Docket No. 50-346
License No. NPF-3
Serial No. 973
July 21, 1983
Attachment 1

VEGETATION SURVEY FOR THE

EFFECTS OF COOLING TOWER DRIFT

RESPONSE TO THE UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGARDING APPENDIX B TECHNICAL
SPECIFICATION 3.1.2b AND
SECTION 4.2 OF THE PROPOSED
ENVIRONMENTAL PROTECTION PLAN

FOR THE DAVIS-BESSE NUCLEAR POWER STATION

THE TOLEDO EDISON COMPANY

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ENVIRONMENTAL MONITORING GROUP
CHEMISTRY AND HEALTH PHYSICS

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SUMMARY

From 1973 to 1980, Bowling Green State University under the direction of William B. Jackson, Ph.D., Director of the Environmental Studies Center, conducted an extensive study of the effects of cooling tower operation on the vegetation surrounding the Davis-Besse Nuclear Power Station. The purpose of these studies was the same as the aerial remote sensing vegetation survey outlined in the Proposed Environmental Protection Plan: to detect and assess the significance of damage, or lack thereof, as related to cooling tower drift dispersions. These studies encompassed more than four pre-operational years and three operational years. Three study locations were chosen - one control location and two indicator locations. The control location was located 9.25 km west of the site in one of the least prevalent wind directions. The two indicator locations were located 0.30 km northwest and 1.8 km east of the cooling tower in the most prevalent wind directions. These two indicator locations were thus good choices for observing any effects of cooling tower operation on surrounding vegetation. Upon completion of these studies in 1980, Bowling Green State University concluded that no direct effects upon vegetation or community succession had been detected as a result of cooling tower operation.

Therefore, we conclude that the intent of Section 4.2 (Vegetation Survey-Aerial Remote Sensing) of the Proposed Environmental Protection Plan has been fulfilled and that further vegetation monitoring in the vicinity of the Davis-Besse Nuclear Station will not result in the generation of new information.

NRC RESPONSE ADDRESSING COMMENTS REGARDING ENVIRONMENTAL TECHNICAL SPECIFICATION 3.1.2.b VEGETATION SURVEY

INTRODUCTION

Because a cooling tower discharges large amounts of warm air and water vapor from a relatively small area, there is the possibility that inadvertent weather modification within the vicinity may occur. Theoretically, possible environmental impacts include increased atmospheric and soil moisture and the fallout of salts from plume drift (USNRC, 1975b).

From August 1973 to December 1980, Bowling Green State University conducted an extensive analysis of the plant communities within the vicinity of the Davis-Besse Nuclear Power Station cooling tower. The purpose of these studies was to determine the effect, if any, of cooling tower operation upon various sensitive plant species. Although the Bowling Green studies were not performed to comply with specific requirements of the Appendix B Technical Specifications, these studies investigated the same environmental affects which were required by the aerial infrared study in Section 3.1.2.b. In particular, this specification required the use of aerial infrared photography to assess the impact of the power plant on "vegetation cover types on and adjacent to the site". Furthermore, the Proposed Environmental Protection Plan (Section 4.2 in letter from NRC dated December 21, 1982) specifies that aerial infrared studies are to be performed to "detect and assess the significance of damage, or lack thereof, as related to cooling tower drift dispersions". The Bowling Green studies, although not aerial infrared, specifically address the purpose of these assessments as extensively as the aerial infrared studies. The Bowling Green studies were also performed at the same time as the aerial infrared.

BOWLING GREEN STATE UNIVERSITY VEGETATION ANALYSIS

To assess the possible impact of cooling tower operation at the Davis-Besse Nuclear Power Station, a vegetation study was started August, 1973 by Bowling Green State University. This study was performed for four years prior to initial operation of the station and cooling tower and during three years of actual operation.

During 1973, all vascular plant species located on the Davis-Besse site were identified and cataloged (Jackson, 1974). From this survey, three specific vegetation monitoring sites were established. At these sites, vegetation, soil, and atmospheric conditions were monitored to locate any changes or impact from operation of the Davis-Besse cooling tower. The three sites established by Bowling Green State University were the Cooling Tower Woods, Lost Peninsula Woods and Beach Areas, and a reference area located at the Ottawa National Wildlife Refuge (See Figure 1). These sites were chosen by Bowling Green State University due to their location and type of plant communities present. Woody species within the Cooling Tower Woods were identified as being very sensitive to soil moisture conditions for germination of their seeds and propagation of the species (Hamilton et al., 1975). Due to the proximity of the cooling tower, the Cooling Tower Woods was chosen as a good indicator of any changes in soil moisture conditions due to operation of the cooling tower. The Lost Peninsula areas were selected, due to their location and because these sites were host to different plant species and communities than the Cooling Tower Woods (Hamilton et al., 1975). Within the Lost Peninsula Woods and Beach areas, shrubs, small vascular plants, and herbaceous plant communities were monitored. Finally, a third site was chosen as a control area having similar plant species as the Cooling Tower Woods and Peninsula areas, but outside of the range of impact from cooling tower drift. This control area was located six miles west of the Davis-Besse cooling tower within the Ottawa National Wildlife Refuge (See map of sites, Figure 1).

Bowling Green State University began their analyses by locating all vascular plant species on the Davis-Besse site, then mapping soil types covering the three study sites. Their analyses included four areas: (A) Vegetation Analysis, (B) Soil Environments, (C) Terrestrial Fauna, and (D) Atmospheric Environments. These four areas are outlined in detail below:

A. VEGETATION ANALYSIS

The vegetation analysis included; vascular plant species distribution, density, frequency, and cataloging of plant communities at all three sites. Calculations of relative frequency, density, and dominance were performed. These relative figures were then used to determine importance values which equal:

$$\frac{\text{Relative Frequency} + \text{Relative Density} + \text{Relative Dominance}}{3}$$

Climatic effects upon vegetation communities were noted and used to determine impact of drift from operation of the Davis-Besse Cooling Tower (Hamilton et al., 1974-80).

B. SOIL ENVIRONMENTS

Soil identification and mapping from aerial photographs at the Cooling Tower Woods and Peninsula Beach areas were performed. The control area soil was not monitored. From the two sites, soil chemistry, moisture, cation exchange capacity, percent base saturation, sulfate, magnesium, and calcium levels were measured on a monthly basis. Soil samples were taken from 10, 20, and 50 cm depths (Limbird, 1973-80).

C. TERRESTRIAL FAUNA

Initially vertebrate species identification at the Cooling Tower Woods and Lost Peninsula areas included herptiles, small and large mammals, and birds. All of these species were monitored using live traps until 1978. The bird studies were continued throughout 1980. The vertebrate species were monitored as sensitive indicators of changes in food chains which might have caused a change in local vegetation (Vessey et al., 1973-78).

D. ATMOSPHERIC ENVIRONMENTS

Meteorological monitoring was performed at four sites: the Cooling Tower Woods, the Lost Peninsula Areas, an on-site meteorological system, and a reference site located at Bowling Green State University. Meteorological data were averaged monthly from these parameters: solar radiation, precipitation, pH of precipitation, soil thermagraphs, relative humidity, dewpoint, wind direction, and wind speed measurements (Frey, 1973-80).

LOCATION AND WINDROSE DOCUMENTATION

To determine if any changes, alterations, benefits, or damage were the result of cooling tower drift, the study sites had to be located in areas where high plume drift would likely occur. In selecting the two vegetation monitoring sites and the control area, Bowling Green State University used both location near the cooling tower and sensitive plant species as their criteria. The Cooling Tower Woods were located 0.30 kilometers northwest of the Davis-Besse cooling tower. Specifically, the Cooling Tower Woods were located within the northeast (NE) and north-northeast (NNE) compass sectors. The Lost Peninsula Woods and Beach areas were located 1.8 km from the cooling tower, in the east (E) and east-southeast (ESE) sectors. The control site in the Ottawa National Wildlife Refuge was located 9.25 km from the Davis-Besse cooling tower in the west (W) sector (See Figure 1).

To confirm that these locations were within areas of plume drift, Toledo Edison prepared a windrose study. Using wind data from the on-site Meteorological Monitoring System, windrose charts were graphed. Wind speed and wind direction data which were averaged hourly were combined into yearly wind averages. Two wind sensor levels were used: at 10m and 100m above ground level. At the 10m level, yearly averages were combined into one windrose representing a two-year period from January 1, 1978, to December 31, 1979.

This 10m windrose most closely illustrates the effect of wind direction and wind speed upon the plume drift at the base of the cooling tower (See Figure 2).

Using wind data from January 1, 1982, to December 31, 1982, a windrose at the 100m level was graphed. Wind speed and wind direction at the 100m level most closely represent prevailing winds at the top of the Davis-Besse cooling tower (150m) from which the plume dissipates (See Figure 3).

These windroses, prepared and analyzed by Toledo Edison, demonstrate that the Cooling Tower Woods and Lost Peninsula area were located within areas where the drift is blown by prevailing winds, while the control area is located within an area of low drift influence. From the windrose charts, at the 10m level the predominant wind directions blow from the southwest (SW), south-southwest (SSW), west (W), and northwest (NW) the majority of the time. Similarly, at the 100m level the prevailing wind directions blow from the west-southwest (WSW), south-southwest (SSW), southwest (SW), west (W), and west-northwest (WNW) directions.

From Figure 2, the wind direction at the 10m level blows toward the Cooling Tower Woods sectors 25% of the time. While at the 100m level the winds blow toward the Cooling Tower Woods 22% of the time. At the Lost Peninsula Woods and Beach location, the 10m and 100m level wind directions blew toward those areas 11% of the time. In contrast, the least prevalent wind directions from the north (N), north-northeast (NNE), southeast (SE), and east-southeast (ESE) were only recorded an average of 4% of the time at 10m and 3% of the time at 100m. Finally, the control area located in the west (W) compass sector demonstrates the drift was blown in that direction 8% of the time at the 10m level and 7% of the time at the 100m level. The highest wind speeds were also recorded from the southwest and northwest sectors towards the two vegetation monitoring sites. In the direction of the control area wind speeds were not as high. Therefore, the cooling tower plume at Davis-Besse would most likely drift toward the sectors where the Cooling Tower Woods and Lost Peninsula areas were located, but not towards the control area. These windrose data demonstrate the Cooling Tower Woods and Lost Peninsula Woods and Beach areas were located in the best areas for assessing possible plume drift effects from the Davis-Besse cooling tower. Furthermore, a control area was used for direct vegetation comparison, and again the windrose analysis demonstrates that this control area was located within an area unlikely to be affected by plume drift.

CONCLUSIONS

Bowling Green State University monitored the vegetation, soil, terrestrial, and atmospheric conditions at highly sensitive areas near the Davis-Besse cooling tower during four years prior to its operation. From these studies, a data base was established for comparison after initial operation of the cooling tower. This data base included trends in soil chemistry, moisture, soil mapping of sites and soil horizons, cation exchange complex, percent base saturation, and erosion. Vegetation parameters included relative frequency, dominance, density, and importance. Limiting factors were determined to be light and soil moisture. Finally,

atmospheric conditions on relative humidity, dewpoint, evaporation rates, precipitation, and pH of precipitation were established. Using this data base, the same studies were continued for three years after initial operation of the unit. Within the vegetation, soil, and atmospheric areas Bowling Green found similar results, operation of the cooling tower at the Davis-Besse Nuclear Power Station had no effect upon surrounding vegetation, soil, or atmospheric conditions. In 1979, Hamilton stated the following conclusions:

> Up to the present time, we have not observed any influence from the initial cooling tower operation that has altered or disrupted such vegetation patterns and related plant survival or succession trends (Hamilton, 1979).

Regarding soil analyses, Limbird made the following determinations in 1979:

> There has been a decline in the ppm calcium since 1979.
>
> The chemical analysis of the cooling tower circulation water were compared with soil analysis for Fulton soil of the Cooling Tower Woods for 1979 and average values for the six year reporting period. Once again, as in 1978, the circulating water had no apparent effect on the levels of calcium and magnesium in the Fulton soil of the Cooling Tower Woods.
>
> It does not appear at this time that the sodium, which may fall out from the cooling tower plume, is producing any cumulative effect on the soil (Limbird, 1979).

Bowling Green State University noted from their studies, one change caused by the cooling tower plume. The pH of precipitation within the localized area of the cooling tower plume was caused to increase. This proved to be beneficial since the pH of the precipitation within this area has been as low as 4.0 (Frey, 1979). Within the final conclusion on atmospheric monitoring, Frey states:

> The vapor plume affects the rain in the local area to the extent that pH readings reflect less acidity than normal rainfall (Frey, 1980).

The rain would be closer to a neutral pH due to the plume drift. Finally, using the information collected and analyzed over the seven year time period, Bowling Green State University concluded.

> The results of "improved" moisture conditions have been survival and growth of plants in the Cooling Tower Woods and Peninsula areas (Hamilton, 1980).

From these studies, the conclusion can be made that there have been no detectable impacts on terrestrial biota as a result of drift deposition from the operation of the cooling tower at the Davis-Besse Nuclear Power Station.

The vegetation studies performed by Bowling Green State University between 1973 and 1980 clearly demonstrate that impact from the cooling tower drift at the Davis-Besse Nuclear Power Station has been addressed. These studies were more comprehensive, than, and met the intent of Section 3.1.2.b of Appendix B Technical Specifications and Section 4.2 of the Proposed Environmental Protection Plan. The Bowling Green State University studies supplement previous aerial infrared photography and analysis performed at the Davis-Besse site. Furthermore, both the aerial infrared analysis and the Bowling Green State University studies concluded that operation of the Davis-Besse cooling tower has not had any effect upon local vegetation. Therefore, further vegetation monitoring is not necessary at the Davis-Besse Nuclear Power Station.

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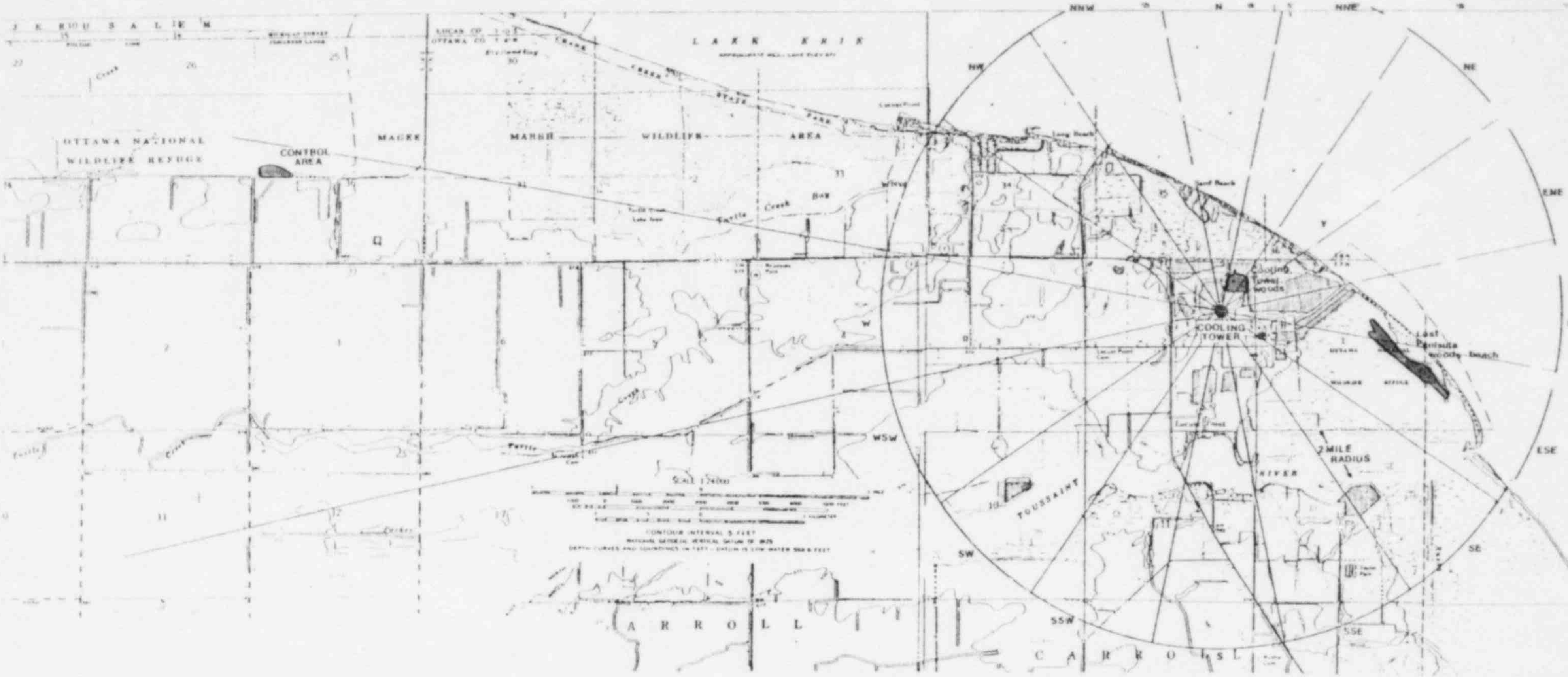
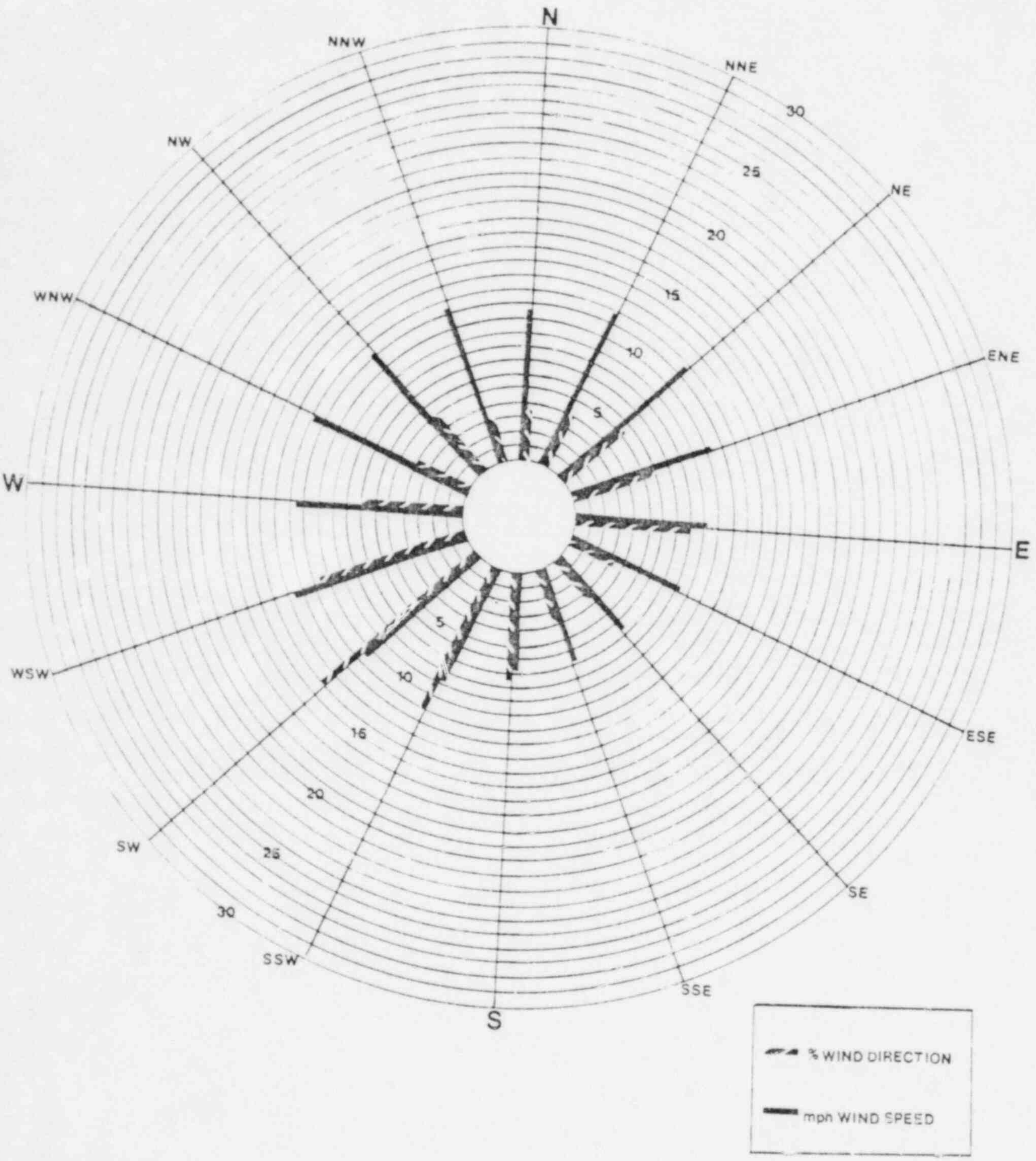
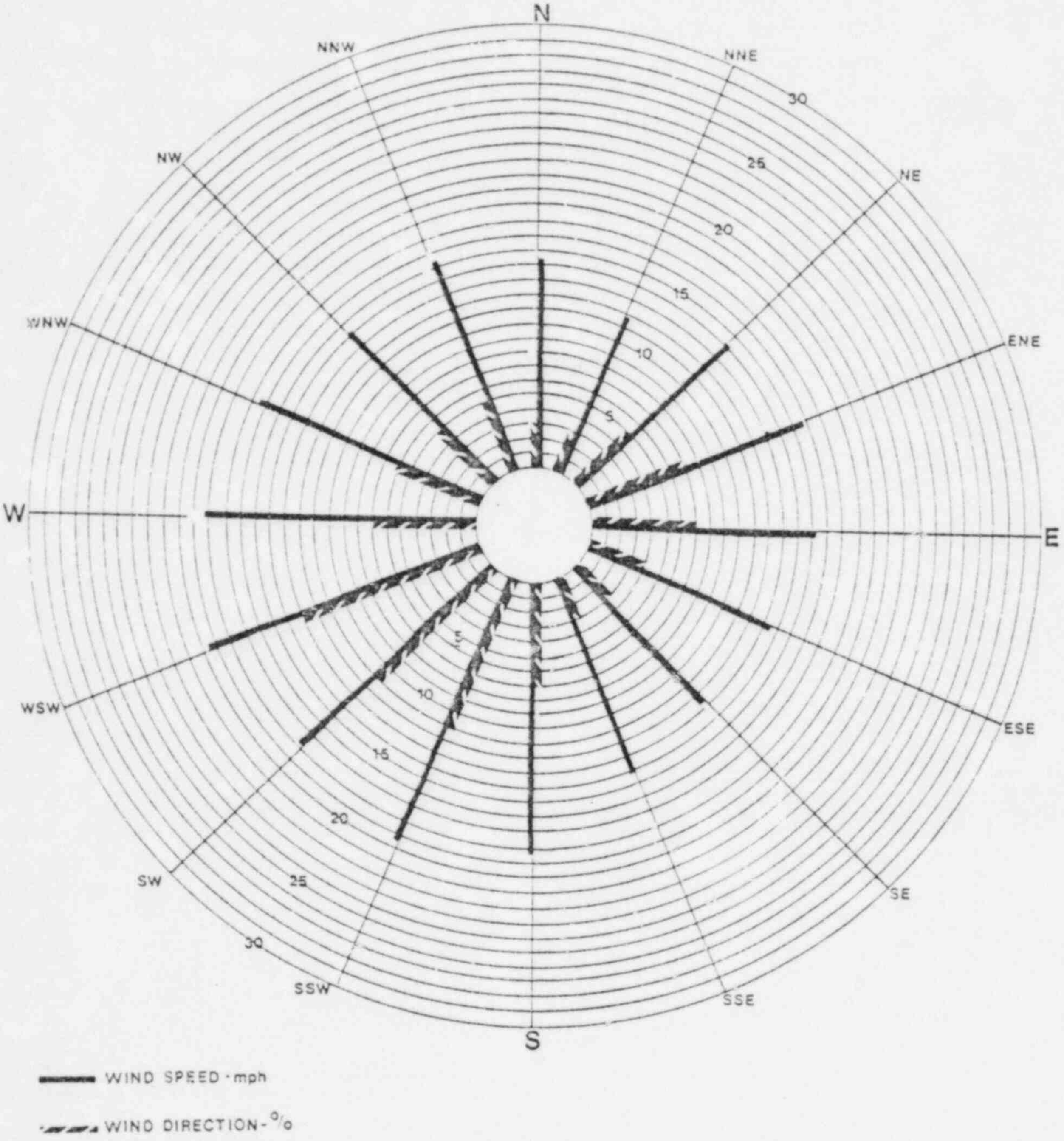


FIGURE 1 - Map of Indicator and Control Locations



DAVIS-BESSE SITE
MONTHLY WIND DISTRIBUTION
AT THE 10 m LEVEL
JANUARY 1, 1978 to DECEMBER 31, 1979

Figure 2



DAVIS-BESSE SITE
MONTHLY WIND DISTRIBUTION
AT THE 100m LEVEL
ENTIRE YEAR 1982

Figure 3