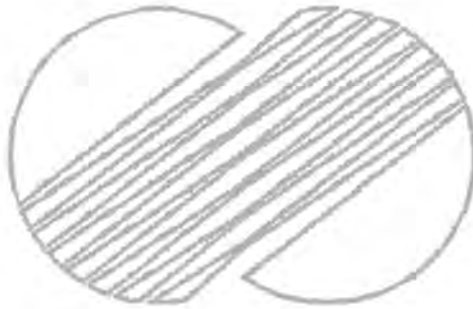


2.1



## 2.0 SITE CHARACTERISTICS

### 2.1 GEOGRAPHY AND DEMOGRAPHY

#### 2.1.1 SITE LOCATION AND DESCRIPTION

##### 2.1.1.1 Site Location

The Kori Nuclear Power Plant Units 3 & 4 (KRN 3 & 4) are located in Gijang-Gun, Busan, on the southeastern coast of Korea, bordering the East Sea, at the village of Kori, on a point known as Kodang Mal.

The coordinates for KRN 3 and 4 are

##### 2.1.1.2 Site Area Map

The location of major structures of the facilities is delineated in figure 2.1-1. The plant property line, which is also the site boundary, and the arrangement of the site occupying approximately 1.01 km<sup>2</sup>, is shown in figure 2.1-2.

The exclusion area of the site is bounded by a 700m radius circle centered at reactor containment. The circle size is sufficient to ensure that the limitations of 10 CFR 100 are met. The entire exclusion area is under the control of the Korea Hydro & Nuclear Power Company (KHNP).

The East Sea is located immediately south of the site and traverses the seaward side of the exclusion area. The access roads to the site are Routes 1019 and 14. Route 1019, which runs between Ulsan and Gyeongju, is 1.4 kilometers from the site to the north-northwest. Route 14 passes Choachun-Ri about 4.8 kilometers from the site to the west.

The railway of Donghaenambu line, Busan to Gyeongju via Ulsan, passes Wolnae Railway Station, about 2.0 kilometers west-northwest, providing freight service to the area.

The nearest streams to the site are Wolnae Creek, about 1.4 kilometers northwest, and Hyoam Creek, 1.9 kilometers southwest. All of the creeks flow into the East Sea, due to the terrain of the site.

#### 2.1.1.3 Boundaries for Establishing Effluent Release Limits

The site restricted area, defined for the purpose of establishing effluent release limits, coincides with the exclusion area boundary as shown in figure 2.1-2. That boundary coincides with limitations set forth in 10 CFR 20.

#### 2.1.2 EXCLUSION AREA AUTHORITY AND CONTROL

##### 2.1.2.1 Authority

The applicant's authority to control all activities such as the removal of industrial facilities, and access of individuals within the exclusion area, was acquired by grant of ownership from the Republic of Korea. All mineral rights in the land portion of the exclusion area are held by KHNP. Access to the exclusion area is strictly controlled. No sea craft are allowed to enter this area without permission.

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##### 2.1.2.2 Control of Activities Unrelated to Plant Operation

Administrative controls have been established over activities in the exclusion area. Any activities unrelated to plant operation are not permitted within the exclusion area.

The following physical security measures were established to minimize uses of the exclusion area not related to plant operation:

- A. A security barrier with an intrusion detection system around the perimeter of the plant and with gates that are kept closed and locked except during times of authorized use.
- B. A perimeter patrol road inside the security barrier.
- C. A well-lit plant area to provide good observation of the site area under normal weather conditions and a glare-type protective lighting system for emergency use.

##### 2.1.2.3 Arrangements for Traffic Control

No railways, highways, or waterways traverse the exclusion area.

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### 2.1.2.4 Abandonment or Relocation of Roads

District Road 1019, which passed the site from Gilchun-Ri via the plant site to Hyoam-Ri was relocated to pass Gilchun-Ri about 1.4 kilometers north of the site.

### 2.1.3 POPULATION DISTRIBUTION

#### 2.1.3.1 Population within 16 Kilometers of the Site

The area within a 16-kilometer radius of the site includes a part of the Yangsan-Kun and Ulju-Kun. The regional population of Changan-Myon was increased as a result of construction of KNU 5 & 6. The population and location of administrative districts within this 16-kilometer radius are shown in the following table:

Town/City	1981	From the Site	
	Population	Distance (km)	Direction
Yangsan-Kun			
Kijang-Eup	21,551	11	SW
Ungsang-Myon	12,039	15	NW
Ilkwang-Myon	14,312	9	SW
Changan-Myon	22,238	5	W
Suhsaeng-Myon	9,630	5	NE
Jungkwan-Myon	4,564	9	W
Chulma-Myon	7,472	14	WSW
Ulju-Kun			
Onsan-Myon	17,333	13	NNW
Onyang-Myon	8,864	11	N



## GEOGRAPHY AND DEMOGRAPHY

### 2.1.3.1.1 Population Growth

The population of the area within 16 kilometers of the plant site is projected to increase from 128,225 people in 1981 to 169,273 by 2030. The population figures for selected years (1990 and from 2000 to 2030 by decade), by sector, and by distance from the plant are shown in tables 2.1-1 through 2.1-6 and in figures 2.1-3 through 2.1-8.

The population within 16 kilometers of the site is projected to expand by 32 percent, an annual increase of 0.56 percent.

The growth rate within the period is expected to fluctuate. The annual rate of growth between 1981 and 1990 is estimated to be 0.72 percent, increasing to 0.85 percent between 2000 and 2010 and then decreasing to 0.39 percent between 2020 and 2030.

### 2.1.3.1.2 Basis of Population Projections

The population projections were developed in the following manner:

- A. On the map of the scale 1:50,000, concentric circles should be drawn at distances of 1.6, 3.2, 4.8, 6.4, 8 and 16 kilometers from the site.
- B. The circles should be divided into 22-1/2° sectors with each sector centered on one of the 16 compass points.

The estimates of population were based on 1981 data.

Population projections for the area within 16 kilometers of the site for the years 1990, 2000, 2010, 2020 and 2030 were estimated as follows:

2.1.3.1.2.1 The Elements Changing Population of the Region and Problems of Population Projections. Population growth in the region changes under the influence of natural elements (birth and death), social elements (influx and efflux), and the actions of the administrative districts; e.g., raising and admitting areas to city status.

Natural increasing rates and gross population are almost projected by fertility and mortality on the age-sex structure. Also, the population resulting from the social element is greatly affected by the regional economic as well as the demographic element. For these reasons, the objective in this section is not to project the population of specific groups

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according to age and sex, but to project the gross population of the region.

In estimating long-term population (1981-2030), all the methods used are not expected to be correct. The data base was not sufficient for use of the Cohort-component method.

**2.1.3.1.2.2 The Several Premises and Suppositions for Population Projection.** The regional population is changed in the range of the gross population for growth of the natural population and results from national land use or economic development.

At present, the regional population is almost determined by population migration caused by urban population increase and rural population decrease.

After establishing the above premises and suppositions, the urban and rural population were estimated in the following table:

Prospects of Gross Population Growth, Urban and Rural  
(Whole Country)

Year	Population (1000)			Urban Population Rate	Annual Growth Rate Percent		
	Gross	Urban	Rural	Percent	Gross	Urban	Rural
1981	38,124	21,845	16,279	57.3	-	-	-
1990	44,261	30,712	13,549	69.4	1.49	3.37	-1.83
2000	50,066	38,631	11,435	77.2	1.23	2.28	-1.69
2010	54,634	42,177	12,457	77.2	0.87	0.87	0.87
2020	58,415	45,096	13,319	77.2	0.67	0.67	0.67
2030	60,844	46,971	13,873	77.2	0.41	0.41	0.41

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2.1.3.1.2.3 Effects of Regional Population Projection. For the above premises and suppositions, the growth rate of the urban and rural population in the region was derived from the component ratio of urban and rural population in the whole country. Therefore, the regional population in the area was projected according to the growth rate of urban and rural populations in following tables:

Prospects for Regional Population Growth  
BUSAN

Year	Regional Population (1000)	Annual Growth Rate (Percent)
1981	3,217	-
1990	4,689	4.13
2000	6,257	2.86
2010	6,829	0.87
2020	7,301	0.67
2030	7,605	0.41

KYONGSANGBUK-DO  
KYONGSANGBUK-DO

Year	Population (1000)			Annual Growth Rate (%)		
	Region	Urban	Rural	Region	Urban	Rural
1981	5,149	3,023	2,126	-	-	-
1990	5,243	3,639	1,604	0.20	2.05	-3.10
2000	5,251	4,054	1,179	0.01	1.07	-3.05
2010	5,736	4,428	1,308	0.87	0.87	0.87
2020	6,133	4,735	1,398	0.67	0.67	0.67
2030	6,388	4,932	1,456	0.41	0.41	0.41

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KYONGSANGNAM-DO

Year	Population (1000)			Annual Growth Rate (%)		
	Region	Urban	Rural	Region	Urban	Rural
1981	3,378	1,937	1,441	-	-	-
1990	3,466	2,406	1,060	0.28	2.40	-3.38
2000	3,410	2,633	777	-0.16	0.90	-3.08
2010	3,715	2,868	847	0.87	0.87	0.87
2020	3,971	3,066	905	0.67	0.67	0.67
2030	4,139	3,194	943	0.41	0.41	0.41

2.1.3.2 Population between 16 and 80 Kilometers

2.1.3.2.1 Population Growth

The population of the area between 16 and 80 kilometers of the site is projected to increase from 5,660,600 in 1981 to 10,294,700 by 2030. The population figures for selected years (1981, and 1990 to 2030 by decade) by sector and distance from the site are shown in tables 2.1-7 to 2.1-12, and figures 2.1-9 to 2.1-14.

The projected annual rate of population growth is 2.1 percent between 1981 and 1990, decreasing to a rate of 0.66 percent between 2010 and 2020. The annual rate of growth is then expected to decrease between 2020 and 2030 to 0.4 percent. Over the entire period from 1981 to 2030, the population is estimated to expand by 81.8 percent, or at a rate of 1.16 percent per year.

Of the residents living between 16 and 80 kilometers of the site in 1981, 20.6 percent lived between 64 and 80 kilometers, and 30.37 percent lived between 48 and 80 kilometers from the site.

By the final year of plant operation in 2030, 12.9 percent of the population between 16 and 80 kilometers from the site will live at a distance of at least 64 kilometers, and 18.8 percent will live at least 48 kilometers from the site. The areas within the subject region in which population increases are expected to be greatest between 1981 and 2030 lie primarily in



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the cities of Busan, Ulsan, Gyeongju, and Masan. The regional population and cities and towns are indicated in table 2.1-13.

### 2.1.3.2.2 Basis of Population Projection

The population projections were developed in the following manner:

- A. On census tract maps of suitable scale 1:50,000, concentric circles should be drawn at distance of 16, 32, 48, 64 and 80 kilometers from the site.
- B. The circles are divided into 22-1/2° sectors with each sector centered on one of the compass points.

Residential population for each sector was calculated for 1981 and for each census decade through the projected plant life.

The population forecasts were derived in the same manner as described in subparagraph 2.1.3.1.2.

### 2.1.3.3 Transient Population

The transient population resulting from recreational and industrial land uses in the area within 16 kilometers of the site has been evaluated to determine seasonal and daily levels and variations. These data are shown in table 2.1-14. The area includes a part of the Yangsan-Kun and Ulju-Kun.

The personnel employed within 16 kilometers of the site are assumed to be included in the traffic count along District Road 1019, National Road 14 and the railway.

There are three recreation centers in this area: Jinha Beach, Ilkwang Beach and Changan Temple. These centers draw many visitors to the 16-kilometer area.

#### 2.1.3.3.1 Industrial

The transient population resulting from industrial land use in Yangsan-Kun and Ulju-Kun within a 16-kilometer radius of the site is insignificant because almost all industrial workers live within the area.

#### 2.1.3.3.2 Recreational

At present, a substantial transient population results from recreational land use which includes tourist activities and resident population in Busan, Ulsan, and Yangsan. Almost all

## GEOGRAPHY AND DEMOGRAPHY

visitors use Route 1019, Route 14, or the Donghaenambu Railway Line. All roads and railways originate outside the 16-kilometer site radius.

There are three major sources of visitors to the 16-kilometer radius for recreation such as Jinha and Ilkwang Beach, and Changan Temple.

The recreational population from these sources was approximately 417,100 in 1981; of this total 367,500 visited the beaches and 49,600 visited the temple.

Total attendance at these activities was greatest during the summer and greater during weekends than on weekdays. The attendance at Jinha Beach, 8 kilometers northeast and Ilkwang Beach, 8 kilometers southwest, are noted in table 2.1-15. The attendance at the Changan Temple, 7 kilometers northwest, is noted in table 2.1-16. This is the only temple within 16 kilometers of the site.

### 2.1.3.3.3 Highway and Railway

Route 1019, Route 14 and the Donghaenambu Railway originate outside the 16-kilometer radius of the site. These transportation facilities carry most of the visitors in and out of the area. The only national road, Route 14, passes the Changan-Myon 4.8 kilometers west of the site. District Route 1019 passes approximately 1.4 kilometers west of the site.

The Donghaenambu Railway passes the Wolnae Railway Station about 2 kilometers west-northwest of the site and connects Busan and Kyongju via Ulsan. Passenger volume on the Donghaenambu Railway is noted in table 2.1-17. Highway passengers along Routes 1019 and 14 are estimated by actual vehicular counts for the periods and applied occupancy per vehicle type, as shown in tables 2.1-18 and 2.1-19.

### 2.1.3.3.4 Forecasts

The transient population in the area should continue to increase in response to local population growth and to tourism in southeastern Korea. Accordingly, the transient population from 1981 to 2030 was projected in connection with the growth of the local population in Yangsan-Kun and Ulju-Kun, as shown in table 2.1-20. This transient population within 16 kilometers of the site is forecast to increase from 10,602,400 in 1981 to 14,754,400 in 2030.

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### 2.1.3.3.5 Peak Seasonal and Daily Population

The estimates of peak seasonal and daily population are based on investigations of traffic and recreational uses within 16 kilometers of the site. The peak seasonal transient population typically occurs in the summer months of July and August. The peak daily transient population generally occurs on Sunday in late July or early August. The peak seasonal transient population is estimated to range from 3,312,600 in 1981 to 4,630,300 in 2030, as shown in table 2.1-21. The peak daily transient population is projected to increase from 45,300 in 1981 to 62,930 in 2030, as shown in table 2.1-22.

### 2.1.3.4 Low Population Zone

The low population zone (LPZ) for the site is bounded by a 5.6 kilometer radius circle centered at the reactor containment building. The LPZ is shown in figure 2.1-15. The nearest population center is the city of Busan. The distance from the reactor containment to the nearest boundary of Busan is 16 kilometers. This distance is the population center distance and is greater than one and one-third times the low population zone boundary distance as required by 10 CFR 100. The basis for selection of the low population zone distance is that postulated dosages at the low population zone boundary are well within the limitations of 10 CFR 100 for fission project release.

#### 2.1.3.4.1 Public Facilities and Institutions in the Vicinity of the LPZ

A survey was conducted in September 1981 to determine existing and planned public facilities and institutions, such as schools, hospitals, prisons, beaches, and parks within 16 kilometers of the site. This area includes a portion of Yangsan-Kun and Ulju-Kun. These facilities are discussed below:

- A. Schools. The schools within 16 kilometers of the site are indicated in table 2.1-23 and figure 2.1-16. In this area, there are 29 elementary schools, 7 middle schools, and 5 high schools. The closest to the site is Wolnae elementary school in the Kilchun-Ri (1.5 km NW) with a 1982 enrollment of 1,354 students.
- B. Hospitals. Hospitals within 16 kilometers of the site are listed in table 2.1-24 and are indicated in figure 2.1-17. The facility closest to the site is in Kori, about 2.4 kilometers north-northwest. All hospitals within 16 kilometers of the site have limited facilities. Well-equipped larger hospitals are numerous in Busan, 32 kilometers southwest, and Ulsan, about 26 kilometers north.



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- C. Prisons. There are no prisons within 16 kilometers of the site.
- D. Parks and Recreational Areas. The area within 16 kilometers southwest and northeast of the site faces the sea. In summertime, many vacationers populate this area. The Jinha Beach, 8 kilometers northeast, and Ilkwang Beach, 8 kilometers southwest, are located within 16 kilometers of the site.

### 2.1.3.5 Population Center

The nearest population center, as defined in 10 CFR 100, is the city of Busan, west of the site, with a 1981 population of 3,246,643.

The distance from the site to the nearest boundary of Busan is about 16 kilometers. This distance is the population center distance and is greater than one- and one-third times the low population zone boundary distance as required by 10 CFR 100. The basis for selection of the low population zone distance is that postulated doses at the low population zone boundary are well within the limitations of 10 CFR 100 for fission product release.

### 2.1.3.6 Population Density

The cumulative residential population for the initial year of operation, 1990, within a 48-kilometer radius will be 5,476,083, as shown in table 2.1-25.

This compares to a cumulative population of 1,413,500 for a uniform density of 500 persons per 2.56 square kilometers. For 2030, the projected population within a 48-kilometer radius is 8,511,247, as noted in table 2.1-26. At a uniform density of 1000 persons per 2.56 square kilometers, the population within the same radius would be 2,827,000.

### 2.1.4 REFERENCES

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5. Kyongsangnam-Do, 1981, Statistical Yearbook of Kyongsangnam-Do.
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8. Bureau of Statistics, Economic Planning Board, ROK, 1981, Continuous Demographic Survey.



GEOGRAPHY AND DEMOGRAPHY

Table 2.1-1

1981 POPULATION BY SECTOR AND DISTANCE  
 WITHIN 16 KILOMETERS OF THE SITE

Sector	0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total 0 - 16 (km)
W	0	1,218	2,738	236	415	4,940	9,547
WNW	0	2,649	110	170	171	5,706	8,806
NW	4,403	4,093	707	693	179	6,771	16,846
NNW	287	617	268	411	545	1,877	4,005
N	0	1,478	836	268	74	9,818	12,494
NNE	268	986	452	388	0	14,893	16,987
NE	0	1,097	2,420	1,018	952		5,467
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	334	12,022	12,356
SW	0	0	3,166	87	4,448	27,471	35,172
WSW	0	0	2,787	1,167	74	2,537	6,565
Total	4,958	12,118	13,484	4,438	7,192	86,035	128,225

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-2

1990 POPULATION BY SECTOR AND DISTANCE  
WITHIN 16 KILOMETERS OF THE SITE

Sector	0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total 0 - 16 (km)
W	0	1,459	3,280	282	305	3,640	8,966
WNW	0	3,173	131	203	204	6,835	10,546
NW	3,240	3,012	846	978	214	8,111	16,401
NNW	211	454	321	492	652	1,383	3,513
N	0	1,087	616	197	54	7,235	9,189
NNE	197	725	333	285	0	17,841	19,381
NE	0	792	1,783	750	701	0	4,026
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	400	14,402	14,802
SW	0	0	3,792	104	5,328	32,910	42,134
WSW	0	0	3,338	1,398	88	3,039	7,863
Total	3,648	10,702	14,440	4,689	7,946	95,396	136,821

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-3

2000 POPULATION BY SECTOR AND DISTANCE  
WITHIN 16 KILOMETERS OF THE SITE

Sector	0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total 0 - 16 (km)
W	0	1,596	3,588	308	221	2,668	8,381
WNW	0	3,471	143	222	223	7,477	11,536
NW	2,314	2,207	925	1,069	234	8,873	15,682
NNW	154	332	351	538	713	1,013	3,101
N	0	796	451	144	40	5,303	6,734
NNE	144	531	244	208	0	19,517	20,644
NE	0	580	1,306	549	513	0	2,348
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	437	15,755	16,192
SW	0	0	4,148	113	5,828	36,003	46,092
WSW	0	0	3,651	1,529	96	3,324	8,600
Total	2,672	9,513	14,807	4,680	8,305	99,933	139,910

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-4

2010 POPULATION BY SECTOR AND DISTANCE  
WITHIN 16 KILOMETERS OF THE SITE

Sector	0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total 0 - 16 (km)
W	0	1,738	3,907	335	237	2,905	9,122
WNW	0	3,779	155	241	242	8,142	12,559
NW	2,587	2,405	1,007	1,164	254	9,662	17,678
NNW	167	361	382	585	776	1,103	3,374
N	441	867	491	156	43	5,774	7,331
NNE	156	578	265	226	0	21,253	22,208
NE	0	632	1,422	597	558	0	3,041
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	475	17,157	17,632
SW	0	0	4,517	123	6,346	39,207	50,193
WSW	0	0	3,975	1,665	104	3,619	9,363
Total	2,910	10,360	16,121	5,092	9,035	108,822	152,340



GEOGRAPHY AND DEMOGRAPHY

Table 2.1-5

2020 POPULATION BY SECTOR AND DISTANCE  
WITHIN 16 KILOMETERS OF THE SITE

Sector	0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total 0 - 16 (km)
W	0	1,857	4,176	358	251	3,102	9,744
WNW	0	4,039	165	257	258	8,703	13,422
NW	2,762	2,588	1,076	1,244	271	10,328	18,249
NNW	178	385	408	625	829	1,178	3,603
N	0	925	524	166	45	6,166	7,826
NNE	166	617	283	241	0	22,719	24,026
NE	0	674	1,518	637	595	0	3,424
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	507	18,340	18,847
SSW	0	0	4,828	131	6,783	41,912	53,654
WSW	0	0	4,249	1,778	111	3,865	10,003
Total	3,106	11,065	17,227	5,437	9,650	116,313	162,798



GEOGRAPHY AND DEMOGRAPHY

Table 2.1-6

2030 POPULATION BY SECTOR AND DISTANCE  
 WITHIN 16 KILOMETERS OF THE SITE

Sector	0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total 0 - 16 (km)
W	0	1,933	4,347	372	263	3,229	10,144
WNW	0	4,205	172	267	268	9,059	13,971
NW	2,875	2,693	1,120	1,295	282	10,751	18,336
NNW	185	400	424	650	862	1,226	3,747
N	0	962	545	172	46	6,418	8,143
NNE	172	642	294	250	0	23,550	24,908
NE	0	701	1,580	663	619	0	3,563
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	527	19,051	19,578
SW	0	0	5,025	136	7,061	43,590	55,812
WSW	0	0	4,423	1,850	115	4,023	10,411
Total	3,232	11,516	17,930	5,655	10,043	120,897	169,273

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-7

1981 POPULATION BY SECTOR AND DISTANCE  
 BETWEEN 16 AND 80 KILOMETERS FROM THE SITE

(Population in thousands)

Sector	16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total 16 - 80 (km)
W	41.0	46.9	182.7	277.6	548.2
WNW	13.5	31.3	53.9	73.6	172.3
NW	16.5	10.4	47.1	149.8	223.8
NNW	23.7	19.9	32.9	132.9	209.4
N	183.9	36.9	141.0	321.8	683.6
NNE	228.2	22.9	24.2	41.6	316.9
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	35.3	0	0	0	35.3
SW	1,660.5	889.4	4.4	70.3	2,624.6
WSW	474.3	206.8	64.5	100.9	846.5
Total	2,676.9	1,264.5	550.7	1,168.5	5,660.6

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-8

1990 POPULATION BY SECTOR AND DISTANCE  
BETWEEN 16 AND 80 KILOMETERS FROM THE SITE

(Population in thousands)

Sector	16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total 16 - 80 (km)
W	32.9	29.1	179.5	295.6	537.1
WNW	16.1	23.1	39.7	54.2	133.1
NW	15.5	7.5	35.5	135.8	194.3
NNW	17.9	15.1	24.8	119.3	177.1
N	209	27.8	157.8	338.8	733.4
NNE	266.8	17.3	18.2	31.4	333.7
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	50.8	0	0	0	50.8
SW	2,391.1	1,280.7	3.2	51.8	3,726.8
WSW	676.2	260.4	70.1	105.2	1,111.9
Total	3,673.3	1,661	528.8	1,132.1	6,998.2

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-9

2000 POPULATION BY SECTOR AND DISTANCE  
 BETWEEN 16 AND 80 KILOMETERS FROM THE SITE

(Population in thousands)

Sector	16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total 16 - 80 (km)
W	26.6	32.9	174	302.9	536.4
WNW	17.6	16.9	29.1	39.7	103.3
NW	14.8	5.6	26.5	125.0	171.9
NNW	13.4	11.3	18.5	108.8	152
N	229.5	20.7	171	352.4	773.6
NNE	297.2	12.9	13.6	23.4	347.1
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	67.7	0	0	0	67.7
SW	3,189.7	1,708.4	2.3	37.9	4,938.3
WSW	898	316.1	72.7	106.3	1,393.1
Total	4,754.5	2,124.8	507.7	1,096.4	8,483.4

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-10

2010 POPULATION BY SECTOR AND DISTANCE  
BETWEEN 16 AND 80 KILOMETERS FROM THE SITE

(Population in thousands)

Sector	16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total 16 - 80 (km)
W	28.9	35.7	189.4	329.8	583.8
WNW	19.1	18.4	31.7	43.2	112.4
NW	16.0	6.1	28.9	136.4	187.4
NNW	14.6	12.3	20.2	118.8	165.9
N	250.5	22.6	186.6	384.7	844.4
NNE	324.5	14.0	14.8	25.5	378.8
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
S	0	0	0	0	0
SSW	73.8	0	0	0	73.8
SW	3,481.2	1,864.5	2.5	41.2	5,389.4
WSW	980	344.6	79.1	115.6	1,519.3
Total	5,188.6	2,318.2	5,532	1,195.2	9,255.2

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-11

2020 POPULATION BY SECTOR AND DISTANCE  
 BETWEEN 16 AND 80 KILOMETERS FROM THE SITE

(Population in thousands)

Sector	16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total 16 - 80 (km)
W	30.9	38.1	202.4	352.5	623.9
WNW	20.4	19.6	33.9	46.1	120.0
NW	17.0	6.5	30.7	145.4	199.6
NNW	15.5	13.0	21.5	126.7	176.7
N	267.6	24.0	199.3	410.9	901.8
NNE	346.8	14.9	15.7	27.1	404.5
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	78.9	0	0	0	78.9
SW	3,721.4	1,993.1	2.6	44	5,761.1
WSW	1,047.5	368.3	84.4	123.5	1,623.7
Total	5,546	2,477.5	590.5	1,276.2	9,890.2



GEOGRAPHY AND DEMOGRAPHY

Table 2.1-12

2030 POPULATION BY SECTOR AND DISTANCE  
BETWEEN 16 AND 80 KILOMETERS FROM THE SITE

(Population in thousands)

Sector	16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total 16 - 80 (km)
W	32.1	39.6	210.6	366.8	649.1
WNW	21.2	20.4	35.3	47.9	124.8
NW	17.7	6.7	31.9	151.3	207.6
NNW	16.1	13.5	22.4	131.9	183.9
N	278.6	24.9	207.5	427.9	938.9
NNE	361.1	15.5	16.3	28.2	421.1
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	82.1	0	0	0	82.1
SW	3,873.9	2,074.8	2.7	45.8	5,997.2
WSW	1,090.4	383.3	87.8	128.5	1,690.0
Total	5,773.2	2,578.7	614.5	1,328.3	10,294.7



GEOGRAPHY AND DEMOGRAPHY

Table 2.1-13

1981 RESIDENT POPULATION CITY AND KUN  
WITHIN 80 KILOMETERS OF THE SITE  
(Sheet 1 of 2)

City and Country	1981 Population	From the Site	
		Distance (km)	Direction
Busan City	3,246,643	32	SW
Kyongsangnam-Do			
Masan City	400,501	66	WSW
Changwon City	128,095	55	W
Ulsan City	450,541	27	NNE
Kimhae City	70,701	40	WSW
Jinhae City	114,060	59	WSW
Yongsan Kun	149,082	23	W
Ulju Kun	117,182	23	NNE
Changyong Kun	115,746	75	WNW
Kimhae Kun	98,898	40	WNW
Euichang Kun	88,611	65	WSW
Geoje Kun	127,365	75	SW
Milyang Kun	161,555	51	WNW

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-13

1981 RESIDENT POPULATION CITY AND KUN  
WITHIN 80 KILOMETERS OF THE SITE  
(Sheet 2 of 2)

City and Country	1981 Population	From the Site	
		Distance (km)	Direction
Kyongsangbuk-Do			
Kyongju City	125,686	58	N
Yongchun City	57,375	78	NNW
Pohang City	206,346	77	N
Wolsung Kun	168,099	58	N
Yongchun Kun	104,458	78	NNW
Chungdo Kun	83,867	61	NW
Kyongsan Kun	137,006	75	NW
Yongil Kun	195,376	77	N

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-14

TRANSIENT POPULATION DISTRIBUTION WITHIN  
A 16-KILOMETER RADIUS OF THE SITE, 1981

Month	Total Transient Population (1000)	The Fraction of Total Transient Population (1000)	Beach Attendance (1000)	Route 1019 (1000)	Route 14 (1000)	Railroad (1000)	Temple (1000)
January	721.7	6.8		288.9	301.9	129.3	1.6
February	632.0	5.9		252.5	263.9	113.1	2.5
March	926.2	8.8		366.2	382.6	163.8	13.6
April	907.3	8.6		363.7	380.0	162.9	0.7
May	982.5	9.3		387.8	416.6	174.9	3.2
June	795.2	7.5		317.1	331.4	141.9	4.8
July	1,212.1	11.4	220.6	397.0	414.7	177.6	2.2
August	1,286.0	12.1	146.9	449.6	469.8	201.1	18.6
September	815.5	7.7		327.0	341.7	146.3	0.5
October	869.3	8.2		348.3	363.9	155.8	1.3
November	723.9	6.8		290.2	303.2	130.2	0.3
December	730.7	6.9		293.1	360.1	131.2	0.3
Total	10,602.4	100	367.5	4,081.4	4,275.8	1,828.1	49.6

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-15

ATTENDANCE AT PUBLIC BEACHES WITHIN  
A 16-KILOMETER RADIUS OF THE SITE, 1981

1981	Jinha Beach (1,000)	Ilkwang Beach (1,000)
January	-	-
February	-	-
March	-	-
April	-	-
May	-	-
June	-	-
July	165.1	55.5
August	111.1	35.8
September	-	-
October	-	-
November	-	-
December	-	-
Total	276.2	91.3

Source: Culture and Public Information Section, Office of Yangsan-Kun.

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-16

ATTENDANCE AT TEMPLE WITHIN  
A 16-KILOMETER RADIUS OF THE SITE, 1981

1981	Total Attendance (Percent)	Changan Temple (1,000)
January	3.2	1.6
February	5.0	2.5
March	27.4	13.6
April	1.4	0.7
May	6.4	3.2
June	9.7	4.8
July	4.4	2.2
August	37.5	18.6
September	1.0	0.5
October	2.6	1.3
November	0.7	0.3
December	0.7	0.3
Total	100.0	49.6

Source: Culture and Public Information Section, Office of Yangsan-Kun.

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-17

ANNUAL VEHICLE TRAFFIC AND ESTIMATED  
PASSENGER POPULATION ALONG THE DONGHAENAMBU  
RAILWAY LINE, 1981

Month	Passenger Trains	Passenger Population (1000)
January	4,550	129.3
February	4,218	113.1
March	4,380	163.8
April	4,436	162.9
May	4,470	174.9
June	4,136	141.9
July	4,660	177.6
August	4,630	201.1
September	4,560	146.3
October	4,370	155.8
November	4,036	130.2
December	4,330	131.2
Total	52,776	1,828.1

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-18  
NUMBERS OF VEHICLES AND PASSENGERS ON DISTRICT  
ROAD 1019 WITHIN 16 KILOMETERS OF THE SITE, 1981

Month	Average Monthly Traffic			Estimated Passenger Population				
	Total	Passenger Cars	Buses	Trucks	Total (1000)	Car (1000)	Bus (1000)	Truck (1000)
January	30,941	14,612	7,592	8,737	288.9	43.8	227.7	17.4
February	27,046	12,773	6,636	7,637	252.5	38.3	199.0	15.2
March	39,214	18,519	9,622	11,073	366.2	55.5	288.6	22.1
April	38,952	18,395	9,558	10,999	363.7	55.1	286.7	21.9
May	40,876	18,795	10,266	11,815	387.8	56.3	307.9	23.6
June	33,962	16,039	8,383	9,590	317.1	48.1	249.9	19.1
July	42,496	20,069	10,427	12,000	397.0	60.2	312.8	24.0
August	48,143	22,735	11,813	13,595	449.6	68.2	354.3	27.1
September	35,013	16,535	8,591	9,887	327.0	49.6	257.7	19.7
October	37,290	17,610	9,150	10,530	348.3	52.8	274.5	21.0
November	31,075	14,675	7,625	8,775	290.2	44.0	228.7	17.5
December	31,380	14,819	7,700	8,861	293.1	44.4	231.0	17.7
Total	436,388	205,576	107,313	123,499	4,081.4	616.3	3,218.8	246.3

1. Source: Traffic Section, Office of Kyongsangnam-Do.

2. The estimated numbers of people per bus, car and truck are 30, 3 and 2, respectively.



GEOGRAPHY AND DEMOGRAPHY

Table 2.1-19  
NUMBERS OF VEHICLES AND PASSENGERS ON NATIONAL ROAD 14  
WITHIN 16 KILOMETERS OF THE SITE, 1981

Month	Average Monthly Traffic				Estimated Passenger Population			
	Total	Passenger Cars	Buses	Trucks	Total (1000)	Car (1000)	Bus (1000)	Truck (1000)
January	49,378	10,868	6,870	31,640	301.9	32.6	206.1	63.2
February	43,169	9,507	6,005	27,657	263.9	28.5	180.1	55.3
March	62,571	13,765	8,707	40,099	382.6	41.3	261.2	80.1
April	62,172	13,693	8,649	39,830	380.0	41.0	259.4	79.6
May	70,865	14,709	9,296	46,860	416.6	44.1	278.8	93.7
June	54,199	11,930	7,541	34,728	331.4	35.8	226.2	69.4
July	67,831	14,940	9,436	43,455	414.7	44.8	283.0	86.9
August	76,843	16,925	10,690	49,228	469.8	50.7	320.7	98.4
September	55,873	12,297	7,774	35,802	341.7	36.9	233.2	71.6
October	49,520	13,110	8,280	38,130	363.9	39.3	248.4	76.2
November	49,595	10,920	6,900	31,775	303.2	32.7	207.0	63.5
December	50,088	11,032	6,968	32,088	306.1	33.0	209.0	64.1
Total	702,104	153,696	97,116	451,191	4,275.8	460.7	2,913.1	902.0

1. Source: Traffic Section, Office of Kyongsangnam-Do.

2. The estimated numbers of people per bus, car and truck are 30, 3 and 2 respectively.

Table 2.1-20  
PROJECTED TRANSIENT POPULATION WITHIN 16 KILOMETERS  
OF THE SITE, 1981 - 2030

Year	Total Attendance (1000)	Beach Attendance (1000)	Route 1019 (1000)	Route 14 (1000)	Railway (1000)	Temple (1000)
1981	10,602.4	367.5	4,081.4	4,275.8	1,828.1	49.6
1990	11,671.0	406.3	4,424.3	4,764.3	2,021.3	54.8
2000	12,196.6	424.6	4,623.3	4,979.3	2,112.2	57.2
2010	13,281.8	462.3	5,034.7	5,422.4	2,300.1	62.3
2020	14,025.3	488.1	5,316.6	5,726.0	2,428.9	65.7
2030	14,754.4	513.4	5,593.0	6,023.7	2,555.2	69.1

Table 2.1-21  
PROJECTED PEAK SEASONAL TRANSIENT POPULATION  
WITHIN 16 KILOMETERS OF THE SITE, 1981 TO 2030

Year	Peak Seasonal Population (1000)	Beach Attendance (1000)	Route 1019 (1000)	Route 14 (1000)	Railway (1000)	Temple (1000)
1981	3,312.6	367.5	1,173.6	1,225.3	525.0	21.3
1990	3,662.7	406.3	1,297.6	1,354.8	580.5	23.5
2000	3,827.5	424.5	1,355.9	1,415.7	293.1	24.5
2010	4,168.1	462.2	1,476.5	1,541.6	319.1	26.6
2020	4,401.5	488.1	1,559.1	1,627.9	336.9	28.1
2030	4,630.3	513.5	1,640.1	1,712.5	354.4	29.5

Table 2.1-22  
PROJECTED PEAK DAILY TRANSIENT POPULATION  
WITHIN 16 KILOMETERS OF THE SITE, 1981 TO 2030

Year	Peak Seasonal Population (1000)	Beach Attendance (1000)	Route 1019 (1000)	Route 14 (1000)	Railway (1000)	Temple (1000)
1981	45.30	7.5	14.9	15.6	6.7	0.6
1990	49.96	8.3	16.4	17.2	7.4	0.66
2000	52.19	8.7	17.1	18.0	7.7	0.69
2010	56.85	9.5	18.6	19.6	8.4	0.75
2020	59.99	10.0	19.6	20.7	8.9	0.79
2030	62.93	10.5	20.6	21.7	9.3	0.83

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-23

SCHOOLS WITHIN 16 KILOMETERS OF PLANT SITE  
(Sheet 1 of 3)

School	Enroll- ment	From the Site		
		Location	Distance (km)	Direction
Elementary				
1. Ungsang	335	Ungsang-Myon	15	NW
2. Dukgye	468	Ungsang	14	WNW
3. Suchang	855	Ungsang	16	NW
4. Kijang	1,351	Kijang	11	SW
5. Daebyon	564	Kijang	12	SSW
6. Jooksung	404	Kijang	10	SSW
7. Ilkwang	946	Ilkwang	8	SW
8. Ilkwanghak-Ri	104	Ilkwang	8	SW
9. Chilam	688	Ilkwang	4	SW
10. Changan	326	Changan	5	W
11. Daeroyng	24	Changan	5	NW
12. Choachun	899	Changan	5	W
13. Wolnae	1,354	Changan	2	NW
14. Suhsaeng	658	Suhsaeng	4	NE
15. Daesong	66	Suhsaeng	7	NE
16. Sungdong	221	Suhsaeng	8	NNE
17. Myungsan	349	Suhsaeng	3	N

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-23

SCHOOLS WITHIN 16 KILOMETERS OF PLANT SITE  
(Sheet 2 of 3)

School	Enroll- ment	From the Site		
		Location	Distance (km)	Direction
18. Jungkwan	431	Jungkwan-Myon	9	W
19. Byungsan	5	Jungkwan	9	WNW
20. Wolpyung	136	Jungkwan	15	WNW
21. Chulma	266	Chulma	13	WSW
22. Shinjin	150	Chulma	14	SW
23. Onyang	1,029	Onyang	10	N
24. Samkwang	120	Onyang	15	NNW
25. Onsan	623	Onsan	12	NNE
26. Dangwol	433	Onsan	12	NNE
27. Sampyung	180	Onsan	10	NNE
28. Chundo	607	Onsan	14	NNE
29. Dukshin	329	Onsan	13	N

Sources: Board of Education, Yangsan-Kun and Ulju-Kun.



GEOGRAPHY AND DEMOGRAPHY

Table 2.1-23

SCHOOLS WITHIN 16 KILOMETERS OF PLANT SITE  
(Sheet 3 of 3)

School	Enroll- ment	From the Site		
		Location	Distance (km)	Direction
Middle Schools				
30. Kaewoon	753	Ungsang-Myon	15	NW
31. Kijang	1,300	Kijang	11	SW
32. Changan	1,438	Changan	4	W
33. Suhsaeng	544	Suhsaeng	5	NE
34. Chulma	166	Chulma	13	WSW
35. Onsan	790	Onsan	15	NNE
36. Namchang	753	Onyang	11	N
High Schools				
37. Hoyam	507	Ungsang	15	NW
38. Kijang	710	Kijang	11	SW
39. Changan	573	Changan	4	W
40. Onsan	663	Onsan	15	NNE
41. Namchang	694	Onyang	11	N

Sources: Board of Education, Yangsan-Kun and Ulju-Kun.

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-24

HOSPITALS WITHIN 16 KILOMETERS OF THE SITE

Hospital	Number of Doctors	Location	From Site	
			Distance (km)	Direction
1. Jaeil Clinic	1	Changan Myon, Wolnae	1.5	NW
2. Changan Clinic	1	Changan Myon, Joachun	4.0	W
3. Myongdong	2	Changan Myon, Wolnae	1.5	NW
4. Kori Clinic	3	Changan Myon, Kilchun	2.4	NNW
5. Daein Clinic	2	Kijang Euop, Daera	11.0	SW
6. Dukha Clinic	2	Kijang Euop, Daera	11.0	SW
7. Kijang Clinic	1	Kijang Euop, Dongbu	11.2	SW
8. Dongin Clinic	1	Ungsang Myon, Samho	16.0	NW
9. Busan Clinic	1	Ungsang Myon, Samho	16.0	NW
10. Dongkwang Clinic	1	Ilkwang Myon, Leechun	8.0	SW
11. Dongsan Clinic	1	Suhsaeng Myon, Sinam	4.0	NE
12. Jungkwan Clinic	1	Jungkwan Myon, Banggok	10.0	W
13. Onsan Clinic	1	Onsan Myon, Bangdo	15.0	NNE
14. Yongsang Clinic	1	Onyang Myon, Namchang	11.0	N

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-25

COMPARISON OF POPULATION BASED ON A DENSITY  
OF 500 PEOPLE PER 2.56 SQUARE KILOMETERS TO  
PROJECTED POPULATION INITIAL YEAR 1990

Distance from Site (km)	Population at 500 <sub>2</sub> People Per 2.56 km <sup>2</sup>		Projected Population	
	Total	Cumulative Total	Total	Cumulative Total
0 - 1.6	1,570	1,570	11,510	11,510
1.6 - 3.2	4,715	6,285	7,802	19,312
3.2 - 4.8	7,850	14,135	14,440	33,752
4.8 - 6.4	11,000	25,135	4,689	38,441
6.4 - 8.0	14,135	39,270	7,946	46,387
8.0 - 16	117,810	157,080	95,396	141,783
16 - 32	471,420	628,000	3,673,300	3,815,083
32 - 48	785,000	1,413,500	1,661,000	5,476,083

GEOGRAPHY AND DEMOGRAPHY

Table 2.1-26

COMPARISON OF POPULATION BASED ON A DENSITY  
 OF 1000 PEOPLE PER 2.56 SQUARE KILOMETERS TO  
 PROJECTED POPULATION INITIAL YEAR 2030

Distance from Site (km)	Population at 1000 People Per 2.56 km <sup>2</sup>		Projected Population	
	Total	Cumulative Total	Total	Cumulative Total
0 - 1.6	3,140	3,140	19,315	19,315
1.6 - 3.2	9,430	12,570	5,231	24,546
3.2 - 4.8	15,700	28,270	17,606	42,152
4.8 - 6.4	22,000	50,270	5,655	47,807
6.4 - 8.0	28,270	78,540	10,048	57,855
8.0 - 16	235,620	314,160	101,292	159,147
16 - 32	942,840	1,257,000	5,773,200	5,932,347
32 - 48	1,570,000	2,827,000	2,578,900	8,511,247

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SITE PLAN  
Figure 2.1-1

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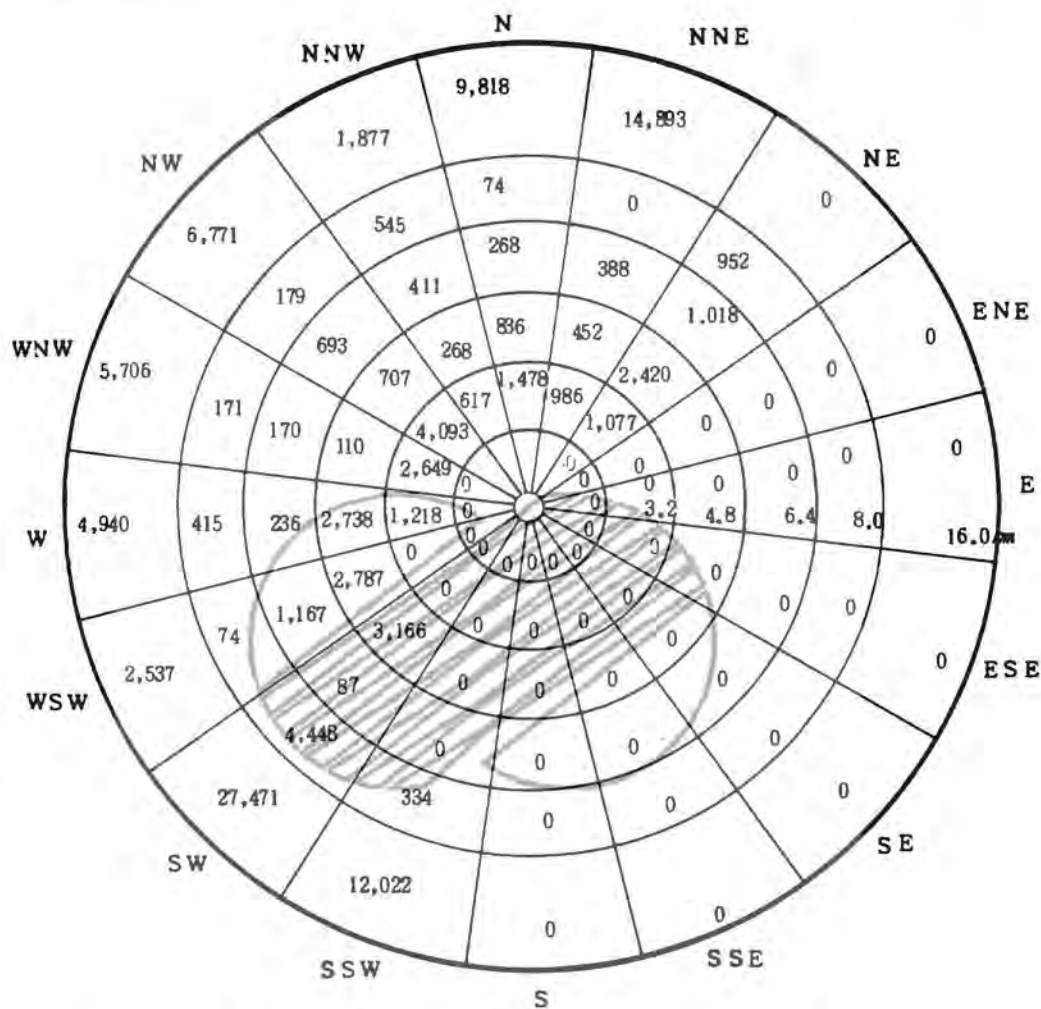
EXCLUSION AREA BOUNDARY  
AND PROPERTY LINE

Figure 2.1-2



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Population within 1.6 km of the site				
Direction	NW	NNW	N	NNE
Population	4,403	287	0	268



0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total
4,958	12,118	13,484	4,438	7,192	86,035	128,225



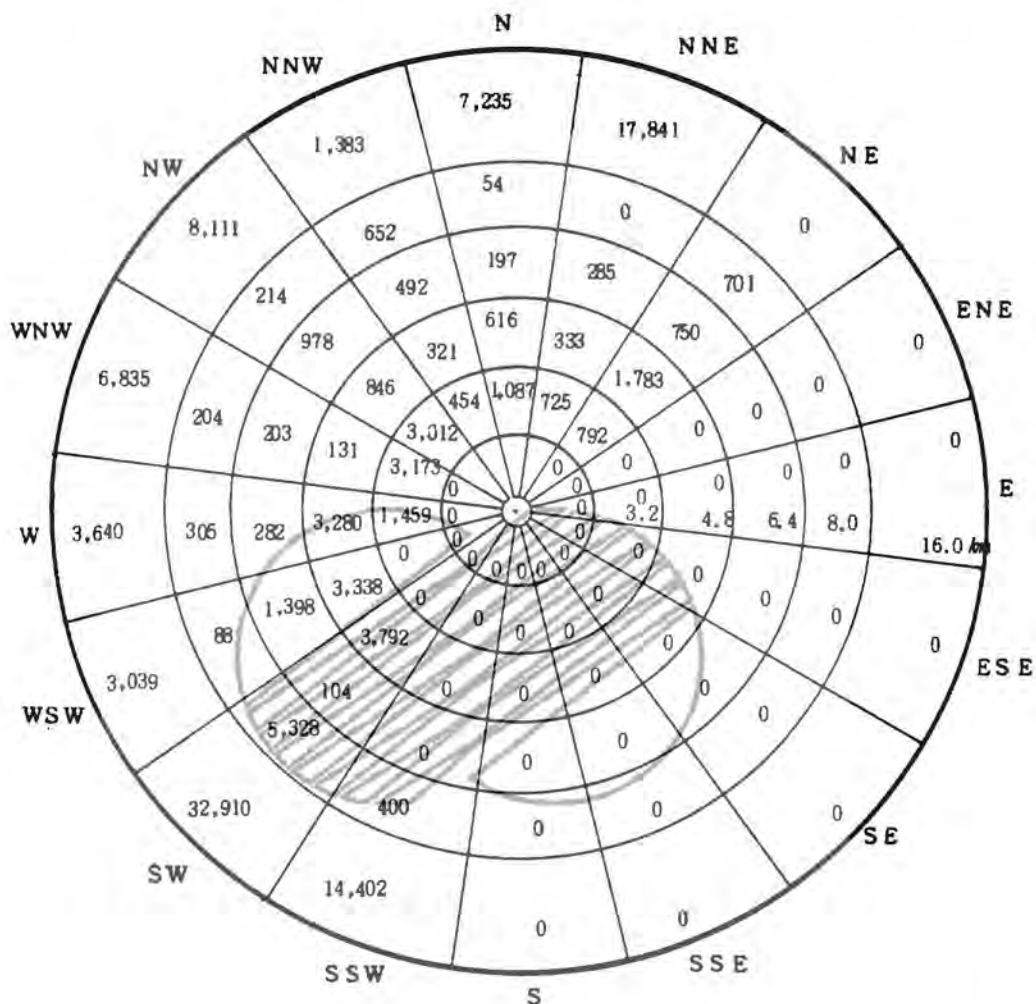
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1981 POPULATION DISTRIBUTION  
WITHIN 16 KM OF THE SITE

Figure 2.1-3

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Population within 1.6 km of the site				
Direction	NW	NNW	N	NNE
Population	3,240	211	0	197



0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total
3,648	10,702	14,440	4,689	7,946	95,396	136,821



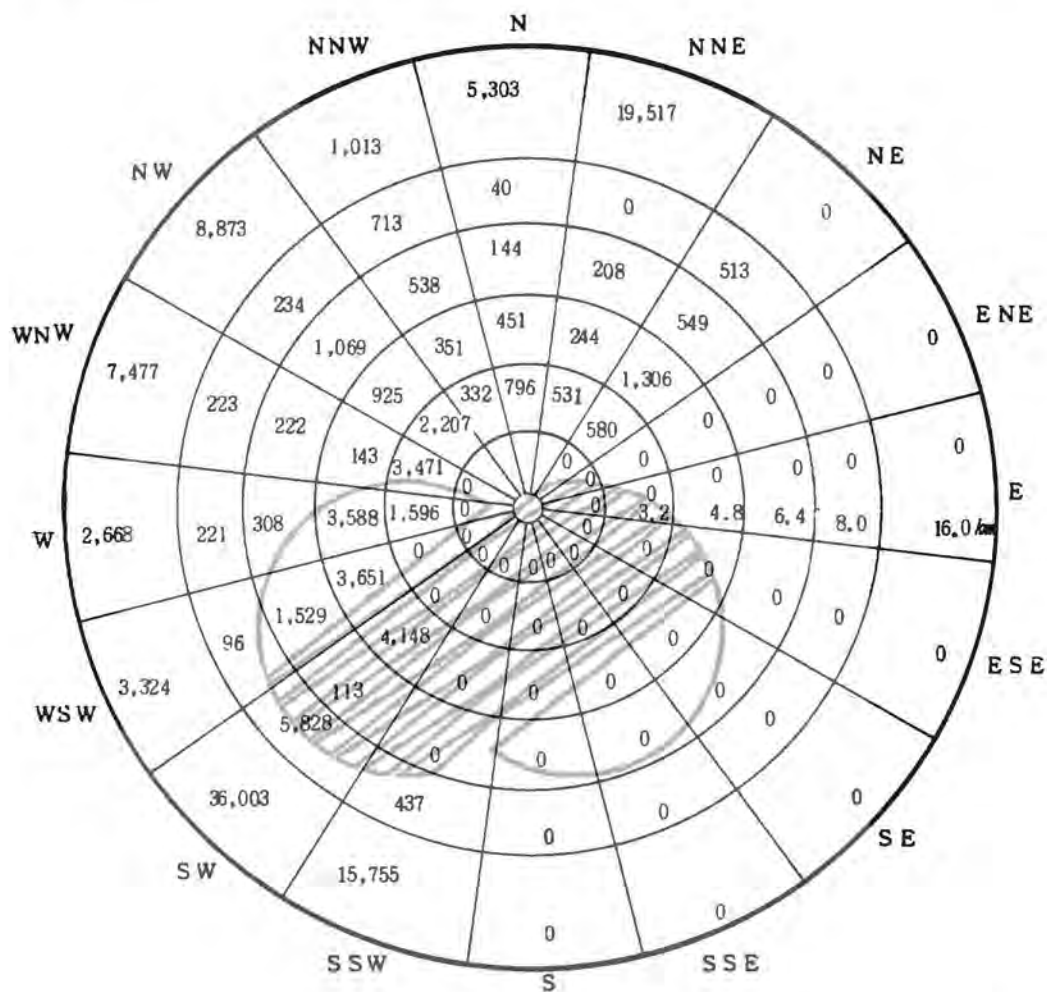
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1990 POPULATION DISTRIBUTION  
WITHIN 16 KM OF THE SITE

Figure 2.1-4

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Population within 1.6 km of the site				
Direction	NW	NNW	N	NNE
Population	2,374	154	0	144



0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total
2,672	9,513	14,807	4,680	8,305	99,933	139,910



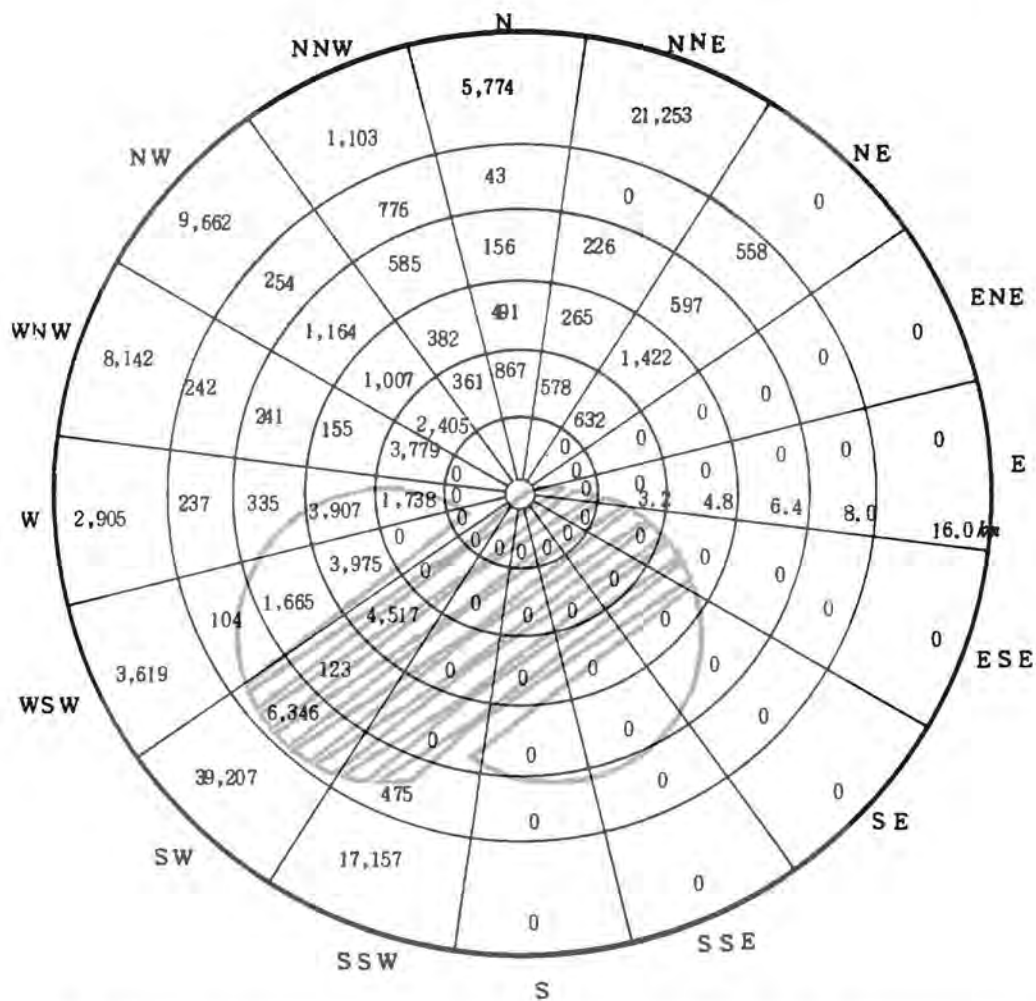
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**2000 POPULATION DISTRIBUTION**  
**WITHIN 16 KM OF THE SITE**

**Figure 2.1-5**

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Population within 1.6 km of the site				
Direction	NW	NNW	N	NNE
Population	2,587	167	0	156



0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total
2,910	10,360	16,121	5,092	9,035	108,822	152,340



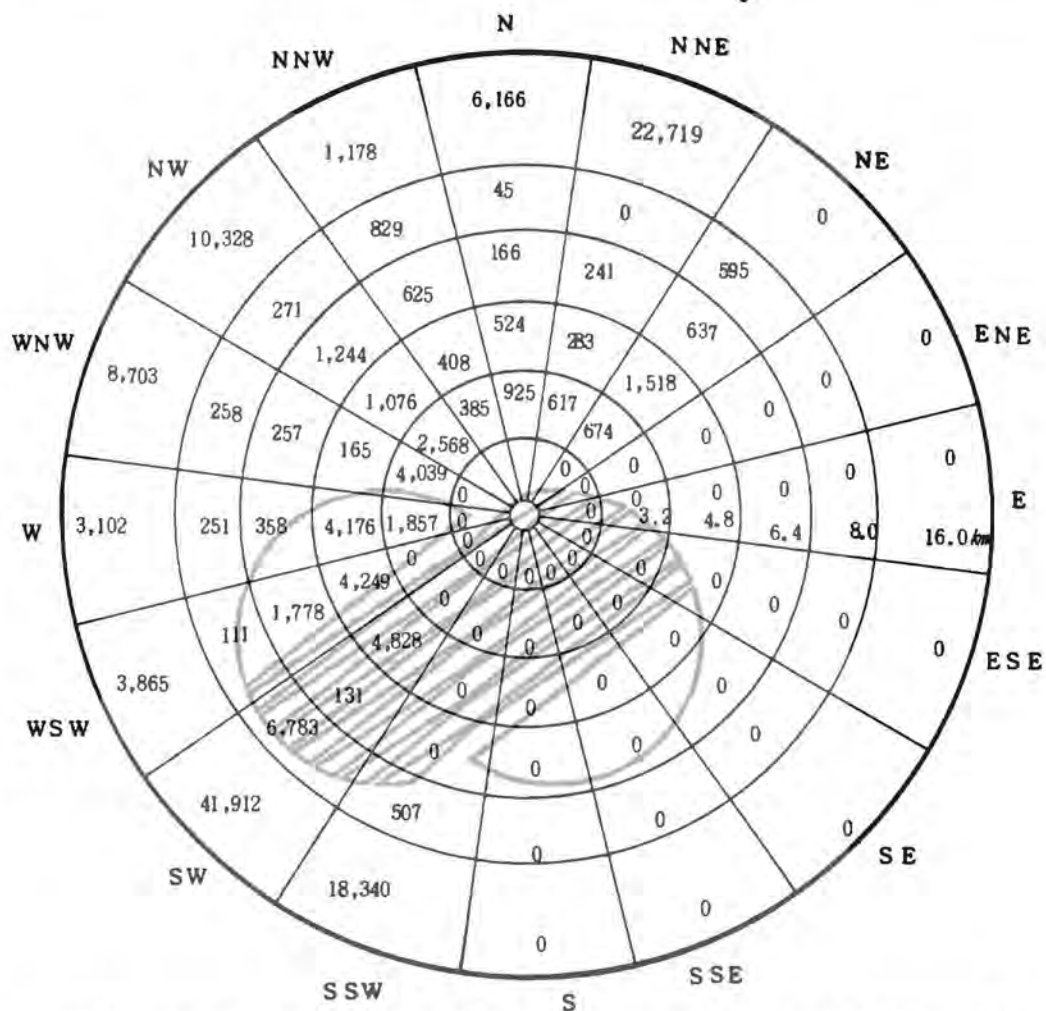
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2010 POPULATION DISTRIBUTION  
WITHIN 16 KM OF THE SITE

Figure 2.1-6

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Population within 1.6 km of the site				
Direction	NW	NNW	N	NNE
Population	2,762	178	0	166



0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total
3,106	11,065	17,227	5,437	9,650	116,313	162,798



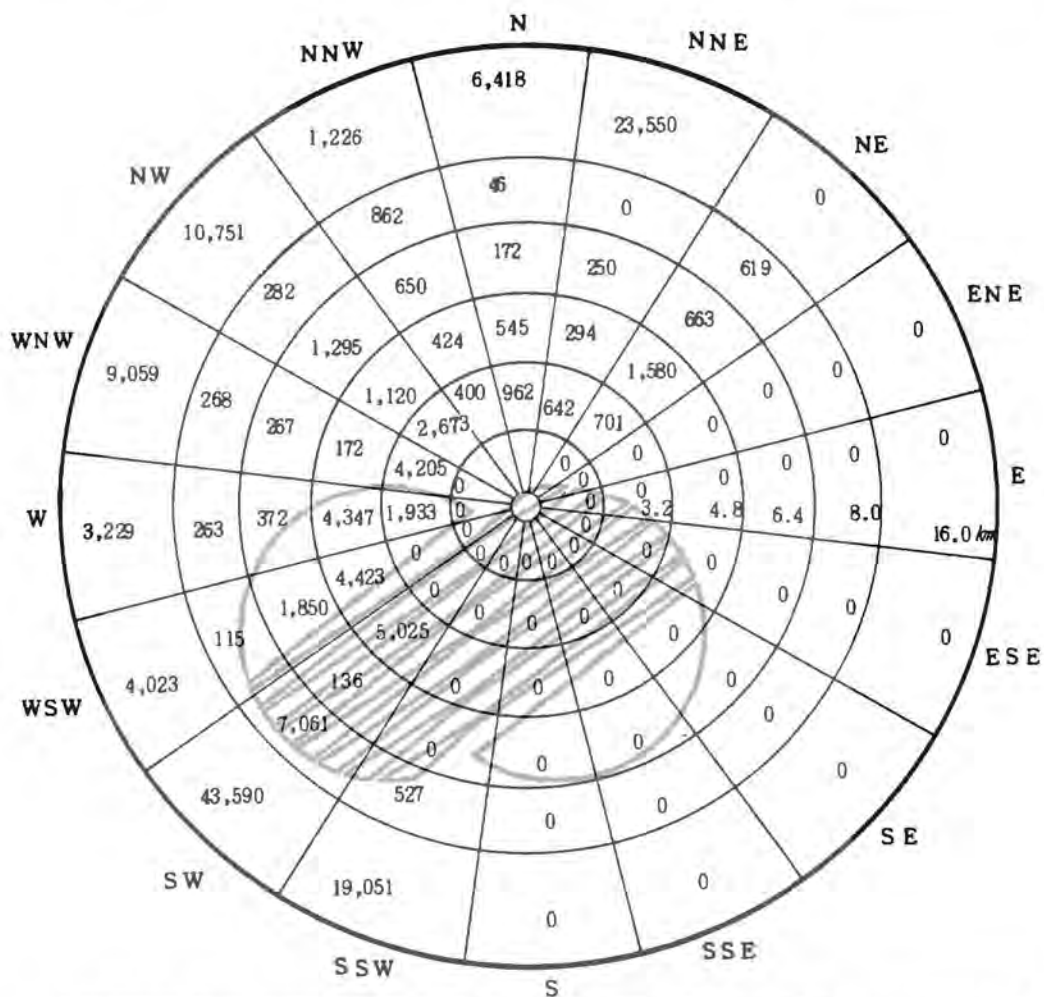
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2020 POPULATION DISTRIBUTION  
WITHIN 16 KM OF THE SITE

Figure 2.1-7

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Population within 1.6 km of the site				
Direction	NW	NNW	N	NNE
Population	2,875	185	0	172



0-1.6 (km)	1.6-3.2 (km)	3.2-4.8 (km)	4.8-6.4 (km)	6.4-8.0 (km)	8.0-16 (km)	Total
3,232	11,516	17,930	5,655	10,043	120,897	169,273



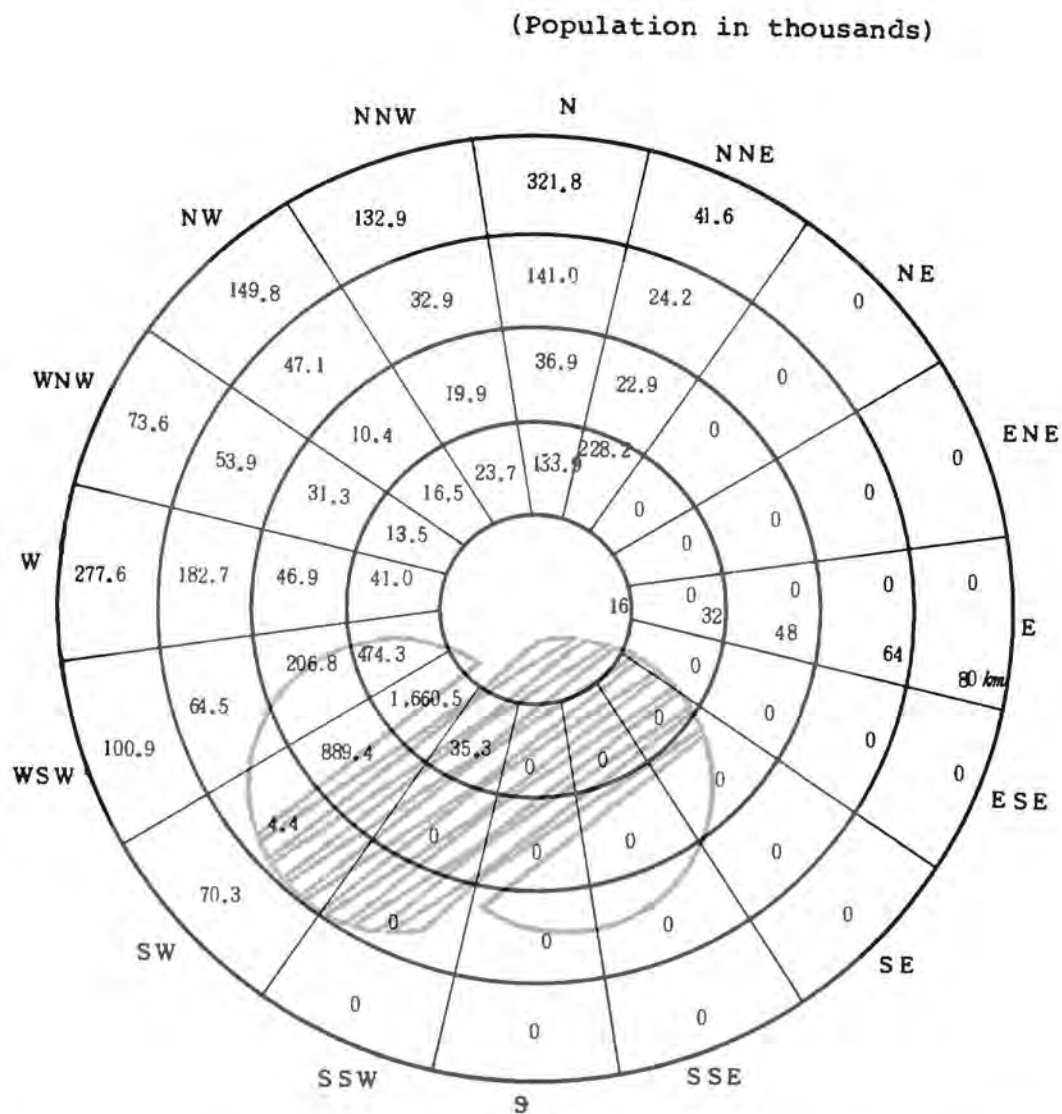
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2030 POPULATION DISTRIBUTION  
WITHIN 16 KM OF THE SITE

Figure 2.1-8



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16 (km)	32 (km)	48 (km)	64 (km)	80 (km)	Total
2,676.9	1,264.5	550.7	1,168.5	5,660.6	

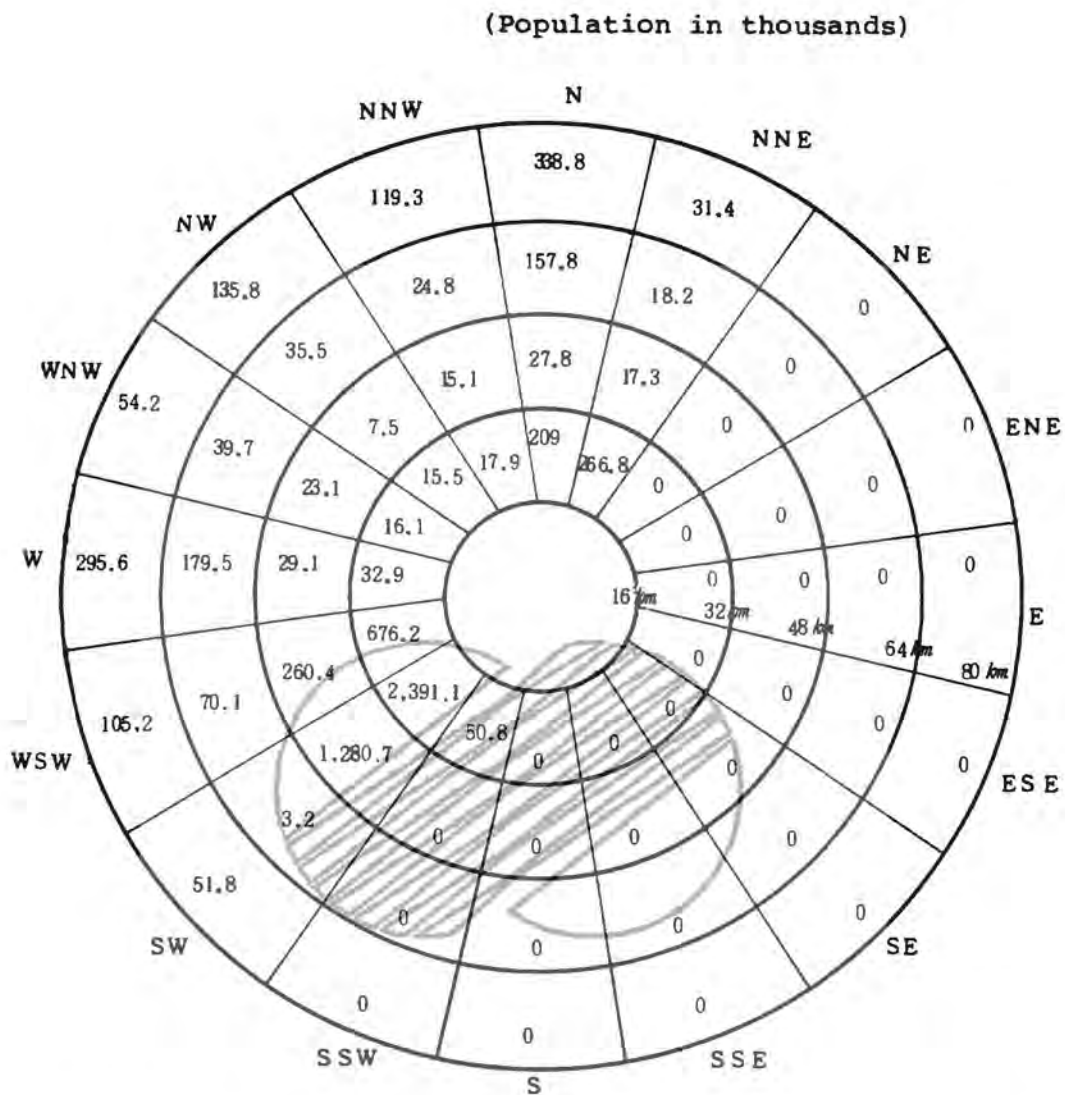


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1981 POPULATION DISTRIBUTION  
BETWEEN 16 AND 80 KM  
FROM THE SITE

Figure 2.1-9

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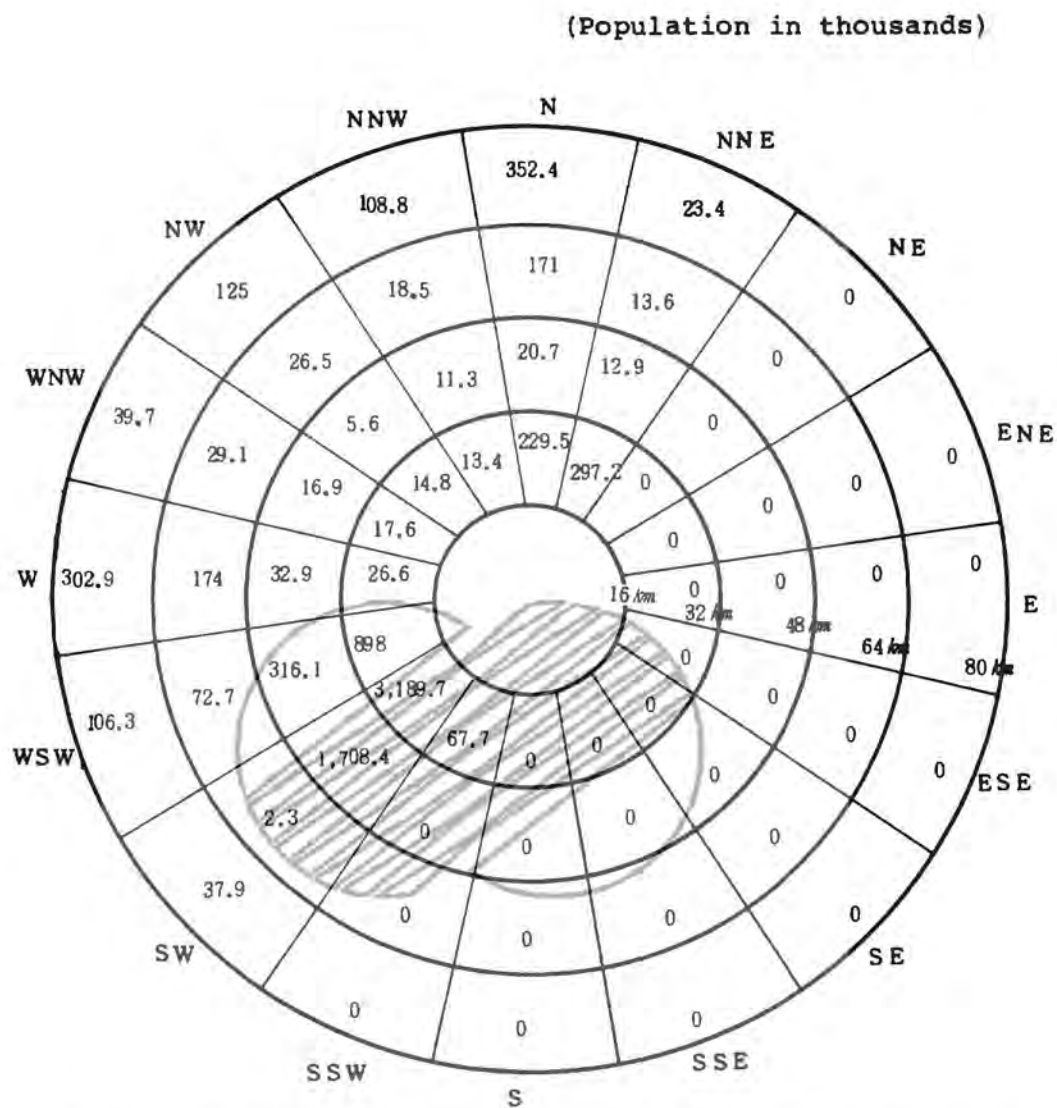
16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total
3,673.3	1,661.0	528.8	1,132.1	6,995.2



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1990 POPULATION DISTRIBUTION  
BETWEEN 16 AND 80 KM  
FROM THE SITE  
Figure 2.1-10

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16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total
4,754.5	2,124.8	507.7	1,096.4	8,483.4

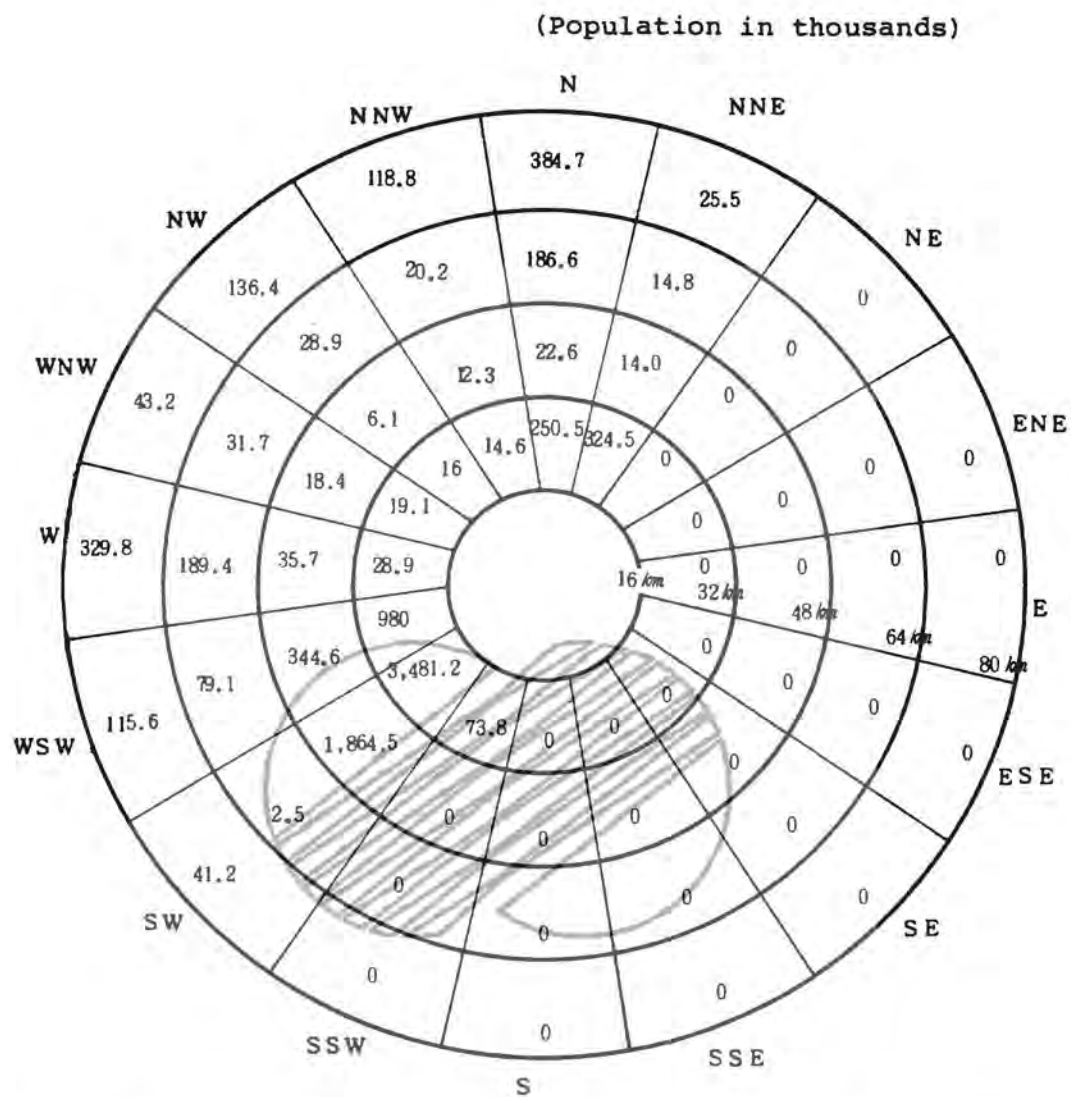


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2000 POPULATION DISTRIBUTION  
BETWEEN 16 AND 80 KM  
FROM THE SITE

Figure 2.1-11

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16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total
5,188.6	2,318.2	5,532.0	1,195.2	9,255.2

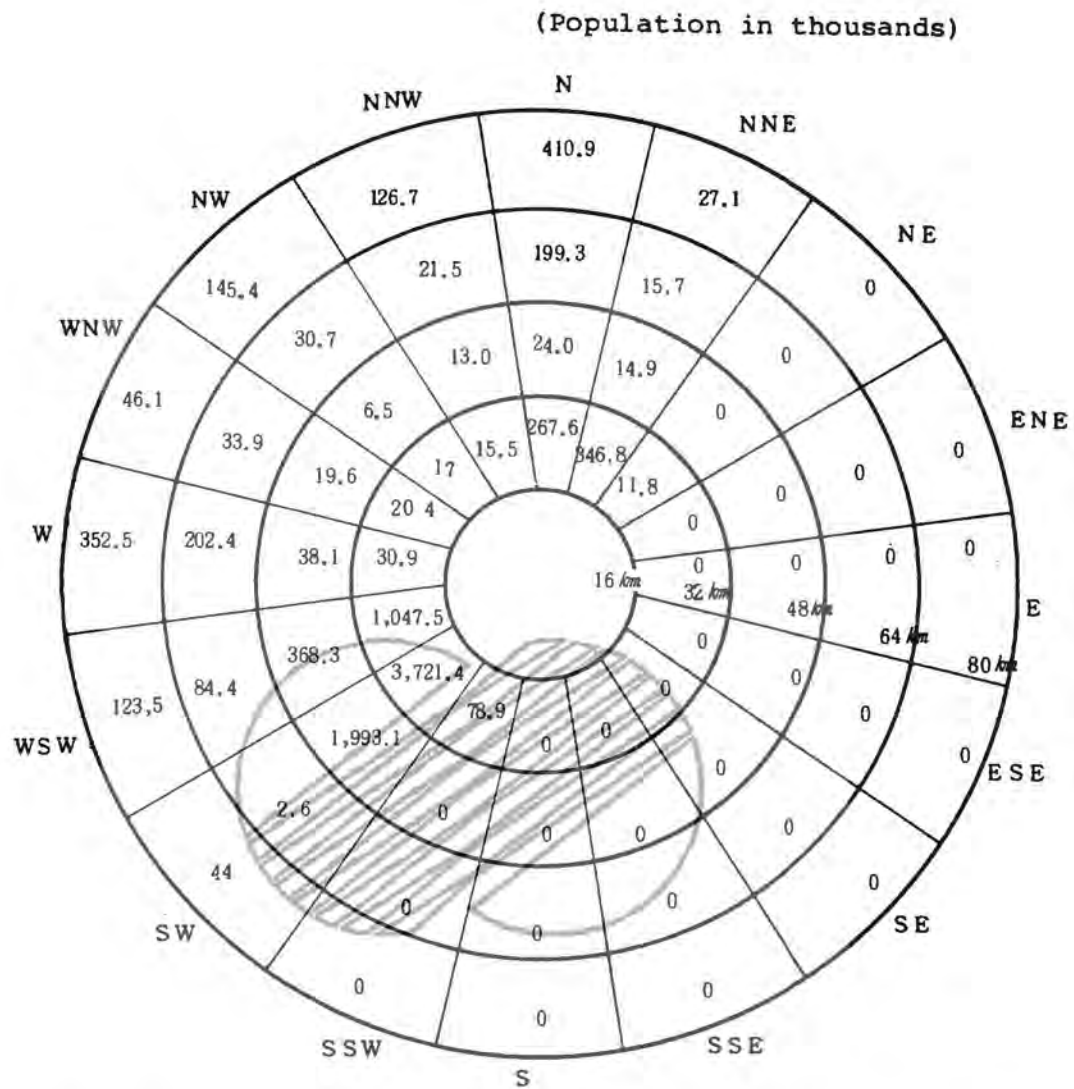


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2010 POPULATION DISTRIBUTION  
BETWEEN 16 AND 80 KM  
FROM THE SITE

Figure 2.1-12

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16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total
5,546.0	2,477.5	590.5	1,276.2	9,890.2

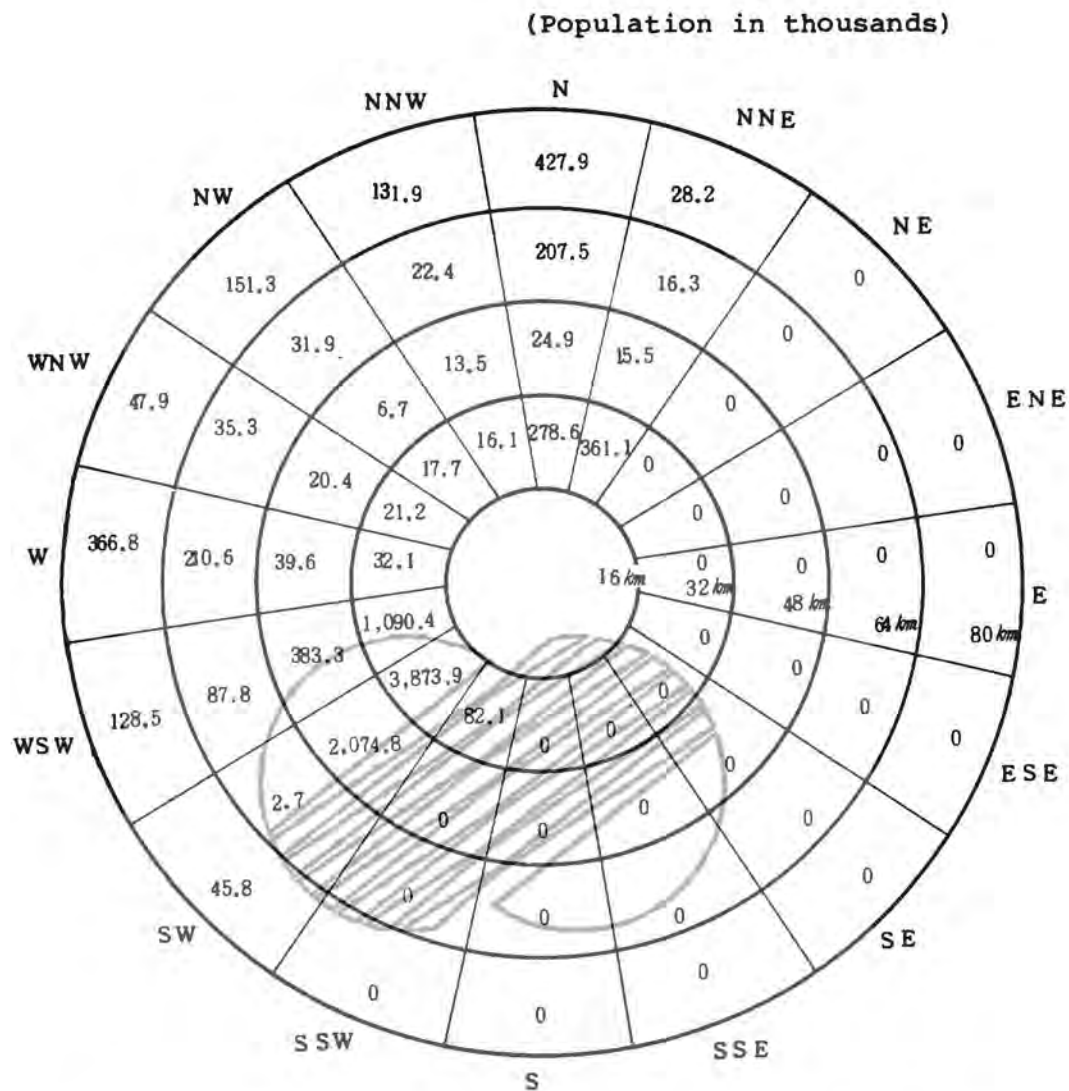


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2020 POPULATION DISTRIBUTION  
BETWEEN 16 AND 80 KM  
FROM THE SITE

Figure 2.1-13

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16 - 32 (km)	32 - 48 (km)	48 - 64 (km)	64 - 80 (km)	Total
5,773.2	2,578.7	614.5	1,328.3	10,294.7



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2030 POPULATION DISTRIBUTION  
BETWEEN 16 AND 80 KM  
FROM THE SITE

Figure 2.1-14



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LOW POPULATION ZONE

Figure 2.1-15

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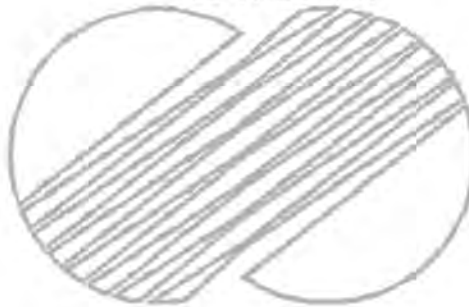
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SCHOOLS WITHIN 16 KM  
OF PLANT SITE

Figure 2.1-16

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HOSPITALS WITHIN 16 KM  
OF PLANT SITE

Figure 2.1-17

2.2



## 2.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

### 2.2.1 LOCATION AND ROUTES

There are two transportation routes and a railway (District Road 1019, National Road 14, and the Donghaenambu Railway Line) located within an 8-kilometer radius of the KNU 5 & 6 site. The routes and railway are shown in figure 2.2-1. Facilities within a 16 kilometer radius of the site are illustrated in figure 2.2-2. The facilities shown in figure 2.2-2 are described in subsection 2.2.2. No explosive or hazardous materials are manufactured within 8 kilometers of the site.

### 2.2.2 DESCRIPTION OF FACILITIES

#### 2.2.2.1 Storage Facilities

There are no gasoline or gas storage facilities of a large scale in the immediate vicinity of the site. The nearest facility involving gasoline storage is the Ssangvong oil company, located approximately [REDACTED] This facility refines oil at a rate of 60,000 barrels per day.

#### 2.2.2.2 Quarrying Operations

The only quarrying operation within a 16-kilometer radius of the site is the Ilkwang copper mine, located in the Won-Ri, Ilkwang-Myon area, approximately 7.3 kilometers west of the site. This facility produces a 250 tons of copper per year.

#### 2.2.2.3 Transportation Routes and Railway

District Road 1019 passes about 1.6 kilometers NNW of the site, and National Road 14 passes approximately 4.8 kilometers west of the site. Total transportation on these two routes during the period October 27 to October 30, 1982 is given below:

Roads	Transportation				
	Cars	Micro Buses	Large Buses	Trucks	Total
National Road 14	437	42	232	1,271	1,982
District Road 1019	587	50	205	357	1,199

NEARBY INDUSTRIAL, TRANSPORTATION  
AND MILITARY FACILITIES

The Donghaenambu Railway Line from Busan to Kyongju via Ulsan passes Wolnae Railway Station, which is approximately 2 kilometers WNW of the site.

The estimated volume of hazardous material and oil transported through the Wolnae Railway Station is given in table 2.2-1.

No accidents involving the transportation of hazardous material and oil over this railway line have occurred during the past twenty years.

2.2.2.4 Description of Products and Materials

A description of the products and materials regularly manufactured in the vicinity of the site is given in table 2.2-2.

There is no facility which manufactures hazardous materials located within 8 kilometers of the site.

2.2.2.5 Pipelines

There are no pipelines for gas or oil within 16 kilometers of the site.

2.2.2.6 Waterways

The KNU 5 & 6 site is almost entirely surrounded by the East Sea.

There are no commercial sea routes which pass within 8 kilometers of the site, and commercial activity in the site area is limited to small fishing boats, which are allowed to enter the exclusion area only with permission from site management.

2.2.2.7 Airports

The nearest airport had been the Sooyong International Airport located 24 kilometers SW of the site. By the end of 1976 this airport had been relocated to Kimhae, [redacted] of the site. No airports are located within 32 kilometers of the site.

There will be no commercial air routes that will approach closer than 16 kilometers to the site. Military aircraft are prohibited from low-level flights over the site.



NEARBY INDUSTRIAL, TRANSPORTATION  
AND MILITARY FACILITIES

2.2.2.8 Projections of Industrial Growth

The Yangsan-Kun and Ulju-Kun area growth will be influenced by the growth of the Busan and Ulsan areas; therefore, industrial oil and chemical uses will increase as a function of future industrial processing and manufacturing requirements. There are no plans for expansion of existing facilities or new industrial developments within an 8-kilometer radius of the site.

The industrial land use within 8 kilometers of the site is minimal, and is limited to agriculture and light industry.

2.2.3 EVALUATIONS

There are no cases that can be postulated which, due to nearby transportation, industrial, and military facilities, could result in an event that could preclude the safe shutdown of the plant. The cooling water intake for the plant is protected by a steel barrier, and underwater access to the area inside the sea wall is prevented by man-made obstacles.

There are no industries in the area that store gas and oil. The site is isolated from the surrounding area by a hill of 112 m elevation to the north and west, and by the East Sea to the south and east.

These features preclude the possibility that fire or other incidents generated offsite could spread to the plant.

There are no airports located within 32 kilometers of the site and, due to the distance of the site from airports and air routes, it is concluded that there are no significant safety implications with regard to accidents occurring during arrivals or departures.

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NEARBY INDUSTRIAL, TRANSPORTATION  
AND MILITARY FACILITIES

Table 2.2-1

MONTHLY TRANSPORTATION OF HAZARDOUS MATERIAL  
AND OIL THROUGH THE WOLNAE RAILWAY STATION

1981	Oil (t)	Chemicals (t)
January	9,925	- (1)
February	16,374	-
March	13,748	-
April	16,105	-
May	17,292	-
June	11,625	-
July	8,790	11,150
August	13,370	8,550
September	14,205	11,200
October	11,995	14,600
November	15,513	13,700
December	14,669	14,350
Total	163,611	73,550

(1) No data available

Table 2.2-2

INDUSTRIES WITHIN 16 KILOMETERS OF THE SITE (Sheet 1 of 5)

Company		Product	Annual Production	Number of Employees	Proximity of Site	
					Distance (km)	Direction
	Yangsan-Kun <sup>(1)</sup>					
1	Yunsin Industrial Co.	Needles	300,000PACK	133	15.0	NW
2	Hanchang Paper Co.	Boxes	50,000(T)	301	15.7	NW
3	Dongmyung Pulp Co.	Papers	8,000(T)	79	15.0	WNW
4	Ajoo Paper Co.	Papers	11,000(T)	174	15.0	WNW
5	Sama Ceramics Co.	Clanker tile	120,000(BOX)	94	15.2	WNW
6	Myungsin Hwasung Co.	Agar	67,000(T)	49	16.0	NW
7	Daesung Industrial Co.	Nails	3,000(T)	28	15.0	WNW
8	Hanil Industrial Co.	Linen	350,000(EA)	35	16.0	NW
9	Dongkwang Wrapping Co.	Wrapping Papers	400(m <sup>2</sup> )	42	14.5	WNW

2.2-5

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NEARBY INDUSTRIAL, TRANSPORTATION AND MILITARY FACILITIES

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Table 2.2-2

INDUSTRIES WITHIN 16 KILOMETERS OF THE SITE (Sheet 2 of 5)

Company		Product	Annual Production	Number of Employees	Proximity of Site	
					Distance (km)	Direction
10	Myungsin Agar Co.	Agar	130(T)	31	15.7	NW
11	Jaeil Paper Co.	Papers	18,000(T)	111	14.7	WNW
12	Wooil Industrial	Furniture	700(EA)	75	15.2	WNW
13	Woosung Industrial	Automobile Accessories	12,000(EA)	17	15.0	NW
14	*Ssangmi Co.	Clothes	-	-	15.0	WNW
15	*Kyungdong Co.	Remicon.	-	-	14.5	WNW
16	*Dongheung Wrapping Industrial	Boxes	-	-	16.0	WNW
17	Samkwang Industrial Co.	Clothing	6,201,000(M/T)	1,127	9.7	SSW
18	Samkwang Development Co.	Pipe	32,700(T)	971	9.5	SSW
19	Samyang Food Co.	Instant Noodles	10,755,000(BOX)	842	15.5	SW
20	Samyang Paper Industrial Co.	Boxes	14,450,000(EA)	62	14.5	SW

2.2-6

KNU 5 & 6 FSAR  
NEARBY INDUSTRIAL, TRANSPORTATION  
AND MILITARY FACILITIES

Table 2.2-2

INDUSTRIES WITHIN 16 KILOMETERS OF THE SITE (Sheet 3 of 5)

	Company	Product	Annual Production	Number of Employees	Proximity of Site	
					Distance (km)	Direction
21	Agrove Ceramics Co.	Tiles	10,000,000(S/F)	374	12.5	SW
22	Kihwa Knitting Co.	Clothing	480,000(EA)	104	12.5	SW
23	Korea Songjun Tile Co.	Tiles	10,106(S/F)	374	10.7	SW
24	Taechang Marine Products Co.	Aquatic Products	110,000(T)	15	12.0	SSW
25	Daejin Co.	Papers	7,000(T)	25	10.7	SW
26	Busan Products	Fish Food	600(T)	29	10.7	SSW
27	Korea National Products	Toilet Articles	200,000(C/T)	10	9.5	SSW
28	Ilkwang Mine	Copper	250(T)	30	7.3	W
29	Korea Glass Co.	Plate Glass	144,787,000(S/T)	565	7.5	SW
30	Lihwa Industry	Room Shoes	1,200,000(C/T)	103	10.5	W

2.2-7

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NEARBY INDUSTRIAL, TRANSPORTATION  
AND MILITARY FACILITIES

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Table 2.2-2

INDUSTRIES WITHIN 16 KILOMETERS OF THE SITE (Sheet 4 of 5)

Company		Product	Annual Production	Number of Employees	Proximity of Site	
					Distance (km)	Direction
31	Dongsung Chemistry Industry	Chemicals	12,000(T)	6	14.5	SW
32	Dongmyung Hides Industry	Hides	25,000(m <sup>2</sup> )	5	14.3	SW
	Uljoo-Kun <sup>(2)</sup>					
33	Ssangyong Oil Co.	Oil	27,100,000BARREL	596	13.7	NNE
34	Korea Copper Refinery Co.	Copper	530,057(T)	823	13.0	NNE
35	Hyosung Aluminum Co.	Aluminum	12,000(T)	383	11.3	NNE
36	Hyosung Metal Industrial Co.	Steel	60,000(T)	660	11.2	NNE
37	Korea Zinc Co.	Zinc Lump	150,300(T)	538	13.2	NNE
38	Hapjataehwa Sanitation	Absorbent Cotton	8,800(COIL)	35	15.0	N

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NEARBY INDUSTRIAL, TRANSPORTATION AND MILITARY FACILITIES

2.2-8



Table 2.2-2

INDUSTRIES WITHIN 16 KILOMETERS OF THE SITE (Sheet 5 of 5)

	Company	Product	Annual Production	Number of Employees	Proximity of Site	
					Distance (km)	Direction
39	Namkwang Tilery Factory	Plain Tile	84,000(EA)	7	12.5	N
40	Lucky Ulsan Factory Co.	Hiti	708,100(T)	907	15.2	N
41	Hanrim Chemistry Co.	Chemicals	5,500(T)	39	13.8	NNE
42	Poongsan Metal Co.	Copper Plate	32,733(T)	1,045	12.5	NNE
43	Donghae Pulp Co.	Pulp	105,000(T)	53	9.0	NNE
44	Jaeil Products	Saccharin	146,800(T)	279	13.5	NNE
45	Onsan Luky	Dyes	1,418(T)	119	13.7	NNE
46	Kyunggi Chemistry <sup>(3)</sup>	Manure	-	-	13.2	NNE

KNU 5 & 6 FSAR

NEARBY INDUSTRIAL, TRANSPORTATION AND MILITARY FACILITIES

- (1) Data as of December 31, 1981.  
 (2) Data as of January 31, 1982.  
 (3) Under construction.

본 문서는 한국수력원자력(주)이 정보 공개용으로 작성한 문서입니다.

THIS FIGURE APPEARS  
IN A SUPPLEMENT  
TO THE FSAR



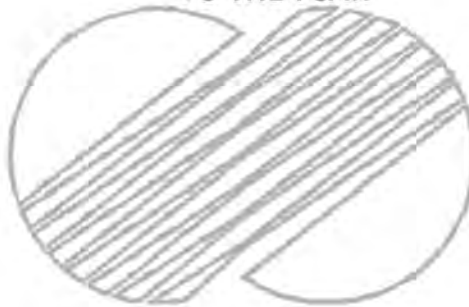
KOREA ELECTRIC POWER CORPORATION  
KOREA NUCLEAR UNITS 5 & 6  
FSAR

TRANSPORTATION NETWORK  
WITHIN 16 KM OF PLANT SITE

Figure 2.2-1

본 문서는 한국수력원자력(주)이 정보 공개용으로 작성한 문서입니다.

THIS FIGURE APPEARS  
IN A SUPPLEMENT  
TO THE FSAR



KOREA ELECTRIC POWER CORPORATION  
KOREA NUCLEAR UNITS 5 & 6  
FSAR

INDUSTRIAL FACILITIES  
WITHIN 16 KM OF PLANT SITE

Figure 2.2-2

## 2.3 METEOROLOGY

This section provides the meteorological description of the site and its environs. Those meteorological factors which bear upon plant design, operation, and safety are presented and discussed.

### 2.3.1 REGIONAL CLIMATOLOGY

Data acquired by the Central Meteorological Office were utilized to determine the normals, means, and extremes of temperature, precipitation, relative humidity, and fog applicable to the Kori site region.<sup>(1)</sup> The Climatic Table of Korea Climatological Standard Normals<sup>(1)</sup> was used for Busan and Ulsan to determine the climatological characteristics of the region.

Data for meteorological extremes were obtained for Busan and Ulsan from the Monthly Weather Report;<sup>(2)</sup> the Annual Weather Report;<sup>(3)</sup> Abnormally Records in Korea, Part 1<sup>(4)</sup> and Abnormally Records in Korea, Part 2<sup>(5)</sup> both published by the Central Meteorological Office; and the Hydrologic Research Office (Rainfall),<sup>(6)</sup> published by the Ministry of Construction.

Site data were obtained from meteorological instrumentation located at the site. Data collection and evaluation began in September 1969 and is continuing.

#### 2.3.1.1 General Climate

Korea is located on the far eastern coast of Euro-Asian continent and the Kori site is on the southeast coast of Korea. The climate of Korea is determined by factors such as latitude (30°N-43°N), the geographical characteristics of the peninsula, atmospheric pressure, and sea current distribution. Korea experiences the typical Asian monsoon and east coastal climate.

In winter, when the atmospheric pressure distribution of west-high and east-low is dominant, Korea has cold, dry weather with prevailing northwest winds due to the Siberian continental polar air masses. In spring, when the wind direction changes progressively, from northerly to southerly, the anticyclones (continental tropical air masses) that form frequently at Yangtze River basin move eastward to Korea, with variable weather resulting.

In summer, when the pressure distribution of south-high and north-low is dominant, hot, moist weather occurs with prevailing southeast or southwest winds caused by northern Pacific maritime tropical air masses. From the last decade of June to the second decade of July the stationary front formed between

## METEOROLOGY

maritime tropical air masses and maritime polar air masses causes frequent heavy rains. After that, the north Pacific air mass covers the Korean peninsula and the sultry summer begins with many thunderstorms. With the decay of the maritime tropical air mass, typhoons pass over the Korean peninsula once or twice a year. In autumn, when the wind direction changes from southerly to northerly, fine, cool weather, due to moving cyclones, prevails (figure 2.3-1). According to the Korean Standard Climate Table, (1) the geographical distribution of main climatic elements is as follows: The annual normal temperatures range roughly from 3C to 15C (figure 2.3-2), showing the low values in the northern region and the high in the south.

In general, the temperature of coastal regions is a little high compared with that of the inland regions of the same latitude and the isothermal trough is formed from the north through the Taebag Mountain range and to the Sobaeg Mountain range. The distribution pattern of the normal temperature in January is simpler than that of the annual normal temperature, but more or less similar. Namely, it indicates the low temperature in the inland and the temperature ridge in the coastal regions, and shows from zero to 20C of distribution throughout the country, except for the southern coastal region (figure 2.3-3).

In August, the normal temperature ranges from 24C to 26C (relatively high), except for the Hamkyeong-do province, where it ranges from 18C to 24C (figure 2.3-4).

The further inland and the higher the latitude, the broader the annual range of temperature (figure 2.3-5).

In Cheju-do the minimum is 22C and in Junggangin the maximum is 44C.

In the east coastal region, the annual temperature range is 25C to 26C. In the central inland region it is 30C and in the east coastal region the range is 23C to 25C.

As described above, Korea has the typical continental climate with a large annual temperature range, because it has low temperatures in winter and high temperatures in summer. The interpolated values of the annual normal temperature, the mean temperature of January and of August, the annual ranges of temperature of the Kori region are 13C to 14C, 0C to 2C, 25C and 24C, respectively. Climatological data for Busan and Ulsan indicate that daily temperature ranges were usually less than 12C during the period from 1931 to 1981, inclusive. (1)

Temperatures below -10C are rare at both the Busan and Ulsan stations. (1) The maximum recorded temperature was 38C at Ulsan. The minimum was -16.7C. (2)



## METEOROLOGY

The geographical distribution of relative humidity, shown in figure 2.3-6, ranges from 65 to 76 percent with the minimum value of 65 percent found inland around the Taebaeg Mountain range and the maximum value of 76 percent in the western coastal region. Particularly, the Kori site region belongs to the region with 70 percent of annual mean relative humidity. The normal annual relative humidity at Busan and Ulsan is 66 percent and 71 percent, respectively. (1)

The distribution of precipitation ranges from 600 to 1,500mm throughout the country. As shown in figure 2.3-7, precipitation is heavier in the southern and eastern parts of the country and relatively light in the western portion. As latitude increases, precipitation gradually decreases.

Korea is characterized by a seasonal variation in precipitation, typified by July, one of the rainy months, with amounts up to 30 percent of the annual total. This 30 percent can be compared to the total precipitation from October to March.

Precipitation from June to August accounts for 40 to 60 percent of the annual total amount. Floods occur every year due to concentrated heavy rains during this rainy season. The Kori site is in a region of slightly greater than 1,300mm of the annual precipitation.

Heavy precipitation occurs during summer and is most often associated with the passage of typhoons and tropical storms during May through September.

One or two typhoons each year come close enough to the coast to affect Korea. These typhoons usually bring torrential rainfall, which, combined with high tides, result in flood conditions in low-lying areas along the coast. However, statistically, less than one typhoon a year actually crosses the Korean coast.

The high pressure system that develops off the Pacific Ocean during the summer season results in a moist southerly flow of air from the South Sea to the site area. During the winter season, a semi-permanent high pressure cell develops over the central region of Mongolia, resulting in a prevailing north-westerly flow of air into the site area. As for the wind speed, Chejudo and Ulreungdo experience the strongest wind of 4.7 to 4.8m/s (mean value) and other areas 2 to 3m/s. The mean annual wind speed for the Busan area is 4.2m/s. The mean annual wind speed for the Ulsan area is 2.6m/s. The annual mean number of days with fog is 24 and 19 in the Busan and Ulsan areas, respectively. Thundershowers are frequent during summer, with the greatest occurrence during June and July.



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From the distribution of the above-mentioned climatic elements, we can see that the annual normal temperature, the relative humidity, the annual range of temperature and the annual amount of precipitation at the Kori site are 13C to 14C, 70 percent, 23C to 24C and 1,300mm, respectively, which are typical of the climate of the southeastern coastal region.

### 2.3.1.2 Regional Meteorological Conditions for Design and Operating Bases

#### 2.3.1.2.1 Typhoons and Storms

Six typhoons, which caused major damage, passed closer than 200 km to the site during the period from 1930 to 1981, inclusive. These typhoons are listed in table 2.3-1. Subtropical cyclones with connected storms pass across the eastern coast. The maximum hourly rainfall due to these storms at Busan (based on 77 years' records), and Ulsan (based on 50 years' records) was 89mm and 74mm, respectively. At the site during the 12-year period from 1969 to 1981, the maximum hourly rainfall was 46mm.

#### 2.3.1.2.2 Tornadoes

Since 1931, when more complete weather recording began, one tornado was reported in the Seoul vicinity on September 13, 1964. (11) No tornadoes have been reported in the Busan and Ulsan area.

#### 2.3.1.2.3 Thunderstorms

Busan averages 6 thunderstorm days per year, with 7 days for Ulsan. The highest frequency of occurrence of thunderstorms for Busan and Ulsan is in August. (1)

#### 2.3.1.2.4 Hail

The total number of days with hail at Busan is 6 during the period from 1931 to 1960 inclusive, and the total number of days with hail at Ulsan is 7 during the period of 1931 through 1960, inclusive.

The highest frequency of occurrence of hail for Busan and Ulsan is in the spring. (1)

#### 2.3.1.2.5 Snow Accumulation

The annual average number of days with snow cover for Busan and Ulsan is 2 and 3, respectively. The maximum 24-hour snow depths in Busan (during 77 years of recorded data), and in Ulsan (during 50 years) were 22.5cm and 21.9cm, respectively.

The annual snow depth of the 100-year return period is estimated as less than 30cm.

#### 2.3.1.2.6 Ultimate Heat Sink

The ultimate heat sink provides cooling water for the NSCWS (Nuclear Service Cooling Water System) during power generation, normal shutdown and cooldown, and under accident conditions. The ultimate heat sink for KNU 5 & 6 is the East Sea. A description of the analysis performed to demonstrate the ability of the ultimate heat sink to meet the requirement of Regulatory Guide 1.27 is presented in subsection 9.2.5.3.

#### 2.3.1.2.7 Extreme Winds

The fastest peak gust recorded at Busan during the 52-year period from 1930 to 1981, inclusive, was 42.7m/s from east-northeast. Ulsan, in 50 years of measurement, reported speeds up 35.0m/s, also from east-northeast. The maximum wind speed data at Busan was recorded on September 17, 1959. This extreme wind speed occurred during the passage of typhoon Sarah. A 100-year return period maximum hourly wind speed of 44.44m/s (100 mi/h) for the site should be a conservative estimate. The vertical distribution of velocity and appropriate gust factor is provided in subsection 3.3.1.3.

#### 2.3.1.2.8 Dust and Sand Storms

Yellow sand phenomena occur an average of 4 to 5 times a year in Korea. These yellow clay particles blow from the drainage basin of the Yangtze river and from the northern part of China to the Korean peninsula.

Although soil types in the vicinity of the site are likely to produce dust, the coverage of the soils by natural vegetation greatly reduces the potential of blowing dust or sand.

The occurrence of blowing or drifting sand from the beach is also minimized because the wind speed is relatively low during onshore wind conditions.

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### 2.3.1.2.9 Freezing Rain

Instances of freezing rain have not been recorded on the southeast coast of Korea.

### 2.3.1.2.10 Air Pollution Potential

The meteorological parameters considered in the evaluation of the air pollution potential of an area are the depth through which pollutants are vigorously mixed, and the average wind speed through this mixing layer. These parameters usually undergo seasonal variations and are the highest in mid-afternoon and lowest in early morning. They also tend to be lowest in valleys, where the ends are restricted, and highest on hilltops or other exposed locations.

The depth of mixing layer in the region of the site is restricted due to an inversion layer through which the temperature increases upward instead of decreasing. The inversion is usually associated with polar continental air masses and subtropical air masses. On average, the inversion has its base at a height of about 700m along the southeast coast.<sup>(2)</sup> It acts as a lid on moisture transport and convective activity. There are two essentially different kinds of inversion present at locations along the southeast coast, such as at the site. One type is the surface layer inversion produced by cooling of the air in contact with ground, which has lost heat by radiation during the night. This type is referred to as a radiation inversion or ground inversion and is a common phenomenon over all land masses. In the site area, it occurs on almost every clear night. The second type includes the frontal inversion and the subsidence inversion. The frontal inversion is associated with the low-pressure system and the subsidence inversion is due to the sinking motion of air spiralling outward from the high-pressure system.

### 2.3.2 LOCAL METEOROLOGY

Data acquired by the Central Meteorological Office were utilized to determine the normals, means and extremes of temperature, precipitation, relative humidity, and fog applicable to the Kori site region.

The Climatic Table of Korea Climatological Standard Normals<sup>(1)</sup> was used for Busan and Ulsan to determine the climatological characteristics of the region.

Data for meteorological extremes were obtained for Busan and Ulsan from the Monthly Weather Report,<sup>(2)</sup> the Annual Weather Report,<sup>(3)</sup> Abnormally Records in Korea, Part 1,<sup>(4)</sup> Abnormally Records in Korea, Part 2,<sup>(5)</sup> and the Hydrologic Research Office (Rainfall).<sup>(6)</sup> These data were published by the Central

## METEOROLOGY

Meteorological Office and the Ministry of Construction. Site data were obtained from meteorological instrumentation located at the site.

Data collection and evaluation began in September 1969 and is continuing.

### 2.3.2.1 Normal and Extreme Values of Meteorological Parameters

Climatological normals and extremes for selected meteorological stations in the region are presented in tables 2.3-2 and 2.3-3.

Normals and extremes of temperature, precipitation, relative humidity, and fog are presented for Busan and Ulsan in tables 2.3-4 and 2.3-5. Site synoptic data are presented in table 2.3-6.

Monthly and annual summaries from long-term records of reasonably representative nearby stations are also provided. When evaluating the onsite data and comparing them with data from nearby stations, the complicating factors of the terrain can be very significant.

Strictly speaking, the meteorological measurements are only representative of the points at which they are taken.

The location of the meteorological tower was chosen so that it would provide the most representative measurements in the layer of air that governs the initial dispersion of the plant effluent. The applicability of the data to other situations depends on how much the meteorological parameters are altered with distance and time and the tolerance for alteration.

The southeast coastal stations such as Busan and Ulsan are reasonably representative for providing much long- and short-term data applicable to the site. Considerations of differences are sometimes important and are discussed when encountered.

#### 2.3.2.1.1 Local Wind at the Site

The distribution of wind direction and speed is considered important when evaluating transport conditions relevant to site diffusion climatology. There are no significant topographic features that would have any major influence on wind direction distribution.

The Busan and Ulsan wind data are summarized in tables 2.3-7, 2.3-8, 2.3-9, and 2.3-10.



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The onsite data from January 1, 1970, through December 31, 1974 were analyzed in the Kori Unit No. 1 Final Safety Analysis Report. The data from March 1, 1975 through February 28, 1976 were analyzed in the Kori Unit No. 2 Preliminary Safety Analysis Report. The data from March 1, 1977 through February 28, 1978 were analyzed in the KNU 5 & 6 Preliminary Safety Analysis Report, and the data from March 1, 1976 through December 31, 1978 were analyzed in the Kori Unit No. 2 Final Safety Analysis Report. In this section, the onsite wind data from March 1, 1979 through February 28, 1982 are analyzed.

On an annual basis, the prevailing wind is from the north and the southwest, as indicated in figure 2.3-8. The wind roses for the four seasons are shown in figure 2.3-9.

The distribution of wind directions is important in these analyses. Wind from a certain direction may transport vent releases to uninhabited areas, as with offshore winds at the site, or conversely for onshore winds to the populated area. Onshore winds are winds that blow from the sea toward the land and are defined at the KNU 5 & 6 location as from northeast through south-southwest, clockwise.

Offshore winds blow from the land toward the sea, from the southwest through the north-northeast, clockwise. Table 2.3-11 illustrates the distribution of onshore and offshore winds. It is significant that offshore winds occur over 66.1 percent of the time on an annual basis.

Onshore winds occur most frequently during spring and summer. The maximum occurrence of offshore winds is during winter. These are typical conditions associated with a sea breeze effect.

Due to the temperature differential between land and sea, land temperatures are warmer than the sea during spring and summer, and colder during autumn and winter.

The seasonal and annual distribution of wind direction is presented in figures 2.3-8 and 2.3-9.

The percentage of occurrence (in percent of the total number of observations in the period) for each of 16 directions is represented by the length of the bars on the wind rose.

Wind occurs mainly from the western half ( $180^{\circ}$  through  $360^{\circ}$ ) of the compass (71.0 percent annually).

There appear to be channeling effects or predominant directions such as a low frequency of easterly winds and high frequency of westerly winds.

Easterly winds, usually associated with local onshore winds at the site, flow against the large-scale gradient flow and consequently are diminished in frequency of occurrence and in velocity.

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Westerly winds are usually associated with the large-scale gradient flow and consequently are increased in frequency of occurrence and in velocity.

Seasonally, there are typical variations in the distribution of wind directions. Wind predominates in the southwest quadrant (42.4 percent) and in the northeast quadrant (32.6 percent) in the spring.

Summer is characterized by a maximum occurrence of southwest (26.7 percent) and northeast (15.5 percent) winds.

Autumn is also characterized by a maximum occurrence of northerly winds (56.5 percent) winds.

Autumn is also characterized by a maximum occurrence of northerly winds (56.5 percent). The majority of winds (70.1 percent) occur in the northwest quadrant during winter.

The seasonal and annual wind speed averages, based on site data, are as follows:

AVERAGE WIND SPEED (m/s): at 10m elevation

Spring	Summer	Autumn	Winter	Annual
3.7	3.2	3.6	3.6	3.5

The maximum occurrence of calms (4.7 percent) at the site is during summer; the minimum (0.0 percent) is during winter. The percentages are quite low, and persistent periods of calm do not appear to pose a problem at the site. The annual percentage of calms is only 1.8, as presented in table 2.3-11.

### 2.3.2.1.2 Wind Direction Persistence

Wind persistence is extremely important when considering possible doses from a radioactivity release. Wind persistence is continuous flow from a given direction or range of directions. Figure 2.3-10 shows the probability of occurrence, based on site data, or wind flow persistence in a  $22\text{-}1/2^\circ$  segment, greater than a time period "t". There is only a 5.2 percent chance of continuous persistence periods greater than 10 hours, only a 2.1 percent chance of periods greater than 15 hours, and only 0.9 percent chance of periods greater than 18 hours. The maximum persistence episodes recorded during 12-years of Kori site data were 31 hours, occurring on July 17, 1979. Wind turbulence was low during the period and a high average wind speed of 7.1m/s was observed.



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Episodes of maximum wind direction persistence in 22-1/2° sectors are presented in figure 2.3-11. No persistence greater than 7 hours associated with calm conditions has been observed during the observed period of recorded data.

### 2.3.2.1.3 Temperature

The temperature summary (table 2.3-6) of onsite data presents monthly and annual averages, highest temperatures.

The annual average temperature at the site was 13.3C and the normal temperature at Busan and Ulsan is 13.8C and 12.8C, respectively.

The temperature extremes in the site region are presented in table 2.3-2. The site data indicate that daily temperature ranges are usually less than 10C during the period from September 1969 to February 1982, inclusive. The lowest temperature at the site was -13C and the highest temperature was 35.5C.

The lowest temperatures were influenced by polar continental air masses and the highest temperatures were associated with the Pacific anticyclone.

### 2.3.2.1.4 Atmospheric Water Vapor (Relative Humidity)

The relative humidity data for the site are given in table 2.3-6.

The annual course of relative humidity shows the highest values in the summer months, coincident with the highest frequency of fog and stratus, and minimum during winter months.

The average and minimum humidity at the site was 73 percent and 21 percent, respectively, during the period of 1970 to 1981, inclusive.

Extreme maximum relative humidity is 100 percent during fog and/or precipitation conditions.

### 2.3.2.1.5 Precipitation

Maximum monthly precipitation amounts and maximum 24-hour amounts at the Kori site are shown in table 2.3-6. Long-term precipitation records for Busan and Ulsan are shown in tables 2.3-4 and 2.3-5, respectively.

There is good agreement between the longer-term normal data and the shorter-term data from the site.

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The precipitation, averaging about 1,300mm per year, occurs mostly in the summer.

The maximum monthly precipitation at the site was 665.7mm, recorded in July 1970.

The maximum 24-hour rainfall at the site during the period of record (table 2.3-6) was 221.7mm (September 1981).

### 2.3.2.1.6 Fog and Smog

The closest available fog data for the site are from the Central Meteorological Office at Busan and Ulsan. The Climate Table of Korea Climatological Standard Normals for Busan indicated an average of 24 days/year of fog based on 30 years of records, and the 19 days/year of fog conditions reported at Ulsan. Kori is expected to be similar to the annual average of fog reported at Busan rather than to that of Ulsan.

Smog along the immediate southeast coast occurs during periods in which offshore continental flow predominates. Days are mostly cloudless and warmer than usual. These situations are usually associated with the inversion which is very low and frequently may extend to the ground. The frequency of occurrence of smog conditions along the east coast is expected to be less than 24 days/year.

The occurrence of smog at the site has no effect on plant operations and, since the plant employs fossil fuel or natural gas only for the occasional testing of emergency diesels, it has an insignificant impact on the photochemical smog.

### 2.3.2.1.7 Atmospheric Stability

Atmospheric stability is important in describing the dispersion capacity of the atmosphere.

Atmospheric stability, as used in this report, refers to the degree of wind turbulence rather than to the vertical thermal structure of the atmosphere.

The actual dispersive power of the atmosphere is affected by the structure and intensity of turbulence.

In the boundary layer, these quantities are controlled by temperature stratification, wind speed, wind shear, and surface roughness.

Temperature stratification is the usual measure of dispersive power, but it contains no information about the effects of surface roughness.

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On the other hand, direct measures of turbulence do contain this information and are, therefore, more useful predictors of dispersive capacity.

The direct measure of turbulence used in this analysis is the standard deviation of the wind azimuth,  $\delta\theta$ , labeled "Sigma" for convenience.

Stable conditions are associated with strong inversion and poor atmospheric diffusion capability. Unstable conditions are associated with a strong lapse rate and favorable diffusion characteristics.

The frequency of occurrence of various stability categories (Pasquill type, A to G) for the KNU 5 & 6 site, as observed onsite during the period from March 1979 to February 1982, is presented in table 2.3-12.

Stable categories (E, F and G, table 2.3-12) occur 71.9 percent of the time at the site. The seasonal distribution of atmospheric stability at the site is shown in table 2.3-13.

Summer is the season of greatest stability with the minimum occurrence of unstable conditions.

The seasonal and annual distribution of atmospheric stability for onshore and offshore winds is indicated in tables 2.3-14 and 2.3-15, respectively.

### 2.3.2.1.8 Mixing Heights

The mixing height (or depth) is defined as the height above the surface through which relatively vigorous vertical mixing occurs.

The lapse rate (temperature change with height) in this layer is roughly dry adiabatic ( $-9.8\text{C}/\text{km}$ ).

The depth of the mixing layer at the site is determined by the height of base of the inversion that exists along the southeast coast. On average, the mixing heights at the site are estimated at about 700m, according to the Pohang station data.<sup>(2)</sup>

### 2.3.2.2 Potential Influence of the Plant and its Facilities on Local Meteorology

The effect of the plant on the local meteorology in mesoscale is insignificant.

Modification of the local terrain as a consequence of the construction of the plant and its facilities will redistribute the natural terrain features and add roughness elements. The detectable micro-scale effect of the change will become undetectable

## METEOROLOGY

to the average climate of the 20-square-mile area around the plant.

The micro-scale effect of the plant and its facilities is variable and complex.

It is unlikely that this effect can be detected in the data from the meteorological tower.

In all wind directions, the only notable effect will be the addition of mechanical turbulence to the air, which enhances diffusion.

Operation of KNU 5 & 6 is not expected to significantly affect the climatology of the region.

The physical structure of the station is expected to increase atmospheric turbulence locally. There is also a potential of somewhat of a decrease in low-level wind speeds in the vicinity of Units 1 and 2.

The effect diminishes rapidly with increasing downwind distance from the containment and is relatively insignificant offsite.

The discharge water from the plant operations will cause modest increases in the localized surface temperature of the water offshore but will not add significantly to the air temperature or water vapor content of the local meteorology.

What little heat is added will increase the instability of the air and will enhance mixing and diffusion.

Figure 2.3-12 is the topographical map of the region within 5 miles of the plant.

Figures 2.3-13 through 2.3-16 show the maximum elevation versus distance from the center of the KNU 5 & 6 with 22.5° compass point sectors.

### 2.3.2.3 Local Meteorological Conditions for Design and Operating Bases

The meteorological conditions used as the design and operating bases are:

#### A. Temperature °C:

Average annual	13
Maximum monthly average (July)	34



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Minimum monthly average (Jan.)	-11
Maximum	38
Minimum	-17

#### B. Precipitation:

Average annual, mm	1,300
Maximum monthly, mm	940
Maximum daily, mm	316
Maximum hourly, mm	89

#### 2.3.3 ONSITE METEOROLOGICAL MEASUREMENT PROGRAM

Meteorology in the region of the site has been evaluated to provide for determination of annual average waste gas release limits, estimates of exposure from potential accidents, and design criteria for storm and typhoon protection.

The onsite meteorological program at Kori consists of a 58m tower and one meteorological station.

The old meteorological observation facility was located at Mountain Bongdae (88 meters above sea level), 400 meters north-northwest of the centerline of the Kori Unit 3 containment building. It operated from January 1972 till the end of April 2015. On May 1st 2015, a new meteorological observation facility near Kori Unit 1 starts operation.

A structural safety diagnosis for the first meteorological observation tower was conducted in December 2013. The recommendation from the diagnosis included demolishing the existing tower and to construct a new observation facility. Accordingly, it was decided to construct the new facility near Kori Unit 1. The location for a new meteorological observation facility was selected among several locations having the same altitude with the graded site for the Kori Units 1~4 reactors to represent weather condition for Kori site, and other factors were also taken into consideration including the land size, easiness of installation, interference from obstacles, etc..

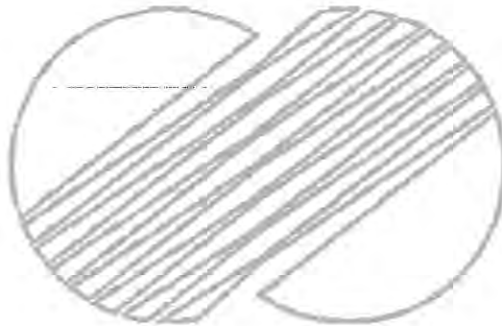
The new observation facility consists of 60m high observation tower and meteorological observation equipment. The tower basement is about 8m above the sea level and is located about 470m west-southwest of the centerline of Kori Unit 3 containment. The meteorological tower of the new facility is a guyed steel tower, and its foundation and supporting wires are reinforced to withstand the wind pressure in the installed area.

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A listing of the instrumentation used is described in table 2.3-16. A wind sensor was mounted on top of the tower, which places the sensor at approximately the same elevation as the top of the containment structure.

Wind and temperature data were analyzed by the vertical rate of change of temperature (lapse rate) for the period January 1, 1970 to December 31, 1974 and are reported in the Kori Unit No. 1 FSAR.<sup>(7)</sup> Wind data for the period March 1, 1975 to February 28, 1977, for March 1, 1977 to February 28, 1978, and for March 1, 1976 to December 31, 1978 were analyzed by the standard deviation method of horizontal wind direction and were reported in Kori Unit No. 2 PSAR,<sup>(8)</sup> KNU 5 & 6 PSAR,<sup>(9)</sup> and Kori No. 2 FSAR,<sup>(10)</sup> respectively.

The meteorology section of this report is based on 36 months of wind data from March 1979 through February 1982. Wind data for the period March 1, 1979 to February 28, 1982 were analyzed by the standard deviation method of horizontal wind direction. Synoptic data were reduced and analyzed for the period from 1970 to 1981.





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2.3.3.1 Instrumentation

2.3.3.1.1 Instrument Specification

The system in operation during the period of March 1979 to February 1982 includes the following:

<u>Parameter</u>	<u>Level at which measurements are taken</u>	
Wind speed	10m	58m
Wind direction	10m	58m

The synoptic observation has been conducted at the meteorological station.

The parameters are temperature, humidity, precipitation, wind speed and direction, and phenomena.

The sensors and location of tower are listed in tables 2.3-17, and 2.3-18. Measurements are described in paragraph 2.3.3.2.

2.3.3.1.2 Data Logging and Recording

The equipment consists of a data logger, a server and sensors. The data logger acquires the observed data which converted from analog into digital form by a signal converter. The data which is passed quality inspection are stored in the memory of the data logger. The server communicates with the data logger through the modem (or LAN) and acquires data.

The 10 minutes time average and observed data are stored in the database of the server and sent to each power plant at 1 minute time interval. The instantaneous observed data are also transmitted through the intranet in real time base.

Data processing of wind speed, wind direction and data processing of temperature differential and standard deviation of wind direction for the calculation of atmospheric stability shall be averaged for 10-minute using more than 180 times instantaneous measured values (3-second interval)

Data processing of temperature, precipitation and humidity shall follow the Korean Meteorological Administration's surface meteorological measurement method.

2.3.3.2 Measurements

The nature of the various measurements is discussed in the following paragraphs.

2.3.3.2.1 Wind Direction

Wind direction is obtained with a single-blade magnesium tail vane and incorporates a combined nose damping vane with static balance. The vane hub uses a pin/slot orientation design to its shaft adapter to provide precise alignment with the transducer, even after removal and replacement. Vane movement is transferred by a shaft into the main housing where connection is made to the azimuth transducer.

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2.3.3.2.2 Wind Speed

The wind speed cups are of three-inch diameter stainless steel. The weather shield/cup hub is assembled to the upper end of the shaft and secured by two set screws. The wind speed transducer and chopper disc are at the lower end of the shaft and protected inside the house.

2.3.3.3 Calibration and Maintenance

2.3.3.3.1 Calibration

All sensors and related equipment are calibrated according to written procedures. These procedures are designed to assure adherence to the Korea Meteorological Administration specifications for accuracy.

The first calibration is accomplished on the fully-assembled system in the plant before delivery.

All meteorological instruments should have an calibration from the Korea Meteorological Administration every three years.

A calibration check is made following installation. Additional calibration are made on half-yearly schedule. Minor checks and adjustments are made at other times. All meters and other equipment used in calibrations are in turn calibrated at frequent intervals.

All calibrated instruments used have evidence of accuracy in the historical record which is traceable to the Korea Meteorological Administration.

2.3.3.3.2 Maintenance

Inspection and maintenance of all equipment is accomplished in accordance with written procedures. Individual components are removed for servicing at intervals specified in the manual, or more frequently if the need is detected. In case of major trouble in the system, an electronics technician or engineer is dispatched to the site to investigate and effect a cure.

For the case of trouble with meteorological instruments, Data logger, Signal converter and Meteorological sensors should be in stock at the immediately available state at least 1 set as the reserve stocks.

2.3.3.3.3 Data Monitoring

All meteorological data should be managed about discrepancies by personnel who are trained according to the law for standardization of weather observation.

The primary purpose of this accuracy control procedure is to detect signs of malfunction or the need for calibration as soon

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after the need arises as possible. When a need for servicing is detected, station personnel are advised immediately and plan and execute the corrective action.

2.3.3.4 Data Analysis Procedures

The analysis procedures used are designed to obtain the most accurate data and analysis possible. They are responsive to Regulatory Guide 1.23.

2.3.3.4.1 Data Accuracy Control

As described in subparagraph 2.3.3.3, all data are subject to an accuracy check which includes the following items:

- A. Adherence to scale
- B. Reasonableness of data
- C. Continuity of data and instrument operation
- D. Evidence of power interruptions and malfunctions

Measured data also must be checked with sensors and electronic equipment at the same time.

The accuracy control procedure is intended to detect electronic or sensor drift or malfunction, improper mechanical zero adjustment, or any other source of error in the data.

2.3.3.4.2 Data Reduction

The purpose of assessing the meteorology of a nuclear reactor site is to ascertain the dilution capacity of the atmosphere in case of radioactive releases. Wind direction and speed are the critical factors. However, wind turbulence also has a significant effect on the dispersion of radioactive releases as it is turbulence that disperses the releases about the centerline of travel (both vertically and horizontally) and results in the conical configuration, which must be considered to determine the dilution of the releases. Stability in this report is classified into categories proposed by Pasquill. (12)

The stability classes proposed by Pasquill range from A, extremely unstable, to G, extremely stable.

In an accordance with Notice of NSSC(reactor.029), atmospheric stability provided by meteorological program is a method that uses temperature difference ( $\Delta T/\Delta z$  method) of 10m and 58m.

Standard deviation of horizontal wind direction ( $\sigma\theta$  method) can also be used if necessary. Analysis method and procedure are as follows.

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### A. Temperature difference ( $\Delta T/\Delta z$ method)

$$\Delta T/\Delta z = (T_{58m} - T_{10m}) \div 48 \times 100$$

where

$T_{58m}$  = temperature of meteorological tower 58m

$T_{10m}$  = temperature of meteorological tower 10m

### B. Standard deviation of wind direction ( $\sigma\theta$ method)

-  $u$  : The component's of wind direction of east and west =  $Ws \times \sin(Wd \times \pi/180)$

-  $v$  : The component's of wind direction of north and south =  $Ws \times \cos(Wd \times \pi/180)$

$Ws$  : wind speed of each height (10m or 58m)

$Wd$  : wind direction of each height (10m or 58m)

- Calculating the sum of average that is each component's wind speed during 10minute

$$\bar{u} = \frac{\text{The total of } u \text{ - component at 10m or 58m during 10min}}{\text{Total No. of observed data during 10min}} = \frac{\sum_{i=N_1}^{i=N_{10}} u_i}{N_{10} - N_1 + 1}$$

$$\bar{v} = \frac{\text{The total of } v \text{ - component at 10m or 58m during 10min}}{\text{Total No. of observed data during 10min}} = \frac{\sum_{i=N_1}^{i=N_{10}} v_i}{N_{10} - N_1 + 1}$$

- Calculating the average of wind speed during 10minute

$$\bar{W}_s = \sqrt{(\bar{u})^2 + (\bar{v})^2}$$

$\bar{W}_d$  calculation

$$\bar{W}_d = 90 - \left\{ \tan^{-1} \left( \frac{\bar{v}}{\bar{u}} \right) \times \frac{180}{\pi} \right\} \quad \text{-----} \quad \bar{u} > 0,$$

$$\bar{W}_d = 0 \quad \text{-----} \quad \bar{u} = 0, \bar{v} > 0,$$

$$\bar{W}_d = 180 \quad \text{-----} \quad \bar{u} = 0, \bar{v} < 0,$$

$$\bar{W}_d = 180 + \left\{ 90 - \left\{ \tan^{-1} \left( \frac{\bar{v}}{\bar{u}} \right) \times \frac{180}{\pi} \right\} \right\} \quad \text{-----} \quad \bar{u} < 0$$

- Calculating the standard deviation of wind direction

$$\delta\theta = \sqrt{\frac{\sum W_d^2}{N} - (\bar{W}_d)^2}$$

$N$  : Total number of wind direction (during 10minute)

- Atmospheric stability categories (Table 2.3-19)

A low degree of wind turbulence and consequently relatively unfavorable diffusion conditions can be expected for stable conditions. Conversely, during turbulence, favorable dilution conditions can be expected.

Site wind data which were observed at Kori meteorological station are saved at one minute interval in the server computer and XQDQWQ code, a program developed by KHNP, operates on these data to determine significant meteorological statistics and distributions(x/Q) for further analysis.

Dilution factors,  $X/Q$  ( $\text{sec}/\text{m}^3$ ), for ground release, a function of wind direction, downwind distance weighted by stability class, and wind rose frequencies are presented in table 2.3-20 and in appendix 2.3A.

Data recovery during this 36-month period was approximately 99 percent.



## 2.3.4 SHORT TERM (ACCIDENT) DIFFUSION ESTIMATES

### 2.3.4.1 Objective

Onsite wind data for the period of March 1979 to February 1982 have been used to evaluate the hypothetical accident for the Kori site. This hypothetical accident is postulated to predict upper limit concentrations and dosages that might occur in the event of a radioactive release. A basic input to the accident analysis is the meteorological conditions which determine the dilution capacity of the atmosphere.

The meteorological conditions postulated for the hypothetical accident are based on considerations of USNRC Regulatory Guide 1.4 (Revision 2, June, 1974) and analysis of available onsite and regional meteorological data. Site data were utilized for quantitative evaluation of the hypothetical accident at Kori.

The estimates, characterized in table 2.3-21, are based primarily on interpretation of weather records made at the site.

#### 2.3.4.1.1 Dispersion for the First Eight Hours After an Accident

As indicated in table 2.3-21, the estimate of maximum X/Q for the zero to 8 hour, post-accident period assumes that wind direction is uniform for 8 hours, at a wind speed of 1m/s, of Pasquill type F stability.

#### 2.3.4.1.2 Dispersion for the 8 to 24 Hour Period After an Accident

For an 8 to 24 hour period, it is assumed that Class F stability exists for the entire period at a wind speed of 2.0m/s. In no case did a Class F condition exist for longer than 17 hours in a 22.5° sector of the Kori site for 12 year data.

The actual mean wind speed for Class F conditions is about 4.8m/s during the period during which the data were acquired.

#### 2.3.4.1.3 Dispersion for the 1 to 4 Day Period After an Accident

For the 1 to 4 day period, it is assumed that wind blows in a 22.5° sector toward the nearest site boundary for 80 percent of the time and that diffusion conditions during this time will be 40 percent type D and 60 percent type F with corresponding mean wind speed of 4.0m/s and 3.0m/s respectively.

This assumption is based on the analysis of onsite wind data.

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### 2.3.4.1.4 Dispersion for the 4 to 30 Day Period After an Accident

For the 4 to 30 day period, it is assumed that wind will blow in a 22.5° sector with frequency of 30 percent and that diffusion conditions are 40 percent type D of wind speed 4.0m/s and 60 percent type G of wind speed 4.0m/s.

This assumption is based on the analysis of onsite wind data; i.e., wind direction, wind velocity, and direction frequency.

Compared with the observation data, this assumption takes surplus value.

### 2.3.4.2 Calculations

In calculating potential exposure, USNRC Regulatory Guide 1.4 procedure is followed, based upon a Gaussian diffusion model. The atmospheric diffusion model used for the zero to 8 hour time period for a ground level point source is given in equation 2.3-2.

$$X/Q = \frac{1}{\pi \delta_y \delta_z U \bar{C}_B} \cdot \frac{1}{C_B} \quad (2.3-2)$$

where:

X = concentration, units per cubic meters

Q = source strength, units per second

$\bar{U}$  = mean wind speed, meters per second

$\delta_y, \delta_z$  = lateral and vertical dispersion parameter, meters

$C_B$  = building wake correction factor, dimensionless

A correction factor, to account for additional dispersion produced by the turbulent wake of the reactor building, is used for this zero to 8 hour time period only. Given as equation 2.3-3, it is divided into the value generated by equation 2.3-2, using a shape factor of 0.5, and a minimum cross-sectional area (1,500m<sup>2</sup>) of the containment building. Lateral and vertical dispersion parameters ( $\delta_y, \delta_z$ ) have Pasquill properties.

$$C_B = 1 + \frac{CA}{\pi \delta_y \delta_z}, \text{ for } 1 + \frac{CA}{\pi \delta_y \delta_z} \leq 3 \quad (2.3-3)$$

$$3, \text{ for } 1 + \frac{CA}{\pi \delta_y \delta_z} > 3$$



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where:

A  $\cong$  Cross-sectional area ( $1,500\text{m}^2$ )

C  $\cong$  Correction factor (0.5)

The X/Q values were calculated using the conditions given in table 2.3-21. A graph depicting dilution factors based on the meteorological model for the hypothetical accident is given in figure 2.3-17, with discrete data given on table 2.3-22. Doses estimated for the conditions of hypothetical accident using this model are well below the 10 CFR 100 guideline.

For the periods greater than 8 hours, the plume is assumed to meander and spread uniformly over a  $22.5^\circ$  sector. For such cases, equation 2.3-4 is used in paragraph 2.3.5.2.

### 2.3.5 LONG-TERM (ROUTINE) DIFFUSION ESTIMATES

In order to determine atmospheric dilution conditions during plant operation, the annual averages for X/Q were computed using actual observation data.

#### 2.3.5.1 Objective

Annual average atmospheric dilution factors (X/Q) were determined for the Kori site. Annual averages for X/Q are computed relationships in paragraph 2.3.5.2 for each sector at distances ranging from 100 meters to 80 kilometers (50 miles).

The results are presented in table 2.3-20 and appendix 2.3A. The estimated atmospheric dispersion of releases summarized in figure 2.3-18 have been developed using onsite weather measurements.

Wind data used to determine the diffusion conditions above were taken from 15 minute averages of wind speed, direction, and directional variance.

Table 2.3-20 predicts that the highest estimated value of X/Q at the site boundary will occur over the sea area at the 700-meter southern boundary and will be about  $7.27 \times 10^{-6}$  (sec/m<sup>3</sup>).

The highest dispersion factor at offsite land is  $5.95 \times 10^{-6}$  (sec/m<sup>3</sup>) located 700 meters to the northeast of the site.

The dispersion factor at the nearest offsite habitation located 700m to the northwest from containment is  $1.91 \times 10^{-6}$  (sec/m<sup>3</sup>).

## METEOROLOGY

### 2.3.5.2 Calculations

Annual average atmospheric dilution factors (X/Q) were determined for the Kori site on a directional basis. The results represent the sector-average concentrations from equation 2.3-4 below, which is the standard Pasquill-Gifford diffusion equation for a ground-level release:

$$X/Q = \left(\frac{2}{\pi}\right)^{1/2} \cdot \frac{8}{\pi} \cdot \sum_{i=1}^n \frac{F_i \cdot f_i}{\sigma_{zi} U_i \cdot d} \quad (2.3-4)$$

where:

- X = Concentration, units per cubic meters
- Q = Source strength, units per second
- U = Mean wind speed, meters per second
- $\sigma_z$  = Vertical dispersion parameters, meters
- i = Pasquill stability categories (A to G) with numerical value (1-7)
- n = Number of stability classes (seven, from A to G)
- $F_i$  = Fraction of time that wind occurs from the sector of interest for stability "i".
- $f_i$  = Fraction of time that wind occurs from the sector of interest when stability "i" exists.
- d = Distance downwind, meters

The dilution factor can be considered as relative concentrations, i.e., concentration relative to the source strength. The configuration of X/Q isopleths reflect the annual distribution of wind direction, wind speed, and atmospheric stability.

### 2.3.6 REFERENCES

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15. Slade, D. H., Editor, Meteorology and Atomic Energy, 1968, U.S. Atomic Energy Commission, Washington, D.C.

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Table 2.3-1

TYPHOONS

Typhoon Name	Date	Approximate Closest Approach of Typhoon Center to Site
None	August 21, 1957	100km NW
Sarah	September 17, 1959	110km NW
Joan	September 2, 1959	90km N
Shirley	June 20, 1963	80km NW
Betty	July 7, 1964	200km NW
Polly	August 16, 1968	90km SE

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Table 2.3-2

METEOROLOGICAL EXTREMES IN THE SITE REGION  
 (DATE OF OCCURRENCE)

PARAMETER	BUSAN	ULSAN	KORI
Maximum temperature, °C	36.0(8/44)	38.0(8/66)	33.5(8/81)
Minimum temperature, °C	-14.0(1/15)	-16.7(1/36)	-13.0(2/11)
Maximum monthly rainfall, mm	937.5(6/63)	686.8(7/34)	665.7(7/70)
Maximum 24-hour rainfall, mm	250.9(7/12)	315.8(9/69)	221.7(9/81)
Maximum 24-hour snowfall, cm	22.5(2/45)	21.9(1/33)	3.6(1/71)
Fastest wind, mps	42.7(9/59)	35.0(9/59)	38.2(4/80)

Table 2.3-3

METEOROLOGICAL MEANS FOR STATION IN THE SITE REGION  
(Period of Record)

PARAMETER	BUSAN	ULSAN	KORI
Mean annual temperature, °C	13.8 (1931 to 1960)	12.8 (1931 to 1960)	13.3 (1970 to 1981)
Mean annual precipitation	1381.6 (1931 to 1960)	1217.6 (1931 to 1960)	1541.8 (1970 to 1981)
Mean annual humidity, %	66 (1931 to 1960)	71 (1931 to 1960)	73 (1970 to 1981)



Table 2.3-4

BUSAN METEOROLOGICAL NORMALS, MEANS, AND EXTREMES  
(Sheet 1 of 4)

Month	Temperature °C						
	Normal			Extremes			
	Daily Max.	Daily Min.	Monthly	Record Highest	Year	Record Lowest	Year
(a)	(b)	(b)	(b)	77		77	
J	6.4	-1.9	1.8	18.4	1906	-14.0	1915
F	8.2	-0.3	3.5	20.3	1979	-12.0	1977
M	12.1	3.5	7.3	22.7	1941	- 9.7	1977
A	17.1	8.9	12.5	26.7	1945	- 1.5	1924
M	21.3	13.4	16.7	34.0	1979	5.4	1911
J	23.7	17.1	19.8	33.4	1927	9.3	1920
J	27.2	21.3	23.7	34.7	1929	13.8	1926
A	29.4	22.9	25.4	36.0	1944	15.4	1913
S	25.8	18.7	21.6	34.3	1944	9.6	1928
O	21.5	13.0	16.0	28.9	1946	2.0	1924
N	16.0	7.4	11.1	25.6	1939	- 6.5	1950
D	9.5	1.3	5.0	20.9	1959	-12.0	1917
Yr.	18.2	10.4	13.8	36.0	1944 Aug.	-14.0	1915 Jan.

(a) Length of Records

(b) Climatological Standard Normals (1931 to 1960)

Table 2.3-4

BUSAN METEOROLOGICAL NORMALS, MEANS, AND EXTREMES  
(Sheet 2 of 4)

Month	Precipitation							Relative Humidity
	Rainfall (mm)					Snow (cm)		Monthly Normal Percent
	Normal Total	Monthly Maximum	Year	Maximum in 24 hours	Year	Max. Snow Cover in 24 hrs.	Year	
(a)	(b)	77		77		77		(b)
J	25.3	229.6	1906	209.8	1906	10.8	1923	49
F	44.1	205.1	1922	84.4	1942	22.5	1945	52
M	88.5	219.5	1972	102.7	1942	45	1915	59
A	113.5	275.2	1977	178.5	1912			66
M	139.3	386.5	1926	190.6	1938			71
J	197.5	937.5	1963	183.6	1963			80
J	247.6	692.3	1925	250.9	1912			85
A	165.0	565.6	1905	237.1	1949			80
S	205.1	515.1	1925	234.0	1969			74
O	73.1	253.1	1933	178.5	1933			64
N	43.9	186.1	1961	125.1	1961	0.4	1932	59
D	38.5	113.3	1920	89.2	1957	17.0	1952	53
Yr.	1381.6	937.5	1963	250.9	1912	22.5	1945	66
			Jun.		Jul.		Feb.	

Table 2.3-4

BUSAN METEOROLOGICAL NORMALS, MEANS AND EXTREMES  
(Sheet 3 of 4)

Wind						Percent of Possible Sunshine
Greatest Gust						
Month	Mean Speed (mps)	Prevailing Direction	Speed (mps)	Direction	Year	
(a)	(b)		23			(b)
J	4.5	W	31.4	NNW	1980	66
F	4.5	NNW	35.7	NNW	1966	62
M	4.5	NNE	29.9	WSW	1972	57
A	4.4	NNE	34.7	SSW	1962	56
M	3.8	SSW	32.8	SW	1963	56
J	3.9	SSW	39.0	SSW	1963	45
J	4.3	SSW	33.4	NE	1974	43
A	4.1	NNE	32.4	NE	1968	56
S	4.0	NNE	42.7	ENE	1959	49
O	3.8	NNE	31.2	NE	1974	62
N	3.8	NW	29.7	NW	1962	63
D	4.3	NW	36.0	NW	1980	65
Yr.	4.2	NNE	42.7	ENE	1959	57
					Sept.	

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Table 2.3-4

BUSAN METEOROLOGICAL NORMALS, MEANS AND EXTREMES  
(Sheet 4 of 4)

Month	Clear	Cloudy	Precipitation 0.1 mm or more	Snow Cover	Fog	Mean No. of Days		Max. Temp.		Min. Temp.	
						30C and above	0C and above	-10C and below	0C and below		
(a)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
J	13	5	5	1	1		2	1	20		
F	11	7	6	1	1		1		15		
M	9	10	8		1				6		
A	7	11	9		2						
M	6	12	9		5						
J	3	17	11		5						
J	3	19	14		6	7					
A	5	13	9		2	14					
S	5	14	11		1	2					
O	10	8	6		1						
N	11	6	5		1						
D	14	5	6				1		1		
Yr.	97	127	99	2	24	23	4	1	12	54	

2.3-30

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Table 2.3-5

ULSAN METEOROLOGICAL NORMALS, MEANS, AND EXTREMES  
(Sheet 1 of 4)

Month	Temperature °C						
	Normal			Extremes			
	Daily Max.	Daily Min.	Monthly	Record Highest	Year	Record Lowest	Year
(a)	(b)	(b)	(b)	50		50	
J	5.8	- 4.5	0.4	19.3	1953	-16.7	1936
F	7.6	- 2.7	2.1	20.2	1950	-12.9	1941
M	11.7	0.9	6.0	25.4	1973	- 9.6	1977
A	17.6	6.1	11.5	29.2	1973	- 3.2	1941
M	22.4	11.4	16.3	34.7	1979	2.4	1934
J	25.1	16.0	20.0	35.2	1958	6.8	1981
J	28.6	21.1	24.3	37.6	1942	12.7	1939
A	29.7	21.8	25.1	38.0	1966	14.8	1956
S	25.5	16.6	20.5	34.7	1944	7.5	1933
O	20.9	9.7	14.8	29.7	1951	- 1.5	1941
N	15.1	3.8	9.0	27.5	1979	- 7.8	1970
D	8.7	- 1.7	3.2	22.4	1953	-11.7	1965
Yr.	18.2	8.2	12.8	38.0	1966 Aug.	-16.7	1936 Jan.

(a) Length of Records

(b) Climatological Standard Normals (1931 to 1960)

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Table 2.3-5

ULSAN METEOROLOGICAL NORMALS, MEANS, AND EXTREMES  
(Sheet 2 of 4)

Month	Precipitation							Relative Humidity
	Rainfall (mm)					Snow (cm)		Monthly Normal Percent
	Normal Total	Monthly Maximum	Year	Maximum in 24 hours	Year	Max. Snow Cover in 24 hrs.	Year	
(a)	(b)	50		50		50		(b)
J	24.2	127.0	1947	42.1	1950	21.9	1933	56
F	46.2	120.9	1959	62.0	1955	10.0	1969	59
M	68.0	198.5	1972	98.4	1972	4.1	1969	65
A	88.4	207.1	1977	108.1	1967			71
M	106.3	200.8	1974	139.6	1938			76
J	154.1	341.5	1946	132.1	1933			81
J	203.7	686.8	1934	226.6	1943			84
A	166.9	414.0	1936	180.6	1957			82
S	208.7	661.3	1969	315.8	1969			80
O	65.0	295.3	1961	138.2	1961			73
N	46.3	165.8	1961	114.4	1961	0.0	1951	68
D	39.8	168.8	1952	164.2	1952	10.8	1959	60
Yr.	1217.6	686.8	1934	315.8	1969	21.9	1933	71
			Jul.		Sept.		Jan.	



Table 2.3-5

ULSAN METEOROLOGICAL NORMALS, MEANS, AND EXTREMES  
(Sheet 3 of 4)

Month	Wind					Percent of Possible Sunshine
	Greatest Gust					
	Mean Speed (mps)	Prevailing Direction	Speed (mps)	Direction	Year	
(a)	(b)		23			(b)
J	3.3	NNW	27.8	WNW	1963	67
F	3.2	NNW	27.4	WNW	1961	62
M	3.2	N	29.3	SSW	1963	56
A	2.8	N	24.6	SSW	1963	55
M	2.4	SSE	24.2	SSW	1963	56
J	2.3	NE	23.3	ENE	1970	45
J	2.3	NE	25.0	NW	1974	43
A	2.3	NNE	20.1	NE	1963	51
S	2.2	N	35.0	ENE	1959	46
O	2.3	N	23.4	W	1972	60
N	2.5	N	23.8	W	1964	63
D	2.9	NNW	26.0	WSW	1963	66
Yr.	2.6	N	35.0	ENE	1959	56
					Sept.	

Table 2.3.5

ULSAN METEOROLOGICAL NORMALS, MEANS, AND EXTREMES  
(Sheet 4 of 4)

Month	Mean No. of Days								
	Clear	Cloudy	Precipitation 0.1 mm or more	Snow Cover	Fog	Max. Temp.		Min. Temp.	
						30C and above	0C and above	-10C and below	0C and below
(a)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
J	13	5	3	2	1		2	1	20
F	11	7	5	1	1		1		15
M	8	9	6		1				6
A	7	11	7		1				
M	6	13	7		2				
J	3	17	8		3				
J	4	18	16		3	7			
A	5		8		2	14			
S	4		9		2	2			
O	10		5		1				
N	11	6	4		1				1
D	13	5	4		1		1		12
Yr.	95	127	76	3	19	23	4	1	54

Table 2.3-6

KORI SYNOPTIC DATA (1970 to 1981)  
(Sheet 1 of 2)

Month	Average Tempera- ture, °C	Record Highest Tempera- ture, °C	Year	Record Lowest Tempera- ture, °C	Year	Average Humidity Percent	Minimum Humidity Percent	Maximum Monthly Precipi- tation mm	Year
J	2.3	18.6	1979	-11.5	1980	60	21	113.8	1972
F	3.5	19.7	1979	-13.0	1977	62	21	140.4	1976
M	7.2	20.1	1980	-11.0	1977	66	24	252.9	1972
A	12.2	25.4	1972	3.5	1981	67	22	280.0	1977
M	16.3	30.4	1979	6.8	1976	76	23	294.1	1973
J	19.4	30.6	1972	7.9	1981	86	30	518.9	1978
J	23.1	33.5	1979	14.2	1976	89	50	665.7	1970
A	24.4	33.5	1981	16.5	1980	86	44	521.9	1980
S	20.9	32.2	1973	10.2	1970	81	38	338.9	1981
O	16.2	27.9	1980	1.8	1980	72	23	168.1	1980
N	9.8	26.4	1979	- 7.6	1970	67	20	176.4	1972
D	4.6	19.5	1977	-12.3	1976	60	22	63.1	1979
Yr.	13.3	33.5	1981	-13.0	1977	73	21	665.7	1970
			July		Feb.				July

Table 2.3-6

KORI SYNOPTIC DATA (1970 to 1981)  
(Sheet 2 of 2)

Month	Maximum 24 hrs. Precipitation mm	Year	Maximum Snow Cover in 24 hrs., cm	Year	Fastest Wind Speed, mps	Year	Greatest Gust Wind Speed, mps	Year	Average Wind Speed, mps
J	42.8	1972	3.6	1971	18.0	1973	23.4	1973	3.8
F	54.8	1979	1.6	1975	15.8	1980	26.5	1973	3.8
M	98.6	1974			20.0	1973	29.7	1973	3.5
A	143.0	1973			22.8	1980	38.2	1980	3.9
M	154.7	1973			18.0	1973	23.7	1977	3.6
J	189.4	1973			18.3	1974	26.0	1977	3.6
J	161.4	1970			20.9	1980	28.2	1980	3.2
A	131.2	1976			26.0	1979	38.0	1979	3.8
S	221.7	1981			26.6	1972	37.5	1972	3.8
O	75.9	1973			17.0	1972	26.3	1972	3.4
N	63.1	1978			18.6	1972	30.7	1972	3.7
D	43.3	1979			20.0	1972	28.7	1972	3.5
Yr.	221.7	1981 Sept.	3.6	1971 Jan.	26.6	1972 Sept.	38.2	1980 Apr.	3.6

Table 2.3-7

PUSAN  
MONTHLY NORMALS  
FREQUENCY OF WIND DIRECTIONS (PERCENT)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm
Jan	9.7	6.5	3.2	1.1	1.1	1.1	1.1	0	1.1	1.1	3.2	5.4	15.1	8.6	21.5	15.1	5.4
Feb	9.4	11.8	4.7	1.2	2.4	1.2	1.2	0	1.2	1.2	3.5	4.7	12.9	7.1	16.5	16.5	4.7
Mar	8.6	11.8	8.6	3.2	3.2	1.1	1.1	1.1	3.2	4.3	5.4	5.4	11.8	5.4	11.8	8.6	5.4
April	5.6	12.2	7.9	4.4	4.4	3.3	1.1	2.2	4.4	7.8	7.8	6.7	10.0	3.3	6.7	4.4	6.7
May	4.3	8.6	9.7	5.4	6.5	2.2	1.1	3.2	7.5	9.7	8.6	5.4	9.7	2.2	4.3	3.2	8.6
June	3.3	11.0	10.0	7.8	5.6	3.3	1.1	2.2	8.9	11.1	8.9	5.6	7.8	2.2	2.2	1.1	7.8
July	3.2	10.8	11.8	6.5	5.4	2.2	2.2	2.2	6.5	14.0	11.8	5.4	8.6	2.2	1.1	1.1	5.6
Aug	4.3	18.3	11.8	6.5	5.4	4.3	1.1	1.1	5.4	9.7	8.6	5.4	6.5	1.1	2.2	1.1	7.5
Sept	7.8	23.3	10.0	5.6	5.6	3.3	1.1	1.1	3.3	4.4	3.3	3.3	5.6	2.2	5.6	4.4	10.0
Oct	10.8	18.3	8.6	3.2	4.3	3.2	1.1	1.1	2.2	2.2	2.2	3.2	6.5	4.3	9.7	8.6	10.8
Nov	8.9	10.0	6.7	2.2	2.2	2.2	1.1	1.1	2.2	2.2	3.3	4.4	8.9	5.6	15.6	13.3	10.0
Dec	9.7	7.5	3.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	3.2	4.3	14.0	7.5	20.4	15.1	7.5
Ann.	7.1	12.5	8.1	4.0	3.9	2.4	1.2	1.4	3.9	5.7	5.8	4.9	7.9	4.3	9.8	7.7	7.5

본 문서는 한국수력원자력(주)이 정보 공개용으로 작성한 문서입니다.

Table 2.3-8

PUSAN  
MONTHLY NORMALS  
MEAN WIND SPEED WITHIN SPECIFIED DIRECTIONS (m/s)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm	Mean
Jan	4.5	4.8	4.4	3.4	2.5	2.8	2.3	0.0	1.5	2.6	5.2	5.2	4.9	4.6	5.1	5.2	0.2	4.6
Feb	5.0	5.3	4.8	4.3	3.4	2.7	2.4	0.0	4.6	4.0	5.2	5.5	4.6	4.6	5.0	5.1	0.2	4.6
Mar	4.3	5.5	5.4	4.3	4.0	3.9	2.6	3.2	5.0	5.7	5.6	5.0	5.0	4.3	4.9	4.5	0.2	4.6
April	3.5	5.4	4.6	4.4	4.3	4.1	2.8	3.1	4.3	6.0	5.6	5.2	5.1	3.5	4.3	4.2	0.2	4.4
May	2.9	4.8	4.5	3.9	3.8	4.0	3.1	3.2	4.4	5.1	4.5	4.8	4.1	3.2	4.2	3.3	0.2	3.9
June	3.1	4.5	4.2	4.1	3.8	4.1	3.2	3.3	4.5	5.0	5.0	4.3	4.3	3.4	3.4	2.8	0.2	3.9
July	4.3	5.1	4.0	4.0	3.7	3.5	3.1	3.3	4.6	6.1	6.0	4.6	4.6	2.7	1.8	2.1	0.2	4.5
Aug	3.5	4.6	4.6	4.4	4.2	4.2	3.6	4.2	4.8	5.6	4.8	4.4	3.6	3.0	3.0	3.6	0.2	4.1
Sept	4.0	5.1	4.8	4.9	3.9	3.9	3.7	2.8	4.2	5.6	4.8	4.7	4.0	2.9	3.7	3.2	0.2	4.1
Oct	4.0	5.1	5.2	4.6	3.9	3.3	2.5	2.6	3.4	3.9	4.8	4.1	4.0	3.6	4.4	4.3	0.2	3.9
Nov	3.8	5.2	4.9	3.9	3.0	2.5	2.8	1.4	2.1	3.6	4.8	4.5	6.2	3.8	4.5	4.8	0.2	3.9
Dec	4.5	5.0	4.7	3.8	2.5	2.3	2.0	0.7	0.7	2.7	4.7	4.5	4.8	4.3	5.1	5.0	0.2	4.3
Annual	4.4	5.2	4.6	4.0	3.7	3.6	2.8	2.7	3.9	5.3	5.2	4.8	4.7	4.1	4.7	4.9	0.2	4.4



Table 2.3-9

ULSAN  
MONTHLY NORMALS  
FREQUENCY OF WIND DIRECTIONS (PERCENT)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm
Jan	16.1	5.4	2.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	2.2	3.2	6.5	8.6	16.1	16.1	16.1
Feb	15.3	8.2	4.7	1.2	2.4	1.2	1.2	2.4	1.2	1.2	2.4	2.4	7.1	5.9	12.9	17.6	12.9
Mar	14.0	6.5	5.4	3.2	2.2	2.2	2.2	3.2	3.2	2.2	3.2	2.2	5.4	5.4	8.6	12.9	18.3
April	7.8	5.6	5.6	3.3	2.2	2.2	4.4	6.7	4.4	2.2	4.4	3.3	5.6	4.4	6.7	6.7	24.4
May	6.5	5.4	4.3	5.4	2.2	2.2	6.5	7.5	4.3	3.2	2.2	3.2	5.4	3.2	3.2	5.4	30.1
June	5.6	6.7	7.8	5.6	4.4	3.3	5.6	6.7	4.4	4.4	3.3	2.2	3.3	2.2	3.3	4.4	26.7
July	4.3	6.5	7.5	5.4	5.4	3.2	5.4	6.5	6.5	6.5	5.4	3.2	2.2	2.2	2.2	1.1	26.9
Aug	7.5	7.5	6.5	5.4	3.2	4.3	4.3	6.5	4.3	3.2	4.3	3.2	2.2	2.2	2.2	4.3	29.5
Sept	11.1	7.8	7.8	4.4	3.3	1.1	4.4	3.3	2.2	1.1	2.2	2.2	3.3	3.3	4.4	8.9	28.9
Oct	10.8	8.6	6.5	5.4	4.3	1.1	3.2	2.2	2.2	1.1	2.2	2.2	5.4	5.4	8.6	9.7	21.5
Nov	15.6	7.8	3.3	2.2	1.1	2.2	2.2	2.2	1.1	1.1	1.1	2.2	5.6	5.6	10.0	15.6	21.1
Dec	14.0	5.4	3.2	1.1	1.1	1.1	2.2	1.1	1.1	1.1	2.2	3.2	7.5	7.5	15.1	16.1	17.2
Annual	10.7	6.8	5.4	3.6	2.7	2.1	2.8	4.1	3.0	2.4	2.9	2.7	4.9	4.7	7.8	9.9	20.3

Table 2.3-10

ULSAN  
MONTHLY NORMALS  
MEAN WIND SPEED WITHIN SPECIFIED DIRECTIONS (m/s)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm	Mean
Jan	3.7	3.7	3.2	2.7	1.2	1.5	1.4	2.3	1.5	1.4	3.4	3.2	3.9	4.9	4.8	4.5	0.2	3.4
Feb	4.0	4.0	3.6	3.2	2.4	2.5	2.5	2.6	1.9	3.1	3.4	3.6	3.5	4.1	4.8	4.5	0.2	3.5
Mar	3.9	4.3	4.4	4.3	4.0	3.7	3.3	3.5	3.5	3.1	3.7	3.5	3.5	3.9	4.2	3.9	0.2	3.2
April	3.1	3.4	3.6	4.5	3.3	3.5	3.5	4.0	3.5	4.3	4.7	4.1	3.1	3.1	3.2	2.9	0.2	2.7
May	2.9	3.5	3.3	3.6	3.1	2.5	3.5	3.4	3.5	3.2	3.1	3.4	2.6	2.2	2.4	3.1	0.2	2.2
June	3.4	3.2	3.1	3.3	3.1	3.1	3.4	3.7	3.0	3.1	3.7	3.2	2.2	2.2	1.7	2.6	0.2	2.3
July	2.5	2.7	2.8	3.2	2.6	2.5	3.0	3.0	3.1	3.2	3.8	4.0	2.3	1.9	1.9	2.3	0.2	2.2
Aug	3.2	3.9	4.0	4.2	4.0	3.5	3.7	3.5	3.8	4.1	3.3	3.2	2.7	1.6	1.9	2.7	0.2	2.5
Sept	3.2	3.7	4.1	4.3	2.9	2.5	2.7	3.0	2.7	3.1	2.9	2.7	2.2	2.1	2.6	3.0	0.2	2.3
Oct	3.5	4.0	4.2	4.5	3.4	2.7	2.9	3.1	2.4	1.9	2.0	2.0	2.3	2.7	3.5	3.2	0.2	2.6
Nov	4.1	4.0	3.5	3.2	3.0	2.6	2.7	2.3	2.0	2.4	2.2	2.5	2.4	3.4	3.8	4.0	0.2	2.8
Dec	4.3	3.9	3.4	3.3	2.3	1.0	1.4	1.9	1.3	1.3	2.5	3.2	3.8	4.1	4.7	4.7	0.2	3.4
Annual	3.2	3.2	3.3	3.5	2.9	2.8	3.2	3.5	3.2	3.5	3.5	3.2	2.9	3.1	3.3	3.4	0.2	2.7

METEOROLOGY

Table 2.3-11  
 WIND DISTRIBUTION, PERCENT

Period	Onshore (NE - SSW)	Offshore (SW - NNE)	Calm
Spring	42.3	56.0	1.7
Summer	45.8	51.3	2.9
Autumn	26.2	71.6	2.2
Winter	14.1	85.4	0.5
Annual	32.1	66.1	1.8

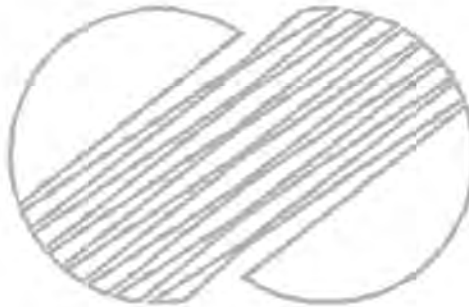
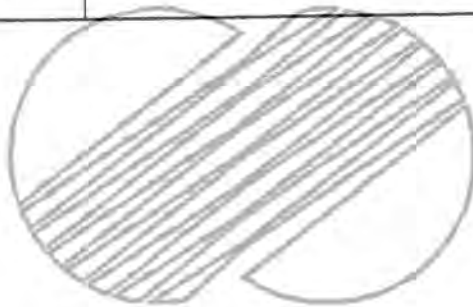


Table 2.3-12

STABILITY AND WIND SPEED DISTRIBUTION

Stability Category	Frequency of Occurrence (Percent)	Mean Wind Speed (m/s)
A-extremely unstable	1.1	2.3
B-moderately unstable	1.2	
C-slightly unstable	2.8	
D-neutral	23.0	4.8
E-slightly stable	45.7	5.6
F-moderately stable	18.7	4.8
G-extremely stable	7.5	4.9

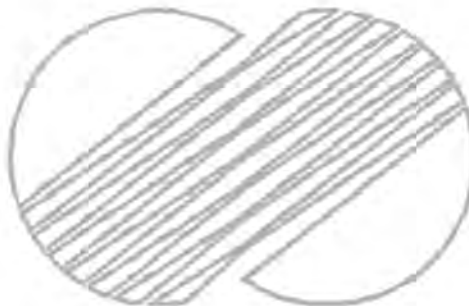


METEOROLOGY

Table 2.3-13

ATMOSPHERIC STABILITY (PERCENT)

Period	Unstable (A to C)	Neutral (D)	Stable (E to G)
Spring	5.0	27.5	67.5
Summer	3.7	18.3	77.9
Autumn	3.8	19.9	76.3
Winter	7.8	26.3	65.9
Annual	5.1	23.0	71.9



METEOROLOGY

Table 2.3-14

STABILITY WITH ONSHORE NE-SSW WINDS (PERCENT)

Period	Unstable (A to C)	Neutral (D)	Stable (E to G)
Spring	2.25	11.06	28.96
Summer	1.78	7.31	36.49
Autumn	1.66	5.74	18.64
Winter	2.60	5.10	6.26
Annual	2.07	7.30	22.58





METEOROLOGY

Table 2.3-15

STABILITY WITH OFFSHORE SW-NNE WINDS (PERCENT)

Period	Unstable (A to C)	Neutral (D)	Stable (E to G)
Spring	2.52	16.20	37.24
Summer	1.26	10.21	39.61
Autumn	1.51	13.46	56.63
Winter	4.99	21.16	59.31
Annual	2.57	15.25	48.19



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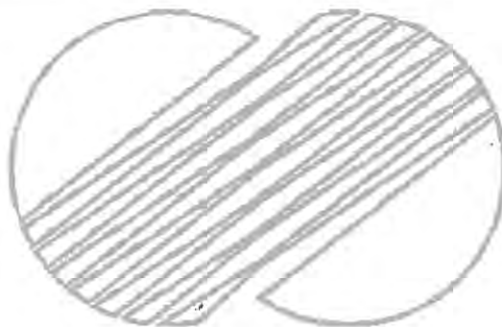
Table 2.3-16

INSTRUMENT LIST

Instruments	Quantity
Temperature Sensor	3
Humidity Sensor	1
Wind Speed Sensor	2
Wind Direction Sensor	2
<b>Precipitation Gauge</b>	1
Data Logger	1
Web-based Server for Database	1 set

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Amendment 523  
2015.06.17

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Table 2.3-17

INSTRUMENTATION SYSTEM INSTALLED  
IN THE KORI METEROLOGICAL STATION

Sensor Type	Installation Point (Direction from Tower, Distance from Tower)
Temperature	Tower 58m (E, 1.5m) Tower 10m (E, 1.5m) Yard (E, 20m)
Humidity	Yard (E, 20m)
Precipitation Gauge	Yard (SW, 20m)
Wind Direction	Tower 58m (E, 1.5m) Tower 10m (E, 1.5m)
Wind Speed	Tower 58m (E, 1.5m) Tower 10m (E, 1.5m)

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METEOROLOGY

Table 2.3-18

METEOROLOGICAL SENSOR AND SYSTEM SPECIFICATION AND ACCURACIES

Parameter	Specification and Minimum System Accuracy
Wind Speed	Type : Cup anemometer Range = 0 ~ 75 m/s Starting speed = 0.3 m/s Accuracy = $\pm 0.2$ m/s (Under 10m/s), $\pm 5\%$ (10 m/s or over) Output : frequency
Wind Direction	Type : Vane (Optical Code Disk) Range = $0^{\circ} \sim 360^{\circ}$ Starting speed = 0.3 m/s Accuracy = $\pm 3.0^{\circ}$ Output : Digital
Temperature	Type : Platinum Resistance Thermometers (PT 100 $\Omega$ ) Range = $-50 \sim 60^{\circ}\text{C}$ Accuracy = $\pm 0.3^{\circ}\text{C}$ (yard 1.5m) $\pm 0.1^{\circ}\text{C}$ (Tower 10m & 58m) Output : DC voltage
Humidity	Range = 0~100%RH Accuracy = $0 \sim \leq 90\% \text{RH} \pm 2\%$ $> 90 \sim 100\% \text{RH} \pm 3\%$ Output : DC voltage
Precipitation Gauge	Type : Tipping bucket (200mm) Measurement Resolution = 0.2mm Accuracy = $\pm 3\%$ Output : Contact signal

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METEOROLOGY

Table 2.3-19  
STABILITY CATEGORIES

Stability Type	Pasquill Categories	Ambient Temperature Change with Height (°C/100 m)	Range of Standard Deviation
Extremely Unstable	A	$\Delta T/\Delta z \leq -1.9$	$22.5^\circ \leq \sigma_\theta$
Unstable	B	$-1.9 < \Delta T/\Delta z \leq -1.7$	$17.5^\circ \leq \sigma_\theta < 22.5^\circ$
Slightly Unstable	C	$-1.7 < \Delta T/\Delta z \leq -1.5$	$12.5^\circ \leq \sigma_\theta < 17.5^\circ$
Neutral	D	$-1.5 < \Delta T/\Delta z \leq -0.5$	$7.5^\circ \leq \sigma_\theta < 12.5^\circ$
Slightly Stable	E	$-0.5 < \Delta T/\Delta z \leq 1.5$	$3.8^\circ \leq \sigma_\theta < 7.5^\circ$
Stable	F	$1.5 < \Delta T/\Delta z \leq 4.0$	$2.1^\circ \leq \sigma_\theta < 3.8^\circ$
Extremely Stable	G	$4.0 < \Delta T/\Delta z$	$\sigma_\theta < 2.1^\circ$

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Table 2.3-20  
 CHI/Q FOR EACH DIRECTION AND DISTANCE

DIST(METER)	SSW	SW	WSW	W	WNW	NW	NNW	N
300.00	.124E-04	.184E-04	.705E-05	.885E-05	.390E-05	.779E-05	.625E-05	.633E-04
700.00	.291E-05	.448E-05	.169E-05	.214E-05	.940E-06	.191E-05	.150E-05	.344E-05
1000.00	.141E-05	.210E-05	.805E-06	.101E-05	.401E-06	.890E-06	.711E-06	.166E-05
3000.00	.222E-06	.329E-06	.126E-06	.158E-06	.694E-07	.138E-06	.111E-06	.262E-06
5633.00	.100E-06	.124E-06	.476E-07	.597E-07	.259E-07	.512E-07	.418E-07	.101E-06
10000.00	.385E-07	.554E-07	.214E-07	.263E-07	.113E-07	.222E-07	.185E-07	.448E-07
20000.00	.144E-07	.203E-07	.787E-08	.965E-08	.409E-08	.796E-08	.677E-08	.167E-07
30000.00	.834E-08	.117E-07	.453E-08	.552E-08	.232E-08	.450E-08	.387E-08	.967E-08
50000.00	.439E-08	.615E-08	.239E-08	.290E-08	.185E-08	.236E-08	.203E-08	.506E-08
80000.00	.242E-08	.338E-08	.131E-08	.158E-08	.659E-09	.128E-08	.111E-08	.278E-08
DIST(METER)	NNE	NE	ENE	E	ESE	SE	SSE	S
300.00	.148E-04	.250E-04	.141E-04	.236E-04	.141E-04	.203E-04	.187E-04	.307E-04
700.00	.335E-05	.595E-05	.339E-05	.574E-05	.334E-05	.500E-05	.430E-05	.727E-05
1000.00	.166E-05	.285E-05	.162E-05	.271E-05	.161E-05	.232E-05	.209E-05	.349E-05
3000.00	.265E-06	.448E-06	.254E-06	.424E-06	.254E-06	.364E-06	.329E-06	.550E-06
5633.00	.103E-06	.171E-06	.961E-07	.161E-06	.962E-07	.138E-06	.126E-06	.211E-06
10000.00	.463E-07	.766E-07	.430E-07	.720E-07	.430E-07	.610E-07	.565E-07	.948E-07
20000.00	.176E-07	.285E-07	.159E-07	.264E-07	.159E-07	.223E-07	.211E-07	.354E-07
30000.00	.103E-07	.164E-07	.914E-08	.152E-07	.915E-08	.128E-07	.122E-07	.205E-07
50000.00	.539E-08	.864E-08	.481E-08	.801E-08	.481E-08	.673E-08	.642E-08	.108E-07
80000.00	.296E-08	.474E-08	.264E-08	.439E-08	.263E-08	.369E-08	.352E-08	.593E-08
DATA COLLECTION PERIOD: 1979.3.- 1982.2.								



METEOROLOGY

Table 2.3-21

METEOROLOGICAL MODEL - HYPOTHETICAL ACCIDENT

Time Period	Stability Class	Wind Speed Meters/sec	Fi	fi	Wind Conditions
0 - 8 hrs	F	1.0	1.0	1.0	Invariant
8 - 24 hrs	F	2.0	1.0	1.0	Sect. Avg.
1 - 4 days	D	4.0	0.4	0.8	Sect. Avg.
	F	3.0	0.6	0.8	Sect. Avg.
	D	4.0	0.4	0.3	Sect. Avg.
4 - 30 days	D	4.0	0.4	0.3	Sect. Avg.
	G	4.0	0.6	0.3	Sect. Avg.

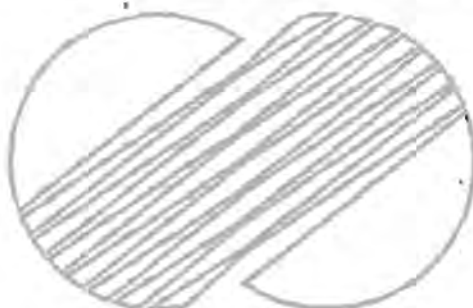
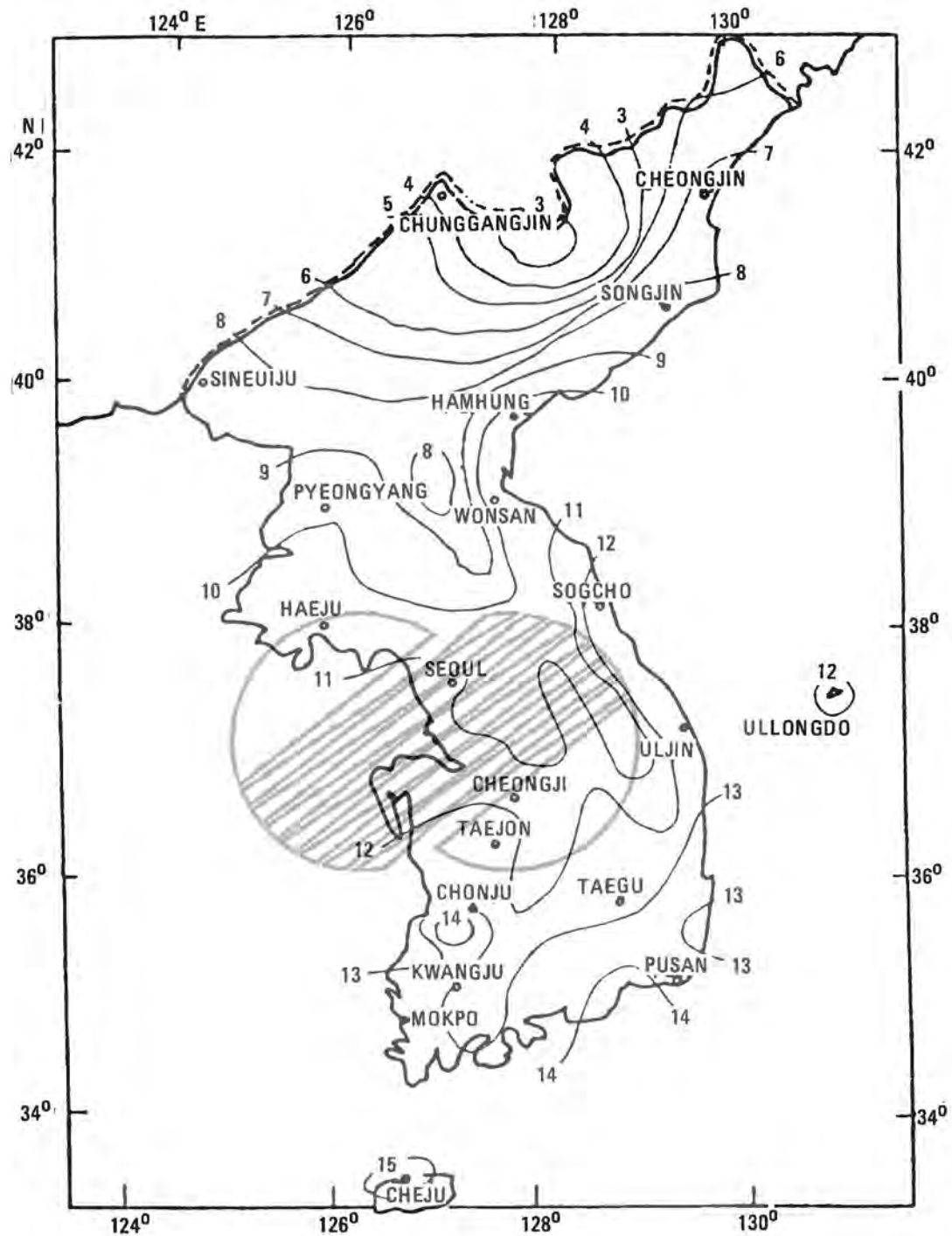


Table 2.3-22  
 SITE DISPERSION FACTORS  
 (X/Q, Sec/m<sup>3</sup>)

Distance (Meters)	0-8 hrs	8-24 hrs	1-4 days	4-30 days
100	1.27E-02	4.62E-03	1.80E-03	7.75E-04
200	3.49E-03	1.30E-03	5.09E-04	2.10E-04
300	1.85E-03	6.51E-04	2.50E-04	1.05E-04
400	1.04E-03	3.74E-04	1.45E-04	6.03E-05
500	8.36E-04	2.57E-04	9.94E-05	4.16E-05
700	6.42E-04	1.38E-04	5.16E-05	2.25E-05
1,000	4.45E-04	7.26E-05	2.83E-05	1.17E-05
1,200	3.61E-04	5.43E-05	2.11E-05	8.75E-06
1,500	2.71E-04	3.76E-05	1.46E-05	6.05E-06
2,000	1.83E-04	2.31E-05	8.95E-06	3.63E-06
3,000	1.10E-04	1.17E-05	4.57E-06	1.92E-06
4,000	7.80E-05	7.94E-06	3.04E-06	1.28E-06
5,000	5.91E-05	5.72E-06	2.19E-06	9.13E-07
5,633	5.05E-05	4.78E-06	1.83E-06	7.59E-07
6,000	5.63E-05	4.34E-06	1.66E-06	6.88E-07
10,000	2.46E-05	2.16E-06	8.08E-07	3.39E-07
20,000	1.24E-05	8.61E-07	3.16E-07	1.32E-07
30,000	6.85E-06	5.13E-07	1.86E-07	7.74E-08
50,000	3.80E-06	2.67E-07	9.64E-08	4.03E-08
80,000	2.28E-06	1.46E-07	5.19E-08	2.20E-08

Figure 2.3-1

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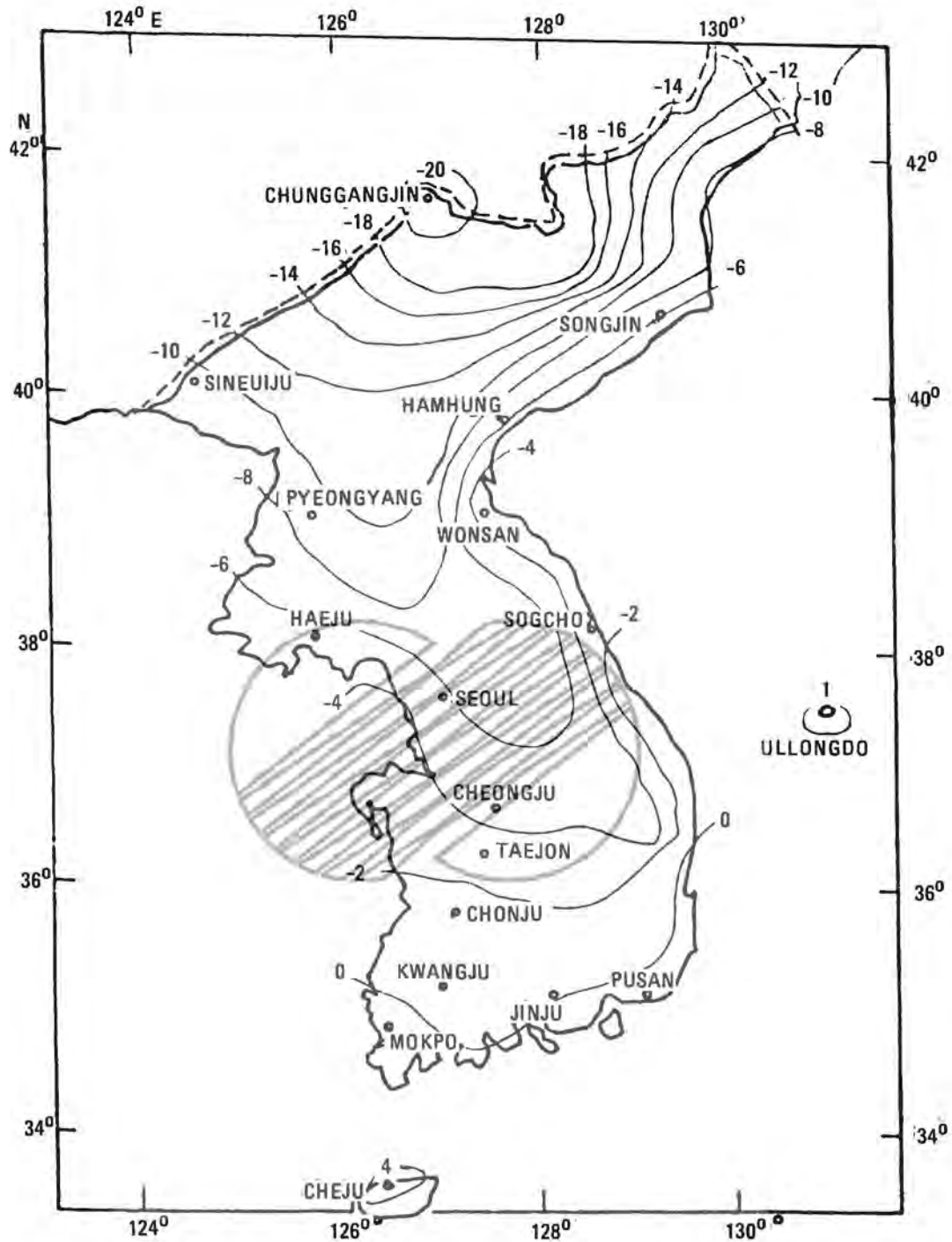


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ANNUAL MEAN  
TEMPERATURE (°C)

Figure 2.3-2

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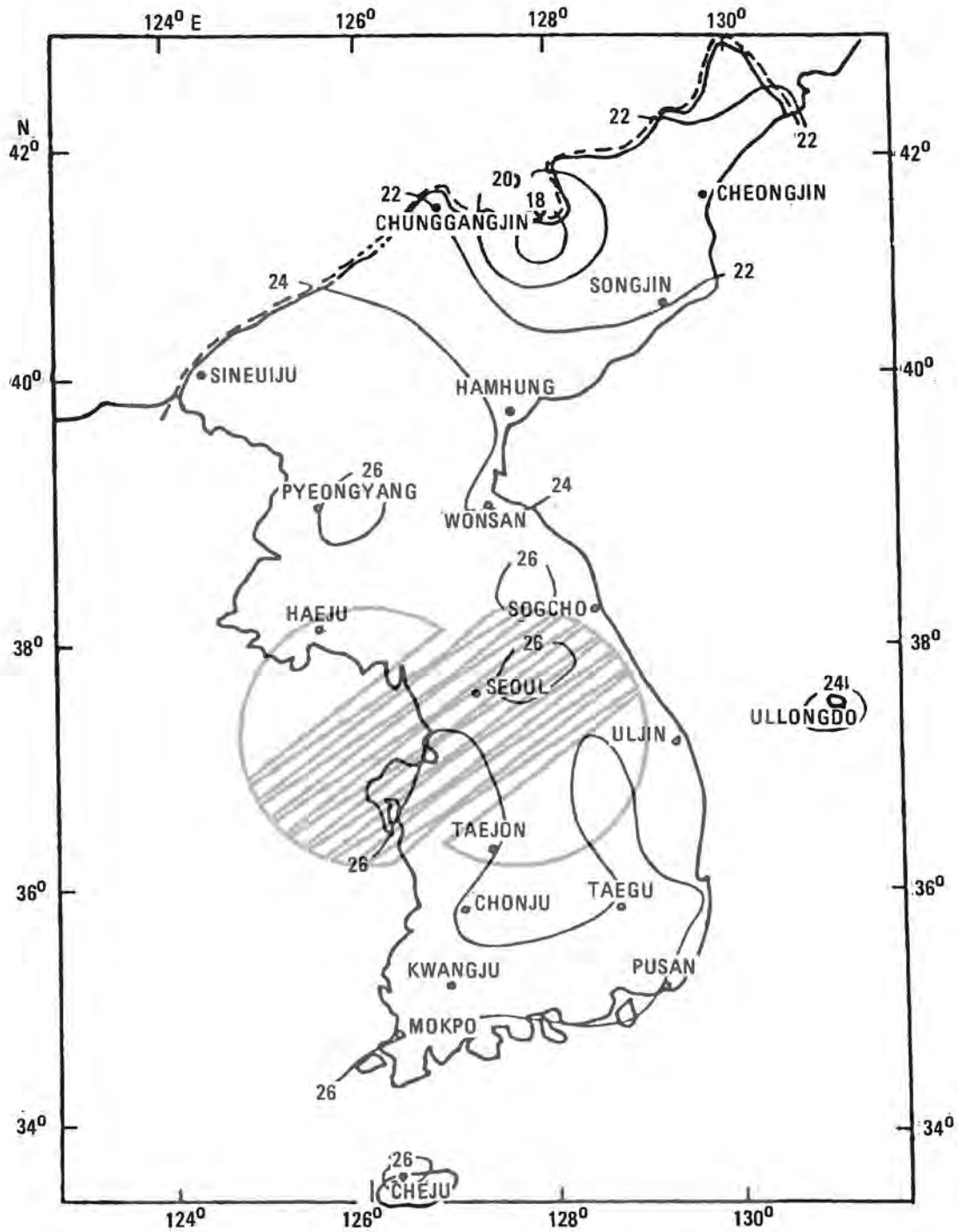


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MEAN TEMPERATURE  
IN JANUARY (°C)

Figure 2.3-3

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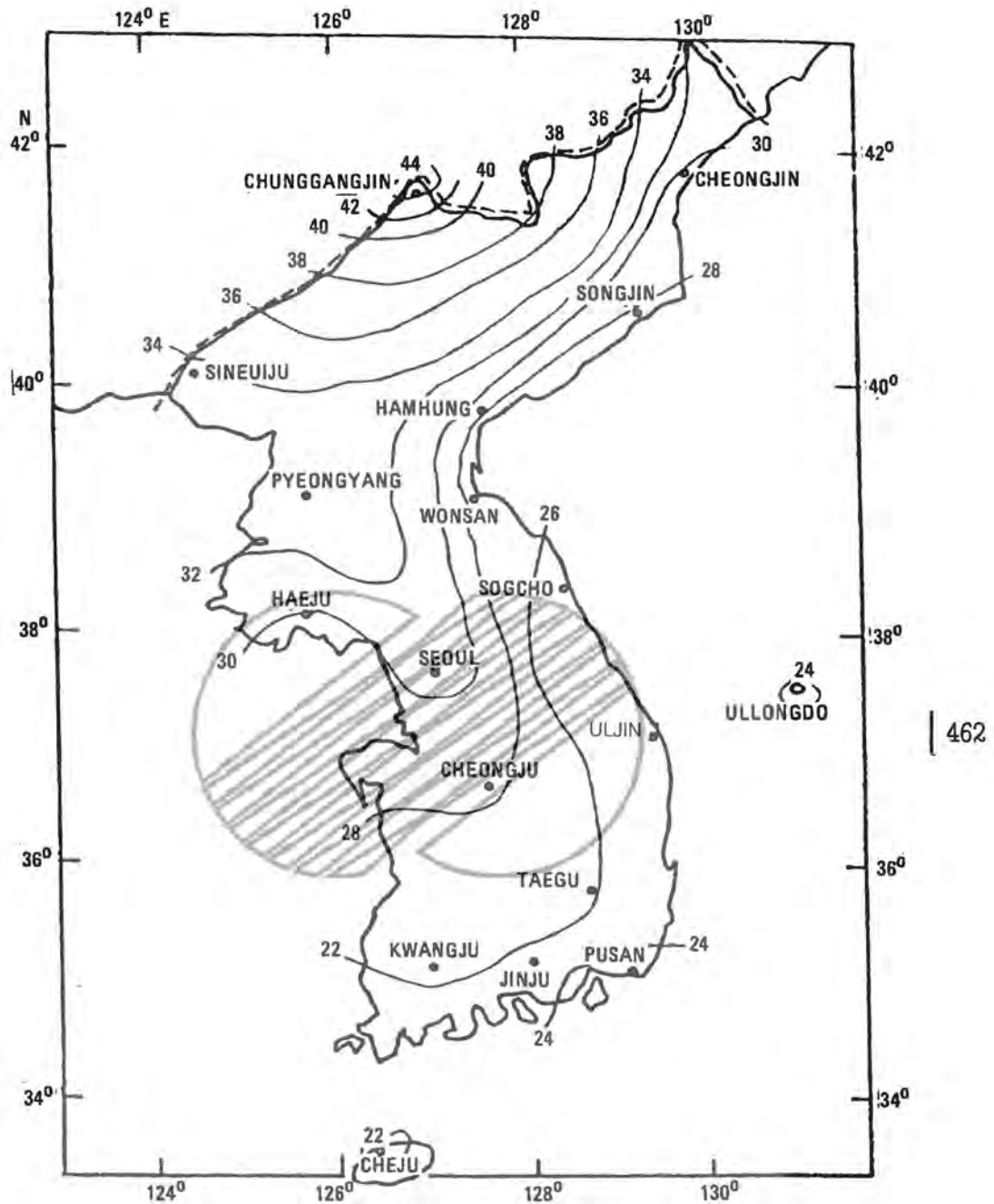


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MEAN TEMPERATURE  
IN AUGUST (°C)

Figure 2.3-4

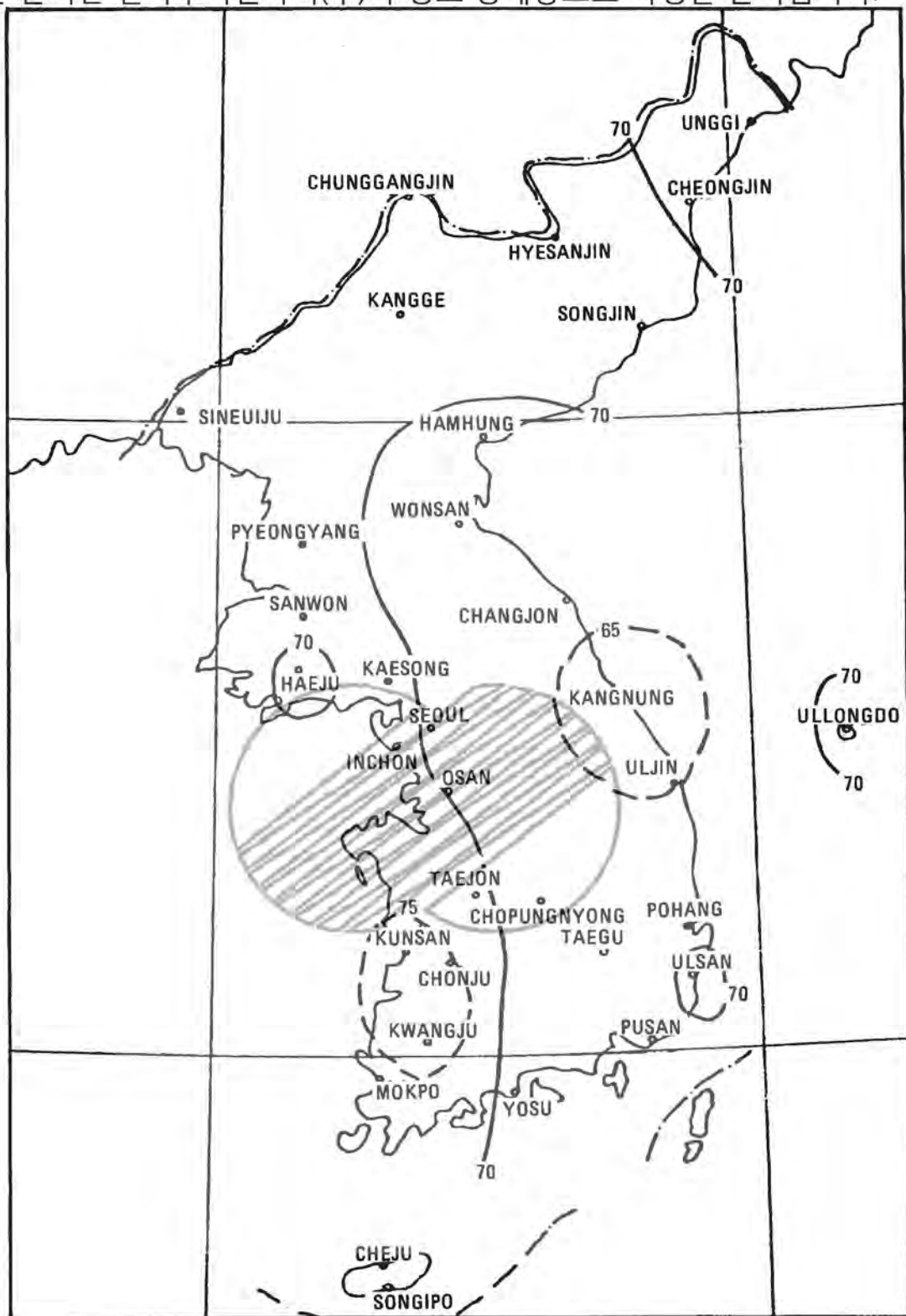




Amendment 462  
2012. 07. 24.

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	KRN 3 & 4 FSAR
	DIFFERENCE BETWEEN THE NORMAL MEAN DAILY TEMPERATURE OF THE HOTTEST AND COLDEST MONTH (°C) Figure 2.3-5

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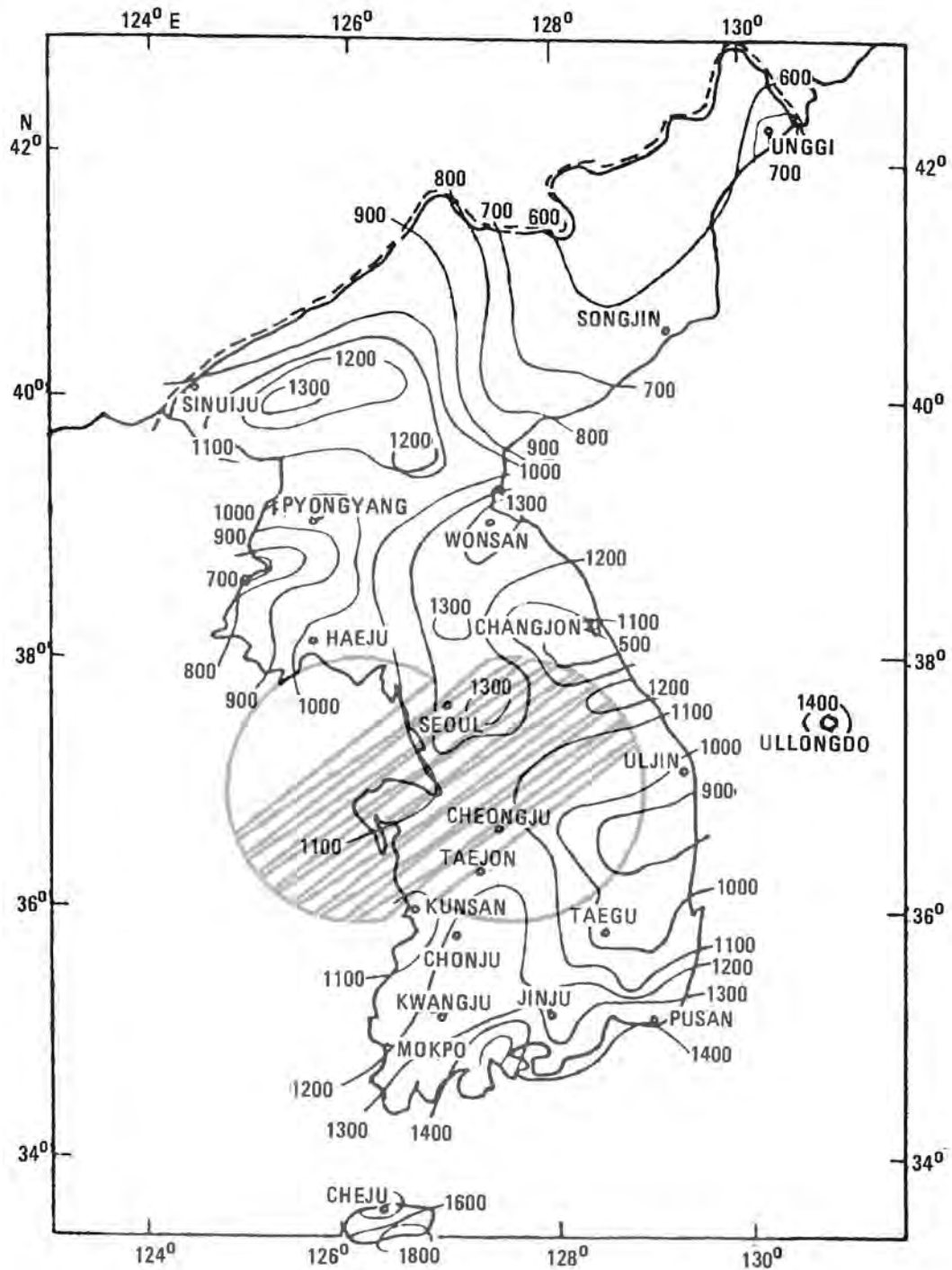


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RELATIVE HUMIDITY

Figure 2.3-6

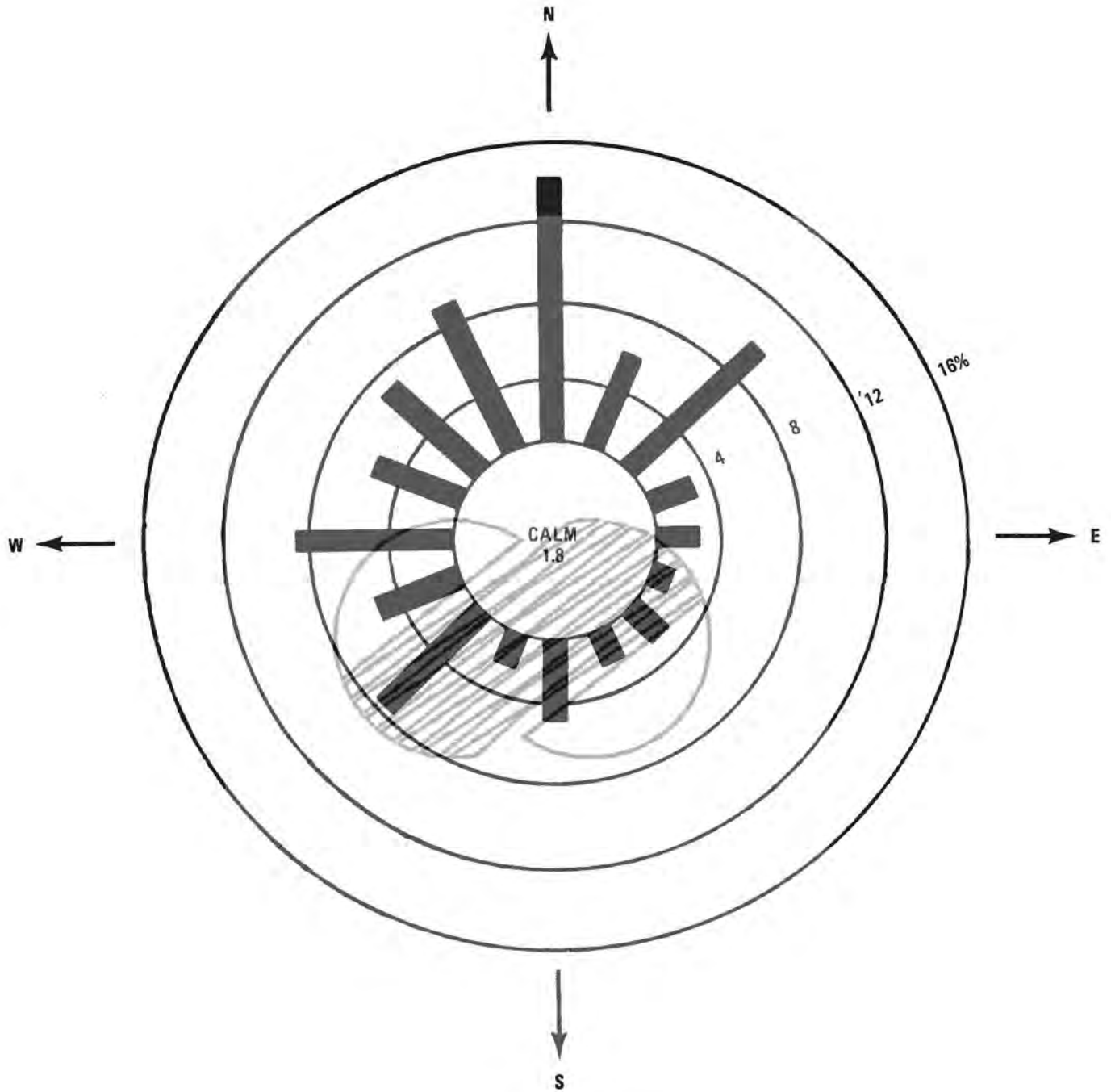
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ANNUAL AMOUNT  
OF PRECIPITATION (mm)

Figure 2.3-7



(3/79-2/82)

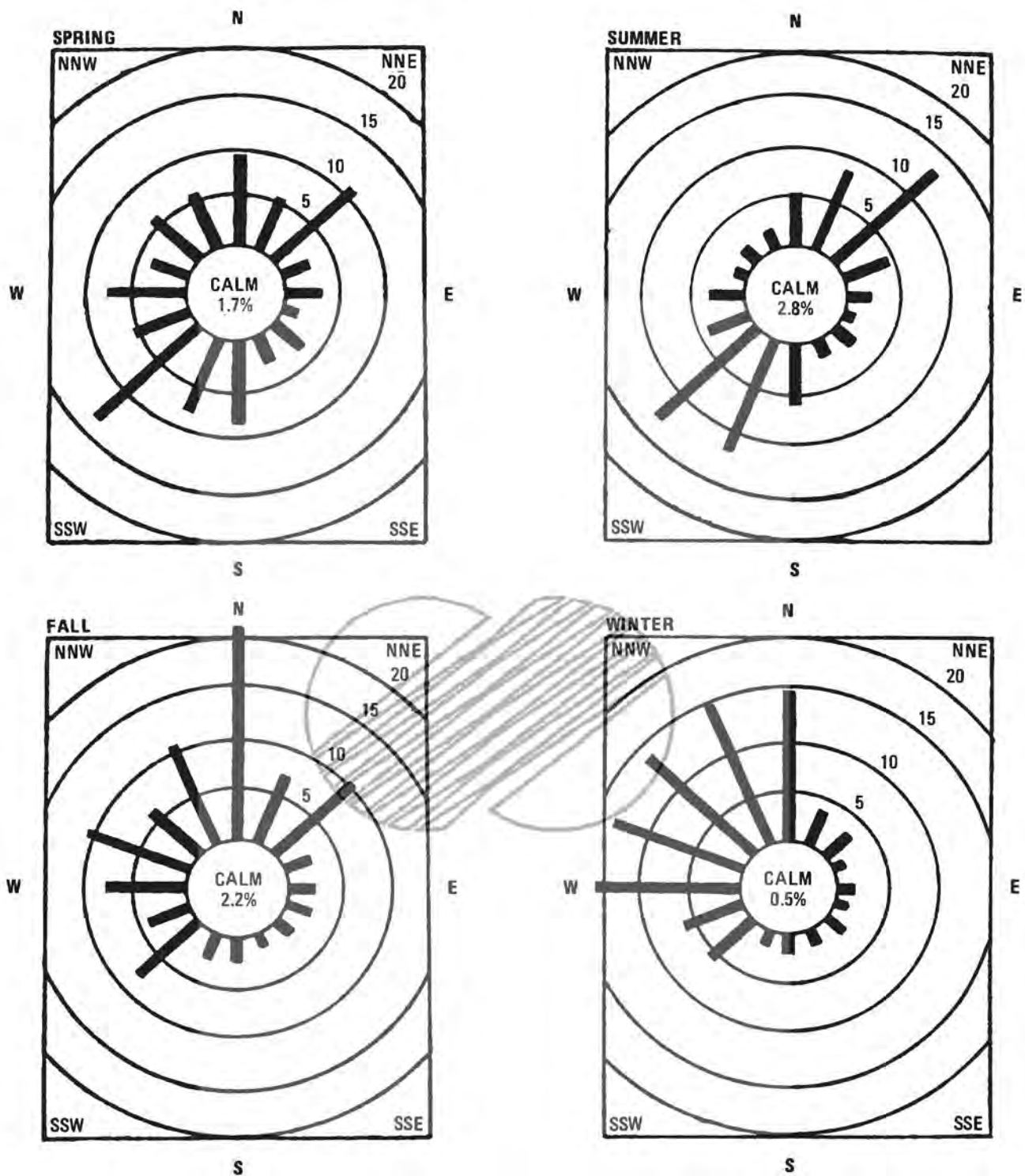


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WIND DIRECTION  
FREQUENCY ROSE (%)

Figure 2.3-8

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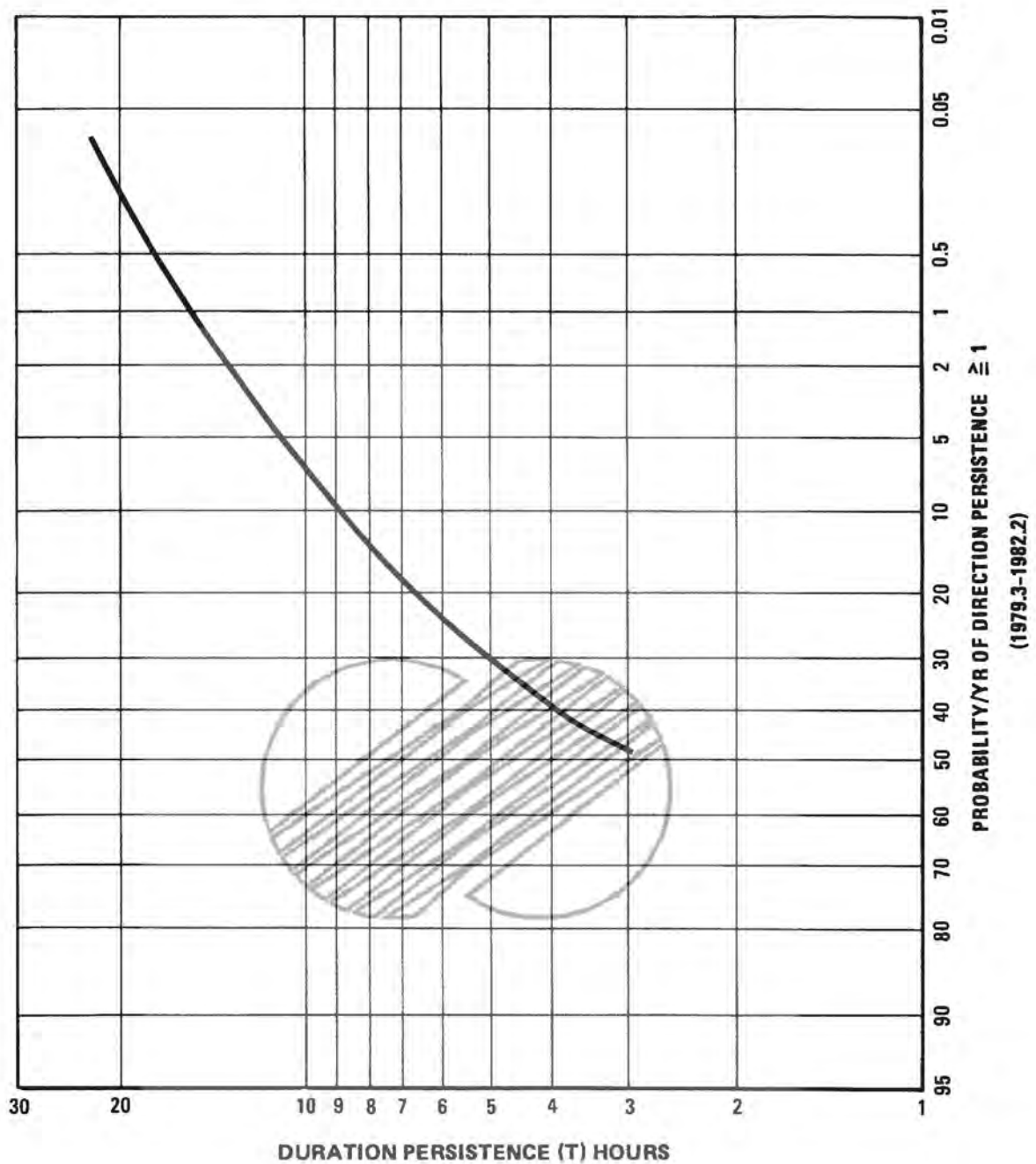


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SEASONAL WIND DIRECTION  
FREQUENCY ROSE (%)

Figure 2.3-9

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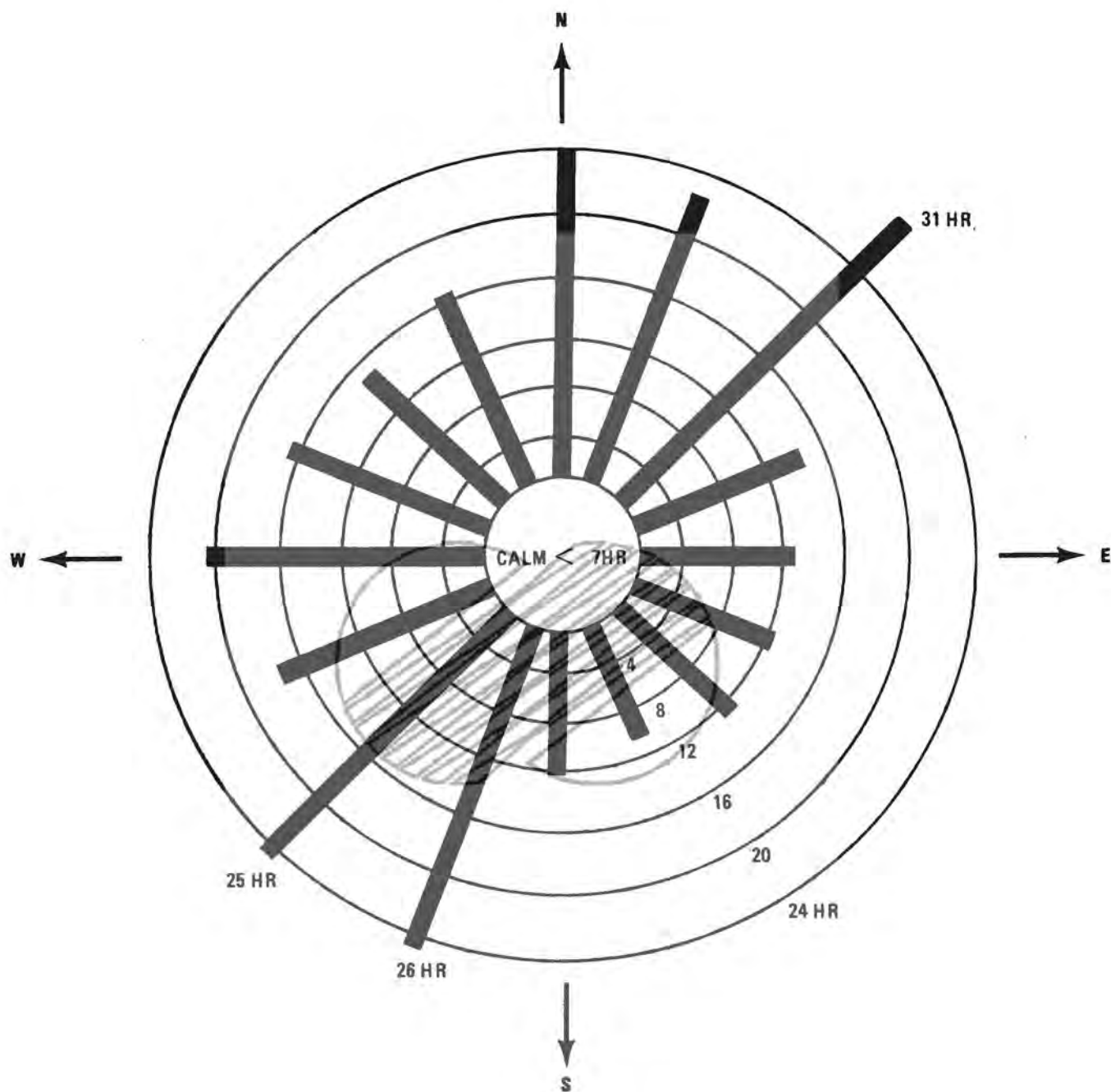
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KORI WIND  
DIRECTION PERSISTENCE

Figure 2.3-10



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(8/1/69-2/28/82)



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ONE SECTOR WIND DIRECTION  
PERSISTENCE ROSE  
MAX. NO. OF HOURS WIND BLOWS  
FROM INDICATED DIRECTION

Figure 2.3-11

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THIS FIGURE APPEARS  
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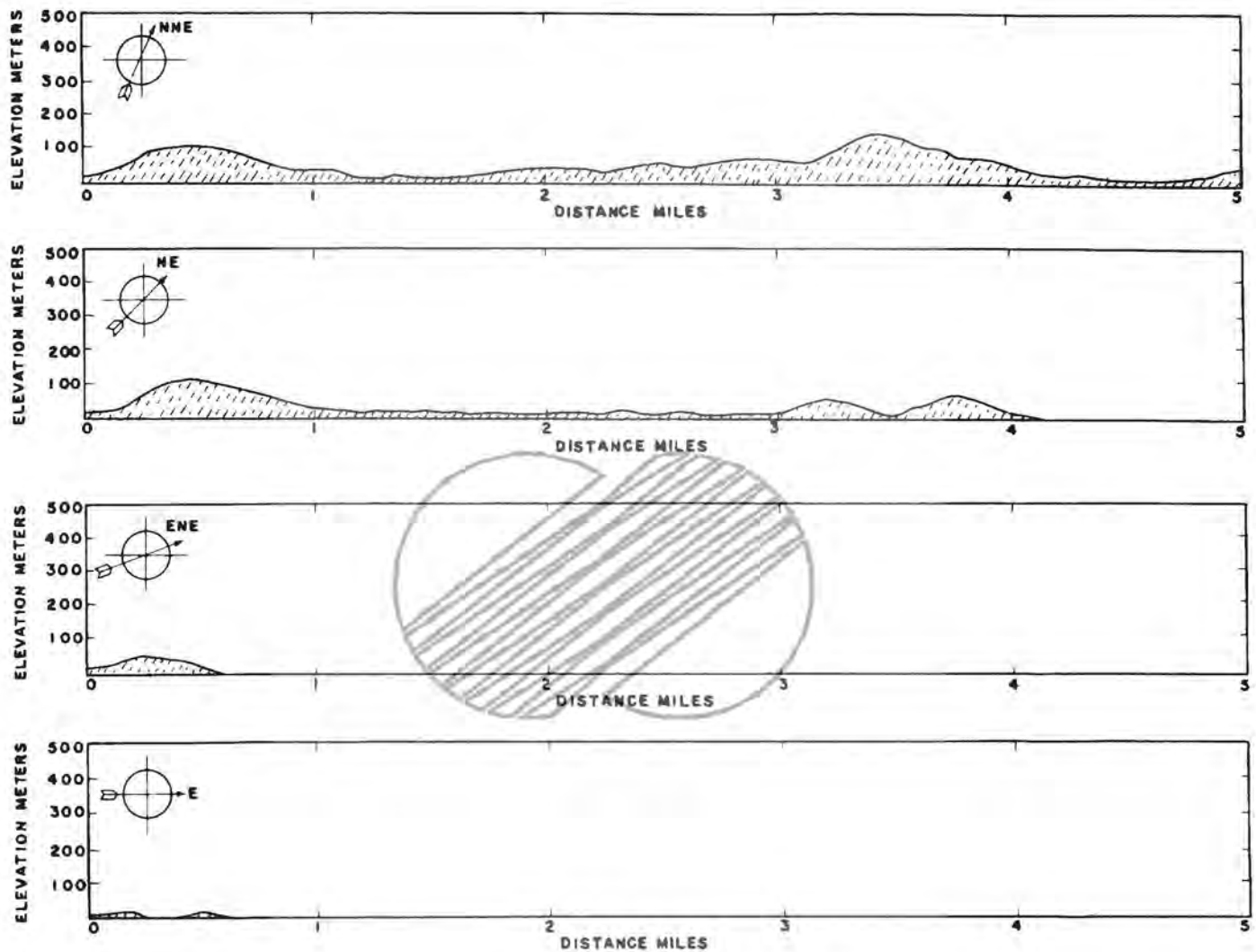


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TOPOGRAPHIC FEATURE (0-5 MILES  
FROM KORI SITE)

Figure 2.3-12

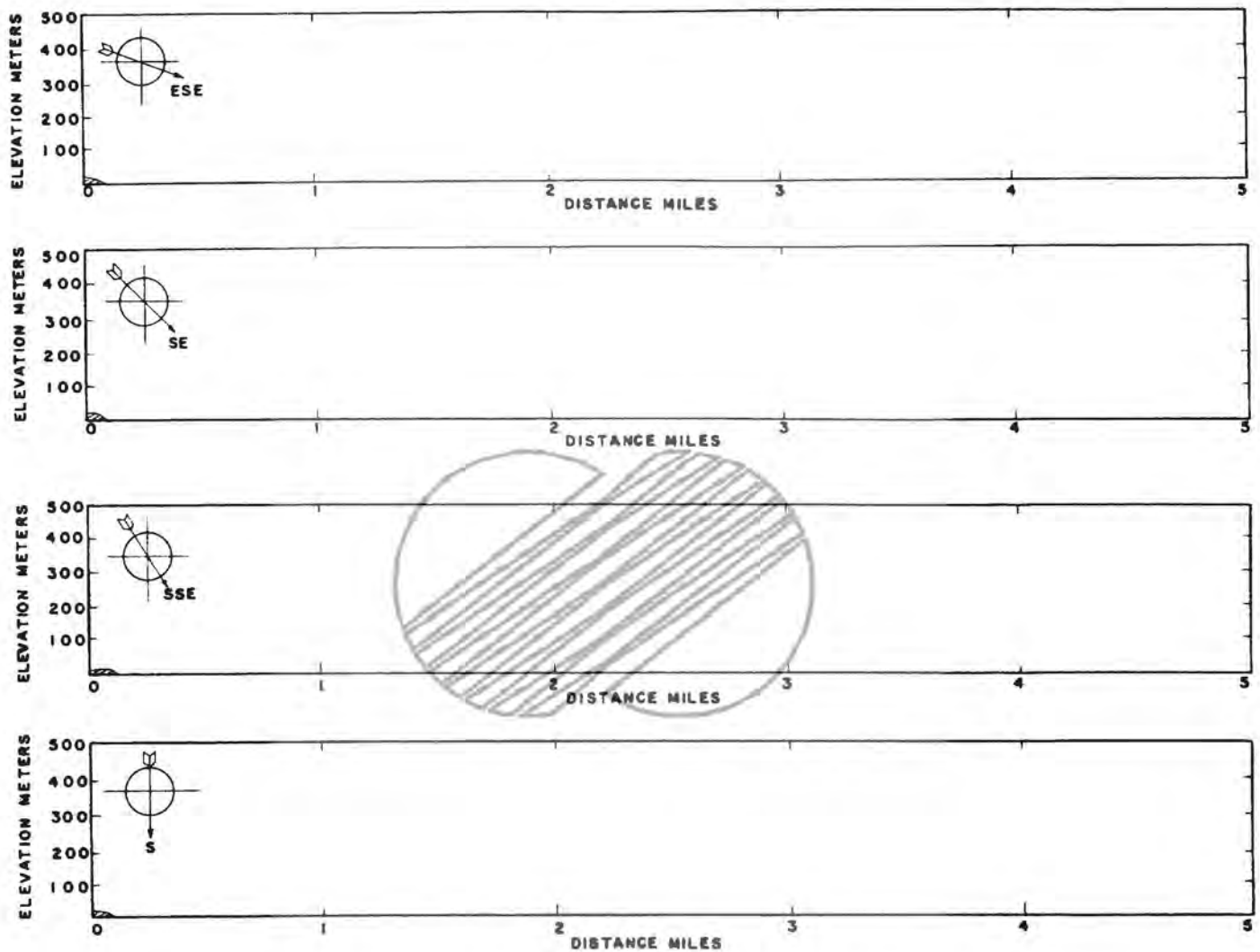
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TOPOGRAPHIC CROSS SECTIONS  
(0-8 KM FROM KORI STATION)

Figure 2.3-13)

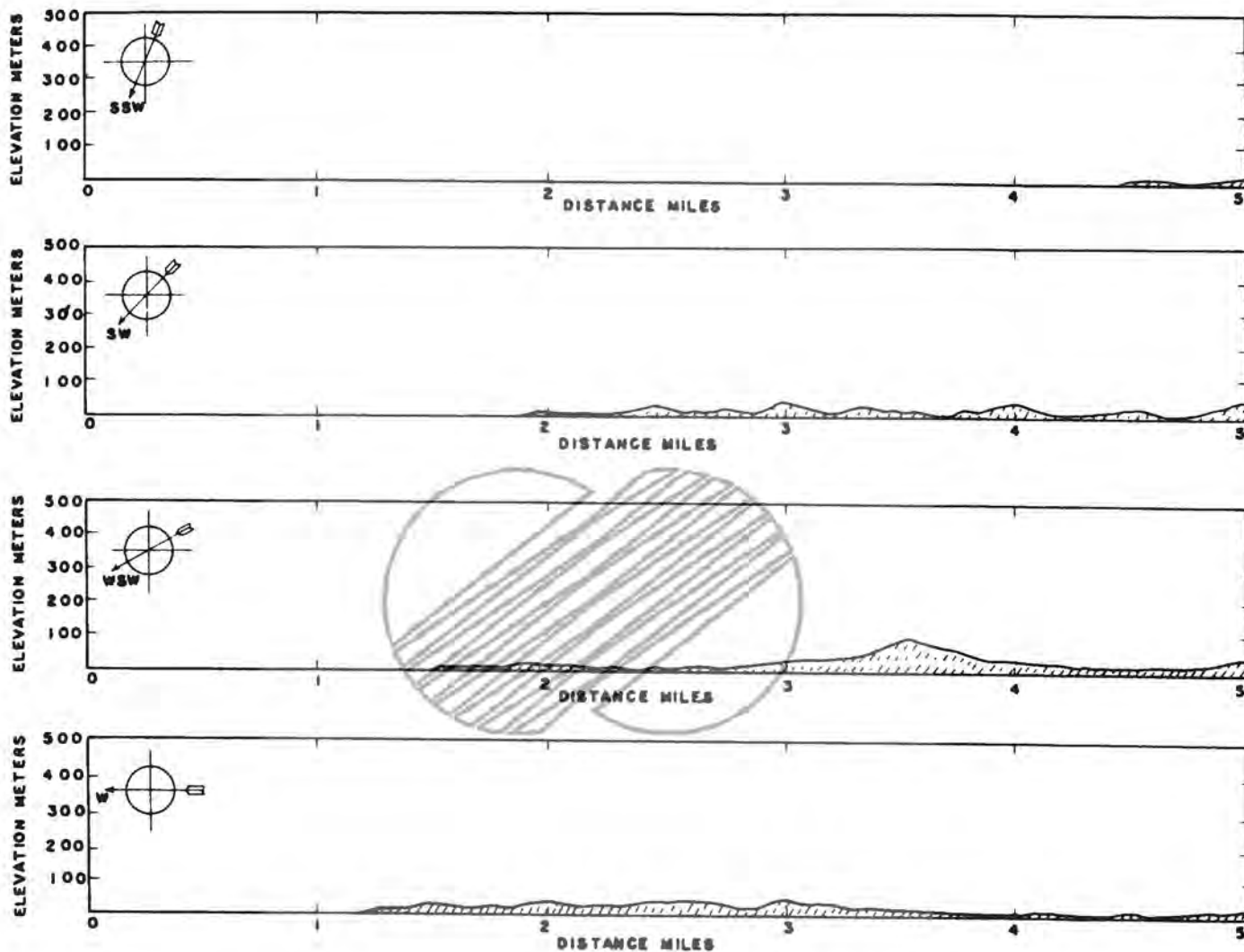


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TOPOGRAPHIC CROSS SECTIONS  
(0-8 KM FROM KORI STATION)

Figure 2.3-14

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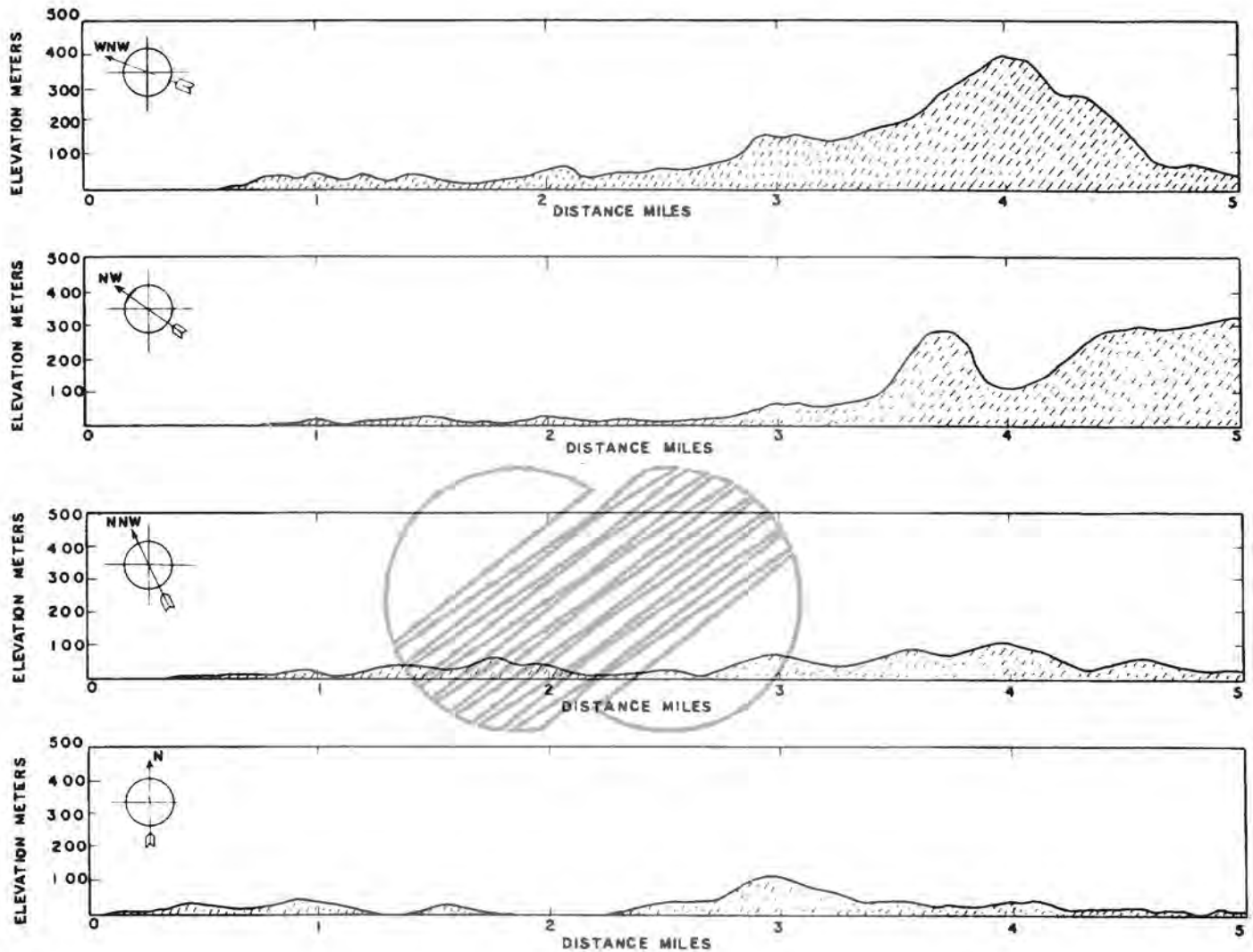


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TOPOGRAPHIC CROSS SECTIONS  
(0-8 KM FROM KORI STATION)

Figure 2.3-15

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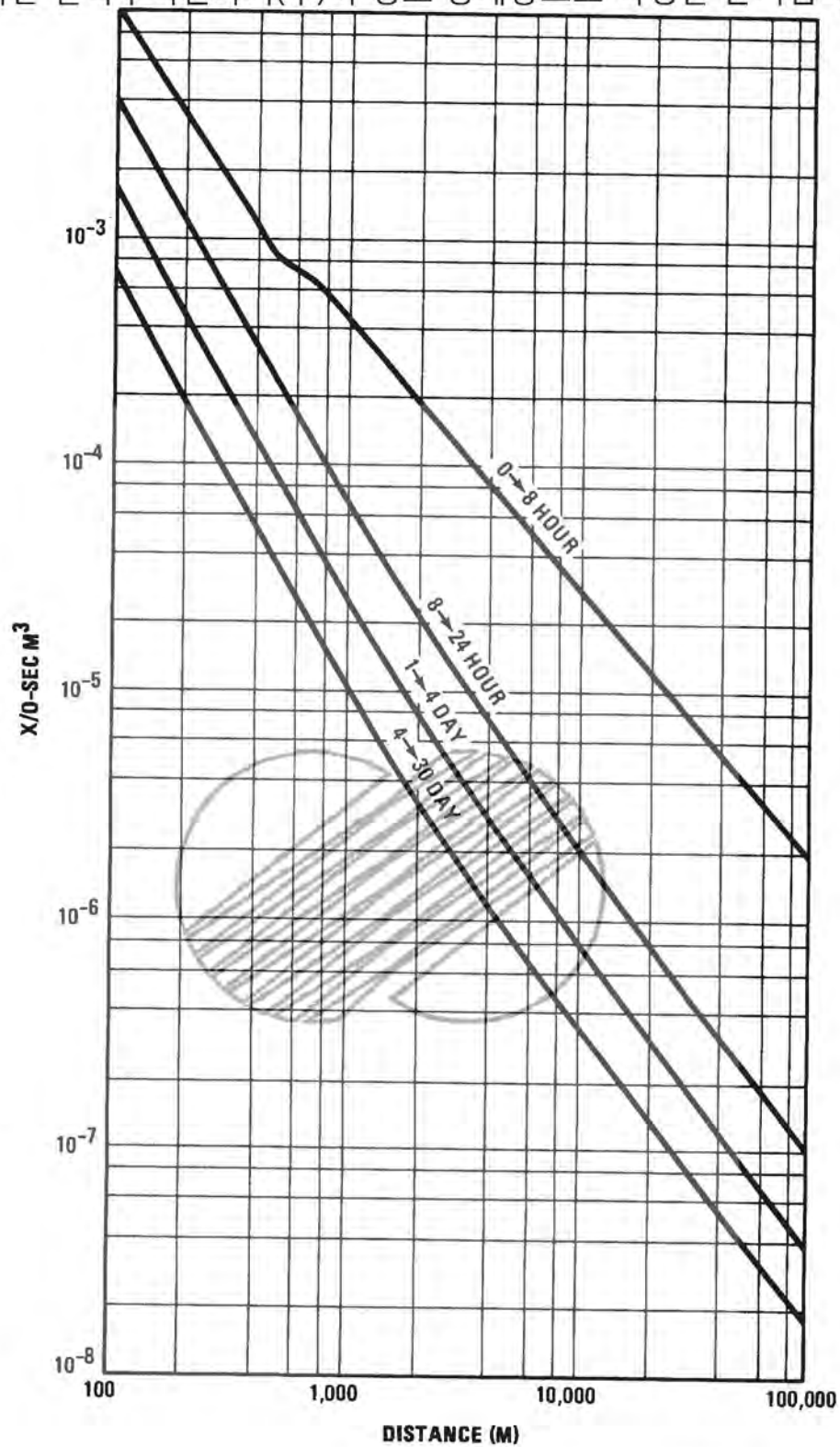
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TOPOGRAPHIC CROSS SECTIONS  
(0-8 KM FROM KORI STATION)

Figure 2.3-16



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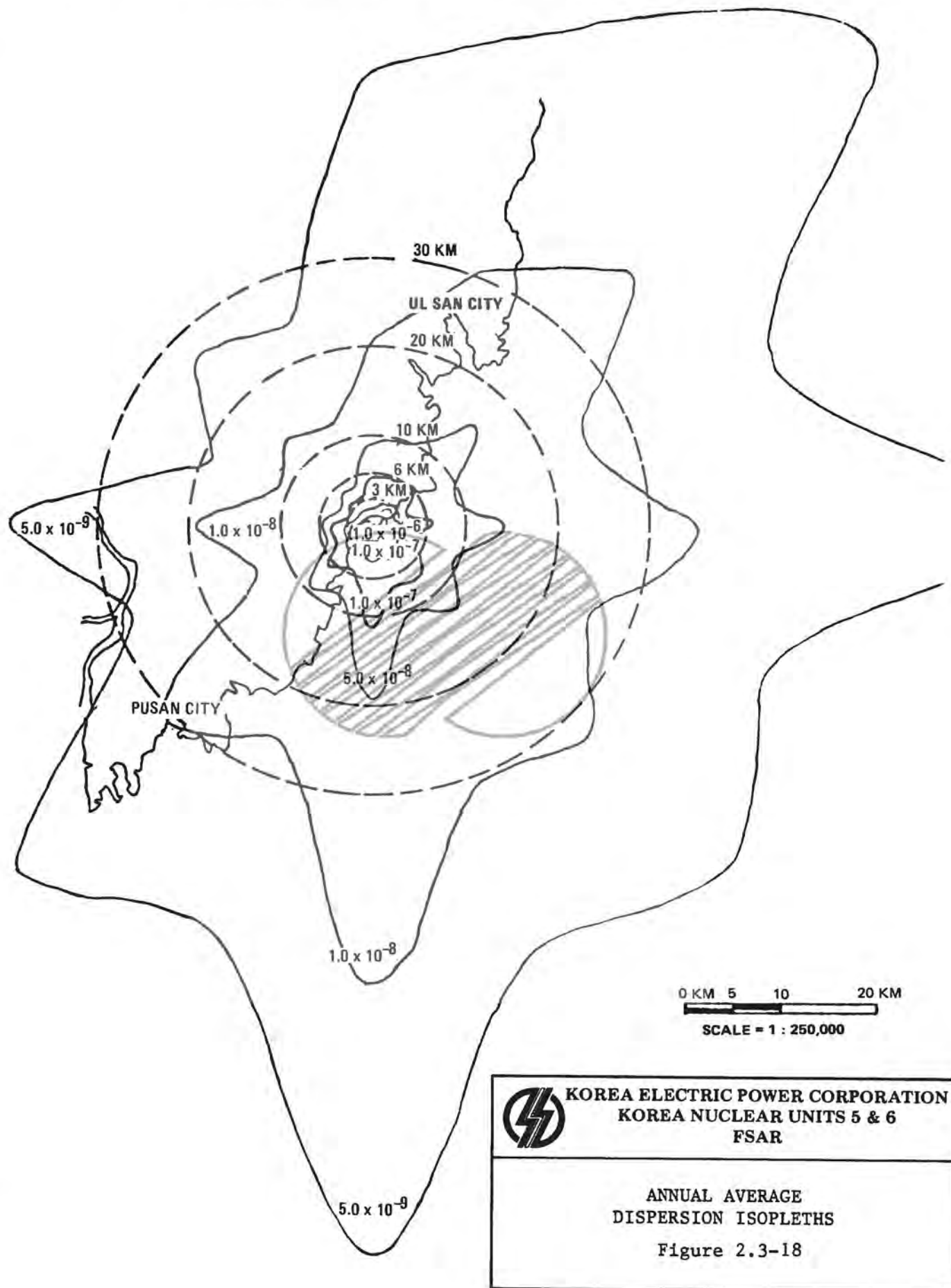


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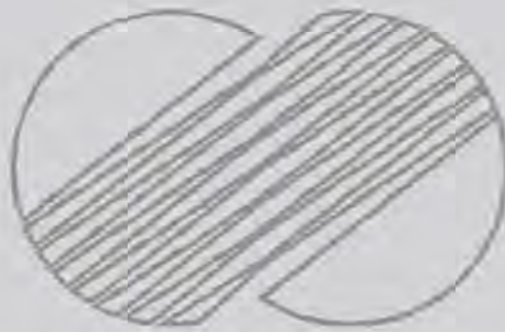
SITE DISPERSION FACTORS  
ACCIDENT MODEL

Figure 2.3-17

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491



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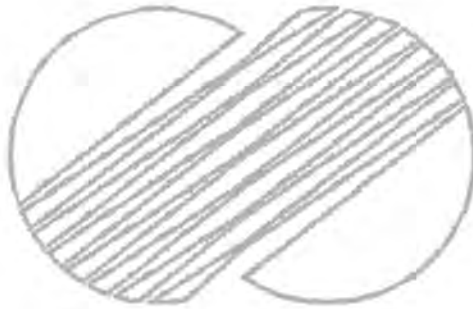


KHNP  
NUCLEAR UNITS KORI 3&4  
FSAR

ONSITE METEOROLOGICAL  
MEASUREMENT SYSTEM

Figure 2.3-19

2.4



## 2.4 HYDROLOGIC ENGINEERING

### 2.4.1 HYDROLOGIC DESCRIPTION

#### 2.4.1.1 Site and Facilities

The KNU 5 & 6 site is located on the southeastern coast of Korea, approximately 32 kilometers northeast of Busan, on Kodang Mal area. Bordering the site to the west is Kori Nuclear Power Plant No. 1 under operation and No. 2 under physics test; to the south and east is the East Sea. The remaining northern section is bordered by hilly land, giving the site a blunt peninsular shape.

The site area was originally terraced for rice paddies and farmland and had a slope of about 19 percent. Since then, the land has been graded for construction and the area where the main plant structures are located is fairly level. The leveled ground elevation is 9.50 meters above mean sea level (MSL).

The provincial road of Route 1019 passes near the site. The natural drainage area near the site is shown in figure 2.4-1.

#### 2.4.1.2 Hydrosphere

The major body of water affecting the site is the adjacent East Sea. The East Sea is elliptical in shape and is bounded by Korea, Japan, and the USSR. The bottom topography of the East Sea in the vicinity of the site is shown in figures 2.4-2 and 2.4-3.

There are three creeks near the site that are used for industrial and domestic water.

Creek	HyoAm	WolNae	ChoaKwang
Direction from the Site	NE	NW	SW
Horizontal distance from the Site (km)	1.9	1.4	3.0
Drainage Area (km <sup>2</sup> )	27	35	43
Stream Length (km)	10	12	16

## HYDROLOGIC ENGINEERING

To find the current pattern of the coastal area around the site, a current survey was conducted from September 1978 to August 1979 by KORDI<sup>(1)</sup> at the observation points listed in figure 2.4-4. The current meters were moored, using the U-type techniques of mooring, with two subsurface buoys and two marking buoys on the sea surface as shown in figure 2.4-5.

Table 2.4-1 presents the maximum speed at each station and the mean speed which was obtained by averaging observed values of speed during the observation period.

Among the maximum speeds, the largest value was 80.46 cm/sec, which occurred at station 37, while the smallest values of the maximum speed were recorded near station 24. All observations near station 37 show important values for the year. The range of the maximum surface currents is from 22.50 to 80.46 cm/sec.

For the mean speed, it does not vary much from one place to another and the range is from 12.11 cm/sec at station 07 to 22.10 cm/sec at station 16. High mean speeds are observed near the stations where the maximum speeds are recorded.

Table 2.4-2 presents directions of ebb and flood currents in which probability densities are maximum, in tidal direction and the mean velocities in the corresponding directions.

The surface ebb and flood currents given in table 2.4-2 are synthesized in figure 2.4-6 where the discontinuous arrows indicate the speeds estimated from their scatter plots. Maximum measured ebb and flood currents at spring tides are presented in table 2.4-3 and figure 2.4-7.

The net drift rate is expressed as the vector of the mean velocity measurement (table 2.4-4 and figure 2.4-8).

The mean drift current is important in the survey area and it flows toward the direction similar to that of ebb current. The speed is related to the distance from the coast to the observation point, and to the bottom condition. The direction of mean drift current is deflected 0 - 35° to the left of the direction of the corresponding ebb current.

### 2.4.2 FLOODS

#### 2.4.2.1 Flood History

There are no streams or rivers which could affect the site by a considerable flood.

Observations of tidal variations have been made at the site and also in the port of Busan, located 32 km southwest of the



## HYDROLOGIC ENGINEERING

site. High and low water levels, as indicated by the land datum, are as follows: (2)(3)

A.	Highest High Water Level (HHWL)	+1.133 m
B.	High Water Level (HWL)	+0.705 m
C.	Mean Water Level (MWL)	+0.309 m
D.	Low Water Level (LWL)	-0.087 m
E.	Lowest Low Water Level (LLWL)	-0.497 m

### 2.4.2.2 Flood Design Consideration

The design of high seawater level protection elevation for safety-related facilities, systems, and equipment is based on the maximum high water level, including wave runup associated with the probable maximum typhoon and tsunami. For this particular site no other factors such as flood and seiche causing the maximum high water level need to be included.

The elevation of the safety-related facilities, systems, and equipment of the KNU 5 & 6 site is above the maximum high water level.

### 2.4.2.3 Effects of Local Intense Precipitation

The Kori region is susceptible to major storm activity during the months of June through September. The drainage area for the site is approximately 560,000 m<sup>2</sup> (0.56 km<sup>2</sup>). The maximum hourly rainfall is 89 mm.

The average annual and maximum precipitations are as follows at Busan and Ulsan during the period of 1931 to 1981:

Average annual precipitations

(Unit: mm)

Station \ Period	1931 - 1960	1961 - 1981 <sup>(4)</sup>
Busan	1,381.6	1,477.9
Ulsan	1,217.6	1,280.3
Ko-Ri		1,532.6*

\*1970-1981

## HYDROLOGIC ENGINEERING

### Maximum precipitations

(Unit: mm)

Division Station	Yearly	Daily	Hourly
Busan	2,195.5	250.9	89
Ulsan	1,936.5	315.8	74
Ko-Ri	2,131.3*	235.0**	

\* 1980

\*\*Sept. 14, 1969

The site drainage system is shown in figure 2.4-9. Compound pipes (150 mm - 1350 mm, inside diameter) were designed for the site storm drainage system.

#### 2.4.3 PROBABLE MAXIMUM FLOOD (PMF) ON STREAMS AND RIVERS

This section is not applicable because there are no streams or rivers which could cause flooding on the Kori site.

##### 2.4.3.1 Probable Maximum Precipitation (PMP)

The total annual precipitation is about 1300 mm at the site. The largest amount of rainfall for 24 hours during the period of 1931 to 1981 was recorded at 315.8 mm at Ulsan, and 250.9 mm at Busan. The maximum hourly rainfall is 89 mm. Figure 2.4-10 shows the annual precipitation variation at Busan and Ulsan for the period of 1961 to 1981. (4)

The monthly and seasonal precipitations during the period of 1961 to 1981 are as follows: (4)

# HYDROLOGIC ENGINEERING

## Monthly precipitations

(Unit: mm)

Month Station	Jan.	Feb.	Mar.	Apr.	May	Jun.
Busan	30.3	38.4	78.7	157.6	152.6	224.9
Ulsan	32.2	39.8	68.1	127.9	104.1	164.3
Ko-Ri*	45.1	50.8	78.8	166.3	158.2	219.4

Month Station	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Busan	245.8	213.6	175.8	63.9	69.9	26.2
Ulsan	221.6	193.2	178.0	69.3	60.3	21.7
Ko-Ri*	246.4	203.6	191.5	78.1	63.7	30.7

\*1970-1981

## Seasonal precipitations

(Unit: mm)

Season Station	Spring (Mar.-May)	Summer (Jun.-Aug.)	Autumn (Sep.-Nov.)	Winter (Dec.-Feb.)
Busan	389	684	310	95
Ulsan	300	579	308	94
Ko-Ri	403	669	333	127

Snow is uncommon during winter, with an estimated annual accumulation of 30 cm/yr from nearby stations Busan and Ulsan. Precipitation during the winter months occurs principally as rain on the southeast coast.

#### 2.4.3.2 Precipitation Losses

This section is not applicable because there are no streams or rivers that could cause flooding on the site.

#### 2.4.3.3 Runoff and Stream Course Models

This section is not applicable because there are no streams or rivers that could cause flooding on the site.

#### 2.4.3.4 Probable Maximum Flood Flow

This section is not applicable because there are no streams or rivers that could cause flooding on the site.

#### 2.4.3.5 Water Level Determinations

This section is not applicable because there are no streams or rivers that could cause flooding on the site.

#### 2.4.3.6 Coincident Wind Wave Activity

A discussion of coincident wind wave activity is included in subsection 2.4.5.3.

#### 2.4.4 POTENTIAL DAM FAILURE, SEISMICALLY INDUCED

This section is not applicable because there are no dams existing or proposed in the area adjacent to the site.

#### 2.4.5 PROBABLE MAXIMUM SURGE AND SEICHE FLOODING

##### 2.4.5.1 Probable Maximum Winds and Associated Meteorological Parameters

The recorded maximum wind speeds are 31.7 m/sec at Ulsan and 34.7 m/sec at Busan for the period 1912 to 1981. These records were caused by typhoon Sarah on Sept. 17, 1959. The maximum wind speed was 26.6 m/sec at Ko-Ri during the period of 1970 to 1981, as described in table 2.3-6. To determine the effects of surge flooding, the Korean Advanced Energy Research Institute

(KAERI) was retained as a consultant to KHNP. The data provided by KAERI included the maximum runup and tsunami water levels. This data, together with observed data and calculated water levels based on typhoons, was used to calculate the probable maximum water level. 554

The crest of storm-induced wave runup at the seashore in the vicinity of the site is assumed to be 3.0 meters and the maximum probable tsunami height is calculated at 0.4 meter. (5)

#### 2.4.5.2 Surge and Seiche Water Levels

The change of tidal elevation is as follows:

##### A. Forecasting the increase of tide level by wind:

$$Y = K \frac{Fv^2}{h} \cos \theta \quad (6)$$

where,

Y = increased height by wind

K = factor varies to seashore

h = water depth, 200 m

F = fetch length, 210 km (typhoon Sarah direction: SE)

v = mean wind velocity, 19 m/sec by typhoon Sarah

$\theta$  = angle of incidence of the wind to the normal of the shore, 45°

$$K = \gamma_s^2 \frac{\rho_a}{\rho} \frac{1}{g} \quad (7)$$

$$\gamma_s^2 = 2.6 \times 10^{-3} \quad (\text{general}) \quad (8)$$

$$\frac{\rho_a}{\rho} = 1.2 \times 10^{-3} \quad (11)$$

where,

$\gamma_s^2$  = sea surface friction coefficient

$\rho_a$  = atmospheric air density

$\rho$  = density of sea water



HYDROLOGIC ENGINEERING

$$\begin{aligned}K &= 2.6 \times 10^{-3} \times 1.2 \times 10^{-3} \times 9.8^{-1} \\&= 0.32 \times 10^{-6} \text{ (sec}^2/\text{m)} \\&= 0.32 \times 10^{-3} \text{ (sec}^2/\text{km)} \\Y &= 0.32 \times 10^{-3} \times \frac{210}{200} \times 19^2 \cos 45^\circ \\&= 0.00032 \times 1.05 \times 361 \times 0.707 \\&= 0.086 \text{ m}\end{aligned}$$

- B. The increase of tide level by pressure reduction:

$$\Delta h = 0.991 \Delta p \text{ (6)}$$

where,

$\Delta h$  = increasing height by pressure reduction, cm

$\Delta p$  = reduced pressure, mb

$$= 1013 - 970 \text{ (970 mb by typhoon Sarah)}$$

$$= 43 \text{ mb}$$

$$\Delta h = 0.991 \times 43 = 42.6 \text{ cm} = 0.426 \text{ m}$$

- C. Total height of increase in tide level:

$$H = Y + \Delta h$$

$$= 0.086 + 0.426$$

$$= 0.512 \text{ m}$$

- D. The probable maximum water level was determined as follows:

$$H = \text{H.H.W.L.} + \text{runup} + \text{storm surging} + \text{tsunami}$$

$$= 1.133 + 3.0 + 0.512 + 0.4$$

$$= 5.045 \text{ m}$$

As can be seen above, this study assumes that all elements of natural water tide phenomena act concurrently. The grade elevation of the site is above the probable maximum water level by 4.455 m, and the site is, therefore, judged to be protected against flooding.



#### 2.4.5.3 Wave Action

Since long-term wave data at the site are not available, the wave data at Mipo have been adopted for the KNU 5 & 6 site. Mipo is located in the Ulsan area and has the nearest wave recording station relative to the site.

Average  $H_{\max}$  = 1.0 m (1978 - 1981)

Average  $H_{1/3}$  = 0.75 m (1979 - 1981)

Average  $T_{1/3}$  = 3.9 sec (1979 - 1981)

Average  $H_{\text{mean}}$  = 0.5 m (1979 - 1981)

Wave direction = NE - SE

The highest wave height at Mipo for the period of 1975 to 1981 was recorded as 6.8 meters on November 27, 1978. The high wave heights occurred when northwest winds blew at the site and the wave direction was northeast. The highest wave heights are presented in table 2.4-5 and histograms for the waves are shown in figures 2.4-11 to 2.4-15.

#### 2.4.5.4 Resonance

Since the coastline of the site is not shaped as a bay but straight to open sea, the resonance effects to the site are disregarded.

#### 2.4.5.5 Protective Structures

The KNU 5 & 6 site is 4.48 meters above the worst possible water level. This is well above the maximum seawater elevation predicted for the occurrence of a maximum tsunami coincident with storm surge.

Special structures designed to protect the site against wave action include the seawall and screen-wall perimeter wall. The onshore intake structure is arranged so that all penetrations, except in the screen-wall, are sealed against leakage of rising or surging seawater.

The cooling water intake for the plant is protected by a steel barrier and underwater access to the area inside the seawall is prevented by man-made obstacles.

## HYDROLOGIC ENGINEERING

### 2.4.6 PROBABLE MAXIMUM TSUNAMI FLOODING

#### 2.4.6.1 Probable Maximum Tsunami

The maximum probable tsunami height is calculated, as 0.4 meter and is derived from the following postulations: <sup>(5)</sup>

- A. The probable tsunamic generating place is 125 kilometers southeast of the site.
- B. Tsunami will follow Green's Law for small amplitude waves <sup>(11)</sup>.

#### 2.4.6.2 Historical Tsunami Record

There is no record of tsunami occurring on the east coast of Korea.

#### 2.4.6.3 Source Tsunami Wave Height

As indicated in paragraph 2.4.6.1, the maximum probable tsunami height is only 0.4 meters. There are no remarkable sources locally or at a distance.

#### 2.4.6.4 Tsunami Height Offshore

Since the maximum probable tsunami height is only 0.4 meters at the site, this paragraph is not significant.

#### 2.4.6.5 Hydrography and Harbor or Breakwater Influence on Tsunami

This paragraph is not applicable because there is no history of damaging tsunami on the east coast of Korea.

#### 2.4.6.6 Effect on Safety-Related Facilities

This paragraph is not applicable because there is no history of damaging tsunami on the east coast of Korea.

### 2.4.7 ICE EFFECTS

It is highly unlikely that the formation of ice on the coast of the site would obstruct the flow due to the salinity of the seawater.

## HYDROLOGIC ENGINEERING

### 2.4.8 COOLING WATER CANALS AND RESERVOIRS

Since the cooling water is provided by the East Sea, this subsection does not apply.

### 2.4.9 CHANNEL DIVERSIONS

This subsection does not apply.

### 2.4.10 FLOODING PROTECTION REQUIREMENTS

The maximum probable high water level associated with the probable maximum typhoon, including highest high water and tsunami effect, is 5.02 meters above MSL. The elevation of the site ground is 9.5 meters above MSL<sup>(9)</sup> and, therefore, flooding protection is not required.

### 2.4.11 LOW WATER CONSIDERATIONS

#### 2.4.11.1 Low Flow in Rivers and Streams

This paragraph is not applicable.

#### 2.4.11.2 Low Water Resulting from Surges, Seiches, or Tsunami

The lowest recorded water level in the site area is 0.497 meters below MSL.

#### 2.4.11.3 Historical Low Water

This section is not applicable because there are no streams or rivers on the site.

#### 2.4.11.4 Future Control

Provisions for future control are not needed as cooling water for the plant comes from the East Sea.

#### 2.4.11.5 Plant Requirements

The makeup water for the circulating water system will be obtained from the main cooling intake.

The circulating water pumps are capable of operating at the level of lowest low water and the normal required circulating water flow is 56 m<sup>3</sup>/sec for each unit.

## HYDROLOGIC ENGINEERING

### 2.4.11.6 Heat Sink Dependability Requirements

The East Sea provides the ultimate heat sink. The design of the cooling water system (subsection 9.2.1) is such that it will perform all safety functions throughout all postulated surge and tides and with a minimum steady water level of -0.497 meter. Dependability of the ultimate heat sink with respect to postulated failures in associated components or structures is described in subsection 9.2.5.

### 2.4.12 DISPERSION, DILUTION, AND TRAVEL TIMES OF ACCIDENTAL RELEASES OF LIQUID EFFLUENTS IN SURFACE WATERS

The surface water environment has no ability to disperse, dilute, or concentrate accidental liquid releases of radioactive effluents as related to existing or potential future water users. Hence, any normal or inadvertent releases to surface water will be directed to the seashore by water mass.

In case of radioactive effluent flow to the adjacent seashore, its dilution factors, dispersion coefficients, flow velocity, and travel times are described in section 11.2.

### 2.4.13 GROUNDWATER

#### 2.4.13.1 Description and Onsite Use

The hydrologic boundaries of the site are the surrounding hill and the adjacent sea. All boundaries are within the exclusion area and precipitation runs off toward the sea. The slope of the hills surrounding the site precludes migration of site groundwater into the outer region.

#### 2.4.13.2 Sources

The principal sources of potable water supplies in the vicinity of the site are shallow wells which exist throughout the rural region. Presently, use of wells is diminishing and use of surface water for domestic purposes has decreased.

In the villages of Kilchon and Wolnae, the nearest villages to the site, there are many shallow wells for domestic water supply, but now the water supply to the villages is made by pipelines from the Hyoam pumping station.

#### 2.4.13.3 Accident Effects

The closest offsite shallow wells are located in the village of Hyoam about 1.6 kilometers northeast of the site. These



## HYDROLOGIC ENGINEERING

wells supply domestic water to private residences. As indicated in subsection 2.4.12 and paragraph 2.4.13.1, the site is hydrologically separated from the outer region and the wells are not affected by waterflow from the site.

There is no possibility of well water contamination due to site groundwater migration.

### 2.4.13.4 Monitoring or Safeguard Requirements

The monitoring of various wells is incorporated into the environmental sampling for the plant.

### 2.4.13.5 Design Bases for Subsurface Hydrostatic Loading

Dewatering during construction is carried out such that any portion under construction is completely dewatered. Water is not permitted to rise until the structure is completely stable with respect to hydrostatic forces. Four-inch diameter perforated PVC pipes wrapped up in drain materials are installed for the permanent dewatering system; this system is connected with the storm drainage system.

All safety-related structures are designed to withstand the appropriate design loads at maximum groundwater conditions.

### 2.4.14 TECHNICAL SPECIFICATION AND EMERGENCY OPERATION REQUIREMENTS

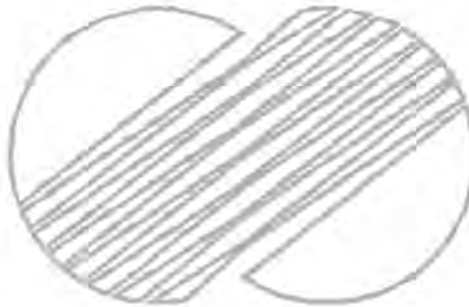
There is no water associated with the impact of adverse hydrologically-related events upon safety-related facilities and, consequently, there are no related technical specification nor emergency operation requirements.

### 2.4.15 REFERENCES

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4. Central Meteorological Office, 1961 - 1981, Annual Report

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5. Roh, J., Cha, J., and Park, Ho., April 1974, "The Effects of Sea Wave by Meteorological Conditions and Tsunami for the Construction of the Kori Nuclear Power Plant," KAERI
6. U.S. Army Coastal Engineering Research Center, 1977, "Shore Protection Manual, Vol. 1"
7. Yeong Bak, C., January 1980, "Port Engineering," Moon Woon Dang
8. Shuto, N., March 1981, "Hydraulics of Oceanographical Waves," Japan Society of Civil Engineers, in Japanese
9. "Kori Site Plot Plan," Drawing No. A-5.6-C21-3-1.1, Rev. A
10. Hydrographic Office, June 1975, "Technical Reports," (1973-1974), R.O.K.
11. Committee on Hydraulics, November 1971, "Hydraulic Formulae," Japan Society of Civil Engineers, in Japanese





HYDROLOGIC ENGINEERING

Table 2.4-1  
OBSERVED MAXIMUM AND MEAN SPEED

Station	Speed (cm/sec)		Standard Deviation	Period of Observations
	Maximum	Mean		
01	44.62	18.31	6.51	Sept. 4 - Oct. 3, 1978
03	41.82	16.65	8.18	Sept. 11 - Sept. 18, 1978
06	44.62	16.94	6.12	Oct. 3 - Oct. 31, 1978
07	31.74	12.11	4.45	Oct. 31 - Dec. 22, 1978
09	62.26	21.53	9.21	Nov. 26 - Dec. 22, 1978
10	35.38	13.90	6.51	Dec. 15 - Dec. 19, 1978
11	39.86	15.85	7.57	Dec. 15 - Dec. 19, 1978
12	38.74	17.25	8.17	Dec. 16 - Dec. 19, 1978
13	31.74	14.58	6.03	Dec. 19 - Dec. 22, 1978
14	27.54	13.09	5.37	Dec. 19 - Dec. 22, 1978
15	25.30	12.24	4.34	Dec. 19 - Dec. 22, 1978
16	78.50	22.10	8.12	Dec. 22, 1978 - Jan. 23, 1979
18	31.74	17.12	4.35	Dec. 22, 1978 - Jan. 23, 1979
19	26.14	12.17	3.56	Jan. 21 - Feb. 19, 1979
20	41.82	13.25	3.87	Jan. 21 - Feb. 19, 1979
23	26.98	13.06	3.52	Feb. 19 - Mar. 25, 1979
24	22.50	13.22	2.99	Feb. 19 - Mar. 25, 1979
25	49.66	20.20	6.93	Feb. 19 - Mar. 25, 1979
27	37.34	14.32	3.63	Mar. 26 - Apr. 25, 1979
28	78.14	22.04	7.24	Mar. 26 - Apr. 25, 1979
29	75.42	13.34	10.57	Apr. 25 - June 1, 1979
	*28.38	9.25	4.46	Apr. 25 - June 1, 1979
30	27.82	13.05	8.40	Apr. 25 - June 1, 1979
31	31.18	12.61	11.40	June 1 - June 13, 1979
33	67.02	19.98	6.67	June 13 - July 15, 1979
37	80.46	17.70	11.41	July 15 - Aug. 28, 1979

\* denotes the measuring depth of 15 meters below sea surface.

HYDROLOGIC ENGINEERING

Table 2.4-2

DIRECTIONS AND SPEEDS OF MEAN EBB AND FLOOD CURRENTS

Station	Ebb		Flood	
	Direction ( $^{\circ}$ )	Speed (cm/sec)	Direction ( $^{\circ}$ )	Speed (cm/sec)
01	115	21.84	265	27.98
03	45	*	245	*
06	115	18.94	265	20.50
07	115	13.34	265	13.91
09	65	25.30	255	25.10
10	65	*	245	*
11	55	*	235	*
12	65	*	235	*
13	45	*	235	*
14	45	*	225	*
15	45	*	225	*
16	75	25.67	255	23.87
18	115	18.41	255	19.51
19	115	12.30	265	10.80
20	115	13.19	355	13.06
23	115	14.15	255	11.84
24	125	13.05	355	12.90
25	75	23.92	255	21.67
27	85	14.76	265	14.49
28	75	27.70	255	22.61
29	75	20.06	255	15.42
	** 55	10.93	265	9.86
30	85	13.46	265	13.68
31	95	12.61	265	14.02
33	75	21.90	265	21.33
37	65	18.11	255	21.91

\* represents that the exact speed was not calculated.

\*\* denotes the measuring depth of 15 meters below sea surface.

Table 2.4-3  
MAXIMUM EBB AND FLOOD CURRENTS AT SPRING TIDES

Station	Maximum Ebb Current			Maximum Flood Current				
	Speed cm/s	Direction Degrees	Time	Date	Speed cm/sec	Direction Degrees	Time	Date
01	33.70	119	22:42	Sept. 17, 1978	33.42	276	15.:12	Sept. 17, 1978
03	40.42	60	22:44	Sept. 17, 1978	35.22	234	16:34	Sept. 17, 1978
06	28.38	117	11:10	Oct. 3, 1978	43.22	259	16:30	Oct. 3, 1978
07	31.74	102	09:52	Nov. 1, 1978	26.70	265	02:12	Nov. 1, 1978
09	49.10	73	13:20	Dec. 2, 1978	48.54	247	04:00	Dec. 2, 1978
10	39.86	35	16:15	Dec. 17, 1978	29.78	230	06:10	Dec. 16, 1978
12	38.74	49	16:40	Dec. 17, 1978	30.34	234	06:50	Dec. 16, 1978
16	49.94	73	11:05	Dec. 31, 1978	46.30	256	01:35	Dec. 31, 1978
19	25.58	137	23:20	Jan. 28, 1979	26.14	309	02:30	Jan. 29, 1979
20	23.62	147	10:10	Jan. 28, 1979	39.58	302	01:40	Jan. 29, 1979
21	37.62	80	12:10	Jan. 30, 1979	48.94	247	02:50	Jan. 29, 1979
23	20.82	104	12:30	Mar. 1, 1979	26.98	264	15:50	Mar. 1, 1979
24	21.10	153	04:40	Mar. 11, 1979	17.46	261	12:20	Mar. 11, 1979
25	49.66	70	13:40	Mar. 1, 1979	45.18	250	16:40	Feb. 26, 1979
27	23.90	76	07:30	Mar. 30, 1979	28.56	219	04:20	Mar. 31, 1979
28	48.54	79	00:30	Apr. 15, 1979	45.74	262	16:10	Mar. 31, 1979
30	26.14	68	18:20	Apr. 27, 1979	23.62	268	15:00	Apr. 12, 1979
31	21.94	69	17:10	June 9, 1979	31.18	282	03:30	Apr. 27, 1979
33	67.02	60	00:45	July 11, 1979	37.34	250	06:05	June 8, 1979
37	74.86	55	22:40	July 24, 1979	80.46	231	14:20	July 11, 1979
								July 24, 1979

HYDROLOGIC ENGINEERING

Table 2.4-4

MEAN NET CURRENTS NEAR KORI

Station	Speed cm/s	Direction degree	Station	Speed cm/s	Direction degree
01	4.4	130	19	3.7	120
06	4.7	140	20	4.8	95
07	3.1	145	21	8.8	80
09	5.4	60	23	4.5	145
10	4.8	40	24	5.4	110
11	8.9	43	25	5.0	75
12	15.0	60	27	2.2	120
13	7.1	18	28	8.6	77
14	14.0	33	*29	3.3	52
15	5.6	12	30	5.4	63
16	9.8	65	33	6.1	55
18	4.2	140			

\* represents that measuring depth is 15 meters below sea surface.

HYDROLOGIC ENGINEERING

Table 2.4-5

THE HIGHEST WAVE HEIGHTS AT  
 MIPO WAVE STATION, NEAR THE SITE

(Unit: m)

Month	Year	1975	1976	1977	1978	1979	1980	1981
Jan.		4.2	2.1	3.3	4.3	4.0	3.0	2.0
Feb.		3.1	4.2	2.2	4.1	4.5	3.7	3.7
Mar.		5.8	3.4	4.2	5.9	3.4	3.0	2.5
Apr.		3.5	4.8	3.5	2.3	4.1	4.5	2.5
May		3.1	2.7	3.8	3.3	3.8	1.9	3.0
Jun.		1.8	4.0	3.4	3.0	2.5	3.5	1.6
Jul.		2.5	3.4	1.3	2.3	2.7	3.5	2.0
Aug.		6.0 <sup>a</sup>	3.1	5.4 <sup>c</sup>	2.5	6.5 <sup>e</sup>	3.2	2.0
Sep.		3.4	6.2 <sup>b</sup>	4.2	5.0	4.2	4.8	4.0 <sup>g</sup>
Oct.		4.1	2.7	3.5	4.0	3.7	3.0	2.8
Nov.		4.2	4.0	5.0	6.8 <sup>d</sup>	2.6	3.7	2.1
Dec.		4.7	4.3	3.4	3.2	3.4	5.5 <sup>f</sup>	3.3

Annual Maximum

- a: Aug. 17, '75 by Typhoon Phyllis
- b: Sep. 13, '76 by Typhoon Fran
- c: Aug. 24, '77 by Typhoon Amy
- d: Nov. 27, '78 by Low Pressure
- e: Aug. 17, '79 by Typhoon Irving
- f: Dec. 25, '80 by Low Pressure
- g: Sep. 3, '81 by Typhoon Agnes

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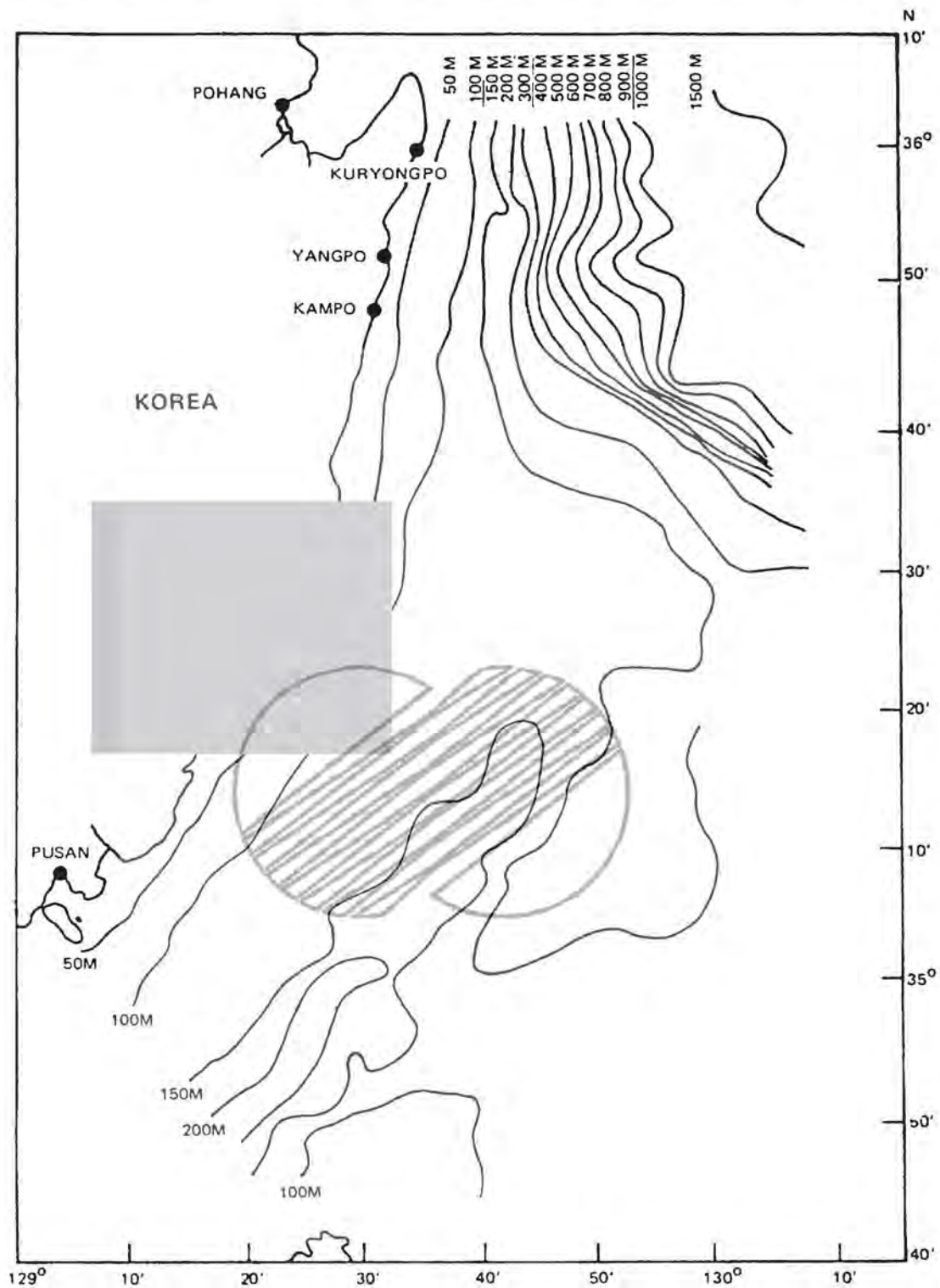
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DRAINAGE BASIN OF THE  
SITE AT KORI

Figure 2.4-1



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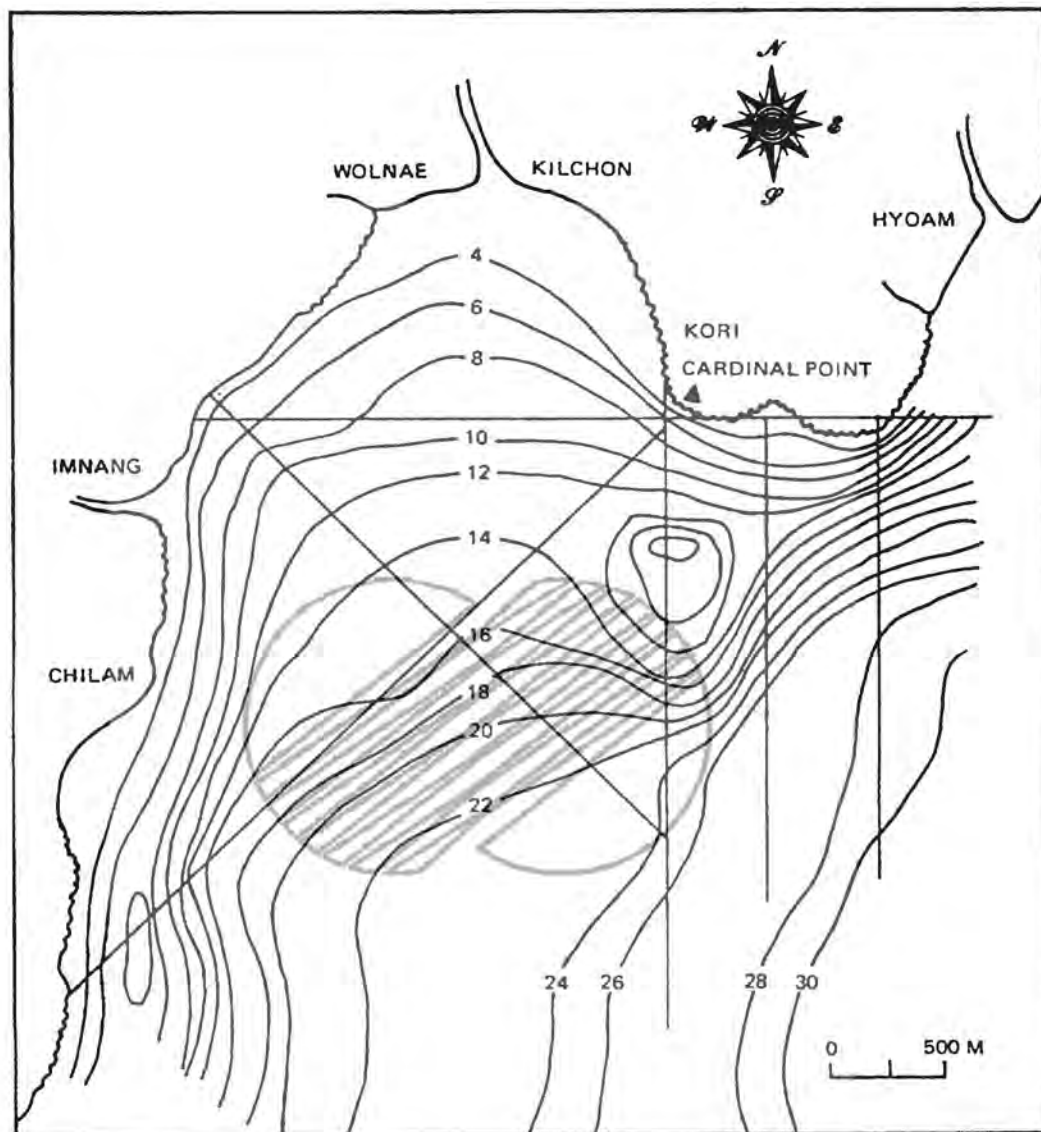


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BOTTOM TOPOGRAPHY OF THE  
SOUTHWESTERN PART OF THE EAST SEA

Figure 2.4-2

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NOTE: STRAIGHT LINES SHOW SCUNDING LINE.

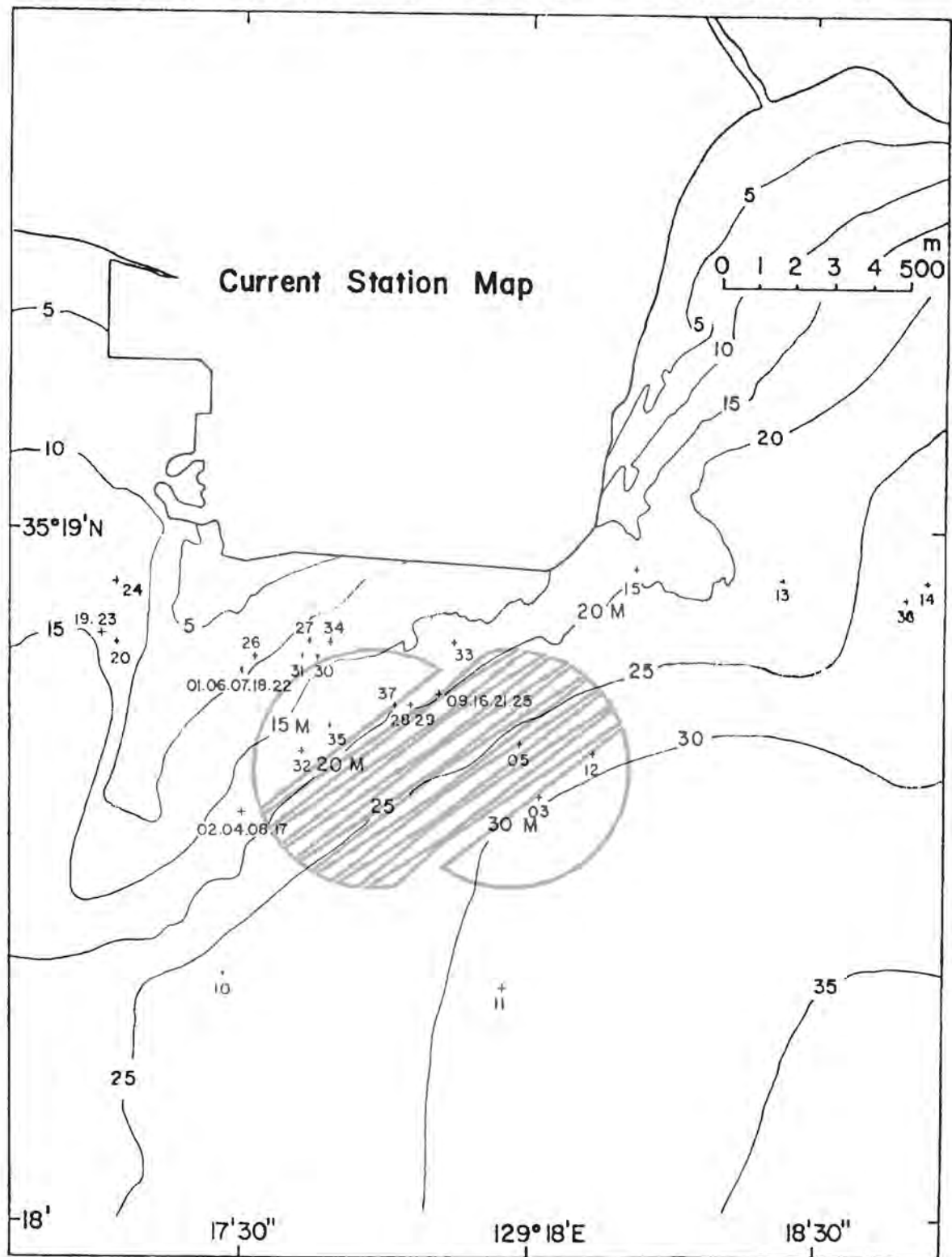


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BATHYMETRIC CHART IN THE VICINITY  
WITH CONTOURS IN METERS

Figure 2.4-3

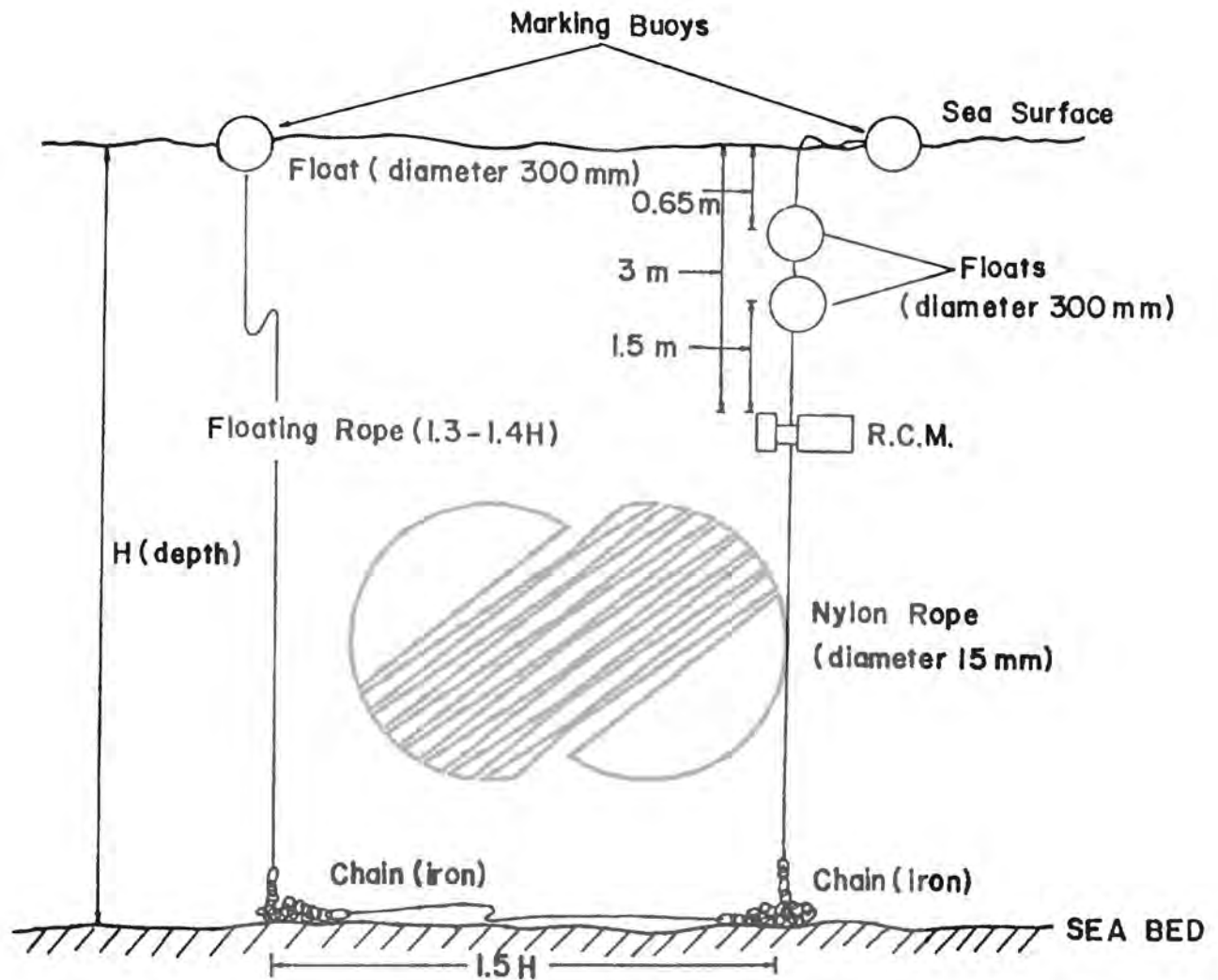
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LOCATIONS OF CURRENT MEASUREMENTS  
NEAR KORI

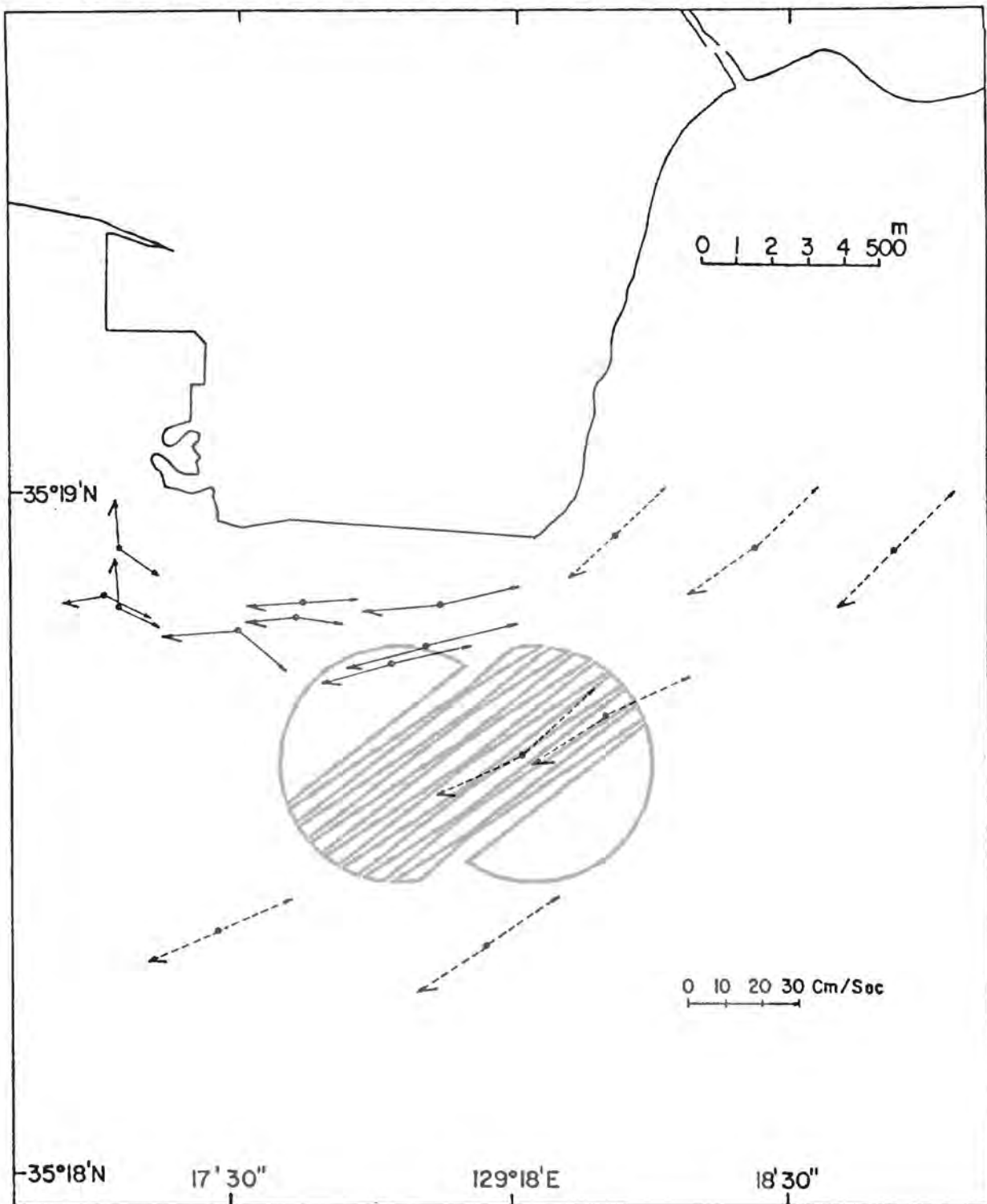
Figure 2.4-4



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U-TYPE TECHNIQUES OF MOORING  
Figure 2.4-5

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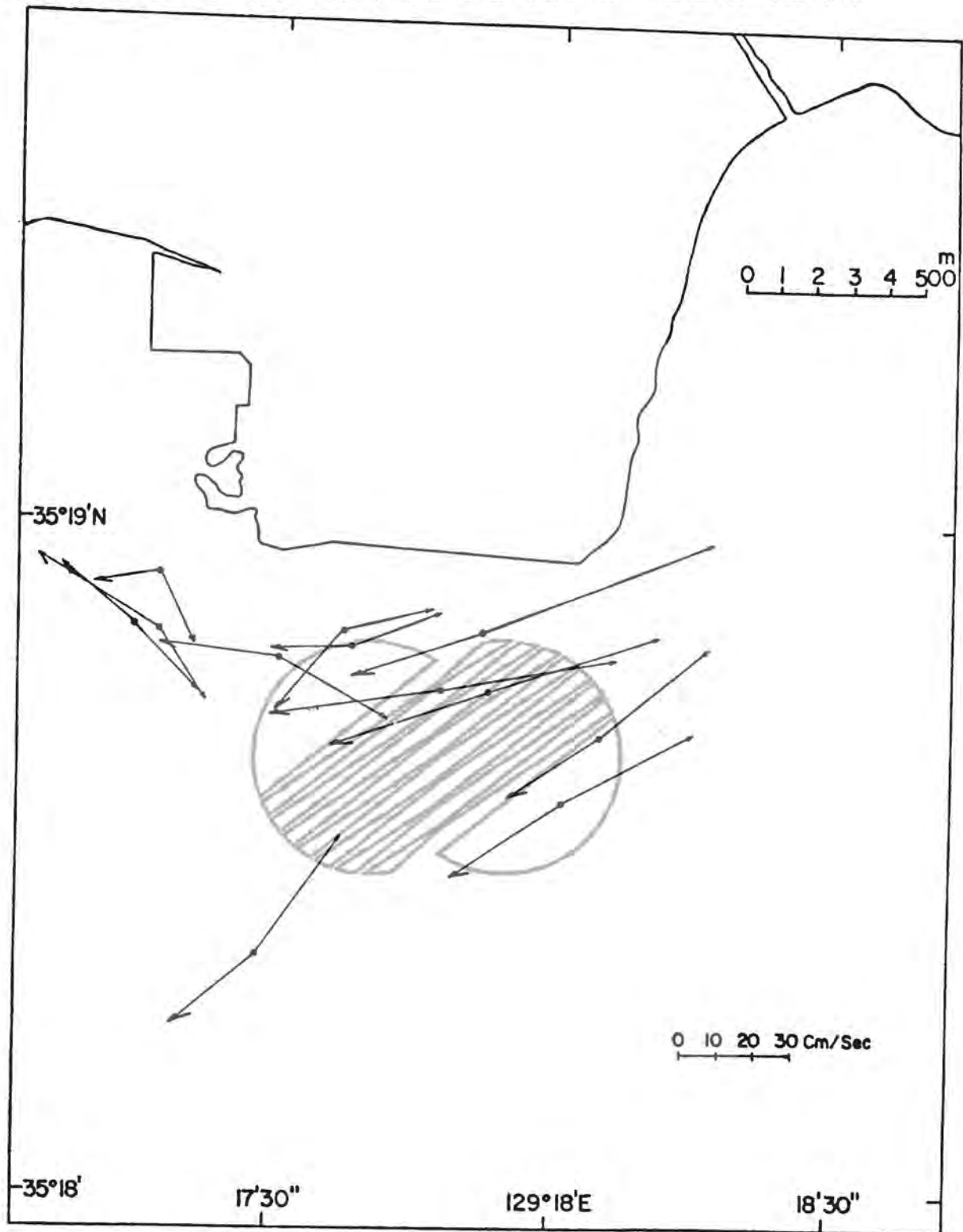


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MEAN EBB AND FLOOD CURRENT  
NEAR KORI SITE

Figure 2.4-6

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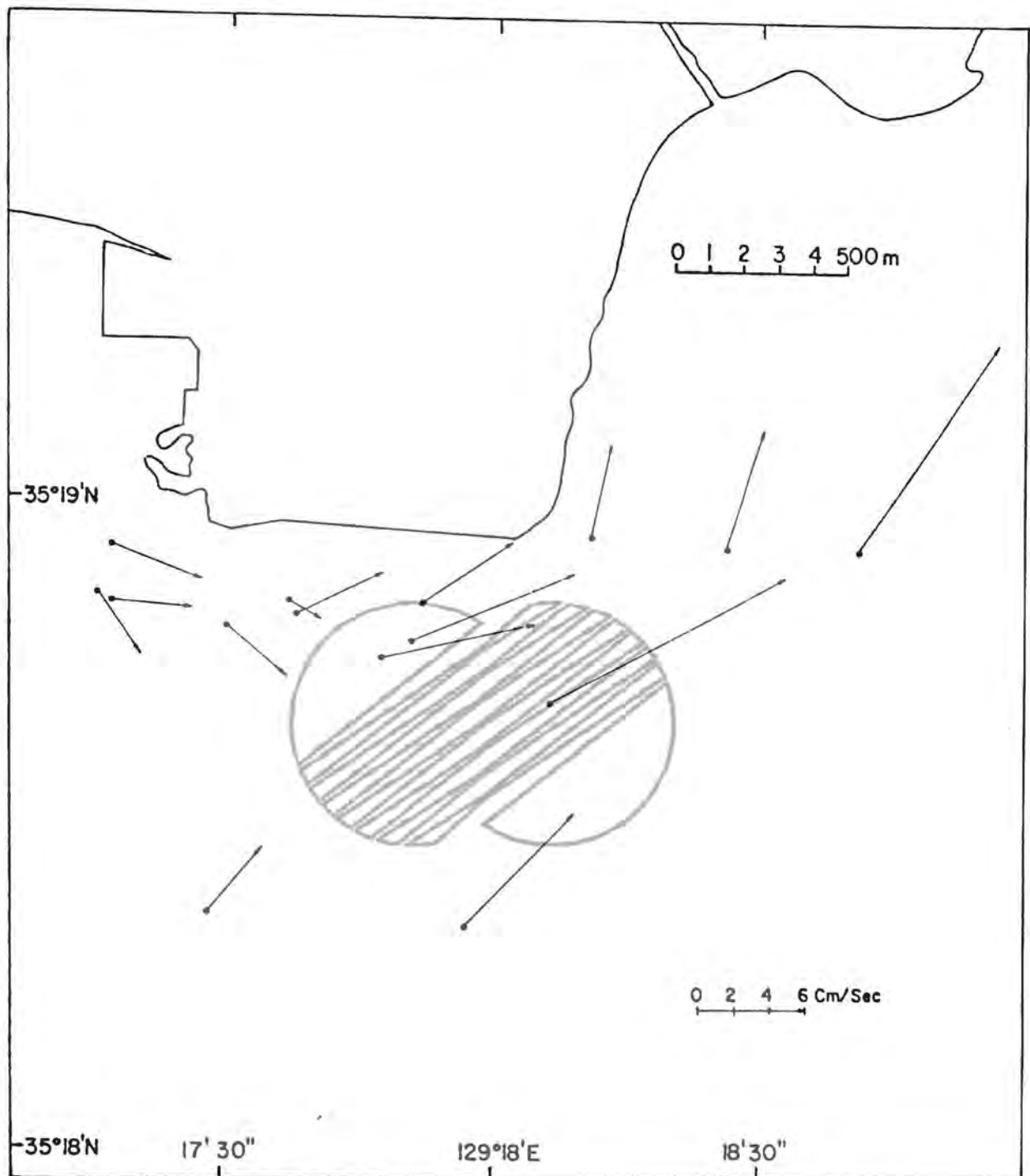
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MAXIMUM EBB AND FLOOD CURRENTS  
AT SPRING TIDES

Figure 2.4-7



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<b>MEAN NET CURRENTS NEAR KORI</b> <b>Figure 2.4-8</b>	

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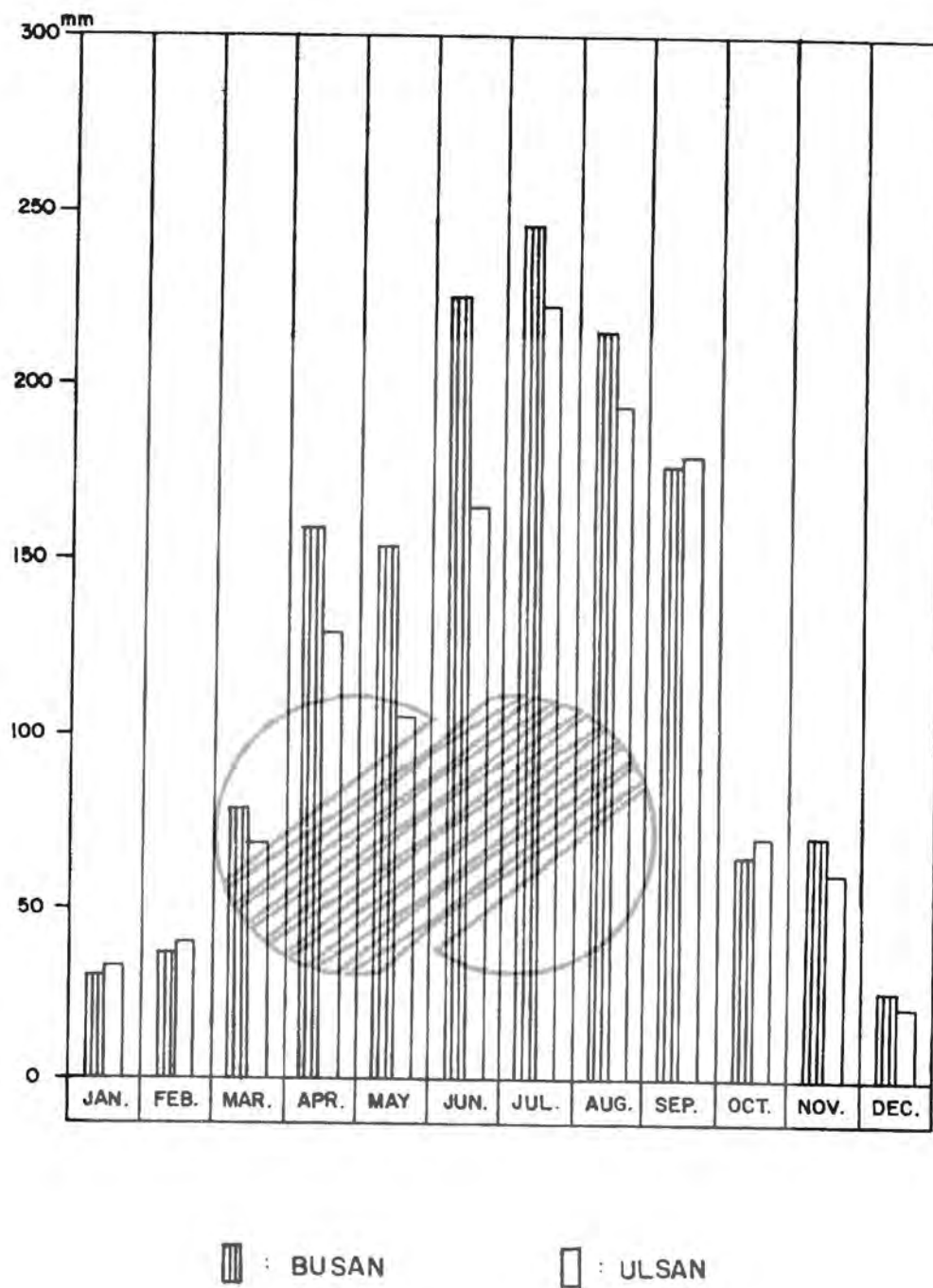


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SITE STORM DRAINAGE SYSTEM

Figure 2.4-9

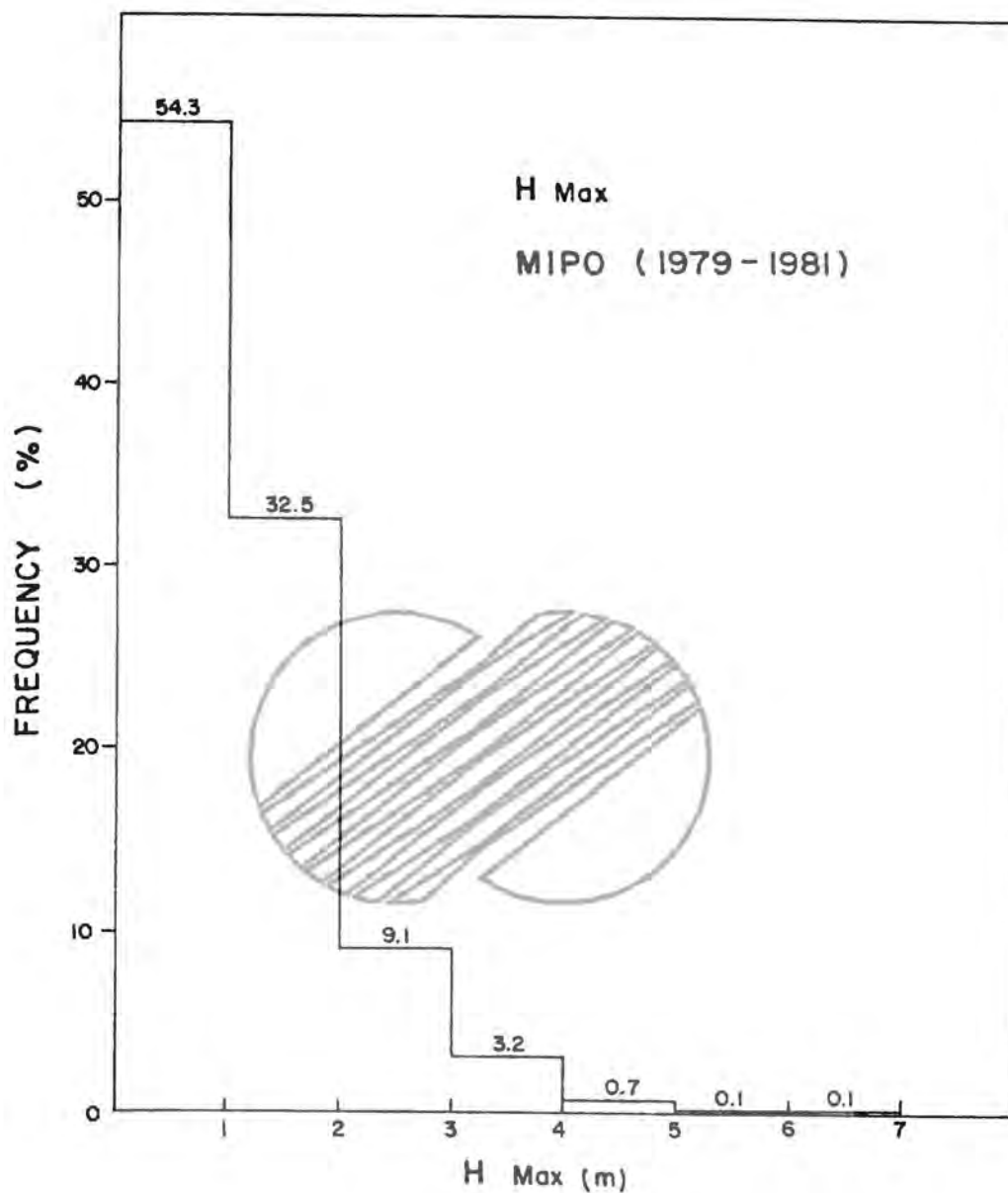
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ANNUAL PRECIPITATION (1961-1981)

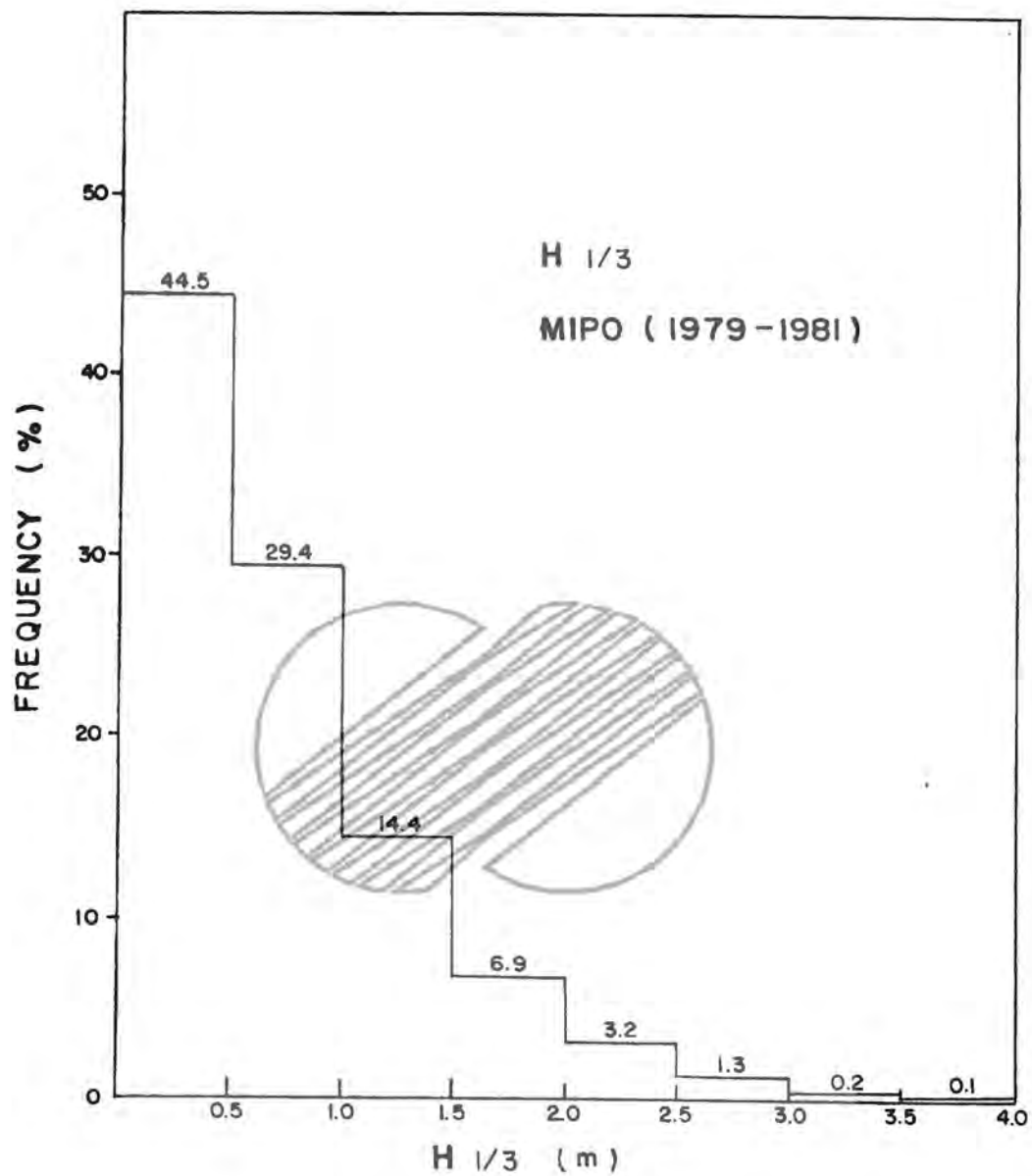
Figure 2.4-10



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HISTOGRAM OF MAXIMUM WAVE  
HEIGHT ( $H_{Max}$ ) AT MIPO WAVE STATION

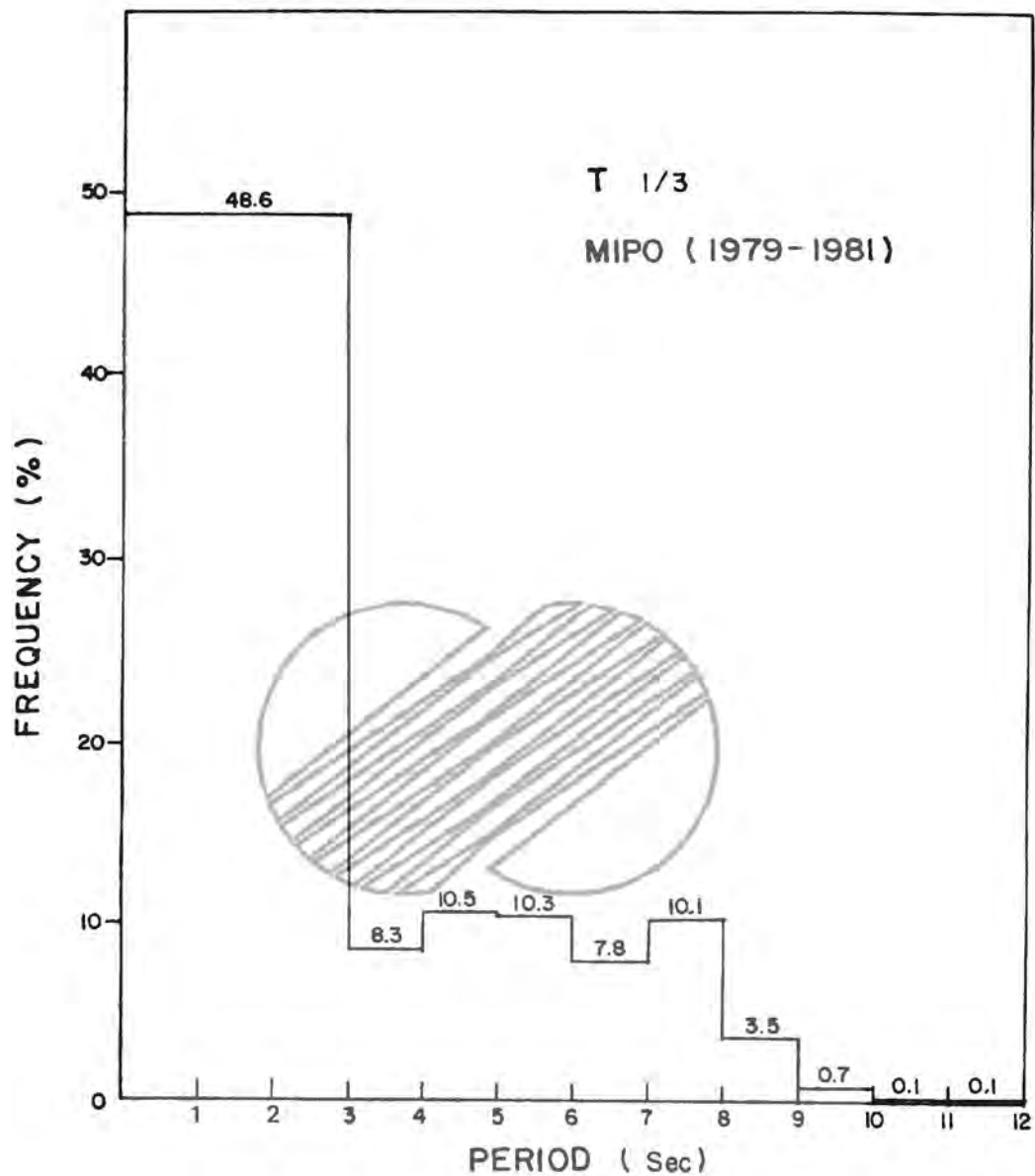
Figure 2.4-11



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HISTOGRAM OF SIGNIFICANT WAVE  
HEIGHT ( $H_{1/3}$ ) AT MIPO WAVE STATION

Figure 2.4-12

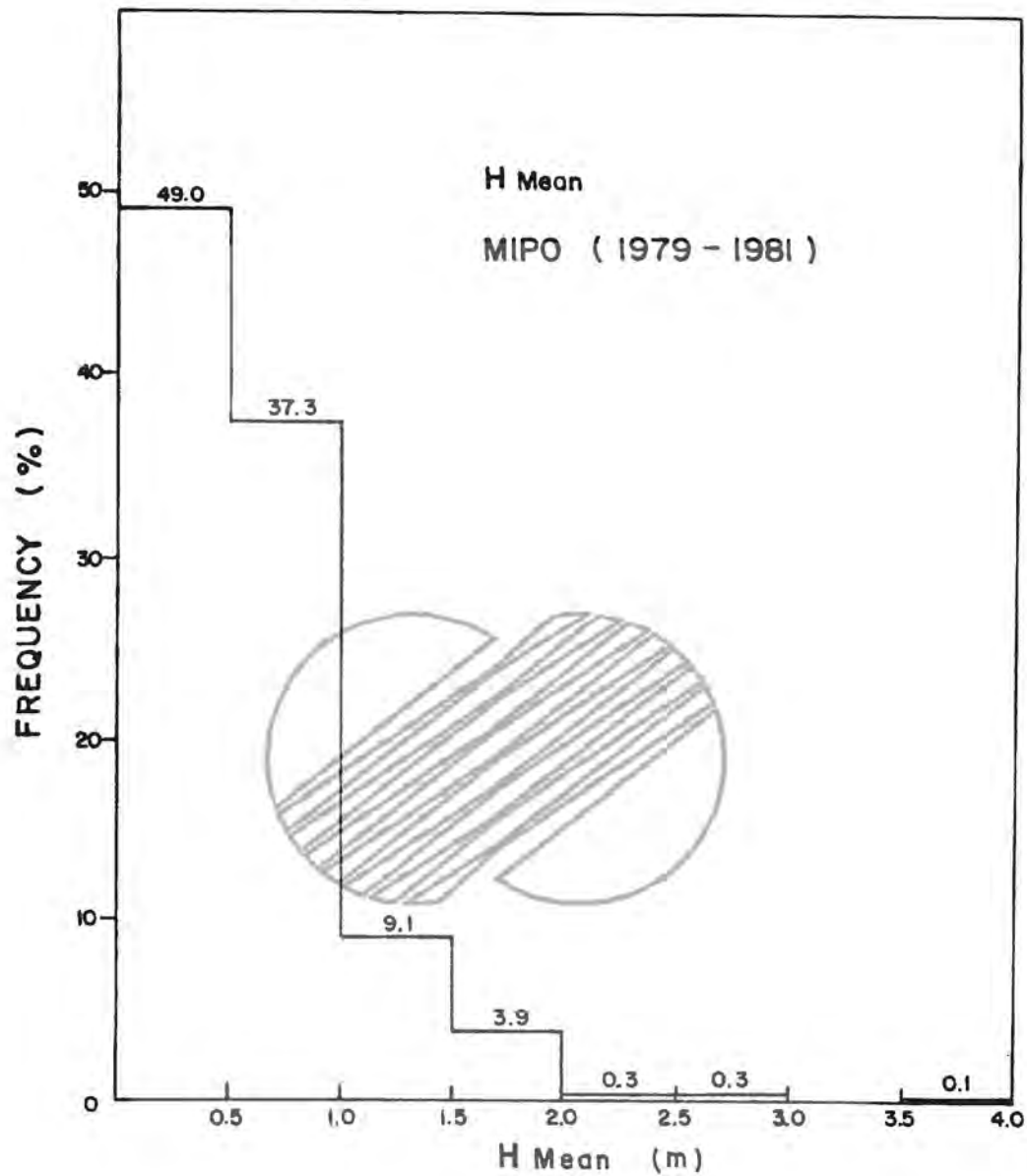


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PERIOD HISTOGRAM OF SIGNIFICANT  
WAVE ( $T_{1/3}$ ) AT MIPO WAVE STATION

Figure 2.4-13

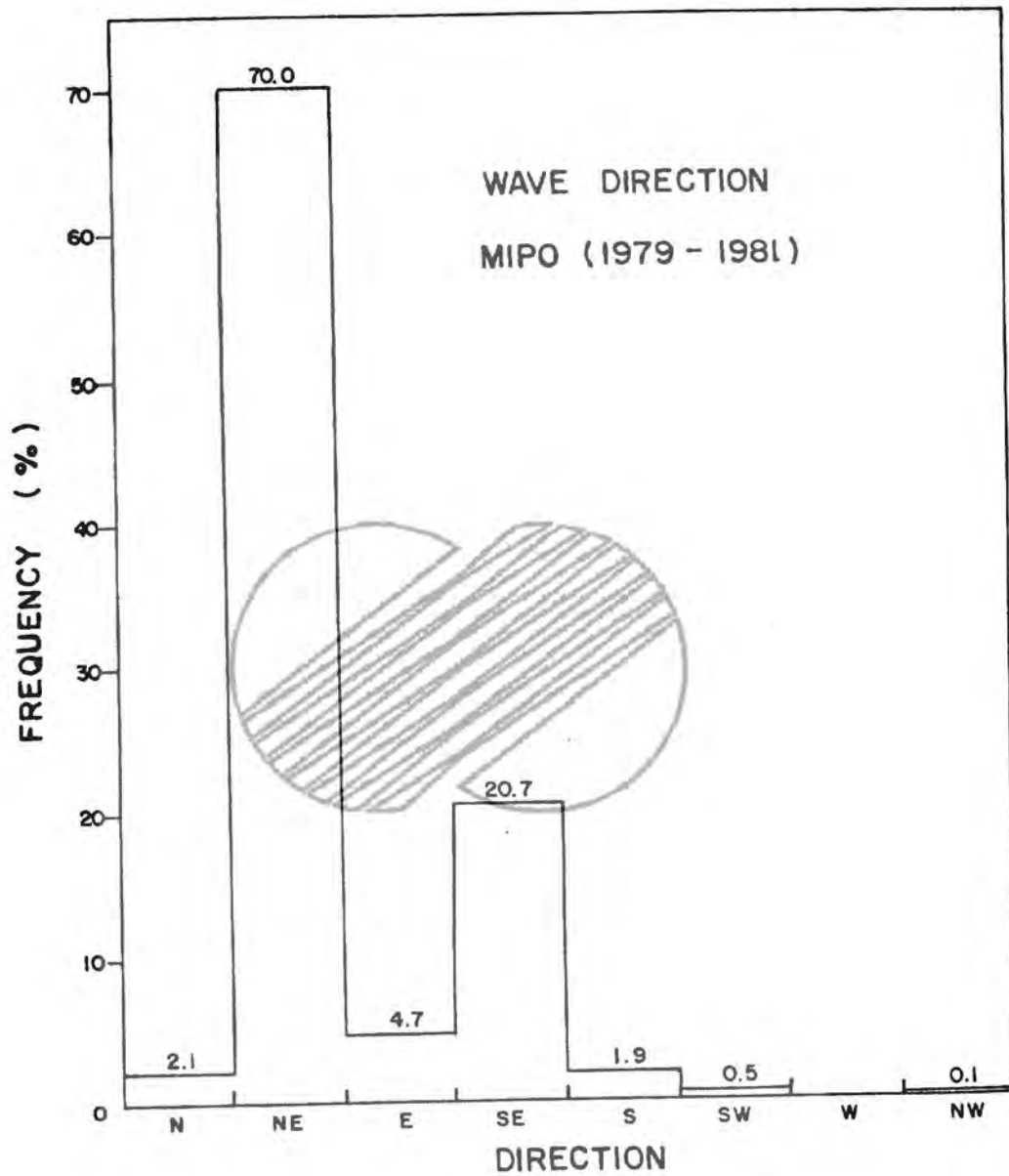




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HISTOGRAM OF MEAN WAVE HEIGHT  
( $H_{Mean}$ ) AT MIPO WAVE STATION

Figure 2.4-14



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HISTOGRAM OF WAVE DIRECTION  
AT MIPO WAVE STATION

Figure 2.4-15