. This compound kills bacteria by reacting with their enzymatic systems. As the reactions with HOCl and the enzymes proceed, the residual chlorine is dissipated.

The presence of ammonia in the water leads to the rapid formation of chloramines. The reactions are as follows:

$$NH_3 + HOCl \longrightarrow NH_2Cl + H_2O \qquad (3.6\text{-}3)$$

$$NH_2Cl + HOCl \longrightarrow NHCl_2 + H_2O \qquad (3.6\text{-}4)$$

$$NHCl_2 + HOCl \longrightarrow NCl_3 + H_2O \qquad (3.6\text{-}5)$$

The formation of monochloramines (Equation 3.6-3) takes precedence over that of di- and trichloramines and is generally instantaneous. The chloramines formed are present as monochloramines due to the small ratio of HOCl to NH_3. The chlorine in chloramines still retains about half of its oxidizing potential and is still effective as a bactericide. The reaction rate of chloramines, however, is lower than that of HOCl.

The small concentrations of chloramines formed and the residual chlorine present are not expected to persist in the water for three reasons. First, the circulating water contains bacteria that assimilate the residual chlorine and chloramines of the nonessential service water. The residual chlorine and chloramines of the essential service water are assimilated when combined with the blowdown from the essential cooling pond, which will still contain bacteria. Second, part of the volatile chloramines are lost due to evaporation. Third, while retaining their oxidizing potential, HOCl and chloramines react with and are destroyed by reducing agents like S=, F++, and Mn++, as shown in the following equations:

$$H_2S + 4HOCl \longrightarrow H_2SO_4 + 4HCl \quad (3.6\text{-}6)$$

$$2Fe(HCO_3)_2 + HOCl + HCl + Ca(HCO_3)_2 \longrightarrow 2Fe(OH)_3 + CaCl_2 + 6CO_2 + H_2O \quad (3.6\text{-}7)$$

$$MnSO_4 + HOCl + HCl + 4NaOH \longrightarrow MnO_2 + 2NaCl + Na_2SO_4 + 3H_2O \quad (3.6\text{-}8)$$

Since there is no accurate way to predict the chlorine demand of the pond, the exact quantity of NaOCl used is impossible to predict. The feed rate is carefully monitored. The service water, which may have a small residual chlorine content after chlorination, is returned to the cooling pond. Since the condenser cooling water is chlorinated after the blowdown take-off point, chlorine concentration at the point of blowdown discharge is negligible.

3.6.2 Makeup Water Treatment System

Surface water from the freshwater holding pond is used to sup- 2
ply the makeup water required for the steam cycle. As shown in Figure 3.3-1, the water is passed through a chlorine retention tank, clarifiers, and a clear well. From there the water passes through three parallel sand filters. Each filter operates at 3.0 gpm/ft^2 during normal operation and a maximum of 4.5 gpm/ft^2 when one filter is out of service. After each use, each filter is backwashed for 5 to 10 minutes, using 1000 gpm of filtered water for each filter. The filtered water is stored in a 150,000 gallon tank.

Three filtered-water transfer pumps (one a spare) supply water to the demineralizer trains for treatment. There are two identical demineralizer trains, each capable of producing a net daily average of 150 gpm. Each train consists of, in order, a primary, strong-acid cation unit, a secondary, strong-acid cation unit, a weak-base anion unit, a strong-base anion unit, and a mixed bed unit. After treatment, the water goes to the condensate storage tank or primary storage tank.

3.6.2.1 Regeneration Wastes

After a quantity of water has been processed through the demineralizer train, the ion exchange resin is exhausted and needs chemical regeneration. Regeneration of the exhausted resins may take place once each day. During regeneration, which lasts about 4 hours, the only chemicals added are sulfuric acid (H_2SO_4) and sodium hydroxide (NaOH). Each regeneration require 2240 pounds of 93% H_2SO_4 and 792 pounds of 100% NaOH for regeneration and neutralization. The 70,095 gallons of waste produced during each regeneration are routed into the circulating water flow.

3.6.2.2 Filter Backwash Effluent

The makeup filter subsystem consists of three parallel sand filters and carbon filters. Each filter is backwashed once each day with water from the filtered water storage tank. The backwash water contains dissolved solids and suspended solids that are collected during the filtering process. The sand filters are backwashed each day for a 10-minute period at a rate of 1.9 cubic feet per second (cfs), and the carbon filters are backwashed each day for a 10-minute period at a rate of 0.76 cfs. The discharge from this backwashing operation is routed to the waste treatment building.

3.6.3 Waste Treatment

Treatment consists of an oil separator, an agitated equalization basin, chemical addition, a Quadricell separator, and 2
filtration, after which the clean water effluent is routed to the circulating water system. 1

The oil separator is equipped with skimmers to remove oil. The skimmed oil flows to a waste oil holding tank. The waste oil is disposed of, as necessary, by a licensed contractor in an approved manner.

Sludge from the Quadricell is pumped by sludge transfer pumps to sludge drying beds. Underflow from the beds is pumped by underflow pumps to the equalization tank. The dried sludge is scraped off and hauled away by a licensed contractor for disposal in a certified landfill site. 1

3.6.4 Potable Water System

The volume of water used for potable and sanitary purposes is small (about 15,000 gallons per day [gpd]) in comparison with other plant uses. Water is taken from the filtered water storage tank. The water is chlorinated with hypochlorite, which is fed at a rate proportional to the flow rate. The chlorinated water is then stored for potable and sanitary use.

All sanitary wastes are treated in a sewage treatment system of approved design (for further details see Section 3.7). The discharge from the sewage treatment plant is continuously chlorinated, as indicated in Section 3.7, and is discharged with the cooling pond blowdown. The chlorine dosage is usually 3 to 10 mg/liter. This dose results in a free residual chlorine concentration of about 0.5 ppm. After mixing with the cooling pond blowdown, the chlorine concentration is negligible.

3.6.5 Radwaste System

The discharge from the radwaste system is high-purity distilled water. The radwaste plant receives and decontaminates wastes that result from the operation of the nuclear reactors. After the necessary decontamination, the liquid effluents are batch discharged to the cooling pond blowdown. Section 3.5 discusses the radwaste system in detail.

Table 3.6-2 shows the estimated effluent analysis, and Table 3.6-3 the average analysis, of the final discharge, which in both cases meets all State of Illinois effluent standards.

TABLE 3.6-1

SEASONAL ANALYSIS OF KANKAKEE RIVER WATER

(All Values in mg/liter)

	WINTER	SPRING	SUMMER	FALL	AVERAGE	MAXIMUM
Calcium	71.9	78.7	81.8	77.8	77.6	118
Magnesium	23.9	21.3	24.8	24.0	23.5	31.0
Sodium	16.4	7.2	13.8	14.7	13.0	25.6
Alkalinity (As $CaCO_3$)	178	140	159	202	170	235
Sulfate	62.4	60.4	45.7	93.9	65.6	164
Chloride[a]	23.0	22.5	21.0	21.5	22.0	25
Nitrate	1.7	4.5	2.2	C.9	2.3	6.2
Silica	2.3	3.1	4.2	3.2	3.2	5.3
Filterable Residue	381	361	397	411	388	489

1

Note: pH average 8.2, range 7.0 to 9.0

Samples taken at Location 3, Intake Area

Sources: Illinois Natural History Survey 1977-1979, 1981

[a] Commonwealth Edison 1977-1978

TABLE 3.6-2

ESTIMATES OF AVERAGE EFFLUENT ANALYSIS

(All Values in mg/liter)

	POND BLOWDOWN	DISCHARGE TO RIVER
Calcium	100	100
Magnesium	50	50
Sodium	26	26
Alkalinity (as $CaCO_3$)	120	120
Sulfate	273	273
Chloride	44	44
Nitrate	5	5
Silica	6	6
Total Dissolved Solids	900	900
Phosphate (as PO_4)	1.1	1.2

2

TABLE 3.6-3

ESTIMATES OF MAXIMUM EFFLUENT WATER COMPOSITION

(All Values in mg/liter)

	POND BLOWDOWN[a]	DISCHARGE TO RIVER[b]
Calcium	120	120
Magnesium	70	70
Sodium	33	33
Alkalinity (as $CaCO_3$)	160	160
Sulfate	360	360
Chloride	46	46
Nitrate	9	9
Silica	8	8
Total Dissolved Solids	980	980
Phosphate (as PO_4)	1.7	2.2

2

[a] Highest of the four seasonal average river analyses were used (see Table 3.6-1).

[b] In this analysis, the radwaste and sanitary waste discharges to the blowdown were negligible.

3.7 SANITARY AND OTHER WASTE SYSTEMS

3.7.1 Sanitary Wastes

The sanitary wastes from the Braidwood Nuclear Generating Station - Units 1 & 2 (Braidwood Station) are collected by a sewer system and discharged into a packaged sewage treatment plant located at the station. The treatment plant is designed to handle a maximum of 15,000 gallons per day. The treated effluent is combined with the cooling pond blowdown and discharged to the Kankakee River. The effluent contains a residual of up to 1 mg/liter free chlorine, and after mixing with the cooling pond blowdown, the residual chlorine content is negligible. Water from onsite wells is used for the sanitary system during construction. During station operation, water from the Kankakee River will be used for the sanitary system.

The sewage treatment unit for permanent plant service operates as an extended aeration system for 553 operating personnel at approximately 25 gallons per person per day. The effluent from the unit is given tertiary treatment (consisting of filtration and recirculation in a packaged unit) and then is chlorinated before discharge. During construction, factory-installed modifications allowed the package unit to operate as a contact stabilization system designed for 1,500 construction personnel at 15 gallons per person per day, or a total of 22,500 gallons for the 8-hour work day. 2

The environmental effect of the treated sewage is discussed in Sections 4.1 and 5.5.

3.7.2 Other Waste Systems

The station maintains four diesel generators to provide emergency electrical power during a loss of offsite power. The station also has two diesel-driven auxiliary feedwater pumps, one miscellaneous equipment diesel, and one diesel-driven fire pump. These engines exhaust directly to the atmosphere through muffler systems. The use of these systems other than for routine testing is not anticipated during normal operation.

Two No. 2 fuel oil-fired auxiliary steam boilers, each rated at about 75 x 10^6 Btu, are used to supply steam for initial plant startup and for those infrequent occasions when both nuclear units are shut down. These boilers are supplied with low-sulfur distillate oil to meet Illinois state emission standards for control of gaseous sulfur dioxide emissions. When firing distillate oil, these standards limit SO_2 emission to 0.3 lb per million Btu heat input. In addition, the oil used has a low ash content so that the emission of particulate matter from the stack is within the Illinois state emission standard of 0.1 lb per million Btu heat input. The emission standard on the visual scale is 30% opacity, which is achieved when firing the low-ash distillate oil. Table 3.7-1 lists the state emission standards

for new distillate oil-fired units of less than 250×10^{6} Btu. These are the only standards currently applicable to the auxiliary steam boilers.

During normal operation, one boiler is expected to operate an average of about 2 weeks per year at 80% capacity.

Trash from the plant is disposed of offsite by an independent contractor. Laundry wastes and wastes from chemical laboratory drains are processed through the radwaste system, which is described in Section 3.5. Solid, nonradioactive chemical wastes are disposed of offsite by an independent contractor.

CHAPTER 4.0 - ENVIRONMENTAL EFFECTS OF SITE PREPARATION, STATION CONSTRUCTION, AND TRANSMISSION FACILITIES CONSTRUCTION

4.1 SITE PREPARATION AND PLANT CONSTRUCTION

4.1.1 Construction Schedule

A Nuclear Regulatory Commission (NRC) construction permit for the Braidwood Nuclear Generating Station - Units 1 and 2 (Braidwood Station) was issued on December 31, 1975. As of April 1, 1983, 51% of the estimated $3.1 billion project cost had been expended. Completion dates for Units 1 and 2 have been set for October 1985 and October 1986, respectively. The specific conditions for environmental protection attached to the contruction permits are listed in Section 4.5. 1 2

The effects of site preparation and construction activities on land and water use are described in the following subsections.

4.1.2 Land Use

In the development of the 4454 acre Braidwood Station site, 130 acres are affected for actual plant building activities, including 35 acres of woods and 70 acres of cultivated fields that will be changed during the life of the station from current use. There are also 25 acres of fallow fields within the station construction area. After building construction is completed, 20 acres will be occupied by permanent physical structures (Edmonds 1974). 1

The exclusion area around the station and switchyards includes approximately 300 acres, of which 120 acres are wooded. Approximately 35 acres of open woodland will be cleared for construction. The other 85 acres will remain standing. This limited clearing will maintain the availability of biotic cover in the Braidwood Station site area (Edmonds 1974).

Aerial photographic measurements conducted by Westinghouse Environmental Systems Department (WESD) during initial site surveys indicated that the proposed cooling pond will encompass 3540 acres, and construction will affect 704 acres of cultivated land, 301 acres of fallow-field vegetation, 222 acres of woods and 2313 acres of strip-mine spoil. Subsequent Commonwealth Edison Company (CECo) projections indicate that after the completion of mining in the area, the affected pond area is expected to comprise 2838 acres of strip-mine spoil, 204 acres of fallow fields, 117 acres of woods, and 381 acres of agricultural fields. Approximately 784 acres within the site will not be affected by station construction (Edmonds, 1974). 1

Additional exposure pathways include direct exposure from contaminated ground and vegetation and exposure from ingestion of contaminated vegetables and meats.

The gaseous effluent concentrations were calculated for each 22.5^{0} sector within 50 miles of the Braidwood Station based on 3 years of meteorological data gathered at the site. Resultant skin, thyroid, inhalation, and whole-body dose rates were calculated for the predicted population in each sector for the year 2000 and for the hypothetical individual exposed continuously to the gaseous effluents at the site boundary where minimum effluent dilution has occured. The inhalation dose to such a "maximum" individual was also calculated. The resultant exposure rates are conservative estimates since occupancy factors and the shielding afforded by structures such as houses were ignored.

5.2.1.2.2 Aquatic Pathways

The aquatic pathways of radiation exposure to persons will be essentially the same as those described for biota other than man in Subsection 5.2.1.1.2. The two important exposure pathways for persons are the following:

a. internal exposure from ingestion of water or contaminated food chain components; and

b. external exposure from the surface of contaminated water or sediment.

There are no municipal water intakes or public drinking water intakes within 50 miles downstream from the Braidwood Station. 2
The nearest downstream municipal water intake is located at the city of Peoria, 115 miles below the Braidwood Station on the Illinois River. 2

Recreational uses of the Kankakee River include fishing and boating, but little swimming other than that associated with water skiing (see Subsection 2.1.2.3). Public exposure to radioactivity in the Kankakee River during fishing and boating activities would therefore be generally restricted to the extremely small amount of radiation escaping from the river surface. Activities such as swimming or water skiing would be expected to result in slightly higher, although still insignificant, radiation doses.

Commercial fishing is illegal on the Kankakee River, and there is very little commercial fishing within 50 miles downstream from the site.

Since there is no known use of the Kankakee River for irrigating crops within 50 miles of the discharge, the only pathways for radiation exposure of the public through the aquatic food chain is by the consumption of fish caught by sport fishermen in the general vicinity of the blowdown discharge and through the drinking water consumed by the small number of employees at the Illinois Nitrogen Company.

External dose rates were estimated for an individual boating or swimming at the discharge point. The exposure rate from contaminated shoreline sediments was also calculated. A drinking-water dose was estimated, although consumption of water near the discharge is not anticipated. Evaluation of each pathway was based on maximized conditions; no credit was taken for dilution of the effluents by mixing in the river. All interactions were assumed to occur with the radionuclide concentrations that will occur at the point of discharge.

5.2.2 Radioactivity in Environment

This subsection describes quantitatively the distribution in the environment of the small releases of radioactivity from the Braidwood Station. These releases are included in the liquid and gaseous effluents discharged from the station.

5.2.2.1 Surface Water Models

The models used to predict the fate of radionuclides released into surface waters estimated the physical effects using conservative assumptions.

The radionuclides released in the blowdown from the Braidwood Station cooling pond will be rapidly diluted in the Kankakee River. The average annual blowdown rate is 43.2 cubic feet per second (cfs) compared with the average annual river flow rate of 3952 cfs. | 2

Dilution of station effluents by ambient river water occurs immediately after release of blowdown to the river. A dilution factor of 90 times for the blowdown was calculated from the average | 2 yearly river flow. Also, a reduction in radionuclide concentrations will occur due to radioactive decay between the time of effluent release and the time of exposure; however, credit for this reduction in concentration was not taken in the calculation of doses in order to obtain the most conservative dose estimate.

The concentration of isotopes in the Kankakee River and the bioaccumulation factors for fish, crustaceans, mollusks, and aquatic plants are listed in Table 5.2-1. The radionuclide

estimated dose from gaseous effluents for the year 2000 population within a 50-mile radius of the site appears in Table 5.2-10. This table shows whole-body, skin, and thyroid doses resulting from exposure from immersion, inhalation, and ground deposition.

The population dose caused by direct radiation to all individuals living within a 50-mile radius of the Braidwood Station was also calculated using population data projected for the year 2000; it is given in Table 5.2-11.

The population dose resulting from natural background radiation to all individuals living within a 50-mile radius of the Braidwood Station is given in Table 5.2-11. This dose was calculated assuming a dose to individuals of 135 mrem/yr and was based on population data projected for the year 2000.

5.2.5 Summary of Annual Radiation Doses

The estimated radiation doses to the regional population from all station-related sources are summarized in Table 5.2-11.

TABLE 5.2-1

CONCENTRATION OF RADIONUCLIDES IN THE DISCHARGE AND THE CORRESPONDING BIOACCUMULATION FACTORS

ISOTOPE	RELEASED ACTIVITY[a] (Ci/yr)	CONCENTRATION AT DISCHARGE POINT[a] (pCi/liter)	AQUATIC BIOACCUMULATION FACTORS			
			FISH	CRUSTACEAN	MOLLUSK	ALGAE
H-3	3.0×10^{2}	1.6×10^{4}	9.0×10^{-1}	9.0×10^{-1}	9.0×10^{-1}	9.0×10^{-1}
Cr-51	6.2×10^{-5}	3.3×10^{-3}	2.0×10^{1}	2.0×10^{3}	2.0×10^{3}	4.0×10^{3}
Mn-54	1.0×10^{-3}	5.4×10^{-2}	4.0×10^{2}	9.0×10^{4}	9.0×10^{4}	1.0×10^{4}
Fe-55	5.4×10^{-5}	2.9×10^{-3}	1.0×10^{2}	3.2×10^{3}	3.2×10^{3}	1.0×10^{3}
Fe-59	3.5×10^{-5}	1.9×10^{-3}	1.0×10^{2}	3.2×10^{3}	3.2×10^{3}	1.0×10^{3}
Co-58	4.5×10^{-3}	2.4×10^{-1}	5.0×10^{1}	2.0×10^{2}	2.0×10^{2}	2.0×10^{2}
Co-60	8.8×10^{-3}	4.8×10^{-1}	5.0×10^{1}	2.0×10^{2}	2.0×10^{2}	2.0×10^{2}
Br-83+d	1.8×10^{-5}	9.7×10^{-4}	4.2×10^{2}	3.3×10^{2}	3.3×10^{2}	5.0×10^{2}
Rb-86	4.7×10^{-5}	2.5×10^{-3}	2.0×10^{3}	1.0×10^{3}	1.0×10^{3}	1.0×10^{3}
Sr-89	1.3×10^{-5}	7.0×10^{-4}	3.0×10^{1}	1.0×10^{2}	1.0×10^{2}	5.0×10^{2}
Mo-99+d	2.0×10^{-3}	1.1×10^{-1}	1.0×10^{1}	1.0×10^{1}	1.0×10^{1}	1.0×10^{3}
Mo-99d	2.0×10^{-3}	1.1×10^{-1}	1.0×10^{1}	1.0×10^{1}	1.0×10^{1}	1.0×10^{3}
Tc-99m	2.3×10^{-3}	1.2×10^{-1}	1.5×10^{0}	5.0×10^{0}	5.0×10^{0}	4.0×10^{1}
Te-127	1.4×10^{-5}	7.6×10^{-4}	4.0×10^{2}	7.5×10^{1}	7.5×10^{1}	1.0×10^{2}
Te-129m+d	4.6×10^{-5}	2.5×10^{-3}	4.0×10^{2}	7.5×10^{1}	7.5×10^{1}	1.0×10^{2}
Te-129	3.0×10^{-5}	1.6×10^{-3}	4.0×10^{2}	7.5×10^{1}	7.5×10^{1}	1.0×10^{2}
Te-131m	3.3×10^{-5}	1.8×10^{-3}	4.0×10^{2}	7.5×10^{1}	7.5×10^{1}	1.0×10^{2}
Te-132	6.2×10^{-4}	3.3×10^{-2}	4.0×10^{2}	7.5×10^{1}	7.5×10^{1}	1.0×10^{2}
Te-132d	6.2×10^{-4}	3.3×10^{-2}	4.0×10^{2}	7.5×10^{1}	7.5×10^{1}	1.0×10^{2}
I-130	1.1×10^{-4}	5.9×10^{-3}	1.5×10^{1}	5.0×10^{0}	5.0×10^{0}	4.0×10^{1}
I-131	8.0×10^{-2}	4.3×10^{0}	1.5×10^{1}	5.0×10^{1}	5.0×10^{0}	4.0×10^{1}
I-132	1.8×10^{-3}	9.7×10^{-2}	1.5×10^{1}	5.0×10^{0}	5.0×10^{0}	4.0×10^{1}
I-133	3.7×10^{-2}	2.0×10^{0}	1.5×10^{1}	5.0×10^{0}	5.0×10^{0}	4.0×10^{1}
I-135	4.3×10^{-3}	2.3×10^{-1}	1.5×10^{1}	5.0×10^{0}	5.0×10^{0}	4.0×10^{1}
Cs-134	2.8×10^{-2}	1.5×10^{0}	2.0×10^{3}	1.0×10^{2}	1.0×10^{2}	5.0×10^{2}
Cs-136	6.9×10^{-3}	3.7×10^{-1}	2.0×10^{3}	1.0×10^{2}	1.0×10^{2}	5.0×10^{2}
CS-137	3.5×10^{-2}	1.9×10^{0}	2.0×10^{3}	1.0×10^{2}	1.0×10^{2}	5.0×10^{2}
Np-239	2.3×10^{-5}	1.2×10^{-3}	1.0×10^{1}	4.0×10^{2}	4.0×10^{2}	3.0×10^{2}

1

[a]Values based on 1-unit operation and 21.6 cfs average blowdown rate. 2

5.3 EFFECTS OF CHEMICAL AND BIOCIDE DISCHARGES

At the Braidwood Nuclear Generating Station - Units 1 & 2 (Braidwood Station) there are three major systems utilizing water. In each instance, decisions were made regarding the necessity of water treatment for these systems and, if necessary, the type of treatment to be used. These decisions reflect the engineering experience of Commonwealth Edison Company and its contractors. The major systems discharging chemicals or biocides are (a) the cooling water system, (b) the steam cycle makeup water system, and (c) the potable and sanitary water systems. These systems are discussed in Sections 3.6 and 3.7. The major source of chemical and biocide discharges into the Kankakee River at the Braidwood Station is the cooling pond blowdown. The average concentrations of chemicals and biocides from this source is expected to be within state effluent and water quality standards (see Table 5.3-1).

The circulating water system is one of the components of the cooling water system. Kankakee River water is used for the Braidwood cooling pond makeup. The cooling pond blowdown will contain the same chemical constituents as the river, but at higher concentrations because of evaporative water losses (see Table 5.3-1). Total dissolved solids concentrations will be raised because of the carbon dioxide feed added to prevent scale formation in the heat exchange equipment. 2

The expected chemical concentrations of the blowdown from the cooling pond to the Kankakee River is shown in Table 5.3-1. Leaching is expected to have a very insignificant effect on the Braidwood cooling pond water chemistry. Tables 2.4-6 and 2.4-7 provide a quantified breakdown of leached soil components and their possible effect on the water quality of the Braidwood cooling pond (see Subsection 2.4.1.4.2 for discussion). The effect of the cooling pond on groundwater is discussed in Subsection 2.4.2.2.3.

Another component of the plant's cooling water systems is the service water system, comprising the non-essential system and the essential system. Both service water systems use pond water and are hypochlorinated periodically to prevent biological growths. Blowdown to the river is not expected to contain free chlorine because of the long path (about 10 miles) and long time (about 3 days) of exposure before the plant effluent reaches the discharge. 2

The plant makeup water system uses surface water from either the Kankakee River or the cooling pond, demineralized by means of ion exchange methods. The chemical waste products of this process are routed into the circulating water flow (see Subsection 3.6.2.1).

In Table 5.3-1 the concentrations of chemical constituents in the blowdown are listed together with state effluent and water quality standards. It can be seen that the expected TDS discharge to the river is considerably lower than the maximum allowed by the effluent limits for total dissolved solids. The expected pH of the discharge to the river is also within the effluent limits. There are no effluent limits on the other chemical discharges. The expected maximum discharge concentrations of chlorides and TDS listed in Table 5.3-2 satisfy the water quality standards without river dilution. In the case of sulfate, sufficient mixing occurs within a mixing zone of 26 acres to dilute the effluent sulfate concentration to a value well below the 500 mg/liter standard.

The actual mixing zone required to bring the sulfate concentration within allowable limits may be determined by relation to the area required for the thermal mixing zone. Since the same diffusion and transport phenomena account for temperature gradients in the mixing zone as the concentration gradients, the concentration distributions may be explicitly related to the temperature distributions. If t is the temperature along a given isotherm (constant temperature line), then the concentration of a chosen constituent along the same isotherm is given by:

$$C = C_r + (C_b - C_r)\left[\frac{(t - T_r)}{(T_b - T_r)}\right] \qquad (5.3\text{-}1)$$

where,

C = concentration of the constituent,
T = temperature,
r = river ambient, and
b = blowdown stream at discharge point.

For the sulfate concentration to decrease to a value of 500 mg/liter from the maximum discharge value of 588 mg/liter, the following mixing ratio is required:

$$\left[\frac{t - T_r}{T_b - T_r}\right] \le 0.81 \qquad (5.3\text{-}2)$$

It may be seen from the values of cooling pond blowdown temperature (T_b) and ambient river temperature (T_r) in Table 5.1-1 that the mixing ratio at a particular isotherm ($t - T_r$) reaches a maximum during the month of August when average river flow rates are lowest. For this month, a 2° F isotherm corresponds to a mixing ratio:

$$\left[\frac{2^\circ}{T_b - T_r}\right] = \left[\frac{2^\circ}{91 - 79.5}\right] = 0.17 \qquad (5.3\text{-}3)$$

Hence, any sulfate discharged to the Kankakee River from the operation of the Braidwood Station complies with water quality standards by river dilution within an area that does not exceed the extent of the 5° F isotherm. As shown in Table 5.1-2, the area of the thermal plume within the 5° F isotherm is 0.16 acres in August; this area is well below the 26-acre mixing zone allowed by Illinois Water quality standards.

The estimated concentrations of chemicals discharged in the cooling pond blowdown at locations on the Kankakee River corresponding to 5° F and 2° F isotherms are provided in Table 5.3-2. This table shows that most chemicals reach near-ambient values at the 2° isotherm. As noted previously, these concentrations are based on the thermal plume model that considers the volume of river water necessary in August to reduce the blowdown temperature to that of the indicated isotherms; this water volume also causes a dilution of chemical effluents from the cooling pond. No adverse effects of these discharges upon the Kankakee River biota are anticipated. All concentrations are below existing standards and most are at near-ambient values.

TABLE 5.3-1

CHEMICAL DISCHARGES OF THE BRAIDWOOD STATION INCLUDING LEACHING EFFECTS

(All values except pH in mg/liter)

	AMBIENT RIVER[a]	AVERAGE POND BLOWDOWN	AVERAGE DISCHARGE TO RIVER	APPLICABLE ILLINOIS STANDARDS EFFLUENT	APPLICABLE ILLINOIS STANDARDS WATER QUALITY	
Alkalinity (as $CaCO_3$)	170	120	120	None	None	
Calcium	77.6	100	100	None	None	
Chlorides	27.0	44	44	None	500	
Magnesium	23.5	50	50	None	None	
Nitrates	2.3	5	5	None	None	
pH	7.0-9.0	Within Limits	Within Standards	5-10	6.5-9.0	2
Silica	3.2	6	6	None	None	
Sodium	13.0	26	26	None	None	
Sulfates	65.6	273	273	None	None	
Total Dissolved Solids	388	900	900	3500[b]	1000	

[a]From Table 3.6-1.

[b]Applicable limit for recycling or other pollution abatement practices.

TABLE 5.3.2

ESTIMATED MAXIMUM CONCENTRATIONS OF CHEMICALS

DISCHARGED TO THE KANKAKEE RIVER

(All values in mg/liter)

	MAXIMUM DISCHARGE	AT 5° ISOTHERM[a]	AT 2° ISOTHERM[b]	MAXIMUM AMBIENT RIVER
Alkalinity (as $CaCO_3$)	160	203	222	235
Calcium	120	119	118	118
Chlorides	46	34	29	25
Magnesium	70	48	38	31
Nitrates	9	7	7	6.2
Silica	8	6	6	5.3
Sodium	33	29	27	25.6
Sulfates	360	248	198	164
Total Dissolved Solids	980	699	573	489

2

[a]Estimated August isotherm area = 0.16 acres.

[b]Estimated August isotherm area = 1.42 acres.

5.4 EFFECTS OF SANITARY WASTE DISCHARGES

All sanitary waste systems derive their water from the potable water system. Floor drains from the service building and common sewage are routed to the sanitary waste system. The largest portion of the sanitary waste is sewage.

After the sanitary waste has been treated by extended aeration, with tertiary treatment for the additional removal of nutrients, the effluent is chlorinated on a continuous basis to maintain fecal coliforms at or below allowed levels (geometric mean, 200 fecal coliforms/100 ml) (Illinois EPA 1972) The plant effluent chlorine level is about 1 ppm. This concentration is discharged at an average rate of less than 0.1 cfs into the pond blowdown, which is maintained at an average flow of about 43.2 cfs. Dilution by this means should be more than adequate to reduce the nutrient and residual chlorine levels to values below that of the river. All sanitary waste effluents meet the applicable standards of the state of Illinois. 2

5.7 RESOURCES COMMITTED

Resource commitments due to operation of the Braidwood Nuclear Generating Station - Units 1 & 2 (Braidwood Station) fall into two categories: resources committed during the active lifetime of the plant and resources consumed (i.e., committed irretrievably) during plant operation. Resources committed during plant construction are described in Section 4.3.

5.7.1 Resources Committed During Plant Lifetime

Section 2.2 describes the present ecological characteristics of the Braidwood Station site area. The expected impact of plant construction on the surrounding ecological community is described in Section 4.1. The expected ecological impact due to plant operation is presented in this section. Although changes in the local terrestrial ecology attributable to the presence of Braidwood Station could be interpreted as being commitments of resources, a distinction should be made between such consequences as the displacement of animal populations and the destruction of animal habitats; i.e., natural vegetation. Plant operation should not reduce further the wildlife habitat altered by plant construction and therefore should not displace any more animal populations. Ecological monitoring will identify and document changes in the quantity and quality of the chemical and thermal discharges and the resultant effects on the biotic community in the Kankakee River (see Section 6.2).

Resources committed during plant life cannot reasonably be considered as irretrievable long-term net losses. Preconstruction surveys (see Section 2.2) indicated that there are no known threatened or endangered species of plants or animals indigenous to the Braidwood Station area. Since no undue or extreme environmental disturbance is expected to result from plant operation, it is anticipated that natural flora and fauna could reestablish themselves after the plant is decommissioned if the area is allowed to revert to a natural state.

The use of land for the Braidwood Station is also a resource commitment. Subsection 4.3.1 describes the land that is removed from natural and agricultural production by plant construction. During plant operation, 4454 acres will be occupied by plant facilities, the cooling pond, and the exclusion area. The cooling pond provides a habitat for waterfowl, shore birds, and semi-aquatic mammals. Portions of this land not occupied or disturbed during construction will be allowed to return to their natural state in order to provide habitat for terrestrial wildlife. The land that will be unavailable to agriculture represents only about 0.22% of the total agricultural land in Will County. Most of it could be reclaimed after the plant is decommissioned (see Section 5.8). 2

Makeup water is expected to be withdrawn from the Kankakee River at an average annual rate of 90.8 cfs (see Table 3.3-1). An additional 9.3 cfs of rainfall will be added to the Braidwood pond (see Table 3.3-1). An average of 56.8 cfs of water is expected to be lost through evaporation and seepage from the cooling pond. Although most of this water is eventually returned to the earth as precipitation, it is an immediate loss to the local area. In addition, an annual average blowdown of 43.2 cfs is eventually returned to the Kankakee River (see Table 3.3-1).

5.7.2 Irretrievable Commitments of Resources

The environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level and high-level wastes are within the scope of the NRC report entitled "Environmental Survey of the Uranium Fuel Cycle" (see Table 5.7-1).

The operation of the Braidwood Station will involve the consumption of a certain amount of uranium ore that represents a fraction of the current reserves and resources of the United States. The radioactive materials inventory appears in Section 3.8. During the expected lifetime of the plant, the estimated annual use will be 64,450 pounds of UO_2 or 56,810 pounds of U.

CHAPTER 6.0 - EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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All fish collected are identified to species, weighed, and measured. Samples are identified by date, sampling station, and method of collection. Fecundity is also measured. Scales or spines are taken from each species (excluding minnows) that is examined for length and weight. They are used to determine both age and growth. Food habits are determined for sport fish and ictalurids that are eviscerated for sex determination. Condition factors [K(TL)] are determined for the immature fish and for the adults that have had their sex determined. Condition factors are kept separate by season, sex, age, year, and sampling station. Physical abnormalities of fish and incidence of external disease and parasitism are noted from gross examination and recorded.

Fish eggs and larvae are collected once a week over a 24-hour period beginning in mid-April and continuing through mid-July at sampling locations 1, 2, 3, and 6. Sampling is extended for an additional 6 weeks from mid-July through August if fish eggs and larvae are found in early July. The samples are taken with metered nets using a No. 0-mesh plankton net. Horse Creek (location 2) has one sampling point, the surface. The sampling boat is anchored in position, and the nets are lowered to the proper depth and held in place until an adequate volume of water is sampled. The concentrated sample is preserved in buffered formalin. Later, the eggs and larvae are identified and counted.

6.1.2 Groundwater

6.1.2.1 Physical and Chemical Parameters

The properties and configurations of the local aquifers at the Braidwood Station site are described in Subsection 2.4.2. Seven shallow water wells were installed in 1973 to obtain groundwater table data around the periphery of the Braidwood Station cooling pond. These wells, which were installed in the glacial drift, were monitored from July 1973 through June 1975.

In late 1975, eight additional observation wells were installed in the glacial drift around the Braidwood Station power block excavation and outside the slurry trench to monitor groundwater quality and level during construction. These wells, site wells 1 through 8 were installed in pairs at varying distances from the slurry trench (see Figure 6.1-4). Commonwealth Edison Company (CECo) began monitoring all 15 wells for both water quality and level in January 1976. 2

In 1978, 71 additional observation wells were installed to monitor any effects of pond filling on groundwater levels. Subsequently, 10 additional wells were added to the program. The water levels are checked monthly in these 81 wells.

The preoperational monitoring program for groundwater quality in the vicinity of the site was modified in March 1981. This modification involved selection of some new wells and the establishment of action guides.

Water quality analyses are performed in accordance with EPA approved procedures: Standard Methods for Examination of Water and Wastewater, 14th Edition (APHA 1975). This groundwater monitoring program is not part of any future radiological monitoring program. Well depths are determined for those wells where access is available by use of a meter connected to a probe that is lowered into the well. The meter operates on the principle of specific conductance, that is, when the probe reaches the water level, the meter indicates electrical conductance. The depth is read from the connecting line, which is calibrated in feet.

Under the modified program, the following wells are sampled quarterly for water quality: 2

1. G-1 and G-2

2. D-1, D-2, D-3 and D-4

Wells G-1 and G-2 are onsite wells close to the town of Godley. The D-series wells are domestic wells that are in current use. The location of these wells are depicted on Figure 6.1-3. The criteria used to select the various wells involved selecting representative locations on and around the site in coordination with groundwater hydrological characteristics. Action guides are assigned to each parameter measured at each well.

The establishment of these action guides took into consideration data collected during construction for the D and G series wells. For pH, the action guide is 0.5 pH units greater than the highest observed background value or 0.5 pH units less than the lowest observed background value. For all other parameters, the levels are 50% greater than the highest observed background level or 50% less than the lowest observed background value. The parameters measured and the levels established by the guide are listed in Table 6.1-5A.

This water quality program will continue through one year of commercial station operation. Samples will be collected quarterly. 2

6.1.2.2 Models

No mathematical groundwater models were used in the preoperational groundwater investigations.

6.1.3 Air

6.1.3.1 Meteorology

A 320-foot meteorological tower was erected on the Braidwood Station site approximately 1880 feet northeast of the Braidwood Station reactor building, the major plant structure closest to the tower. The tower is located on relatively level terrain in the center of a large, open grassy field with no other tall structures or trees in the vicinity. The tower is thus essentially free of aerodynamic influences from the Braidwood Station buildings for all directions. The elevation of the base of the tower is close to the final plant grade, 600 feet above mean sea level (MSL). The location of the tower is shown in Figure 2.1-5. The meteorological instruments are mounted on booms that extend more than one tower width away from the open-latticed structure of the tower.

The meteorological monitoring system at the Braidwood Station is operated in accordance with the recommendations of Regulatory Guide 1.23. Wind speed and wind direction are measured at 34 feet and 203 feet above grade level. Temperature is measured at 30 feet, and temperature difference (delta T) is measured between the 30- and 199-foot levels. Relative humidity (dew point) is measured at both the 30- and 199-foot levels. A precipitation gauge is used to measure rain and snowfall at ground level near the base of the tower. (During November 1977 the wind speed and direction instrumentation at both tower levels was raised by 4 feet from 30 and 199 feet above grade level. This change in instrumentation levels resulted from equipment modifications to improve system reliability.)

All meteorological data are recorded on an analog recording system. An additional analog recording system serves as a

6.1.5 Radiological Monitoring

The preoperational radiological monitoring program planned for the Braidwood Station was described in the Environmental Report - Construction Permit Stage (ER-CPS). The monitoring program currently planned incorporates some changes in sample collection and analysis that were made to obtain more useful data. The area to be monitored is essentially the same as that described in the ER-CPS (see ER-CPS Subsection 6.1.5).

CECo plans to start its preoperational radiological monitoring
program by August, 1983. The preoperational monitoring program 2
will provide measurements of natural background and other radi-
ation sources, such as fallout, that are external to Braidwood 1
Station. This program will continue until the plant loads
nuclear fuel and the operational-phase monitoring program be-
gins. Details of the proposed monitoring program are discussed
in this subsection.

6.1.5.1 Sampling Media, Locations, and Frequency

Table 6.1-10 presents the preoperational radiological sampling
program to be used at the Braidwood Station. The media to be 2
sampled include the most important dose pathways. Air sampling
stations and surface and well water sampling sites that will be
in the program are shown in Figure 6.1-7. Air sampling sites
were selected on the basis of population and site meteorological conditions. Environmental samples will be collected at these locations with the frequencies specified in the technical specifications.

TABLE 6.1-5

PESTICIDES AND POLYCHLORINATED BIPHENYLS MEASURED IN WATER SAMPLES COLLECTED FROM THE KANKAKEE RIVER AND HORSE CREEK DURING THE BRAIDWOOD AQUATIC MONITORING PROGRAM 1974-1975

PARAMETER	REPORTING UNITS	ANALYTICAL PROCEDURES[a]
BHC[b] (alpha)	μg/liter	*
BHC (beta)	μg/liter	*
BHC (gamma)	μg/liter	*
BHC (delta)	μg/liter	*
BHC (total)	μg/liter	*
2, 4, D[c]	μg/liter	*
2, 4, 5, T[d]	μg/liter	*
DDE[e]	μg/liter	*
DDD[f]	μg/liter	*
DDT[g] (PP')	μg/liter	*
DDT (OP')	μg/liter	*
DDT (total)	μg/liter	*
Dieldrin	μg/liter	*
Heptachlor epoxide	μg/liter	*
PCB[h]	μg/liter	*

[a] Asterisk (*) indicates procedures used are those described in Proposed Water Quality Information (U.S. EPA 1973).

[b] Benzene Hexachloride.

[c] 2-(2, 4 - dichlorophenoxy) acetic acid.

[d] 2-(2, 4, 5 - trichlorophenoxy) acetic acid.

[e] 2, 2 - bis (4 - chlorophenyl) - 1, 1 - dichloroethylene.

[f] 1, 1 - bis (4 - chlorophenyl) - 2, 2 - dichloroethane.

[g] 2, 2 - bis (4 - chlorophenyl) - 1, 1 - trichloroethane.

[h] Polychlorinated biphenyl.

TABLE 6.1-5A

GROUNDWATER MONITORING ACTION LEVELS BY WELL
(Values Given as Higher/Lower Action Level)

Parameter	D-1	D-2	D-3	D-4	G-1	G-2
Depth (inches)	a	a	a	a	185/29	139/16
pH	7.6/6.6	9.1/7.4	8.6/6.8	8.8/7.0	8.4/6.7	8.0/6.3
Fecal Coliform (number/ml)	2/< 1	2/< 1	2/< 1	2/< 1	10/< 1	4/< 1
Ammonia, as N (mg/l)	0.95/< .05	0.56/0.06	0.21/< 0.05	0.32/< 0.05	0.77/0.13	0.26/< 0.05
Arsenic (mg/l)	0.003/< 0.001	0.003/< 0.001	0.002/< 0.001	0.002/< 0.001	0.039/< 0.001	0.038/< 0.001
Boron (mg/l)	1.1/< 0.1	3.5/0.4	1.2/< 0.1	0.9/< 0.1	1.2/< 0.1	0.5/< 0.1
Dissolved Solids (mg/l)	1150/261	591/175	471/115	372/92	477/102	678/205
Phosphorus (mg/l) (total, total, as P)	0.045/< 0.005	0.182/< 0.005	0.240/< 0.005	0.132/< 0.005	0.273/0.017	0.404/< 0.005
Sulfate (mg/l)	245/41	3/< 1	113/28	117/18	6/< 1	204/51

[a] The D-Series are active off-site domestic water wells; depth cannot be determined.

TABLE 6.1-6

DESCRIPTION OF BRAIDWOOD FALL BASELINE TERRESTRIAL SURVEY TRANSECTS 1972-1973

TRANSECT NUMBER	AREA DESCRIPTION	SAMPLE DESCRIPTION	LENGTH (ft)
1	Fallow Field	Veg.-line intercept	600
		Mam.-20 stations, 4 nights	1000
		Birds-quantitative	1000
		Insects and Herpetofauna-qual.	1000
2	Recently Strip-mined	Veg.-line intercept	2000
		Mam.-16 stations, 4 nights	800
		Birds-quantitative	2000
		Insects and Herpetofauna-qual.	2000
3	Strip-mined in 1940's	Veg.-point intercept	1000
		Mam.-20 stations, 3 nights	1000
		Birds-quantitative	1000
		Insects and Herpetofauna-qual.	1000
4	Uncultivated Woodlands and Soybean Fields	Veg.-point intercept	1600
		Mam.-20 stations, 3 nights	1000
		Birds-quantitative	2000
		Insects and Herpetofauna-qual.	1000
5	Strip-mined in 1950's (offsite area)	Veg.-qualitative	1000
		Mam.-qualitative	1000
		Birds-quantitative	1000
		Insects and Herpetofauna-qual.	1000
6	7- to 10-year-old Strip-mined Area	Veg.-point intercept	1000
		Mam.-6 stations, 2 nights	300
		Birds-quantitative	1000
		Insects and Herpetofauna-qual.	1000
7	Cultivated Corn Field (offsite area)	Veg.-qualitative	500
		Mam.-8 stations, 2 nights	400
		Birds-quantitative	1000
		Insects and Herpetofauna-qual.	1000
8	Uncultivated Woodlands	Veg.-point intercept	900
		Mam.-qualitative	1000
		Birds-quantitative	1000
		Insects and Herpetofauna-qual.	1000

D-4
D-3
TO HORSE CREEK
POND MAKE UP DISCHARGE STRUCTURE
ESSENTIAL COOLING POND
POND SCREENHOUSE
TOP OF INTERIOR DIKE EL. 600'-0" (TYP.)
CIRCULATING WATER DISCHARGE STRUCTURE
D-1
G-1
G-2
TOP OF DIKE EL. 600'-0" (TYP.)
OVERFLOW SPILLWAY
TO MAZON RIVER
Godley
Braceville
Central City
Mine Dump
13
14
24
25
26
36

LEGEND:

- EXISTING DRAINAGE
- NEW DITCHES
- DIKES
- PROPERTY LINE
- ▲ G-1 GROUNDWATER MONITORING WELL

NORTH

3000 0 3000

SCALE IN FEET

BRAIDWOOD NUCLEAR GENERATING STATION
UNITS 1 & 2
ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

FIGURE 6.1-3

LOCATIONS OF GROUNDWATER MONITORING WELLS

6.4 PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING DATA

The preoperational radiological monitoring program for the
Braidwood Nuclear Generating Station - Units 1 and 2 will begin 1
in the summer of 1983. When 12 months of monitoring data,
including data from a crop harvest and a complete growing
season, are available, they will be submitted. 2

8.2 OPERATIONAL PHASE ANNUAL STATION PROPERTY TAX BENEFITS

The annual property tax breakdown for Braidwood Station, both for 1981 and projected to 1986, is listed in Table 8.2-1. 1

TABLE 8.2-1

BRAIDWOOD STATION ANNUAL PROPERTY TAXES

TAXING UNIT	ACTUAL 1981 TAXES	ESTIMATED 1986 TAXES[a]
County	$ 567,198	$1,518,900
Forest Preserve	206,209	443,000
Reed Township	74,123	121,600
Braidwood Fire District	186,480	306,800
School District U-225	3,641,618	6,078,100
Community College District 525	249,426	592,300
Fossil Ridge Public Library	134,908	221,200
TOTAL	$5,039,942	$9,281,900

2

1

[a] Estimated 1986 taxes are in 1982 dollars. 2

CHAPTER 11.0 - SUMMARY COST-BENEFIT ANALYSIS

Information on the summary cost-benefit analysis for the Braidwood Nuclear Generating Station - Units 1 & 2 (Braidwood Station) is presented in Table 11.0-1.

TABLE 11.0-1

SUMMARY OF COST-BENEFIT ANALYSIS OF THE BRAIDWOOD STATION

CONDITIONS AND CHARACTERISTICS	PRESENT BRAIDWOOD STATION ENVIRONMENT	NUCLEAR POWER STATION WITH ASSOCIATED COOLING POND	
Total Anticipated Capital Investment		$3.1 billion	1 2
Economy of the Braidwood Station Region	Resource-based economy especially oriented toward agriculture and mining	Annual permanent employee payroll: $14.6 million	1
		Annual local taxes on station: $9.3 million estimated for 1986 when the second unit becomes commercial	1
		Taxes (local, state, federal) over 30-year period $1,482.4 million	1
Economy of the Commonwealth Edison Company Service Area	Extremely diverse economy, highly industrialized in Chicago metropolitan area and some outlying centers (Joliet, Rockford), and primarily agriculturally oriented in non-metropolitan areas	Annual value of power produced under present schedules: $836 million	1
Physical and Chemical	Lands: The present land use in the area is primarily strip-mine spoil with some cultivated land	Approximately 4454 acres of land have been acquired for use by the proposed station and cooling pond. Of this acreage, about 820 acres will form the exclusion area. Cropland and residential land in the exclusion area will be changed because no crops will be grown and house and farm buildings have been removed. The actual station structure will occupy 130 acres. Loss	1

TABLE 11.0-1 (Cont'd)

SUMMARY OF COST-BENEFIT ANALYSIS OF THE BRAIDWOOD STATION

CONDITIONS AND CHARACTERISTICS	PRESENT BRAIDWOOD STATION ENVIRONMENT	NUCLEAR POWER STATION WITH ASSOCIATED COOLING POND
		of wildlife habitat is expected to be small. Construction of the cooling pond requires the diversion of 704 acres of cultivated agricultural land. Of the remaining area required for pond construction, the major portion, 2313 acres, currently consist of strip-mine spoil
	Water: Kankakee River near site: average flow = 3952 cfs	Water consumed through evaporation and seepage loss: approximately 57 cfs
	Temperature ranges: Summer 16.5° to 30.0°C; Spring and Fall 0.5° to 26.5°C; Winter 0.0° to 9.5°C	The concentration of radionuclides in the discharge will be much less than the maximum permissible concentration (MPC) of 10 CFR 20 and will meet the design objectives of 10 CFR 50, Appendix I.
	Quality is good, with little effect due to domestic and industrial discharge	Thermal discharge to river is expected to be negligible and in compliance with thermal mixing zone regulations.
		Chemical discharge into the Kankakee River due to operation of the station is not considered significant.
		The only discharge to the groundwater (approximately 5 cfs) will be associated with seepage from the cooling pond.

2

TABLE 11.0-1 (Cont'd)

CONDITIONS AND CHARACTERISTICS	PRESENT BRAIDWOOD STATION ENVIRONMENT	NUCLEAR POWER STATION WITH ASSOCIATED COOLING POND
	Air: Quality is good. Heavy fog (visibility 0.25 mile or less) occurs an average of 24 days annually.	The evaporation rate from the cooling pond will vary seasonally with weather conditions and station load factor. There will be some steam fog over the pond whenever the air is sufficiently colder than the pond surface water. Approximately 0.2 hours of fog per year will be caused along Illinois State Highways 53 and 129. No damage to surrounding vegetation due to ice or fog is expected.
	Noise:	The station and screen house will be designed and constructed to operate in compliance with Illinois EPA, U.S. EPA, and HUD[a] noise regulation guidelines.
Biological	Plankton: Extremely rich and diverse plankton community. Diatoms are the most dominant, indicative of good water quality.	No change in plankton will result from thermal plume effects.
	Benthos: Diverse benthic community that does not appear depressed or indicative of organic pollution. Aquatic insects predominate.	No change in benthos composition will result from thermal plume effects.
	Nekton: Moderately diverse fish community representing 46 species. High abundance of channel cat fish, rock bass, smallmouth bass and walleye. No commercial fishing.	Thermal plume effects on adult fish are expected to be negligible. No effects on fish migration. It may be assumed that all fish eggs and larvae taken in with makeup water will be killed. No appreciable fish loss due to impingement and entrainment on structure because of low intake volume and velocity (0.5 feet per second). Species composition of the Braidwood cooling pond will be similar to that of the Kankakee River.
Cultural, Historical, and Archaeological Features	Rural society, primarily strip-mine spoil with some cultivated land. No national historic places of interest or natural landmarks are located on or near the site. Previous mining activities, which lessened the value of the Braidwood Station site land for other purposes, has caused fossils to be exposed and accessible.	The aesthetic value of the cooling pond enhances the existing landscape since it resembles a natural backwater area of the Kankakee River. Much of the land required for the pond construction is currently strip-mine spoil. The diversion of strip-mine spoil to an aquatic state must be considered an aesthetic change.

[a]HUD = Department of Housing and Urban Development.

TABLE 11.0-1 (Cont'd)

SUMMARY OF COST-BENEFIT ANALYSIS OF THE BRAIDWOOD STATION

CONDITIONS AND CHARACTERISTICS	PRESENT BRAIDWOOD STATION ENVIRONMENT	NUCLEAR POWER STATION WITH ASSOCIATED COOLING POND
		An archaeological survey determined that no archaeological site of significance was threatened by the site development plans, and the impact has been mitigated in accordance with the Historic and Archaeological Preservation Act of 1974 (P.L. 93-291).
		CECo has reached an agreement with the Field Museum of Natural History to provide access to portions of the pond to allow collection of fossils of scientific interest (Braidwood FES, App. G-3). 2

CHAPTER 13.0 - REFERENCES

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This section contains the NRC request for additional information based on B. J. Youngblood's letter of May 24, 1983, followed by the response to the question. In some cases the response includes a reference to the appropriate updated sections of the text.

QUESTION E100.1

In addition to other requested information, provide a summary and brief discussion, in table form, by section, of differences between currently projected environmental effects (including those that would degrade and those that would enhance environmental conditions) and the effects discussed in the environmental report and environmental hearings associated with the construction permit review. On a similar basis, indicate changes in plant or plant component design, location or operation that have been made or planned since the construction permit review.

RESPONSE

The differences between the environmental effects discussed in the construction permit environmental report and the current operating license stage environmental report are presented in the attached Table Q100.1-1. The changes in plant or plant component design location or operation are presented in the attached Table Q100.1-2.

TABLE QE100.1-1

DIFFERENCES IN ESTIMATED ENVIRONMENTAL EFFECTS

SECTION	BRAIDWOOD ER-CP	BRAIDWOOD ER-OLS	DISCUSSION OF ENVIRONMENTAL EFFECT
2.3.4	No consideration of archaeological resources on transmission rights-of-way.	Archaeological surveys have been completed on the transmission right-of-way.	Previously unkown archaeological sites are now recorded and can be protected from future impacts.
3.9.1	Two transmission line rights-of-way.	One transmission line right-of-way.	Reduces all the impacts normally associated with transmission lines including less river and highway crossings, fewer acres of farm land, woodlands and wetlands disturbed, reduced visual impact and reduction in cost.
3.9.1.2	Lattice steel towers.	Tangent and light angle structures to be single shaft.	Reduction in acres of farm land taken out of production, less interference with farming practices.
5.7	Noise at property line not covered.	Noise levels at property line to be in accordance with applicable state and federal standards.	Ambient, predictive and some operational noise surveys have been conducted.
8.0	Station operation to create about 200 new jobs at an estimated annual payroll of $3 million (1972 dollars).	Station operation to create approximately 533 new jobs with an estimated annual payroll of $14 million (1982 dollars).	Larger staff and induced employment will provide additional job opportunities to the local population and the resulting larger payroll will enhance the local economy. Larger staff, however,

TABLE QE100.1-1 (continued)

DIFFERENCES IN ESTIMATED ENVIRONMENTAL EFFECTS

SECTION	BRAIDWOOD ER-CP	BRAIDWOOD ER-OLS	DISCUSSION OF ENVIRONMENTAL EFFECT
			will increase local traffic and require local governmental and health services (police and fire protection, sewers, schools, doctors and hospitals). Comparing the 1970 and 1980 censuses shows population growth in some of the local towns and villages. No infrastructure problems are anticipated.
8.4	Total property taxes for 1981 estimated to be $3,218,000.	Actual property taxes for 1980, paid in 1981, were $5,039,942 for the partially completed plant. For 1986, the first year the plant is completed . The estimated property taxes are $9,281,900.	Local property taxes paid by Braidwood Station represent the major source of revenue to the local taxing units of the Braidwood and Reed Township area.

TABLE QE100.1-2

CHANGES IN PLANT DESIGN

SECTION	BRAIDWOOD ER-CP	BRAIDWOOD ER-OLS	DISCUSSION OF DIFFERENCE
2.1	Cooling pond size, 2,640 surface acres.	Cooling pond size, 2,537 surface acres.	The 2640 acre figure was an estimate. The 2537 acre figure is as-built after filling the pond.
2.7.1.1	Site size, 4,320 acres.	Site size, 4,454 acres.	Approximately 160 acres of strip mined land was added to the southeast section of the site. Minor reductions due to sale or exchange of small tracts and final survey adjustments re- in a net increase of 134 acres.
3.1.1	Size of structures.	Technical Support Center (TSC) added to the turbine building. Station gate house enlarged and permanent parking lot enlarged.	The TSC addition is an elongation of the turbine building. The gate house and parking lot are also enlargements and are not obtrusive.
3.1.3	Architectural Features	River screenhouse modified to lower profile and a screenwall was added to hide trashrack cleaning equipment.	The river screenhouse profile was lowered and the screenwall was added to improve the appearance of the facility.
3.3.4 3.3.5	Sanitary water system and demineralizer system water obtained from deep wells.	Sanitary and demineralizer system water will be drawn from the fresh water holding pond with surface water from the Kankakee River.	Poor quality groundwater resulted in decision to use surface water.

TABLE QE100.1-2 (continued)

CHANGES IN PLANT DESIGN

SECTION	BRAIDWOOD ER-CP	BRAIDWOOD ER-OLS	DISCUSSION OF DIFFERENCE
3.9.1	Two transmission rights-of-way (R.O.W.). One to Joliet Station and one to Crete Transmission Substation.	One transmission R.O.W. to Crete Transmission Substation.	Two 345 kv circuits from LaSalle County Station to East Frankfort Transmission Substation were tapped into the Braidwood Station Switchyard eliminating the need for the transmission line to Joliet Station. The effects of this transmission line and R.O.W. utilization were considered in the licensing of LaSalle County Station.
3.9.1.2	Lattice steel towers.	Single shaft structures for tangent and light angles (up to 13^{o}) lattice steel towers for angles over 13^{o}.	Reduces the acreage needed for tower bases and lessens the inconvenience to the farmers.

QUESTION E100.2

Much of the environmental descriptive information in the Environmental Report OL Stage is several years old. These descriptions formed the bases for site environmental quality and plant operational phase impact assessments. Provide updated information, as available, on the abiotic and biotic resources of the site and vicinity, as compiled from various construction or preoperational phase monitoring programs including studies of the cooling pond during the filling and post-filling periods. Indicate, with bases, whether this new information changes the assessments of the environmental quality of the site and surroundings or of the environmental impacts of plant operation.

RESPONSE

Amendment 1 of the Environmental Report contains summaries of the terrestrial and aquatic monitoring programs that have been conducted during the construction period at Braidwood Station. A summary of the terrestrial monitoring program for the years 1979 through 1982 is contained in Section 4.1.4.1 of the ER. Copies of the reports for these years have been furnished for NRC staff review. The corresponding aerial photographs were made available for NRC staff inspection during the May 3-5, 1983 site visit.

The results of the aquatic studies for the period 1977 through 1981 are contained in Section 4.1.4.2.1 of the ER and the executive summaries of the reports are contained in Appendix 4.1C. A summary of the 1976 and 1981 clam bed mapping program is contained in Section 4.1.4.3. Copies of the clam bed mapping survey reports as well as the aquatic studies reports were provided for staff review during the site visit.

No species of plant or animal on the Illinois list of endangered or threatened species was collected in any of the study programs. The Asiatic clam *Corbicula fluminea* was collected during the clam bed mapping survey.

Based on the results of the construction phase studies discussed above there has been no new information collected which changes the assessments of the environmental quality of the site and surroundings or of the environmental impacts of plant operation.

QUESTION E290.1

Indicate the likely extent, location and duration of all presently active or future strip mining on the site.

RESPONSE

Strip mining on the site ceased prior to the beginning of plant construction in 1975. No strip mining has been done on the site since that time and none is planned for the future.

QUESTION E290.2

In the ER-OL on p. 5.5-1, it is implied that herbicides will be used to control undesirable woody plants in those portions of the rights-of-way that traverse woodland. Indicate which herbicides, if any, will be used, whether they are on the current EPA list of approved herbicides and the justification for use of any that are not on the current EPA list. Indicate whether the transport, handling and application of all herbicides to be used will comply with current EPA regulations. Describe and provide the rationale for any such activities that do not comply with the EPA regulations.

RESPONSE

The maintenance program used to control tall growing trees on the Braidwood Station transmission line right of way will include the use of some herbicides. 2-4-D is an approved herbicide and will be used in this program. Materials such as Banvel 520 and Weedone 170 are the commercial names of two of the currently used herbicides which contain 2-4-D. These products are used on the stumps of trees to prevent their regrowth and also are used on a selective basis as a basal spray on standing brush and trees. It is not possible to estimate the volume of herbicide that will be used as that is dependent on the number of trees that resurge and threaten to interfere with the transmission lines. It is estimated that the right-of-way includes approximately 234 acres of wooded land. With the selective control methods described above, the volume of herbicides used will be minimized. The frequency of application is planned to be about once every five years. All herbicides used in the control programs will be transported, handled and applied in accordance with the restrictions stated on the registered container labels.

QUESTION E290.3

Identify the area, location and classification of any portion of the site that is classified as prime, unique or locally important agricultural land by the Soil Conservation Service.

RESPONSE

Figure 2.5-2 of the ER has been revised and it now illustrates the extent of prime agricultural land on the Braidwood Station site prior to construction. There is no unique or locally important agricultural land on the site.

QUESTION E290.4

Describe any consultation with the Will County Soil and Water Conservation District as to the best use of spare land onsite.

RESPONSE

Consultation with the Will County Soil and Water Conservation District has been through the Will County Soil Conservationist. The subject of the most recent consultation was the use of approximately 36 acres of land that previously had been farmed on the site. It was agreed that the best use would be to plant and maintain the area for wildlife habitat enhancement. His recommendations for fertilizer, seeding mixtures and maintenance of naturalizing ground covers have also been used for land on the site, on the makeup - blowdown corridor and for the land at the river screenhouse.

QUESTION E291.1

Indicate the location, size and fate of drainage from any on-site ponds that will remain after the completion of the Braidwood cooling pond.

RESPONSE

No onsite ponds with discharge into drainage systems will remain after the completion of the Braidwood construction activities.

QUESTION E291.2

Indicate the date or expected date when the Braidwood cooling pond reached normal operating level (i.e., 595 ft MSL).

RESPONSE

The initial filling of the pond commenced on December 1, 1980 and terminated on February 18, 1981 when pond reached desired level. Additional water has been pumped into the cooling pond from time to time for various pump tests and to refill the fresh water holding pond.

QUESTION E291.3

Describe the area, volume and purpose of the "fresh water holding pond" shown on Figure 2.1-3.

RESPONSE

The surface of the fresh water holding pond at the maximum water surface elevation is 1.39 acres with storage volume of about 12.0 acre-feet.

The cooling pond make-up water from the Kankakee River is pumped into this pond and allowed to flow through a weir dam into the cooling pond. The purpose of this fresh water holding pond is to assure a supply of good quality water for domestic water use and to supply the plant demineralizer system.

QUESTION E291.4

Indicate the expected frequency, duration and rate of Braidwood cooling pond overflow to the Mazon River.

RESPONSE

The normal operating pool elevation of the Braidwood cooling pond is 595.0 feet MSL. This level will be maintained by adjusting the operation of the makeup pumps. The crest elevation of the overflow spillway is at El. 595.75 feet. The runoff from a 100-year rainfall will be contained between the normal pool and the crest of the overflow spillway. There would be no overflow from the cooling pond if the rainfall on the drainage basin of the pond is less than one in one-hundred year recurrence interval event. Whenever the rainfall is in excess of one in one-hundred year rainfall event, overflow from the pond over the spillway will occur. The frequency, duration and the rate of overflow will depend on a particular rainfall event which is more severe than the one in one-hundred year rainfall event. The rate of outflow and the duration of flow through the overflow spillway due to an extreme rainfall event of the Probable Maximum Precipitation are shown on FSAR Figure 2.4-32.

QUESTION E291.5

Provide an update of the status of developments of the groundwater monitoring program (operational phase) that was submitted to the NRC as part of the Operating License application.

RESPONSE

The preoperational groundwater monitoring was implemented in March 1981 with action level established in June of 1983. Subsection 6.1.2 has been amended to indicate the well locations, parameters being measured, frequency of sampling and action levels established.

QUESTION E291.6

Indicate the plant operating and annual average load factor used as a basis for the water use and waste discharge sections of the Environmental Report.

RESPONSE

The water consumption values contained in Section 3.3 STATION WATER USE were calculated on the basis of 100% load factor with the exception of subsection 3.3.6 where reference is made to Table 3.3-2 VARIATIONS IN PLANT WATER USE. The 100% load factor case was used to define the anticipated maximum water use. The anticipated annual average load factor for the station is 65%. The estimated average water consumption at 65% load factor would be 33.9 cubic feet per second as calculated by interpolation of the values contained in Table 3.3-2.

The estimated waste discharges from the station are based on 100% load factor.

QUESTION E291.8

Considering the channeling of the Braidwood cooling pond expected to occur during operation, estimate the resultant effective volume of the pond and the resultant average residence time for water in the pond between station discharge and intake. Also provide, if available, information on the bathymetry of the cooling pond, particularly indicating shallow pond areas of fisheries importance.

RESPONSE

The estimated effective volume of Braidwood cooling pond is 18,490 acre feet with an average residence time for water in the pond between the station discharge and intake of 2.9 days. The normal operating water level of the cooling pond is 595 feet MSL.

A figure has been furnished that presents the available data of the bathymetry of the cooling pond. The shallow pond areas that may have importance as a fishery can be determined from the figure. In particular many areas of the shoreline along the exterior dike from station marker number 190 to 380 should provide areas for spawning, juvenile development and feeding. There are also a number of areas suitable for these activities along sections of the interior dike system. Depth measurements were taken in several of the known deeper areas where there was standing water when the aerial bathymetric survey was taken.

QUESTION E291.9

Indicate the transit time for condenser cooling water through Braidwood Station.

RESPONSE

The estimated transit time for cooling water from the pond intake through the condensers and back to the pond discharge canal is eleven minutes.

QUESTION E291.10

Provide a scaled diagram showing location and plan elevation of the circulating water discharge structure. Provide the same for the essential service water discharge structure.

RESPONSE

Scaled diagrams showing the location, plan and elevation of the circulating water and essential service water discharge structures were provided at the site visit.

Simplified figures depicting the requested information will be provided in a future amendment to this ER.

QUESTION E291.11

Indicate the basis for the effluent analysis values given in Tables 3.6-2 and 3.6-3. If these values differ from those that would result from consideration of expected cooling pond quality as source water, provide an analysis based on the expected cooling pond quality.

RESPONSE

The circulating water blowdown chemistry from the Braidwood Station cooling pond is based on an optimized two cycles of concentration with carbon dioxide (CO_2) feed to maintain non-scaling conditions. The analysis is based on the expected cooling pond water quality. Tables 3.6-2 and 3.6-3 have been revised to reflect updated water quality data on Table 3.6-1 and use of CO_2 rather than sulfuric acid for scale control.

QUESTION E291.12

Indicate whether acid treatment and chlorination of plant cooling water systems are expected to be conducted all year around. Provide the expected frequency and duration of the chlorination of the circulating and service water systems.

RESPONSE

It is anticipated that chlorination of the plant cooling water systems will occur all year round. The expected frequency and duration of chlorination is as follows:

System	Frequency	Duration
Circulating Water	Twice per day	5 to 30 minutes
Essential Service Water	Twice per day	5 to 30 minutes
Non-essential Service Water	Twice per day	5 to 30 minutes

Chlorination of the Circulating Water System is accomplished by sequentially injecting sodium hypochlorite into each of the four condenser water boxes on both Unit 1 and Unit 2. There is sufficient dilution with this method so that no chlorine residual is expected at the discharge point into the cooling pond.

It is expected that the cleanliness of the main condensers can be maintained with chlorination and use of the Amertap Condenser Tube Cleaning System installed on each unit. If scale formation cannot be controlled with the Amertap system, additional chemical treatment will be implemented. If the pond water pH must be lowered to prevent scale formation, liquid carbon dioxide will be injected into the system rather than sulfuric acid as originally anticipated. Alternatives to pH control will also be considered, such as injecting small amounts of polymers for crystal growth inhibition.

QUESTION E291.14

Estimate the average amount of sludge expected to be produced from the waste treatment system each year.

RESPONSE

The estimated average sludge production is 800 pounds per day of dry sludge. This sludge will be disposed of off-site by a licensed contractor.

QUESTION E291.15

Provide a copy of the following documents:

a. Illinois EPA Division of Water Pollution Control 401 Certification for Braidwood Station and all modifications thereto.

b. U.S. EPA NPDES Permit for construction and operation (if applicable) of Braidwood Station and all modifications thereto.

c. Application for operational NPDES permit.

RESPONSE

The copies of the requested documents have been provided.

QUESTION E291.16

Resolve the differences in reported Kankakee River average flow of 3952 cfs (ER p. 2.4-2), 3640 cfs (ER Fig. 3.3-1) and 4116 cfs (ER Table 11.0-1).

RESPONSE

The differences in average flows reported are due to different averaging periods being used for each flow. The estimated average annual flow rate of 3952 cfs for the Kankakee River at the screenhouse was obtained from the flow records published by U.S. Geological Survey at the Wilmington Gaging Station for the period 1933-1976. This average flow of 3952 cfs will be used in this ER. Figure 3.3-1 and ER Table 11.0-1 have been amended to include this flow rate.

QUESTION E291.17

Identify the intake locations which are representative of the estimated approach velocities of 0.32 fps and 0.48 fps, given on ER, p. 3.4-2.

RESPONSE

The indicated velocities were presented in the 316(b) Demonstration for the Braidwood Generating Station, dated February 1, 1977, which was prepared by Commonwealth Edison Company. The calculations indicate that at the normal make-up rate of 107 cfs using two pumps, the river intake velocities at the approach inlet, at the opening through the concrete wall of the intake structure after the trash bars, will be 0.32 fps at normal water level of 538 feet MSL and 0.48 fps at low water level 534 feet MSL.

QUESTION E291.19

Provide the status of any recreational plans for the Braidwood cooling pond.

RESPONSE

There are no plans for recreational use of the Braidwood Station cooling pond at this time.

QUESTION E291.20

Define the concept of "fish preserve" as used to describe the Kankakee River.

RESPONSE

The following wording is taken from the state law and is their basis for declaring the Kankakee River a fish preserve:

Illinois Department of Conservation Laws
Chapter 56 Article 6 Section 6.1
effective January 1, 1980

All waters in the state including boundary waters under the jurisdiction of the state, Lake Michigan, Mississippi River and the Wabash River shall be fish preserves.

Hook and line or sport fishing gear up to 50 hooks except as provided in this act and subsequent administrative orders, are the only lawful means of taking fish.

The Illinois Department of Conservation, however, has the authority through administrative order to prohibit all sport fishing or certain sport fishing devices in designated waters and also has the authority through administrative order to regulate all commercial fishing in designated waters by regulating commercial fishing devices used, in the interest of the total management of the fishery resources.

QUESTION E291.21

Provide the status of any required operational demonstration under Section 316(b) of the Clean Water Act.

RESPONSE

An impingement program was conducted during the filling of the cooling pond, however, because the filling occurred during the winter, an entrainment study was not conducted. We have suggested that a one year impingement study be conducted during the first year of unit one operation. We plan to conduct an entrainment study during the first spring and summer seasons following Unit 1 being placed in commercial service. The enclosed correspondence explains the program.

2. From April 15, 1980 to August 31, 1980, net samples will be taken in the intake bay on every Tuesday that pumping into the pond is occurring. Sampling locations and frequencies will be the same as discussed in number one.

3. If fish eggs or larvae are found in the last sample taken in August, 1980, net samples will be taken, in the forebay on Tuesdays when pumping is occurring, until no fish eggs or larvae are found or until September 30, 1980, whichever occurs first. Sampling locations and frequencies will be the same as discussed in number one.

4. From April 15, 1980 to August 31, 1980, fish egg and larvae samples will be taken on Tuesdays in the Kankakee River at the railroad bridge transect (four locations, two depths, two replicates, once during the day and once during the night over a twenty-four hour period) and in Horse Creek (one location, one depth, four replicates, once during the day and once during the night over a twenty-four hour period).

5. Fish egg and larvae samples will be taken on Tuesdays in the discharge canal if the plant is discharging water from April 1, 1980 to July 1, 1980, (one location, one depth, two replicates, once during the day and once during the night). It may become necessary to modify this part of the study based on assessment of the situation once water is actually being discharged from the pond. Any proposed change would be discussed with the IEPA staff.

6. Two hundred of the samples collected during the fish egg and larvae program will also be examined for macroinvertebrate drift. Samples to be examined will be selected so that samples from each sampling transect, date and time period are represented.

B. Operational (after operation of Unit One)

If it is determined that an entrainment study is needed after Unit One is operational, it would be conducted following the same methods, schedules, sampling locations, ect., as discussed above under items 3 through 6. If after conducting the preoperational program, changes are indicated for the operational program any such changes will be coordinated with the IEPA staff. The proposed

QUESTION E291.21

Provide the status of any required operational demonstration under Section 316(b) of the Clean Water Act.

RESPONSE

An impingement program was conducted during the filling of the cooling pond, however, because the filling occurred during the winter, an entrainment study was not conducted. We have suggested that a one year impingement study be conducted during the first year of unit one operation. We plan to conduct an entrainment study during the first spring and summer seasons following Unit 1 being placed in commercial service. The enclosed correspondence explains the program.

Commonwealth Edison
72 West Adams Street, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

July 27, 1979

CERTIFIED MAIL

Mr. William Busch
Illinois Environmental
Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

Dear Mr. Busch:

This letter is in response to your letter of June 13, 1979, regarding the impingement and entrainment studies to be conducted at Braidwood Station (NPDES Permit No. IL 0048321) and is a follow-up to a meeting held at the Braidwood site with R. Schacht on July 17, 1979.

As a result of modifications in the construction schedules, the start of pond fill has changed from August, 1979 to fall (September-November) 1979, and the service date of Unit one has changed from October, 1981 to October, 1982.

During the site meeting, sampling locations were visited and sampling problems were discussed.

This meeting resulted in the following modifications and clarifications to the impingement and entrainment studies:

I. Impingement

The proposed impingement monitoring program (three consecutive twenty-four hour periods per week) will be conducted during the period of pond fill.

II. Entrainment

A. Preoperation (Before operation of Unit One)

1. If pond fill begins during September, 1979, net samples will be taken every Tuesday, during the month of September, in the intake forebay of the river screenhouse when pumping is occurring. In each of the two intake bays, two locations and two depths will be sampled once during the day and once during the night over a twenty-four hour period.

2. From April 15, 1980 to August 31, 1980, net samples will be taken in the intake bay on every Tuesday that pumping into the pond is occurring. Sampling locations and frequencies will be the same as discussed in number one.

3. If fish eggs or larvae are found in the last sample taken in August, 1980, net samples will be taken, in the forebay on Tuesdays when pumping is occurring, until no fish eggs or larvae are found or until September 30, 1980, whichever occurs first. Sampling locations and frequencies will be the same as discussed in number one.

4. From April 15, 1980 to August 31, 1980, fish egg and larvae samples will be taken on Tuesdays in the Kankakee River at the railroad bridge transect (four locations, two depths, two replicates, once during the day and once during the night over a twenty-four hour period) and in Horse Creek (one location, one depth, four replicates, once during the day and once during the night over a twenty-four hour period).

5. Fish egg and larvae samples will be taken on Tuesdays in the discharge canal if the plant is discharging water from April 1, 1980 to July 1, 1980, (one location, one depth, two replicates, once during the day and once during the night). It may become necessary to modify this part of the study based on assessment of the situation once water is actually being discharged from the pond. Any proposed change would be discussed with the IEPA staff.

6. Two hundred of the samples collected during the fish egg and larvae program will also be examined for macroinvertebrate drift. Samples to be examined will be selected so that samples from each sampling transect, date and time period are represented.

B. Operational (after operation of Unit One)

If it is determined that an entrainment study is needed after Unit One is operational, it would be conducted following the same methods, schedules, sampling locations, ect., as discussed above under items 3 through 6. If after conducting the preoperational program, changes are indicated for the operational program any such changes will be coordinated with the IEPA staff. The proposed

sample schedules will be followed unless a holiday or unforessen problems arise i.e., severe inclement weather, flooding conditions. If such an event occurs, appropriate actions will be taken.

A final report for the studies involving the preoperational impingement and entrainment studies will be submitted 120 days after completion of the study (report is due on December 31, 1980).

We will await your response to these proposed programs before initiating them. In order for the program to start in September, 1979 (if pond fill has begun), a response by late August would be appreciated. If you have any questions we will be happy to meet with you or you may call Dr. Richard Monzingo of my staff at 312/294-4450.

Sincerely,

John H. Hughes
Director of Water Quality

RGM:JHH:ds

cc: Mr. R. Schacht
Mr. A. Manzardo

ILLINOIS EPA
Environmental Protection Agency
2200 Churchill Road, Springfield, Illinois 62706

217/782-1696

August 20, 1979

Mr. John H. Hughes
Director of Water Quality
Commonwealth Edison Company
72 West Adams Street
Post Office Box 767
Chicago, Illinois 60690

Dear Mr. Hughes:

The Agency finds your proposed impingement and entrainment monitoring programs for the Braidwood Station (NPDES Permit No. IL0048321) acceptable as proposed in your letter of July 27, 1979.

Any changes to the proposed programs will require prior Agency approval.

Very truly yours,

Wm H Busch

William H. Busch, Manager
Field Operations Section
Division of Water Pollution Control

WHB:bld/9818a/10

cc: Gary Milburn, USEPA

Commonwealth Edison
72 West Adams Street, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

November 21, 1980

Mr. William Busch
Illinois Environmental
Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

Subject: NPDES Permit No. IL 0048321
Braidwood Generating Station

Dear Mr. Busch:

Construction at the Kankakee River Screenhouse for the Braidwood Station resumed in September, 1980. The coffer dams were removed in September.

The filling of the Braidwood Cooling Pond began on November 18, 1980. It will take from three to five months to fill the pond, based on current projections.

The required impingement study, began on November 18, 1980. The other field studies will resume or begin in the Spring of 1981.

The projected operating date for Unit One is now October, 1985, followed by Unit Two in October, 1986.

If you have any questions, we will be happy to meet with you or you may call Dr. Richard G. Monzingo of my staff at 312/294-4446.

Sincerely,

Thomas E. Hemminger
Thomas E. Hemminger
Director of Water Quality

RGM:TEH:ds

cc: Mr. R. Schacht
Mr. A. Manzardo

Commonwealth Edison
72 West Adams Street, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

December 29, 1981

Mr. William Busch
Illinois Environmental Protection
Agency
2200 Churchill Road
Springfield, Illinois 62706

Subject: Braidwood Generating Station
NPDES Permit No: ILL0048321

Dear Mr. Busch:

Attached is a report concerning the impingement study which was conducted at Braidwood's Kankakee River screenhouse during the filling of the cooling pond (as approved in the August 20, 1979 letter from W. Busch to J. Hughes).

The impingement study covers the period December 1, 1980 through February 18, 1981. On December 1, 1980 we began filling the cooling pond on a continuous 24 hour basis. The pond was declared filled on February 18, 1981).

An entrainment study was not conducted because continuous pumping did not occur during the study period April 15 through September 30. Pumping did occur on four occasions in June for brief periods of time. This pumping was related to preliminary testing of the make-up demineralizer. The water level in the cooling pond remained up, therefore, there was no need to pump additional water into the cooling pond.

The impingement data obtained during the filling of the cooling pond could not be extrapolated to the whole year because the sampling period was too short. We suggest that a one year impingement study be conducted when Braidwood Unit One begins commercial operation.

If you have any questions, we will be happy to meet with you or your staff or you may call Dr. Richard G. Monzingo of my staff at 312/294-4446.

Sincerely,

Thomas E Hemminger

Thomas E. Hemminger
Director of Water Quality

TEH:RGM:pc
Attachment

cc: Mr. R. Schacht w/att.
Mr. A. Manzardo w/att.

QUESTION E291.22

Provide copies of correspondence, if any, regarding federal or state agencies review and/or approval of results from the clam bed mapping studies.

RESPONSE

Page QE291.22-2 is a copy of a letter from the Department of Interior to the Corps of Engineers dated March 18, 1977 which indicates that the first clam survey, conducted before construction of the intake and discharges began, was reviewed. This letter also requests that another study be conducted approximately one year after the construction of the intake and outfall structures is completed.

Page QE291.22-4 is a copy of a letter to the Corp of Engineers from Commonwealth Edison dated June 6, 1983 which transmits the results of the clam study that was performed one year after construction was complete.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
LWR

MAR 18 1977

Colonel Andrew C. Remson, Jr.
District Engineer
U.S. Army Engineer District
Chicago
219 South Dearborn Street
Chicago, IL 60604

Dear Colonel Remson:

This letter refers to Public Notice NCCOD-P 3807411 dated August 9, 1974, and the Department of the Interior's letters of November 1, 1974, and July 22, 1976, regarding an application by Commonwealth Edison Company for a permit to construct a river intake screen house and blowdown outlet along the south bank of the Kanakakee River at the Braidwood Nuclear Power Generating Units 1 and 2 in Will County, Illinois.

These comments have been prepared in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and are consistent with the intent of the National Environmental Policy Act of 1969.

On January 25, 1977, biologists from the Service's Rock Island Field Office met with representatives of Commonwealth Edison to resolve the remaining difficulties with this permit application. Revised drawings were submitted on January 19, 1977, eliminating the cofferdam. The report of January 20, 1977, describing the clam bed mapping in the Kankakee River was reviewed, and Commonwealth Edison agreed to repeat this survey approximately one year after construction is completed.

The Department of the Interior, therefore, has no objection to the issuance of a permit provided the following conditions are stipulated in the permit issued for work proposed in the subject public notice.

1. Construction be modified as detailed in drawings dated January 19, 1977.

2. The aquatic monitoring program as submitted to the Nuclear Regulatory Commission by Commonwealth Edison in an August 26, 1976, letter be implemented.

3. Clam bed mapping as documented in the January 20, 1977, report be repeated approximately one year after completed construction of the intake and outfall structures in order to monitor possible impacts of construction on the mussel population.

Sincerely yours,

Raymond L. St. Ores

Raymond L. St. Oros
Acting Assistant Regional Director

cc: U.S. EPA, Federal Activities Branch, Chicago
Illinois EPA, Springfield Attn: Mr. Ward L. Akers
Illinois Dept. of Conservation, Springfield

Commonwealth Edison
72 West Adams Street, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

June 6, 1983

Lt. Colonel Christes A. Dovas
District Engineer
U.S. Army Engineer District
219 South Dearborn Street
Chicago, Illinois 60604

Dear Lt. Colonel Dovas:

On August 9, 1977 a permit (Application Number 3807411) was issued by Colonel Remson to Commonwealth Edison for construction of intake and outfall structures on the Kankakee River. One of the special conditions (e) was that Edison conduct a clam survey after construction was completed, as requested by the U.S. Department of the Interior, Fish and Wildlife Service in a letter to the Corps dated March 18, 1977.

Enclosed is a copy of the required report, which was prepared by Ecological Analysts, Inc., entitled "Freshwater Mussel Mapping of the Kankakee River near Custer Park, Illinois" and dated January, 1982.

If you have any questions, please contact Dr. Richard Monzingo of my staff at 312/294-4446.

Sincerely,

Thomas E. Hemminger
Director of Water Quality

2408E
RGM:TEH:ds

cc: U.S. Fish and Wildlife - Rock Island Office

QUESTION E310.1

Are there any substantial changes in the station external appearance or layout which have been made subsequent to the description in Section 3.1? If so please describe.

RESPONSE

The station building has been enlarged to accommodate the Technical Support Center. The Security Building has been enlarged and the parking lot has been expanded. The river screenhouse design was modified to present a lower profile by elimination of the overhead crane penthouse and the trash rack cleaning machinery has been screened from view from the river and the opposite shore. In addition, the screenhouse area was also extensively landscaped to minimize the aesthetic effects.

Figure 2.1-4 will be amended to depict changes in station layout and will be included in a future amendment to this ER.

QUESTION E310.2

Are there any new roads, transmission corridors or rail lines or relocations of roads, transmission corridors or rail lines near the plant which have been proposed subsequent to the description in Section 3.1 and 3.9? If so, please describe.

RESPONSE

There are no new roads, transmission corridors or rail lines or relocations of roads, transmission corridors or rail lines off site near the plant which have been proposed that would alter the current descriptions in Sections 3.1 and 3.9 to the best of our knowledge.

QUESTION E310.3

Section 2.1.2.1 states: "House counts were converted to population by assuming 3.4 persons per household based on 1970 U.S. Bureau of Census data for Will County. Comparable values for Grundy and Kankakee Counties were 3.17 and 3.15, respectively."

The NRC staff has calculated 1970 and 1980 values of persons per household for Will, Grundy, and Kankakee Counties using U.S. Bureau of Census data. The following table contains the results:

Persons per Household
by County

County	1970	1980
Will	3.38	2.96
Grundy	3.00	2.65
Kankakee	3.28	2.74

Source: U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population and Housing, Illinois, PHC80-V-15, March 1981.

Please revise the 1980 population estimates within 10 miles of the station using 1980 township based Census data of persons per househould.

RESPONSE

The 1980 population estimates within 10 miles of the station have been revised based on 1980 census data. The revised estimates are discussed in Section 2.1.2.1 and are shown in Table 2.1-2. The methods used for estimating the population are included in Section 2.1.2.

QUESTION E310.4

Section 2.1.2.1 indicates that the population growth within 10 miles is based on 1970 Census data, at the latest. Please revise your estimates to reflect the demographic data included in the 1980 Census.

RESPONSE

The estimated population growth within 10 miles of the station has been revised based on 1980 census data. The revised growth estimates are discussed in Section 2.1.2.1 and are shown in Table 2.1-2. The methods used for estimating and projecting are included in Section 2.1.2.

QUESTION E310.5

Section 2.1.2.2, which describes population between 10 and 50 miles of the station, describes population projections being made generally according to the same techniques used for the 0 to 10 mile region. Please revise the projections to reflect the demographic data available in the 1980 Census.

RESPONSE

Section 2.1.2.2 has been revised based on 1980 Census data. The revised estimates and projections for 10 to 50 miles from the station are shown in Table 2.1-3. The techniques used for making the estimates and projections are included in Section 2.1.2.

QUESTION E310.6

Section 2.6 of the ER-OL refers to plans for paleontologists to recover fossils in the strip-mining pits. The appendix of that section contains a letter dated June 13, 1974 from Byron Lee, Jr., Commonwealth Edison to B. J. Youngblood, NRC which refers to a Commonwealth Edison agreement with Dr. Eugene S. Richardson of the Field Museum of Natural History. The agreement is with regard to allowing collectors to search for fossils in the area of the site which had been strip-mined. The letter stated that "details remain to be developed."

What is the present status of that agreement and are any changes in the agreement foreseen once the station commences operation?

RESPONSE

The present agreement allows limited access to the Braidwood Station site for fossil collectors with admission passes jointly issued by the Field Museum of Natural History (Museum) and Commonwealth Edison Company (CECo). Access to the site for limited periods for others are arranged by obtaining preapproval from the Museum.

Access is granted to other fossil hunters to the strip-mined area south of the Braidwood Station site that is owned by CECo and leased to others by issuance of one day passes.

This policy will be reviewed at the time fuel is delivered to the site and again at the time fuel is loaded to assess the effect on security and emergency planning requirements.

QUESTION E310.7

Are the estimated 1986 taxes as shown in Table 8.2-1 in 1986 dollars? If so, please convert to 1982 dollars.

RESPONSE

The estimated 1986 taxes shown in Table 8.2-1 are in 1982 dollars. Table 8.2-1 has been revised to so indicate.

QUESTION E310.8

Section 2.6.2 reports that "the archeological investigations have not yet been completed" along the Braidwood-Crete transmission line. What is the present status of the archeological survey and when may the NRC expect to receive a report on that survey? Also, if there exists any correspondence with the State Historic Preservation Officer on the survey along the transmission line, please provide copies to the NRC.

RESPONSE

The archaeological investigations have been completed. The field work on the Braidwood to Davis Creek Substation portion of the transmission line and on the Davis Creek Substation site was done in 1978 and 1979 prior to construction of the transmission line and the substation. Field work on the Davis Creek to Crete portion of the transmission line began in 1979 and continued in 1980. The resurvey testing of four known prehistoric sites and the field work on parcels of right-of-way where access had been disputed and where facilities would be located was completed in March, 1983. Two reports covering all the phases of the investigation have been prepared. The first report was completed in 1981 and covered the 1978, 1979 and 1980 field work. The second report, completed in 1983, covers the final field work done in 1983. Both reports have been submitted to the State Historic Preservation Officer for review and approval and to the NRC staff.

QUESTION ER470.1

The applicant should provide the following information, which is necessary to estimate population and maximum-exposed individual doses due to gaseous releases. This information should reflect 1981-1982 (or most recent available) data.

1. Within 80 km of the reactor: the total projected year 2010 population, (based on 1980 census), annual meat production (kg/yr), annual milk production (liters/yr), and vegetable production (kg/yr) with separate data for leafy (e.g., lettuce) and nonleafy (e.g., corn) vegetables.

2. Fraction of year leafy vegetables are grown.

3. Fraction of ingested crop from garden.

4. Fraction of year cows, beef cattle, and goats are on pasture.

5. Fraction of daily intake of cows, beef cattle, and goats derived from pasture food while on pasture.

6. Absolute or relative humidity over growing season.

7. Average temperature over growing season.

8. Reconfirmation that data in Tables 2.1-13 and 2.1-14 are valid.

9. Tabulation of beef cattle within five miles of Braidwood similar to Tables 2.1-13 and 2.1-14.

The information requested above may be presented in tabular form.

RESPONSE

1. The total projected population within 80 km of the reactor for the year 2010 is found in the Environmental Report in revised Table 2.1-2 (0-10 miles) and Table 2.1-3 (10-50 miles). These tables have been revised based on 1980 census data. The information on meat production is found in revised Tables 2.1-17 (beef) and 2.1-18 (pork). Table 2.1-19 (mutton and lamb production) was not revised because statistics are no longer kept on mutton production

in this area, due to low volume. The information on milk production is found in revised Table 2.1-20. The vegetable production is found in revised Table 2.1-21 (leafy) and new Table 2.1-21A (nonleafy). The information in these tables is the most recent that is available from the U.S. Department of Commerce, the Illinois and Indiana Crop and Livestock Reporting Services and from the county agriculture extension advisors in Grundy, Kankakee and Will Counties.

2. The fraction of the year leafy vegetables are grown is 0.5. This is based on the local growing season of May through October.

3. The fraction of ingested crop from the garden is 0.76 for produce and 1.0 for leafy vegetables.

4. The fraction of the year cows, beef cattle and goats are on the pasture is 0.5.

5. The fraction of daily intake of cows, beef cattle and goats derived from pasture food while on pasture is 0.5.

6. The mean relative humidity over the growing season of 1982 was 73%.

7. The mean temperature over the 1982 growing season was 65.0°F.

8. Tables 2.1-13 and 2.1-14 have been revised and contain information obtained by a survey conducted on June 23, 1983.

9. Table QER470.1-1 shows the nearest beef animal and the nearest pig within 5 miles of the station in each sector.

TABLE QER470.1-1

SURVEY OF BEEF CATTLE AND PIGS
WITHIN A 5-MILE RADIUS OF THE BRAIDWOOD STATION

DIRECTION	BEEF CATTLE APPROXIMATE DISTANCE (miles)	PIGS APPROXIMATE DISTANCE (miles)	USE (Home or for sale)
N	2.4	2.3	Home
NNE	3.4	3.4	For sale
NE	3.8	3.3	For sale
ENE	2.9	--[a]	For sale
E	2.8	--	For sale
ESE	2.3	--	Home
SE	4.6	--	For sale
SSE	3.4	--	For sale
S	--[a]	--	--
SSW	--	--	--
SW	3.0	3.0	For sale
WSW	3.7	3.7	For sale
W	3.9	3.9	For sale
WNW	--	--	--
NW	1.7	--	Home
NNW	--	--	--

[a]None within 5 miles in this direction.

Survey was conducted by A. Lewis on June 23, 1983.

QUESTION E470.2

The applicant should provide the following information, which is necessary to estimate population and maximum-exposed individual doses due to liquid releases. This information should reflect 1981-1982 (or most recent available) data.

1. Projected year 2010 population (based on 1980 census) to 80 km.

2. Locations and estimates of commercial vertebrate and invertebrate fishing catches and sport vertebrate and invertebrate fishing catches (kg/yr) downstream of plant (to 80 km). Include bases for each estimate and representative dilution factors and discharge transit times to each location.

3. Locations and estimates of recreational use downstream including shoreline, boating, and swimming uses (to 80 km). Include bases for each estimate and representative dilution factors and discharge transit times to each locations.

4. Downstream locations and estimate of drinking water intakes (to 80 km). Include bases for each estimate and representative dilution factors and discharge transit times to each location.

The information requested above may be presented in tabular form.

RESPONSE

1. The population estimates and projections of growth for the years 1980, 1990, 2000, 2010 and 2020 from 0 to 80 km have been revised and the information is contained in Tables 2.1-2 and 2.1-3 in Section 2.1.2.

2. A point eighty kilometers (50 miles) downstream of the Braidwood Station discharge would include a 15 mile stretch of the Kankakee River (to its confluence with the Des Plaines River which forms the Illinois River); a small part of the Dresden Pool; all of the Marseilles pool; and most of the Starved Rock Pool. The approximate Illinois River mile for the Starved Rock, Marseilles, and Dresden Dams and the mouth of the Kankakee River are 231, 247, 271, and 273, respectively.

Since the Kankakee River is a fish preserve, commercial fishing for vertebrates and invertebrates is not allowed. The commercial fishing data for the Illinois River is by pools. The most recent data available from the state is as follows:

Year	Commercial Fish Catch by Pool in Pounds: Starved Rock Pool	Marseilles Pool	Dresden Pool
1977	2655	0	0
1978	3990	0	0
1979	315	0	0
1980	0	0	0
1981	0	0	0

This data indicates that commercial fishing in the Illinois River within 80 kilometers of the Braidwood Station discharge structure is negligible.

The state does not have data on the sport fishing take for the portions of the Kankakee and Illinois Rivers t'at are within the 80 km area of interest. The lack of commercial fishing takes in the three Illinois River pools in the area of interest indicates that a significant sport fishing take from these pools is unlikely.

In 1978 and 1979, a creel survey was conducted by CECo on a 25 mile reach of the Kankakee River from its mouth. Data from these surveys, when extrapolated indicate an annual take of 17,189 lbs of fish in the Kankakee River downstream from the Braidwood Station discharge. Most of this catch is carp and redhorse species 32% and 31% of total catch, respectively. The majority of the fish are caught in the area of the Wilmington dam to the mouth of the Kankakee. The estimated discharge transit time to the Wilmington dam is four hours with a dilution factor of ninety. Estimated discharge travel times and dilution factors for the Illinois River pools are:

	Pool		
	Dresden	Marseilles	Starved Rock
Estimated Travel Time - Hours	15	17	41
Dilution Factors	193	193	286

3. There are no authorized swimming areas or beaches downstream within 80 km of the station discharge.

Recreational boating is important on the navigable portion of the lower Kankakee River and on the Illinois River. The major categories of use are cruising, water skiing and fishing. The boating season for cruising and water skiing covers the period from mid-May to mid-September with most of the water skiing activity occurring in June, July and August. Both of these uses are mainly confined to weekends. Fishing is more important on the lower Kankakee than on any of the other pools within 80 km. The fishing season is longer than the water skiing and cruising seasons both in the spring and the fall. Fishing is popular during the weekday periods when there is not as much water skiing activity. Boat launchings for fishing during the week are conservatively estimated to be at a level of about 10% of the peak weekend launching numbers. Fall waterfowl hunting is an additional use throughout the area of interest. All access points report some hunting activity. The uses by area and pool are tabulated in Table QE470.2-1 as part of this response.

From the station discharge to the Wilmington Dam the Kankakee River is navigable for power boats but access is restricted to residents because there is no public launching ramp in the area. Recreation activity is almost exclusively boat fishing and bank fishing from residents properties and from the city park in Wilmington. Below the dam the river is shallow to a point downstream of the I-55 bridge. Bank fishing and caneoing are the main activities on this part of the river.

The lower Kankakee River and the first two miles of the Illinois River (from the confluence of the Kankakee and

Des Plaines Rivers to the Dresden Island Dam) are accessible to boaters from several points. The Des Plaines Fish and Wildlife Area provides a boat launching ramp on the Kankakee and there are marinas and boat clubs on the lower Des Plaines which provide ramps and mooring slips. The major categories of use for the combined areas are cruising, water skiing, and fishing. The operators report that most of the moored boats are used for cruising, while most of the ramp launched boats are used for water skiing and fishing. It was felt that most of the boats on the lower Kankakee and the Dresden pool of the Illinois remain in the pool for their activities. Bank fishing is done on both sides of the lower Kankakee River from the Des Plaines Fish and Wildlife Area and from the residential area on the opposite shore.

On the Marseilles Pool access to the river for boating is obtained from two State parks, William G. Stratton at Morris and Illini at Marseilles. In addition, there is a large marina and other private facilities. The major uses in the Marseilles Pool are cruising and water skiing. There is some boat fishing throughout the pool and some bank fishing reported at the State parks. The majority of the boats remain on the Marseilles Pool.

On the Starved Rock Pool there is no state park access point. There are no water front activities at Buffalo Rock State Park and the boat launching ramp at Starved Rock State Park is below the Starved Rock Lock and Dam. There are marinas and clubs on the pool plus a municipal boat ramp provided by the Ottawa Park District. Cruising and water skiing are the major uses. Houseboats are popular on the Starved Rock Pool. The result is larger average numbers of passengers and longer duration of time spent on the water. The majority of the boats remain in the pool for their activities.

4. There are no drinking water intakes from either the Kankakee or the Illinois Rivers within the distance of 80 km downstream from the Braidwood Station discharge.

TABLE QE470.2-1

RECREATIONAL USES DOWNSTREAM WITHIN 80 KM OF THE BRAIDWOOD STATION DISCHARGE

PEAK DAY USE WEEKEND/HOLIDAY	KANKAKEE RIVER DISCHARGE TO I-55 BRIDGE	ILLINOIS RIVER LOWER KANKAKEE AND DRESDEN POOL	ILLINOIS RIVER MARSEILLES POOL	ILLINOIS RIVER STARVED ROCK POOL
Number of Boats	*	650	570	530
Percent of Use				
Cruising		40%	45%	45%
Water Skiing		40%	45%	45%
Fishing	100%	20%	10%	10%
Boat Party Size	*	4	5	6
Duration of Activity (Hours)	*	4-5	6-8	8-10
Remain in Pool	100%	95%	95%	90%
Travel Time from Discharge to Area (Hours)	0	4	17	41
Dilution Factors	90	90(1) 193(2)	193	286

* Information not available.

(1) For lower Kankakee River.

(2) For Dresden Pool.

Sources:

Pohl, R., 1983, Des Plaines Fish and Wildlife Area, Telephone Conversation on June 28, 1983 with B. Barickman, CECo, Environmental Affairs (EA).

Walker, R., 1983, Joliet Yacht Club, Telephone Conversation on June 27, 1983 with B. Barickman, CECo, EA.

Vitek, J., 1983, Bayhill Marina, Telephone Conversation on June 27, 1983 with B. Barickman, CECo, EA.

Carr, D., 1983, William G. Stratton State Park, Telephone Conversation on June 27, 1983 with B. Barickman, CECo, EA.

Thorpe, J., 1983, Springbrook Marina, Telephone Conversation on June 28, 1983 with B. Barickman, CECo, EA.

Castelli, R., 1983, Illini State Park, Telephone Conversation on June 27, 1983 with B. Barickman, CECo, EA.

Schomas, B., Fox River Marina, Telephone Conversation on June 28, 1983 with B. Barickman, CECo, EA.

Powers, R., 1983, Starved Rock Marina, Telephone Conversation on June 28, 1983 with B. Barickman, CECo, EA.

Kleczewski, R., 1983, Starved Rock State Park, Telephone Conversation on June 27, 1983 with B. Barickman, CECo, EA

QUESTION ER470.3

The applicant should update Section 6.2.3 of the Environmental Report to include tables equivalent to tables presented in USNRC Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program, Revision 1," November 1979 (attached). The licensee should also indicate when the pre-operational radiological monitoring program will begin.

RESPONSE

Section 6.1.5, Radiological Monitoring, contains a description of the program from its start, Summer of 1983, continuing through the first two years after commercial operation of the plant begins.

The monitoring program after two years of commercial operation is described in Section 6.2.3.

Both Sections 6.1.5 and 6.2.3 have been revised in Amendment 2, July 1983, to provide the latest available information.

QUESTION 7.1.11

1. Discuss the status of the evacuation plan. When will reliable evacuation speed estimates be available?

RESPONSE

The present status of the Braidwood Station evacuation plan is the "Preliminary Evacuation Time Study of the 10-Mile Radius Emergency Planning Zone at the Braidwood Station," dated August 1980. A copy of this study, which was attached to the L. O. Del George (CECo) letter to D. G. Eisenhut, dated August 29, 1980, has been provided to the staff as a partial response to this question. This study presents evacuation time estimates which are very conservative.

A new evacuation time study for Braidwood Station is expected to be completed by December 1983 using present standards and updated population data.