Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

March 16, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Braidwood Station Units 1 and 2
Additional FSAR Information
NRC Docket Nos. 50-456/457

References (a): B. J. Youngblood letter to L. O. DelGeorge dated January 14, 1983

Dear Mr. Denton:

The above Reference requested that the Commonwealth Edison Company provide certain additional information concerning our FSAR for Braidwood Station Units 1 and 2.

The Attachment to this letter provides our response to Questions 330.2, 371.7, 371.8, 371.11, and 371.13 through 371.15. Our FSAR will be amended to include the information contained in the Attachment to this letter as appropriate. Additionally, our schedule for submittal of the remaining open items is currently being discussed with Ms. Janice A. Stevens.

Please address any questions that you or your staff may have concerning this matter to this office.

One (1) signed original and fifteen (15) copies of this letter with Attachment are provided for your use. For the purposes of clarity, one (1) set of 11" x 17" figures referenced in our responses to the above questions are being sent directly to Ms. Janice A. Stevens.

Very truly yours,

E. Douglas Swartz

E. Douglas Swartz
Nuclear Licensing Administrator

Attachment

cc: J. G. Keppler - RIII
RIII Inspector - Braidwood
6150N

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1/16

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A PDR

QUESTION 330.2

"Please provide an update to the population data shown in Section 2.1 to reflect the 1980 Census data."

RESPONSE

As requested, Tables 2.1-2, 2.1-3, 2.1-7, 2.1-8, 2.1-9, and 2.1-10, and Figures 2.1-8, 2.1-11, and 2.1-12 have been revised. Subsections 2.1.3 and 2.1.4 have also been revised.

Transient population values have not been updated since these are generally not affected by the 1980 census data. However, in the case of transient population within the 1-1/8 mile low population zone (LPZ) (see Table 2.1-8), the applicant has investigated the status of the Chicago Beagle Club located within the LPZ in the southwest sector. It was determined that the peak daily attendance at the club facilities is 500 persons. This is considerably less than the estimated peak daily attendance of 1500 which currently appears in Table 2.1-4.

Note also that the population projections in the revised tables have been made to the year 2020.

b. public notice of hearing on this matter was given,

c. a public hearing was held, and

d. a final hearing was held and a final order issued.

Paul Abraham (Highway Commissioner of Reed Township) and Mildred Blecha (Town Clerk for Reed Township) were the public authorities who made the final determination. No roads will be relocated.

2.1.3 Population Distribution

The population projections and the list of cities with their projected populations, found in Tables 2.1-2, 2.1-3, 2.1-9, and 2.1-10 are generated by a system of Sargent & Lundy (S&L) developed computer programs (Reference 1). The demographic tables present the population figures broken into 16 directional segments and 10 distance increments surrounding the site, while the list of cities details populations in urban areas, their distance and direction from the site, and their 2020 projected populations.

The U.S. Bureau of the Census 1980 population for all townships between 10 and 50 miles of the station was proportioned into each of the 16 directional sectors and distance increments. 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. The population thus derived from each sector was used as input to the computer program.

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 georgraphic 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.

For greater accuracy in the 0- to 10-mile region, a house count was obtained from a combination of data obtained from 1981 and 1982 aerial photographs, and 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 based on the Census Bureau's statistics listed in Table 2.1-11 (Reference 2).

2.1.3.1 Population Within 10 Miles

The geographical location of the sectors within 10 miles are identified in Figure 2.1-7. Table 2.1-2 shows the 1980 and projected population distribution within 10 miles of the Braidwood Station. 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 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.

2.1.3.2 Population Between 10 and 50 Miles

The 1980 population distribution and the estimated projected population distribution 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 and is projected to approach 5,124,734 by 2020.

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 south and south-southwest sectors are the least populated sectors with an estimated population of 8,886 and 12,123 respectively.

Braidwood FSAR

Editor Note

No change

2.1-7

mile area, which is highly unlikely, the total population of this area would increase during working hours by only about 5%.

As shown in Table 2.1-6, there are 16 schools within 10 miles of the site, and they had a total 1975-1976 enrollment of 5817 students and a staff of 283 teachers. The great majority of students attending these schools reside within a 10-mile radius of the site.

The 1980 and projected population within the 10-mile radius from the site is given in Table 2.1-7. This table includes the residential population and the peak daily transient population resulting from recreational activities within the 10-mile area.

2.1.3.4 Low Population Zone

The Low Population Zone (LPZ) as defined in 10 CFR 100 is "the area immediately surrounding the Exclusion Area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protection measures could be taken in their behalf in the event of a serious accident." 10 CFR 100.11 list a numerical criterion to be met by the LPZ, namely, that the LPZ be "of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of passage) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure."

The LPZ for the Braidwood Station is the area including the Exclusion Area within a 1-1/8-mile (1810-meter) radius (measured from the midpoint between the two reactors) of the site. This choice of the LPZ radius satisfies the radiation dose criteria (see Chapter 15.0). The closest population center of 25,000 person or more is Joliet, Illinois, located approximately 20 miles north-northeast of the station.

Figure 2.1-10 depicts the highways, railroads, and recreational facilities within the LPZ. The 1980 and projected population within the LPZ by sectors is given in Table 2.1-8. This table includes the residential population and the transient populations resulting from activities in the LPZ.

As shown in Table 2.1-4, there is one private recreational facility located within the LPZ. The Chicago Beagle Club, located approximately 1/2 mile southwest of the site near the village of Godley, has 75 families who are members and an estimated peak daily attendance of 500 persons. Field trials are held three times a year (April, August, and November) for a duration of 1 day. A meeting to elect club officers is held in January. Some of the members (perhaps a dozen or less) also use the facilities on weekends for dog trials and training (Reference 7).

In addition to the recreational facility within the LPZ, there are 11 private recreational facilities located between 1-1/8 and 5 miles from the site. Their approximate locations, membership and estimated peak daily attendance are outlined in Table 2.1-4.

There are no schools within the LPZ. The nearest schools are the Braidwood Elementary School, located approximately 1.4 miles north-northeast in Braidwood, the Reed Custer High School, located approximately 1.4 miles north-northeast in Braidwood, and the Braceville Elementary School, located approximately 2.0 miles southwest in Braceville.

In addition to the above three schools, there are four schools located between 3 and 5 miles from the site. Table 2.1-6 outlines the approximate location and number of teachers and students for each school.

There are no industrial establishments within the LPZ. Table 2.1-5 outlines the industries within 5 miles of the site and gives their approximate number of employees. There are also no known commercial establishments located within the LPZ which could be expected to produce sizeable changes in the transient population of the area. The only known commercial establishment is the Hileman's Junk Yard, located approximately 2/3 mile north-northeast of the center of the reactors. The estimated 1980 and projected transient population within the LPZ is 500. This estimated transient population is related to the Chicago Beagle Club located within the LPZ.

2.1.3.5 Population Center

The nearest population center is Joliet, located approximately 20 miles north-northeast of the site. This distance meets the population center criterion of 10 CFR 100.11, namely, that a population center distance be "at least one and one-third times the distance from the reactor to the outer boundary of the low population zone." According to the 1980 population census, Joliet had a population of 77,956, a decrease of 3% during the last decade. Kankakee, the second closest population center, located approximately 20 miles east-southeast, had a population of 30,141 in 1980. Joliet and Kankakee are projected to be 82,501 and 31,065, respectively, by 2020. Table 2.1-9 lists the population centers within 50 miles of the site with their 1980 and projected 2020 population, and Figure 2.1-11 locates them. There is a total of 25 population centers within a 50-mile radius. Most of these centers are located near the greater Chicago municipal area, 40 to 50 miles northeast of the site.

Table 2.1-10 shows the distance and approximate direction to and the 1980 population of all urban centers (population greater than 2500) within a 30-mile radius of the site along with their projected 2020 population. It should be noted that there are only 22 such urban centers and that only two of these, Joliet and Kankakee, are population centers.

2.1.3.6 Population Density

The average population density within 10 miles of the site is estimated to be 87 people/mi^2. The maximum densities within 10 miles are in and around the cities of Braidwood (1 to 3 miles north and north-northeast) and Wilmington (5-10 miles northeast and east-northeast). The population density within 10 miles is projected to be 113 by 2020.

The average population density in 1980 within 50 miles of the site is estimated to be approximately 583 people/mi^2. By 2020, the average density is projected to reach 653 people/mi^2 within 50 miles. Figure 2.1-12 shows the 1980 and 2020 projected populations with relation to the uniform densities of 500 people/mi^2 and 1000 people/mi^2 respectively in each of the 16 compass directions within 50 miles of the plant site. Tables 2.1-2 and 2.1-3 detail the cumulative populations shown in Figure 2.1-12.

2.1.4 References

1. Demog Studies (DEMOG) 11.1.018-3.1 (1974), Sargent & Lundy Computer Program, revised 1982.

2. U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population and Housing, Washington, D.C., 1981.

3. "Recreational Areas," Illinois Department of Conservation, State of Illinois, 1976.

4. "Goose Lake Prairie State Park," Illinois Department of Conservation, State of Illinois, 1974.

5. "Kankakee River State Park," Illinois Department of Conservation, State of Illinois, 1974.

6. "Illinois and Michigan Canal State Trail," Illinois Department of Conservation, State of Illinois, 1975.

7. Ms. P. Zidich, Co-President, Chicago Beagle Club, Telephone Conversation with Ms. B. Barickman, Commonwealth Edison, October 28, 1982.

TABLE 2.1-2

ESTIMATED 1980 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	0.0 TO 1.0	1.0 TO 2.0	2.0 TO 3.0	3.0 TO 4.0	4.0 TO 5.0	5.0 TO 10.0	0.0 TO 10.0
N	34	690	389	15	2	309	1439
NNE	75	823	960	294	70	234	2456
NE	0	107	103	0	480	4735	5425
ENE	4	12	22	22	291	1980	2331
E	0	0	13	28	22	1027	1090
ESE	0	0	17	18	50	236	321
SE	0	0	4	9	8	156	177
SSE	0	0	60	9	235	358	662
S	0	0	0	3	3	686	692
SSW	0	8	17	29	173	849	1076
SW	402	296	214	19	89	1384	2404
WSW	82	218	0	37	214	163	714
W	0	34	179	3	11	794	1021
WNW	8	0	8	37	13	251	317
NW	4	25	42	1499	1340	928	3838
NNW	6	256	119	1692	526	920	3519
Sum for radial interval	615	2469	2147	3714	3527	15010	27482
Cummulative total to outer radius	615	3084	5231	8945	12472	---	27482
Average density (people/mi^2) in radial region	196	262	137	169	125	64	87

BRAIDWOOD-FSAR

TABLE 2.1-2 (Cont'd)

PREDICTED 1990 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	0.0 TO 1.0	1.0 TO 2.0	2.0 TO 3.0	3.0 TO 4.0	4.0 TO 5.0	5.0 TO 10.0	0.0 TO 10.0
N	44	890	502	18	2	356	1812
NNE	97	1061	1238	307	73	247	3023
NE	0	138	133	0	501	5037	5809
ENE	5	15	26	25	327	2084	2482
E	0	0	15	31	25	1105	1176
ESE	0	0	20	20	56	269	365
SE	0	0	5	10	9	181	205
SSE	0	0	77	11	276	414	778
S	0	0	0	4	4	772	780
SSW	0	8	17	30	177	869	1101
SW	478	304	220	20	94	1473	2589
WSW	104	224	0	38	221	167	754
W	0	35	184	3	12	857	1091
WNW	8	0	8	38	14	297	365
NW	5	26	43	1560	1663	1291	4588
NNW	8	328	140	2246	715	1414	4851
Sum for radial interval	749	3029	2628	4361	4169	16833	31769
Cummulative total to outer radius	749	3778	6406	10767	14936	---	31768
Average density (people/mi^2) in radial region	238	321	167	198	147	71	101

TABLE 2.1-2 (Cont'd)

PREDICTED 2000 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	0.0 TO 1.0	1.0 TO 2.0	2.0 TO 3.0	3.0 TO 4.0	4.0 TO 5.0	5.0 TO 10.0	0.0 TO 10.0
N	47	956	539	19	2	375	1938
NNE	104	1140	1330	317	75	255	3221
NE	0	148	143	0	517	5219	6027
ENE	6	17	28	26	343	2154	2574
E	0	0	16	33	26	1148	1223
ESE	0	0	22	21	59	283	385
SE	0	0	6	11	10	191	218
SSE	0	0	83	12	291	436	822
S	0	0	0	4	4	809	817
SSW	0	8	18	31	181	893	1131
SW	506	313	226	20	97	1527	2689
WSW	111	230	0	39	228	171	779
W	0	36	189	3	12	891	1131
WNW	8	0	8	39	15	314	384
NW	6	26	44	1608	1776	1405	4865
NNW	8	352	148	2426	776	1561	5271
Sum for radial interval	796	3226	2800	4609	4412	17632	33475
Cummulative total to outer radius	796	4022	6822	11431	15843	---	33475
Average density (people/mi^2) in radial region	253	342	178	210	156	75	107

TABLE 2.1-2 (Cont'd)

PREDICTED 2010 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	0.0 TO 1.0	1.0 TO 2.0	2.0 TO 3.0	3.0 TO 4.0	4.0 TO 5.0	5.0 TO 10.0	0.0 TO 10.0
N	48	983	554	20	2	386	1993
NNE	107	1173	1368	326	77	262	3313
NE	0	152	147	0	532	5368	6199
ENE	6	17	29	27	352	2216	2647
E	0	0	17	34	27	1180	1258
ESE	0	0	22	22	61	291	396
SE	0	0	6	11	10	197	224
SSE	0	0	86	12	299	448	845
S	0	0	0	4	4	832	840
SSW	0	9	18	31	186	919	1163
SW	520	322	233	21	100	1570	2766
WSW	114	237	0	40	234	176	801
W	0	37	195	3	13	917	1165
WNW	9	0	9	40	15	323	396
NW	6	27	46	1654	1826	1445	5004
NNW	9	362	153	2495	798	1605	5422
Sum for radial interval	819	3319	2883	4740	4536	18135	34432
Cummulative total to outer radius	819	4138	7021	11761	16297	---	34432
Average density (people/mi^2) in radial region	261	352	184	216	160	77	110

TABLE 2.1-2 (Cont'd)

PREDICTED 2020 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	0.0 TO 1.0	1.0 TO 2.0	2.0 TO 3.0	3.0 TO 4.0	4.0 TO 5.0	5.0 TO 10.0	0.0 TO 10.0
N	50	1011	570	20	2	397	2050
NNE	110	1206	1407	336	80	270	3409
NE	0	157	151	0	547	5520	6375
ENE	6	18	30	27	363	2279	2723
E	0	0	17	35	27	1214	1293
ESE	0	0	23	22	62	299	406
SE	0	0	6	11	10	202	229
SSE	0	0	88	12	308	461	869
S	0	0	0	4	4	856	864
SSW	0	9	19	32	192	945	1197
SW	535	331	239	21	103	1615	2844
WSW	117	244	0	42	241	181	825
W	0	38	200	4	13	943	1198
WNW	9	0	9	42	16	332	408
NW	6	28	47	1701	1878	1486	5146
NNW	9	372	157	2566	820	1651	5575
Sum for radial interval	842	3414	2963	4875	4666	18651	35411
Cummulative total to outer radius	842	4256	7219	12094	16760	---	35411
Average density (people/mi^2) in radial region	268	362	189	222	165	79	113

TABLE 2.1-3

ESTIMATED 1980 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	10.0 TO 20.0	20.0 TO 30.0	30.0 TO 40.0	40.0 TO 50.0	10.0 TO 50.0	0.0 TO 50.0
N	18118	21607	159852	196880	396457	397896
NNE	18014	140555	210493	806860	1175922	1178378
NE	4170	31037	328860	1831653	2195720	2201145
ENE	1252	7008	135725	251879	395864	398195
E	1875	7055	6972	16999	32901	33991
ESE	25876	45742	9524	3854	84996	85317
SE	3479	6320	2591	9739	22129	22306
SSE	1963	1977	5545	2618	12103	12765
S	1191	1583	2918	2502	8194	8886
SSW	833	1395	6401	2418	11047	12123
SW	4928	2012	14651	6144	27733	30137
WSW	711	2612	21515	5561	30399	31113
W	1075	2013	8987	31459	43534	44555
WNW	1970	9491	19687	4206	35354	35671
NW	11138	3675	12042	4979	31834	35672
NNW	1840	6195	29119	11818	48972	52491
Sum for radial interval	98431	290277	974882	3189569	4553159	4580641
Cummulative total to outer radius	125913	416190	1391072	4580641	---	4580641
Average density (people/mi^2) in radial region	104	185	443	1128	604	583

TABLE 2.1-3 (Cont'd)

PREDICTED 1990 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	10.0 TO 20.0	20.0 TO 30.0	30.0 TO 40.0	40.0 TO 50.0	10.0 TO 50.0	0.0 TO 50.0
N	24174	27526	187765	247373	486838	488650
NNE	18675	150493	268507	790971	1228646	1231669
NE	5273	44293	379601	1676391	2105558	2111367
ENE	1367	8580	154612	258285	422844	425326
E	1219	5192	8140	22523	37074	38250
ESE	30443	47173	10307	4231	92154	92519
SE	3821	6630	2636	9663	22750	22955
SSE	2140	2005	5524	2388	12057	12835
S	1313	1577	2730	2247	7867	8647
SSW	849	1368	6436	2083	10736	11837
SW	5268	1926	15657	6067	28918	31507
WSW	622	2499	20820	5292	29233	29987
W	1087	2349	9290	30514	43240	44331
WNW	2246	10293	18757	4296	35592	35957
NW	11881	4141	14168	4814	35004	39592
NNW	2127	7868	34744	14888	59627	64478
Sum for radial interval	112505	323913	1139694	3082026	4658138	4689907
Cummulative total to outer radius	144274	468187	1607881	4689907	---	4689907
Average density (people/mi^2) in radial region	119	206	518	1090	618	597

TABLE 2.1-3 (Cont'd)

PREDICTED 2000 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	10.0 TO 20.0	20.0 TO 30.0	30.0 TO 40.0	40.0 TO 50.0	10.0 TO 50.0	0.0 TO 50.0
N	26127	29520	198444	264664	518755	520693
NNE	19241	156133	288030	804612	1268016	1271237
NE	5648	48379	399855	1678125	2132007	2138034
ENE	1424	9137	162464	270509	443534	446108
E	1092	4868	8640	24871	39471	40694
ESE	32184	48546	10729	4506	95965	96350
SE	3985	6849	2704	9862	23400	23618
SSE	2228	2056	5640	2387	12311	13133
S	1370	1610	2746	2236	7962	8779
SSW	871	1392	6585	2051	10899	12030
SW	5464	1948	16237	6182	29831	32520
WSW	615	2527	21114	5345	29601	30380
W	1114	2480	9565	30962	44121	45252
WNW	2360	10708	18950	4412	36430	36814
NW	12317	4342	14978	4881	36518	41383
NNW	2241	8433	36828	15936	63438	68709
Sum for radial interval	118281	338928	1203509	3131541	4792259	4825734
Cummulative total to outer radius	151756	490684	1694193	4825734	---	4825734
Average density (people/mi^2) in radial region	126	216	547	1108	636	614

TABLE 2.1-3 (Cont'd)

PREDICTED 2010 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	10.0 TO 20.0	20.0 TO 30.0	30.0 TO 40.0	40.0 TO 50.0	10.0 TO 50.0	0.0 TO 50.0
N	26871	30361	204093	272197	533522	535515
NNE	19788	160577	296228	827514	1304107	1307420
NE	5809	49756	411236	1727849	2194650	2200849
ENE	1465	9397	167114	285085	463061	465708
E	1123	5007	8948	26282	41360	42618
ESE	33100	49928	11049	4758	98835	99231
SE	4098	7043	2781	10150	24072	24296
SSE	2292	2114	5801	2455	12662	13507
S	1409	1656	2824	2300	8189	9029
SSW	896	1431	6772	2109	11208	12371
SW	5619	2004	16699	6358	30680	33446
WSW	632	2599	21715	5497	30443	31244
W	1146	2550	9837	31843	45376	46541
WNW	2427	11013	19490	4538	37468	37864
NW	12668	4465	15404	5019	37556	42560
NNW	2304	8673	37876	16389	65242	70664
Sum for radial interval	121647	348574	1237867	3230343	4938431	4972863
Cummulative total to outer radius	156079	504653	1742520	4972863	---	4972863
Average density (people/mi^2) in radial region	129	222	563	1143	655	633

TABLE 2.1-3 (Cont'd)

PREDICTED 2020 POPULATION BY ANNULAR SECTORS

DISTANCE RANGE FROM SITE(MILES)

SECTOR	10.0 TO 20.0	20.0 TO 30.0	30.0 TO 40.0	40.0 TO 50.0	10.0 TO 50.0	0.0 TO 50.0
N	27636	31225	209902	279945	548708	550758
NNE	20352	165147	304659	851067	1341225	1344634
NE	5974	51172	422941	1779099	2259186	2265561
ENE	1507	9665	171899	300466	483537	486260
E	1155	5149	9267	27773	43344	44637
ESE	34042	51349	11379	5025	101795	102201
SE	4215	7244	2860	10447	24766	24995
SSE	2357	2175	5966	2525	13023	13892
S	1449	1703	2905	2365	8422	9286
SSW	921	1472	6965	2169	11527	12724
SW	5779	2061	17175	6539	31554	34398
WSW	650	2673	22333	5654	31310	32135
W	1178	2623	10117	32749	46667	47865
WNW	2497	11326	20044	4667	38534	38942
NW	13028	4592	15843	5162	38625	43771
NNW	2370	8920	38954	16856	67100	72675
Sum for radial interval	125110	358496	1273209	3332508	5089323	5124734
Cummulative total to outer radius	160521	519017	1792226	5124734	---	5124734
Average density (people/mi^2) in radial region	133	228	579	1179	675	653

TABLE 2.1-7

1980 AND PROJECTED POPULATION DISTRIBUTION BETWEEN 0-10 MILES OF THE BRAIDWOOD SITE INCLUDING PEAK DAILY TRANSIENT POPULATION

SECTOR DESIGNATION	1980	1990	2000	2010	2020
N	3,439 (1,439+2,000*)	3,812 (1,812+[illegible])	3,938 (1,938+2,000*)	3,993 (1,993+2,000*)	4,050 (2,050+2,000*)
NNE	5,456 (2,456+3,000*)	6,0[illegible]3 (3,02[illegible]+3,000*)	6,221 (3,221+3,000*)	6,313 (3,313+3,000*)	6,409 (3,409+3,000*)
NE	6,825 (5,425+1,400*)	7,209 (5,809+1,400*)	7,427 (6,027+1,400*)	7,599 (6,199+1,400*)	7,775 (6,375+1,400*)
ENE	2,331	2,842	2,574	2,647	2,723
E	34,090 (1,090+33,000*)	34,176 (1,176+33,000*)	34,223 (1,223+33,000*)	34,258 (1,258+33,000*)	34,293 (1,293+33,000*)
ESE	321	365	385	396	406
SE	177	205	218	224	229
SSE	1,262 (662+600*)	1,378 (778+600*)	1,422 (822+600*)	1,445 (845+600*)	1,469 (869+600*)
S	717 (692+25*)	805 (780+25*)	842 (817+25*)	865 (840+25*)	889 (864+25*)
SSW	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	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	779	801	825
W	1,020	1,091	1,131	1,165	1,198
WNW	317	365	384	396	408
NW	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	10,331 (3,519+6,812*)	11,663 (4,851+6,812*)	12,083 (5,271+6,812*)	12,234 (5,422+6,812*)	12,387 (5,575+6,812*)
Sum for 0-10-mile interval	78,919 (27,482+51,437*)	83,206 (31,769+51,437*)	84,912 (33,475+51,437*)	85,[illegible]69 (34,432+51,437*)	86,848 (35,411+51,437*)
Average density (persons/mi^2) in 0-10-mile interval	251	265	270	273	276

*Denotes transient population only.

TABLE 2.1-8

1980 AND PROJECTED POPULATION DISTRIBUTION WITHIN THE LPZ INCLUDING TRANSIENT POPULATION

SECTOR DESIGNATION	1980	1990	2000	2010	2020
N	68	88	94	96	100
NNE	113	146	156	161	165
NE	0	0	0	0	0
ENE	4	5	6	6	6
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	902 (402 + 500*)	978 (478 + 500*)	1,006 (506 + 500*)	1,020 (520 + 500*)	1,035 (535 + 500*)
WSW	98	112	119	123	126
W	0	0	0	0	0
WNW	8	8	8	9	9
NW	4	5	6	6	6
NNW	12	16	16	18	18
Sum for LPZ	1,205 (705 + 500*)	1,358 (858 + 500*)	1,411 (911 + 500*)	1,439 (939 + 500*)	1,465 (965 + 500*)
Average density (persons/mi^2) in LPZ	303	342	355	362	368

*Denotes transient population only. (Reference)

Reference:

P. Zidich, Co-President Chicago Beagle Club, Telephone Conversation with B. Barickman, Commonwealth Edison, October 28, 1982.

TABLE 2.1-9

POPULATION CENTERS WITHIN 50 MILES OF THE SITE

(1980)

POPULATION* CENTER	COUNTY	1980 POPULATION	2020 POPULATION
Joliet	Will	77,956	82,501
Kankakee	Kankakee	30,141	31,065
Park Forest	Will and Cook	26,222	35,023
Aurora	Kane	81,293	92,830
Chicago Heights	Cook	37,026	43,046
Downers Grove	DuPage	39,274	53,334
Harvey	Cook	35,810	39,869
Oak Lawn	Cook	60,590	66,883
Wheaton	DuPage	43,043	57,640
Calumet City	Cook	39,673	43,908
Chicago (part)	Cook	3,005,072	2,847,231
Lombard	DuPage	37,295	41,175
Hammond	Lake (Ind.)	93,714	98,434
Elmhurst	DuPage	44,251	50,140
Maywood	Cook	27,998	27,136
Tinley Park	Will and Cook	26,171	39,936
Highland	Lake (Ind.)	25,935	27,241
East Chicago	Lake (Ind.)	39,786	41,790
Oak Forest	Cook	26,096	32,529
Lansing	Cook	29,039	32,444
Addison	DuPage	28,836	37,059
Bolingbrook	DuPage and Will	37,261	64,928
Naperville	DuPage and Will	42,330	65,976
Berwyn	Cook	46,849	44,418
Cicero	Cook	61,232	59,853

*A population center is defined as an urban area having 25,000 or more persons.

BRAIDWOOD-FSAR

TABLE 2.1-10

URBAN CENTERS WITHIN 30 MILES OF THE SITE

(1980)

URBAN CENTER*	COUNTY	1980 POPULATION	2020 POPULATION
Coal City	Grundy	3,028	3,898
Wilmington	Will	4,424	5,032
Morris	Grundy	8,833	9,954
Dwight	Livingston	4,146	4,905
Bourbonnais	Kankakee	13,280	18,776
Bradley	Kankakee	11,008	15,564
Joliet	Will	77,956	82,501
Kankakee	Kankakee	30,141	34,489
Manteno	Kankakee	3,155	1,077
Crest Hill	Will	9,252	10,907
New Lenox	Will	5,792	8,916
Lockport	Will	9,017	10,188
Plainfield	Will	4,485	6,160
Romeoville	Will	15,519	23,172
Momence	Kankakee	3,297	4,001
Marsailles	LaSalle	4,766	5,659
Channahon	Will	3,734	5,791
Frankfort	Will	4,357	7,374
Mokena	Will	4,578	7,748
Peotone	Will	2,832	3,507
Shorewood	Will	4,714	7,556
Braidwood	Will	3,429	5,026

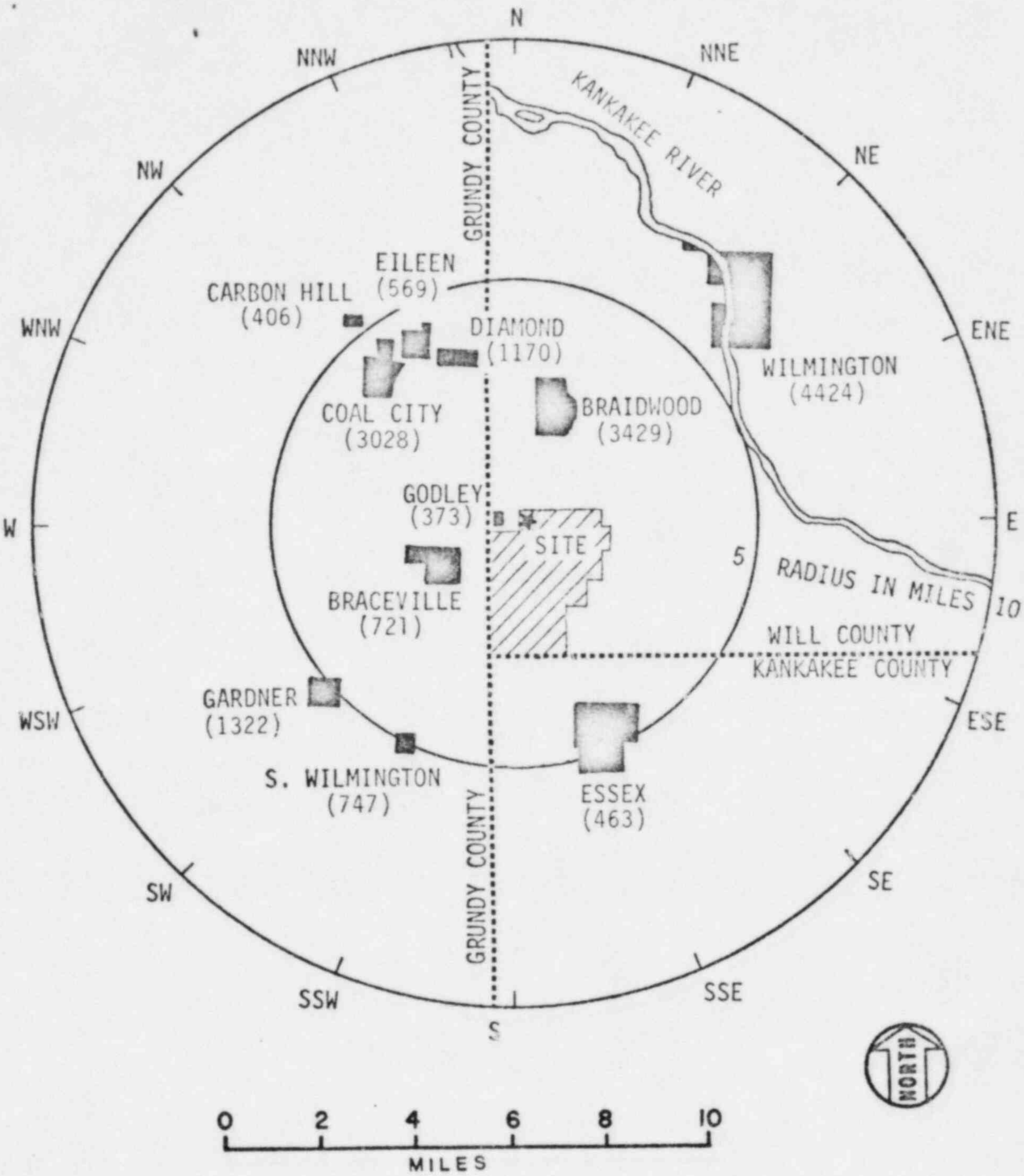
*An urban center is defined as an incorporated or an unincorporated place with a population of over 2500 according to the 1970 census.

TABLE 2.1-11

AVERAGE NUMBER OF PEOPLE PER HOUSEHOLD

IN TOWNSHIPS WITHIN 10 MILES OF SITE

COUNTIES (TOWNSHIPS)	AVERAGE NO. OF PEOPLE PER HOUSEHOLD
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



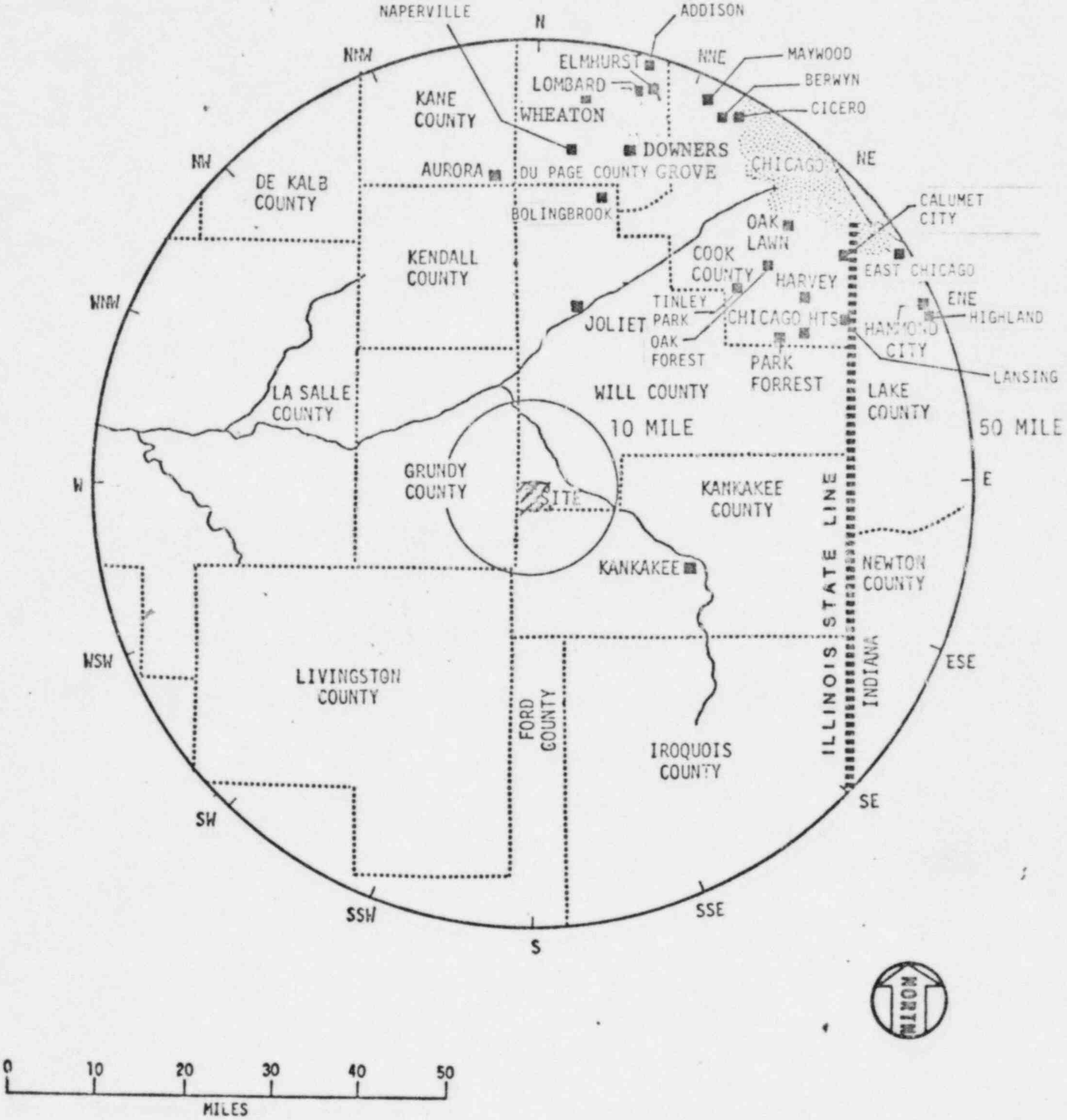
( ) INDICATES 1980 CENSUS POPULATION

BRAIDWOOD STATION

FINAL SAFETY ANALYSIS REPORT

FIGURE 2.1-8

CITIES AND VILLAGES
WITHIN TEN MILES OF THE SITE

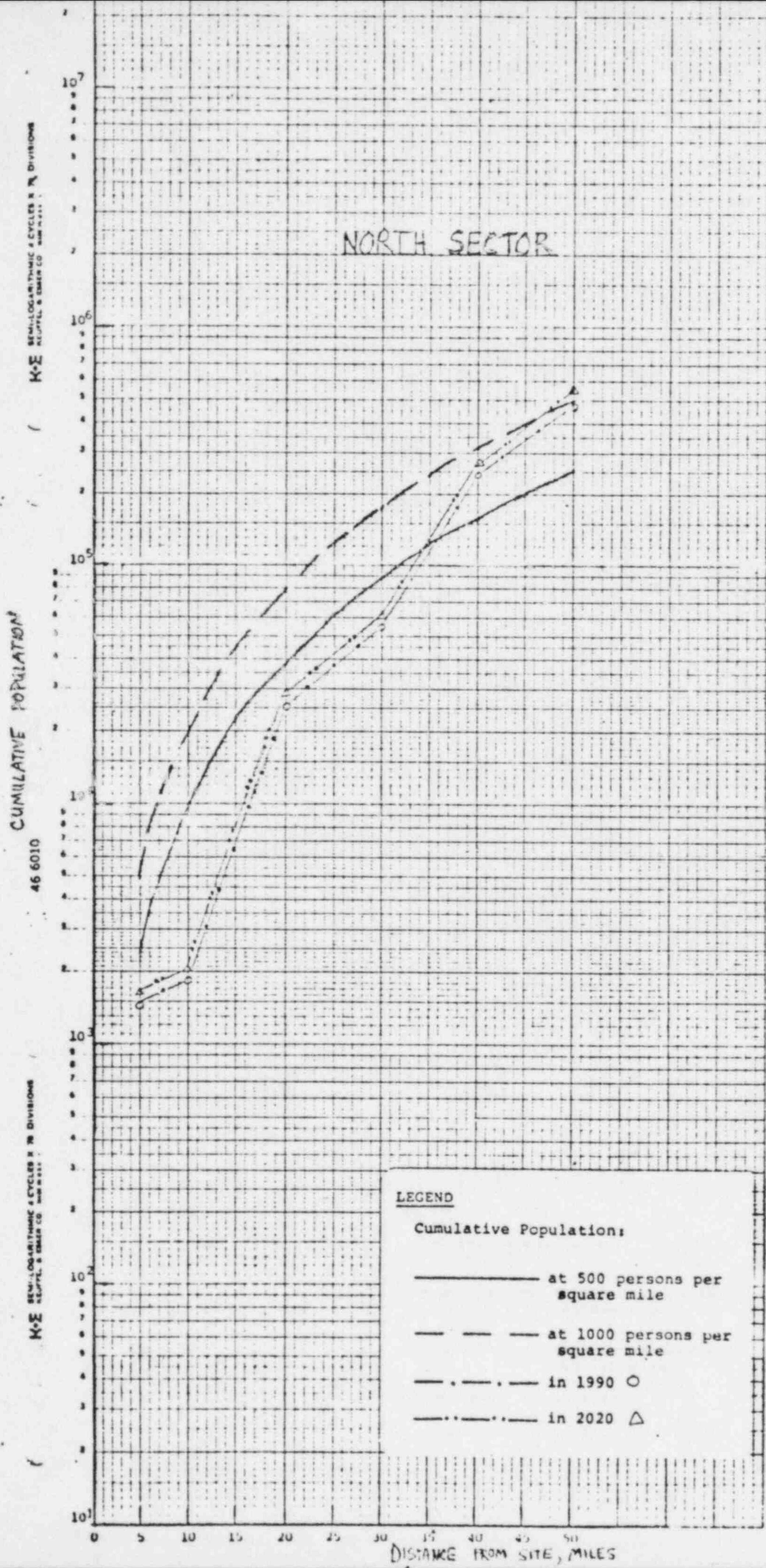


BRAIDWOOD STATION

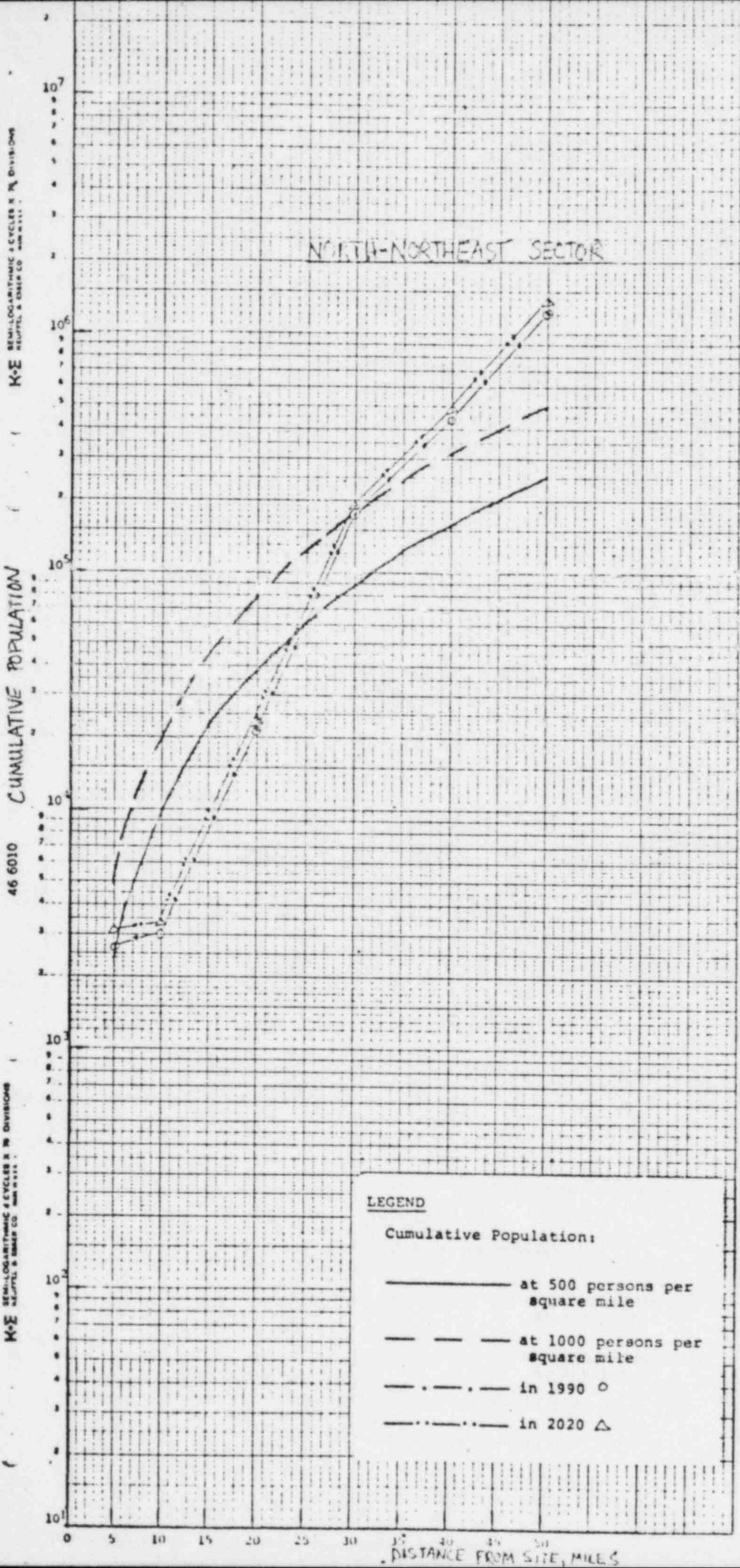
FINAL SAFETY ANALYSIS REPORT

FIGURE 2.1-11

POPULATION CENTERS
WITHIN 50 MILES OF THE SITE



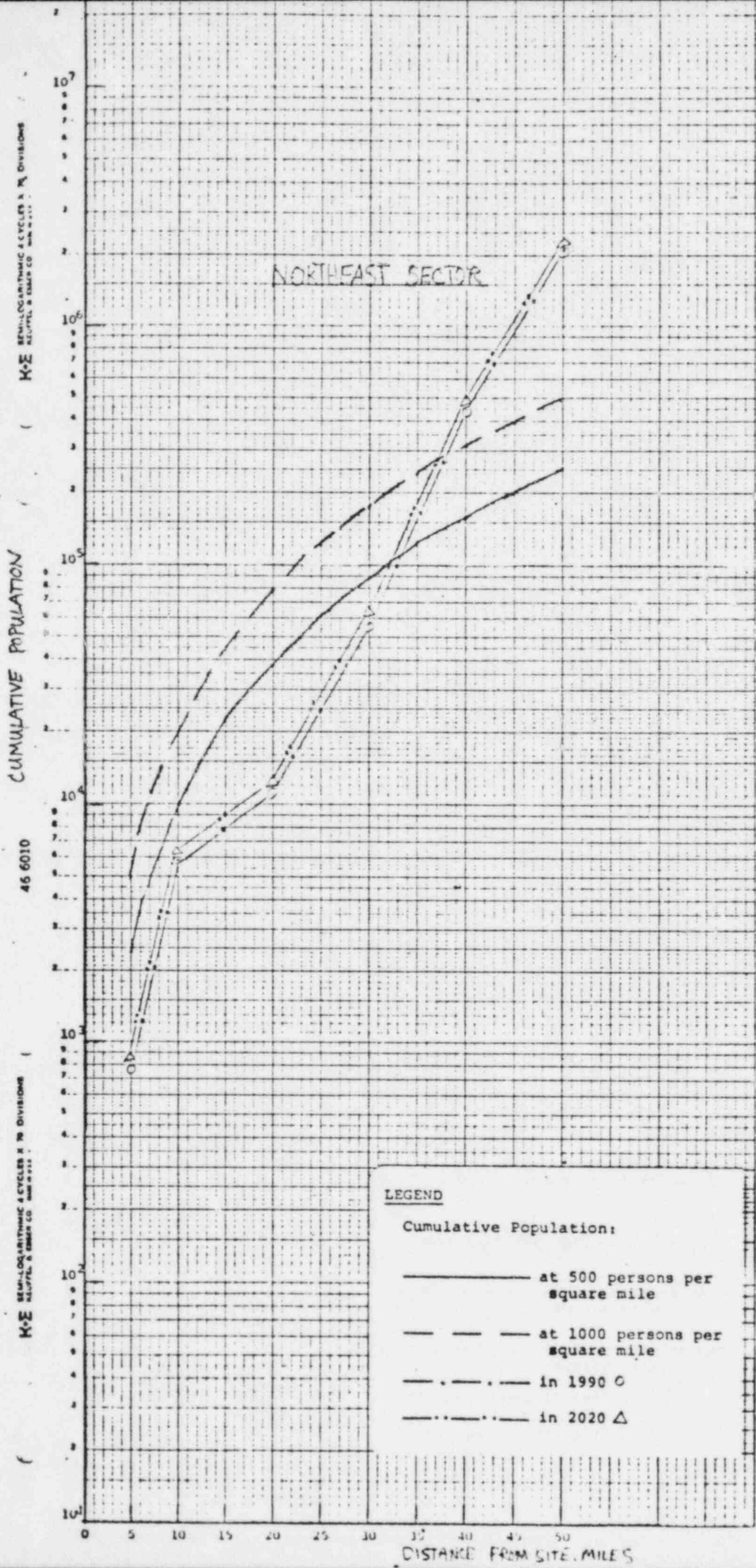
Braidwood – FSAR
Figure 2.1-12
1990 and 2020 Population Density Within 50 Miles of the Site
(Sheet 1 of 16)



Braidwood - FSAR

Figure 2.1-12

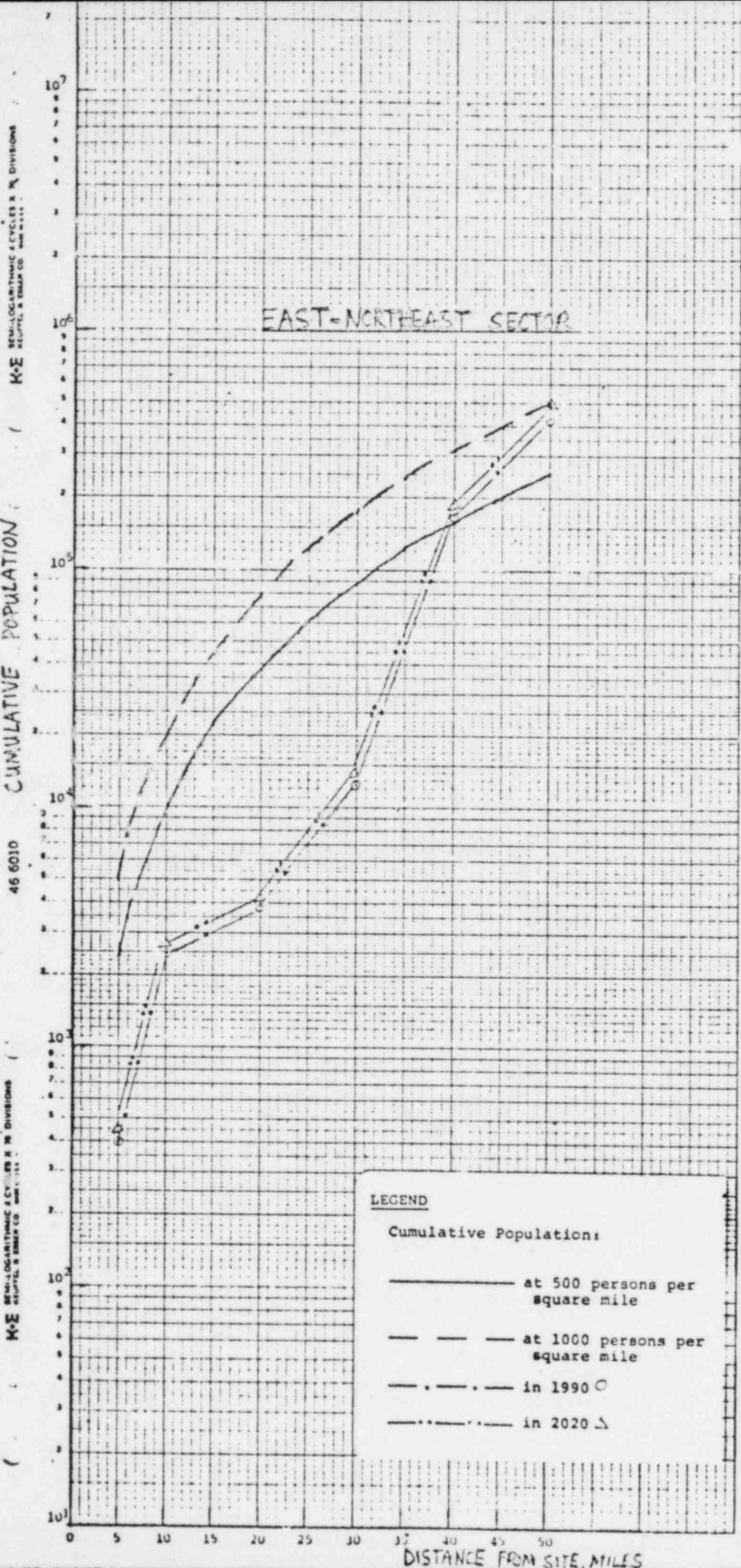
(Sheet 2 of 16)



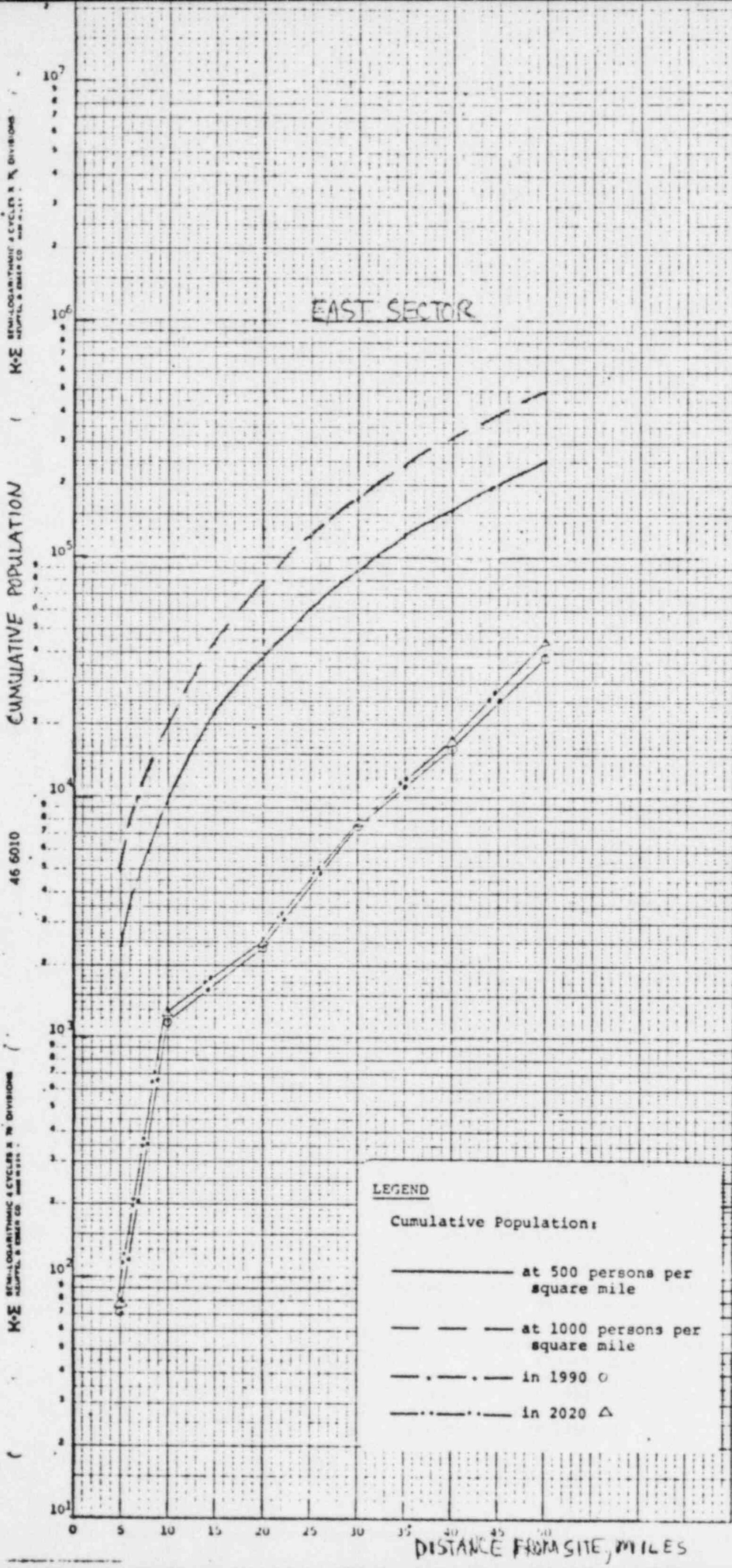
Braidwood - FSAR

Figure 2.1-12

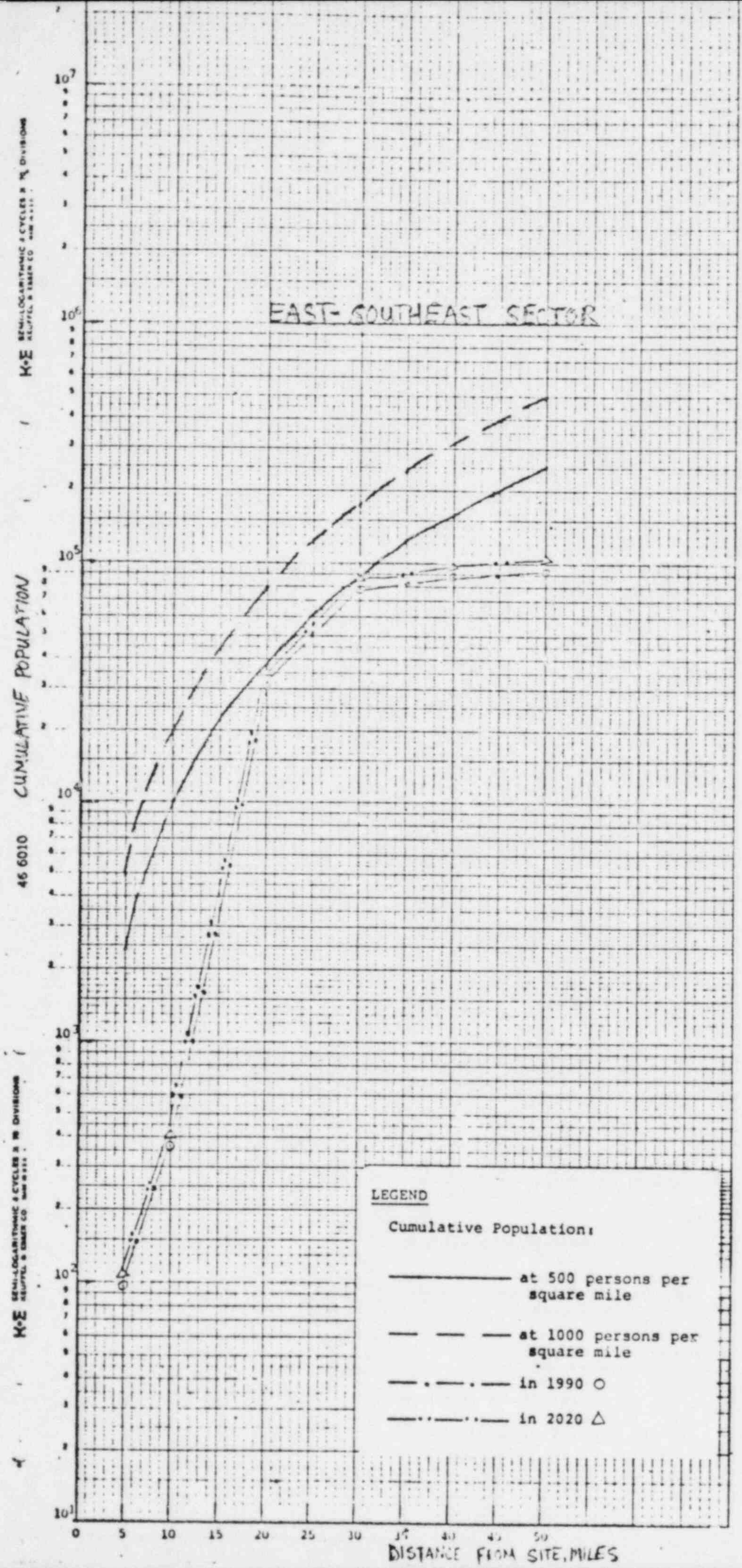
(Sheet 3 of 16)



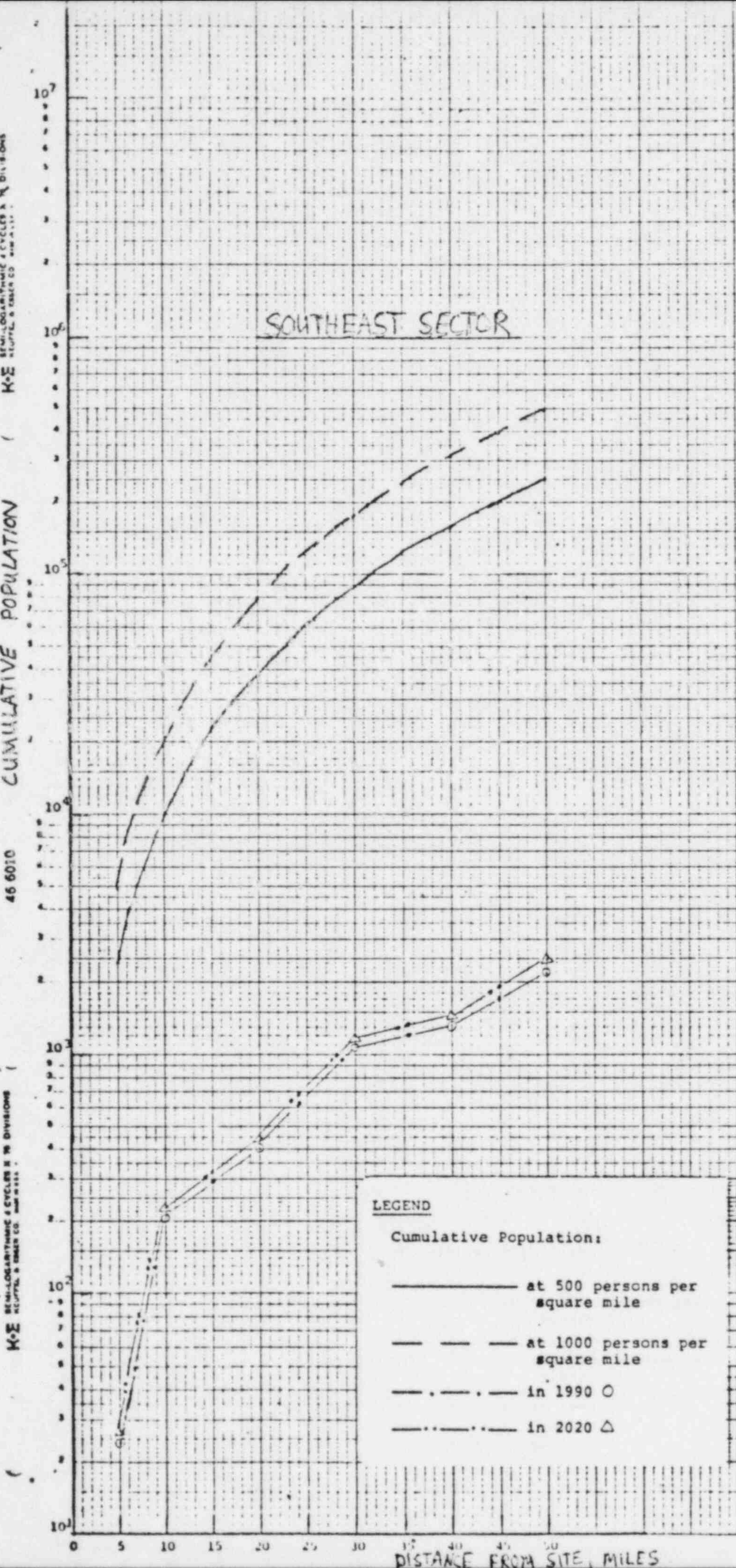
Braidwood - FSAR
Figure 2.1-12
(Sheet 4 of 16)



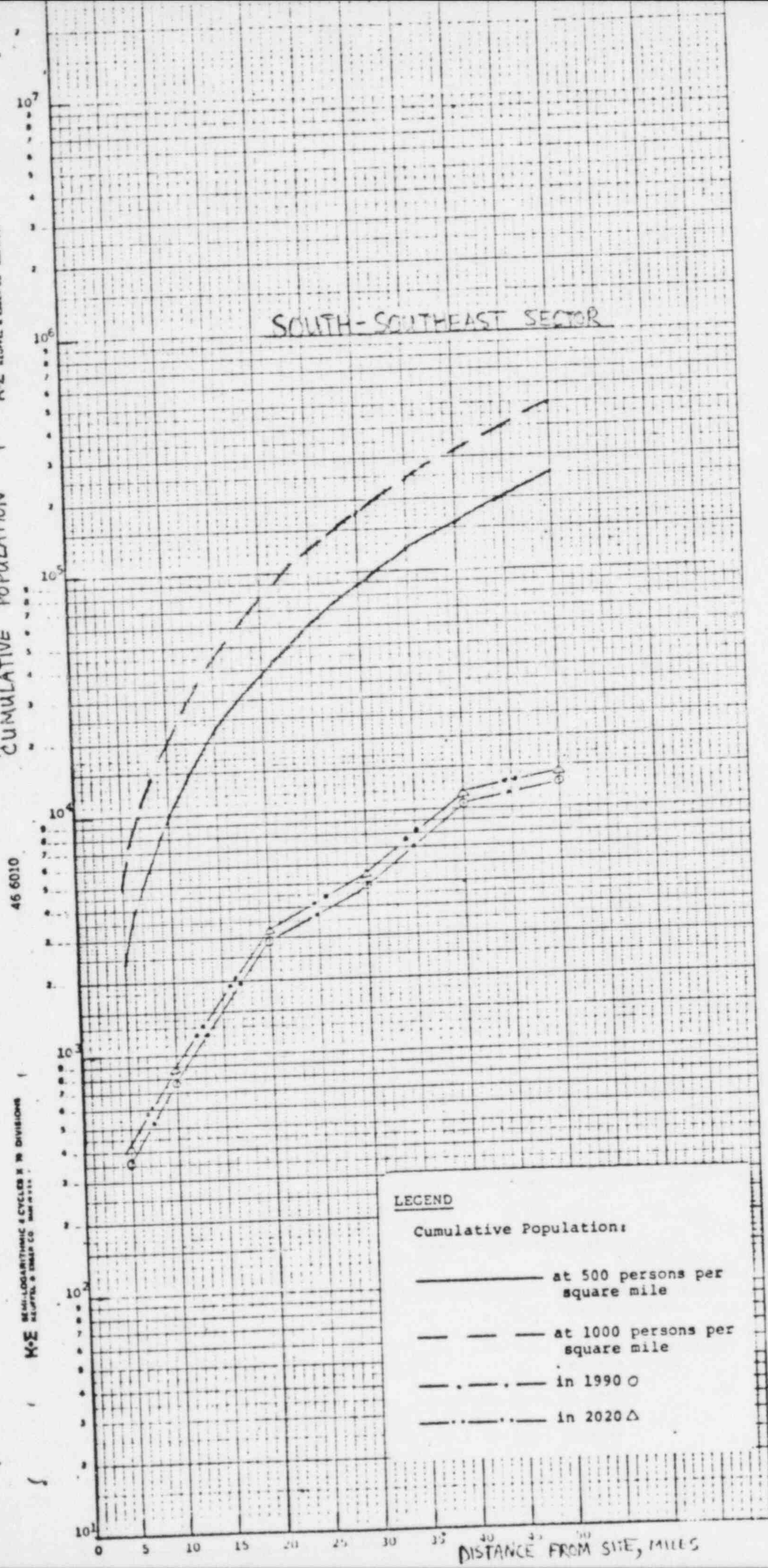
Braidwood - FSAR
Figure 2.1-12
(Sheet 5 of 16)



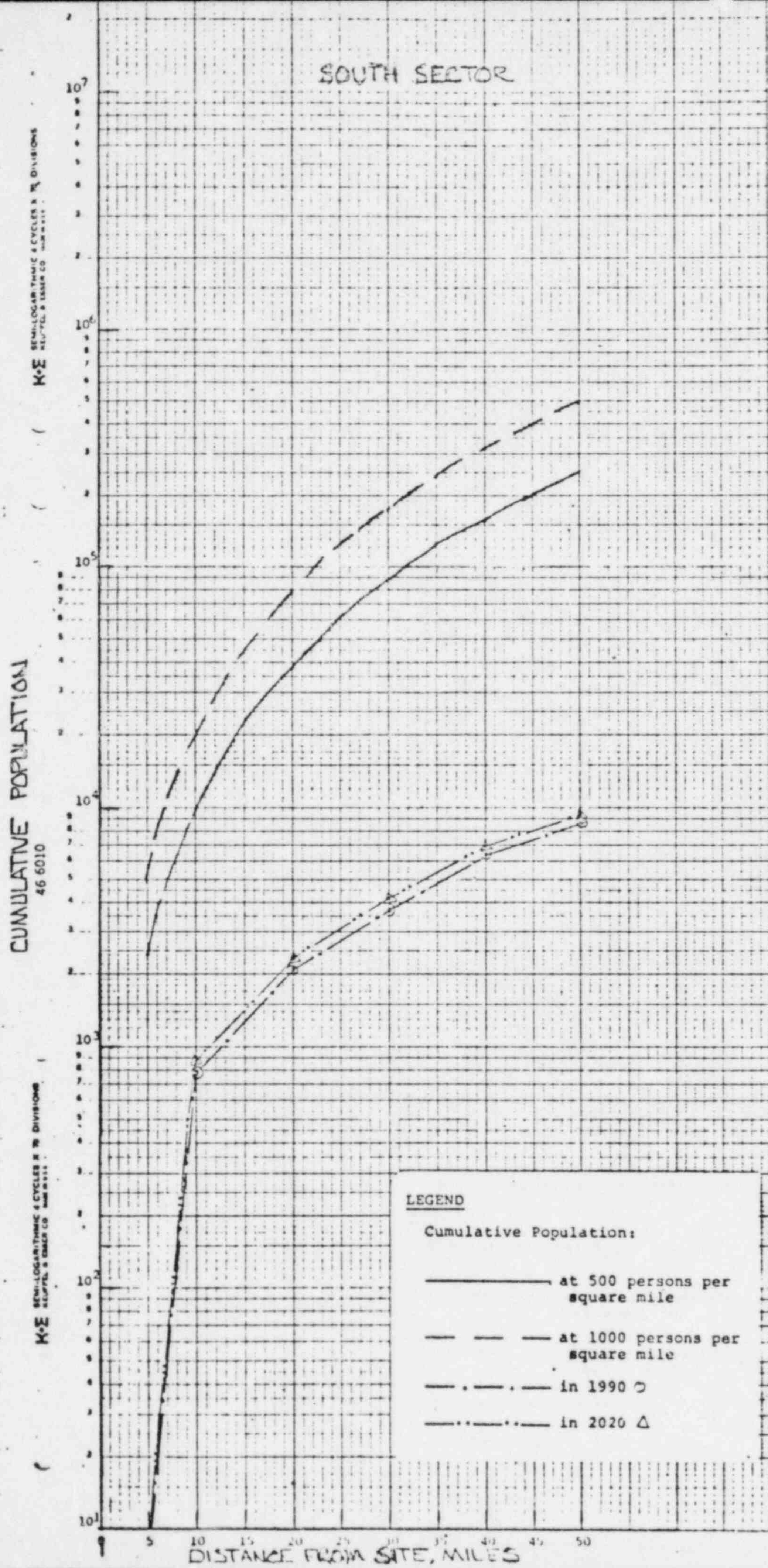
Braidwood - FSAR
Figure 2.1-12
(Sheet 6 of 16)



Braidwood - FSAR
Figure 2.1-12
(Sheet 7 of 16)



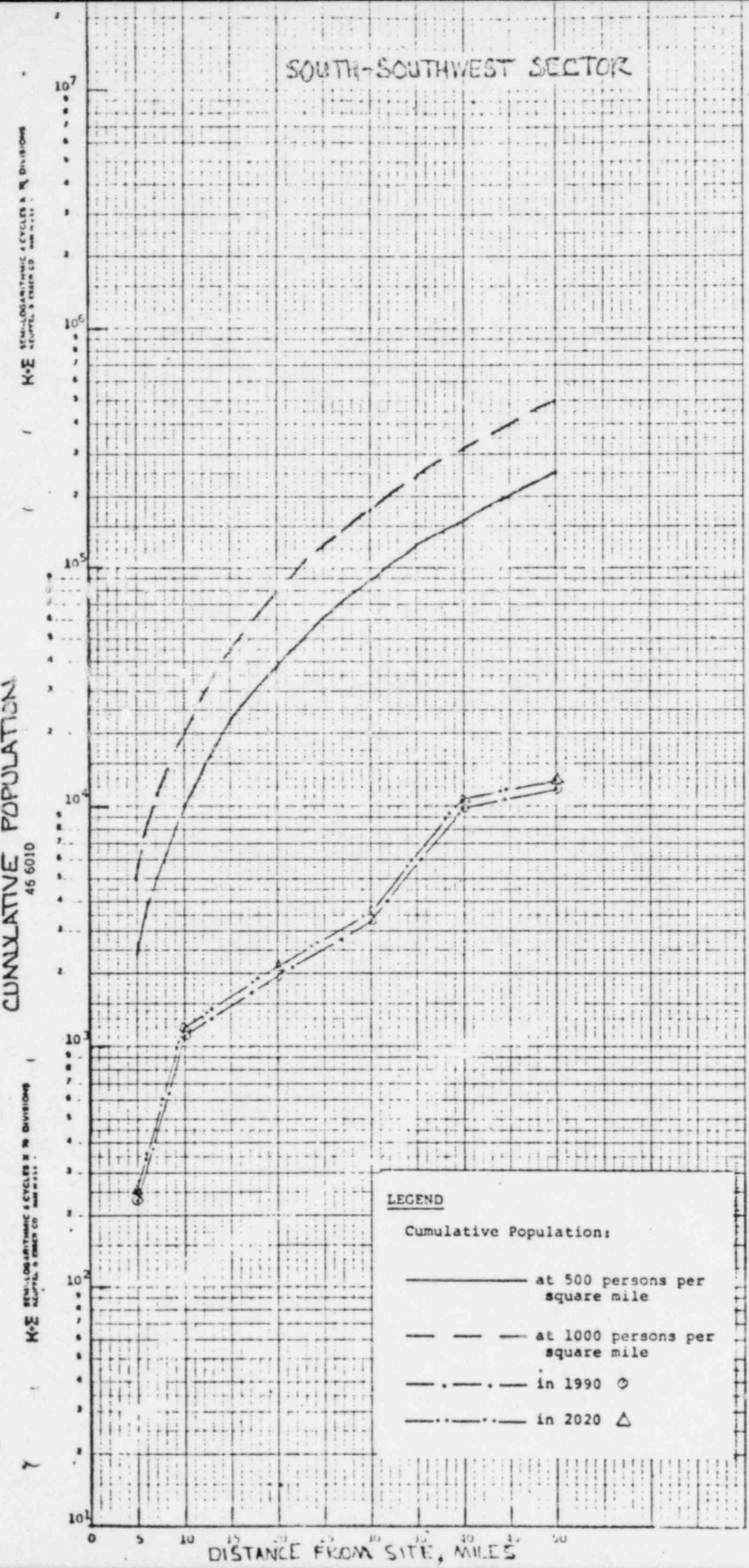
Braidwood - FSAR
Figure 2.1-12
(Sheet 8 of 16)



Braidwood - FSAR

Figure 2.1-12

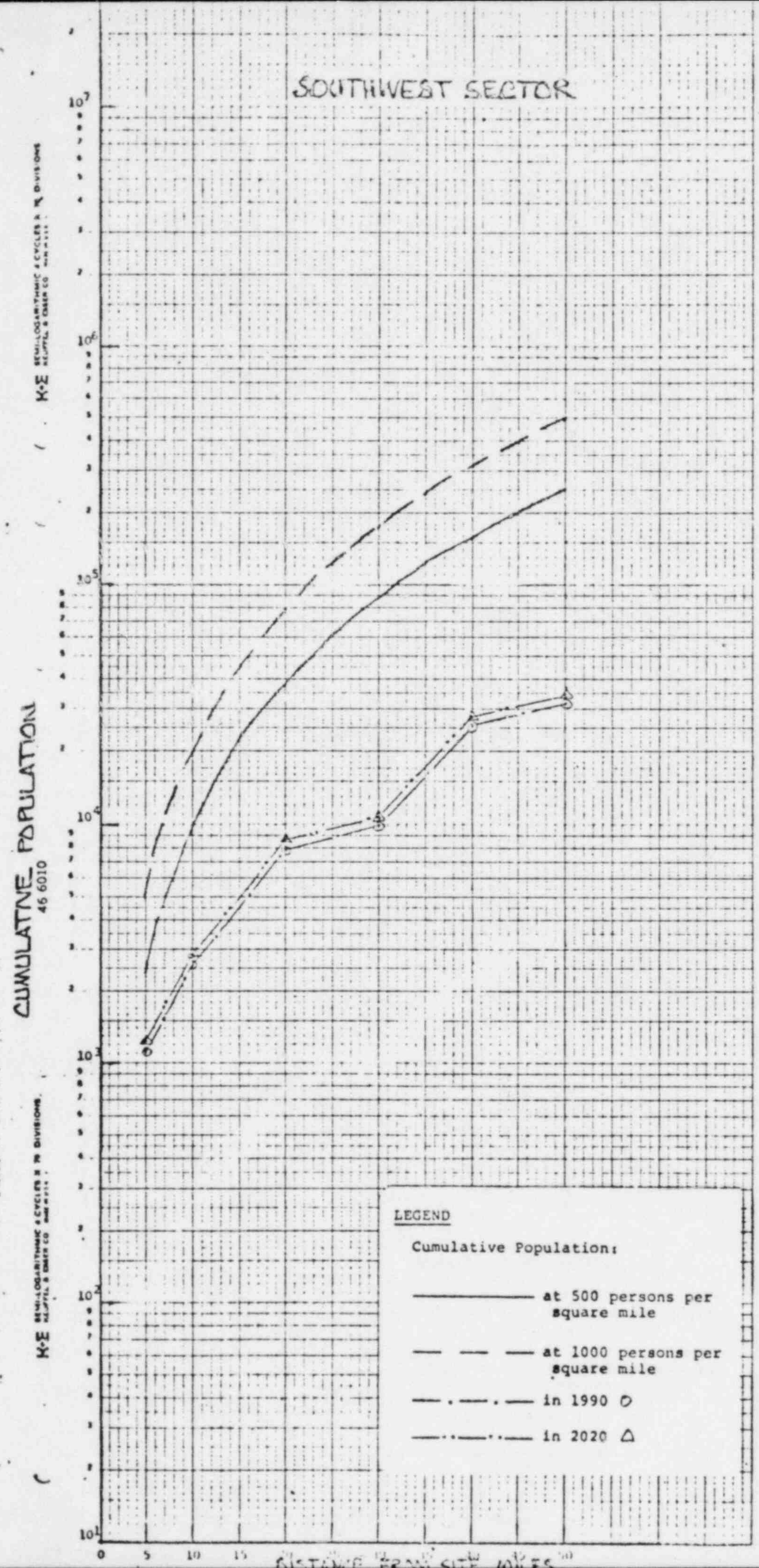
(Sheet 9 of 16)



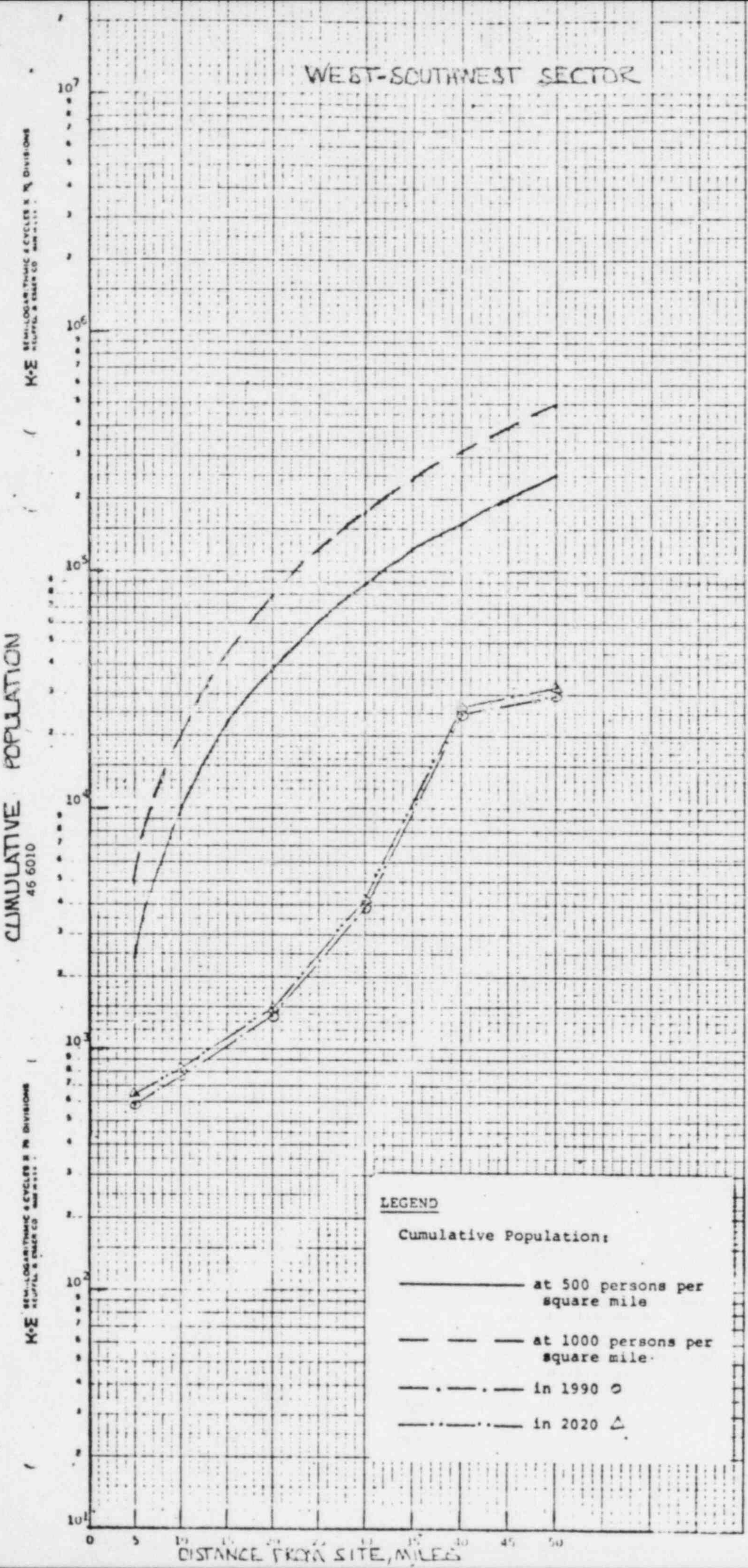
Braidwood - FSAR

Figure 2.1-12

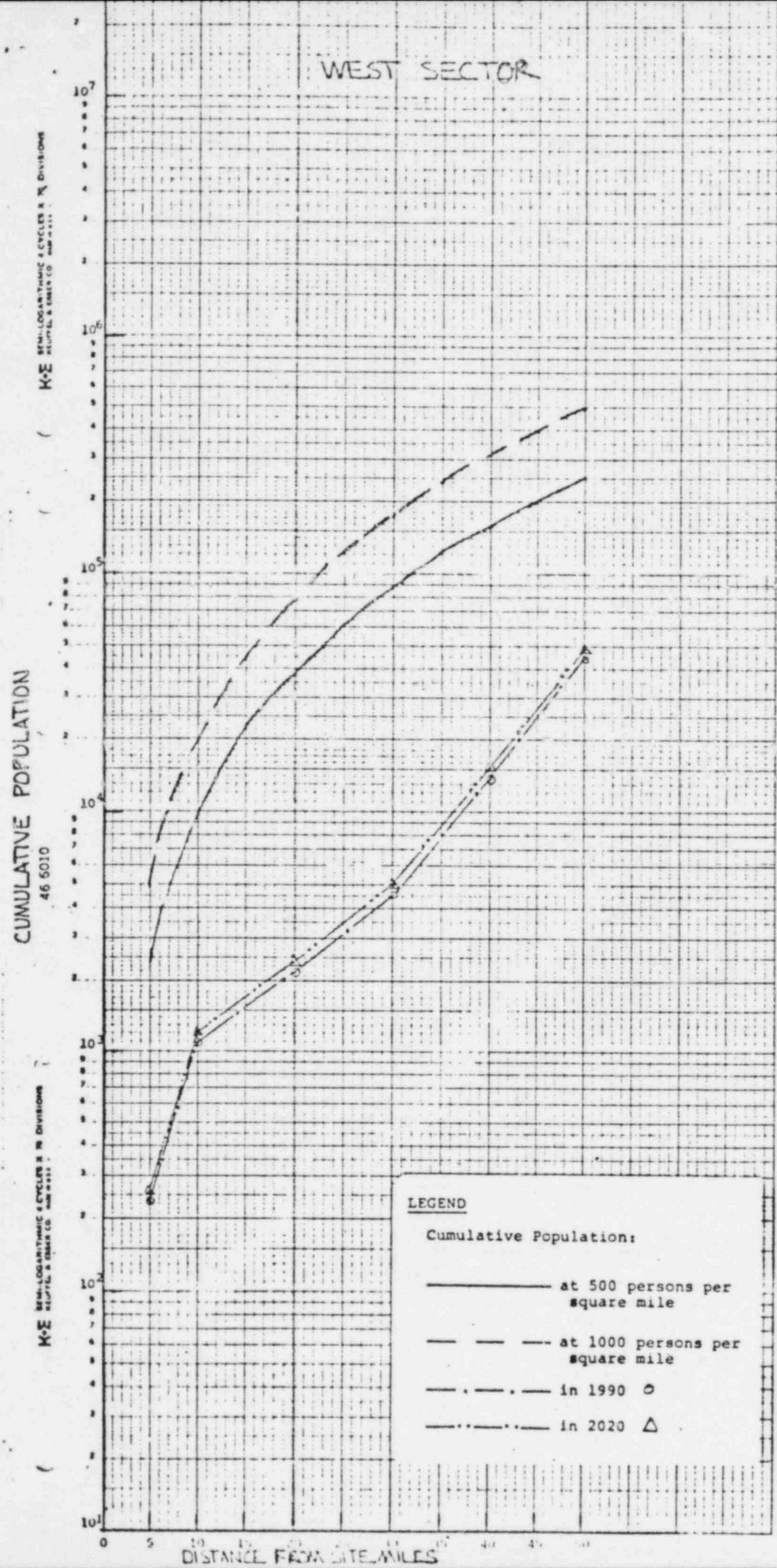
(Sheet 10 of 16)



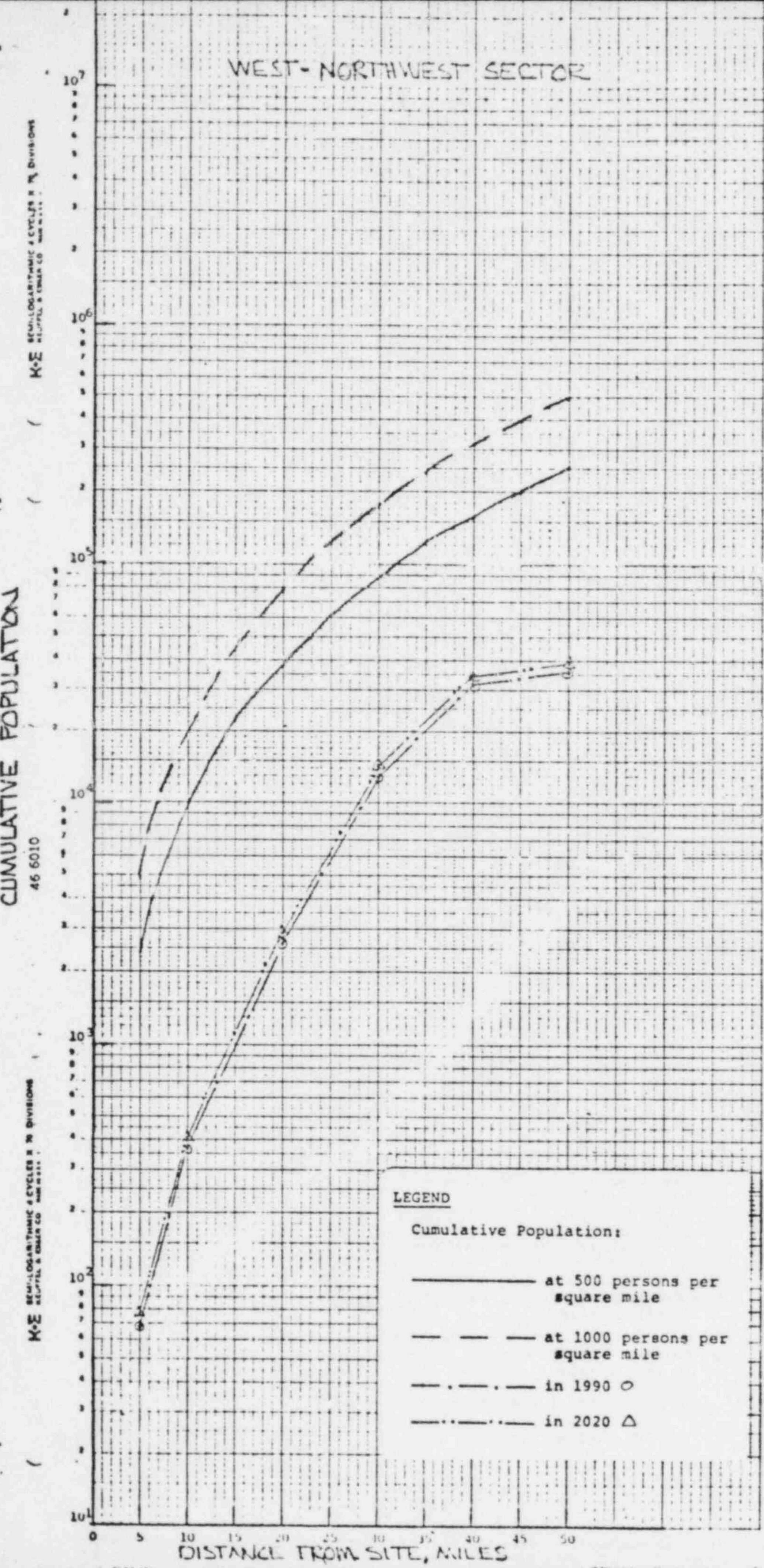
Braidwood - FSAR
Figure 2.1-12
(Sheet 11 of 16)



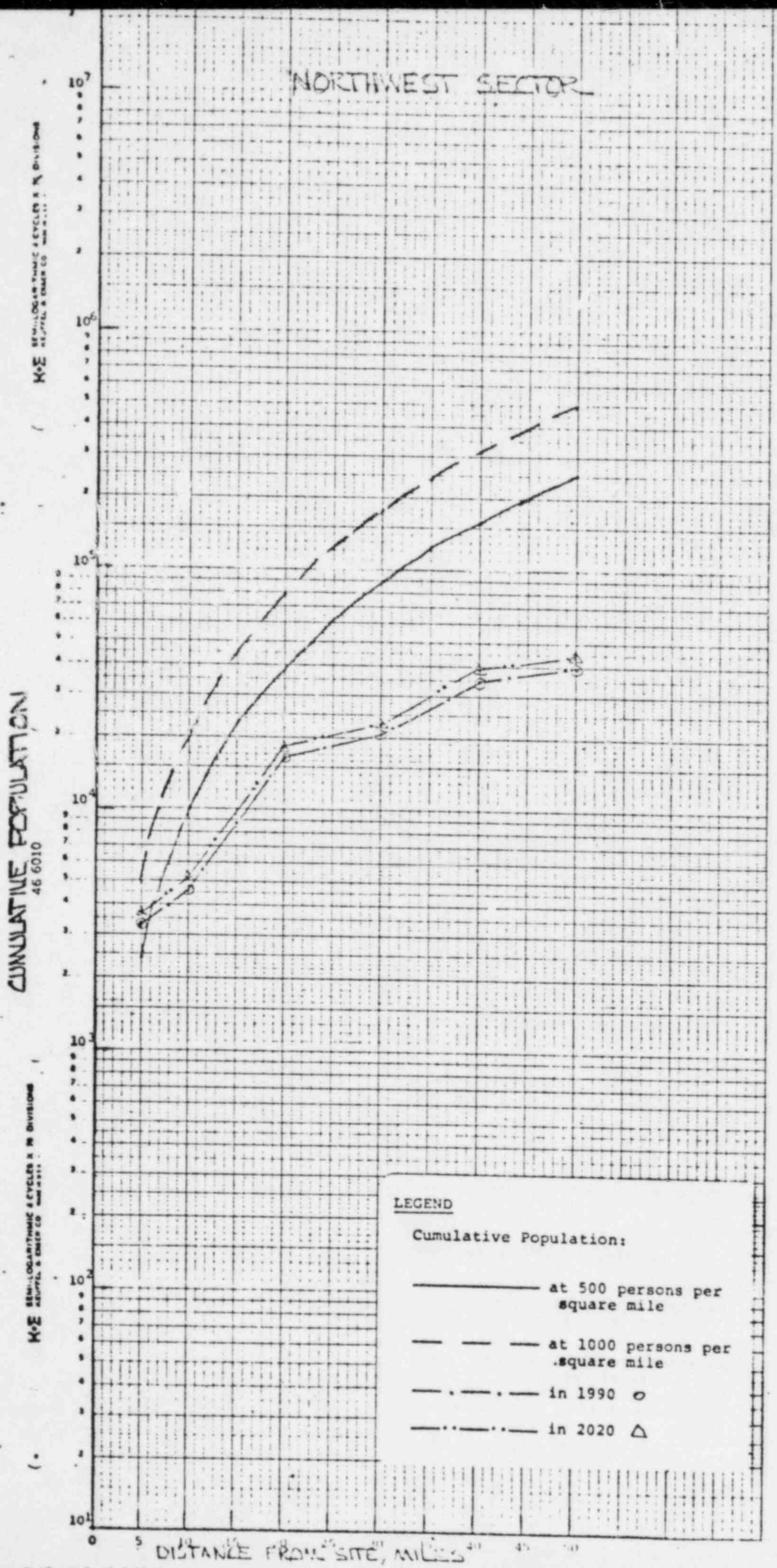
Braidwood-FSAR
Figure 2.1-12
(Sheet 12 of 16)



Braidwood-FSAR
Figure 2.1-12
(Sheet 13 of 16)



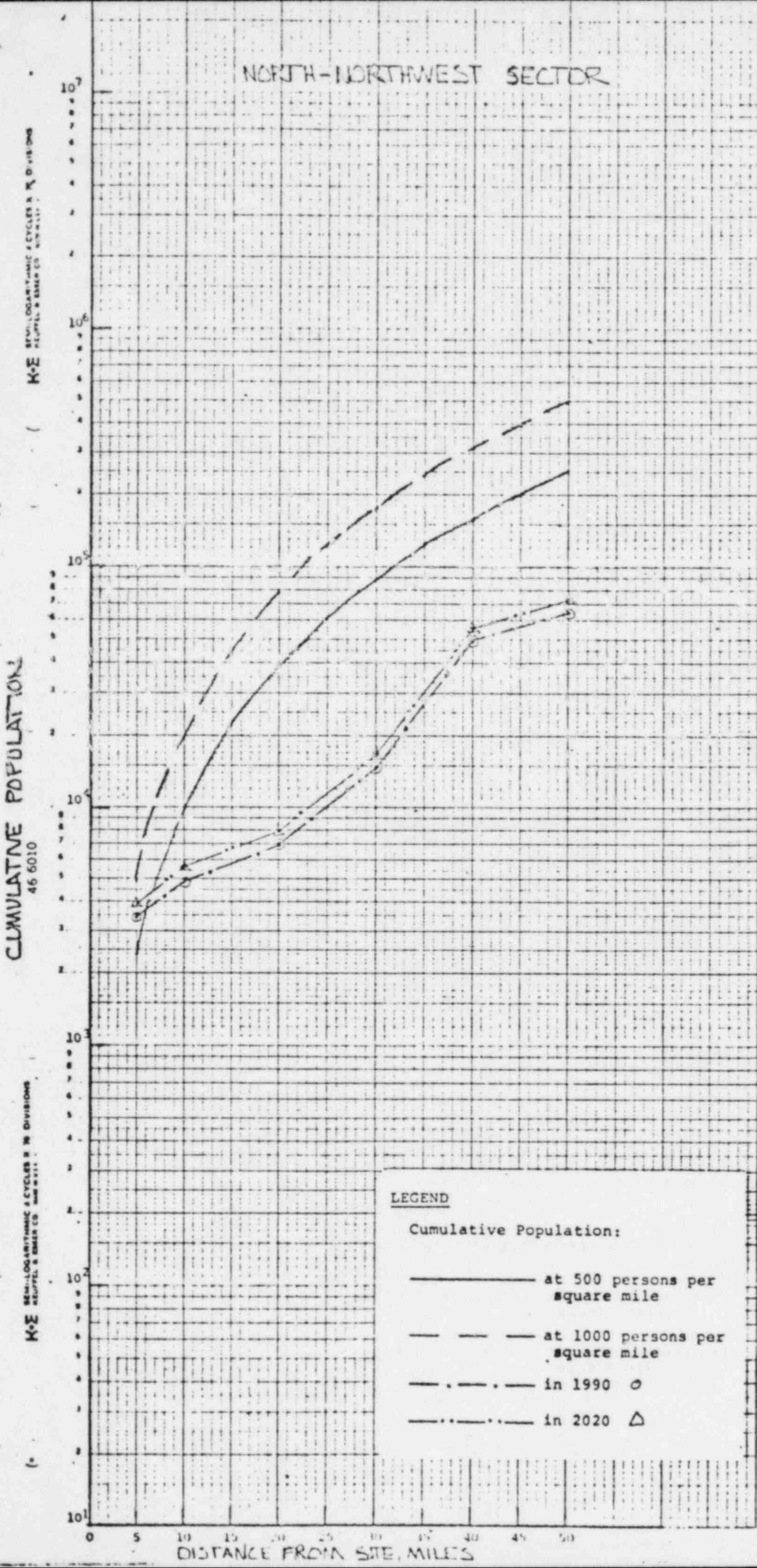
Braidwood - FSAR
Figure 2.1-14
(Sheet 14 of 16)



Braidwood - FSAR

Figure 2.1-12

(Sheet 15 of 16)



Braidwood-FSAR
Figure 2.1-12
(Sheet 16 of 16)

QUESTION 371.7

"1. Is the surface area of 2475 acres based on the normal pool elevation of 595 ft msl? What is the storage volume at normal pool level? What is the average depth?

"2. The list of Category I structures is not complete. It should include, as a minimum, the portion of the Lake Screen House that contains the ESW pipes and water supply, the turbine building basemat and refueling water storage tanks. Figure 2.4-1 should include all Category I structures and piping associated with the ESWS.

"3. Define the term 'average depth' for the essential cooling pond."

RESPONSE

Item 1: The pond has a normal pool elevation of 595.0 feet msl, and a surface area of 2475 acres, or 3.87 mi^2, at this normal pool elevation. (The surface area of the pond at normal pool elevation, as measured from the as-built topographic maps, is 2537 acres. However, this value is not significantly different from the FSAR value.) The storage volume of the cooling pond at the normal pool elevation of 595.0 feet msl is 22,300 acre-feet. The average depth at normal pool elevation is approximately 8.21 feet, as given in Subsection 2.4.8.2.6.

Item 2: Seismic Category I buildings include the containment building, the auxiliary building, and the fuel handling building. In addition, the portion of the lake screenhouse housing the essential service water intake, the essential service cooling pond, and the ESW intake and discharge pipes are also classified as safety Category I facilities. For a detailed listing of Category I buildings and components, see Table 3.2-1. See also Figures 2.4-1, 2.4-26 through 2.4-29, and 2.4-47.

Item 3: The essential service cooling pond (ESCP) is an excavated pond within the cooling pond with a bottom elevation of 584.0 feet. The ESCP has a surface area of 99 acres and a depth of 6 feet at a pool elevation of 590.0 feet (see Figure 2.4-47), which is the maximum elevation at which the ESCP will function (see Subsection 2.4.11.6).

QUESTION 371.8

"Show the site location on Figure 2.4-5 and provide the drainage area of the Kankakee River upstream of the site."

RESPONSE

See revised Figure 2.4-5. The drainage area of the Kankakee River at the location of the river intake is 5000 mi^2 (see Subsection 2.4.11.3).

QUESTION 371.11

"You mention a 48 hour PMP with a 100 year recurrence interval. We believe the 100 year event should refer to snow load. In any event this statement should be corrected and the correction should provide values and basis for the PMP and coincident snow. You should consider the occurrence of the PMP first with roof drains blocked (we would assume blockage by prior accumulation of debris, ice and/or slush), followed by freezing temperatures resulting in an ice cover on the ponded water sufficient to support the snow load."

RESPONSE

Subsection 2.4.2.3 has been revised. However, if the roof load is calculated as suggested in the question by superimposing the 100-year snow load of 28 lbs/ft^2 on the maximum 48-hour winter (March) PMP of 14.7 inches, the roof load will be 104 lbs/ft^2.

As stated in Subsection 2.4.2.3, the roofs of all safety-related structures are designed for a load of 104 lbs/ft^2.

QUESTION 371.13

"The staff estimates the peak PMF discharge for the Kankakee River at the intake (based on PMF studies for the Dresden Nuclear Plant Site) to be at least about 350,000 cfs. The generalized curves in Regulatory Guide 1.59 give a peak discharge of about 650,000 cfs. Since you are doing a conservative analysis to show a dry site, we suggest you use a conservative peak PMF discharge of about 400,000 cfs in lieu of the 209,000 cfs used in your current analysis. See question 371.14 on water surface elevation.

"Use the square root of the ratio of drainage areas when transposing flows between locations."

RESPONSE

Refer to the response to Question 371.14.

QUESTION 371.14

"1. Provide additional clarification on the method used to develop the Kankakee River rating curve at the site from data at Wilmington and Custer Park and also explain how the curve was extrapolated to PMF levels. Provide a cross section of the Kankakee River at the site. If the channel cross section is not available, then provide the bankfull capacity and indicate the bankfull width on the overbank cross section.

"2. It appears that your PMF peak discharge estimates are not consistent with cross section locations on Granary Creek and Mazon River; e.g., the PMF discharge should be evaluated at the cross section location where the design basis water level is determined. The Mazon River PMF peak discharge should be computed for the drainage area above cross section X-MD2. The Granary Creek PMF peak discharge and cross section should be furnished for a point just upstream of the confluence of the East Fork and Granary Creek. Also provide the energy gradient at X-MD2 and at the new X-section on Granary Creek."

RESPONSE

Item 1: A typical cross section of the Kankakee River near the river screenhouse is presented in new Figure 2.4-14a (see also revised Subsection 2.4.3.5).

The discharge rating curve to be used at the location of the river screenhouse was developed using the following method.

The daily flows for the Kankakee River at Wilmington, Illinois for the period 1950 to 1970 were obtained from the data published by the U.S. Geological Survey and the daily stage data for the Kankakee River at Custer Park, Illinois was obtained for the same period from the U.S. Army Corps of Engineers. From this data, the observed peak river flows at Wilmington for each year and the corresponding peak river elevations at Custer Park were obtained, and plotted in revised Figure 2.4-9. The discharges at the river screenhouse are estimated from the discharges at Wilmington in the ratio of the square root of corresponding drainage areas. The water levels for a given discharge at the river screenhouse are conservatively assumed to be the same at Custer Park, which is approximately 1/2 mile upstream of the river screenhouse.

The peak discharge of record at Wilmington, Illinois is 75,900 cfs with a corresponding peak stage of 551.5 at Custer Park, Illinois and 522.26 feet at Wilmington, Illinois. The distance between the two gauging stations is 9.4 miles. Therefore, the water surface slope of the Kankakee River for a flow of 75,900 cfs is computed to be 0.000589. Using this water surface slope and the typical cross section of the river shown in Figure 2.4-14a the Manning's "n" value is computed to be 0.03, corresponding to the flow of 75,900 cfs. The water surface elevations in the river cross section were obtained for higher flows of 209,000 cfs and 400,000 cfs using the above values of Manning's "n" and the water surface slope, and the discharge rating curve is extrapolated as shown in Figure 2.4-9.

The water level in the Kankakee River near the river screenhouse is 561.3 feet for the estimated PMF peak discharge of 209,000 cfs. However, as suggested in Question 371.13, if the peak discharge is conservatively postulated to be 400,000 cfs, the estimated peak water level at the screenhouse would be approximately 571.0 feet. Since this peak elevation is 29 feet below the plant grade elevation of 600.0 feet and the plant site is 4 miles away from the Kankakee River, the plant site will not be affected by the PMF in the Kankakee River.

Item 2: The peak PMF discharges for Mazon River and Granary Creek are presented in the FSAR at the locations where the design basis water level is determined. The Mazon River PMF peak discharge is 112,000 cfs at cross section X-MD2 with a corresponding water level of 581.5 feet as shown in Table 2.4-8. The PMF peak discharge in Granary Creek just upstream of its confluence with East Fork Mazon River is 19,500 cfs and the corresponding water level is 576.0 feet as presented in Subsections 2.4.3.4, 2.4.3.5, and Table 2.4-5. The energy gradients at cross section X-MD2 on the Mazon River and at the cross section of Granary Creek just upstream of its confluence with East Fork Mazon River are 0.000345 and 0.000746, respectively. The cross section of Granary Creek just upstream of its confluence with East Fork Mazon River is presented in Figure 2.4-17a. Subsection 2.4.3 has been revised to clarify the above information.

QUESTION 371.15

"The initial loss of one inch is too high. The staff would normally allow about ½ inch initial loss, but since 75% of the drainage area is the pond, there should be no initial loss for that area. Therefore, it is the staff conclusion that an initial loss of 1/8 inch for the total drainage area is appropriate for the conditions. Either use this value or provide justification for a higher value."

RESPONSE

The initial loss of 1 inch was applied only to that part of the drainage basin excluding the pond surface area. No initial loss was considered for the pond area, which is 73% of the total drainage area. As explained in Subsections 2.4.8.2.2 and 2.4.8.2.3, due to the presence of strip-mined area, poor drainage conditions, and impervious soil, an initial loss of 1 inch was used for the drainage basin excluding the pond area. This amounts to an initial loss of 1/4 inch over the total drainage area instead of 1/8 inch over the total drainage area suggested in this question. However, if a loss of 1/8 inch instead of 1/4 inch occurs as used in the FSAR, it will amount to an additional volume of water of 35 acre-feet in the cooling pond from the 5.3 mi^2 drainage area. This additional amount of water will raise the maximum PMF water level by 0.014 feet, which will not have any effect on the safety-related facilities of the plant.

2.4 HYDROLOGIC ENGINEERING

2.4.1 Hydrologic Description

2.4.1.1 Site and Facilities

The site is located about 4 miles southwest of the Kankakee River near the town of Custer Park in a strip-mined region presently characterized by many water-filled trenches and ponds. Cooling water for the plant is supplied by a cooling pond which covers one of these strip-mined areas. (Note: the condenser water cooling facility at Braidwood Station is referred to as a cooling pond in the FSAR rather than as a cooling lake as in the PSAR. This is consistent with the definition of "pond" in EPA Effluent Guidelines and Standards for Steam Electric Power Generation, 40 CFR 423, Section 423.11, Item m, which became effective in 1974.) The pond has a normal pool elevation of 595 feet MSL (all elevations refer to USGS 1929 datum), with a surface area of 2475 acres or 3.87 mi^2 and a storage volume of 22,300 acre-feet at normal pool elevation. The water surface area is 73% of its total drainage area of 5.3 mi^2. The pond is contained by dikes having a top elevation of 600 feet, except for that portion of the dike just south of the plant, which has a top elevation of 602.5 feet. The dike system is not a Seismic Category I structure.

Seismic Category I buildings include the Containment Building, the Auxiliary Building, and the Fuel Handling Building. In addition, the portion of the lake screenhouse housing the essential service water (ESW) intake, the essential service cooling pond (ESCP), and the ESW intake and discharge pipes, are classified as safety Category I facilities. The grade floor elevation of these buildings is at 601.0 feet. Seismic Category I structures are shown in Figures 2.4-1, 2.4-26 through 2.4-29, and 2.4-47.

The 93.5-acre (at the average depth) essential service cooling pond is located in the northwestern corner of the cooling pond in an area excavated below the surrounding pond bottom, to an elevation of 584 feet. The ESCP has a surface area of 99 acres and a depth of 6.0 feet at a pool elevation of 590.0 feet.

Makeup water for the pond is pumped from the River Screen House on the Kankakee River via pipeline to the northeast corner of the cooling pond. Blowdown water is discharged from the plant by pipeline to the blowdown outfall structure and discharge flume to the Kankakee River.

The Kankakee River is joined by Horse Creek at Custer Park. Horse Creek lies about 2.5 miles east of the site at its nearest point. The Mazon River flows northwest to the Illinois River. At its closest point, the Mazon River is joined by Granary Creek, 1 mile southwest of the site and about 4 miles south of the safety-related facilities. Crane Creek, a tributary of Granary Creek, flows north to meet Granary Creek about 1.5 miles south of the site. The flow in both creeks is intermittent. Floods on these small local streams and the Kankakee River would not affect safety-related portions of the plant.

The nearest highways to the site, Illinois State Routes 53 and 129, are adjacent to the northwest boundary of the site. Interstate 55 is less than 2 miles west-northwest of the site (centerline of the reactors), and State Route 113 is given in Tables 2.4-2 and 2.4-3. The maximum 6-hour PMP is subdivided into 5-minute intervals as shown in Table 2.4-4 (Reference 2a).

The roofs of all safety-related structures are designed to withstand the higher of the loads caused by the 24-hour all-season PMP or the 100-year maximum snow pack combined with the winter PMP of 48-hour duration at the plant site.

Postulating that the roof drains get clogged at the time of PMP, the maximum accumulation of water on the roofs of safety-related structures will be up to the height of the parapet walls plus the depth of overflow over the parapet wall. The height of the parapet walls is 1 foot 4 inches. The maximum depth of overflow is estimated to be 2.0 inches. Therefore, the corresponding water load due to summer PMP on the roofs will be 93.6 lb/ft^2. The maximum 48-hour winter PMP at the site is 14.7 inches in March (Reference 2). The snow load at the site corresponding to a 100-year mean recurrence interval is 28 lb/ft^2. Due to the 1-foot, 4-inch-high parapet walls, accumulation of the entire winter PMP with the above snow load is not possible on the roofs, and the excess precipitation overflows the parapet. Therefore, the governing roof load is 93.6 lb/ft^2. However, as explained in Subsection 3.8.4, the roofs of all safety-related structures are designed for a load of 104 lb/ft^2.

Figure 2.4-7 shows the plant drainage, roads, and tracks. Areas surrounding the plant are graded to direct surface runoff away from the plant to the existing natural drainage. The general plant area is subdivided as shown in Figure 2.4-7a. Figure 2.4-7a also shows the location of culverts, manholes, and roads which act as weirs during the PMP. Pertinent data for culverts are tabulated in Table 2.4-4a. All the ditches are 2 feet wide at the bottom with side slopes of 2:1.

During the local PMP, some ponding is expected in areas enclosed by the roads and tracks near the plant. Under ponding conditions, manholes will be operating under higher than design heads and will pass larger flows. However, the manholes in the immediate plant area are assumed to pass their 100-year design discharge throughout the duration of PMP. To be conservative, no credit for culvert flow during the PMP is taken in the analysis. The roads around the plant at elevations below 601.0 feet will act as weirs, passing the runoff away from the plant. The weir coefficient of 2.5 is used conservatively in the calculations. The analytical procedure consists of routing the surface runoff away from the plant through the drainage system and over the roads. Runoff ultimately enters the natural drainage pattern, which discharges to the Mazon River. It is conservatively assumed that no retention losses or infiltration take place during the PMP.

Peak discharges from PMP on drainage subareas are listed in Table 2.4-4b. Flows from Areas A and B will be discharged over Road 1 (see Figure 2.4-7a). The maximum water surface elevation at Road 1 will be 600.22 feet, with a discharge of 178 cfs flowing over the length of road 690 feet. Backwater effects are less than 0.01 foot, and there is no effect of downstream submergence. Hence, the maximum water surface elevation at the plant will be 600.22 feet.

Flows from Areas C, D, and E will be discharged over Road 2. The maximum water surface elevation at Road 2 will be 600.13 feet, with a discharge of 75.6 cfs flowing over the length of road 645 feet. Backwater effects from Road 2 to the plant are negligible, and there is no effect of downstream submergence.

For Area F, the large amount of storage available below the roads and tracks permits the PMP to pond without reaching an elevation that would potentially flood the plant.

The results of this analysis predict a maximum water surface elevation of 600.2 feet at the plant. The plant floor elevation is at 601.0 feet. This water surface elevation is temporary and is expected only during the peak rainfall period of the PMP. Thus, the local PMP will not have any effect on the safety-related plant facilities.

2.4.3 Probable Maximum Floods on Streams and Rivers

The probable maximum flood (PMF) is defined by the Corps of Engineers as the hypothetical flood characteristics that are considered to be the most severe reasonably possible at a particular location, based on relatively comprehensive hydrometeorological analysis of critical runoff-producing precipitation and hydrologic factors favorable for maximum flood runoff.

PMF elevations were calculated for the Kankakee River, Mazon River, Granary Creek downstream from Crane Creek, and the cooling pond. The Kankakee River PMF elevation at the river screen house and elevations for other streams near the site are calculated and described in the following paragraphs. The cooling pond PMF is evaluated in Subsection 2.4.8.2. These locations and water levels are summarized in Table 2.4-5 along with the low, average annual, and flood-of-record flow elevations for the Kankakee River at the intake. As shown in the following subsections, none of the stream floods would have any effect on the plant safety-related systems.

for Crane and Granary Creeks and the Mazon River, the precipitation increments are given for 3-hour intervals. For the Kankakee River, the PMP was distributed into 6-hour intervals.

2.4.3.2 Precipitation Losses on the Kankakee River, the Mazon River, and Crane and Granary Creeks

Part of a storm's rainfall is retained by the basin and does not contribute to storm runoff. The significant factors in basin retention are depression storage, interception by vegetation, and soil infiltration. The rate of retention depends largely on soil types, land use, and antecedent soil moisture.

For the Kankakee River Basin, initial retention was assumed to be 0.5 inch, with infiltration thereafter taken to be 0.1 inch per hour. For the Mazon River and Crane and Granary Creeks, initial retention was assumed to be 1.0 inch, with subsequent infiltration taken as 0.1 inch per hour. Selection of these conservatively low values was based on land use and the soils in the basins. Soils (References 1 and 5) in the Mazon River Basin in the area are evenly mixed between hydrologic class C (minimum infiltration 0.05 to 0.15 in./hr) and B (0.15 to 0.30 in./hr) (References 6 and 7).

2.4.3.3 Runoff Models for the Kankakee River, the Mazon River, and Crane and Granary Creeks

The basins are shown in Figures 2.4-3, 2.4-4, and 2.4-5.

The unit hydrograph and PMF hydrograph for the Kankakee River at the Wilmington gauge are given in Figure 2.4-8, The PMF hydrograph was constructed by applying the PMP for the area (Reference 2) (after infiltration losses) to the synthetic unit hydrograph determined by the method developed by the State of Illinois Division of Waterways for Illinois Streams (Reference 3).

Reference 3 provides a generalized method of computing flood hydrographs based on an extensive study and verification of several Illinois streams. In view of the insignificance of the river PMF levels for plant safety, it was found reasonable to utilize the previously established watershed parameters.

Unit hydrographs for the Mazon River at section X-MD2 below the East Fork Mazon River and the combined Crane-Granary Creeks basin are shown on Figures 2.4-11 and 2.4-12. They were computed using the Snyder synthetic method. Some important parameters for the basin characteristics and the unit graphs are given in Table 2.4-7. The values of 640Cp and C_t for the Mazon River at Coal City (drainage area 470 mi^2) are 530 and 3.7 respectively (Reference 3). The 640Cp value of 530 is considered to be conservatively high for the basin topography. C_t and Cp are coefficients in Snyder's synthetic-unit hydrograph formulas and depend on basin characteristics. For the combined Crane and Granary Creeks basin, a higher C_t of 5.0 and a lower

640Cp of 320 were used. Although these coefficients yield low peaks, they are considered to reasonably represent flood-producing characteristics of this watershed, since the basin is long and narrow and there are strip-mined areas in the downstream portion of the basin which will retard flood runoff from the basin.

2.4.3.4 Probable Maximum Flood Flow on the Kankakee River, the Mazon River, and Crane and Granary Creeks

The PMF hydrograph (Figure 2.4-8) for the Kankakee River at the Wilmington gauge yields a peak discharge of 211,981 cfs. This flow was adjusted to the intake location by multiplying the peak discharge at the Wilmington gauge by the ratio of the square roots of the drainage areas. The drainage area of the Kankakee River at the Wilmington gauge is 5,150 mi^2. The drainage area at the intake is 5,000 mi^2. The drainage area at the intake is 5,000 mi^2. This results in a PMF peak discharge of 209,000 cfs at the intake.

The PMF hydrographs for the Mazon River and for Crane and Granary Creeks are shown in Figures 2.4-13 and 2.4-14 respectively. The hydrographs include a base flow equal to the lowest mean daily flow in the wettest month of record on the Mazon River at Coal City transposed to the flood site by the ratio of the drainage areas. The base flow on the Mazon River is 200 cfs and 50 cfs for Crane and Granary Creeks. The PMF peak discharge on Granary Creek at a point about 1 mile south-southwest of the southwest corner of the site, just upstream from its junction with the East Fork Mazon River, is 19,500 cfs. The peak discharge on the Mazon River at old Route 66 at section X-MD2 is 112,000 cfs.

There are no dams on any of the streams to affect the PMF flow. The dam at Kankakee on the Kankakee River will not affect its PMF flow. No channel routings were made.

2.4.3.5 Water Levels for the Kankakee River, the Mazon River, and Crane and Granary Creeks

The PMF elevation at the intake on the Kankakee River for a peak flow of 209,000 cfs is 561.3 feet above mean sea level. This elevation was determined by relating flow as measured by the U.S. Geological Survey at Wilmington, Illinois to the corresponding stages measured above Custer Park, Illinois (close to the intake point), by the Army Corps of Engineers, as shown in Figure 2.4-9. The rating curve for the Kankakee River at Wilmington gauge as developed by the U.S. Geological Survey from actual measurements is shown in Figure 2.4-10. A typical cross section of the Kankakee River near the river screenhouse is shown in Figure 2.4-14a.

The plant grade elevation of 600 feet is 38.7 feet higher than the estimated PMF elevation. The PMF line would be 3 miles away from the site facilities. Hence, the PMF on the Kankakee River would pose no threat to site facilities.

Peak discharge elevations for the Mazon River and Crane and Granary Creeks, as listed in Table 2.4-5, were approximated by assuming normal depth of flow through a cross section at the points of interest, just upstream from old Alternate Route 66 on the East Fork Mazon River (Figure 2.4-18) and on Granary Creek just upstream of East Fork Mazon River (Figure 2.4-17a). An overall Manning's "n" of 0.06 was used based on field observations correlated with known values (Reference 8). Because the peak elevations are 18 feet or more below the plant safety-related facilities grade of 600 feet, refinement of "n" values and determination of the elevations in more detail by backwater computations is not warranted. An increase of 0.02 in "n" value adds approximately 1 foot to the water surface elevation.

Two typical cross sections for each of the streams, the East Fork Mazon River, Crane and Granary Creeks, and the Mazon River below Crane and Granary Creek are shown on Figures 2.4-15, 2.4-16, 2.4-17, and 2.4-18. The locations of these cross sections are shown in Figure 2.4-19. The rating curves at these cross sections are shown on Figures 2.4-20, 2.4-21, 2.4-22, and 2.4-23. The flood elevations in the site vicinity are tabulated in Table 2.4-8.

2.4.3.6 Coincident Wind Wave Activity

The intake structure on the Kankakee River is not a Seismic Category I structure and is designed for the flood of record only. During the PMF at elevation 561.3 feet, the wind velocity of 40 mph will produce a significant wave height of 0.8 foot. During the flood of record, elevation 552.0 feet, a wind velocity of 40 mph will produce a significant wave height of 0.65 foot. The intake structure operating floor (elevation 557 feet) is located above the flood of record, elevation 552 feet, plus wind wave (0.8). Coincident wind wave activity on other rivers and creeks which would amount to 1 or 2 feet at most will not affect the plant safety-related facilities.

2.4.4 Potential Dam Failures, Seismically Induced

The nearest upstream dam on the Kankakee River is at Kankakee, about 15 miles from the river screen house. The dam is 12 feet high, with a normal pool elevation of 595 feet. Failure of the dam would create minor flood waves which would dissipate before reaching the site area. During river floods, the dam would be completely submerged, so that failure would not cause a flood wave.

The nearest downstream dam is at Wilmington, approximately 5 miles from the river screen house; the dam is 11 feet high, with a crest elevation of 530.5 feet. A rock ledge across the river 7700 feet upstream of the dam maintains a pool elevation of 534 feet during low flows. Thus, failure of this dam due to flood flows or seismic disturbance would in no way affect safety-related portions of the plant.

depressions due to strip mining would add to the overland flow time lag between rainfall and runoff into the pond, resulting in flow rates lower than those computed.

Rain falling onto the pond would have no retention losses. Rain falling onto the ground was reduced by basin retention to determine surface runoff. Thus, total runoff volume was the total rainfall volume on the total drainage basin minus initial retention and infiltration on the basin area excluding the pond surface area. The resulting PMF runoff volume and peak inflow rate are given in Table 2.4-9.

2.4.8.2.4 Probable Maximum Flood Flow for Cooling Pond

The initial cooling pond elevation for the PMF routing is estimated to be 596.10 feet. This is based on an antecedent storm equivalent to one-half the maximum 6-hour PMP occurring 3 days prior to the PMP. Given the area-capacity curve for the cooling pond and based on outflow over the 200-foot-wide broadcrested spillway (Figures 2.4-30 and 2.4-31), the initial elevation was estimated by using the U.S. Army Corps of Engineers program for spillway rating and flood routing (Reference 10). The elevation 596.10 feet would occur at the end of the third day of the storm.

Superimposing the 48-hour PMP distribution as given in Table 2.4-3 on the above water surface elevation of 596.10 feet results in the maximum water surface elevation of 598.17 feet MSL.

The PMF inflow hydrograph is shown on Figure 2.4-32. The spillway crest length of 200 feet gives a maximum reservoir rise of 3.17 feet above normal pool. Peak discharge under this condition would be 2184 cfs. The PMF outflow hydrograph is also shown on Figure 2.4-32. The spillway rating table is shown as Table 2.4-10. Wind wave action is discussed in Subsection 2.4.8.2.6.

2.4.8.2.5 Water Level Determinations

The time history of the pond water surface elevation during the PMF is shown on Figure 2.4-33. It would take about 8 days for the PMF surcharge above the spillway crest to be evacuated.

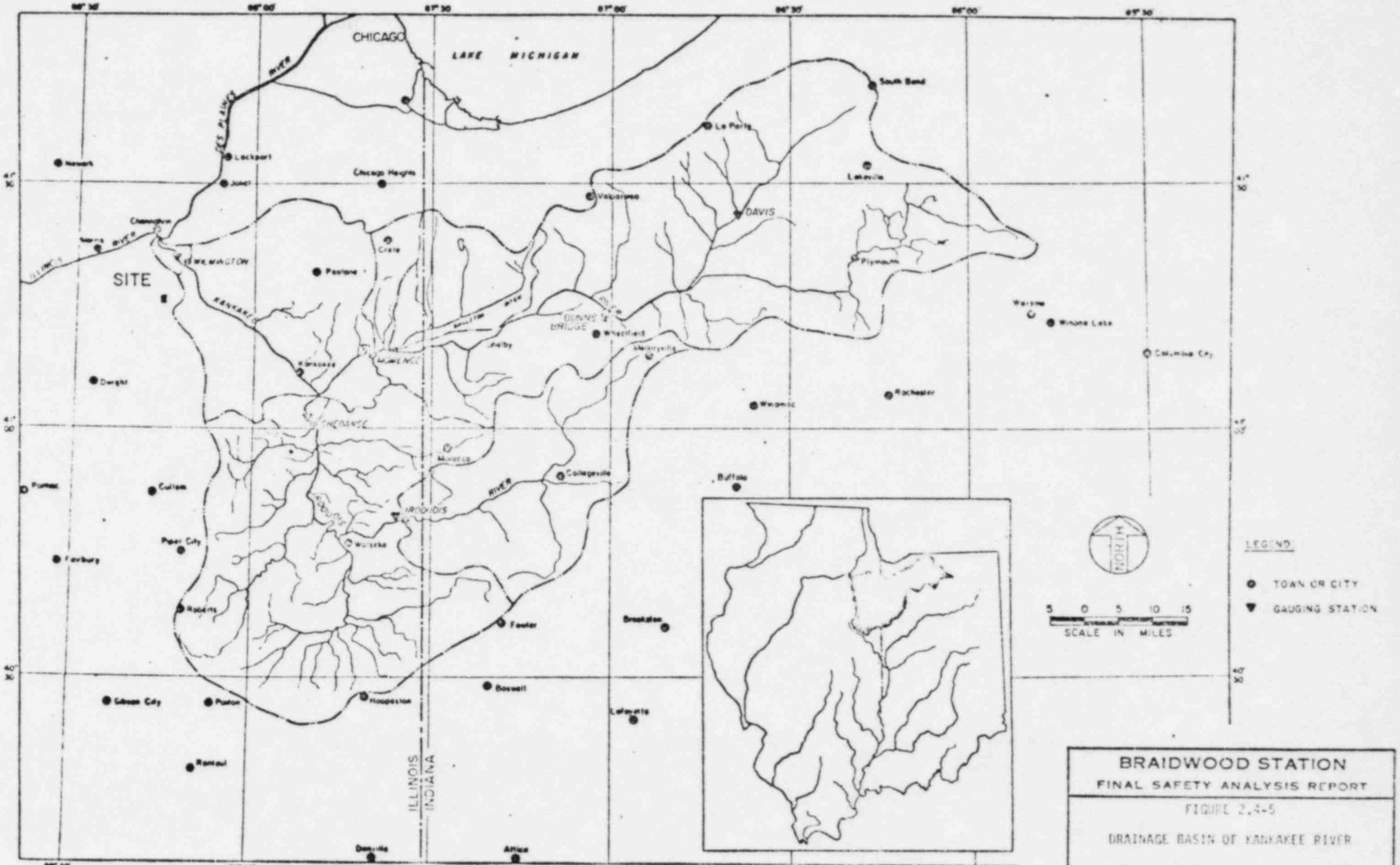
2.4.8.2.6 Coincident Wind Wave Activity

Wind wave action, wind tide, and runup were considered at various locations around the cooling pond. Wave determinations were made for various fetches, wind speeds, and pool elevations. Pond depth was computed as the average depths at regular intervals along the wind path, giving more weight to depths closer to the runup area. Setup and runup were computed by methods presented in References 11, 12, and 13. Shallow-water significant wave height, wave period, wave length, and equivalent deep-water wave height and length were computed from information in Reference 13.

TABLE 2.4-5

PROBABLE MAXIMUM FLOOD AND OTHER ELEVATIONS

LOCATION	MAXIMUM ELEVATION (ft)
Pond PMF	598.17
Kankakee River at intake:	
- PMF	561.30
- low flow	534
- average annual flow	538
- flood of record	552
Mazon River at old Highway 66	582
Granary Creek just upstream of East Fork Mazon River	576



BRAIDWOOD STATION
FINAL SAFETY ANALYSIS REPORT

FIGURE 2.4-5

DRAINAGE BASIN OF KANKAKEE RIVER

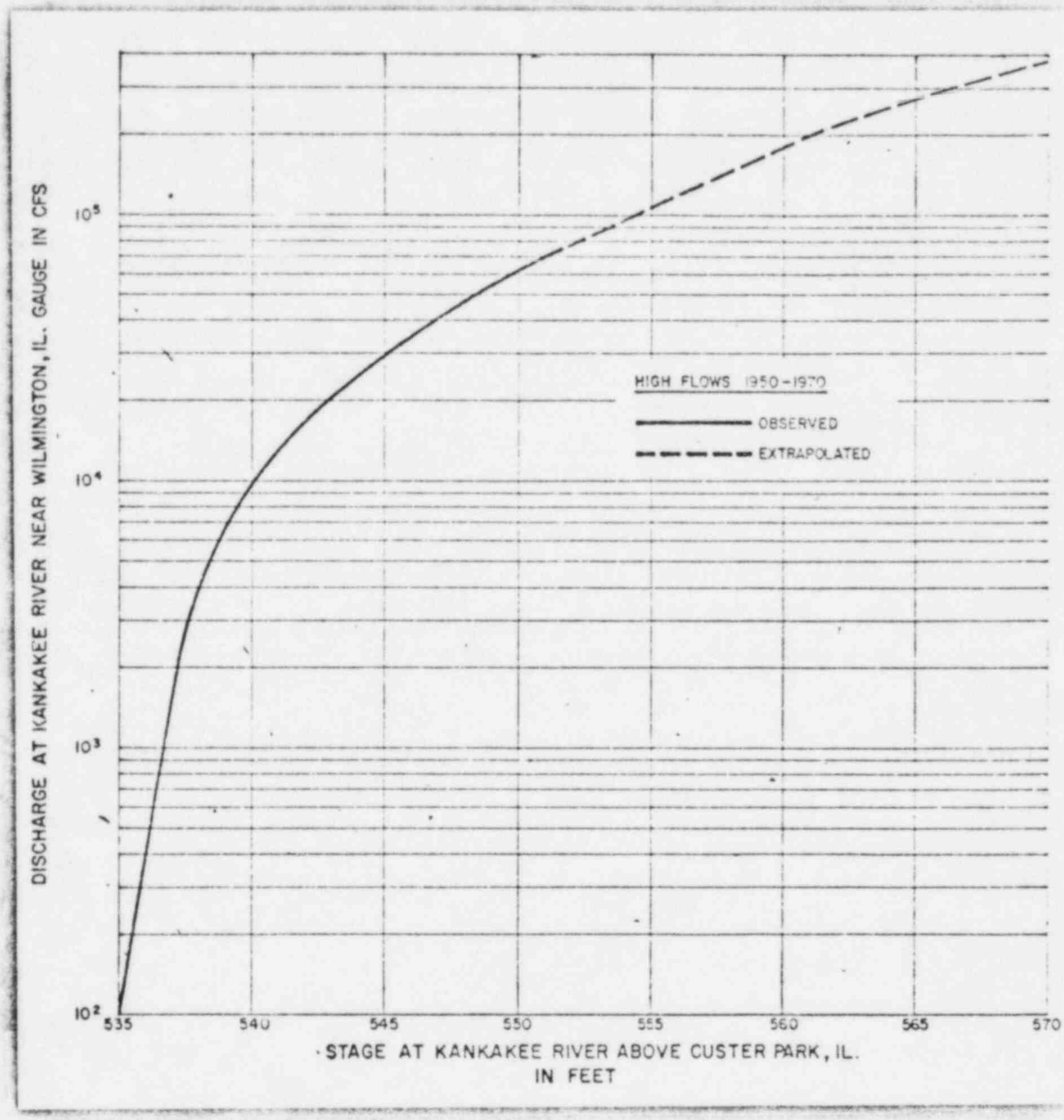


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FIGURE 2.4-9

KANKAKEE RIVER STAGE AT CUSTER PARK VERSUS DISCHARGE AT WILMINGTON, ILLINOIS

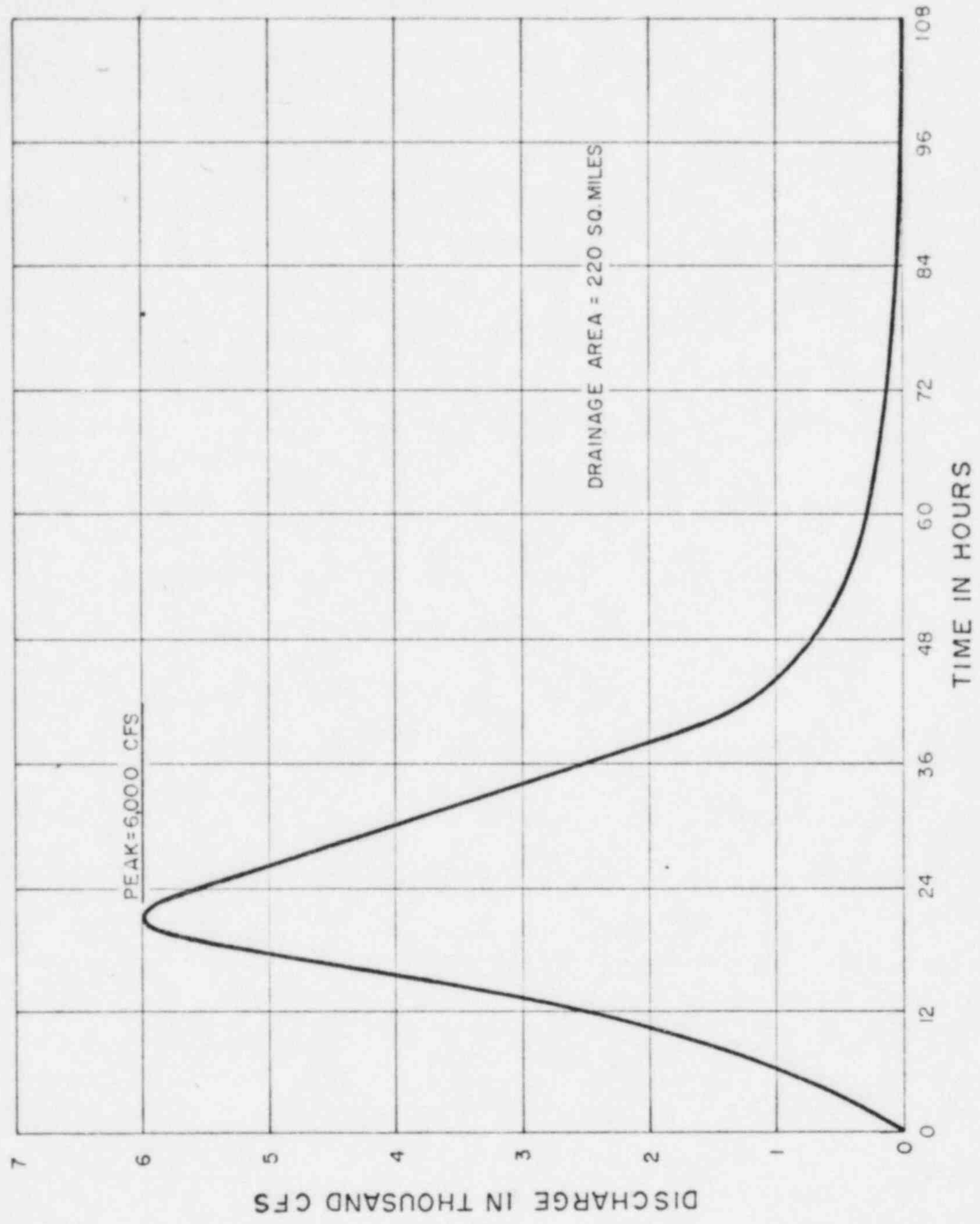

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FIGURE 2.4-11

MAZON RIVER 3-HOUR UNIT HYDROGRAPH

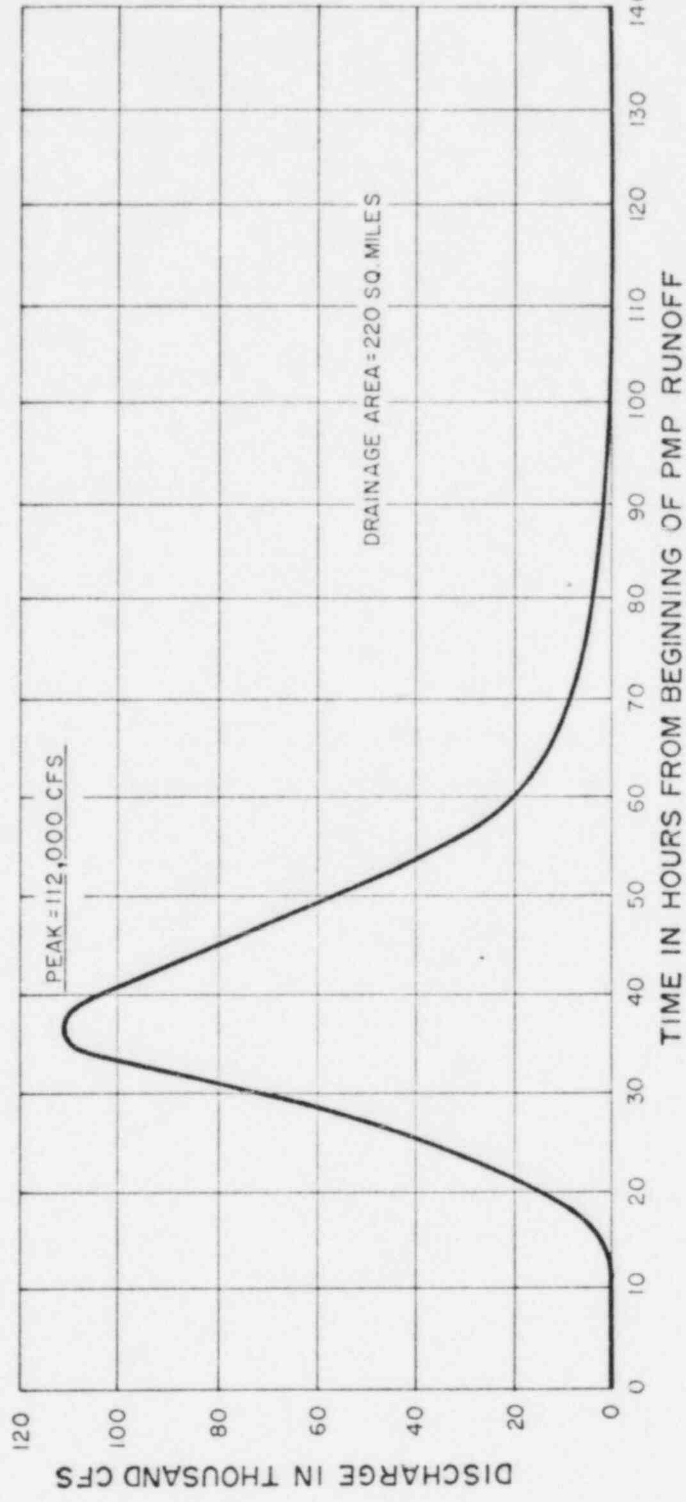

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FIGURE 2.4-13

MAZON RIVER PMF HYDROGRAPH

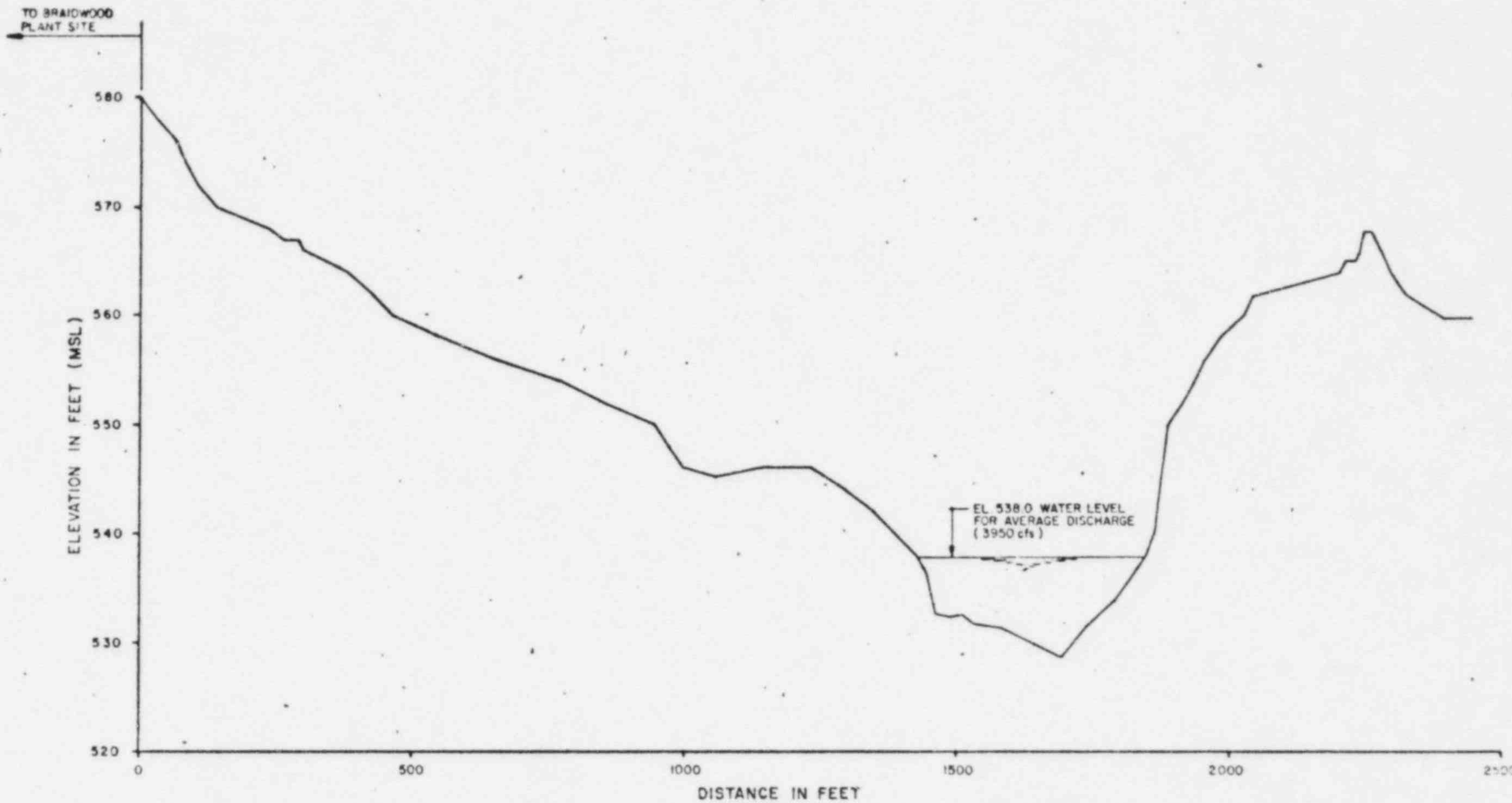

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FIGURE 2.4-14a

TYPICAL CROSS SECTION OF THE KANKAKEE RIVER NEAR RIVER SCREENHOUSE

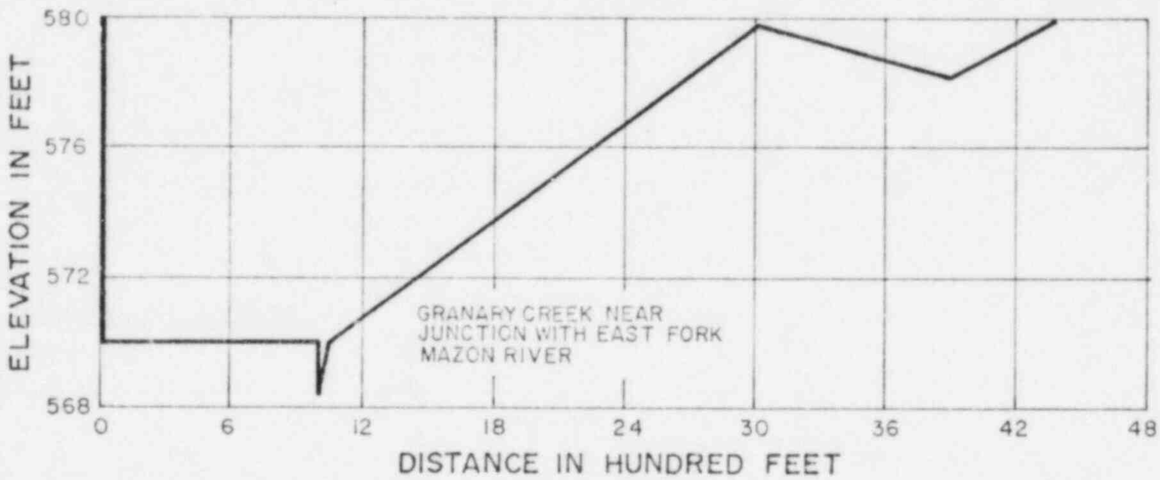

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FIGURE 2.4-17a

CROSS SECTION OF GRANARY CREEK
JUST UPSTREAM OF EAST FORK MAZON RIVER