2.5 Socioeconomics

This section presents the socioeconomic resources that have the potential to be impacted by the construction, operation, and decommissioning of the new units. The section is divided into four subsections: 1) demographics, 2) community characteristics, 3) historic properties, and 4) environmental justice. These subsections include spatial (e.g., regional, vicinity, and site) and temporal (e.g., 10-year increments of population growth) considerations, where appropriate, as referenced.

2.5.1 Demography

The population distribution surrounding the ESP site, up to an 80-km (50-mi.) radius, has been estimated, based on the most recent U.S. Census Bureau decennial census data (Reference 1). The population distribution encompasses nine concentric rings at 2 km (1.2 mi.), 4 km (2.5 mi.), 6 km (3.7 mi.), 8 km (5.0 mi.), 10 km (6.2 mi.), 16 km (10 mi.), 40 km (24.9 mi.), 60 km (37.3 mi.), and 80 km (50 mi.), and 16 directional sectors. The projected population estimates for Years 2010, 2020, 2030, 2040, and 2065 have been calculated with a formula adopted from the Weldon Cooper Center for Public Service (Reference 2) using the 1990 Census and 2000 Census data as the base.

2.5.1.1 Resident Population Within 16 km (10 miles)

Figure 2.5-1 shows the general locations of the municipalities and other features within 10 miles (16 km) of the ESP site. According to the 2000 Census survey, Mineral, which has a population of 424 located within about 1 square mile (incorporated), is the largest community within 10 miles of the site (Reference 5). As reported in NAPS UFSAR (Reference 4, Section 2.1.3.1), the population in 1990 was 452. Therefore, the population of Mineral has remained constant during the past decade.

The population distribution within 16 km (10 miles) of the site has been computed by overlaying the 2000 Census block points data (the smallest unit of census data) (Reference 1) on the grid shown on Figure 2.5-1, and summing the population of the census block points falling in each of the polar sectors comprising the grid. The census block-point summation and allocation has been accomplished using the Landview 5 (LV5) software, operating directly on census data, and the MARPLOT mapping software (Reference 1). The system can display Census 2000 demographic data, jurisdictional entities, and many statistical entities of the U.S. Census Bureau. It can also calculate Census 2000 population, racial distribution, census block count, and housing unit count within a user-defined radius. Using MARPLOT, the grid system was created as shown on Figure 2.5-1. LV5 was designed to summarize the population distribution and other information, once the user selected an area of interest within the grid system. The entire grid system is evenly divided into 16 directions, each direction consisting of 22.5 degrees.

The population distributions and related information have been recorded on a spreadsheet to tabulate the results at the distances of interest for all sixteen directions. In order to generate more accurate counts, census block points were used in LV5 to calculate population distributions.

Population projections for the area within 10 miles of the ESP site up to 65 years from the 2000 census were developed. The formula used for average annual growth (percentage of growth) is adopted from Reference 2. The Weldon Cooper Center for Public Service group has performed the 2001 provisional population estimates for the Commonwealth of Virginia.

$$\text{Annual Average Growth} = \frac{\text{Log}_{10}\left(\text{Population}_{2000} / \text{Population}_{1990}\right)}{(2000 - 1990) \times 0.4342945}$$

The 1990 population distributions within each county and city considered in Virginia and Maryland were also obtained from the U.S. Census Bureau (Reference 25). The same formula is also used for projection of the transient population up to the year 2065. The 10-mile population distribution for Year 2000 is shown on Figure 2.5-3. The 16-km (10-mile) resident and transient population projections for the years 2010, 2020, 2030, 2040, and 2065 are given in Figure 2.5-4 through Figure 2.5-7.

In 2000, the total population within 16 km (10 mi.) of the ESP site was 15,511. Based on the average annual growth, the estimated population for 2010 is 20,996. This is a projected increase of 35.4 percent. In 2020, an estimated 26,480 people will live within the 16-km (10-mi) radius of the site. This constitutes a 26.1 percent increase from 2010. For each decade, there is a slight downward trend in the percent increase of the population. The growth between 2020 and 2030 is projected to be 20.7 percent and between 2030 and 2040 to be 17.2 percent. Table 2.5-1 presents the population distribution within a 16-km (10-mi) radius of the ESP site for four decades (2000 to 2040).

Table 2.5-2 presents the estimated sex distribution of the population within a 16-km (10-mi) radius of the ESP site. The ratio of men to women is fairly consistent throughout the different concentric rings. The ratio of men to women in Virginia is slightly over 96 men to every 100 women (see Table 2.5-3). The ratio of men to women living within the 16-km (10-mi) radius of the ESP site is about the same: 97 men to every 100 women.

Table 2.5-4 presents the estimated age distribution of the population within a 16-km (10-mi) radius of the ESP site. The number of individuals in the 20-to-24 age group and the 65 and over age group is significantly lower than the rest of the age groups. However, this is typical of the Commonwealth of Virginia as a whole (see Table 2.5-14). The percentage of each age group tends to be very similar across each concentric ring. There appear to be no large groupings of any specific age group.

Table 2.5-6 presents the racial and ethnic distribution of the population within a 16-km (10-mi) radius of the ESP site. The white population is by far the majority within the 0- to 16-km (0- to

10-mi.) radius, with 12,805 people (82.6 percent of the population). However, the percentage of white people living within a given radius changes throughout the entire 16-km (10-mi.) radius from 94.3 percent in the 2-km (1.2-mi.) radius to 76.4 percent in the 8-km (5-mi.) radius to 83.6 percent in the 16-km (10-mi.) radius.

The percentage of black people living within a given radius also changes greatly throughout the entire 16-km (10-mi) radius from 4.8 percent in the 2-km (1.2-mi.) radius to 21.5 percent in the 8-km (5-mi.) radius to 13.5 percent in the 16-km (10-mi.) radius. The overall percentage of black people within the 0- to 16-km (0- to 10-mi.) radius from the site is 14.9 percent (2309 people).

Table 2.5-7 presents the estimated income distribution of the population within a 16-km (10-mi.) radius of the ESP site. Income distribution provided in the 2000 census data set has been recorded only up to Year 1999. Most of the individuals 15 years of age and older earn below $25,000 per year. Within the 0- to 16-km (0- to 10-mi.) radius, an estimated 5404 individuals (approximately 45.7 percent) earn less than $25,000. This is consistent with the overall Virginia numbers within one percent (see Table 2.5-7). The percentage of individuals earning between $50,000 and $75,000, between $75,000 and $100,000, and over $100,000 increases almost consistently throughout the different concentric rings.

Overall, the characteristics of the population within each concentric ring are basically the same.

2.5.1.2 Resident Population Between 16 km (10 miles) and 80 km (50 miles)

The 80-km (50-mi.) radius around the ESP site covers thirty counties and four cities in Virginia and one county in Maryland (See Figure 2.5-2). The Town of Louisa is approximately 12 miles to the west of the site. The population of the town has increased from 1088 (Reference 4) to 1400 (Reference 9, Section 2.2.8.5) between 1990 and 2002. About 40 miles south-southwest of the site is Richmond, Virginia, with a population of 197,790 in the Year 2000. About 36 miles west of the ESP site is Charlottesville, Virginia, which has a population of 45,049 according to the 2000 Census. About 22 miles northeast of the ESP site is Fredericksburg, Virginia, with a population of 19,279. The nearest population center with more than 25,000 residents is the City of Charlottesville. The closest point of Fredericksburg is 22 miles to the northeast with a projected 2065 population of about 20,950.

In addition to the thirty counties within Virginia, the 80-km (50-mi.) radius from the ESP site also encompasses Charles County, Maryland. The population distribution within that 80-km (50-mi.) radius for Charles County, which at its closest point is 37 miles northeast from the site, is 9270 based on the 2000 census data.

The 80-km (50-mi.) Year 2000 resident and transient population distribution throughout the four concentric distance rings and the 16 directional sectors is shown on Figure 2.5-8. The resident and transient population projections for the area between 16 and 80 km (10 and 50 mi.) for years 2010, 2020, 2030, 2040, and 2065 are based on the same methodology as the 16-km (10-mi.)

projections. These population projections throughout the four concentric rings and the 16 directional sectors are given in Figure 2.5-9 through Figure 2.5-12A.

The total population within 80 km (50 mi.) of the ESP site is 1,538,156, according to the 2000 Census. Based on the average annual growth, the estimated 2010 population is 1,849,908, which is a projected increase of 20.3 percent. Table 2.5-8 presents the population distribution within an 80-km (50-mi) radius of the site for four decades (2000 to 2040).

In 2020, an estimated 2,161,660 people will live within the 80-km (50-mi) radius. This constitutes a 16.9 percent increase from 2010. For each decade, there is a slight downward trend in the percent increase of the population. The growth between 2020 and 2030 is projected to be 14.4 percent and between 2030 and 2040 to be 12.6 percent.

Table 2.5-9 presents the estimated sex distribution of the population within an 80-km (50-mi.) radius of the ESP site. The population within this 80-km (50-mi.) radius contains about 94 males for every 100 females. This is a bit lower than the overall state of Virginia, which averages slightly over 96 men to every 100 women (See Table 2.5-3).

The estimated sex distribution throughout the 80-km (50-mi.) radius is fairly consistent. The distribution within each concentric ring is basically the same and is very close to the ratio for Virginia as a whole (see Table 2.5-3).

Table 2.5-10 presents the estimated age distribution of the population within an 80-km (50-mi.) radius of the ESP site. The age group with the largest percentage of people is the 25- to 44-year-old age group. The next largest age group is the 0- to 19-year-old age group. This could be based on the fact that most parents are between the ages of 25 and 44, and their children, would be 19 years old and younger.

For each age group, the percentages are fairly consistent, regardless of the size of the population within the specific radius; although, there are a couple of inconsistencies. These inconsistencies include the 0-to-16-km (0-to-10-mi.) radius's 25-to-44 age group (which is lower than the same group in the other concentric circles) and the 0-to-16 km (0-to-10 mi.) radius's 0-to-19 age group (which is higher than the same group in the other concentric circles).

Table 2.5-11 presents the racial and ethnic distribution of the population within an 80-km (50-mi.) radius of the ESP site. The ratio of the white population to the black population within 80-km (50-mile) radius is 3 to 1 (see Table 2.5-12) which is consistent with the ratio of 3.7 to 1 for the Commonwealth of Virginia in its entirety.

The black population increases significantly between the 60-km (37.3-mi.) radius and the 80-km (50-mi.) radius. This increase is due to the population of the City of Richmond. In Richmond, the ratio of white individuals to black individuals is 67 to 100 (see Table 2.5-12).

Table 2.5-13 presents the estimated income distribution of the population within an 80-km (50-mi.) radius of the ESP site. The largest percentage of the population earned less than $25,000 in 1999.

This was consistent with the rest of the state. The distribution of earnings within each concentric ring is fairly consistent throughout the entire 80-km (50-mi.) radius from the ESP site.

The majority of current NAPS employees reside in Henrico, Louisa, Orange, and Spotsylvania counties. Spotsylvania and Louisa counties are two of the fastest growing counties in Virginia. While Virginia as a whole has increased in population by 13.4 percent between 1990 and 2000, Spotsylvania and Louisa counties have increased in population by 45.4 percent and 23.3 percent, respectively. Henrico and Orange counties have also surpassed the Virginia average by increasing in population by 18.6 and 18.9 percent, respectively. However, the City of Richmond decreased in population by 2.5 percent in the same time period.

Table 2.5-3 presents the sex distribution of the population in the counties that contribute most of the current NAPS employees, in comparison to the entire state of Virginia. The counties' sex-distributed populations closely track within one percent. The exceptions are Henrico County and the City of Richmond in which both locations have a larger female population.

Table 2.5-14 presents the age distribution of the population in the counties that contribute most of the current NAPS employees in comparison with the entire state of Virginia. The counties' age-distributed populations closely track within 3 percent. The exceptions are Spotsylvania County's 0-to-19 age group (which is 4.8 percentage points higher than the Virginia average), Orange County's 25-to-44 age group (which is 3.8 percentage points lower than the Virginia average), and Orange County's 65-and-older age group (which is 6 percentage points higher than the Virginia average).

Table 2.5-12 presents the racial and ethnic distribution of the population in the counties that contribute most of the current NAPS employees in comparison with the entire state of Virginia. The counties' racial and ethnic-distributed populations closely track within 5 percent. The exceptions are Orange County's white population group (which is 12.1 percentage points higher than the Virginia average), the City of Richmond's white population group (which is 34 percentage points lower than the Virginia average), Spotsylvania County's white population group (which is 10.6 percentage points higher than the Virginia average), Orange County's black population group (which is 5.8 percentage points lower than the Virginia average), the City of Richmond's black population group (which is 37.6 percentage points higher than the Virginia average), and Spotsylvania County's black population group (which is 7.1 percentage points lower than the Virginia average).

Table 2.5-7 presents the income distribution of the population in the counties that contribute most of the current NAPS employees in comparison with the entire state of Virginia. The counties' income-distributed populations closely track within 4 percent. The exceptions are Henrico County's $1000-$25,000 income group (which is 5.3 percentage points lower than the Virginia average), Louisa County's $1000-$25,000 income group (which is 5.5 percentage points higher than the Virginia average), the City of Richmond's $1000-$25,000 income group (which is 9.8 percentage points higher than the Virginia average), Spotsylvania County's $1000-$25,000 income group

(which is 6.3 percentage points lower than the Virginia average), and Henrico County's $25,000-to-$50,000 income group (which is 6.6 percentage points higher than the Virginia average).

The population distributions throughout the 9 concentric rings and the 16 directional sectors extending to a 50-mile radius for the Present Date, Startup Date, and 40-year Date are summarized in Table 2.5-15. The startup date was conservatively assumed to be around Year 2025, based on the assumption that the period of ESP approval is between 2005 and 2025.

2.5.1.3 Transient Population

2.5.1.3.1 Transient Population Within 16 km (10 miles)

Information concerning transient population for the area has been collected from several sources, because the information is not available from the 2000 census data. The area within 10 miles (16 kilometers) of the ESP site is predominantly rural and is characterized by farmland and wooded tracts of land. Since there are no significant industrial or commercial facilities in the area, and none are anticipated (Reference 4, Section 2.1.3.3), the transient employment population is likely to move out of, rather than into, the area.

Recreational use of Lake Anna, including Lake Anna State Park, is the greatest contributor to transient population in the area. The usage of the lake was estimated from a number of contributing factors including the number of boat ramps, wet slips, campsites, picnic areas, etc. These contributing factors are listed in Table 2.5-16.

An estimate of lake usage on a peak weekend day in the peak summer season has been developed based on representative usage of recreational facilities (e.g., boating, picnicking, camping) provided by the VDCR (Reference 4, Section 2.1.3.3) and the Lake Anna recreational facilities listed in Table 2.5-16. However, residents should have been included in the census data. This estimate does not include use by local residents with their own docks. In addition, many residents without docks keep their boats in marina wet slips or use the boat ramps and are, therefore, included in the lake usage.

There are six marinas in the vicinity of the ESP site. The closest is 1.4 miles north-northeast of the site. The remaining marinas are from 2 to 2.5 miles distant. A survey of several of the marinas indicate that their actual boat launches, per ramp, ranged from 15 to 40 per peak day, which is significantly lower than the number of 80 per day provided by the VDCR as an upper limit, and that the usage per ramp has dropped as new ramps are added. This was attributed to parking space limitations and the fact that the lake usage by recreational boaters may be approaching saturation. A rate of 50 launches per ramp per day was selected as being more representative of Lake Anna conditions.

Based on 50 launches per ramp per day, these marinas and other boat ramps, including those at Lake Anna State Park, could provide access for up to 1450 pleasure craft on Lake Anna. Peak day

usage estimates for boats moored in wet slips ranged from 30 to 50 percent. Assuming that all slips are rented, 150 additional boats would be added, bringing the total, excluding boats from private docks, to 1600. The resulting transient population at three persons per boat would be 4800 (Reference 4, Section 2.1.3.3).

The two commercial campgrounds, with a combined total of more than 200 campsites, has been estimated by the Virginia State Department of Conservation and Recreation to contribute about 650 persons to the transient population assuming three persons per campsites. The number of picnickers has been estimated at 450. Since both campsites have boat ramps, significant double counting is likely (Reference 4, Section 2.1.3.3)

Lake Anna State Park provides facilities for picnicking, fishing, boat launching, swimming and biking. The Lake Anna State Park Manager estimated a peak daily attendance of 4372 from June 2002 through August 2002, and an annual attendance of 187,302 between July 1, 2001 and June 30, 2002, based on traffic counts. Double counting is likely as boaters are included in the traffic count.

The resulting estimated total peak daily transient population on Lake Anna (including the WHTF and Lake Anna State Park) is less than 11,270 (see Table 2.5-17). Since use of the WHTF is limited to residents and their guests, there are no public boat ramps. The WHTF transient population, estimated at less than 1,000, is based on one guest for each resident in the polar sectors encompassing the WHTF.

Annual transient population is uncertain because of the dramatic drop in boating on weekdays and during non-summer months. Based on the Lake Anna State Park data, assuming 180 days of operation, the average daily attendance is less than one quarter of the peak daily attendance. Conservatively assuming that the average attendance, excluding the park, is one half the peak daily figure, the total annual attendance would be about 807,300, based on a 180-day season.

Transient population within 16 km of the ESP site combined with the resident population in that area for Year 2000 and for projected years 2010, 2020, 2030, 2040, and 2065 are presented in Figure 2.5-3 through Figure 2.5-7.

2.5.1.3.2 **Transient Population Between 16 km (10 miles) and 80 km (50 miles)**

It is difficult to provide an accurate count of the transient population between 10-mile (16-km) and 50-mile (80-km) concentric circles from the ESP site. There are colleges, schools and hospitals within 50 miles. However, compared to the resident population within the same area, use of these facilities by transient population is expected to be insignificant.

Between 16 km and 80 km of the ESP site, the only major recreational facility that induces a significant amount of transient population is Paramount's Kings Dominion Amusement Park. Paramount's Kings Dominion is 35 miles southeast from the site. The park opens from March to November and hosts about 2 to 2.5 million visitors annually. According to the park's public relations

manager, the park could experience slow growth in the future, until it reaches its current maximum capacity of 2.875 million visitors per year (i.e., an additional 15 percent above the current attendance). On average, the park opens to the public about 138 days per year (Reference 6). Using the maximum capacity of the park and the average number of days open, the average daily park visitor count is conservatively estimated to be 20,830.

There is no official count of visitors that come from areas outside the 50-mile radius from the ESP site. However, the majority of the park visitors are expected to come from Richmond and Fredericksburg areas due to their proximity to the park. It is conservatively assumed that 40 percent of the daily park visitors come from areas outside the 50-mile radius. The 8350 park visitors from further than 50 miles are considered transient population and the number is included in the population distribution estimates (See Table 2.5-15).

Transient population between 16 km and 80 km of the ESP site combined with the resident population in that area for Year 2000 and for projected years 2010, 2020, 2030, 2040, and 2065 are presented in Figure 2.5-8 through Figure 2.5-12A.

2.5.1.4 Migrant Labor

Migrant laborers are typically members of minority or low-income populations. Because migrant workers travel and can temporarily spend a significant amount of time in an area without being actual residents, they may be unavailable for census counts. Therefore, migrant workers could be under-represented in U.S. Census Bureau minority and low-income population counts.

Migrant workers do not harvest agricultural crops in Louisa County; however, they do re-plant forest land that has been harvested. Over the past 5 years, most completely harvested forestland in Louisa County has been reforested (replanted) or allowed to regenerate naturally. Planting takes place from late January through March and is often done under Virginia Department of Forest contract. Data on the number of migrant workers participating in the planting are not available, but the number is considered to be small. Given the expected small number of migrant workers, and the probability of the population being concentrated in a single location, their temporary domicile would not be long in duration. Therefore, migrant workers would not materially change the population characteristics of any particular census tract within Louisa County.

2.5.1.5 Population Density

Given an approved ESP period of 20 years and an assumed ESP approval date of 2005, the startup date of new units is conservatively assumed to be 2025. Assuming an operational period of 40 years for new units, new unit operations could extend until 2065.

Figure 2.5-13 shows the actual cumulative populations in Year 2000 and projected cumulative population in Year 2065 as a function of 10-mile to 50-mile radial distances from the site. On the same figure, population density curves, spanning the same radial distances, are shown for 500 persons per square mile, and of 1000 persons per square mile.

By inspection of the curves for actual population densities of Year 2000 and Year 2065 projections, it is concluded that at the time of initial site approval and within about 5 years thereafter, the population densities, including weighted transient population, averaged over any radial distance out to 20 miles (cumulative population at a distance divided by the circular area at that distance), would not exceed 500 persons per square mile. The results conform to the guidance in RG 4.7, Regulatory Position C.4 (Reference 7).

Similarly, by inspection and projection of the same curves to account for trends over the lifetime of the new units, it is concluded that the expected population densities, including weighted transient population, averaged over any radial distance out to 30 miles (cumulative population at a distance divided by the area at that distance), would not exceed: 1) 500 persons per square mile at the time of initial operation, and 2) 1000 persons per square mile over the lifetime of new units (Reference 8).

2.5.2 Community Characteristics

The region around the ESP site has a medium density population (Reference 9). The permanent workforce at the existing units consists of approximately 850 employees. During planned outages of an existing unit (every 18 months/unit), an additional 700 to 1000 workers are onsite for a period of 30 to 40 days. During construction of the new units, a peak workforce of approximately 5000 would be expected. Depending on the reactor design selected and the scheduling of the installation of the new units, this peak workforce could be onsite for 5 to 7 years. Approximately 720 new employees would be required for the operation of the new units. For planned outages, about the same number of additional workers could be expected for a new unit as is used for an existing unit.

The communities with the greatest potential to be impacted socio-economically by the installation and operation of new units at the ESP site are in Henrico, Louisa, Orange, Hanover, and Spotsylvania Counties, and the City of Richmond because most employees reside in one of these counties. These counties are in central Virginia, which has experienced a steady growth in population and economic activity in the last decade. As presented in Section 2.5.1, the population growth over the last decade has been greatest in Louisa and Spotsylvania Counties. Conversely, the City of Richmond population during this period has declined.

The existing socio-economic situation of the area around the NAPS site has been addressed in detail by the Environmental Report (ER) prepared by Virginia Power as part of its Application for Renewed Operating Licenses for NAPS Units 1 and 2 (Reference 10), and by the Supplemental Environmental Impact Statement (SEIS) prepared by the NRC for the license renewal of NAPS Units 1 and 2 (Reference 11). Although both documents have been prepared within the last two years, the information provided in these documents has been updated when more recent information was available and pertinent to the installation of new units at the ESP site. The following discussion is based primarily on these sources.

2.5.2.1 Economy

Information on the population distribution (by county and by distance from the ESP site), including breakdowns by age, sex, race and ethnic background, are presented in Section 2.5.1. Tables on estimated income distribution are also provided, identifying income group by distance from the ESP site and county. These tables include similar information for the Commonwealth of Virginia as a point of comparison in assessing whether the area around the ESP site is similar to the rest of the state. The conclusion is that, in general, there are no great differences in the income distributions between the area around the ESP site and throughout the state as a whole.

Percent unemployment, individual poverty rates, and median household incomes for the five counties of interest and the City of Richmond have been obtained from the Virginia Employment Commission (VEC) website (Reference 12) and include data generated by the U.S. Census Bureau from the 2000 Census (Reference 13). The information is presented in Table 2.5-18.

Similar data for Virginia as a whole are also presented to provide a point of comparison for the local data. The unemployment rates, individual poverty rates, and median household incomes for Charles County in Maryland and for the State of Maryland are also presented in this table, because the 80 km (50 mile) radius that defines the potential area of impact for the new units includes part of Charles County. Furthermore, the history of major construction at NAPS shows that part of the construction work force has originated from Maryland. (Reference 10) The data have been obtained from the Maryland website for the Maryland Department of Labor, Licensing, and Regulation (Reference 14), and includes data generated by the U.S. Census Bureau from the 2000 Census.

Based on Table 2.5-18, the total civilian labor force in the region (November 2002) was 434,366, of which 65,349 were in Charles County, Maryland.

2.5.2.1.1 Hanover County, Henrico County, and the City of Richmond

Henrico County, Hanover County, and the City of Richmond are part of the Richmond-Petersburg metropolitan statistical area (MSA), which is home to approximately 1 million people (Reference 15). Of this number, 262,300 people live in Henrico County, 86,320 in Hanover County, and 197,790 in the City of Richmond. The MSA is located approximately 161 km (100 miles) from Washington, D.C. and is the primary economic driving force within an 80-km (50-mile) radius of the ESP site. This MSA has a transportation network of trucking and railroad terminals, interstate highway access to main east-west and north-south corridors, and an international airport. The CSX Corporation headquarters is located in Richmond. The Port of Richmond, the westernmost inland port, has direct access to the Atlantic Ocean, serving both domestic and international markets. A map of the area, taken from the North Anna License Renewal Application (Reference 10), is presented as Figure 2.5-16. Paramount's Kings Dominion, located in Hanover County, is a major tourist attraction for the area.

The Richmond area is headquarters for more than 35 major corporations, including 12 Fortune 1000 companies, of which 6 are Fortune 500 companies, and 3 are Forbes 500 largest companies.

Capital One Financial Corporation is the largest private employer in the area. Service is the largest employment sector in the MSA, followed by retail and wholesale trades, manufacturing, finance, and construction. (Reference 15)

Approximately 45 percent of resident workers in Henrico County commute to jobs outside the county, as compared to almost 64 percent of resident workers in Hanover County and about 40 percent of resident workers in the City of Richmond. The unemployment rate for Henrico County is 3.3 percent, as of November 2002, which is higher than the 2.4 percent for Hanover County and lower than the corresponding rate of 5.8 percent for the City of Richmond. (Reference 12)

2.5.2.1.2 **Louisa County**

Louisa County is in the triangle between Richmond, Fredericksburg, and Charlottesville. Interstate 64 runs east-west through the county, as does a CSX rail line. Louisa County, with a population of 25,627, continues to be a rural community with most of the land forested or under cultivation. There are two incorporated towns in the county, Louisa and Mineral, both of which are within 15 miles of the ESP site. Because the ESP site is located there, Louisa County has benefited economically more from the plant than the other counties that could be impacted by the installation of the new units. Table 2.5-19 lists the top five employers in the county, their product, and the number of employees. The remaining 14 employers have less than 100 employees, with most generally having fewer than 25 employees. (Reference 16)

There has been relatively little growth in industry in the last ten years although there has been significant growth in population. The county is actively pursuing additional industries in an effort to diversify and expand its industrial base. Almost 62 percent of the resident workers in Louisa County commute to jobs outside the county. (Reference 12)

The existing units operations have contributed more than 50 percent of the property taxes paid to Louisa County over the past decade, and, therefore, have allowed the property tax assessment rates to remain below those of neighboring counties. While recognizing the benefits of the existing units, the county is still looking to expand its industrial base so as to become less dependent on one facility.

2.5.2.1.3 **Orange County**

Orange County, with a population of 25,881, has two incorporated towns, Orange and Gordonsville, and one planned, gated residential community, Lake of the Woods. It borders the northwestern extent of Lake Anna and is about 72 miles from Richmond, 75 miles from Washington, D.C., and 25 miles from Charlottesville, the home of the University of Virginia. Agribusiness is the main business sector in Orange County; although, manufacturing has played a significant role for over 80 years. Approximately 97 percent of the land in Orange County is forested, under cultivation, or pasture land. (Reference 17)

Of the 11,925 resident workers in the county, approximately 53 percent commute to jobs outside the county (Reference 12). According to the Chamber of Commerce, there are over 535 businesses and industries in the county, most of which employ fewer than 25 workers, many employing fewer than 10 workers. Major private employers in the county, defined by Orange County as having 25 or more employees, are listed in Table 2.5-20 (Reference 17).

2.5.2.1.4 **Spotsylvania County**

Spotsylvania County, with a population of 90,395, is midway between Washington, D.C. and Richmond. Its southwestern border is the North Anna River, most of which was flooded when Lake Anna was formed as a source of cooling water for the power station.

Economically, the county is more associated with the Washington, D.C. area through commuting patterns of its residents and federal procurement opportunities. Almost 60 percent of the resident workers commute to jobs outside the county. (Reference 12)

Although agriculture and forestry have been important components of the county's economy, the relative economic importance of these industries has declined over the years as the commercial and industrial base of the county has grown. Additionally, the number of employees in the state, local, or federal government sectors has increased significantly over the last ten years. Major private employers in Spotsylvania (defined by Spotsylvania County to be those with 100 or more employees) are listed in Table 2.5-21 (Reference 18).

In addition to the private employers, the Spotsylvania County Government employs about 600 workers; that is, the county is the second largest employer in the county, second only to Capital One.

2.5.2.2 **Taxes**

In Virginia, counties and towns collect most of their taxes through property taxes and sales taxes. Property taxes include business personal property and individual tangible personal property as well as real estate. business personal property includes such items as office furniture, fixtures, equipment, machinery and tools. (Reference 19)

Annual power station property taxes are paid to Louisa, Orange, and Spotsylvania Counties. Table 2-15 of the SEIS (Reference 11) presents the breakdown of property taxes collected by each county, the amount paid, and the percent of total property taxes that the payment represents. The total budget for each county is also presented for comparison purposes. Data are presented for the period of 1995 to 2000. The preponderance of the property taxes paid for the power station goes to Louisa County, and represents about 46 percent of the total property taxes collected by the county. The other two counties are paid taxes that represent about 1.5 percent of the total property taxes collected by each. Overall, the property taxes paid to Louisa County amounted to about 22.5 percent of the total budget for the county during the 1995–2000 time period. The SEIS points out that the property tax payments would be expected to decline as the existing facility depreciates.

The SEIS also points out that the potential effects of electric utility deregulation within Virginia are not known. However, it is reasonable to conclude that the installation of new units should result in a relative increase in property tax payments even with the depreciation of the existing units.

The SEIS discusses the relatively large increases in the economy of Henrico County over the past two decades due to the increased business investments in the Richmond area, as well as in the economy of Spotsylvania due partly to the large increase in government and other white collar workers who have chosen to live in Spotsylvania. To a lesser extent, Orange and Louisa Counties have benefited from this growth in the economies of Henrico and Spotsylvania Counties. Louisa County has benefited from the growth in second and retirement homes that have been constructed around Lake Anna. Since these homes have generally been upscale, the land values around the lake have increased significantly. Property tax revenues have also risen as a result of this construction as well as with construction of moderately priced houses around the county.

Many of these moderately-priced houses are intended to accommodate workers who commute to the Richmond-Petersburg MSA or to Washington, D.C., or to companies around the Dulles Airport and the Capital Beltway. The Louisa County land use planning document anticipates that such construction would continue at a rate of about 300 new homes per year for the foreseeable future. However, such increases in home building also require to some extent increased expenditures for infrastructure, which would tend to offset the increased property taxes paid to the county. If the current efforts by Louisa County to attract industry are successful and if the numbers of new homes continue to increase, increased property tax revenues as well as increases in sales tax revenues may be sufficient to offset the depreciation of the existing units. However, as is discussed in more detail in Section 5.8.2, new units would result in an increase in property tax revenues that would more than offset any decreases due to the depreciation of the existing units. (Reference 16)

2.5.2.3 Schools and Recreational Areas

Each county and the City of Richmond have a public school system for kindergarten through high school (Reference 13). The numbers at each level of school is dependent on the size of the local population, being greatest in the Richmond-Petersburg MSA. The Richmond-Petersburg MSA also has a number of private schools for grammar through high school education. Higher educational facilities, both public and private, are located in the Richmond-Petersburg MSA and in Spotsylvania, with none located in either Louisa or Orange Counties. However, both Louisa and Orange Counties are in close proximity to such facilities in the areas mentioned and to the University of Virginia in Charlottesville. During previous major construction activities at the NAPS site, the construction workforce did not require relocation of large numbers of workers into the area. Therefore, unless there is a need for relocation of a large number of construction workers into either or both of these counties, the SEIS (Reference 11) conclusion that any impacts on the school systems would be small, also applies to the construction of the new units. This construction-related information is addressed in more detail in Section 4.4.2.

All of the surrounding counties and the City of Richmond have established parks and other recreational areas for their residents. In Louisa and Orange Counties, these areas typically consist of one or two parks plus playing fields at the local schools. However, as is presented in Section 2.5.1.3, the Lake Anna area has become established as a recreational center not only for the local residents of Louisa, Orange, and Spotsylvania Counties, but also for other in-state and out-of-state visitors. The SEIS (Reference 11) conclusion that any impacts on these parks and other recreational areas would be small, generally applies to the construction of new nuclear generating unit(s), so long as there is no relocation of a large number of construction workers into the counties that border the lake.

A potential exists for negative transportation impacts on the number of people from outside the bordering counties who use the lake recreationally. The potential for negative impacts on the numbers of people using Lake Anna during construction of the new facility and suggested mitigation measures to avoid or reduce these impacts is addressed in more detail in Section 4.4.2.

2.5.2.4 **Housing**

Approximately 80 percent of the permanent employees at the NAPS site live in Hanover, Henrico (including the City of Richmond), Louisa, Orange, or Spotsylvania Counties, with the greatest number living in Louisa County. A detailed breakdown, by county and city (Reference 11, Table 2-5) shows that the number of permanent employees living in Louisa, Spotsylvania, and Orange Counties are 237, 186, and 120, respectively.

A breakdown, by county, of housing units by number occupied and vacant in 1990 and 2000, is presented in Table 2-6 of the SEIS (Reference 11). “Vacant” housing is equated to “available” housing. However, a review of the U.S. Census Bureau’s 2000 Census data reveals that there is a further breakdown of the category “vacant” housing, pertinent sections of which are presented in Table 2.5-22.

This detailed breakdown of “vacant” units is not of concern when renewing operating licenses, nor for planned outages of each existing unit. However, the number of “vacant” housing units that are “for seasonal, recreational, or occasional use” is important in relation to construction. In this case, “vacant” units should not automatically be considered to be available to those members of the large construction workforce who decide to relocate to the area during the installation of the new units. This category of “vacant” housing units would not be available for use by the longer-term workforce and could represent an issue associated with the new units, especially if a larger percentage of the workforce decides to relocate to the area around the ESP site for the duration of their work. However, the “for rent” and “for sale” vacant housing units should be considered as available for their use, if needed. Such use would be in competition with the housing demands from the projected population growth in each county and the City of Richmond. This situation is addressed further in Section 4.4.2.

2.5.2.5 Public Services

Public services addressed here include water supply, education, and transportation. These services provide a baseline from which construction period impacts and operational impacts can be estimated.

2.5.2.5.1 Water Supply

As described in the SEIS, Henrico County buys its water from the City of Richmond whose source of water supply is the James River. Spotsylvania County supplies most residential, commercial, and industrial areas via a public water system that draws from the Ni River. Additional water capacity is being constructed in both Richmond City and Spotsylvania County.

In Louisa and Orange Counties, groundwater is the primary source of water for the residents, excluding the towns of Louisa and Orange. About 80 percent of Louisa County residents and about 90 percent of Orange County residents rely on groundwater.

The residents of these more rural counties normally have individual septic systems rather than access to a sewer system with a publicly owned treatment works (POTW).

The SEIS identifies a concern regarding access to the public water supplies in the towns surrounding the NAPS site, if new employees associated with the new units were to settle in these towns. The SEIS states that there are plans to construct new treatment plants or expand existing facilities in the towns, which would alleviate these concerns.

Table 1-7 of the SEIS presents the projected population growth in 2010 for the surrounding counties and the City of Richmond. For Louisa County and Orange County, the projected growth in population between Years 2000 and 2010 is 4,380 and 3,920, respectively – values that are similar to the numbers being projected for a peak construction workforce brought in to add new units. These projected population growths and their possible impacts on the local infrastructure, including water and sewer services, have been incorporated into the comprehensive land use plans for both counties. The potential impact of construction and operation on the infrastructure of the area, including the water and sewer systems, is considered further in Section 4.4.2 and Section 5.8.2, respectively.

2.5.2.5.2 Education

The SEIS provides information on the number of high schools, middle schools, and elementary schools in each surrounding county and incorporated municipality. A review of this information reveals that Louisa and Orange Counties have school systems that could potentially limit the number of students that could be assimilated by their educational systems if a sudden large influx of families were to relocate into these areas. For Louisa County, with one high school, one middle school, and three elementary schools, a large influx of families with children at these levels of education could tax the capacity of these schools. For Orange County, with one high school, one middle school, and five elementary schools, a large influx of families with children in middle or high

school could similarly tax the capacity of the school system. This issue is addressed in Section 4.4.2.

2.5.2.5.3 Transportation

The area within the 80-km (50-mile) radius of the ESP site is serviced by Interstate 95, running in a north-south direction between Washington, D.C. and Richmond, and Interstate 64, running between Richmond and Charlottesville; as well as numerous Virginia highways and local roads Figure 2.5-16. According to the SEIS, all local roads in the NAPS area carry a level-of-service designation “B.” Designation “B” means that there is stable traffic flow, such that the freedom to select speed is unaffected, but the freedom to maneuver is slightly diminished. The potential impacts during construction and operation, including likely measures that can be implemented to reduce these impacts during each phase, are addressed in Section 4.4.2 and Section 5.8. Of primary concern is the seasonal use of Lake Anna and the resulting traffic on local roads in the vicinity of NAPS.

2.5.2.5.4 Police, Fire, and Medical Facilities

The police force of each of the counties within the 80-km (50-mile) radius about the ESP site consists of a County Sheriff who is typically headquartered in the County Seat and who is assisted by Sheriff’s Deputies who patrol the entire area of the county. The Sheriff’s Department also normally dispatches emergency services through the 911 system in each county. The incorporated towns and cities within the counties have their own police force. The more heavily populated areas of Henrico County and the City of Richmond also have a Division of Police.

Volunteer fire departments protect Hanover, Orange, Louisa, and Henrico counties and the City of Richmond as shown in Table 2.5-23. Emergency medical protection is provided in each county by volunteer rescue squads. The County Sheriff’s Department in each county dispatches these volunteer rescue squads. The independent towns in these counties each have their own volunteer fire departments. Both Henrico County and the City of Richmond have more extensive fire departments and EMS units.

Contacts and arrangements made by Virginia Power with local, state, and federal governmental agencies with emergency planning responsibilities are identified in Part 2: Section 13.3.3.

Medical facilities generally consist of local physicians’ offices in the counties. However, there are major medical facilities in Fredericksburg, Charlottesville, Mechanicsville, and the City of Richmond that are readily accessible to the populations of the counties.

2.5.3 Historic Properties

The region surrounding the ESP site has been identified as having prehistoric and historic Native American and historic Euro-American resources. To assess known and potential cultural resource sites surrounding the site, surveys have been conducted for items of historic, archaeologic, and geologic interest. The results are included in the application for license renewal (Reference 10).

Reconnaissance-level archaeological and historical investigations were completed for both the site and the lakebed, with few results. A few artifacts were noted in the area, but the investigator identified them as insignificant and determined that no further evaluations were necessary. In addition, records in the Louisa County Historical Society files identified 33 historic-period cemeteries along the river. Many of the cemeteries were avoided by adjusting project boundaries although, some were removed prior to inundation. Five cemeteries are recorded as on or near NAPS site.

The above referenced environmental report concludes that there are no sites or items of historic, archaeologic, or geologic significance within the vicinity of NAPS. The report conclusions are based on the review of available literature and several database sources. In addition to the work that was completed in 1973 (Presented in Section 2.5.3.2) (Reference 20), a cultural resource assessment for the area within 1-mile of the NAPS fence line and the site itself was commissioned by Dominion and completed in 2001. The results are documented in a report prepared by Louis Berger Group, Inc., (Reference 21) the conclusions of which are summarized in Section 2.5.3.2.

Virginia Power consulted with the State Historic Preservation Office (SHPO) regarding NAPS license renewal. No issues were identified as a result of that consultation. Dominion has initiated informal discussions with the SHPO regarding evaluation for an ESP and those discussions would continue throughout the review process.

Should archaeological resources or artifacts be discovered during pre-construction activities, personnel would be instructed to stop work. Dominion would contact the appropriate organization and/or regulatory agency for proper evaluation and designation, in accordance with the existing procedures.

2.5.3.1 Description of Historic Properties near the ESP site

There are three counties in the vicinity of the ESP site. Table 2.5-24 lists each county and the number of known historic places listed on the National Register of Historic Places (NRHP) (Reference 22) within these respective counties.

Of the 60 national historical sites identified in Table 2.5-24, four sites exist within 10 miles of the ESP site. These sites are listed and described in Table 2.5-25.

Figure 2.5-19 locates the NRHP sites near the ESP site.

2.5.3.2 Description of Historic Properties Within the NAPS Site

The Louis Berger Group, Inc. completed a cultural resource assessment (Reference 21) of the NAPS site and a 1-mile-radius surrounding the existing units (study area) during the license renewal project time period, and the assessment included the following activities:

- A background investigation of related information to compile known information about the NAPS study area; and

- The delineation of areas within the study area containing potential archaeological resources.

The investigations were conducted in accordance with the National Historic Preservation Act of 1966, the Archaeological and Historical Preservation Act of 1974, Executive Order 11593, and Title 36 of the Code of Federal Regulations, Part 660-66 and 800 (as appropriate). The field investigations and technical report met the qualifications specified in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (FR 48:190:44716-44742). The qualifications of the Project Manager and Project Archaeologist who performed the investigations met or exceeded the requirements described in the Secretary of the Interior's Professional Qualifications Standards (FR 48:190:44716-44743).

Examination of archaeological and historical site files at the Virginia Department of Historic Resources' archives has indicated that no recorded cultural resource sites are known to exist at the NAPS site. Similarly, review of historical documentation at the Louisa County Historical Museum, including historic maps dating between 1751 and 1863, have indicated few historic resources in the study area, other than an early road paralleling the south side of the North Anna River, which appears to be near the western boundary of the NAPS site. An unpublished map, based on county deeds from 1765 to 1815, shows the presence of the Jerdones Mill on the North Anna River bank, just upriver from the NAPS site, along with the associated Jerdones Mill Road. The same map shows an Old Mine Road within the North Anna site area.

No extant historic architectural resources have been identified within the study area and no historic architectural resources are present within the NAPS site. There are five architectural resources within a 1.5-mile radius of the NAPS site; however, the report's conclusions state that none of these resources are affected by current or planned activities. As a follow-up to the initial assessment, five known historic-period cemeteries have been recorded, three of which lie within the administrative boundary of the NAPS site (see Figure 2.5-18) and two that are located south of the North Anna Dam where no activities are planned.

Conclusions made in the report include that previously undisturbed lands within the NAPS site boundary have the potential to contain both unrecorded prehistoric and historic archaeological properties. On the basis of this conclusion, the NAPS site has been classified with respect to the potential for discovering archaeological resources. The three classifications are areas with the following:

- No Potential for Archaeological Resources
- Low Potential for Archaeological Resources
- Moderate-to-High Potential for Archaeological Resources

For areas with low and moderate to high potential for containing archaeological resources (see Figure 2.5-17), subsurface testing would be performed, dependent on existing ground conditions, prior to any ground disturbing activities.

2.5.3.3 Transmission Line Rights-of-Way

The NAPS site transmission line rights-of-way (ROW) have been categorized and inventoried and do not cross over any known archaeological or historic sites of significance (Reference 20).

2.5.3.4 Native American Sites

Among the six state-recognized Indian tribes in Virginia, the closest tribal reservations belong to the Pamunkey and Mattaponi Tribes. The Pamunkey Tribe Reservation is approximately 53 miles southeast of the ESP site and was confirmed to the Tribe in 1658 by the Governor, the Council, and the General Assembly of Virginia. The Mattaponi Indian Reservation, also established in 1658, is approximately 62 miles southeast of the ESP site. There are no known Native American cultural or religious tribal resources that exist within the NAPS site.

2.5.4 Environmental Justice

Federal agencies must identify and address, as applicable to their actions, disproportionately high and adverse human health or environmental impacts of its activities on minority or low-income populations. The NRC has committed to undertake environmental justice reviews in consideration of the NEPA of 1969 and the 1997 Council of Environmental Quality (CEQ) guidance.

For the purpose of the ESP environmental justice review, the geographic distribution of minority and low-income populations within 80 km (50 miles) of the ESP site have been determined, employing data from the 2000 Census and applying the following definitions from Appendix D of LIC-203 (Reference 23):

A minority population or low-income population exists if either of the following criteria are met:

1. A “minority population” is considered to be present if: 1) The minority population in the census block group or environmental impact site exceeds 50 percent, or 2) the minority population percentage of the environmental impact area is significantly greater (typically at least 20 percentage points) than the minority population percentage in the geographic area chosen for the comparative analysis, for example, the county or State, or

2. A “low-income population” is considered to be present if: 1) the low-income population in the census block group or environmental impact area exceeds 50 percent, or 2) the percentage of households below the poverty level in an environmental impact area is significantly greater (typically at least 20 percentage points) than the low-income population percentage in the geographic area chosen for the comparative analysis.

For this review, the percentage of any minority or low-income population within census tracts that could potentially be affected by the installation of new units has been calculated and compared to the corresponding percentage of minority or low-income populations within the entire Commonwealth of Virginia or State of Maryland (for Charles County, MD) as appropriate, to

determine if they exceed the State values for each category by at least 20 percent. All census tracts with at least 50 percent of their area within the 80-km (50-mile) radius around the ESP site are included in the analysis.

Using the Census Bureau's LandView 5 software and 2000 Census data for the region of interest (ROI) (Reference 24), the distributions of minority populations and low-income populations were developed. The results are shown on Figure 2.5-14 and Figure 2.5-15, respectively.

Generally, the minority populations are found in the sectors to the east through the southwest about the ESP site. There is a black minority population within Louisa County about 20 km southwest, and a similar size black minority population in the southeastern part of Caroline County, where it borders Hanover and King William Counties. About 60 to 80 km to the east and southeast of the site, there are large black minority populations in King and Queen, Essex, and Westmoreland Counties. These three counties are only partially within the area defined by the 80-km radius.

A large, black minority population exists in the City of Richmond and adjoining parts of Henrico County (60 to 80 km southeast of the site). To the south-southwest about 44 km distant, there is a small, black minority population in the northern part of Powhatan County. Another large, black minority population exists in the northern part of Buckingham County, about 60 to 80 km south-southwest of the site.

Charlottesville, approximately 58 km west of the site, contains small populations of minority Asians and blacks. Small, black minority populations also exist to the northeast in Fredericksburg and Stafford County, and a small Hispanic minority population is in Prince William County about 80 km northeast.

A small, low-income population exists, about 60 to 80 km south-southeast of the site, in the City of Richmond. Another, small, low-income population exists in Charlottesville.

The potential for disproportionate human health or environmental impacts on minority or low-income populations associated with the construction and operation of new units is evaluated and presented in Section 4.4.3 and Section 5.8.3, respectively. The potential impacts on minority and low-income populations at alternative sites are part of the more global evaluation of the environmental impacts associated with locating a new nuclear generating station that is presented in Section 9.3.

Section 2.5 References

1. U.S. Department of Commerce, Bureau of the Census, 2000 Census of Population, Custom CDs (Virginia, Maryland), Land View 5, A1-T00-LV05-22-001, September 2002.

2. Weldon Cooper Center for Public Service, www.ccps.virginia.edu:/demographics/estimates/city-co/2001estimates.pdf, accessed September 22, 2003.

3. Town of Mineral, www.louisa.net/mineral/, accessed October 14, 2002.

4. North Anna Updated Final Safety Report, Rev. 38, Dominion Virginia Power.

5. U.S. Department of Commerce, Bureau of the Census, 2000 Census of Population, www.census.gov/main/www/cen2000.html, accessed October 1, 2002.

6. Paramount's Kings Dominion website, www.kingsdominion.com/visit_calendar.jsp, accessed August 15, 2003.

7. Regulatory Guide 4.7, Rev. 2, General Site Suitability Criteria for Nuclear Power Stations, U.S. Nuclear Regulatory Commission, April 1998.

8. NRR Review Standard RS-002, Processing Applications of Early Site Permits: Draft for Interim Use and Public Comment, December 23, 2002, as supplemented.

9. NUREG 1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, U.S. Nuclear Regulatory Commission (GEIS), 1996 and 1999.

10. *Environmental Report* (ER) prepared by Dominion as Appendix E of the North Anna Power Station Units 1 and 2 Application for Renewed Operating Licenses, Dominion Virginia Power, May 2001.

11. NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (SEIS), Supplement 7, Regarding North Anna Power Station, Units 1 and 2, U.S. Nuclear Regulatory Commission, November 2002.

12. Virginia Employment Commission (VEC) Website, www.vec.state.va.us, 1/2/03–1/31/03.

13. U.S. Census Bureau Website, www.census.gov, 1/2/03–1/31/03.

14. Maryland Department of Labor and Licensing (MLL) Website, www.dllr.state.md.us, 1/2/03–1/31/03.

15. Greater Richmond Partnership, Inc., Website, www.grpva.com/new_pages/home.html, 1/2/03–1/31/03.

16. Louisa County, VA, Website, www.yeslouisa.com, 1/2/03–1/31/03.

17. Orange County, VA, Website, www.orangecova.com, 1/2/03–1/31/03.

18. Spotsylvania County, VA, Website, www.spotsylvania.va.us, 1/2/03–1/31/03.

19. Hanover County, VA, Website, www.co.hanover.va.us/econdev/index2.htm, 1/2/03–1/31/03.

20. *Atomic Energy Commission (AEC), Docket Nos. 50-338 and 50-339, Federal Environmental Impact Statement (FEIS)* Section 2.3, "Historic and Natural Landmarks," Virginia Electric and Power Company, 1973.

21. Cultural Resource Assessment, North Anna Power Station. Louisa County Virginia, Louis Berger Group, Inc. and Dominion Resources, Inc. March 2001.

22. Virginia Landmarks Register, National Register of Historic Places, June 15, 2001, http://www.dhr.state.va.us/home.htm (accessed 07/14/03).

23. LIC-203, Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues, NRR Office Instruction, U.S. Nuclear Regulatory Commission, June 21, 2001.

24. LandView 5, U.S. Census Bureau Viewer for the U.S. EPA, U.S. Census Bureau, and U.S. Geological Survey Data and Maps (2002) Custom CD-ROM for NAPS Region.

25. U.S. Department of Commerce, Bureau of the Census, 1990 Census of Population, website, www.census.gov/main/www/cen1990.html, accessed October 1, 2002.

Table 2.5-1 Population Distribution from 2000 to 2040 Within 16-km (10-mi) of the ESP Site

Year	0 to 2 km (0–1.2 mi.)	2 to 4 km (1.2–2.5 mi.)	4 to 6 km (2.5–3.7 mi.)	6 to 8 km (3.7–5.0 mi.)	8 to 10 km (5.0–6.2 mi.)	10 to 16 km (6.2–10 mi.)	Total
2000	210	717	1394	1351	2218	9621	15,511
2010*	263	943	1884	1837	2986	13,083	20,996
2020*	316	1169	2375	2322	3753	16,545	26,480
2030*	369	1395	2865	2808	4521	20,007	31,965
2040*	422	1621	3355	3293	5288	23,469	37,449

* All populations in this year are estimates.

Table 2.5-2 Estimated Sex Distribution of Population in 2000 Within 16-km (10-mi.) of the ESP Site

	0 to 2 km (0–1.2 mi.)		2 to 4 km (1.2–2.5 mi.)		4 to 6 km (2.5–3.7 mi.)		6 to 8 km (3.7–5.0 mi.)		8 to 10 km (5.0–6.2 mi.)		10 to 16 km (6.2–10 mi.)	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Male	104	49.5	350	48.8	687	49.3	665	49.2	1,092	49.2	4,738	49.2
Female	106	50.5	367	51.2	707	50.7	686	50.8	1,126	50.8	4,883	50.8
Total	210	—	717	—	1394	—	1351	—	2218	—	9621	—

Table 2.5-3 Sex Distribution of Population in the Major Employee-Contributing Counties and Virginia

	Henrico		Louisa		Orange		City of Richmond		Spotsylvania		Virginia	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Male	122,922	46.9	12,611	49.2	12,524	48.4	92,068	46.5	44,532	49.3	3,471,895	49.0
Female	139,378	53.1	13,016	50.8	13,357	51.6	105,722	53.5	45,863	50.7	3,606,620	51.0
Total	262,300	—	25,627	—	25,881	—	197,790	—	90,395	—	7,078,515	--

Table 2.5-4 Estimated Age Distribution of Population in 2000 Within 16-km (10-mi.) of the ESP Site

Age Group	0 to 2 km (0–1.2 mi.)		2 to 4 km (1.2–2.5 mi.)		4 to 6 km (2.5–3.7 mi.)		6 to 8 km (3.7–5.0 mi.)		8 to 10 km (5.0–6.2 mi.)		10 to 16 km (6.2–10 mi.)	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
0–19	53	27.6	200	28.8	412	29.8	394	29.8	656	29.5	2885	29.9
20–24	8	4.2	36	5.2	64	4.6	66	5.0	110	4.9	471	4.9
25–44	62	32.3	220	31.7	434	31.4	420	31.8	694	31.2	3,000	31.1
45–64	46	24.0	171	24.6	333	24.1	318	24.1	536	24.1	2,294	23.8
65+	23	12.0	68	9.8	140	10.1	124	9.4	229	10.3	991	10.3

Table 2.5-5 Estimated Income Distribution of Population Within 16-km (10-mi) of the ESP Site (for ages greater than 15)

Income Group*	0 to 2 km (0–1.2 mi.)		2 to 4 km (1.2–2.5 mi.)		4 to 6 km (2.5–3.7 mi.)		6 to 8 km (3.7–5.0 mi.)		8 to 10 km (5.0–6.2 mi.)		10 to 16 km (6.2–10 mi.)	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
$0	18	12.3	65	12.6	119	11.4	114	11.2	189	11.1	822	11.1
$1–$25	75	51.4	249	48.3	482	46.0	465	45.6	789	46.5	3,344	45.2
$25–$50	40	27.4	143	27.7	297	28.3	297	29.1	480	28.3	2,127	28.7
$50–$75	9	6.2	43	8.3	103	9.8	98	9.6	166	9.8	742	10.0
$75–$100	2	1.4	9	1.7	26	2.5	27	2.6	42	2.5	197	2.7
$100+	2	1.4	7	1.4	21	2.0	18	1.8	32	1.9	168	2.3
Total	146	—	516	—	1,048	—	1,019	—	1,698	—	7,400	—

* All incomes are in thousands of dollars.

Table 2.5-6 Racial & Ethnic Distribution of Population in 2000 Within 16-km (10-mi.) of the ESP Site

Race Group	0 to 2 km (0–1.2 mi.)		2 to 4 km (1.2–2.5 mi.)		4 to 6 km (2.5–3.7 mi.)		6 to 8 km (3.7–5.0 mi.)		8 to 10 km (5.0–6.2 mi.)		10 to 16 km (6.2–10 mi.)	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
White	198	94.3	615	85.8	1,171	84.0	1,032	76.4	1,748	78.8	8,041	83.6
Black	10	4.8	83	11.6	187	13.4	290	21.5	437	19.7	1,302	13.5
Indian	2	1.0	1	0.1	7	0.5	5	0.4	2	0.1	41	0.4
Asian	0	0.0	2	0.3	15	1.1	1	0.1	9	0.4	57	0.6
Hawaiian	0	0.0	0	0.0	0	0.0	0	0.0	1	0.0	4	0.0
Other	0	0.0	1	0.1	1	0.1	4	0.3	0	0.0	24	0.2
Multi	0	0.0	15	2.1	13	0.9	19	1.4	21	0.9	152	1.6
Hispanic	2	1.0	10	1.4	12	0.9	5	0.4	14	0.6	92	1.0
Total*	210	—	717	—	1,394	—	1,351	—	2,218	—	9,621	—

* Total does not include Hispanic category.

Table 2.5-7 Income Distribution of Population in the Major Employee-Contributing Counties and Virginia (For Ages Greater Than 15)

Race Group	Henrico		Louisa		Orange		City of Richmond		Spotsylvania		Virginia	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
$0	17,410	8.4	2,319	11.3	2,364	11.3	15,444	9.6	7,468	11.0	594,604	10.6
< $25	85,966	41.4	10,678	52.2	10,312	49.1	90,896	56.5	27,350	40.4	2,627,798	46.7
$25 - $50	67,249	32.4	5,360	26.2	5,762	27.5	37,779	23.5	20,517	30.3	1,449,617	25.8
$50 - $75	21,065	10.1	1,429	7.0	1,693	8.1	9,216	5.7	8,299	12.3	521,861	9.3
$75- $100	7,515	3.6	360	1.8	373	1.8	3,128	1.9	2,189	3.2	208,019	3.7
$100+	8,502	4.1	314	1.5	484	2.3	4,346	2.7	1,843	2.7	221,729	3.9
Total	207,707	—	20,460	—	20,988	—	160,809	—	67,666	—	5,623,628	—

*All incomes are in thousands of dollars.

Table 2.5-8 Population Distribution from 2000 to 2040 Within 80-km (50-mi) of the ESP Site

Year	0 to 16 km (0 – 10 mi.)	16 to 40 km (10–24.9 mi.)	40 to 60 km (24.9–37.3 mi.)	60 to 80 km (37.3– 50 mi.)	Total
2000	15,511	185,456	487,842	849,347	1,538,156
2010*	20,996	239,813	604,455	984,645	1,849,908
2020*	26,480	294,169	721,067	1,119,943	2,161,660
2030*	31,965	348,526	837,680	1,255,241	2,473,411
2040*	37,449	402,883	954,292	1,390,539	2,785,163

* All populations in this year are estimates.

Table 2.5-9 Estimated Sex Distribution of Population in 2000 Within 80-km (50-mi.) of the ESP Site

	0 to 16 km (0 – 10 mi.)		16 to 40 km (10 – 24.9 mi.)		40 to 60 km (24.9–37.3 mi.)		60 to 80 km (37.3 – 50 mi.)		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Male	7,636	49.2	90,484	48.8	236,507	48.5	411,186	48.4	745,813	48.5
Female	7,875	50.8	94,972	51.2	251,335	51.5	438,168	51.6	792,350	51.2
Total	15,511	—	185,456	—	487,842	—	849,354	—	1,538,163	—

Table 2.5-10 Estimated Age Distribution of Population in 2000 Within 80-km (50-mi) of the ESP Site

Age Group	0 to 16 km (0 – 10 mi.)		16 to 40 km (10 – 24.9 mi.)		40 to 60 km (24.9–37.3 mi.)		60 to 80 km (37.3 – 50 mi.)		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
0 to 19	4,600	29.8	53,939	29.1	138,057	28.3	246,080	29.0	442,676	28.8
20 to 24	755	4.9	11,006	5.9	27,944	5.7	59,135	7.0	98,840	6.4
25 to 44	4,830	31.2	56,643	30.5	157,037	32.2	270,643	32.0	489,153	31.8
45 to 64	3,698	23.9	43,210	23.3	111,462	22.8	190,145	22.4	348,515	22.7
65+	1,575	10.2	20,640	11.1	53,355	10.9	83,352	9.8	158,922	10.3
Total*	15,458	—	185,438	—	487,855	—	849,355	—	1,538,106	—

* Differences in totals are due to calculation round-off.

Table 2.5-11 Racial & Ethnic Distribution of Population in 2000 Within 80-km (50-mi) of the Site

Race Group	0 to 16 km (0–10 mi.)		16 to 40 km (10–24.9 mi.)		40 to 60 km (24.9–37.3 mi.)		60 to 80 km (37.3–50 mi.)		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
White	12,805	82.6	146,841	79.2	392,074	80.4	543,709	64.0	1,095,429	71.2
Black	2309	14.9	31,687	17.1	69,776	14.3	253,248	29.8	357,020	23.2
Indian	58	0.4	607	0.3	1452	0.3	2972	0.3	5,089	0.3
Asian	84	0.5	1,767	1.0	12,632	2.6	18,690	2.2	33,173	2.2
Hawaiian	5	0.0	66	0.0	202	0.0	555	0.1	828	0.1
Other	30	0.2	1,744	0.9	4,257	0.9	14,282	1.7	20,313	1.3
Multi	220	1.4	2,744	1.5	7,449	1.5	15,891	1.9	26,304	1.7
Hispanic	135	0.9	4,276	2.3	11,285	2.3	31,374	3.7	47,070	3.1
Total*	15,511	—	185,456	—	487,842	—	849,347	—	1,538,156	—

* Total does not include Hispanic category.

Table 2.5-12 Racial and Ethnic Distribution of Population in the Major Employee-Contributing Counties and Virginia

Race Group	Henrico		Louisa		Orange		City of Richmond		Spotsylvania		Virginia	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
White	180,761	68.9	19,617	76.5	21,833	84.4	75,744	38.3	74,924	82.9	5,120,110	72.3
Black	64,805	24.7	5530	21.6	3566	13.8	113,108	57.2	11,255	12.5	1,390,293	19.6
Indian	920	0.4	108	0.4	53	0.2	479	0.2	288	0.3	21,172	0.3
Asian	9451	3.6	64	0.3	88	0.3	2471	1.2	1243	1.4	261,025	3.7
Hawaiian	82	0.0	3	0.0	5	0.0	157	0.1	45	0.1	3946	0.1
Other	2562	1.0	46	0.2	102	0.4	2948	1.5	941	1.0	138,900	2.0
Multi	3719	1.4	259	1.0	234	0.9	2883	1.5	1699	1.9	143,069	2.0
Hispanic	5946	2.3	182	0.7	330	1.3	5074	2.6	2536	2.8	329,540	4.7
Total*	262,300	—	25,627	—	25,881	—	197,790	—	90,395	—	7,078,515	—

* Total does not include Hispanic category.

Table 2.5-13 Estimated Income Distribution of Population Within 80-km (50-mi) of the ESP Site (For Ages Greater Than 15)

Income Group[a]	0 to 16 km (0 – 10 mi.)		16 to 40 km (10 – 24.9 mi.)		40 to 60 km (24.9–37.3 mi.)		60 to 80 km (37.3 – 50 mi.)		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
$0	1327	11.2	15,406	10.6	36,982	9.7	67,138	10.1	120,853	10.0
$1–$25	5404	45.7	66,395	45.9	163,203	42.8	297,535	44.7	532,537	44.2
$25 - $50	3384	28.6	40,735	28.1	113,734	29.8	186,066	28.0	343,919	28.6
$50 - $75	1161	9.8	14,365	9.9	39,156	10.3	66,472	10.0	121,154	10.1
$75-$100	303	2.6	4,013	2.8	14,533	3.8	23,955	3.6	42,804	3.6
$100+	248	2.1	3,874	2.7	14,151	3.7	24,112	3.6	42,385	3.5
Total	11,827	—	144,788	—	381,759	—	665,278	—	1,203,652	—

a. All incomes are in thousands of dollars.

Table 2.5-14 Age Distribution of Population in the Major Employee-Contributing Counties and Virginia

Age Group	Henrico		Louisa		Orange		City of Richmond		Spotsylvania		Virginia	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
0 to 19	69,875	26.6	6,787	26.5	6,499	25.1	50,724	25.6	29,131	32.2	1,937,086	27.4
20 to 24	15,380	5.9	1,159	4.5	1,134	4.4	18,386	9.3	4,603	5.1	480,574	6.8
25 to 44	86,166	32.9	7,656	29.9	7,184	27.8	62,712	31.7	29,062	32.2	2,237,655	31.6
45 to 64	58,278	22.2	6,710	26.2	6,620	25.6	39,839	20.1	20,073	22.2	1,630,867	23.0
65+	32,601	12.4	3,315	12.9	4,444	17.2	26,129	13.2	7,526	8.3	792,333	11.2
Total	262,300	—	25,627	—	25,881	—	197,790	—	90,395	—	7,078,515	—

Table 2.5-15 Population Distribution Table

	Distances (km)								
Sectors	**0–2**	**2–4**	**4–6**	**6–8**	**8–10**	**10–16**	**16–40**	**40–60**	**60–80**
North									
Present Date (2002)	0	25	125	149	254	262	9,688	11,808	32,461
Startup Date (2025)	0	49	246	293	498	512	14,710	15,276	41,822
40-year Date (2040)	0	65	324	386	656	676	17,985	17,537	47,926
North-Northeast									
Present Date (2002)	20	93	19	131	170	856	14,662	34,780	133,414
Startup Date (2025)	38	181	36	256	333	1,676	28,608	63,124	209,729
40-year Date (2040)	51	239	48	338	439	2,211	37,704	81,610	259,500
Northeast									
Present Date (2002)	2	10	262	187	142	784	81,323	63,006	60,243
Startup Date (2025)	4	19	512	365	278	1,535	137,973	117,941	93,921
40-year Date (2040)	6	25	676	482	366	2,025	174,918	153,768	115,885
East-Northeast									
Present Date (2002)	0	37	80	25	0	1,432	13,493	8,733	18,066
Startup Date (2025)	0	73	156	49	0	2,804	25,376	12,790	24,452
40-year Date (2040)	0	96	206	65	0	3,698	33,126	15,436	28,616
East									
Present Date (2002)	0	87	49	50	158	741	8,123	2,193	4,565
Startup Date (2025)	0	171	96	98	310	1,450	11,234	2,872	5,824
40-year Date (2040)	0	225	127	130	408	1,912	13,262	3,315	6,644
East-Southeast									
Present Date (2002)	0	16	187	206	77	724	7,305	4,783	9,717
Startup Date (2025)	0	32	365	404	152	1,372	9,609	6426	12,800
40-year Date (2040)	0	42	482	532	200	1,794	11,111	7498	14,811
Southeast									
Present Date (2002)	0	136	15	40	42	485	5,537	40,418	68,717
Startup Date (2025)	0	205	22	60	63	782	9,249	66,451	106,438
40-year Date (2040)	0	251	27	73	77	976	11,669	83,429	131,038

Table 2.5-15 Population Distribution Table

	Distances (km)								
Sectors	**0–2**	**2–4**	**4–6**	**6–8**	**8–10**	**10–16**	**16–40**	**40–60**	**60–80**
South-Southeast									
Present Date (2002)	39	12	52	71	125	717	8,239	220,811	374,800
Startup Date (2025)	58	17	79	107	188	1,089	13,731	304,881	447,880
40-year Date (2040)	71	21	96	131	229	1,332	17,312	359,710	495,541
South									
Present Date (2002)	61	2	128	13	119	487	6,648	17,891	48,351
Startup Date (2025)	92	3	193	19	180	734	10,192	29,482	73,642
40-year Date (2040)	112	4	235	23	220	896	12,503	37,042	90,136
South-Southwest									
Present Date (2002)	0	37	0	243	25	314	6,366	6,531	7,437
Startup Date (2025)	0	55	0	366	38	474	9,173	10,313	11,488
40-year Date (2040)	0	67	0	447	46	578	11,003	12,780	14,130
Southwest									
Present Date (2002)	10	30	13	0	140	963	3,280	3,852	6,072
Startup Date (2025)	16	46	19	0	212	1,453	4,955	6,814	8,750
40-year Date (2040)	19	56	23	0	258	1,773	6,047	8,746	10,496
West-Southwest									
Present Date (2002)	0	14	65	121	322	866	6,142	16,351	8,600
Startup Date (2025)	0	21	98	183	486	1,308	9,814	31,685	13,010
40-year Date (2040)	0	25	119	224	594	1,596	12,208	41,685	15,886
West									
Present Date (2002)	85	117	2	46	141	271	4,655	33,491	78,028
Startup Date (2025)	128	177	3	69	213	409	7,021	44,190	100,553
40-year Date (2040)	156	216	4	85	260	499	8,565	51,167	115,244
West-Northwest									
Present Date (2002)	0	95	168	50	213	276	6,980	14,230	12,016
Startup Date (2025)	0	144	254	76	322	476	10,028	22,879	19,679
40-year Date (2040)	8	175	310	93	393	607	12,017	28,519	24,676

Table 2.5-15 Population Distribution Table

	Distances (km)								
Sectors	**0–2**	**2–4**	**4–6**	**6–8**	**8–10**	**10–16**	**16–40**	**40–60**	**60–80**
Northwest									
Present Date (2002)	0	26	229	53	423	475	7,582	9,939	3,231
Startup Date (2025)	0	39	346	95	828	909	10,658	11,573	3,675
40-year Date (2040)	0	48	422	123	1,093	1,192	12,665	12,638	3,965
North-Northwest									
Present Date (2002)	4	25	99	63	19	660	6,304	22,349	10,688
Startup Date (2025)	6	49	194	124	36	1,292	9,018	32,677	13,930
40-year Date (2040)	8	65	256	163	48	1,704	10,787	39,412	16,044
Annual Total									
Present Date (2002)	221	762	1,492	1,448	2,372	10,313	196,327	511,165	876,407
Startup Date (2025)	343	1,282	2,620	2,565	4,137	18,276	321,348	779,373	1,187,592
40-year Date (2040)	422	1,621	3,355	3,293	5,288	23,469	402,883	954,292	1,390,539

Cumulative Total	**0–80 km**
Present Date (2002)	1,600,506
Startup Date (2025)	2,317,535
40-year Date (2040)	2,785,163

Table 2.5-16 Lake Anna Recreational Facilities

Facility	Distance	Number of Wet Slips	Number of Ramps	Camp Sites
Marinas				
Anna Point	2.3 miles NNW	25	1	—
Dukes Creek	2.2 miles E	55	5	—
High Point	2.3 miles NNW	50	4	—
Lake Anna	1.4 miles NNE	160	2	—
Rocky Branch	2.3 miles NNE	—	4	—
Sturgeon Creek	2 miles N	36	5	—
Public Landings				
Christopher Run Campground	6 miles WNW	—	1	152
Hunters Landing	6.6 miles NW	—	1	—
Lake Anna Campground	2.5 miles NW	—	1	61
Lake Anna Landing	9 miles NW	—	1	—
Lake Anna State Park	4.3 miles NNW	—	2	—
Pleasants Landing	5.6 miles SE	—	1	—
Sullivan's Landing	8 miles NW	—	1	—
Total		326	29	213

Source: Reference 4, Table 2.1-1.
Note: "—"means no data was reported in source.

Table 2.5-17 Tourist Attractions, Parks and Recreational Areas

Facility	Location	Annual Usage	Peak Daily Usage *	Comments
Lake Anna Recreational Usage	1.4 Mi, NNE	530,000	5900 **	Annual usage based on 180 days at 2,950 people per day.
Waste Heat Treatment Facility	—	90,000	<1,000	Peak daily usage based on doubling the resident population in cooling lagoon sectors (one guest per resident). Annual usage based on 180 days at 500 people per day.
Lake Anna State Park	2.8 Mi, NNW	187,300	4370	Annual use was 187,300 between July 1, 2001 and June 2002. Park closed in winter. Use includes occupants of boats launched at the park.
Paramount's Kings Dominion Amusement Park	35 Mi, SE	2,875,000	20,835	Annual use was 2 to 2.5 million between March and November. Add 15% to calculate maximum capacity. Park closed in winter.

* Peak daily usage is based on a peak weekend day during the summer.

** This number is based on an average of 3 persons per boat, campsite and picnic area.

Table 2.5-18 Employment and Income Statistics by State, County, and City

	Work Force (November 2002)[a]	Unemployment (% November 2002)[a]	Poverty (% Estimated 1999)[b]	Median Household Income (1999)[b]
Hanover County	50,114	2.4	4.2	$58,082
Henrico	147,138	3.3	6.7	$47,903
Louisa	10,577	5.3	9.0	$38,177
Orange	12,364	3.9	8.9	$41,285
City of Richmond	100,290	5.8	17.9	$30,169
Spotsylvania	48,534	2.2	5.5	$55,534
Commonwealth of Virginia	3,773,075	3.6	9.0	$44,848
State of Maryland	2,908,759	3.9	8.0	$49,781
Charles County, MD	65,349	2.8	6.5	$57,408

a. Virginia Employment Commission; Maryland Department of Labor, Licensing and Regulation.

b. 2000 Census Data.

Table 2.5-19 Major Employers in Louisa County, Virginia

Employer	Product	Number of Employees
Dominion Energy	Power Generation	1500
Kloeckner-Pentaplast	Rigid PVC	630
Klearfold, Inc.	Plastic Packing	176
Tradewinds of Virginia	Wood Products	130
Tri-Dim	Filters	100

Table 2.5-20 Major Private Employers in Orange County, Virginia

Employer	Product	Employees
Von Holtzbrinck Publishing Svcs.	Book Distribution Center	305
American Woodmark Corp.	Cabinet Components	300
American Press, Inc.	Printer of Periodicals and Catalogs	250
RIDGID Products	Plumbing/Drain Equipment	211

Table 2.5-20 Major Private Employers in Orange County, Virginia

Employer	Product	Employees
A, B, &C Group	Direct Marketing	138
Battlefield Farms, Inc.	Bedding and Holiday Plants	80
General Shale	Brick	80
Klockner/Intertrans Carrier Co.	Motor Carrier/Distribution Center	72
Elcotel/Technology Service Group	Telephones and Parts	70
Zamma Corp.	Molding and Furniture Components	45
Central Virginia Newspapers, Inc.	Newspaper Publishing and Printing	34
MSAG Data Consultants, Inc.	Computer Mapping/Data	26
Atlantic Research Corp.	Rocket Propulsion Systems	25

Table 2.5-21 Major Private Employers in Spotsylvania County, Virginia

Employer	Product	Employees
Capital One	Call Center	1200
CVS Pharmacy	Distribution Center	450
General Products Company	Manufacturing	375
Diversified Mailing Services	Commercial Mailing Service	300
General Motors	Manufacturing	300
Sheridan Books	Printing	250
Rappahannock Electric Cooperative	Electric Service	250
Printpack Inc.	Flexible	180
Kaeser Compressors, Inc.	Air Compressors	175
Simmons USA	Bedding	130
E-OIR Measurements, Inc.	Sensor Technology Firm	125
Walter Grinders	Tool Grinding Machines	120
National Coach Works	Charter Motor Coach Services	115
United Parcel Service	Package Delivery/Pickup Service	110
A. Smith Bowman Distillery	Manufacturer of Distilled Spirits	100
Carlisle Motion Control	Manufacturer of Brake Lining	100
The Shockey Precast Group	Manufacturer of Precast Concrete	100

Table 2.5-22 Vacant Housing Units by County During 2000

County	Total Vacant	For Rent	For Sale Only	For Seasonal, Recreational, or Occasional Use	Remainder of Vacant Units
Henrico	4449	1970	806	454	1219
Louisa	1910	73	124	1226	487
Orange	1204	116	170	484	434
Spotsylvania	2021	359	449	564	649
Richmond City	7733	3113	849	249	3522

Table 2.5-23 Regional Fire Stations and Emergency Service Centers

Hanover County	**Orange County**	**Louisa County**
Henry Vol. Fire	Barboursville Fire Department	Louisa Vol. Fire
Mechanicsville Vol. Fire	Gordonsville Fire Department	Mineral Vol. Fire
Eastern Hanover Vol. Fire	Orange Fire Department	Bumpass Vol. Fire
Black Creek Vol. Fire	Lake of the Woods Fire Department	Holly Grove Vol. Fire
Farrington Vol. Fire	Mine Run Fire Department	Locust Creek Vol. Fire
Hanover County Vol. Fire	Rapidan Fire Department	Trevillians Vol. Fire
Beaverdam Vol. Fire	Lake of the Woods Rescue Squad	Zion Crossroad Vol. Fire
Hanover Industrial Airpark Fire	Orange County Rescue Squad	Louisa Rescue
Montpelier Vol. Fire		Mineral Rescue
Rockville Vol. Fire	**Henrico County**	Holly Grove Rescue
Ashland Vol. Fire & Rescue	5 Fire Stations & Fire Medic Units	Lake Anna Rescue
West Hanover Vol. Fire & Rescue	15 Fire Stations	
East Hanover Rescue	Fire Rescue 33 (Tuckahoe #1 VRS)	**City of Richmond**
Ashcake Rescue	Fire Rescue 34 (Tuckahoe #2 VRS)	21 Fire Companies
Emergency Operations Center	Fire Rescue 32 (Lakeside VRS)	EMS Headquarters
	Fire Rescue 31 (Henrico VRS)	

Table 2.5-24 Historic Sites in Counties Near the ESP Site

County	Number of Listed Historic Sites
Louisa	13
Spotsylvania	15
Hanover	32
Total	60

Table 2.5-25 Historic Sites within the Vicinity

Historic Site	County	Approximate Distance from ESP site	National Register of Historic Places (NRHP) Number
Andrew's Tavern	Spotsylvania	4 miles	88-136
DESCRIPTION: Samuel Andrews built Andrews Tavern in 1815. The site is currently a private residence. The building's craftsmanship, combined with its hall and parlor plan, make it a model of the Federal provincial architecture of Piedmont Virginia. The property retains a high degree of integrity, in both its buildings and setting. During its 186 years, Andrews Tavern has served as a post office, tavern, polling place, school, store, militia site, and residence. **SIGNIFICANCE:** Event, Architecture/Engineering **NOTE:** Spotsylvania Board of Supervisors removed Andrews Tavern from the historic properties register at the request of the property owner in mid-2001. It remains on the Virginia and National listings.			
Cuckoo House	Louisa	9 miles	54-16
DESCRIPTION: Captain Henry Pendleton erected the present building in 1781 on the site of an old tavern. Some are of the opinion that part of the present structure is a portion of the old Cuckoo Tavern. The home is built of brick laid in the common bond, the plan of architecture being the shape of the letter "T." Cuckoo was originally the site of an old tavern, known at one time as King's Ordinary and afterwards known as Cuckoo Tavern. Jack Jouett was the "other rider" the night of famous Paul Revere's ride to warn the Virginia General Assembly that the British were coming. It was from the Cuckoo Tavern that Jouett rode to Charlottesville to warn the Virginia General Assembly of the British approach. The tavern was the stopping place for the aristocrats. **SIGNIFICANCE:** Architecture/Engineering, Event			
Jerdone Castle	Louisa	7 miles	54-45
DESCRIPTION: It is estimated that John Jerdone erected the structure in the early 1750's. The house is a rectangular frame building, with a lean-to on the East side. It is one and one-half stories. An addition to the house was made in the 1850's. **SIGNIFICANCE:** Architecture/Engineering, Person			
Prospect Hill	Spotsylvania	9 miles	88-56
DESCRIPTION: The Holladay family has owned The Prospect Hill property since 1798. The name Prospect Hill is believed to be attributed to the extraordinary view of the surrounding country from the property site. The main house was erected in 1812. The frame structure has two stories and an attic. Waller Holladay, scholar and a poet, was educated as a lawyer; but did not practice long. He is closely linked to Thomas Jefferson and Edmund and John Randolph (of Roanoke). The home had been raided by Union soldiers. **SIGNIFICANCE:** Event, Architecture/Engineering, Person			

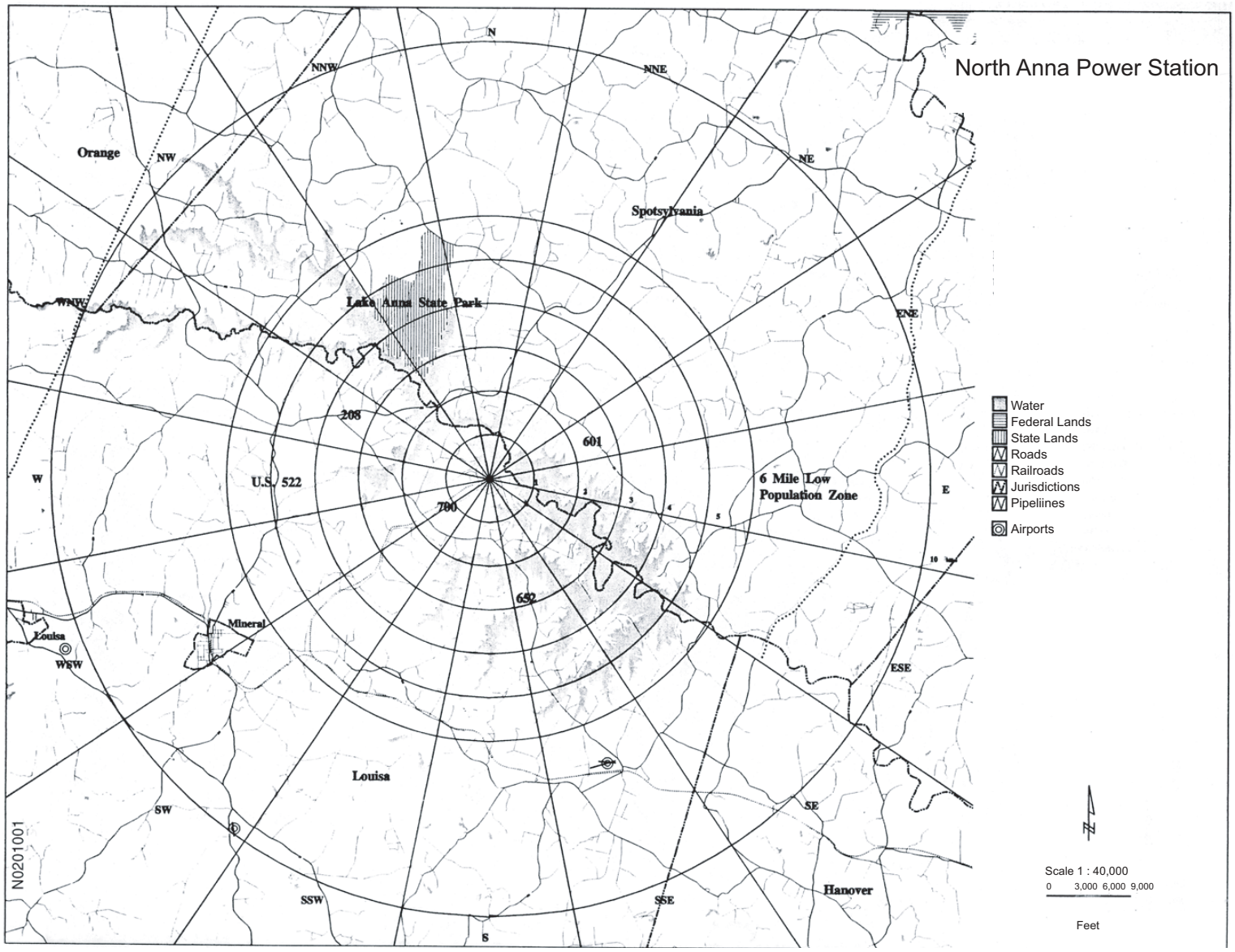


Figure 2.5-1 10-Mile Surrounding Area

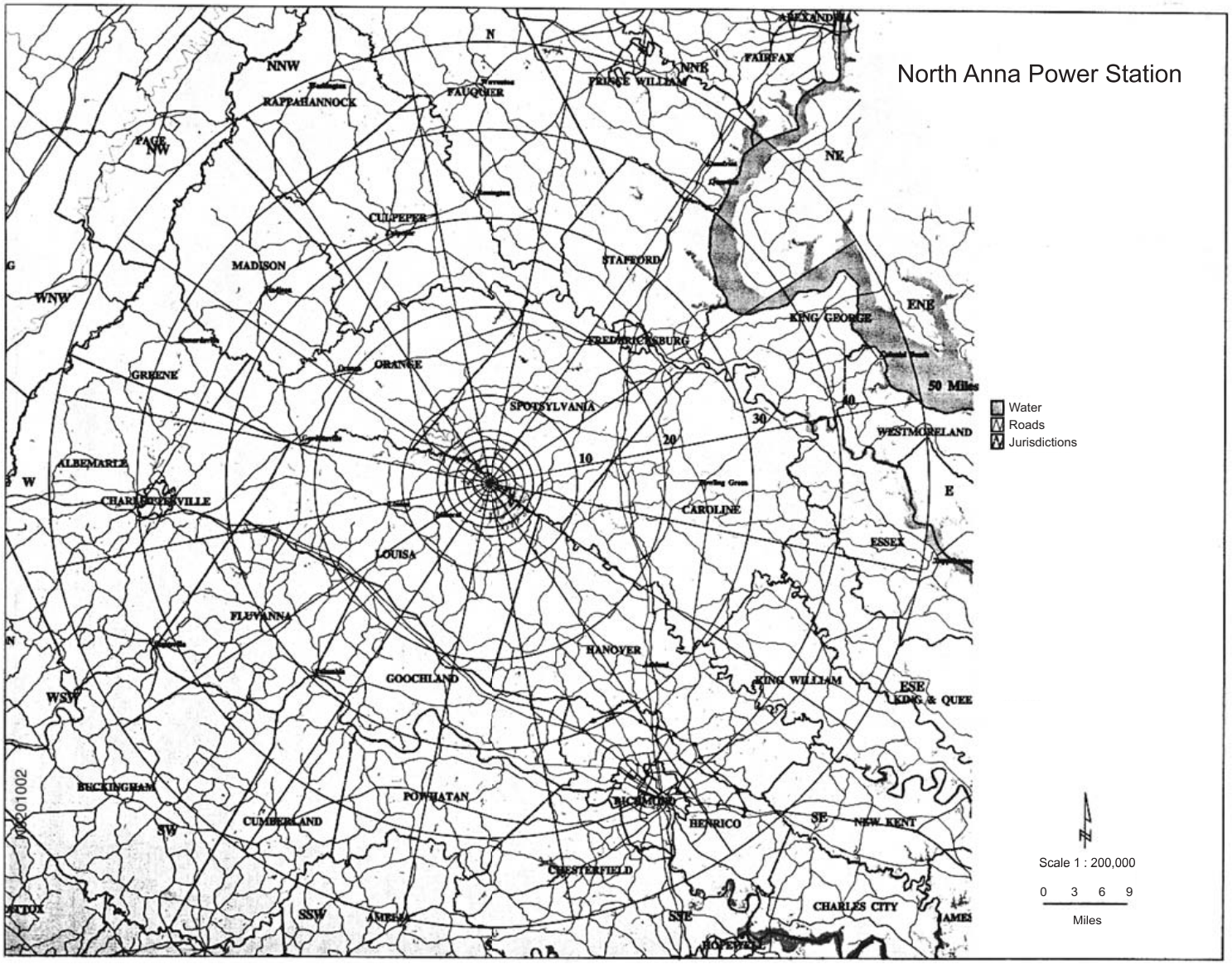
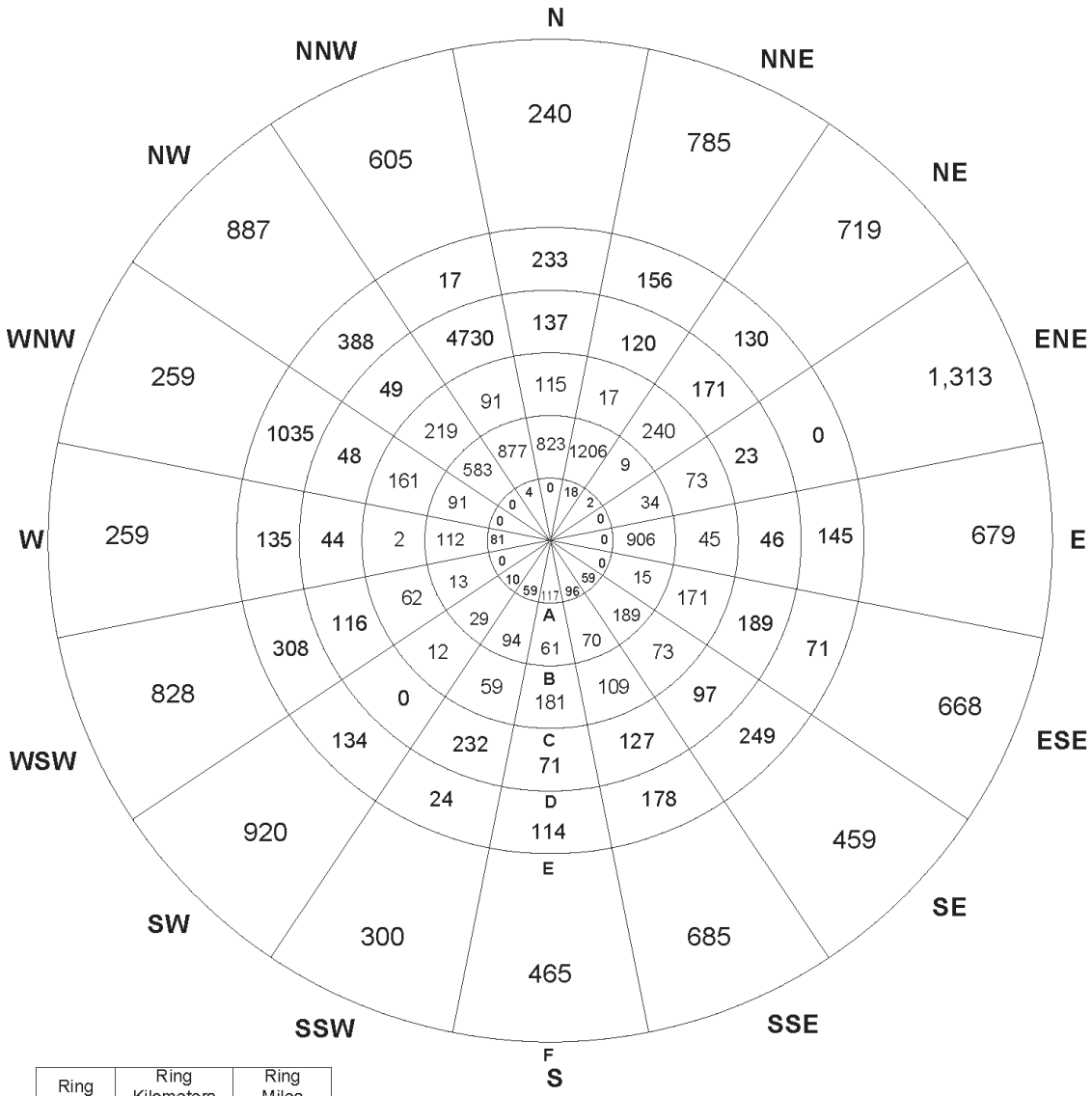
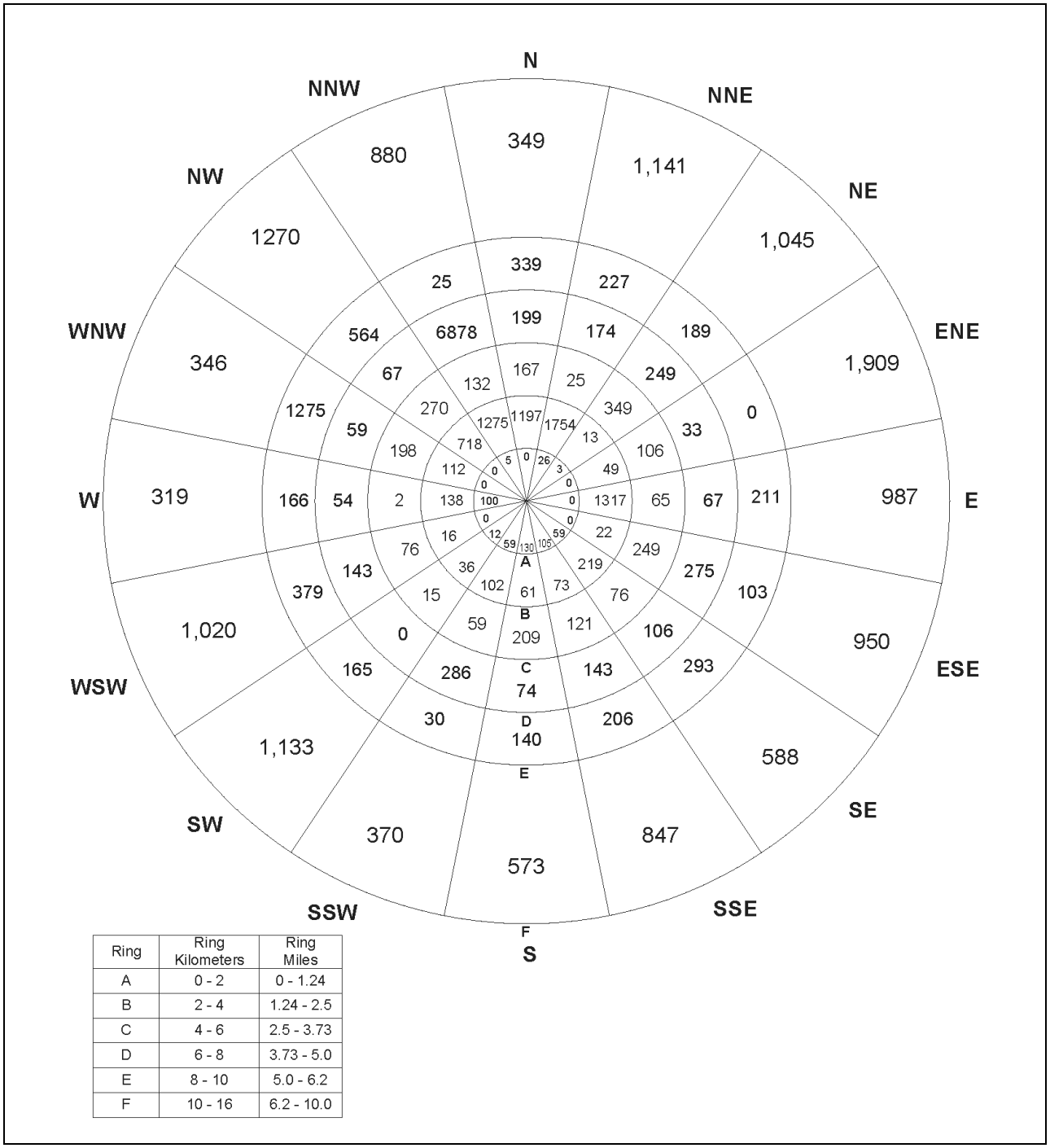


Figure 2.5-2 50-Mile Surrounding Area



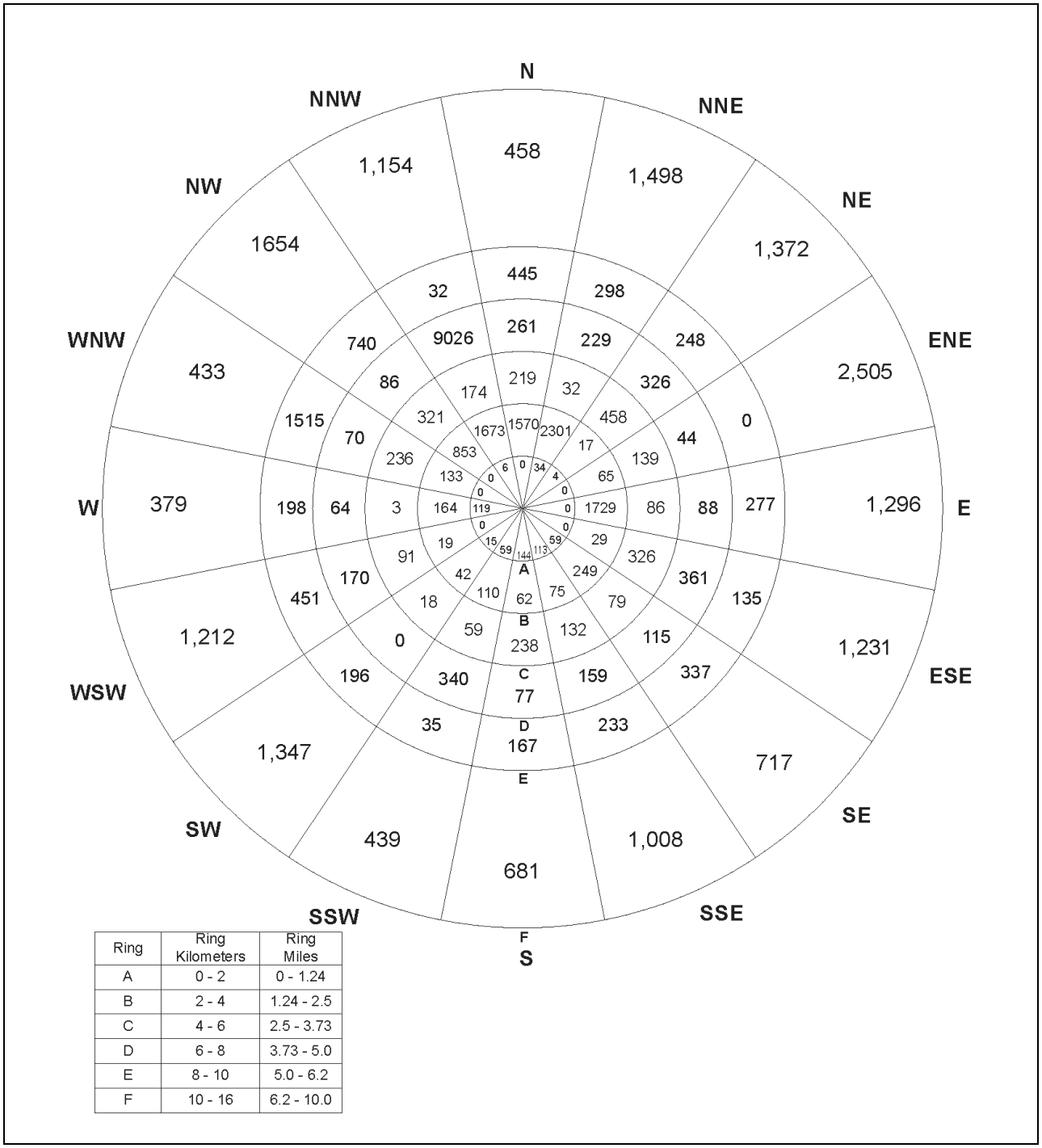
Ring	Ring Kilometers	Ring Miles
A	0 - 2	0 - 1.24
B	2 - 4	1.24 - 2.5
C	4 - 6	2.5 - 3.73
D	6 - 8	3.73 - 5.0
E	8 - 10	5.0 - 6.2
F	10 - 16	6.2 - 10.0

Figure 2.5-3 16-Kilometer (10-Mile) Resident and Transient Population Distribution–2000



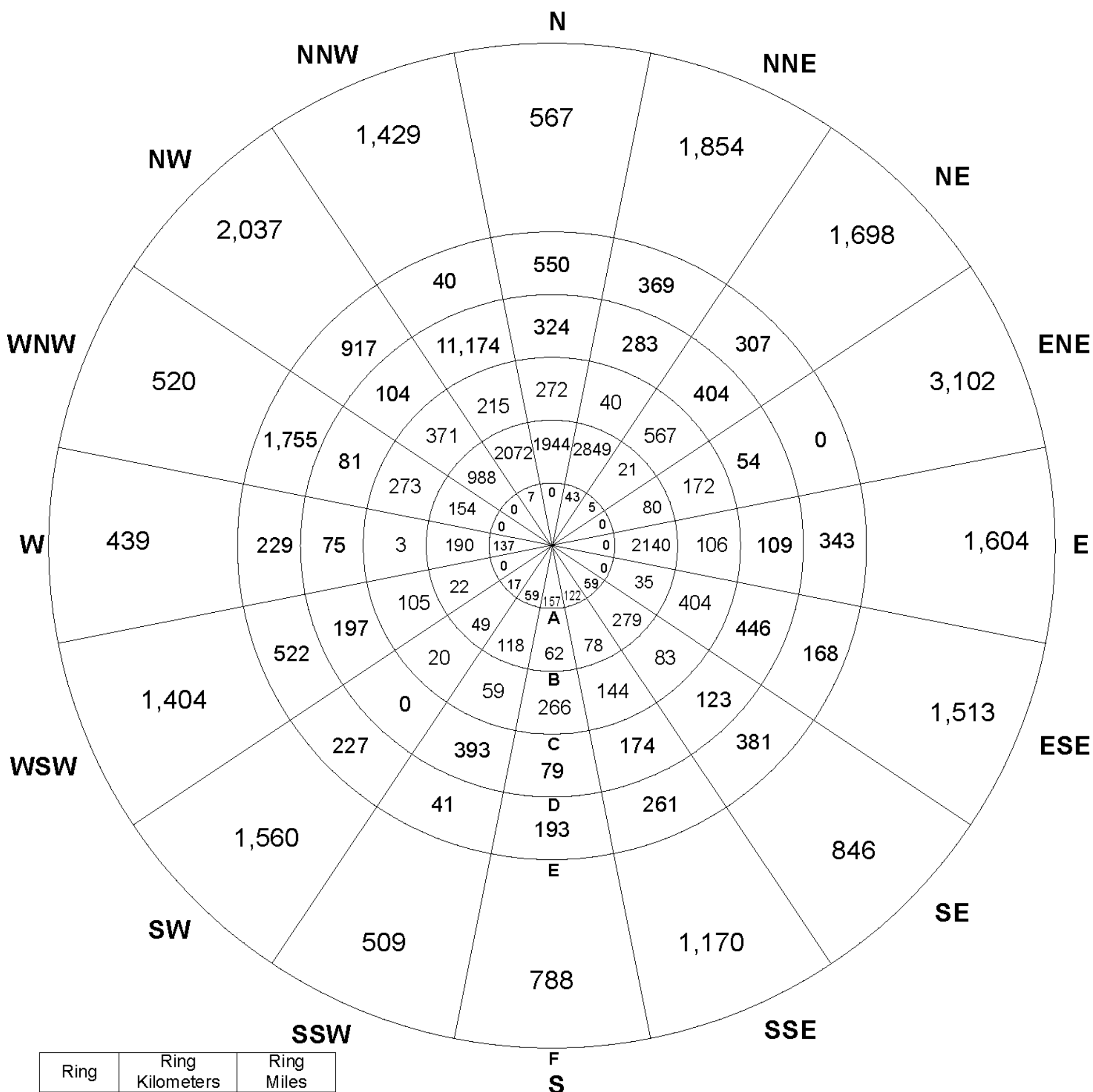
Ring	Ring Kilometers	Ring Miles
A	0 - 2	0 - 1.24
B	2 - 4	1.24 - 2.5
C	4 - 6	2.5 - 3.73
D	6 - 8	3.73 - 5.0
E	8 - 10	5.0 - 6.2
F	10 - 16	6.2 - 10.0

Figure 2.5-4 16-Kilometer (10-Mile) Resident and Transient Population Distribution–2010



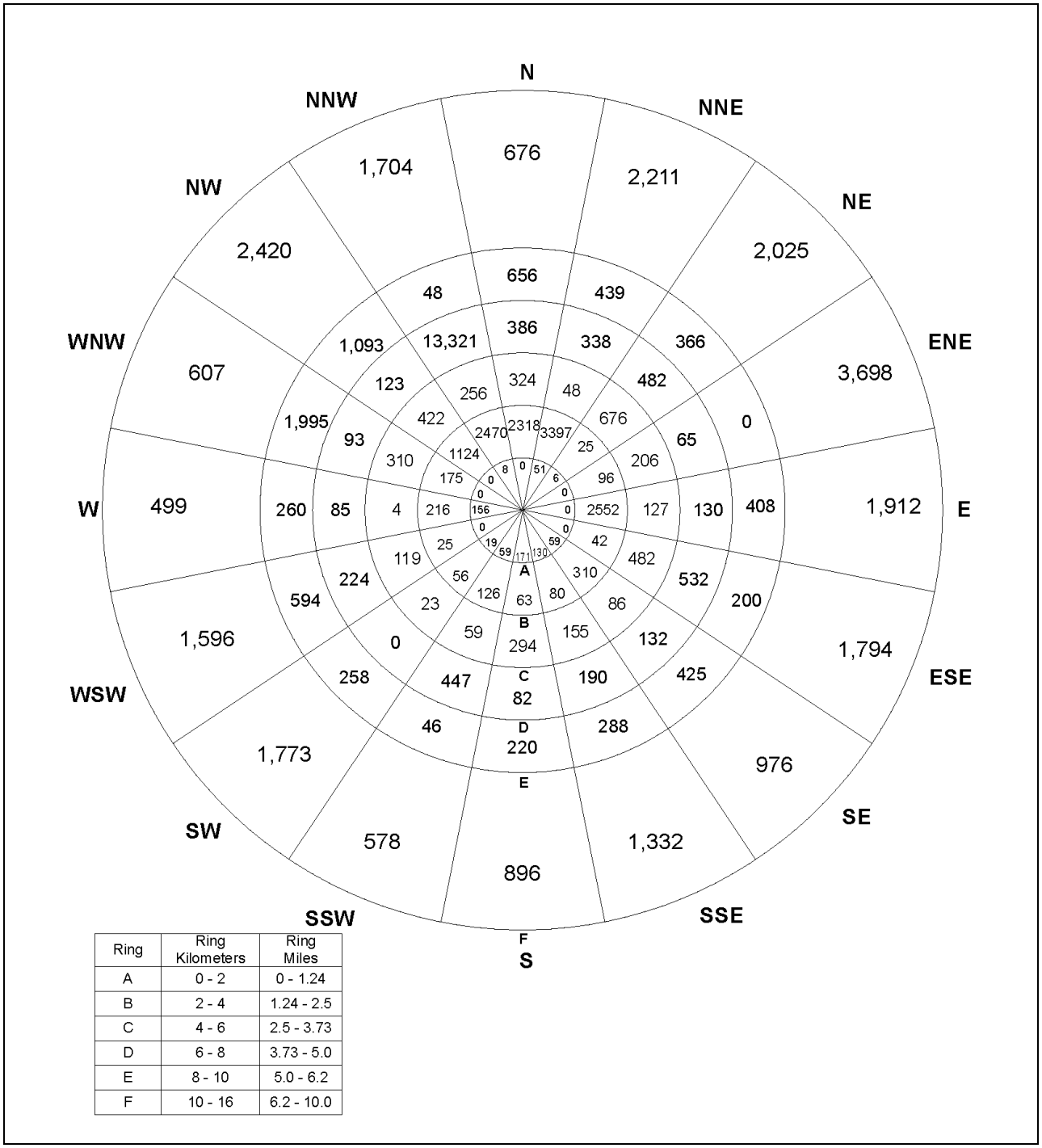
Ring	Ring Kilometers	Ring Miles
A	0 - 2	0 - 1.24
B	2 - 4	1.24 - 2.5
C	4 - 6	2.5 - 3.73
D	6 - 8	3.73 - 5.0
E	8 - 10	5.0 - 6.2
F	10 - 16	6.2 - 10.0

Figure 2.5-5 16-Kilometer (10-Mile) Resident and Transient Population Distribution–2020



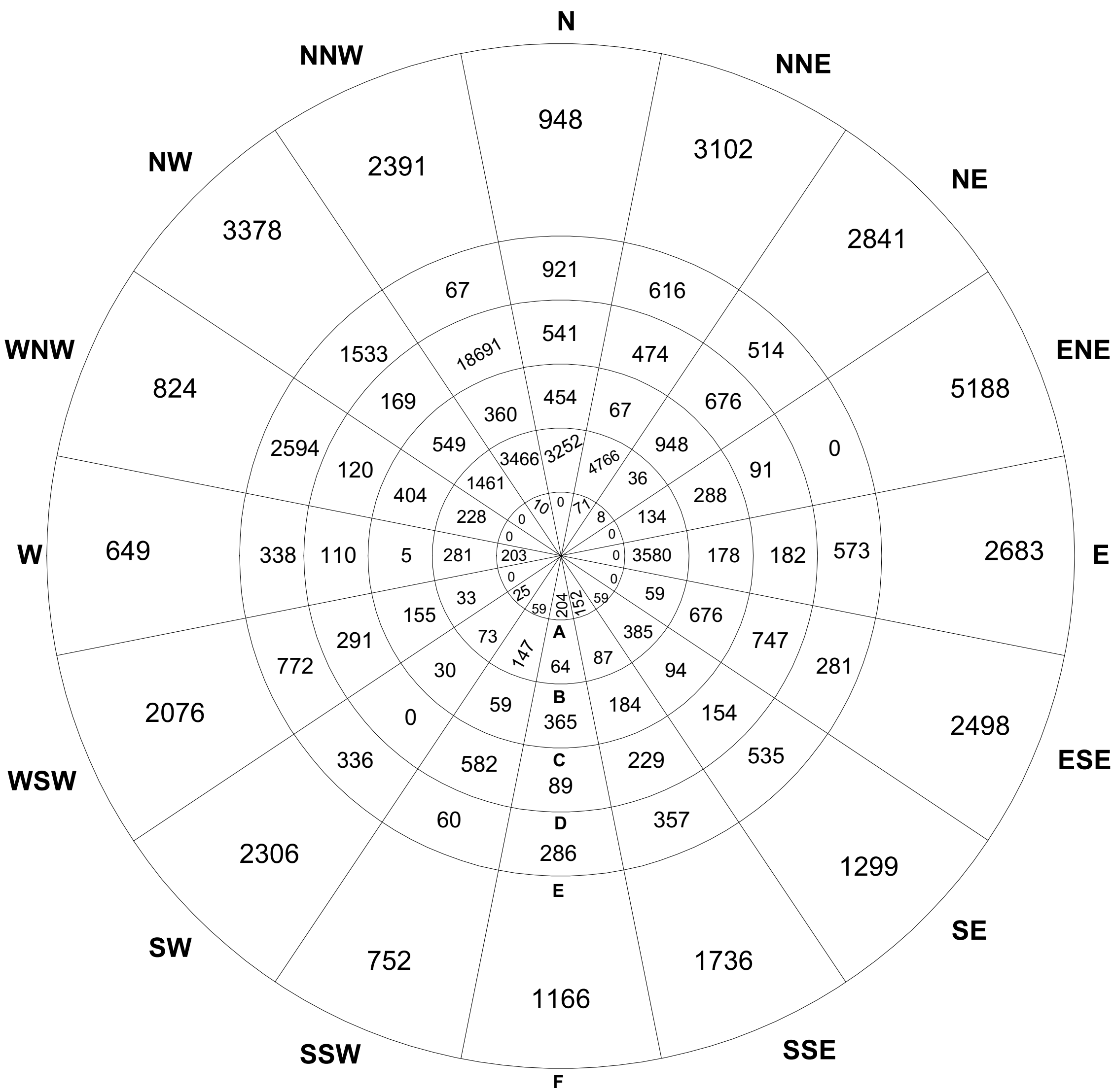
Ring	Ring Kilometers	Ring Miles
A	0 - 2	0 - 1.24
B	2 - 4	1.24 - 2.5
C	4 - 6	2.5 - 3.73
D	6 - 8	3.73 - 5.0
E	8 - 10	5.0 - 6.2
F	10 - 16	6.2 - 10.0

Figure 2.5-6 16-Kilometer (10-Mile) Resident and Transient Population Distribution–2030



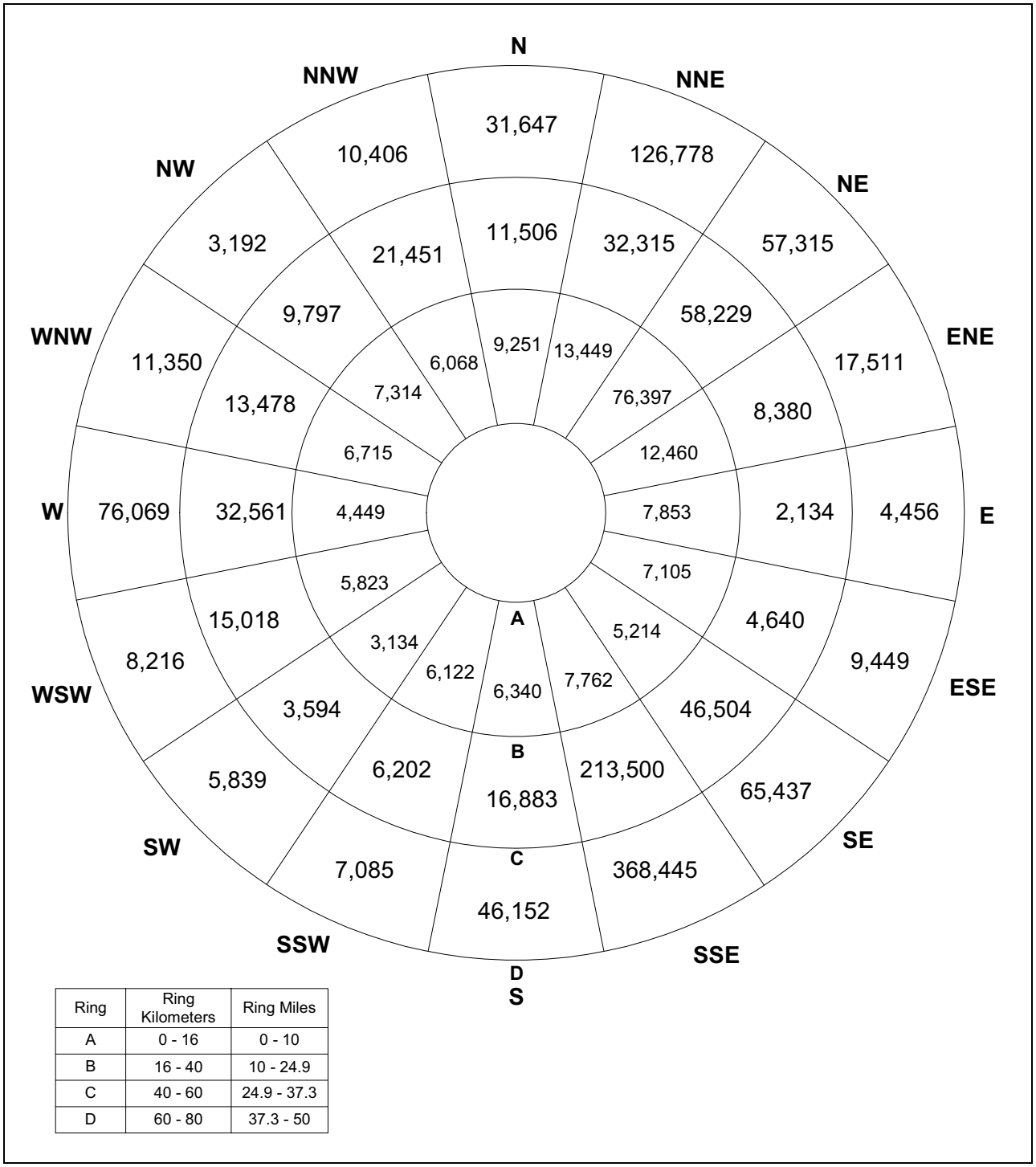
Ring	Ring Kilometers	Ring Miles
A	0 - 2	0 - 1.24
B	2 - 4	1.24 - 2.5
C	4 - 6	2.5 - 3.73
D	6 - 8	3.73 - 5.0
E	8 - 10	5.0 - 6.2
F	10 - 16	6.2 - 10.0

Figure 2.5-7 16-Kilometer (10-Mile) Resident and Transient Population Distribution–2040



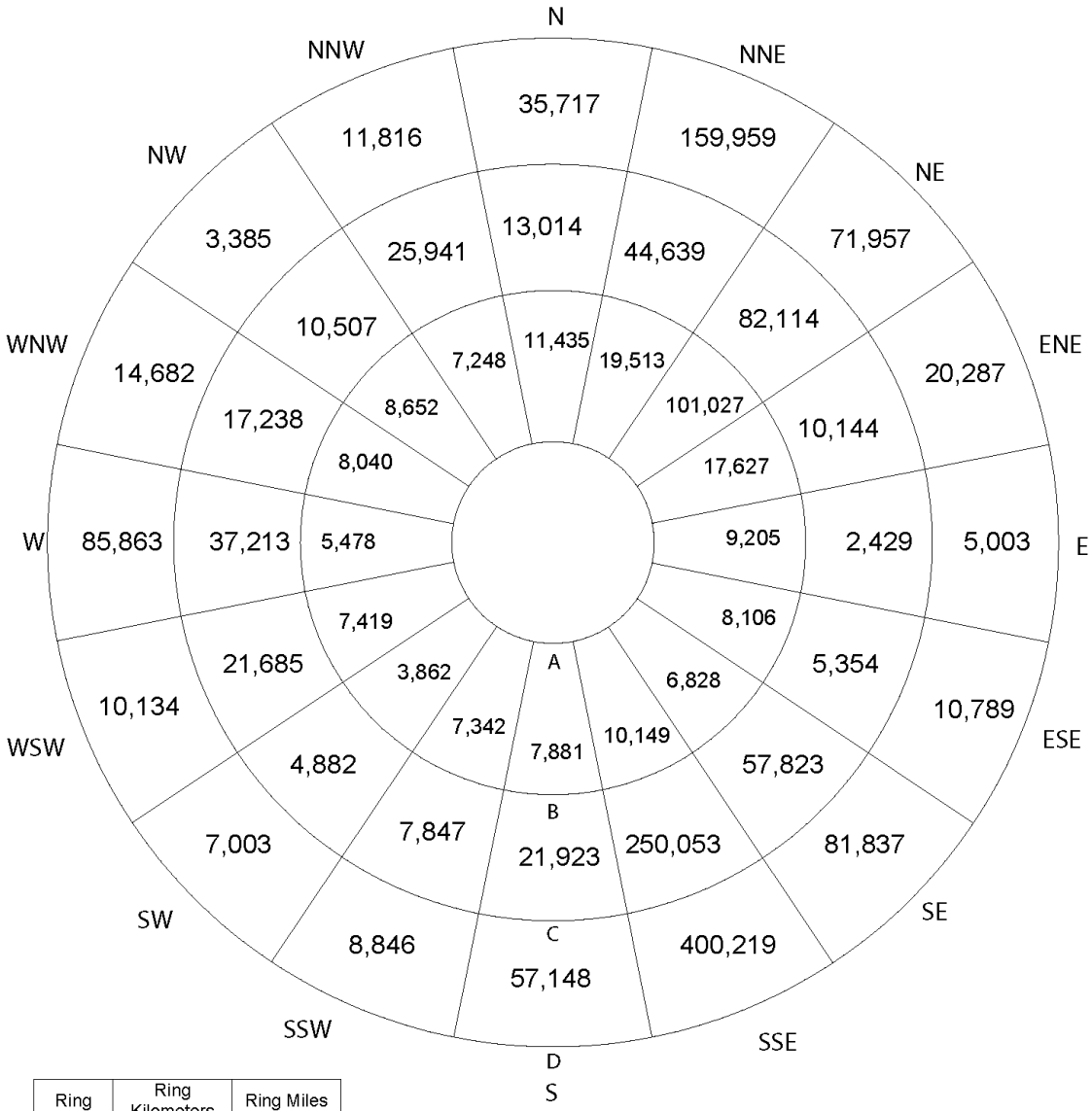
Ring	Ring Kilometers	Ring Miles
A	0 - 2	0 - 1.24
B	2 - 4	1.24 - 2.5
C	4 - 6	2.5 - 3.73
D	6 - 8	3.73 - 5.0
E	8 - 10	5.0 - 6.2
F	10 - 16	6.2 - 10.0

Figure 2.5-7A 16-Kilometer (10-Mile) Resident and Transient Population Distribution–2065



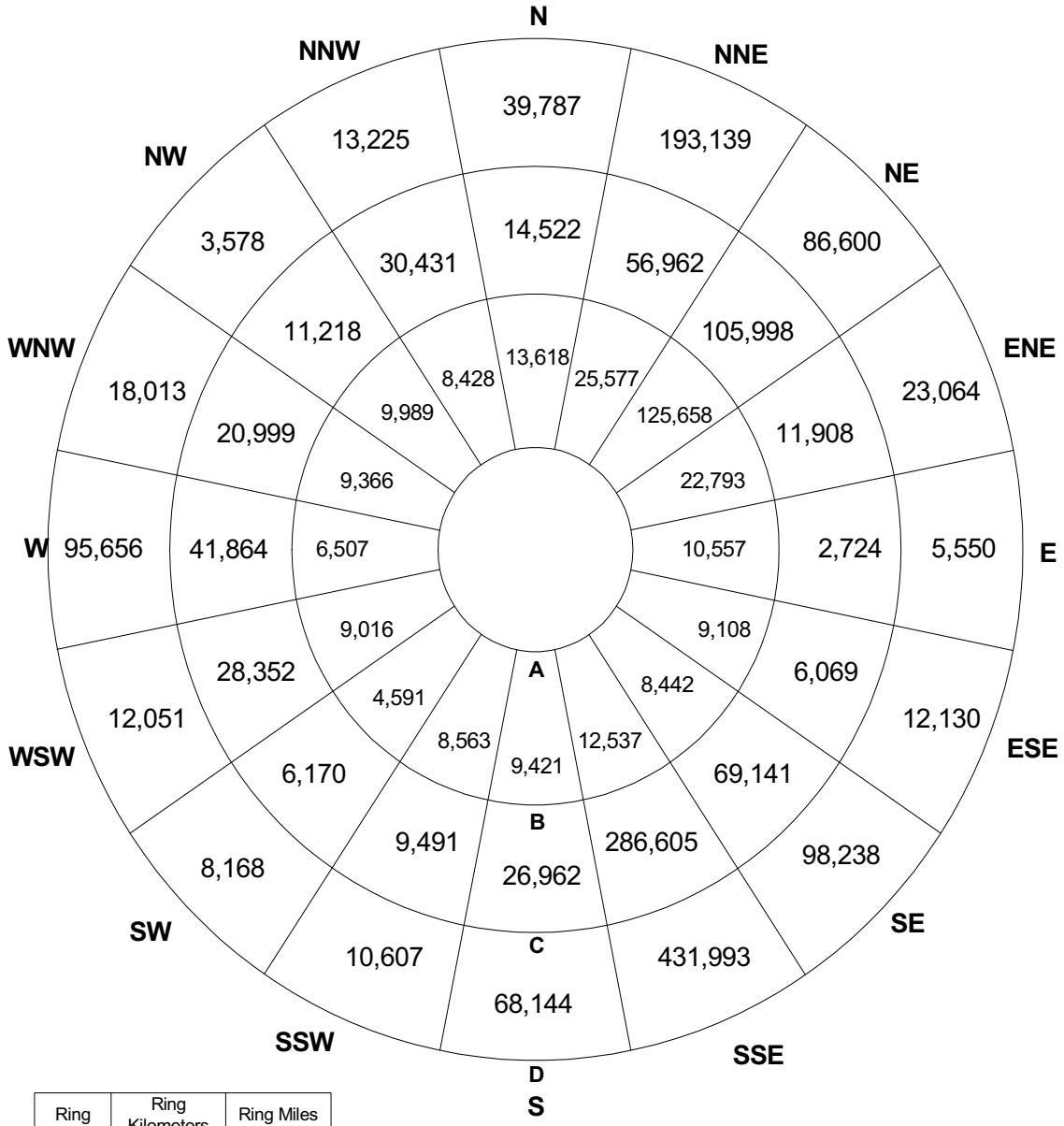
Ring	Ring Kilometers	Ring Miles
A	0 - 16	0 - 10
B	16 - 40	10 - 24.9
C	40 - 60	24.9 - 37.3
D	60 - 80	37.3 - 50

Figure 2.5-8 80-Kilometer (50-Mile) Resident and Transient Population Distribution–2000



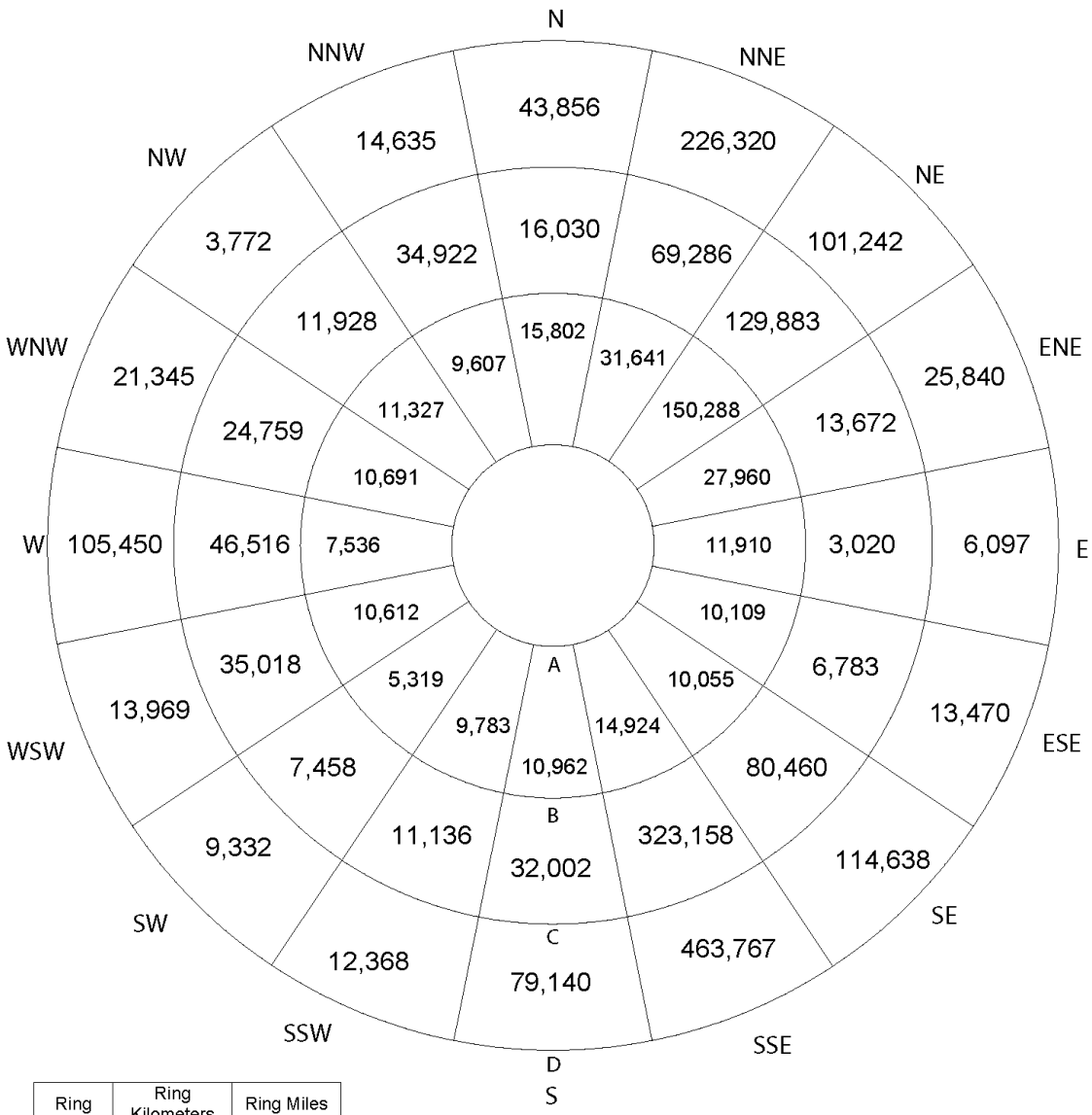
Ring	Ring Kilometers	Ring Miles
A	0 - 16	0 - 10
B	16 - 40	10 - 24.9
C	40 - 60	24.9 - 37.3
D	60 - 80	37.3 - 50

Figure 2.5-9 80-Kilometer (50-Mile) Resident and Transient Population Distribution–2010



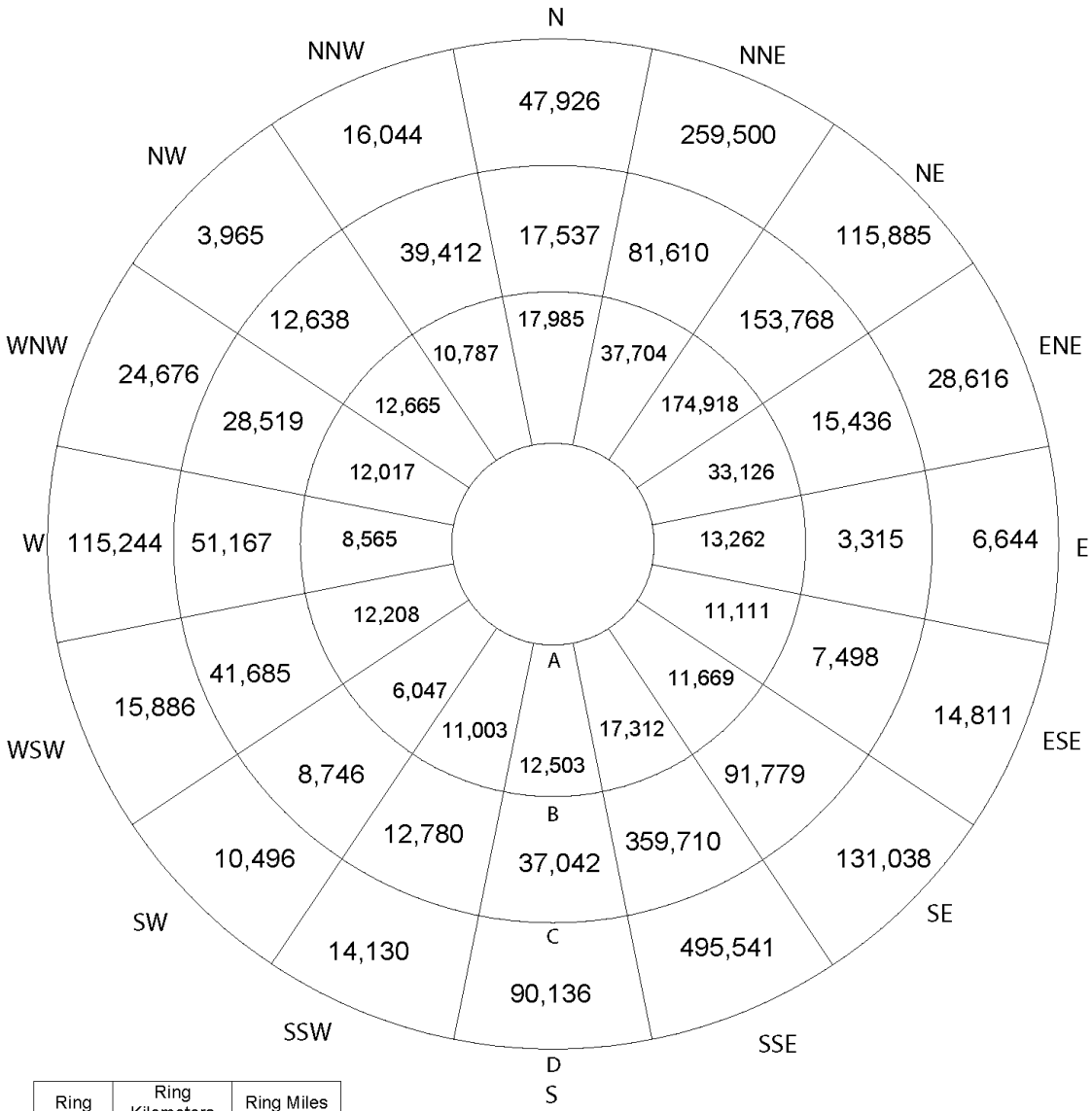
Ring	Ring Kilometers	Ring Miles
A	0 - 16	0 - 10
B	16 - 40	10 - 24.9
C	40 - 60	24.9 - 37.3
D	60 - 80	37.3 - 50

Figure 2.5-10 80-Kilometer (50-Mile) Resident and Transient Population Distribution–2020



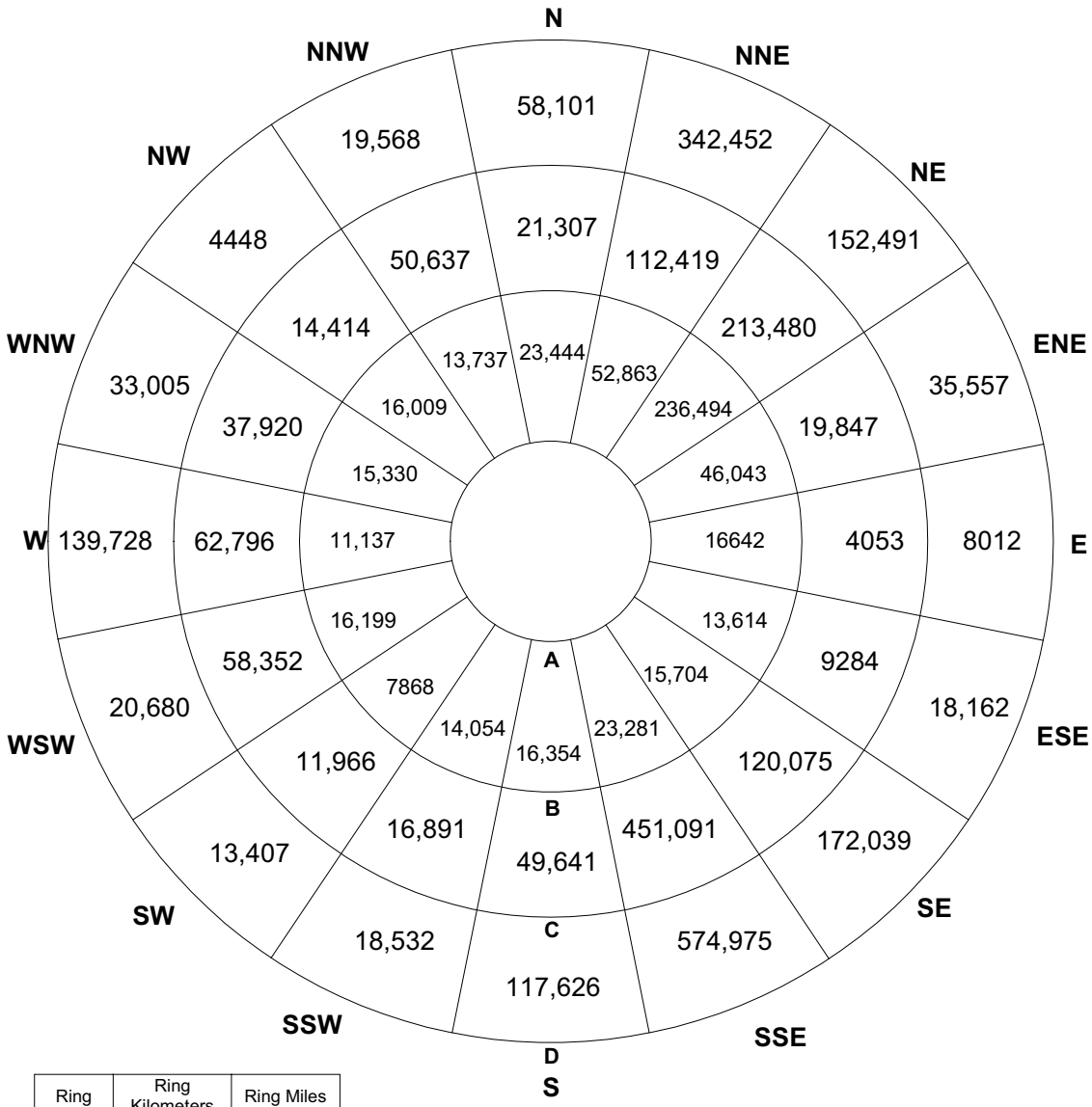
Ring	Ring Kilometers	Ring Miles
A	0 - 16	0 - 10
B	16 - 40	10 - 24.9
C	40 - 60	24.9 - 37.3
D	60 - 80	37.3 - 50

Figure 2.5-11 80-Kilometer (50-Mile) Resident and Transient Population Distribution–2030



Ring	Ring Kilometers	Ring Miles
A	0 - 16	0 - 10
B	16 - 40	10 - 24.9
C	40 - 60	24.9 - 37.3
D	60 - 80	37.3 - 50

Figure 2.5-12 80-Kilometer (50-Mile) Resident and Transient Population Distribution–2040



Ring	Ring Kilometers	Ring Miles
A	0 - 16	0 - 10
B	16 - 40	10 - 24.9
C	40 - 60	24.9 - 37.3
D	60 - 80	37.3 - 50

Figure 2.5-12A 80-Kilometer (50-Mile) Resident and Transient Population Distribution–2065

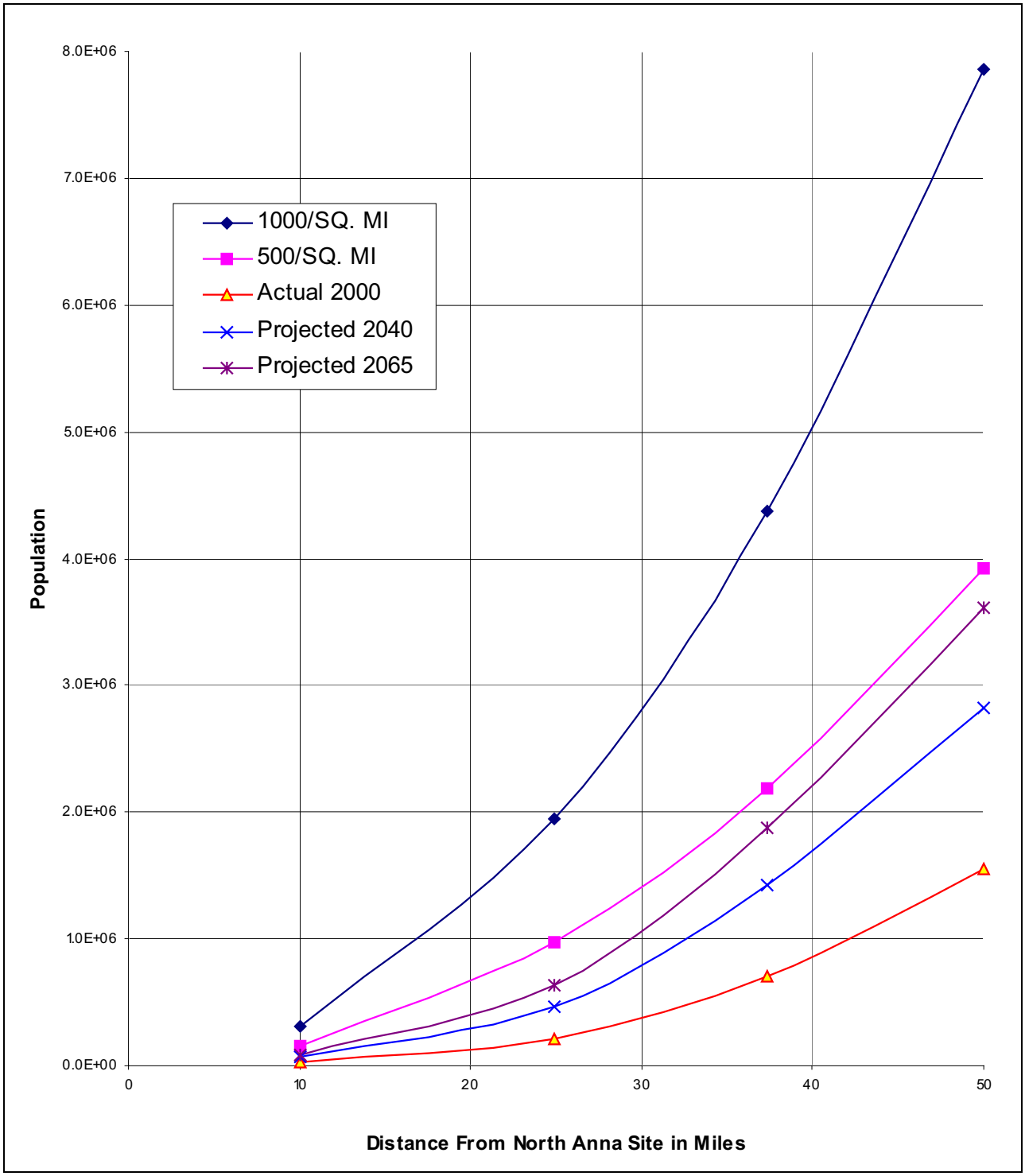
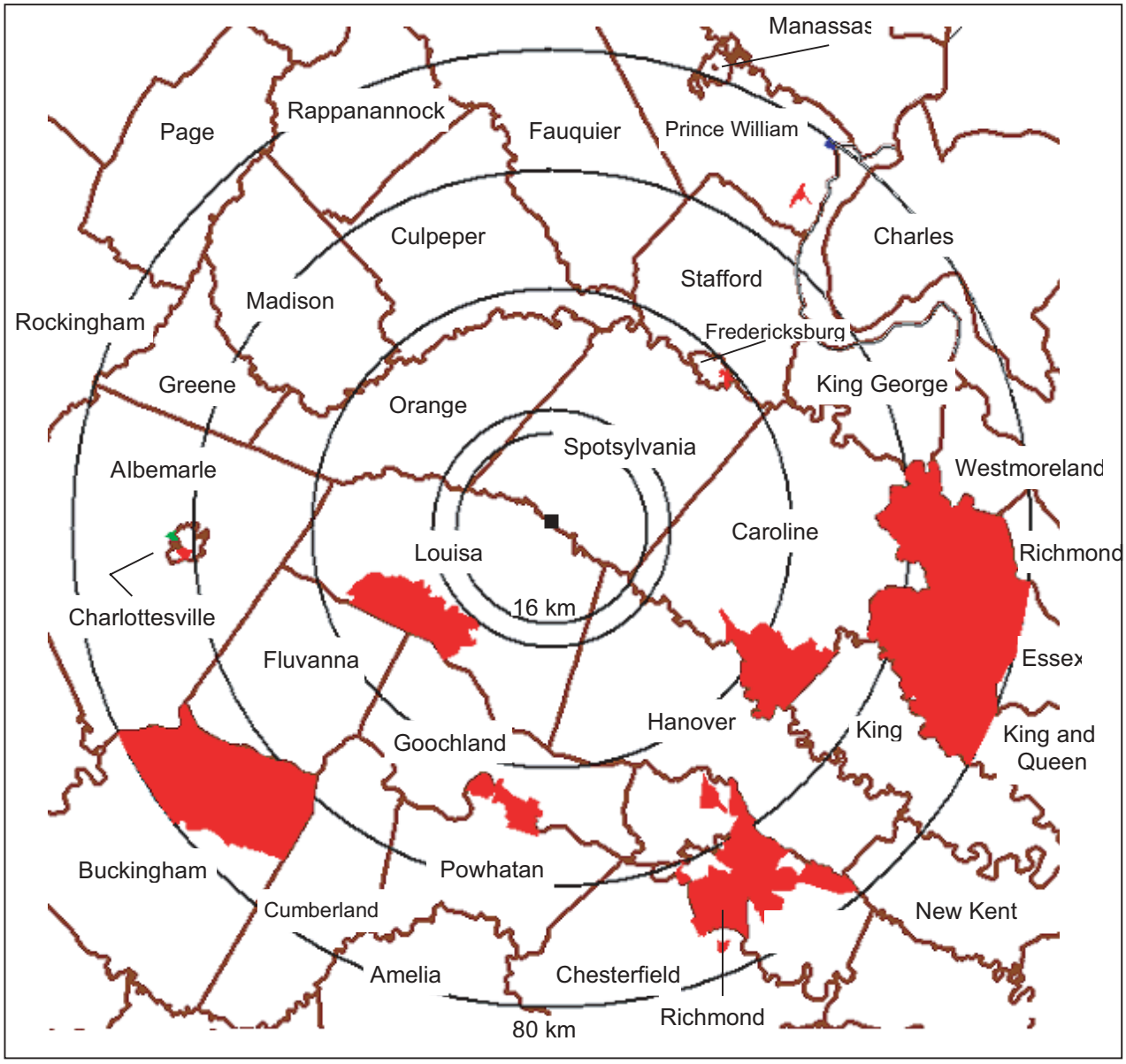


Figure 2.5-13 Population Density



LEGEND

- Black / African American Minority Population
- Hispanic Minority Population
- Asian Minority Population
- North Anna Power Station

0 25 50 km
0 10 20 30 mi

Figure 2.5-14 Minority Population

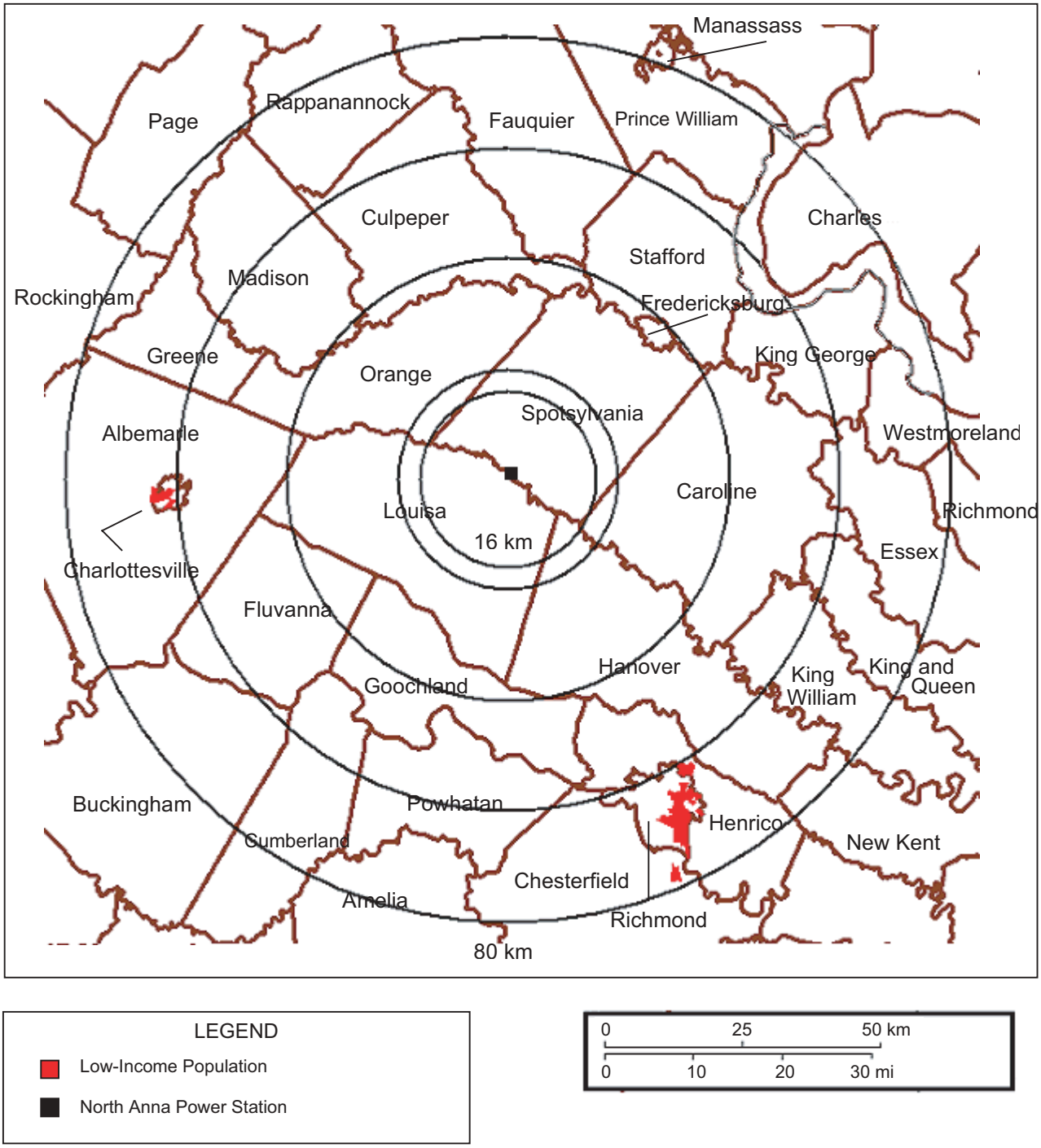


Figure 2.5-15 Low-Income Population

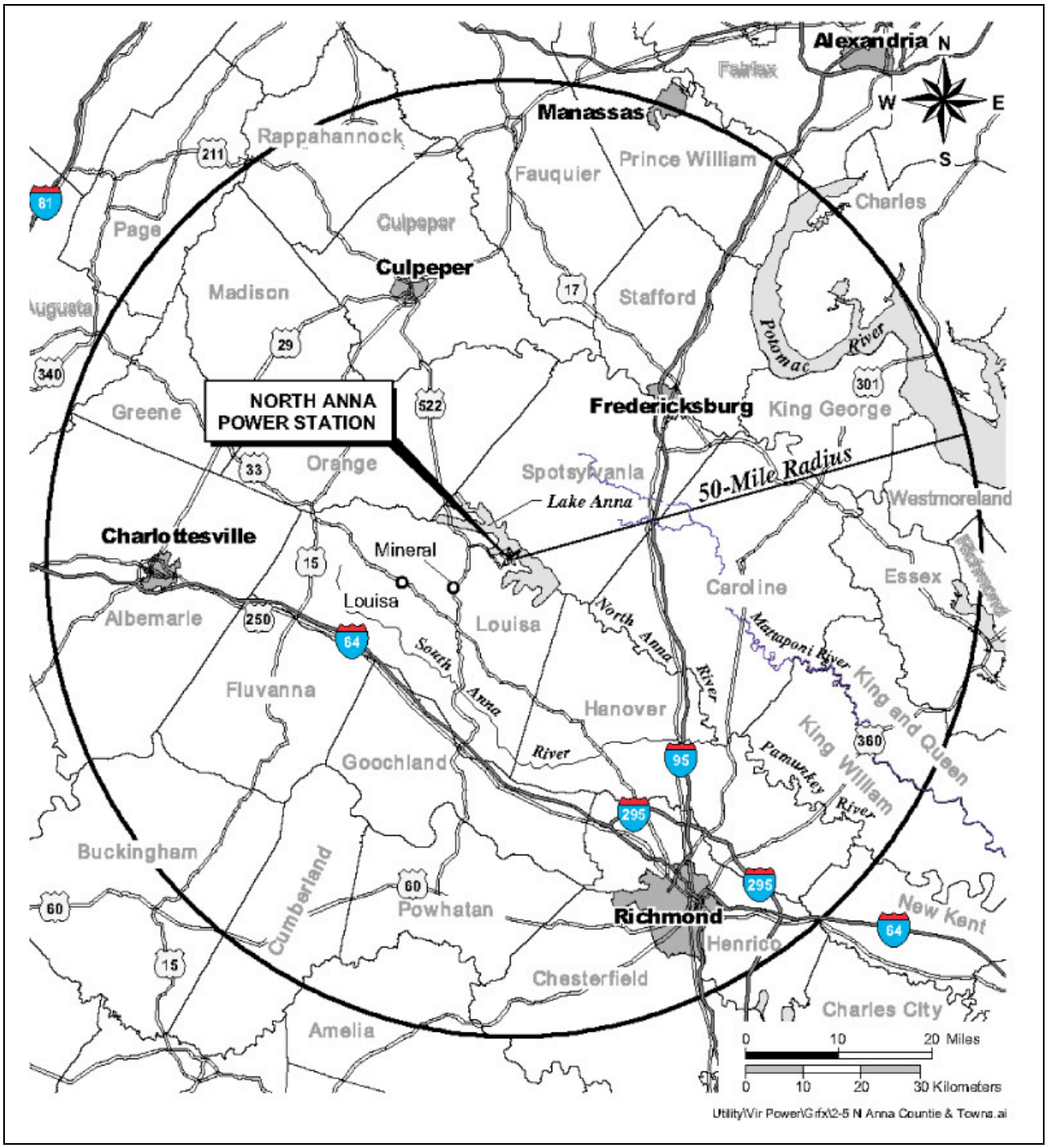


Figure 2.5-16 50-Mile Vicinity Map Showing Counties and Important Towns and Cities

Source: North Anna Power Station, Units 1 and 2 Application for Renewed Operating Licenses Appendix E – Environmental Report, Figure 2-5

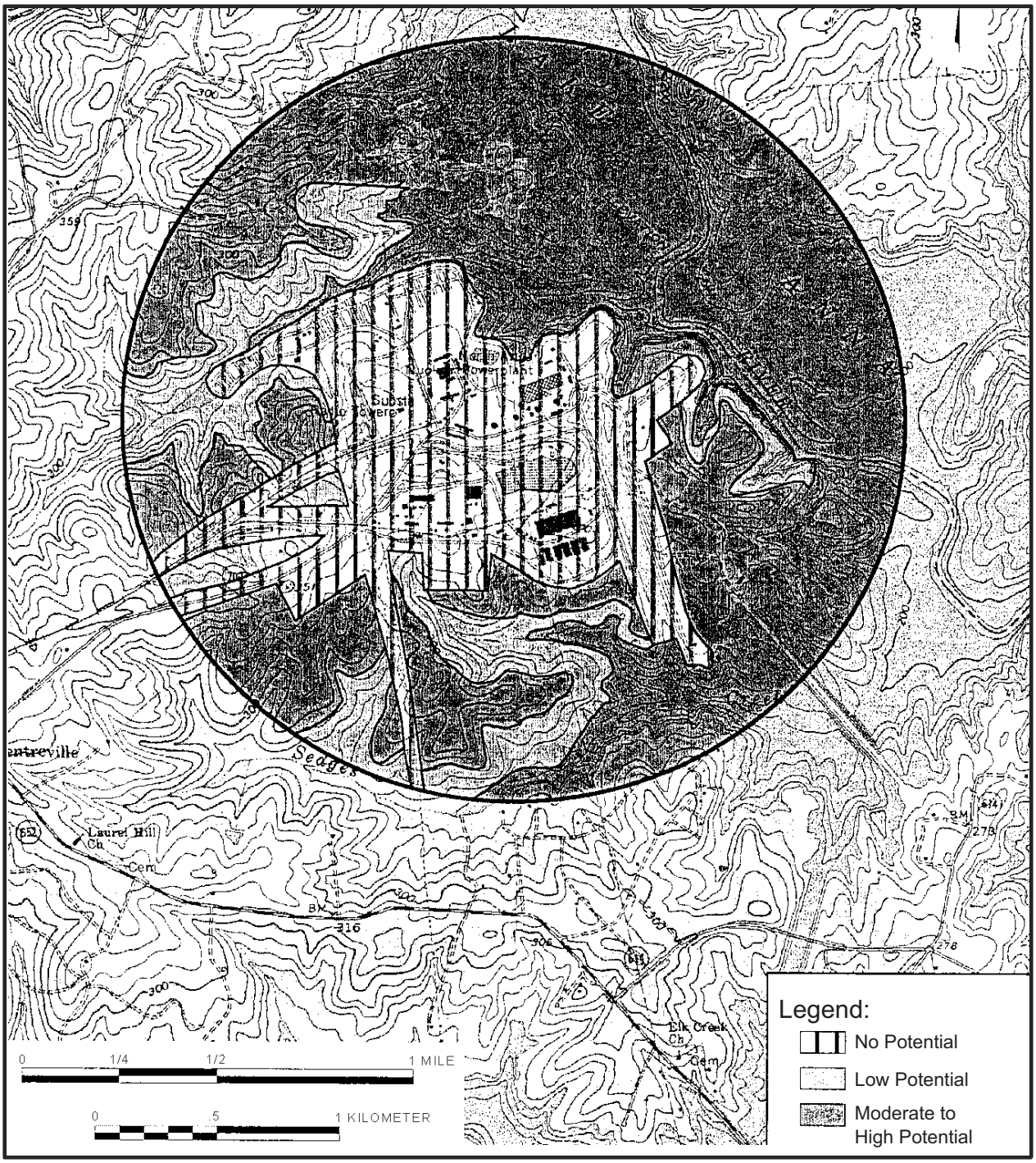


Figure 2.5-17 Area Potentials for Yielding Archeological Resources Within the Study Area

Source: Cultural Resources Assessment, Louis Berger Group, 2001 (Reference 21)

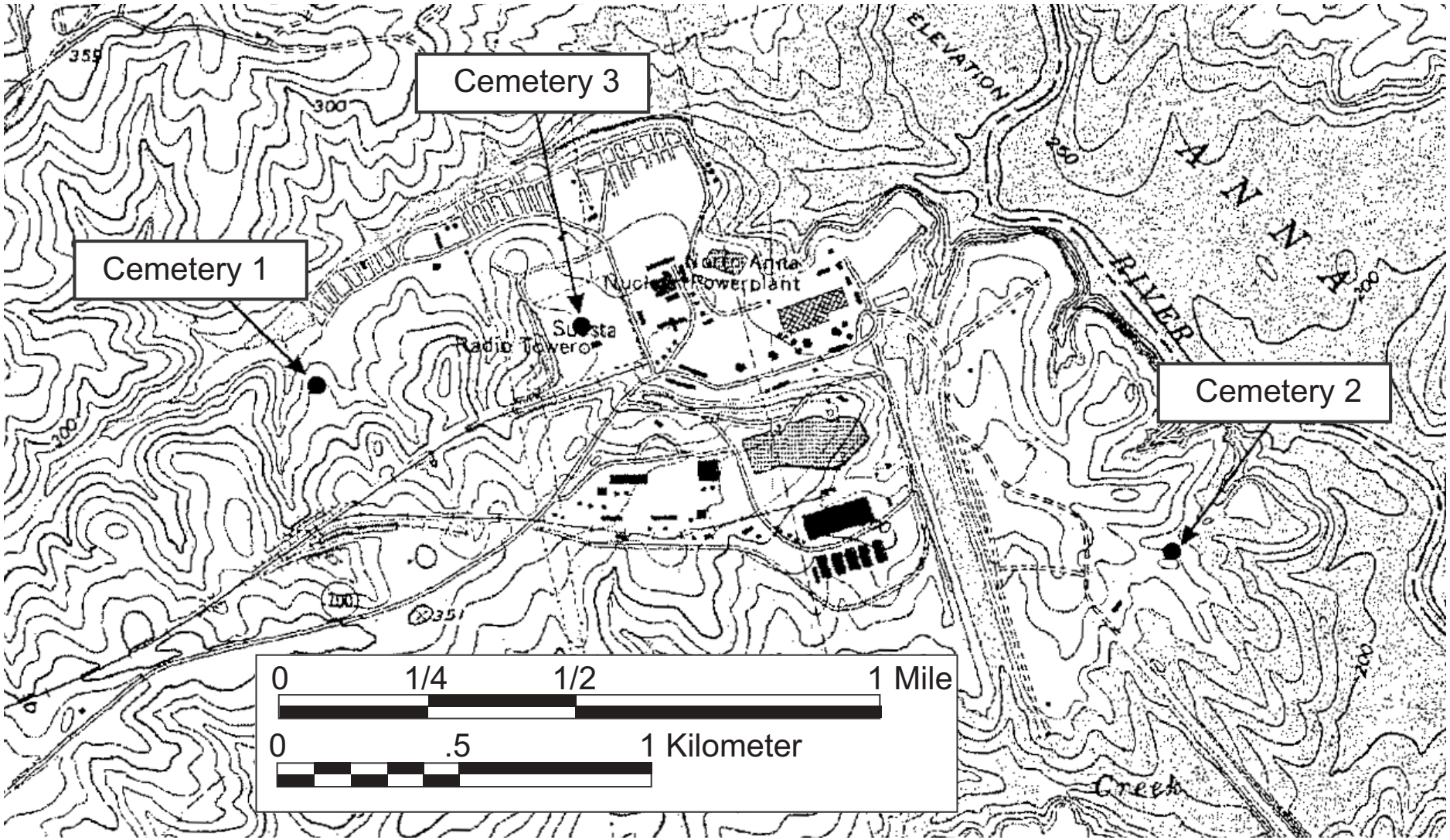


Figure 2.5-18 Cemeteries Within the NAPS Site Boundary

Source: Cultural Resources Assessment, Louis Berger Group, 2001 (Reference 21)

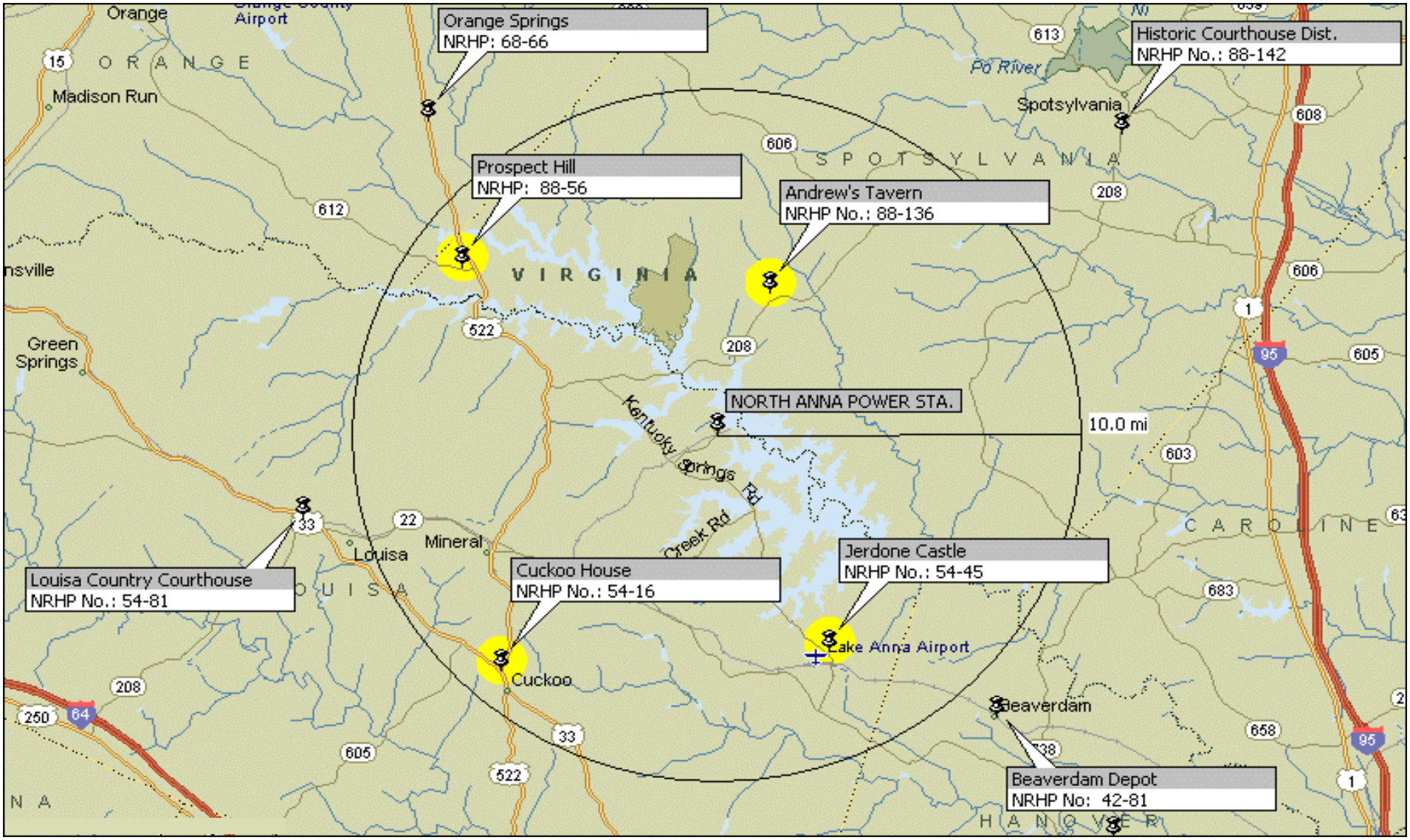


Figure 2.5-19 Location of Historic Sites in the Vicinity of NAPS

2.6 Geology

The following sections summarize geological, seismological, and geotechnical conditions at the ESP site. These conditions and utilization of the ESP site for new units are then evaluated for potential environmental impacts. The information is subdivided into three categories, corresponding to the subject conditions. The geological, seismological, and geotechnical information has been developed in accordance with the guidance provided in RG 4.2 (Reference 1).

The geological, seismological, and geotechnical information presented in this section is based on reviews of previous reports prepared for the existing units and the abandoned Units 3 and 4, geologic literature, and the results of a subsurface investigation performed in late 2002 (Part 2: Appendix 2.5.4B) as part of the ESP application activities. Previous NAPS site-specific reports reviewed include the UFSAR for the existing units (Reference 2) and the ISFSI Safety Analysis Report (Reference 3). Reports prepared by Dames and Moore for licensing of the existing units (Reference 4) and the abandoned Units 3 and 4 (Reference 5) (Reference 6) were also reviewed.

Geological and geotechnical investigations conducted for the existing units and for the abandoned Units 3 and 4 included over 100 borings to depths ranging from 20 to 175 feet (Reference 4) (Reference 5). Test pits were excavated in the area of abandoned Units 3 and 4, and detailed field geologic mapping was performed (Reference 6). During the foundation excavation for abandoned Units 3 and 4, the rock comprising the excavation walls and floor was mapped (Reference 7). As part of the ESP subsurface investigation program, seven borings, eight cone penetrometer tests, two seismic cone penetrometer tests, and cross-hole and down-hole seismic tests were performed. The data obtained by the ESP investigation are presented in Part 2: Appendix 2.5.4B. Field and aerial reconnaissance geologic mapping was also performed as part of the ESP seismicity investigation program.

2.6.1 Geological Conditions

2.6.1.1 Physiography

The ESP site lies within the Piedmont Physiographic Province (Figure 2.6-1). The Piedmont Province is a rolling hilly area that extends from its boundary with the Coastal Plain Province on the east to the Blue Ridge Province on the west. Elevations range from about 800 to 1500 feet along the western border of the Province and slope eastward to elevations of about 200 feet at its eastern border (Reference 8).

The ESP site is located within the Piedmont Upland section (referred to as subprovince in some publications) of the Piedmont Province, approximately 15 miles west of the Coastal Plain Province (Figure 2.6-1). Topography in the vicinity of the ESP site is characteristic of the Piedmont Upland section with a gently undulating surface varying in elevation from about 200 to 500 feet (Figure 2.6-2). The ESP site is surrounded by forest and brushwood-covered land interspersed with

an occasional farm and is well dissected by streams (Reference 2). Slopes in the region typically range from 2 to 5 percent with steeper slopes ranging from 7 to 10 percent along the lower tributaries of some of the larger streams.

2.6.1.2 **Stratigraphy**

The Piedmont Upland section is underlain by Late Precambrian and Paleozoic age crystalline rocks, which are overlain by Cenozoic age residual soils. The crystalline rocks consist of deformed and metamorphosed sedimentary, igneous, and volcanic rocks, intruded by mafic dikes and granitic plutons (Reference 9). The rocks belong to a number of northeast trending lithotectonic belts, bounded by low-angle thrust faults (Paleozoic in age), and are interpreted to have formed along the shore and offshore of ancestral North America. The lithotectonic belts are: the Goochland-Raleigh belt; the Carolina and Eastern Slate belts; the Charlotte, Milton and Chopawamsic belts; and the Western/Inner Piedmont belt (Reference 10) (Figure 2.6-3).

The ESP site is located in the Chopawamsic belt. The Chopawamsic belt is bounded on the west and east by the Chopawamsic and Spotsylvania thrust faults, respectively, and is interpreted to be a volcanic-arc that was accreted to ancestral North America. The belt is comprised of the Chopawamsic Formation and the Ta River Metamorphic Suite, which are overlain unconformably by the Quantico Formation and intruded by rocks of the Falmouth Intrusive Suite (Figure 2.6-4 and Figure 2.6-5). The Chopawamsic Formation and Ta River Metamorphic suite have been assigned to the Cambrian and/or Ordovician Periods (Reference 11) and the Quantico Formation and Falmouth Intrusive Suite have been assigned to the Ordovician and Carboniferous Periods, respectively (Reference 12).

The ESP site is underlain by rocks of the Ta River Metamorphic Suite, which extend thousands of feet below the ground surface (Reference 13). The main rock encountered in borings completed during previous subsurface investigations at the NAPS site and in borings completed as part of the ESP subsurface investigation is a gneiss. The gneiss is generally described as a gray to dark gray:

- quartz gneiss with some biotite quartz gneiss, and
- hornblende gneiss, biotite quartz gneiss, and quartz gneiss.

The gneiss is moderately to intensely jointed and contains layers of quartz, pegmatite, chlorite, and clay. The upper part of the gneiss (averaging about 30 feet thick) is highly weathered and fractured, becoming less weathered and fractured with increasing depth.

Residual soil overlying the gneiss consists predominantly of saprolite. The saprolite is derived from weathering of the underlying bedrock and retains many of the structural and mineraological features of the bedrock. The saprolite extends to the top of the rock from which it was derived; however, the contact between the saprolite and sound rock may be gradational and not well defined. The saprolite at the site generally consists of micaceous clayey, silty, fine to coarse sand

with some to many relict rock fragments and in some areas of the site it extends to a depth of about 100 feet below the ground surface.

2.6.1.3 Faults

Seven bedrock faults (Paleozoic in age) have been mapped within 5 miles of the ESP site (Figure 2.6-4 and Figure 2.6-5). Two of the faults, the Spotsylvania and Chopawamsic, are major thrust faults that separate lithotectonic belts within the Piedmont Province. The Long Branch and Sturgeon Creek faults are thrust faults, and the remaining three unnamed faults are designated as faults “a”, “b”, and “c” on Figure 2.6-4 and Figure 2.6-5.

2.6.2 Seismological Conditions

2.6.2.1 Tectonic Setting

The northeast trending, fault-bounded belts comprising the Piedmont Physiographic Province (Paleozoic in age) are defined essentially on the basis of rock type and metamorphic grade. The faults that separate the belts are low-angle thrust faults created by large-scale detachment and northwest thrusting of rocks along a basal decollement. Below the decollement are rocks that form the North American basement complex. The basal decollement is a nearly horizontal blind thrust fault that dips gently southeast and is at a depth of approximately 3 to 6 miles below the ground surface (Reference 14) (Reference 15). The low-angle thrust faults rise from the basal decollement and either terminate in the subsurface or extend to the ground surface. Also located in the Piedmont Province are a number of Mesozoic age grabens and half-grabens (“Triassic basins”) that are bounded on their western side by normal faults. The normal faults are considered to be either listric into the Paleozoic thrust faults or penetrate into the North American basement complex (Reference 16).

2.6.2.2 Seismic Sources

Seismic activity in the Piedmont Province is generally considered to originate in the North American basement. Geologic structures considered to be responsible for earthquake activity in the province are the basal decollement and associated thrust structures and the normal faults and intrusions associated with rifting that occurred during Mesozoic time (Reference 17).

2.6.2.2.1 Seismic Source Zones

The region (200-mile radius) encompasses two areas where seismic sources have been delineated. These areas have been designated as seismic source zones and consist of the Central Virginia seismic source zone and the Giles County seismic source zone (Reference 18) (Figure 2.6-6).

The CVSZ is an area of persistent, low-level seismicity. The zone is about 75 miles long and 90 miles wide and seismicity ranges in depth from about 2 to 11 miles below the ground surface

(Reference 19). The ESP site lies within the zone, near its northern boundary (Reference 18). Seismic sources within the CVSZ vary from place to place. In the central and western parts of the zone, seismicity is considered to be attributed to west-dipping reflectors (interfaces between media of different elastic properties that reflect seismic waves) that form the roof of a detached antiform. In the eastern part of the zone, seismicity is considered to be related to intrusions that have created an extensive near-vertical dike swarm (Reference 20). Given the depth distribution of 2 to 11 miles and broad spatial distribution of seismicity, however, it is difficult to uniquely attribute the seismicity to any known geologic structure, and earthquakes are considered to occur within the upper portion of the North American basement complex or within thrust fault bounded crust above the basal decollement. The largest historical earthquake to occur in this zone occurred in Goochland County on December 23, 1875, about 30 miles southwest of the ESP site. It had a body-wave magnitude (m_b) of 5 (Reference 21) and a Modified Mercalli Intensity (MMI) of VII. Isoseismal maps indicate that the ESP site would have experienced a shaking intensity of MMI V (Reference 22).

The Giles County seismic zone is located in Giles County, Virginia, near its southwestern border with West Virginia. The zone is about 25 miles long, 6 miles wide and seismicity ranges in depth from 3 to 16 miles below the ground surface (Reference 23) (Reference 24). The ESP site is about 150 miles northeast of this zone (Reference 18). The source of seismicity within the Giles County seismic zone is considered to be due to normal faulting within the North American basement complex (Reference 16) (Reference 24). The largest known earthquake to occur in Virginia and the second largest earthquake to occur in the southeastern United States occurred in this zone on May 31, 1897. It had a magnitude m_b of 5.8 and an intensity MMI of VIII (Reference 25). Isoseismal maps indicate that the ESP site would have experienced a shaking intensity of MMI V (Reference 22) from this earthquake.

2.6.2.2.2 **Tectonic Sources (Faults)**

The Spotsylvania and Chopawamsic thrust faults bound the eastern and western margins of the Chopawamsic belt, respectively. They have been mapped over significant distances within the Piedmont Province (Reference 12). The Spotsylvania thrust fault is about 4.5 miles southeast of the site and juxtaposes rocks of the Ta River Metamorphic Suite against rocks of the Goochland belt. It is a fault zone, rather than a single fault, having a width of approximately 1.5 miles (Reference 13) (Reference 26) and a length of over 300 miles (Reference 11). The Chopawamsic thrust fault is about 4.5 miles northwest of the site and separates rocks of the Chopawamsic Formation from rocks of the Western Piedmont belt. Interpretations indicate that this structure extends for a distance of over 45 miles (Reference 27).

The Long Branch thrust fault is about 2 miles west of the site and separates rocks of the Quantico Formation from rocks of the Chopawamsic Formation and Ta River Metamorphic Suite. The fault has been mapped for over 45 miles and along its length it is locally displaced by smaller faults (Reference 12) (Reference 13).

The Sturgeon Creek fault is about 1 mile west of the site and displaces the fault contact between the Quantico Formation and the Ta River Metamorphic Suite. It has been mapped for a distance of about 10 miles (Reference 13).

Unnamed fault ("a") extends directly through the NAPS site. The fault was found in the Ta River Metamorphic Suite during the foundation excavation for abandoned Units 3 and 4. The fault was investigated by Dames and Moore (Reference 6) and the results were presented to the U.S. Atomic Energy Commission (Reference 28). The results of the investigation indicate that movement occurred along the fault approximately 200 million years ago and that movement has not occurred since, or at least not within the last one million years, given the relatively undisturbed thickness of residual soil overlying the fault. The results of the investigation also concluded that the fault is of limited extent (Reference 6), although subsequent interpretation has extended the fault north and south for a total distance of about 7 miles (Reference 26) (Reference 29). Aerial reconnaissance, field reconnaissance and air photo interpretation carried out for this ESP application, however, did not reveal any evidence for existence of the fault over this distance. Bedrock exposures that are poor to non-existent along the entire 7-mile length of the postulated fault trace, and a lack of geomorphic expression do not support this extension of the fault.

Unnamed faults "b" and "c" are located east of the Long Branch thrust fault, approximately 1 and 4 miles west and north of the ESP site, respectively Figure 2.6-4. The longer of the two faults ("b") juxtaposes rocks of the Quantico Formation against rocks of the Ta River Metamorphic and Falmouth Intrusive Suites. It is about 16 miles long, is offset by the Sturgeon Creek fault and is truncated at its northern end by the unnamed fault "c." This fault juxtaposes rocks of the Quantico Formation against rocks of the Falmouth Suite.

2.6.3 **Geotechnical Conditions**

For geotechnical purposes, the subsurface materials at the NAPS site were initially classified into the following five categories (Reference 4):

- I Residual clays and clayey silts
- IIA Saprolite (rock fragments less than 10 percent of volume of overall mass)
- IIB Saprolite (rock fragments 10 to 50 percent of soil mass)
- III Weathered Rock (rock fragments more than 50 percent of volume of mass)
- IV Parent Rock (slightly weathered to fresh rock below zone of soil and rock fragments)

In addition to these five categories, a sixth category termed Zone III-IV, representing a slightly to moderately weathered rock, was subsequently added to further describe the soil and rock with regard to engineering properties (Reference 2) (Reference 4) (Reference 5). The engineering properties for Zones IIA, IIB, III, III-IV, and IV, based on the previous and ESP field investigation and laboratory testing programs, are presented in Table 2.6-1.

Bedrock at the ESP site exhibits various degrees of weathering that affects its engineering behavior and properties. Zone III bedrock is generally a poor quality rock, with an average rock quality designation (RQD) value of 20 percent, while Zone III-IV and IV bedrock is typically a good to excellent quality rock, with average RQD values of 50 and 95 percent, respectively.

While the saprolite at the ESP site has the relict structure of the parent bedrock, its engineering properties typically resemble those of a soil. It exhibits certain aspects that are characteristic of both cohesive and cohesionless soils. Zone IIA saprolite has been classified as silty sand (SM), clayey sand (SC), and high and low plasticity silt and clay (MH, ML, CH, and CL). Zone IIB saprolite has been classified as mainly silty sand (SM). Standard penetration test (SPT) N-values for the Zone IIA saprolite indicates medium dense conditions, while SPT N-values for the Zone IIB saprolite indicates very dense conditions. The presence of mica in the saprolite (about 5 to 20 percent) contributes to high void ratios, high compressibilities, and low compacted densities (Reference 30). Therefore, due to the potential for excessive settlement of the Zone IIA saprolite, as occurred beneath the Units 1 and 2 SWR, no safety-related structures would be founded on the Zone IIA saprolite without ground improvement.

2.6.4 Environmental Impact Evaluation

2.6.4.1 Geological Impacts

2.6.4.1.1 Zones of Alteration, Weathering, and Structural Weakness

Occasional zones of severely weathered and fractured rock have been identified in the weathered and unweathered gneiss at the ESP site (Reference 4) (Reference 5) (Reference 7) (Part 2: Appendix 2.5.4B). The zones are typically 0.5 to 1 foot thick and contain quartz, clay, and iron oxides. Because of the tendency for zones of severely weathered rock to weather further upon exposure, where encountered in excavations for plant structures and judged to have a potential for impact on the stability of the foundation, they would be removed from the face of the excavation and replaced with cement grout. As a result, no adverse environmental impacts due to the effects of inadequate bearing capacity of the foundation rock mass resulting from the presence of weathered and fractured rock are anticipated for the ESP site.

2.6.4.1.2 Effects of Human Activity

Massive sulfide and gold deposits have been mined from rocks of the Chopawamsic belt in the vicinity of the ESP site. The deposits have been mined predominantly in and around the town of Mineral, approximately 7 miles west of the site. Mined deposits within a 5-mile radius of the site have been designated the Allah Cooper, Sulfur, Cofer and Old Dominion (Reference 31) (Reference 32) (Reference 33) (Reference 34). Published documentation of these mining activities indicate that the ESP site has not been nor would it be affected by these mining activities. As a result, no adverse environmental impacts due to the effects of mining activities are anticipated for the ESP site.

2.6.4.1.3 Construction Groundwater Control

Groundwater at the ESP site generally occurs at depths ranging from about 6 to 58 feet below the present day ground surface, with the exception of the area of the abandoned Units 3 and 4 excavation where groundwater is within about 2 feet of the ground surface. Groundwater levels at the site are such that foundation excavations extending below the water table during plant construction are likely to require temporary dewatering. Any dewatering that may be required would be performed in a manner that minimizes drawdown effects on the surrounding environment. As a result, no adverse environmental impacts due to dewatering are anticipated for the ESP site.

2.6.4.1.4 Unforeseen Geologic Features

Evaluation of the ESP site's geology indicates that no conditions are present that could potentially produce an adverse environmental impact associated with plant construction or operation. The ESP site has not been adversely affected by human activity with respect to the development of natural resources or groundwater withdrawal, nor are any such future activities expected to produce adverse effects at or beyond the site.

2.6.4.2 Seismological Impacts

2.6.4.2.1 Ground Shaking

The upper-bound maximum earthquake magnitude estimate, developed for the Central Virginia and Giles County Seismic Source Zones, ranges from m_b 6.6 to 7.2 (Reference 18). The two largest earthquakes to occur in the ESP site region are the 1875 Goochland County and 1897 Giles County earthquakes with intensities of MMI VII and VIII, respectively. Isoseismal maps indicate that the ESP site would have experienced a shaking intensity of MMI V from these two earthquakes (Reference 22). There is no physical evidence at the site, such as fissuring, liquefaction, landsliding, or lurching, to suggest that the surficial sediments or the underlying bedrock were disturbed by ground shaking during these events.

Damaging earthquake ground shaking is not expected to occur at the ESP site during the life of the new units. However, safety-related structures, systems, and components would be designed to accommodate the maximum horizontal ground accelerations determined for the ESP site. Therefore, adverse environmental impacts resulting from the effects of ground shaking on plant structures would be small.

2.6.4.2.2 Surface Fault Rupture

The seven bedrock faults mapped within the vicinity of the ESP site are not considered to be capable tectonic sources, as defined in RG 1.165, Appendix A (Reference 35). The faults are considered to be old structures that formed during Pre-Cambrian and Paleozoic time, and no deformational or geomorphic features indicative of potential Quaternary activity have been associated with them. No historical seismic activity has been reported as being associated with any

of the faults (Reference 23) (Reference 36). Therefore, the resulting environmental impacts of potential surface fault rupture would be small.

2.6.4.3 Geotechnical Impacts

2.6.4.3.1 Settlement

Settlement at the ESP site is only a consideration for structures founded directly on the Zone IIA saprolite. Larger than expected settlement was initially recorded beneath the existing units SWR pumphouse, which is founded on about 65 feet of Zone IIA saprolite, mainly micaceous sand and silt. The settlement was considered to be a result of the weight of the pumphouse itself and the 30 feet of embankment fill built up around it.

The potential for excessive settlement of the Zone IIA saprolite makes it unsuitable, in its natural state, for the support of any safety-related structures due to the possibility of adverse environmental impacts that could result from damage to the structure during plant operation. The Zone IIA saprolite may be used to support safety-related structures if ground improvement methods are used and assuming adequate bearing capacity strengths can be achieved.

2.6.4.3.2 Slope Stability

The only existing slope at the NAPS site with a potential to affect the safety of the new units is the 55-foot high, 2H:1V slope that presently exists between abandoned Units 3 and 4 and the existing units SWR. Static long-term analyses of modification of the existing slope using the computer program SLOPE/W produced a factor of safety in excess of the minimum 1.5 required. Pseudo-static analyses using horizontal and vertical seismic accelerations developed in support of this ESP application produced a factor of safety less than the minimum acceptable value of 1.1. However, when the pseudo-static analyses were run with the seismic input modified to conform to the reductions given by Seed (Reference 37), the computed factor of safety against slope failure is in excess of 1.1.

The Seed reductions are considered reasonable and valid, and the slope is considered to have an adequate factor of safety against failure during the ESP design seismic event.

A new slope may be excavated to the west of the existing SWR to accommodate ultimate heat sinks for the new units. This slope would have the same configuration and composition as the existing slope. The analytical conclusions for the existing slope would apply to the new slope, i.e., the new slope would be stable under seismic and long-term static conditions. If analysis during detailed engineering indicates unacceptable factors of safety against slope failure, modifications would be employed to ensure adequate slope stability.

Based on the preceding discussion, slope failure and the potential environmental implications associated with damage to the facility are not an issue for the new units.

2.6.4.3.3 Liquefaction

Liquefaction of site soils during an earthquake event could affect the safety of the new units by causing foundation bearing failures and excessive settlement and slope failure. Liquefaction can occur when all of the following criteria are met:

- Design ground acceleration is high.
- Soil is saturated.
- Soils are sands or silty sands in a loose to medium dense condition.

At the ESP site, the first criterion is met, and the second criterion applies in many areas of the ESP site. However, the third criterion, involving the type and density of the soil, is less clearly applicable. The Zone IIB soils are extremely dense and the Zone III weathered rock has over 50 percent rock fragments. Neither of these materials meets the loose or medium dense criterion and neither has liquefaction potential.

The only soil at the NAPS site with the gradation and relative density attributes than can potentially result in liquefaction is the Zone IIA saprolite. However, the structure, fabric, and mineralogy of this saprolite substantially reduces its potential for liquefaction. No evidence of liquefaction has been reported at the NAPS site. The possibility of isolated liquefaction effects in localized zones at the site may exist, although the fabric and structure of the soil are considered to minimize such effects. To avoid these zones, structures associated with the new units would not be sited above them, or ground improvement measures would be implemented to mitigate any liquefaction effects. As a result, no adverse environmental impacts associated with possible liquefaction effects at the ESP site are anticipated.

2.6.4.3.4 Excavation

a. **Excavation in Soil and Rock**

   Temporary excavations in soil would have slopes no steeper than 1.5H:1V and would be performed in accordance with OSHA regulations. Where there is insufficient space to slope the excavations, vertical cuts would be supported with sheet pile, soldier piles and lagging or other suitable methods. For large excavations, this support may be supplemented by the use of tiebacks that are angled down and anchored, where possible, into bedrock. Temporary excavations into bedrock would be vertical, except where the structure of the rock dips into the excavation, in which case the excavation would be carried out parallel to the dip of the structure (about 1H:1V). The potential for the failure of temporary excavation slopes and walls during construction at the ESP site would be minimized and, therefore, environmental impacts associated with the failure of temporary excavation slopes are anticipated.

b. **Excavation Techniques**

   Excavations in the soils at the ESP site are expected to be achieved using conventional excavating equipment. Excavation in the Zone III rock would likely require the use of powerful

but conventional earthmoving equipment. Excavation in Zone III-IV and Zone IV rock would likely require the use of blasting techniques followed by removal using appropriate earthmoving equipment. To ensure the integrity of the foundation rock, the stability of the excavated slopes, and to limit the blasting impact on surrounding structures and the environment, controlled blasting techniques, such as pre-splitting use of delays, minimizing blast size, etc., would be utilized. Monitoring of the blast vibrations would be performed to determine blast magnitudes on existing structures and equipment in and around the NAPS site. No adverse environmental impacts resulting from excavation methods or the use of heavy construction equipment are anticipated during construction at the ESP site.

Alternatives to blasting for the excavation of rock at the ESP site would be reviewed and considered prior to selection of the final excavation method. The alternative excavation methods to be considered would likely include thermal lance, plasma gun, pile driver and expandable metal slug, drilling and expansive grout, hydraulic splitter, hoe ram, diamond wire saw, trenching machine, and water jet.

c. **Disposal of Excavated Material**

Excavated material would be disposed of either within the NAPS site boundary or at an offsite disposal area. Whether at or off the site, the disposal area would be identified and approval for the intended purpose obtained in advance of the start of construction. The area would be a stable area, not prone to slumping or sliding, and isolated from waterways or streams. Methods such as re-vegetation and erosion control measures would be used to mitigate the potential for the erosion of material at the disposal site. The topsoil would be removed to accommodate disposal of the material and would be used to cover and re-vegetate the stockpile at the completion of construction. No adverse environmental impacts from the disposal of excavated material are anticipated at or in the area or vicinity of the ESP site.

2.6.4.3.5 Backfill

a. **Backfill Material**

Backfill at the ESP site would be a sound, well-graded granular material – either a sandy gravel or a gravelly sand – with less than 10 percent passing the No. 200 sieve. Although a large amount of saprolite would be excavated for the project, the saprolite would not be used as structural fill to support plant structures. An onsite testing laboratory would be established and operated by qualified soils technicians under the direction of a civil or geotechnical engineer to control the quality of the backfill. As a result, no adverse environmental impacts due to the use of poor quality backfill material or the improper placement and compaction of backfill are anticipated at the ESP site.

b. **Source of Backfill**

Backfill material would either be imported or produced at the ESP site. If imported, materials such as dense graded Aggregate (e.g. Size 21A or 21B, as specified by the Virginia

Department of Transportation Road and Bridge Specifications (Reference 38)) would be considered suitable. If the material is produced at the ESP site, a crushing, screening and blending plant would be set up to produce crushed rock to the required gradation specifications for use as structural fill. This would not adversely affect natural resources at or in the vicinity of the ESP site and as a result, no environmental impacts are anticipated.

Section 2.6 References

1. Regulatory Guide 4.2, *Preparation of Environmental Report for Nuclear Power Stations*, Revision 2, U.S. Nuclear Regulatory Commission, July 1976.

2. Updated Final Safety Analysis Report, North Anna Power Station Units No. 1 and 2, Revision 38, September 3, 2002.

3. Independent Spent Fuel Storage Installation Safety Analysis Report, North Anna Power Station Units 1 and 2, Revision 3, Virginia Electric and Power Company, June 2002b.

4. Dames and Moore, Site Environmental Studies, Proposed North Anna Power Station, Louisa County, Virginia, Virginia Electric Power Company, Technical Report, January 13, 1969.

5. Dames and Moore, Site Environmental Studies, North Anna Nuclear Power Station, Proposed Units 3 and 4, Louisa County, Virginia, Virginia Electric Power Company, Technical Report, August 18, 1971.

6. Dames and Moore, Supplemental Geologic Data, North Anna Power Station, Louisa County, Virginia, Virginia Electric and Power Company, Technical Report, August 17, 1973.

7. Geotechnical Report on Excavation, Reinforcement, and Final Conditions of Foundation Rock, North Anna Power Station – Units 3 and 4, Stone and Webster Engineering Corporation for Virginia Electric and Power Company, July 1975.

8. Lane, C. F., *Physiographic Provinces of Virginia*, Virginia Geographer, Volume XV, Fall-Winter 1983.

9. Markewich, H. W., Pavich, M. J., and Buell, G. R., *Contrasting Soils and Landscapes of the Piedmont and Coastal Plain, Eastern United States*, Geomorphology, Volume 3, 417–447, 1990.

10. Bledsoe, H. W., Jr., and Marine, I. W., DP-1559, *Executive Summary: Review of Potential Host Rocks for Radioactive Waste Disposal in the Southeastern United States*, prepared by E.I. du Pont de Nemours and Company for the U.S. Department of the Energy, October 1980.

11. Spears, D. B., and Bailey, C. M., *Geology of the central Virginia Piedmont between the Arvonia syncline and the Spotsylvania high-strain zone*, Thirty-Second Annual Virginia Geological Conference, Charlottesville, Virginia, October 11-13, 2002.

12. Mixon, R. B., Pavlides, L., Powars D. S., Froelich, A. J., Weems, R. E., Schindler, J. S., Newell, W. L., Edwards, L. E., and Ward, L. W., *Geologic Map of the Fredericksburg 30' x 60' Quadrangle, Virginia and Maryland,* U.S. Geological Survey, Geologic Investigations Series Map I-2607, 2000.

13. Marr, J. D., Jr., *Geologic Map of the Western Portion of the Richmond 30 x 60 Minute Quadrangle, Virginia*, Virginia Division of Mineral Resources, Publication 165, 2002.

14. Faill, R. T., *A Geologic History of the North-Central Appalachians, Part 3. The Allegheny Orogeny,* American Journal of Science, Volume 298, 131–179, February 1998.

15. Glover, L., III and Klitgord, K. D., *E-3 Southwestern Pennsylvania to Baltimore Canyon Trough,* Geological Society of America Centennial Continent/Ocean Transect No. 19, 1995.

16. Wheeler, R. L., Earthquakes and the Cratonward Limit of Iapetan Faulting in Eastern North America, Geology, Volume 23, 105–108, 1995.

17. Reger, J. P., *Earthquakes and Maryland,* Maryland Geological Survey Web Source, 2001: www.mgs.md.gov/esic/publications/pubindex.html.

18. *Seismic Hazard Methodology for the Central and Eastern United States*, *Tectonic Interpretations,* Volumes 5 through 10, Technical Report, EPRI, July 1986.

19. Wheeler, R. L, and Johnston, A. C., *Geologic Implications of Earthquake Source Parameters in Central and Eastern North America*, Seismological Research Letters, Volume 63, No. 4, 491–505, 1992.

20. Coruh, C., Bollinger, G. A., and Costain, J. K., *Seismogenic structures in the central Virginia seismic zone*, Geology, Volume 16, 748–751, August 1988.

21. Bollinger, G. A., and Sibol, M. S., *Seismicity, Seismic Reflection Studies, Gravity and Geology of the Central Virginia Seismic Zone: Part I. Seismicity*, Geological Society of America Bulletin, Volume 96, 49–57, January 1985.

22. Bollinger, G. A., and Hopper, M. G., *Virginia's Two Largest Earthquakes – December 22, 1875 and May 31, 1897,* Bulletin of the Seismological Society of America, Volume 61, No. 4, 1033–1039, 1971.

23. Chapman, M. C., and Krimgold, F., *Seismic Hazard Assessment for Virginia*, Virginia Technical Seismological Observatory, Department of Geological Sciences, February 1994.

24. Bollinger, G. A., and Wheeler, R. L., Professional Paper 1355, *The Giles County, Virginia, Seismic Zone – Seismological Results and Geological Interpretations*, U.S. Geological Survey, 1988.

25. Bollinger, G. A., Bulletin 2017, Specification of Source Zones Recurrence Rates, Focal Depths, and Maximum Magnitudes for Earthquakes Affecting the Savannah River Site in South Carolina, U.S. Geological Survey, 1992.

26. Pavlides, L., Revised Nomenclature and Stratigraphic Relationships of the Fredericksburg Complex and Quantico Formation of the Virginia Piedmont, U.S. Geological Survey, Professional Paper 1146, 1980.

27. Harris, L. D., deWitt, W., Jr., and Bayer, K. C., *Interpretive Seismic Profile Along Interstate I-64 from the Valley and Ridge to the Coastal Plain in Central Virginia,* United States Geological Survey Oil and Gas Investigations Chart, OC-123, 1982.

28. Preliminary Safety Analysis Report, North Anna Power Station, Units 3 and 4, Supplement Volume 2, Appendix E – Applicants Correspondence to the Atomic Energy Commission Relevant to the Geological Fault Investigation in Connection with the Construction of North Anna Power Station Units 3 and 4, Dockets Nos. 50-404 and 50-405, Virginia Electric Power Company, February 20, 1974.

29. Pavlides, L., Early Paleozoic composite mélange terrane, central Appalachian Piedmont, Virginia and Maryland; Its origin and tectonic history, Geological Society of America, Special Paper 228, 1989.

30. Sowers, G. F., and Richardson, T. L., *Residual Soils of Piedmont and Blue Ridge*, Transportation Research Board National Academy of Sciences, Transportation Research Record 919, July, 1984.

31. Poole, J. L., Notes on Some Abandoned Copper, Lead, and Zinc Mines in the Piedmont of Virginia, Virginia Minerals, Volume 20, No. 2, May 1974.

32. Hickman, R. C., *Pyrites, Mineral, Louisa County, Virginia*, United States Department of the Interior - Bureau of Mines, Report of Investigations, R.I. 4116, August 1947.

33. Miller, J. W., and Craig, J. R., *Ore Minerals of the Cofer Volcanogenic Massive Sulfide Deposit, Louisa County, Virginia,* The Canadian Mineralogist, Volume 35, part 6, 1465–1483, December 1997.

34. Pavlides, L., Gair, J. E., and Cranford, S. L., Massive Sulfide Deposits of the Southern Appalachians: Central Virginia Volcanic-Plutonic Belt as a Host for Massive Sulfide Deposits, Economic Geology and the Bulletin of the Society of Economic Geologists, Volume 77, No. 2, March-April 1982.

35. Regulatory Guide 1.165, Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion, U.S. Nuclear Regulatory Commission, March 1997.

36. Dames and Moore, A Seismic Monitoring Program at the North Anna Site in Central Virginia, January 24, 1974 through August 1, 1977, Technical Report for Virginia Electric Power Company, October 25, 1977

37. Seed, H. B. Considerations in the Earthquake-Resistant Design of Earth and Rockfill Dams, Geotechnique, Volume 29, No. 3, 1979.

38. *Road and Bridge Specifications*, Virginia Department of Transportation, 2002.

Table 2.6-1 Summary of Geotechnical Engineering Properties

Stratum	IIA		IIB	III	III-IV	IV
	Coarse-grained	Fine-grained				
Description	Saprolite	Saprolite	Saprolite w/10 to 50% Core Stone	Moderately to Highly Weathered Quartz Gneiss w/Biotite	Slightly to Moderately Weathered Quartz Gneiss w/Biotite	Fresh to Slightly Weathered Quartz Gneiss w/Biotite
Rock properties						
Recovery,%	-	-	-	60	90	100
RQD,%	-	-	-	20	50	95
Unconfined compressive strength, ksi	-	-	-	0.6	4	12
USCS symbol	SP, SM, SC	ML, CL, MH, CH	Mainly SM	-	-	-
Range of fines content,%	15 to 45	-	-	-	-	-
Natural moisture content, w,%	-	26	-	-	-	-
Undrained shear strength, c_u, ksf	-	2.0	-	-	-	-
Effective cohesion, c′, ksf	0.25	0.5	-	-	-	-
Effective friction angle, ϕ', degrees	30	25	40	-	-	-
Total unit weight, γ, pcf	125		130	145	163	163
SPT N-value, N_{60}, blows/ft	20		100	-	-	-
Shear and compression wave velocity						
Shear wave velocity range, ft/sec	600 to 1350		-	-	-	4000 to 8000
Shear wave velocity average, ft/sec	950		1600	2000	3300	6300
Compression wave velocity average, ft/sec	2100		3500	4500	7400	14,000
Elastic and shear moduli						
Elastic modulus (high strain), E_{hs}	1200 ksf		3500 ksf	120 ksi	1000 ksi	3750 ksi
Elastic modulus (low strain), E_{ls}	9500 ksf		28,000 ksf	300 ksi	1000 ksi	3750 ksi
Shear modulus (high strain), G_{hs}	450 ksf		1300 ksf	50 ksi	375 ksi	1400 ksi

Table 2.6-1 Summary of Geotechnical Engineering Properties

Stratum	IIA		IIB	III	III-IV	IV
	Coarse-grained	Fine-grained				
Description	Saprolite	Saprolite	Saprolite w/10 to 50% Core Stone	Moderately to Highly Weathered Quartz Gneiss w/Biotite	Slightly to Moderately Weathered Quartz Gneiss w/Biotite	Fresh to Slightly Weathered Quartz Gneiss w/Biotite
Shear modulus (low strain), G_{ls}	3500 ksf		10,000 ksf	125 ksi	375 ksi	1400 ksi
Consolidation characteristics						
Recompression ratio, RR	0.015		-	-	-	-
Coeff. of secondary compression, C_α	0.0008		-	-	-	-
Coeff. of subgrade reaction, k_1, kcf	230		1,500	-	-	-
Coefficient of sliding against concrete	0.35		0.45	0.6	0.65	0.7
Poisson's ratio, μ (high strain)	0.35		0.3	0.33	0.33	0.33
Static earth pressure coefficients						
Active, K_a	0.33		0.22	-	-	-
Passive, K_p	3.0		4.6	-	-	-
At-rest, K_o	0.5		0.36	-	-	-
Hydraulic conductivity, cm/sec	5×10^{-4}		-	-	-	-

Note:"-" denotes no design parameter given.

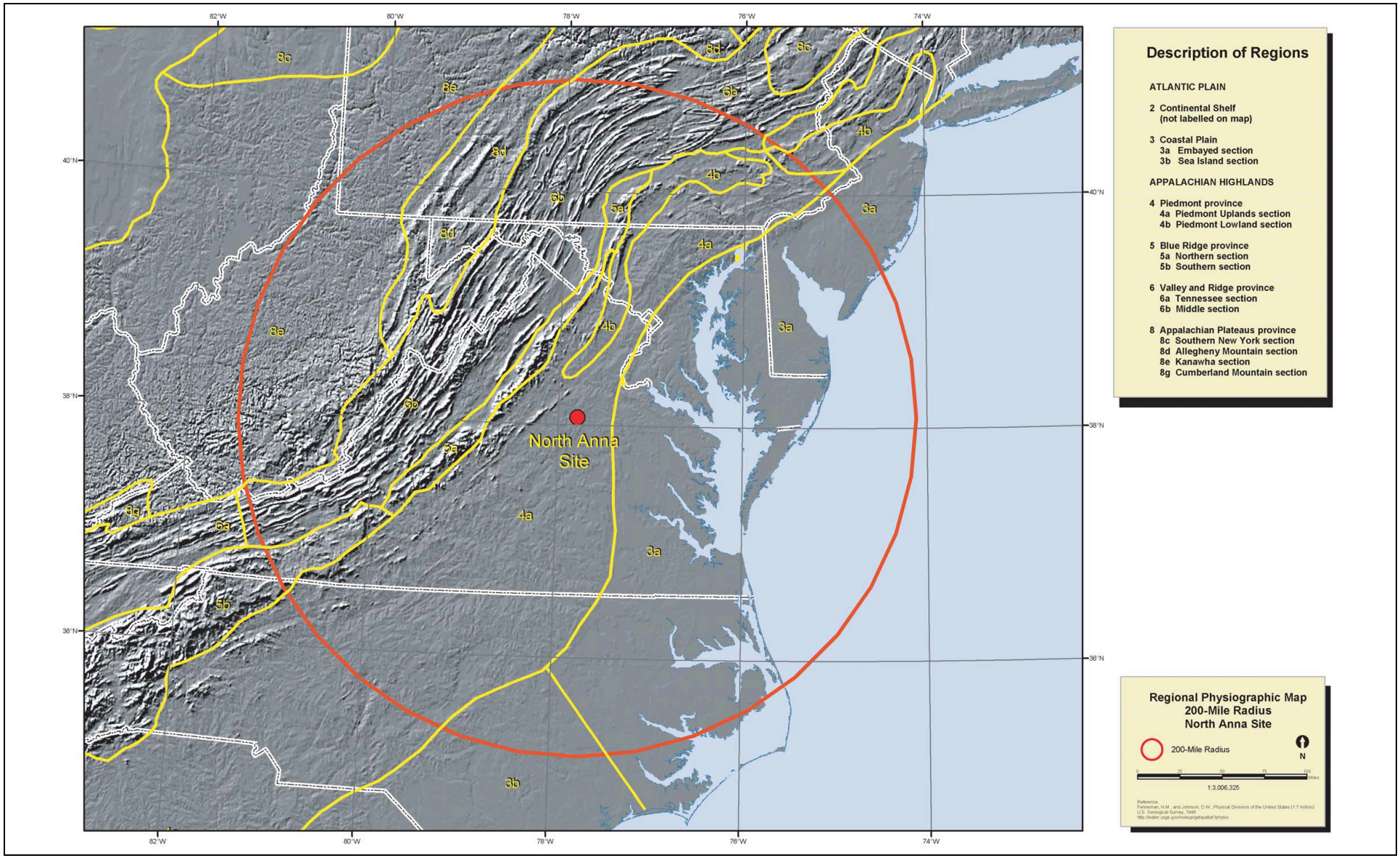


Figure 2.6-1 Regional Physiographic Map (200-Mile Radius)

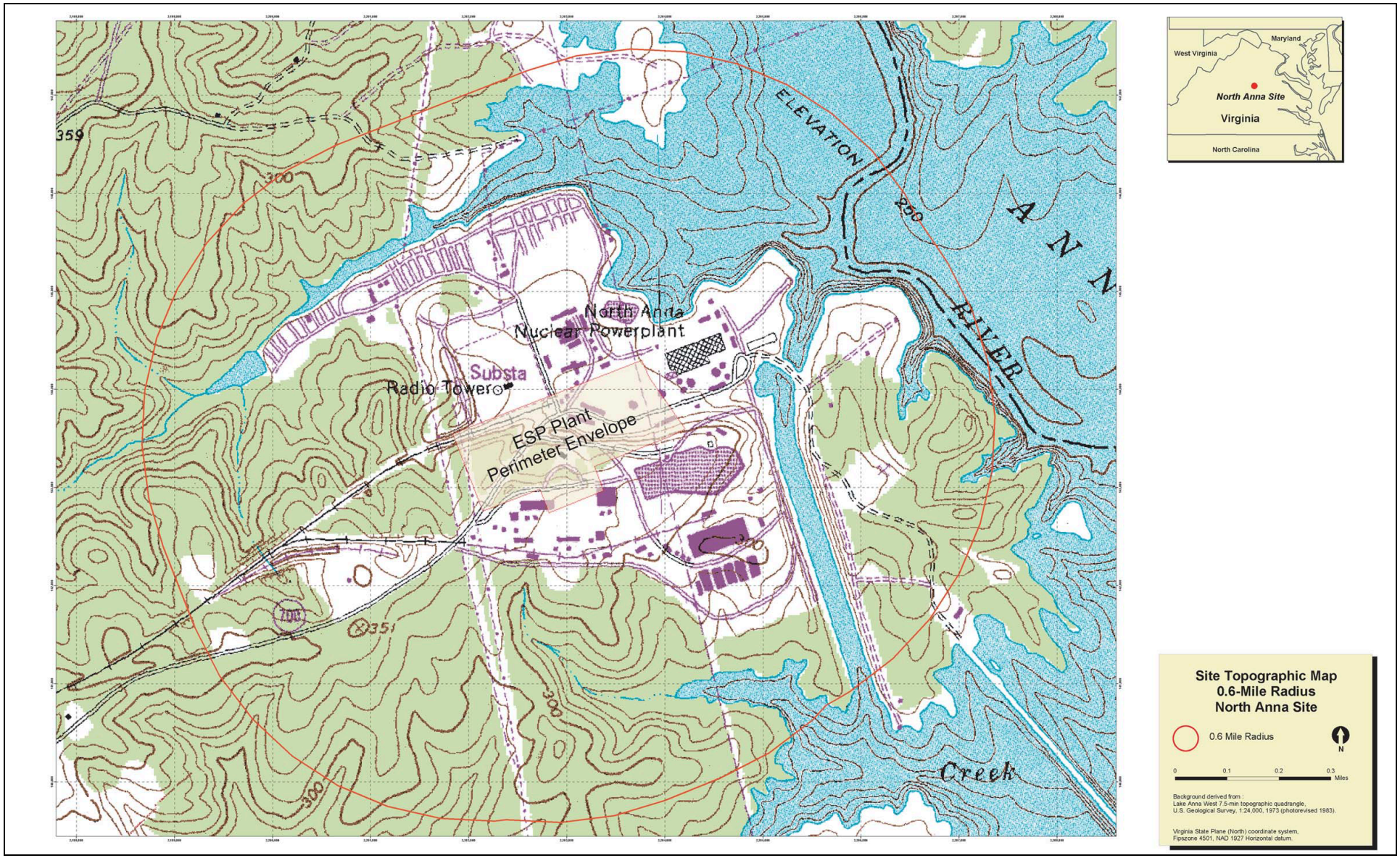


Figure 2.6-2 Site Topographic Map (0.6-Mile Radius)

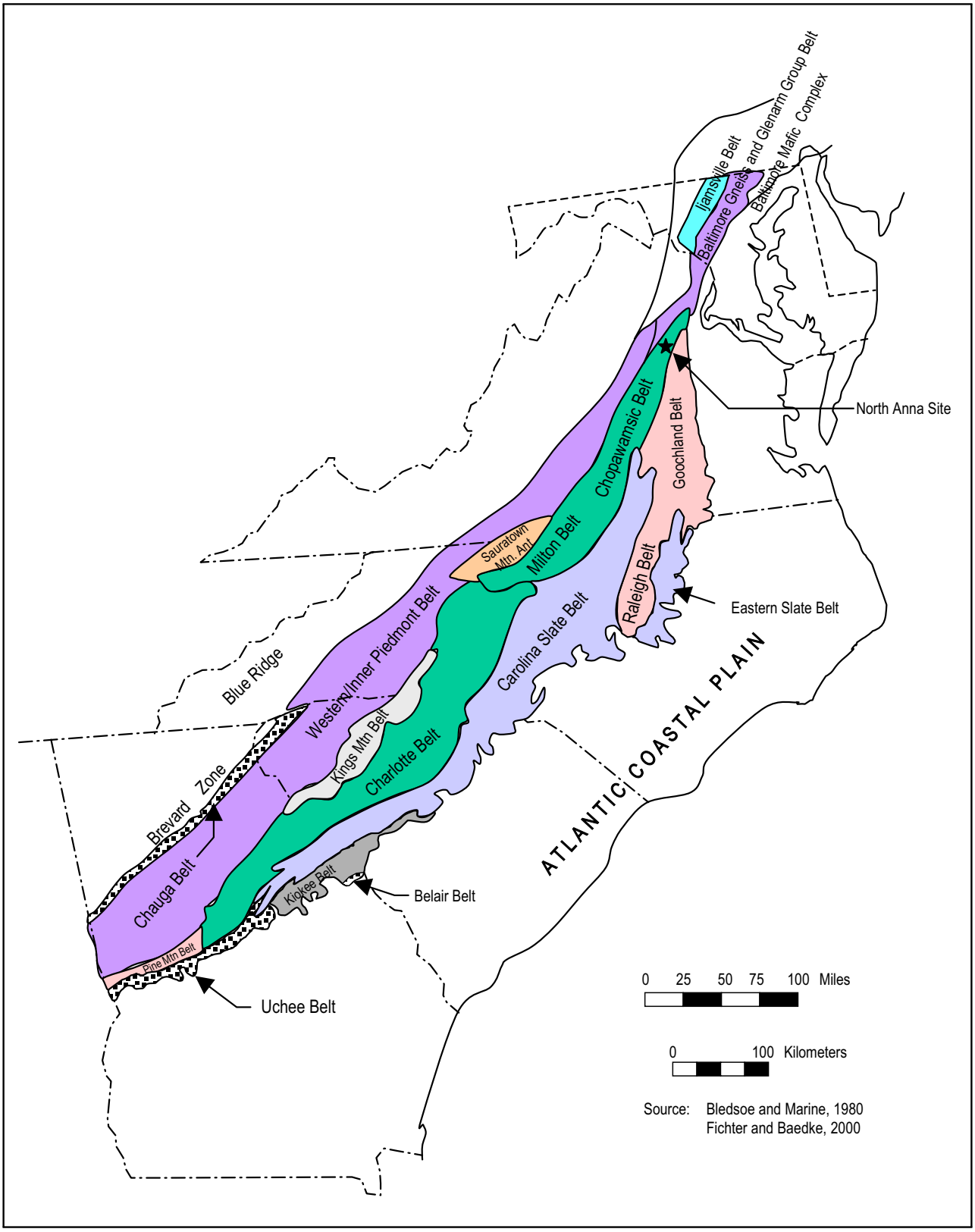


Figure 2.6-3 Lithotectonic Belts of the Piedmont Province

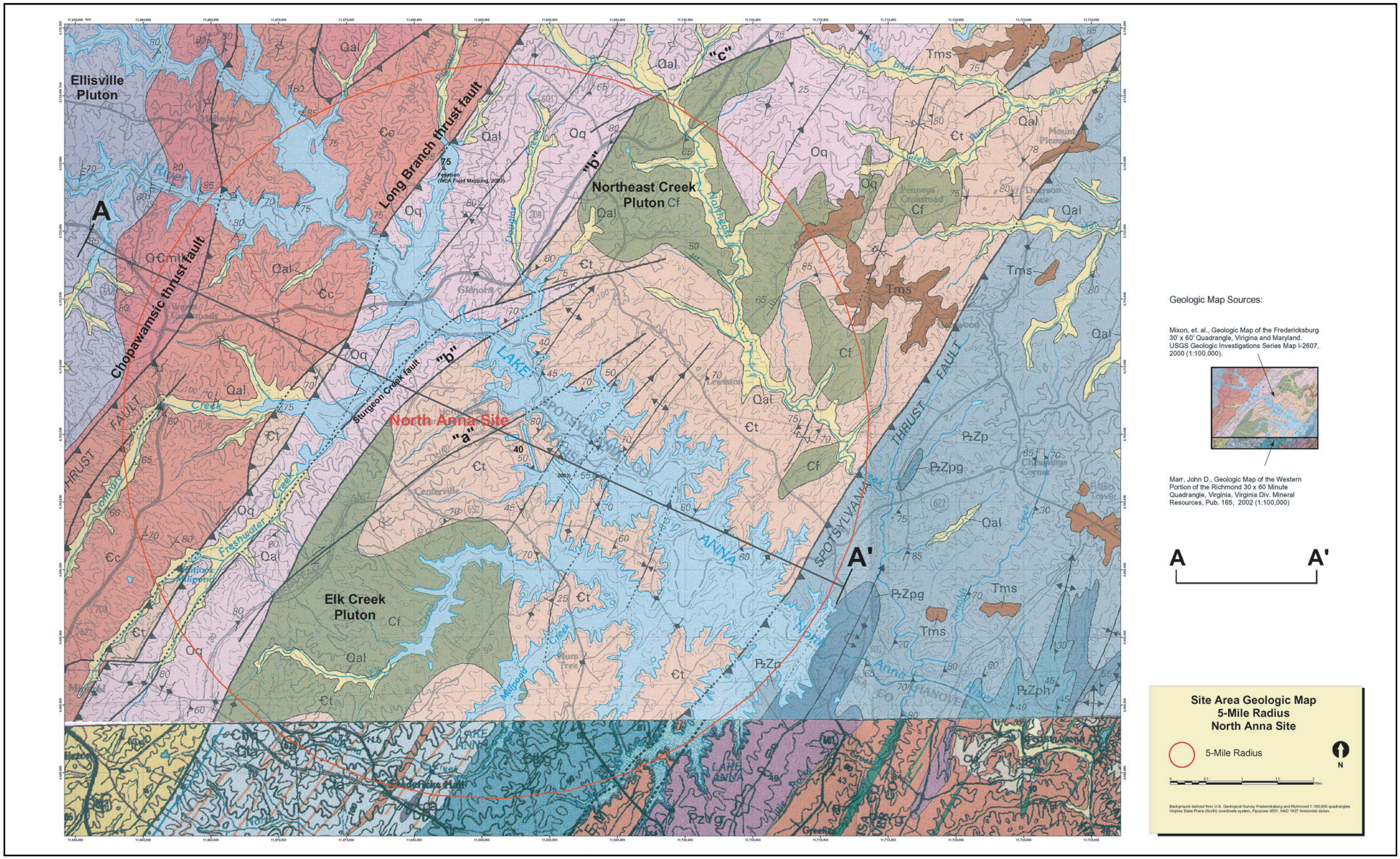


Figure 2.6-4 Site Area Geologic Map (5-Mile Radius) (Sheet 1 of 2)

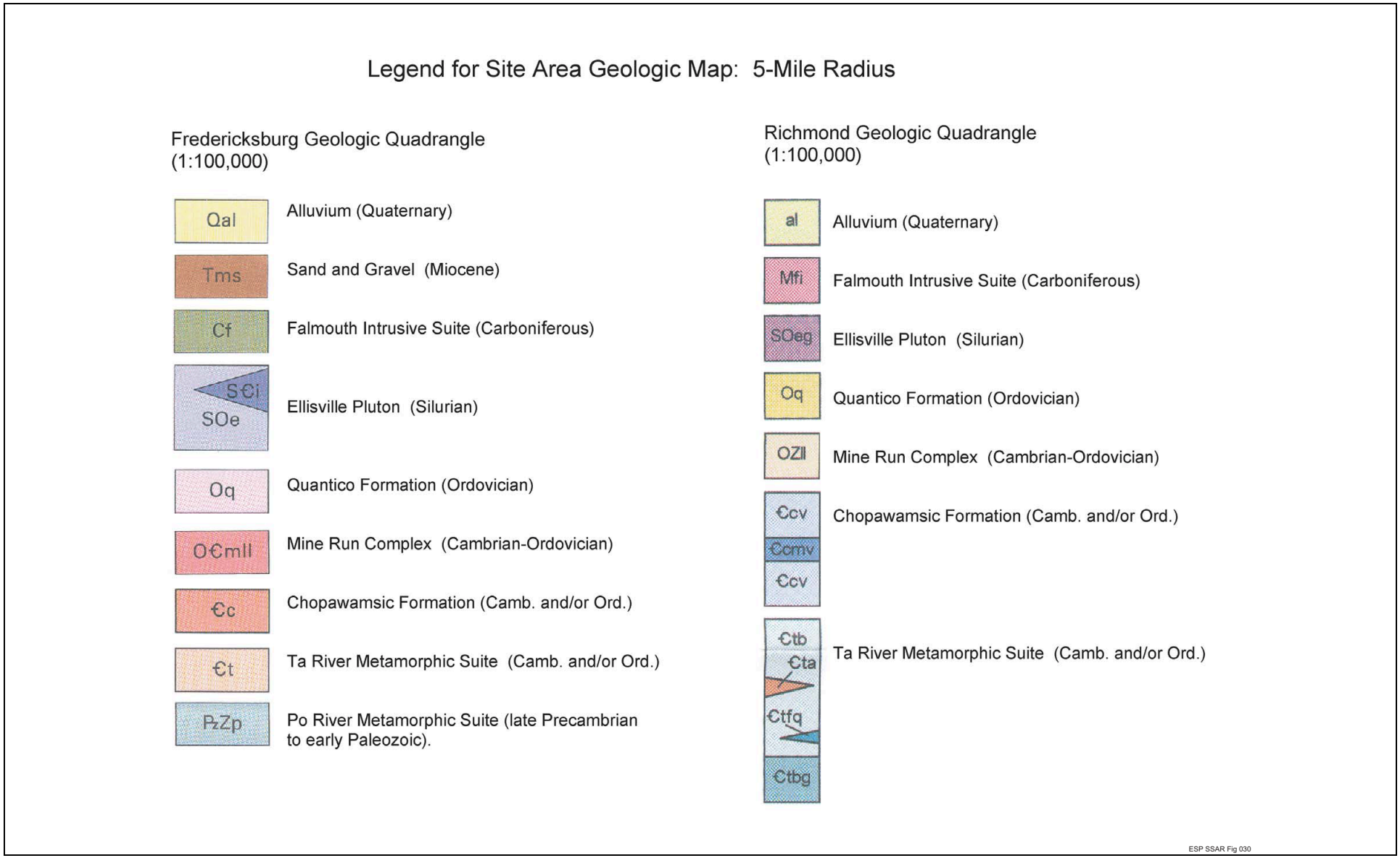
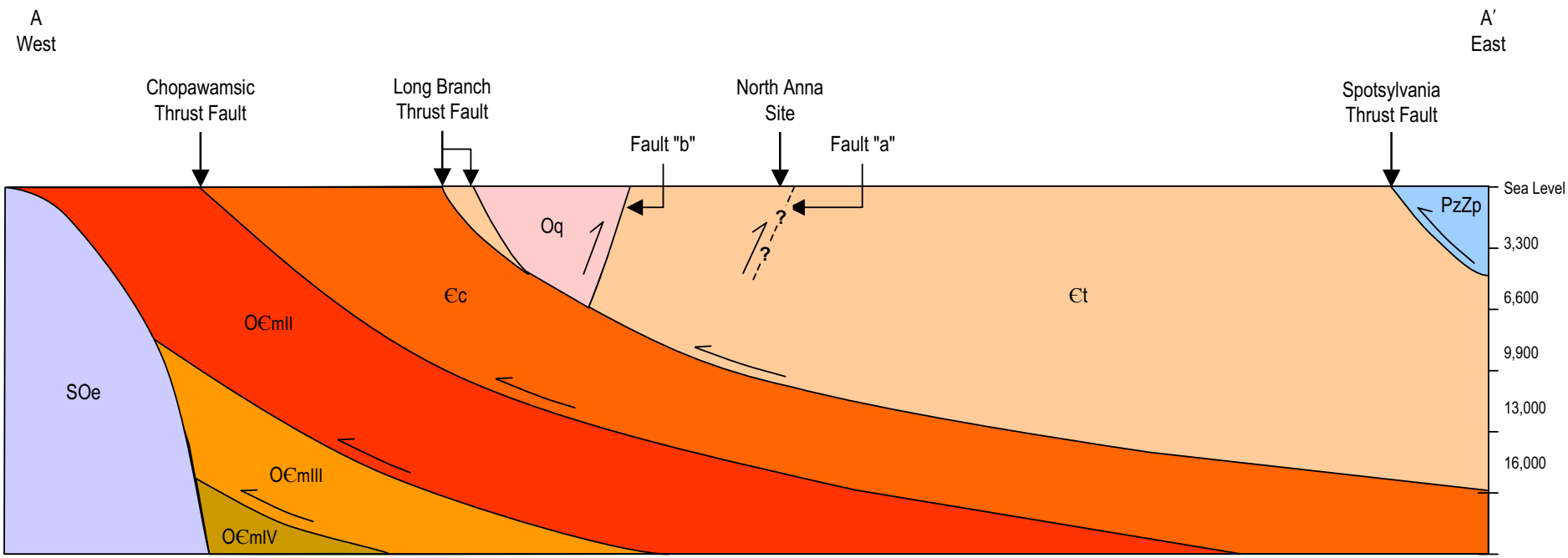


Figure 2.6-4 Site Area Geologic Map (5-Mile Radius) (Sheet 2 of 2)



PzZp	Po River Metamorphic Suite (Late Pre-cambrian to early Paleozoic)
Єt	Ta River Metamorphic Suite (Cambrian and/or Ordovician)
Єc	Chopawamsic Formation (Cambrian and/or Ordovician)
O€mII	Melange Zone II (Cambrian and/or Ordovician)
O€mIII	Melange Zone III (Cambrian and/or Ordovician)
O€mIV	Melange Zone IV (Cambrian and/or Ordovician)
Oq	Quantico Formation (Ordovician)
SOe	Ellisville Pluton (Silurian)

0 0.4 0.8 1.2 1.6 2.0 Miles

Scale 1:24,000

Source: Mixon and Others, 2000

Figure 2.6-5 Site Area Geologic Cross Section (5-Mile Radius)

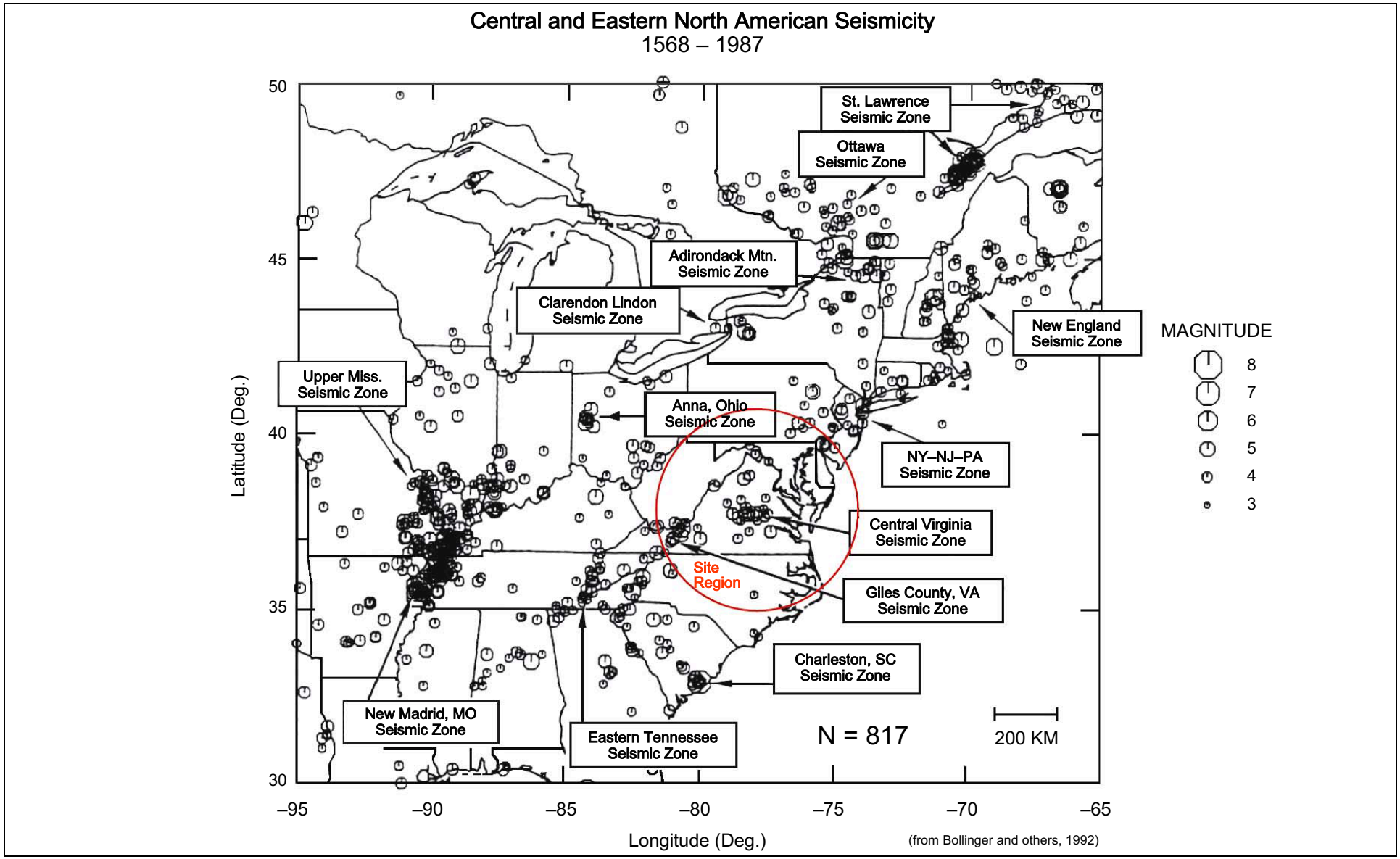


Figure 2.6-6 Seismic Source Zones and Seismicity in Central and Eastern North America

2.7 Meteorology and Air Quality

This section describes the general climate of the ESP site and the regional meteorological conditions used as the basis for design and operational conditions of the new units. This section also provides meteorological information that has been used to evaluate construction and operational impacts.

2.7.1 General Climate

The description of the site general climate is based on regional climatological and meteorological information primarily collected for Richmond, Virginia, and supplemented by the meteorological information collected at the NAPS site. In addition, observations taken at NWS cooperative network stations in the ESP site have been used to supplement the data from Richmond and the NAPS site.

2.7.1.1 General Description

The climate in the Piedmont region of Virginia, where the ESP site is located, is classified as modified continental. Summers are warm and humid and winters are generally mild. The Blue Ridge Mountains to the west act as a partial barrier to outbreaks of cold, continental air in winter. The mountains also tend to channel winds along a general north-south orientation. Temperatures in the site region rarely exceed 100°F or fall below 0°F. (Reference 1)

Based on 30 years of data (1961–1990), the area around the site receives an annual average rainfall of approximately 43.2 inches. Rainfall is fairly well distributed throughout the entire year, with the exception of July and August, when thunderstorm activity raises monthly totals to about 5.0 inches (Reference 1). Tropical cyclones can also contribute substantially to the precipitation totals and to extreme precipitation events.

The 60-year climatological records show that the monthly average snowfall of 4 inches or more occurs only in January. Snow usually remains on the ground only 1 or 2 days at a time. Richmond averages about 16.3 inches of snow a year (Reference 1).

In general, during light wind conditions, the local environmental conditions predominate, resulting in a channeling effect of winds such that the airflow patterns follow the topographical contour lines of the region. Lake Anna has a moderating effect with respect to extreme temperatures in the immediate vicinity of the site. During periods of temperature inversions or light wind conditions, the local dispersion conditions can be somewhat restricted (Reference 2, Section 2.3.1.2.1).

The existing units' Meteorological Monitoring Program began operations in 1971. The system was upgraded in 1978 in accordance with the criteria of RG 1.23 (Reference 2, Section 2.3.3.2.5.1). Data collected by the existing units' meteorological monitoring system is representative of long-term site meteorological conditions. However, long-term regional climatological data are considered more suitable for use for estimates of climatological extremes. Therefore, design and operating

basis conditions (probable maximum precipitation, tornado parameters, snow load, ice thickness, etc.) are based primarily on regional climatological data.

2.7.1.2 Winds

The climatological data indicate that while Richmond's prevailing wind is southerly on an annual basis, there are 6 months when the prevailing wind direction is northerly. The annual average wind speed is 7.9 mph. The monthly average wind speed is slightly lower during the summer season. The monthly average wind speed is highest during late winter and early spring. The maximum 2-minute average wind speed is 46 mph, while the maximum 5-second wind speed is 60 mph.

Based on the data collected from 1974 to 1987 (see Table 2.7-7), the average wind speed is 6.3 mph. Similar to Richmond, the average onsite summer wind speed (5.4 mph) is also lower than those during other seasons (Reference 2, Section 2.3).

2.7.1.3 Temperature

Annual average temperature is 58.2°F in Richmond, based on an 81-year period of record for that station, while the monthly average temperature ranges from the high 30s in January to the high 70s in July. Extreme temperatures recorded in Richmond range from a maximum of 105°F to a minimum of –12°F (Reference 1).

The annual average temperature onsite is 55.8°F, the monthly average temperature ranges from 33.6°F in February to 75.0F° in July (Reference 2, Section 2.3).

2.7.1.4 Atmospheric Moisture

Annual average relative humidity in Richmond is 70 percent. The early morning relative humidity is highest during August and September, with an average of 90 percent. Heavy fog conditions with visibility less than 0.25 mile are infrequent, on average occurring 27.2 days per year (Reference 1).

2.7.1.5 Precipitation

Annual precipitation in Richmond is about 43 inches, based on the 1961 to 1990 period. For the 64-year period (1938–2001), the maximum annual precipitation of 61.3 inches was measured in 1975. During the same period, the minimum annual precipitation of 22.9 inches occurred in 1941 (Reference 1) (Reference 3).

On average, about 48 percent of the annual precipitation at Richmond occurs from May through September each year. Generally, July has the highest amount of precipitation. The normal monthly totals range from about 3 to 5 inches. On average, there are about 11 days per year with precipitation greater than 1.0 inch. The maximum 24-hour precipitation was about 8.8 inches (August 1955). This event was associated with the remnants of Hurricane Connie as presented in Section 2.7.3.4.

Snowfall normally occurs from November through March, with an annual average of 16.3 inches for the 1961 to 1990 period. The monthly maximum snowfall measured in the region was 29.8 inches in Charlottesville in March 1960 (Reference 21). The maximum 24-hour snowfall observed in Richmond was 21.6 inches in January 1940. Annually, there are 4.3 days with snowfall greater than 1.0 inch. (Reference 1)

2.7.2 Regional Air Quality

2.7.2.1 Background Air Quality

The ESP site is in Louisa County, Virginia, which is within the Northeastern Virginia Intrastate AQCR. This region is designated as in attainment or unclassified for all criteria pollutants except $PM_{2.5}$ as noted below. The City of Richmond is within the State Capital Intrastate AQCR. This AQCR is also designated as attainment or unclassified for all criteria pollutants (40 CFR 81.347). Criteria pollutants are those for which NAAQSs have been established, such as SO_2, PM_{10}, $PM_{2.5}$, CO, Ozone, NO_2, and lead (Reference 42). Attainment areas are areas where the ambient air quality levels are better than EPA-designated ambient air quality standards.

The Commonwealth of Virginia is also subject to a revised 8-hour ozone standard and a new ambient air quality standard for $PM_{2.5}$, both promulgated by the EPA in July 1997 (Reference 5) (Reference 6). $PM_{2.5}$ refers to particles with an aerodynamic diameter less than or equal to 2.5 nominal micrometers. The EPA is taking steps to implement the new standard but has not yet designated the non-attainment areas for $PM_{2.5}$. Currently, Louisa County is designated as in attainment for both the ozone 1-hour and 8-hour standards.

The EPA has designated Class I Areas as areas with pristine air quality, such as wilderness areas, national parks, and Indian Reservations. There are two Class I Areas in Virginia: James River Face Wilderness and Shenandoah National Park, in which visibility is an important issue (Reference 7). The Shenandoah National Park is located closer to the ESP site (42 miles away) than is the James River Face Wilderness.

2.7.2.2 Projected Air Quality

VDEQ regulates airborne emissions at the NAPS site. Virginia Power holds an Exclusionary General Permit from VDEQ under Title 9 of the Virginia Administrative Code for all non-radiological airborne emissions resulting from plant operations. These emission sources at the NAPS site include two auxiliary boilers, four emergency diesel generators (3840 HP each), and a blackout generator (4640 HP). No air emission monitoring is performed at the site. Compliance under the Exclusionary General Permit is based on fuel sulfur content and fuel consumption records. Annual operation of the auxiliary boilers and the diesel generators is limited under the permit to 3000 and 500 hours, respectively. Under the terms of the permit, Virginia Power provides VDEQ with emissions update information and compliance certification annually (Reference 8).

The number of new unit-related non-radiological emission sources (i.e., auxiliary boilers, emergency diesel generators or station blackout generators, and cooling towers) on the ESP site is unknown at this time. However, these new emission sources would be regulated under the VDEQ air regulations. If Dominion decides to build the new units, Dominion would provide the required emissions update information to VDEQ. These future non-radiological emission sources would not be expected to cause significant impacts to ambient air quality or to visibility in Class I areas. New unit sources such as emergency and station blackout generators would only be operated for short time periods during tests or in the event of a loss of station power. In addition, the distances between the ESP site and the Class I areas are relatively long.

2.7.2.3 Inversion and High Air Pollution Potential

In the ESP site region, the annual frequency of occurrence of low-level inversions or isothermal layers based at or below 500 feet in elevation is approximately 30 percent according to Hosler (Reference 9). Seasonally, the greatest frequencies of inversions occur during the fall and winter (34 percent and 33 percent, respectively). Spring and summer have the lowest inversion frequencies (about 28 percent of the time for each season). Most of these inversions are nocturnal in nature, generated through nighttime cooling.

The mean maximum mixing height depth (MMMD) is another indication of the restriction to atmospheric dilution at a site. The mixing depth is the distance above the ground in which relatively free vertical mixing occurs in the atmosphere (Reference 10). According to Holzworth, the annual afternoon MMMD value for the ESP site region is about 4900 feet (Reference 11). The seasonal afternoon MMMD values for the ESP site during fall and winter are about 4600 feet and 3300 feet, respectively. Shallow mixing depths have a greater frequency of occurrence during the fall and winter seasons: fall and winter have a higher frequency of inversions. The actual effect of the mixing height on pollutants emitted within the mixing depth is determined by the actual hourly mixing heights.

2.7.3 Severe Weather

2.7.3.1 Thunderstorms, Hail, and Lightning

Based on a 65-year period of record, Richmond averages 36 thunderstorm-days per year. July has the highest frequency of occurrence, about 8 days, on average (Reference 1).

Hail can occur at any time of the year and is associated with well-developed thunderstorms, but has been observed primarily during the spring and summer months. The latest version of the Climate Atlas of the United States (Reference 40), published by the NCDC in 2002 and developed from observations made over the 30-year period of record from 1961 to 1990, indicates that Louisa and Spotsylvania Counties can expect, on average, hail with diameters greater than or equal to 0.75 inch about one day per year. The occurrence of hailstorms with hail greater than or equal to 1.0 inch in diameter averages less than one day per year.

However, the annual mean number of days with hail 0.75 inch or greater is slightly higher in nearby southern and eastern Hanover County (just to the southeast of the ESP site), eastern Goochland County (south of the ESP site) and Henrico County (also southeast of the ESP site), ranging from one to two days per year. Similarly, hailstorms with hail 1.0 inch or greater occur about one day per year on average. The NCDC cautions that hailstorm events are point observations and somewhat dependent on population density.

While no hailstorms of note have been recorded in some years, multiple events have been observed in other years including four in Louisa County during 1998 and three in Spotsylvania County during 1993, both with diameters up to 1.75 inches (Reference 41). Therefore, the slightly higher annual mean number of hail days may be a more representative frequency for the relatively less-populated ESP site area.

In terms of extreme hailstorm events, softball size hail (about 4.5 inches in diameter) has been observed in recent years at two locations in the general ESP site area (Reference 41) - on June 4, 2002 at Free Union, just northwest of Charlottesville in Albemarle County (about 42 miles west of the ESP site) and on May 4, 1996 at Lignum in central Culpeper County (about 28 miles north-northwest of the ESP site).

The mean frequency of lightning strikes to earth can be estimated using a method reported by EPRI (Reference 13). The EPRI formula assumes a relationship between the average number of thunderstorm-days per year (T) and the number of lightning strikes to earth per square mile per year (N).

$$N = 0.31\ T$$

As indicated previously, there are 36 thunderstorm-days per year, on average, at Richmond (Reference 1). Consequently, the number of lightning strokes to earth per square mile is about 11.2 per year. The ESP site plant envelope area is approximately 0.068 mi^2. Using this area as the potential reactor area, the annual average number of lightning strokes in the reactor area can be calculated as follows:

$$11.2/mi^2/year \times 0.068\ mi^2 = 0.76 \text{ lightning strokes per year at the ESP site}$$

2.7.3.2 Tornadoes and Severe Winds

Based on the period of record, 1953-1999 (Reference 14), Virginia ranks 28th in the U.S. for average annual number of tornadoes.

During the period from January 1950 through December 2003, a total of 235 tornadoes were reported within a 2-degree square area around the ESP site (Reference 12). This averages 4.35 tornadoes per year within this area, which includes counties in Virginia, West Virginia, and Maryland, and the District of Columbia. Among those 235 tornadoes, 204 occurred in Virginia, 29 in Maryland, 2 in the District of Columbia, and none in West Virginia. For the same period of record,

the tornado intensities, based on the Fujita-Pearson Tornado Scale, and the number of tornado occurrences in the entire Commonwealth of Virginia are presented in Table 2.7-2.

During the 54-year period (1950–2003), 433 tornadoes were reported in Virginia (Reference 12). This is equivalent to about 8 tornadoes per year. In Louisa County and the immediately adjacent four-county area (Hanover, Spotsylvania, Caroline, and Orange counties), 7 tornadoes were reported in Louisa County, 5 in Hanover County, 5 in Spotsylvania County, 8 in Orange County, and 5 in Caroline County. No F3 or higher intensity tornadoes were reported in Louisa or Spotsylvania counties.

As discussed in the Technical Basis for Regional Tornado Criteria (WASH-1300) (Reference 36), according to statistical methods proposed by Thom, the probability of a tornado striking a point within a given area may be estimated as follows (Reference 15):

$$P = \frac{z \times t}{A}$$

where:

P = the mean probability per year
z = the mean path area of a tornado
t = the mean number of tornadoes per year
A = the area of concern

The Event Record Details provided in the Storm Events report list the path length and path width of each specific tornado (Reference 12). For tornado events within the 2-degree square area around the ESP site, according to the available recorded data, the calculated mean tornado path length is 3.1 miles and the calculated mean path width is 116.7 yards. These values yield a z value of 0.2056 square mile. Using a 2-degree square area as a basis for A and a value of 4.35 tornadoes per year yields an annual probability of 5.94×10^{-5}, or a recurrence interval of 16,835 years. The strike probability, multiplied by the intensity probability yields the total probability that a tornado of a certain strength will strike a certain area.

According to American National Standard ANSI A58.1-1982, the operating basis wind velocity at 33 feet (10 meters) above ground level in the ESP site area associated with a 100-year return period is 64 miles per hour (Reference 38). Values for other recurrence intervals are listed in Table 2.7-3 (Reference 38). The fastest-mile-wind speed is defined as the passage of one mile of wind with the highest speed for the day. The fastest-mile-wind speed at Richmond (68 miles per hour) was recorded at that station in October 1954 (Reference 17). The 3-second gust wind speed that represents a 100-year return period is 96 mph at 10 meters above ground. This wind speed was determined in accordance with the guidance in Reference 37.

2.7.3.3 Heavy Snow and Ice Storms

Frozen precipitation typically occurs in the form of hail (already discussed in Section 2.7.3.1), snow, sleet and freezing rain. The frequency of occurrence of these types of weather events in the ESP site area are based on the latest version of the Climate Atlas of the United States (Reference 40).

The data indicate that the occurrence of snowfalls greater than or equal to 1 inch in the ESP site area ranges from about three to five days per year. However, the frequency of such snow events increases to the west and northwest of the ESP site in far western Louisa County, north-central Fluvanna County, and much of Albemarle and Orange Counties, ranging between 6 and 10 days per year. In general, these differences can be attributed to topographic effects.

On the other hand, the frequency of snowstorms of greater magnitude is similar over the ESP site area because the weather systems that produce such events often affect fairly large areas. On average, the data indicate that daily snowfall totals greater than or equal to thresholds of 5 and 10 inches occur less than one day per year.

Freezing rain falls as a liquid but freezes upon impact forming a glaze on the ground or other exposed objects whose temperature is typically near or below 32°F (0°C). It frequently occurs during the transition from winter rains to ice pellets (sleet) or snow and vice versa depending on the characteristics of the air mass. The Climate Atlas indicates that freezing precipitation events occur, on average, about six to ten days per year in the ESP site area.

2.7.3.4 Tropical Cyclones

On average, a tropical cyclone, or its remnants, can be expected to impact some part of the Commonwealth of Virginia each year (Reference 20). Tropical cyclones include not only hurricanes and tropical storms, but systems classified as tropical depressions, sub-tropical depressions and extra-tropical storms, among others.

This characterization considers all “tropical cyclones” (rather than systems classified only as hurricanes or tropical storms) because storm classifications are generally downgraded once landfall occurs and the system weakens although it may still result in significant rainfall events as it travels through the site region.

A comprehensive database of historical tropical cyclone tracks (i.e., currently extending from 1851 through 2003), available through the NOAA’s Coastal Services Center and based on information compiled by the National Hurricane Center (Reference 39), indicates that a total of 55 tropical cyclone centers or storm tracks have passed within a 100-nautical mile radius of the North Anna ESP site. Storm classifications and respective frequencies of occurrence over this period of record are as follows:

- Hurricanes - Category 3 (1), Category 2 (1), and Category 1 (5)
- Tropical Storms - 27

- Tropical Depressions - 13
- Subtropical Depressions - 1
- Extra-Tropical Storms - 7

Tropical cyclones are responsible for at least two separate record rainfall events in the North Anna ESP site area. In August 1969, Hurricane Camille, a tropical depression by the time it passed through the area within 100-nautical miles of the site, resulted in a record 24-hour (daily) rainfall total of 11.18 inches at the nearby Louisa observation station (see Section 2.7.4.1.5). The Louisa station is part of the National Weather Service's cooperative climatological network.

In August 1955, Hurricane Connie passed within about 120 nautical miles of the site at its closest approach. Although not included in the count of tropical cyclones above, Connie, then classified as a tropical storm, was responsible for the current record 24-hour (daily) rainfall total at Richmond Byrd International Airport (i.e., 8.79 inches) (see Section 2.7.1.5).

2.7.4 Local Meteorology

Data acquired from the NCDC (in Asheville, NC) have been used to determine the normal, means, and extremes of temperature, precipitation, relative humidity, and fog applicable to the ESP site. The 2001 Richmond Local Climatological Data (Reference 1) provides detailed climatological data for this first-order station. Climatological summaries for other stations in the area also provide supplemental information (Reference 21 through Reference 25).

The approximate distance and direction of the Richmond NWS station and at other nearby locations in the NWS' network of cooperative observing stations in the ESP site area are provided in Table 2.7-1:

Table 2.7-1 NWS and Cooperative Observing Stations Near the ESP Site

Station	Distance (miles)	Direction
Partlow 3WNW	5	East
Louisa	12	West
Piedmont Research Station	21	Northwest
Fredericksburg Nat'l Park	26	Northeast
Charlottesville 2W	40	West
Richmond	46	Southeast

The closest station, Partlow 3WNW, was closed on December 31, 1976 (Reference 26); therefore, recent data are not available from this station.

Besides using data from the nearby meteorological and climatological observing stations, data collected from the existing units' meteorological monitoring system was also used to characterize local meteorological conditions. The onsite primary meteorological tower is about 1750 feet east-northeast from the Unit 1 containment building (see Figure 2.7-1 and Figure 2.7-2). Based on proximity, the meteorological parameters (i.e., wind speed and wind direction) collected by the tower are representative of the ESP site. Consequently, they are appropriate for use in describing local meteorological conditions.

2.7.4.1 Normal and Extreme Values of Meteorological Parameters

A summary of normal and extremes of available temperature, precipitation, relative humidity, and fog are presented for Richmond in Table 2.7-4. Climatological means for Richmond and stations in the site region are presented in Table 2.7-5. Monthly temperature means for other applicable stations are presented in Table 2.7-6.

2.7.4.1.1 Wind Direction, Wind Speed and Wind Persistence

The distribution of wind direction and speed is an important consideration when evaluating transport conditions relevant to site diffusion climatology. The topographic features of the site region and/or the general circulation of the atmosphere (i.e., movement of pressure systems and location of semi-permanent zones) are factors in influencing the wind direction within the site region. For the ESP site, the prevailing wind is from the south-southwest during the summer season and from the northwest and north during the winter season. These wind directions are due primarily to the location of the Bermuda High off the eastern coast of the United States during the summer season, and the development of a cold high-pressure zone over the eastern portion of the United States during the winter season.

However, the topographic features of the ESP site region, in conjunction with the movement of pressure systems and the location of the semi-permanent pressure zones, have a definite influence on the wind direction distribution. The Blue Ridge Mountains, which are oriented in a south-southwest to north-northeast direction, are approximately 40 to 50 miles northwest of the ESP site. Consequently, the prevailing winds during the summer season are from the south and south-southwest because of the channeling effect created by the presence of the Blue Ridge Mountains. Additionally, the Blue Ridge Mountains act as a barrier to the prevailing westerly winds at the surface; but even more so, they act as a barrier to the movement of low-pressure cells from the Gulf of Mexico region to the northeast portion of the United States. Consequently, low-pressure cells that are generated in the Gulf are frequently forced to move toward the east on the back (west) side of the Blue Ridge Mountains, therefore, resulting in a southerly flow of air in the ESP site region instead of a southeasterly or easterly wind.

Topographic features also have a definite influence with respect to the wind direction during periods of light winds. Usually, during episodes of near calm, the pressure gradient is weak and there is no organization in the general circulation. However, due to topographic effects such as the presence of

Lake Anna, the airflow typically follows the contour lines of the land. Air is channeled along Lake Anna and the North Anna River Valley during light wind conditions. If there is a sufficient temperature gradient between the ambient air over the lake and surrounding land, a weak lake breeze could form. However, the lake breeze would affect only the area in the immediate vicinity of the lake (less than 1 mile) (Reference 2, Section 2.3.2.2.1.1).

The seasonal and annual average distributions of wind direction based on data collected at the existing units' primary tower are presented in Figure 2.7-3 through Figure 2.7-12 for the lower (33 ft) and upper (159 ft) levels (Reference 2). Winds occur on an annual basis along a north-south orientation with a general westerly component. Wind direction distributions based on the lower level data are similar to those based on the upper level data. However, the upper level data indicate a more distinct north-south orientation of wind flows. Wind data at Richmond show a south-southwest/north orientation that is similar to the general wind flow at the ESP site (Reference 1).

Wind direction distributions show seasonal variations. The frequencies of northerly and southerly winds are generally equivalent during the fall season. Winds from the northwest and south-southwest sectors characterize wind flows during the winter. During the spring season, the wind flow is predominantly from the northwest at the lower level. During the summer months, the predominant wind is from the south-southwest.

Atmospheric dilution is directly proportional to the wind speed (other factors remaining constant). The seasonal and annual mean wind speeds for the ESP site are presented in Table 2.7-7. As indicated in the table, mean wind speeds show seasonal variations.

The mean annual wind speeds at the ESP site are 6.3 mph and 8.6 mph at the lower and upper tower level, respectively. The annual frequencies of calm are 0.37 and 0.75 percent for the lower and upper tower levels, respectively (Reference 2, Section 2.3.2.2.1.1).

Wind persistence is important when considering potential effects of a radiological release. It is defined as a continuous flow from a given direction or range of directions. Wind persistence roses for meteorological data collected at the NAPS site are presented in Figure 2.7-13 through Figure 2.7-22. The maximum 22.5-degree range direction persistence episodes recorded at NAPS during the period of record from the data for the lower level was a 26-hour wind from the north. The maximum persistence period at the upper level was 33 hours from the west-northwest. In general, extreme persistence periods (greater than 18 hours) at the ESP site are associated with moderately high winds and relatively low or moderate turbulence (Reference 2, Section 2.3.2.2.1.2).

2.7.4.1.2 **Atmospheric Stability**

Atmospheric stability, as applied in this report, is determined by the delta T method defined by the NRC (Reference 2, Section 2.3.3.2).

The seasonal and annual frequencies of stability classes and associated wind speeds for the ESP site are presented in Table 2.7-8. The vertical stability data, based on delta T site measurements, indicate the predominance of neutral and slightly stable conditions (Reference 2, Section 2.3.2.2.1.1).

Extremely unstable conditions (Stability Class A) are more frequent and extremely stable conditions (Stability Class G) are less frequent during the summer than during the winter. This situation is attributed to the greater solar heating of the surface during the summer and the large-scale restrictive dilution conditions (presented in Section 2.7.2.3) that generally occur during the winter. Also, ground snow cover is conducive to the formation of stable (or inversion) conditions.

Instrumentation is available in the main control room of the existing units by which personnel can identify atmosphere stability. The existing units' Emergency Plan Implementing Procedures identify station-specific instructions and appropriate temperature values for determining RG 1.23, Table 2 atmospheric stability classifications. This stability classification method allows for the rapid assessment of pertinent meteorological parameters by control room personnel in the event of an accidental release of radioactive material to the atmosphere.

2.7.4.1.3 Temperature

Ambient temperature at the ESP site is measured by the primary tower at the 33-foot level, and differential temperature is measured between the 33-foot and 158.9-foot levels. The annual onsite average temperature, as reported in Reference 2, is 55.8°F, while the annual average temperature in Richmond is 58.3°F, based on the period of record from September 16, 1971 to September 15, 1972. A higher annual average for Richmond is expected because the ESP site is in a rural area, which tends to have slightly lower average temperature than large cities that are influenced by the heat-island effect. In addition, the presence of Lake Anna would also moderate the site temperature.

The annual average temperature measured in Louisa (Reference 23) is 56.1°F, based on the long-term climatological record for that station. Similarly, the nearby Partlow 3WNW station, located in southern Spotsylvania County, has a long-term annual average temperature of 55.2°F. (Reference 25)

2.7.4.1.4 Atmospheric Moisture

The relative humidity data collected in Richmond is described in Section 2.7.1.4. These data are representative of the ESP site area due to its similar exposure to the Atlantic shore.

Based on 24-year (1973–1996) records, the 0.4 percent, 1 percent, and 2 percent wet-bulb temperatures measured in Richmond are 79°F, 78°F, and 77°F, respectively (Reference 43). Wet bulb temperature is used for cooling system-modeling studies.

2.7.4.1.5 Precipitation

As stated in Section 2.7.1.5, the annual precipitation in Richmond is about 43 inches. This annual total is representative of conditions at the ESP site. Based on a 30-year (1951–1980) period, the annual precipitation recorded in Louisa averages 42.08 inches (Reference 23). The annual precipitation in Partlow 3WNW (1952–1971) is about 42.2 inches (Reference 25). In Louisa, the maximum 24-hour precipitation is 11.18 inches (August 1969), while the maximum monthly precipitation is about 16.3 inches (August 1969). The Richmond monthly average precipitation ranges from about 3 to 5 inches (Reference 1), while in Louisa, the monthly averages range from about 3 to 4.5 inches (Reference 23).

In Louisa, the annual snowfall averages about 20 inches (Reference 23). The Partlow 3WNW annual snowfall averages 18.6 inches (Reference 25). These values are slightly higher than the average value of 16.3 inches measured in Richmond. The maximum monthly snowfall measured in Louisa (32.2 inches) is also slightly higher than 28.5 inches measured in Richmond (Reference 1) or 29.8 inches measured in Charlottesville 2W (Reference 21).

2.7.4.1.6 Fog

The closest available fog data for the ESP site area are from the NWS observations at Richmond International Airport in Richmond. The local climatological data for Richmond through 2001 indicate an average of 27.2 days per year of heavy fog based on 73 years of records (Reference 1). Heavy fog is defined by the NWS as fog that reduces visibility to one-quarter of a mile or less. The frequency of fog conditions at the ESP site would be expected to be somewhat different from Richmond. The ESP site is characterized by gentle rolling terrain that rises to an average height of 50 to 150 feet above Lake Anna's level. Low regions at the site and in the vicinity of the lake would be expected to have a higher frequency of fog occurrences attributed to the accumulation of relatively cool surface air due to drainage flows from higher elevations when compared to the relatively flat region of the Richmond airport.

2.7.4.1.7 Topographical Description and Potential Modifications

The ESP site and exclusion area (approximately 1803 acres) is in the northeastern portion of Virginia in Louisa County along the North Anna River. The site region is characterized by gently rolling terrain that rises to an average height of 50 to 150 feet above Lake Anna's level and is cut by the North Anna River. The topography in the site region is characteristic of the Central Piedmont Plateau, which has a gently undulating surface that varies from 200 to 500 feet above sea level. Figure 2.7-23 and Figure 2.7-24 present the topographic features of the site. Section 2.7.4.1.1 presents how the topographic features of the site influence wind direction distribution.

Lake Anna, which extends approximately 17 miles along the old North Anna riverbed, was formed by damming up the North Anna River about 5 miles southeast of the site. As described in Section 2.3.1, the North Anna Reservoir and the WHTF, which together form Lake Anna, cover a surface area of about 13,000 acres and contain approximately 305,000 acre-feet of water.

Because of the gently rolling terrain, there is cold air drainage into low-lying areas at night. Some wind channeling along Lake Anna is expected during low-wind-speed conditions. This same effect also occurred in the natural lowland area before the lake was developed.

The ESP site for the new Units 3 and 4 is immediately west of the existing units. The primary topographic influences on local meteorological conditions at the ESP site are Lake Anna and the North Anna River Valley. During construction of the new units, a portion of the currently undeveloped area of the ESP site would be cleared of existing vegetation and subsequently graded to accommodate the new units and their ancillary structures. No large-scale cut and fill activities would be needed in the area of the ESP Plant Parameter Envelope to accommodate the new units since a large portion of the area to be developed is already relatively level. Undulating surfaces in the area of the planned cooling towers would be leveled to accommodate the towers. Therefore, the expected terrain modifications associated with development of the new nuclear power plant(s) at the ESP site would be limited to the existing NAPS site and would not significantly impact terrain features around the Lake and/or Valley, nor significantly alter the site's existing gently undulating surface that is characteristic of its location in the Piedmont region of Virginia.

2.7.5 Short-Term Diffusion Estimates

2.7.5.1 Basis

To evaluate potential health effects for DBAs, NUREG-1555, Section 7.1 requires the applicant to account for the 50 percentile χ/Q values at appropriate distances from the effluent release points (Reference 27). The NRC-sponsored PAVAN computer code (Reference 28) was used to generate these overall site, 50 percentile χ/Q values.

Recent readily available site meteorological data (1996–1998) were used for a quantitative evaluation of the hypothetical accident at the ESP site. Onsite data provide representative measurements of local dilution conditions appropriate to the ESP site and are reasonable representative of long-term conditions. The use of the recent 3-year data for dispersion analyses involving accidental releases in this ESP application is consistent with the approach used in the license renewal application for the existing units (Reference 29) and also satisfies the requirement of RG 4.7 (Reference 30). These 3-year combined joint frequency distributions of wind direction, wind speed, and atmospheric stability recorded at the NAPS site are presented in Table 2.7-9.

The PAVAN program implements the guidance provided in RG 1.145 (Reference 31) and performs the following calculation procedures. The code computes χ/Q values at the EAB and LPZ for each combination of wind speed and atmospheric stability for each of the 16 downwind direction sectors. Because since the ground level release scenario provides a bounding case, elevated releases were not evaluated. The χ/Q values for each sector are then ranked in descending order, and an associated cumulative frequency distribution is derived based on the frequency distribution of wind

speed and stabilities for that sector. The χ/Q values are also ranked independent of wind direction into a cumulative frequency distribution for the entire site.

The PAVAN model was configured to calculate offsite χ/Q values assuming both wake-credit allowed and wake-credit not-allowed. As described in Section 2.1, the EAB is the perimeter of a 5000-foot-radius circle from the center of the abandoned Unit 3 containment. There are no residential areas in the EAB. The PPE indicates that the highest expected structure would be about 234 feet above grade level. Therefore, the closest EAB is more than 10 building heights away from the boundary of the plant envelope developed for the ESP site. As a result, the entire EAB is located beyond the wake influence zone that would be induced by a containment building. The LPZ is a 6-mile-radius circle centered at the Unit 1 containment building. Because it is located further away from the plant site than the EAB, the "wake-credit not allowed" scenario of the PAVAN results was used for the χ/Q analysis at the EAB and LPZ.

To be conservative, the shortest distances between the ESP plant envelope boundaries to the 5000-ft-radius circle for each downwind sector were entered as input to calculate the χ/Q values at the EAB (see Table 2.7-10). Similarly, the shortest distance from the ESP plant envelope area boundary to the LPZ was entered as input to calculate the X/Q values at the LPZ. With respect to the ESP site, the shortest distance between the ESP site plant envelope boundary and the LPZ is 8843 m (about 5.5 mi.) measured from the southwest of the plant envelope area.

2.7.5.2 PAVAN Modeling Results

Based on the PAVAN-generated ordered χ/Q values (see Table 2.7-11 and Table 2.7-12), the 50-percentile overall site χ/Q values calculated by the model at the EAB and LPZ are 3.34E-05 and 2.17E-06, respectively.

2.7.6 Long-Term (Routine) Diffusion Estimates

2.7.6.1 Basis

The NRC-sponsored, computer code designated XOQDOQ (Reference 32) was used to estimate χ/Q values due to routine releases. The XOQDOQ model implements the assumptions outlined in RG 1.111 (Reference 33). A straight-line trajectory was assumed between the release point and all receptors by the XOQDOQ model.

The primary function of the XOQDOQ computer code, obtained from RSICC (Reference 34), is to calculate annual χ/Q values and annual average relative deposition D/Q values, at interested receptors (i.e., EAB, LPZ, nearest milk cow, residence, garden, meat animal, etc.). The program assumes the material released to the atmosphere to be a Gaussian distribution around the plume centerline. In estimating concentrations for longer time periods, the Gaussian distribution is assumed to be evenly distributed within the directional sector.

Input data and assumptions used in the XOQDOQ modeling are presented below.

- Meteorological Data: Three-year combined (1996–1998) onsite joint frequency distribution of wind speed, wind direction and atmospheric stability.
- Type of Release: Ground level
- Wind Sensor Height: 33 ft
- Vertical Temperature Difference: 33 ft–158.9 ft
- Number of Wind Speed Categories: 7
- Release Height: 33 ft (default height)
- Minimum Building Cross-Sectional Area: 2250 m^2
- Distances from the release point to the site boundary, and the nearest milk cow, vegetable garden, milk goat, and meat animal: See Table 2.7-13.

For dispersion analysis, a smaller cross-sectional area usually results in higher ground level concentrations. To be conservative, the minimum building cross-sectional area of 2250 m^2 was used to evaluate building downwash effect.

When compared to the elevated releases, ground level releases usually produce higher pollutant concentrations for receptors located at ground level. Therefore, ground level releases were conservatively assumed in the χ/Q analysis. Distances from the Unit 1 containment building to various interested receptors (nearest residence, garden, meat animal, site boundary, and vegetable garden) for each directional sector are provided in Reference 35, Appendix C. Because the plant envelope area for the ESP site is an area (not a point), the shortest distances from any point of the plant envelope to the interested receptors were re-calculated for each directional sector. The results are presented in Table 2.7-13. The maximum annual χ/Q (no decay) value at the EAB (0.88 mile to the ESE of the plant envelope) is 3.70×10^{-6} sec/m^3. The maximum annual average χ/Q value calculated for the nearest residence (0.96 mile to the NNE of the plant envelope) is 2.4×10^{-6} sec/m^3. The maximum annual χ/Q for the nearest vegetable garden (0.94 mile to the NE of the plant envelope) is 2.0×10^{-6} sec/m^3. Finally, the maximum annual χ/Q for the nearest meat animal (1.37 miles to the SE of the plant envelope) is 1.4×10^{-6} sec/m^3.

Table 2.7-14 summarizes the maximum χ/Q and D/Q values predicted by the XOQDOQ model for the sensitive receptors due to routine releases. Table 2.7-15 summarizes the maximum annual average χ/Q and D/Q values at distances between 0.25 and 50 miles and for various segment boundaries.

Detailed annual average χ/Q and D/Q estimates generated by the XOQDOQ model for the interested receptors and at distances between 0.25 mile to 50 miles, as well as for various segment boundaries, are also presented. Table 2.7-16 represents χ/Q estimates at the specific points of interest. Table 2.7-17 lists χ/Q estimates at downwind distances between 0.25 and 50 miles. Table 2.7-18 contains χ/Q estimates that include radioactive decay with a half-life of 2.26 days for short-lived noble gases. Table 2.7-19 contains χ/Q estimates that include radioactive decay with a

half-life of 8 days for all iodines released to the atmosphere. Finally, Table 2.7-20 contains estimates of long-term average D/Q at downwind distances between 0.25 and 50 miles.

Section 2.7 References

1. Richmond, Virginia, 2001 Local Climatological Data, *Annual Summary with Comparative Data,* NCDC, National Environmental Satellite, NESDIS, NOAA.

2. *North Anna Updated Final Safety Analysis Report,* Rev. 38, Dominion Virginia Power.

3. Richmond, Virginia, Local Climatological Data, *Annual Summary with Comparative Data,* Environmental Data Service, NOAA, 1973.

4. Deleted

5. 40 CFR 50.7, *National 8-Hour Primary and Secondary Ambient Air Quality Standards for Ozone,* Code of Federal Regulations, July 18, 1997.

6. 40 CFR 50.10, *National Primary and Secondary Ambient Air Quality Standards for Particulate Matter,* Code of Federal Regulations, July 18, 1997.

7. 40 CFR 81, Subpart D, *Identification of Mandatory Class I Federal Areas Where Visibility Is An Important Value,* Code of Federal Regulations, November 30, 1979.

8. NUREG-1437, Supplement 7, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding North Anna Power Station, Units 1 and 2,* Final Report, U.S. Nuclear Regulatory Commission, November 2002.

9. Hosler, C. R. *Low-Level Inversion Frequency in the Contiguous United States,* Monthly Weather Review, Vol. 89, No. 9, 1961, 319–332.

10. *Guidelines for Air Quality Maintenance Planning and Analysis,* Vol. 10, EPA-450/4-77-001, EPA, 1977.

11. Holzworth, G. C. *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States,* EPA, 1971.

12. *Storm Events for Virginia, 01/01/1950 Through 12/31/2003*, NCDC, NOAA, Website, www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms, accessed June 2004.

13. *Summary of Items of Engineering Interest,* Rural Utilities Service, U.S. Department of Agriculture, August 1998.

14. 1999 Annual Summaries, *Flood/Flash Flood, Lightning, Tornado, Hurricane,* NCDC, NOAA.

15. Thom, H. C. S. *Tornado Probabilities,* Monthly Weather Review, Vol. 91, Nos. 10-12, 1963, 730–736.

16. Deleted

17. *Richmond, Virginia, 1989 Local Climatological Data, Annual Summary with Comparative Data*, NCDC, NESDIS, NOAA.

18. Deleted

19. Deleted

20. Virginia Tropical Cyclone Climatology, Website, www.hpc.ncep.noaa.gov/research/roth/vaclimohur.htm, accessed December 12, 2002.

21. *Charlottesville 2W, Virginia, Climatography of the United States, No. 20 (1951–1980)*, NCDC, NESDIS, NOAA.

22. *Fredericksburg National Park, Climatography of the United States, No. 20 (1951-1980)*, NCDC, NESDIS, NOAA.

23. *Louisa, Virginia, Climatography of the United States, No. 20 (1951-1980), NCDC, NESDIS, NOAA*.

24. *Piedmont Research Station, Virginia, Climatological Summary, Means and Extremes for Period 1946-1970, Climatography of the United States, No. 20-44, N*OAA, in cooperation with the Water Resources Research Center and the Research Division of Virginia Polytechnic Institute and State University.

25. *Partlow 3WNW, Virginia, Climatological Summary, Means and Extremes for Period 1952-1971,* Climatography of the United States, No. 20-44, NOAA, in cooperation with the Water Resources Research Center and the Research Division of Virginia Polytechnic Institute and State University.

26. *Virginia Climate Advisory 12/00,* Virginia State Climatology Office, Website, climate.virginia.edu/advisory/2000/ad00-12.htm, accessed March 24, 2003.

27. NUREG-1555, *Environmental Standard Review Plan, Standard Review Plans for Environmental Reviews for Nuclear Power Plants,* NRC, October 1999.

28. NUREG/CR-2858, *PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations,* PNL-4413, NRC, 1982.

29. North Anna Power Station, Units 1 and 2 Application for Renewed Operating Licenses, Dominion Energy, May 2001.

30. Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations,* Rev. 2, NRC, April 1998.

31. Regulatory Guide 1.145, Rev. 1, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants,* NRC, 1982.

32. NUREG/CR-2919, *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations, Final Report,* NRC, 1982.

33. Regulatory Guide 1.111, *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases for Light-Water-Cooled Reactors,* Rev. 1, NRC, 1977.

34. NRCDOSE 2.3.2, CCC-684, *Radiation Safety Information Computational Center,* 2002.

35. Radiological Environmental Monitoring Program, 2001 Annual Report, Dominion Virginia Power, North Anna Power Station, Prepared by Dominion Virginia Power and Teledyne Brown Engineering Environmental Services.

36. *Technical Basis for Interim Regional Tornado Criteria*, WASH-1300, U.S. Atomic Energy Commission, May 1974.

37. *Minimum Design Loads for Buildings and Other Structures*, SEI/ASCE 7-02, Revision of ASCE 7-98, ASCE, and Structural Engineering Institute (SEI), January 2002.

38. *Minimum Design Loads for Buildings and Other Structures*, ANSI A58.1-1982, ANSI, Revision of ANSI A58.1-1972, March 1982.

39. *Historical Hurricane Tracks Storm Query, 1851 through 2003*, NOAA Coastal Services Center, Website, hurricane.csc.noaa.gov/hurricanes/index.htm, accessed June 23 and 25, 2004.

40. *The Climate Atlas of the United States*, Version 2.0 (CD-ROM), NCDC, Climate Services Division, NOAA, September 2002.

41. *Storm Events for Virginia (Hail), 1955 through February 2004*, NCDC, NOAA, Website, www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms, accessed June 25, 2004.

42. 40 CFR 50, *National Primary and Secondary Ambient Air Quality Standards*, Code of Federal Regulations.

43. *Engineering Weather Data*, 2000 Interactive Edition, Version 1.0 (CD-ROM), developed by the Air Force Combat Climatology Center, Asheville, NC, published by the NCDC, summary for Richmond, Virginia.

Table 2.7-2 Summary of Virginia Tornado Intensities

Tornado Intensity (Fujita Tornado Scale)	Number of Occurrences (January 1950–December 2003)
F0	120
F1	184
F2	72
F3	29
F4	2
F5	0
Non-Classified	26
Total	433

Notes: Scale	Wind Speed (mph)
F0	40–72
F1	73–112
F2	113–157
F3	158–206
F4	207–260
F5	261–318

Source: Storm Events for Virginia, 01/01/1950 through 12/31/2003, NCDC, NOAA. (Reference 12)

Table 2.7-3 Extreme 1-Mile Wind Passage at Richmond, Virginia

Probability	Speed (mph)	Recurrence Interval (years)
0.04	56	25
0.02	60	50
0.01	64	100

Source: ANSI A58.1, American National Standard: Minimum Design Loads for Building and Other Structures, ANSI, 1982. (Reference 38)

Table 2.7-4 Richmond Climatological Data

NORMALS, MEANS, AND EXTREMES

RICHMOND, VA

LATITUDE: 37° 30' 40" N LONGITUDE: 77° 19' 24" W ELEVATION (FT): GRND: 164 BARO: 167 TIME ZONE: EASTERN (UTC + 5) WBAN: 13740

	ELEMENT	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F	NORMAL DAILY MAXIMUM	30	45.7	49.2	59.5	70.0	77.8	85.1	88.4	87.1	80.9	70.7	61.3	50.2	68.8
	MEAN DAILY MAXIMUM	81	47.4	50.3	58.9	69.3	77.6	85.1	88.3	86.5	80.8	70.6	60.4	50.0	68.8
	HIGHEST DAILY MAXIMUM	72	80	83	93	96	100	104	105	102	103	99	86	81	105
	YEAR OF OCCURRENCE		1950	1932	1938	1990	1941	1952	1977	1983	1954	1941	1993	1998	JUL 1977
	MEAN OF EXTREME MAXS.	81	69.4	71.2	80.2	87.8	91.1	96.0	97.5	95.9	93.1	85.5	77.8	70.1	84.6
	NORMAL DAILY MINIMUM	30	25.7	28.1	36.3	44.6	54.2	62.7	67.5	66.4	59.0	46.5	37.9	29.9	46.6
	MEAN DAILY MINIMUM	81	28.4	30.0	36.6	45.4	54.7	63.5	68.0	66.6	60.1	47.8	38.4	30.9	47.5
	LOWEST DAILY MINIMUM	72	-12	-10	11	23	31	40	51	46	35	21	10	-1	-12
	YEAR OF OCCURRENCE		1940	1936	1960	1985	1956	1967	1965	1934	1974	1962	1933	1942	JAN 1940
	MEAN OF EXTREME MINS.	81	10.2	14.2	21.6	30.9	41.0	51.1	57.8	55.6	45.4	32.4	22.7	14.6	33.1
	NORMAL DRY BULB	30	35.7	38.7	48.0	57.3	66.0	73.9	78.0	76.8	70.0	58.6	49.6	40.1	57.7
	MEAN DRY BULB	81	38.0	40.1	47.8	57.4	66.2	74.3	78.2	76.6	70.5	59.2	49.5	40.4	58.2
	MEAN WET BULB	17	34.0	36.7	41.9	50.5	59.4	67.3	71.5	66.0	63.6	53.7	44.9	36.8	52.2
	MEAN DEW POINT	17	27.0	29.1	33.9	43.0	54.3	63.2	68.1	63.1	59.9	48.7	38.6	30.0	46.6
	NORMAL NO. DAYS WITH:														
	MAXIMUM ≥ 90°	30	0.0	0.0	0.1	0.8	2.3	8.7	13.8	11.0	4.1	0.3	0.0	0.0	41.1
	MAXIMUM ≤ 32°	30	4.3	1.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	7.6
	MINIMUM ≤ 32°	30	23.0	19.5	10.8	2.3	0.1	0.0	0.0	0.0	0.0	2.1	9.4	19.2	86.4
	MINIMUM ≤ 0°	30	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
H/C	NORMAL HEATING DEG. DAYS	30	908	736	527	241	61	0	0	0	23	233	462	772	3963
	NORMAL COOLING DEG. DAYS	30	0	0	0	10	92	270	403	366	173	34	0	0	1348
RH	NORMAL (PERCENT)	30	68	66	63	61	70	72	75	77	77	74	69	69	70
	HOUR 01 LST	30	75	73	72	73	83	86	88	90	90	86	79	76	81
	HOUR 07 LST	30	79	78	78	76	81	83	86	90	90	89	84	80	83
	HOUR 13 LST	30	56	53	49	45	52	54	57	58	57	52	51	55	53
	HOUR 19 LST	30	65	62	57	53	63	66	69	74	77	75	68	68	66
S	PERCENT POSSIBLE SUNSHINE	46	54	58	62	66	65	69	68	66	65	63	59	54	62
W/O	MEAN NO. DAYS WITH:														
	HEAVY FOG(VISBY≤1/4 MI)	73	2.7	2.1	1.7	1.6	1.8	1.5	2.0	2.4	2.9	3.3	2.3	2.8	27.1
	THUNDERSTORMS	65	0.2	0.4	1.6	2.4	5.3	6.6	8.2	6.2	2.9	1.0	0.6	0.2	35.6
CLOUDINESS	MEAN:														
	SUNRISE-SUNSET (OKTAS)	1			5.6		5.6	3.2							
	MIDNIGHT-MIDNIGHT (OKTAS)	1			5.6										
	MEAN NO. DAYS WITH:														
	CLEAR	1	2.0	1.0	9.0		9.0	10.0							
	PARTLY CLOUDY	1		1.0	5.0		4.0	8.0							
	CLOUDY	1	7.0	4.0	10.0		8.0	1.0							
PR	MEAN STATION PRESSURE(IN)	28	29.91	29.89	29.85	29.81	29.81	29.81	29.83	29.86	29.89	29.92	29.92	29.93	29.87
	MEAN SEA-LEVEL PRES. (IN)	17	30.12	30.11	30.05	29.99	30.00	29.99	30.01	30.04	30.08	30.12	30.14	30.14	30.07
WINDS	MEAN SPEED (MPH)	43	8.3	8.7	9.3	9.2	7.9	7.5	7.1	6.6	7.0	7.2	7.7	7.9	7.9
	PREVAIL.DIR(TENS OF DEGS)	26	01	01	36	19	19	20	19	19	36	36	19	36	19
	MAXIMUM 2-MINUTE:														
	SPEED (MPH)	6	38	39	37	46	41	45	33	44	40	37	36	40	46
	DIR. (TENS OF DEGS)		31	23	22	33	30	26	29	36	01	10	16	15	33
	YEAR OF OCCURRENCE		2000	1997	1996	1999	1997	2000	1999	1996	1999	1996	1999	1996	APR 1999
	MAXIMUM 5-SECOND:														
	SPEED (MPH)	6	48	49	49	56	60	55	44	59	53	46	46	48	60
	DIR. (TENS OF DEGS)		31	26	22	25	28	27	29	32	08	10	16	16	28
	YEAR OF OCCURRENCE		2000	1997	1996	1998	1996	2000	1999	2000	1996	1996	1999	1996	MAY 1996
PRECIPITATION	NORMAL (IN)	30	3.24	3.16	3.61	2.96	3.84	3.62	5.03	4.40	3.34	3.53	3.17	3.26	43.16
	MAXIMUM MONTHLY (IN)	64	7.97	5.97	8.65	7.31	8.87	9.24	18.87	14.10	16.60	9.39	7.64	7.07	18.87
	YEAR OF OCCURRENCE		1978	1979	1984	1987	1972	1938	1945	1955	1999	1971	1959	1973	JUL 1945
	MINIMUM MONTHLY (IN)	64	0.64	0.48	0.94	0.64	0.87	0.38	0.51	0.52	0.26	0.01	0.17	0.40	0.01
	YEAR OF OCCURRENCE		1981	1978	1966	1963	1965	1980	1983	1943	1978	2000	2001	1980	OCT 2000
	MAXIMUM IN 24 HOURS (IN)	64	3.31	2.67	3.43	2.97	3.08	4.61	5.73	8.79	6.52	6.50	4.07	3.16	8.79
	YEAR OF OCCURRENCE		1962	1979	1992	1987	1981	1963	1969	1955	1999	1961	1956	1958	AUG 1955
	NORMAL NO. DAYS WITH:														
	PRECIPITATION ≥ 0.01	30	10.4	9.4	10.2	9.0	10.7	9.6	10.4	9.5	7.6	7.0	8.0	9.1	110.9
	PRECIPITATION ≥ 1.00	30	0.8	0.7	0.8	0.6	1.0	0.9	1.4	1.3	1.0	1.2	0.8	0.7	11.2
SNOWFALL	NORMAL (IN)	30	5.8	5.5	2.4	0.1	0.0	0.0	0.0	0.0	0.0	T	0.3	2.2	16.3
	MAXIMUM MONTHLY (IN)	62	28.5	21.4	19.7	2.0	T	0.0	0.0	0.0	0.0	T	7.3	12.5	28.5
	YEAR OF OCCURRENCE		1940	1983	1960	1940	1994					1979	1953	1958	JAN 1940
	MAXIMUM IN 24 HOURS (IN)	62	21.6	16.8	12.1	2.0	T	0.0	0.0	0.0	0.0	T	7.3	7.5	21.6
	YEAR OF OCCURRENCE		1940	1983	1962	1940	1994					1979	1953	1966	JAN 1940
	MAXIMUM SNOW DEPTH (IN)	77	18	20	13	1	0	0	0	0	0	0	6	9	20
	YEAR OF OCCURRENCE		1922	1922	1980	1964							1938	1958	FEB 1922
	NORMAL NO. DAYS WITH:														
	SNOWFALL ≥ 1.0	30	1.5	1.4	0.6	0.*	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	4.3

Source: Richmond, Virginia, Local Climatological Data, Annual Summary with Comparative Data 2001, NCDC, NOAA.

Table 2.7-5 Mean Annual Meteorological Data for Stations in the Site Region

Location	Mean Annual Temperature (°F)	Mean Annual Precipitation (in.)	Mean Annual Snowfall (in.)
Charlottesville	56.8	45.72	24.2
Fredericksburg	56.2	40.99	17.7
Louisa	56.3	41.62	19.9
Piedmont Research Station	55.9	38.68	22.0
Partlow	55.2	42.24	18.6

Source: Reference 21 through Reference 25.

Table 2.7-6 Comparison of Mean Temperature Data for North Anna, Richmond, Partlow, and Louisa (°F) (September 16, 1971–September 15, 1972)

Month	North Anna	Richmond	Partlow	Louisa
January (1972)	36.6	40.7	37.6	39.5
February (1972)	33.6	37.6	35.5	36.2
March (1972)	43.0[a]	47.2	45.1	46.3[a]
April (1972)	54.7[a]	56.2	54.1	55.0
May (1972)	62.4	64.6	62.4	62.1
June (1972)	68.3	70.1	69.5	68.1
July (1972)	75.0	77.1	77.0	74.8
August (1972)	72.9	75.2	73.1	72.8
September (16-30, 1971; 1-15, 1972)	68.2[a]	69.6	([b])	([b])
October (1971)	62.8	64.6	63.9	63.0[a]
November (1971)	45.8[a]	48.5	46.6[a]	47.1
December (1971)	46.3[a]	48.0	46.8	46.2

Source: Reference 2

a. One or more days of data missing.

b. Data not available.

Table 2.7-7 North Anna Mean Wind Speeds (mph) 1974-1987

Elevation	Spring (Mar, Apr, May)	Summer (Jun, Jul, Aug)	Fall (Sept, Oct, Nov)	Winter (Dec, Jan, Feb)	Annual
Upper Level	9.6	7.5	8.3	9.2	8.6
Lower Level	7.1	5.4	5.9	6.6	6.3

Source: Reference 2

Table 2.7-8 North Anna Vertical Stability (ΔT) and Low-Level Wind Speed Distribution 1974-1987

	Vertical Stability Categories						
Period	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Spring							
Frequency (%)	20.04	5.41	4.86	29.87	24.18	7.92	7.71
Wind Speed (mph)	(8.6)	(8.4)	(8.6)	(7.9)	(6.3)	(4.0)	(2.9)
Summer							
Frequency (%)	25.33	5.38	5.10	29.52	27.21	6.42	1.44
Wind Speed (mph)	(6.1)	(6.2)	(6.2)	(5.7)	(4.3)	(3.2)	(2.9)
Fall							
Frequency (%)	21.28	4.16	4.25	28.71	25.57	10.26	6.14
Wind Speed (mph)	(6.9)	(7.1)	(7.4)	(6.8)	(4.9)	(3.4)	(3.2)
Winter							
Frequency (%)	13.39	4.82	4.85	35.10	27.55	8.09	6.60
Wind Speed (mph)	(7.6)	(7.8)	(8.2)	(7.4)	(5.6)	(3.5)	(2.8)
Annual							
Frequency (%)	20.00	4.91	4.74	30.69	26.08	8.22	5.46
Wind Speed (MPH)	(7.2)	(7.4)	(7.6)	(7.0)	(5.2)	(3.5)	(3.0)

Source: Reference 2

Table 2.7-9 1996–1998 NAPS Meteorological Data (33-ft Level)

Sector	Class														
		Wind Speed (m/s)													
Frequency	**Calm**	0.34-0.50	0.51-0.75	0.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	>10.0	Total
Stability Class A – by ΔT															
N	0	0	2	2	5	3	6	17	19	19	12	5	0	0	90
NNE	0	0	0	0	2	3	5	6	14	4	1	2	0	0	37
NE	0	0	0	2	2	1	4	5	8	3	6	2	0	0	33
ENE	0	0	0	0	2	3	1	10	16	3	0	1	0	0	36
E	0	0	1	2	3	2	22	15	4	5	1	0	0	0	55
ESE	0	0	0	2	4	7	19	26	6	5	0	0	0	0	69
SE	0	0	0	0	1	4	18	26	2	0	0	0	0	0	51
SSE	0	0	0	2	6	2	18	39	1	0	0	0	0	0	68
S	0	0	0	2	3	8	33	113	10	1	0	0	0	0	170
SSW	0	0	0	0	5	5	24	107	73	12	0	1	0	0	227
SW	0	0	0	0	3	3	15	35	50	20	9	1	0	0	136
WSW	0	0	0	0	0	1	11	40	40	12	3	4	0	0	111
W	0	0	0	0	1	4	7	52	55	28	8	3	0	0	158
WNW	0	0	0	1	4	4	19	46	39	36	30	7	0	0	186
NW	0	0	1	2	13	8	41	78	54	26	16	11	3	0	253
NNW	0	0	0	3	12	14	24	20	22	13	18	14	3	0	143
Total	0	0	4	18	66	72	267	635	413	187	104	51	6	0	1823

Table 2.7-9 1996–1998 NAPS Meteorological Data (33-ft Level)

Sector	Class	Wind Speed (m/s)													
Frequency	**Calm**	0.34-0.50	0.51-0.75	0.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	>10.0	Total
							Stability Class B – by ΔT								
N	0	0	0	0	0	1	3	22	10	3	8	9	0	0	56
NNE	0	0	0	1	0	1	5	8	8	3	1	0	0	0	27
NE	0	0	0	0	0	1	4	9	8	5	1	1	0	0	29
ENE	0	0	0	0	1	4	6	10	4	3	0	0	0	0	28
E	0	0	0	1	2	4	12	12	6	2	0	0	0	0	39
ESE	0	0	0	1	1	3	20	30	2	1	1	0	0	0	59
SE	0	0	0	0	0	1	10	13	4	0	0	0	0	0	28
SSE	0	0	0	0	1	0	7	18	1	0	0	0	0	0	27
S	0	0	0	0	2	3	18	39	6	3	0	0	0	0	71
SSW	0	0	0	1	0	2	16	48	40	15	15	8	0	0	145
SW	0	1	0	0	1	1	4	18	26	11	4	3	0	0	69
WSW	0	0	0	0	0	0	4	16	16	9	3	4	0	0	52
W	0	0	0	0	0	1	2	14	11	7	6	1	0	0	42
WNW	0	0	0	0	1	1	5	20	21	13	9	4	2	0	76
NW	0	0	0	2	3	6	18	14	19	25	21	8	8	8	132
NNW	0	0	0	1	4	3	8	23	16	20	19	14	5	0	113
Total	0	1	0	7	16	32	142	314	198	120	88	52	15	8	993

Table 2.7-9 1996–1998 NAPS Meteorological Data (33-ft Level)

Sector	Class	Wind Speed (m/s)													
Frequency	**Calm**	0.34-0.50	0.51-0.75	0.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	>10.0	Total
							Stability Class C– by ΔT								
N	0	0	0	5	5	1	14	17	28	28	28	11	1	0	138
NNE	0	0	0	0	3	1	7	9	9	10	8	0	0	0	47
NE	0	0	0	2	5	3	3	8	5	3	4	0	0	0	33
ENE	0	0	0	1	3	1	10	17	12	6	0	0	0	0	50
E	0	0	0	0	6	7	13	18	8	3	1	0	0	0	56
ESE	0	0	0	3	3	12	31	48	13	3	5	1	0	0	119
SE	0	0	0	0	2	9	20	22	4	0	0	0	0	0	57
SSE	0	0	0	1	0	3	10	10	1	0	0	0	0	0	25
S	0	0	0	0	4	5	34	30	7	1	0	0	0	0	81
SSW	0	0	0	0	0	5	18	72	28	17	11	4	0	0	155
SW	0	0	0	1	1	4	8	35	28	18	14	10	0	0	119
WSW	0	0	0	0	0	0	7	17	8	6	6	4	0	0	48
W	0	0	0	1	4	3	5	14	17	7	4	3	0	0	58
WNW	0	0	0	4	6	2	10	21	17	15	11	1	2	0	89
NW	0	0	1	1	7	2	14	28	26	29	9	19	5	12	153
NNW	0	0	1	0	7	10	22	32	32	39	15	18	2	3	181
Total	0	0	2	19	56	68	226	398	243	185	116	71	10	15	1409

Table 2.7-9 1996–1998 NAPS Meteorological Data (33-ft Level)

Sector	Class	Wind Speed (m/s)													
Frequency	**Calm**	0.34-0.50	0.51-0.75	0.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	>10.0	Total
							Stability Class D– by ΔT								
N	2	0	10	33	51	57	176	460	406	263	86	56	6	2	1608
NNE	0	0	6	23	55	53	173	358	233	122	42	16	5	0	1086
NE	0	0	5	14	52	56	139	290	179	87	23	5	7	1	858
ENE	0	1	7	28	45	54	119	227	138	66	21	7	4	0	717
E	0	2	11	31	60	41	138	230	171	63	20	9	11	0	787
ESE	0	0	6	12	34	32	98	185	115	43	21	2	1	0	549
SE	0	2	7	9	22	21	79	224	59	14	4	0	0	0	441
SSE	0	2	6	13	25	25	56	89	15	2	1	0	0	0	234
S	0	1	5	32	55	75	167	199	38	14	2	0	0	0	588
SSW	1	2	9	39	64	63	176	352	175	91	48	12	0	0	1032
SW	1	2	17	36	51	47	140	266	176	64	41	32	2	0	875
WSW	0	1	13	20	16	21	44	100	102	63	18	4	0	0	402
W	0	4	7	28	31	16	40	67	55	36	17	3	0	0	304
WNW	1	0	3	22	31	32	70	107	74	69	34	25	8	2	478
NW	0	2	2	25	48	59	96	158	119	92	43	27	15	3	689
NNW	0	0	8	25	46	49	147	264	221	141	76	58	7	3	1045
Total	5	19	122	390	686	701	1858	3576	2276	1230	497	256	66	11	11693

Table 2.7-9 1996–1998 NAPS Meteorological Data (33-ft Level)

Sector	Class	Wind Speed (m/s)													
Frequency	**Calm**	0.34-0.50	0.51-0.75	0.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	>10.0	Total
							Stability Class E– by ΔT								
N	2	3	14	27	16	16	31	62	28	24	6	9	3	0	241
NNE	1	7	10	21	23	11	29	54	29	9	3	4	3	0	204
NE	1	6	17	20	23	18	31	41	16	9	2	4	3	4	195
ENE	0	9	11	20	19	20	23	43	7	2	0	0	0	1	155
E	2	8	11	13	26	21	53	38	13	1	1	3	0	1	191
ESE	1	6	13	22	35	24	53	72	21	6	6	0	0	0	259
SE	0	4	17	36	28	31	96	131	21	1	1	1	1	0	368
SSE	0	5	17	39	38	50	96	58	10	5	5	0	0	0	323
S	1	14	54	94	115	117	244	185	58	22	1	0	0	0	905
SSW	4	11	67	132	125	85	157	280	145	33	8	1	0	0	1048
SW	1	9	45	102	101	72	133	229	120	50	12	5	0	0	879
WSW	1	11	39	69	56	40	46	97	69	10	1	2	0	0	441
W	1	13	45	81	111	80	105	141	38	18	5	0	0	0	638
WNW	0	11	30	85	99	93	143	107	45	24	10	10	1	0	658
NW	1	9	26	50	80	49	69	51	18	15	6	1	1	0	376
NNW	0	3	22	30	34	25	42	44	21	7	2	7	1	0	238
Total	16	129	438	841	929	752	1351	1633	659	236	69	47	13	6	7119

Table 2.7-9 1996–1998 NAPS Meteorological Data (33-ft Level)

Sector	Class	Wind Speed (m/s)													
Frequency	**Calm**	0.34-0.50	0.51-0.75	0.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	>10.0	Total
							Stability Class F– by ΔT								
N	1	3	5	4	1	5	1	0	0	0	0	0	0	0	20
NNE	0	1	7	3	6	0	3	2	1	0	0	0	0	0	23
NE	1	4	7	3	4	3	2	0	0	1	0	0	0	0	25
ENE	2	2	7	9	4	2	4	0	0	0	0	0	0	0	30
E	1	6	15	15	4	3	10	2	0	0	0	0	0	2	58
ESE	1	4	5	7	10	5	9	5	1	0	1	0	0	3	51
SE	0	6	8	8	6	5	8	3	0	0	1	0	0	0	45
SSE	0	1	10	12	6	10	4	1	0	0	2	0	0	0	46
S	0	7	10	36	31	20	12	1	0	0	0	0	0	0	117
SSW	1	4	17	55	55	30	28	10	0	0	0	0	0	0	200
SW	0	8	23	37	26	21	27	20	5	0	0	0	0	0	167
WSW	1	8	20	49	36	8	9	10	2	2	0	0	0	0	145
W	2	12	38	75	85	74	109	26	0	0	0	0	0	0	421
WNW	2	12	37	99	101	66	62	36	1	0	3	0	0	0	419
NW	0	6	24	37	44	20	16	10	1	0	0	0	0	0	158
NNW	2	7	14	7	5	4	5	5	0	0	0	0	0	0	49
Total	14	91	247	456	424	276	309	131	11	3	7	0	0	5	1974

Table 2.7-9 1996–1998 NAPS Meteorological Data (33-ft Level)

Sector	Class	Wind Speed (m/s)													
Frequency	**Calm**	0.34-0.50	0.51-0.75	0.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	>10.0	Total
							Stability Class G – by ΔT								
N	3	7	5	5	3	2	0	0	0	0	0	0	0	0	25
NNE	1	6	5	3	1	0	0	0	0	0	0	0	0	0	16
NE	2	5	4	4	1	0	0	0	0	0	0	0	0	0	16
ENE	0	4	5	3	3	0	0	0	0	0	0	0	0	0	15
E	1	6	11	9	2	0	0	0	0	0	0	0	0	0	29
ESE	0	1	7	7	4	0	0	0	0	0	0	0	0	0	19
SE	0	1	2	5	6	4	1	0	0	0	0	0	0	0	19
SSE	0	2	1	2	1	2	0	1	0	0	0	0	0	0	9
S	0	0	1	2	1	3	0	0	0	0	0	0	0	0	7
SSW	0	1	1	1	4	2	5	0	0	0	0	0	0	0	14
SW	1	1	6	6	4	4	5	1	0	0	0	0	0	0	28
WSW	1	2	10	7	6	1	0	0	0	0	0	0	0	0	27
W	0	6	16	31	27	8	9	2	0	0	0	0	0	0	99
WNW	0	5	39	120	117	57	40	5	0	0	0	0	0	0	383
NW	3	15	45	89	86	38	17	3	1	0	0	0	0	0	297
NNW	4	14	25	19	10	3	0	0	0	0	0	0	0	0	75
Total	16	76	183	313	276	124	77	12	1	0	0	0	0	0	1078

Table 2.7-9 1996–1998 NAPS Meteorological Data (33-ft Level)

Sector	Class	Wind Speed (m/s)													
Frequency	**Calm**	0.34-0.50	0.51-0.75	0.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	>10.0	Total
Total Observations – All Stability Categories															
N	8	13	36	76	81	85	231	578	491	337	140	90	10	2	2178
NNE	2	14	28	51	90	69	222	437	294	148	55	22	8	0	1440
NE	4	15	33	45	87	82	183	353	216	108	36	12	10	5	1189
ENE	2	16	30	61	77	84	163	307	177	80	21	8	4	1	1031
E	4	22	49	71	103	78	248	315	202	74	23	12	11	3	1215
ESE	2	11	31	54	91	83	230	366	158	58	34	3	1	3	1125
SE	0	13	34	58	65	75	232	419	90	15	6	1	1	0	1009
SSE	0	10	34	69	77	92	191	216	28	7	8	0	0	0	732
S	1	22	70	166	211	231	508	567	119	41	3	0	0	0	1939
SSW	6	18	94	228	253	192	424	869	461	168	82	26	0	0	2821
SW	3	21	91	182	187	152	332	604	405	163	80	51	2	0	2273
WSW	3	22	82	145	114	71	121	280	237	102	31	18	0	0	1226
W	3	35	106	216	259	186	277	316	176	96	40	10	0	0	1720
WNW	3	28	109	331	359	255	349	342	197	157	97	47	13	2	2289
NW	4	32	99	206	281	182	271	342	238	187	95	66	32	23	2058
NNW	6	24	70	85	118	108	248	388	312	220	130	111	18	6	1844
Total	51	316	996	2044	2453	2025	4230	6699	3801	1961	881	477	110	45	26089

Table 2.7-10 Shortest Distances from the ESP Plant Envelope Boundary to the EAB

Downwind Direction	Distance (ft)	Distance (m)
N	4521	1378
NNE	4589	1399
NE	4697	1432
ENE	4835	1474
E	4707	1435
ESE	4660	1420
SE	4266	1300
SSE	3562	1086
S	3131	954
SSW	2877	877
SW	2860	872
WSW	2838	865
W	2860	872
WNW	2959	902
NW	3242	988
NNW	3822	1165

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

Plant Name: North Anna ESP
Data Period: 1996–1998 JFD
Type of Release: Ground-Level Release
Source of Data: Onsite
Comments: Data period: 1/1/96 - 12/31/98
Program: PAVAN, 10/76, 8/79 Revision, Implementation of RG 1.145
Site Exclusion Boundary Calculations:

Five Percent Overall Site Limit.
Building wake credit is not included.
Correction factors used in the annual average calculations.

Meteorological Instrumentation
Wind Sensors Height: 32.8 ft
ΔT Heights: 32.8 ft–158.9 ft

Below are printed the ordered values of χ/Q and the frequency with which that value is reached or exceeded.
The top number is the χ/Q. The middle number is the frequency normalized to this sector.
The third number is the frequency with respect to all time.

0	9.211E-04	9.140E-04	9.090E-04	8.847E-04	8.381E-04	8.101E-04	7.256E-04	6.790E-04	6.263E-04	6.215E-04
	0.001	0.004	0.005	0.006	0.007	0.008	0.013	0.013	0.029	0.071
	0.00095	0.00360	0.00454	0.00574	0.00713	0.00827	0.01275	0.01325	0.02858	0.07075
0	6.181E-04	6.142E-04	6.099E-04	6.050E-04	6.016E-04	6.016E-04	5.848E-04	5.832E-04	5.755E-04	5.699E-04
	0.094	0.111	0.112	0.114	0.118	0.119	0.120	0.120	0.121	0.148
	0.09374	0.11097	0.11183	0.11413	0.11796	0.11857	0.11969	0.12013	0.12070	0.14753
0	5.680E-04	5.639E-04	5.628E-04	5.527E-04	5.508E-04	5.499E-04	5.334E-04	4.934E-04	4.808E-04	4.617E-04
	0.169	0.170	0.176	0.176	0.180	0.182	0.183	0.237	0.238	0.246
	0.16885	0.17018	0.17573	0.17638	0.18021	0.18185	0.18304	0.23670	0.23803	0.24569
0	4.471E-04	4.177E-04	4.175E-04	4.147E-04	4.143E-04	4.121E-04	4.114E-04	4.091E-04	4.011E-04	4.002E-04
	0.247	0.305	0.324	0.331	0.389	0.408	0.446	0.450	0.477	0.482
	0.24709	0.30459	0.32376	0.33142	0.38892	0.40808	0.44641	0.45025	0.47708	0.48178

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

0	3.977E-04	3.913E-04	3.863E-04	3.834E-04	3.827E-04	3.799E-04	3.776E-04	3.758E-04	3.739E-04	3.720E-04
	0.497	0.501	0.520	0.524	0.547	0.566	0.570	0.581	0.589	0.595
	0.49711	0.50095	0.52011	0.52395	0.54694	0.56611	0.56984	0.58134	0.58901	0.59479
0	3.672E-04	3.665E-04	3.635E-04	3.627E-04	3.627E-04	3.590E-04	3.560E-04	3.539E-04	3.533E-04	3.437E-04
	0.602	0.614	0.618	0.628	0.651	0.653	0.656	0.657	0.662	0.664
	0.60246	0.61377	0.61790	0.62810	0.65110	0.65267	0.65591	0.65734	0.66168	0.66367
0	3.290E-04	3.269E-04	3.240E-04	3.132E-04	3.123E-04	3.107E-04	3.090E-04	3.078E-04	3.041E-04	3.008E-04
	0.759	0.786	0.788	0.799	0.802	0.851	0.863	0.867	0.871	0.897
	0.75949	0.78633	0.78783	0.79933	0.80164	0.85147	0.86296	0.86680	0.87063	0.89746
0	2.850E-04	2.833E-04	2.785E-04	2.765E-04	2.754E-04	2.743E-04	2.727E-04	2.721E-04	2.651E-04	2.644E-04
	0.917	0.919	1.091	1.118	1.137	1.222	1.249	1.272	1.291	1.295
	0.91663	.91889	1.09138	1.11821	1.13737	1.22170	1.24853	1.27153	1.29070	1.29453
0	2.620E-04	2.609E-04	2.601E-04	2.575E-04	2.575E-04	2.568E-04	2.557E-04	2.556E-04	2.552E-04	2.529E-04
	1.297	1.301	1.303	1.452	1.455	1.482	1.483	1.506	1.567	1.583
	1.29749	1.30132	1.30267	1.45216	1.45487	1.48171	1.48307	1.50607	1.56740	1.58273
0	2.506E-04	2.505E-04	2.493E-04	2.492E-04	2.486E-04	2.472E-04	2.472E-04	2.469E-04	2.467E-04	2.467E-04
	1.602	1.613	1.652	1.698	1.709	1.713	1.744	1.745	1.817	1.863
	1.60190	1.61340	1.65173	1.69772	1.70922	1.71306	1.74372	1.74456	1.81739	1.86338
0	2.441E-04	2.421E-04	2.418E-04	2.407E-04	2.406E-04	2.402E-04	2.337E-04	2.321E-04	2.309E-04	2.302E-04
	1.898	1.952	1.982	1.998	2.024	2.055	2.078	2.082	2.090	2.091
	1.89788	1.95154	1.98221	1.99754	2.02437	2.05504	2.07803	2.08228	2.08995	2.09146

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

0	2.280E-04	2.203E-04	2.203E-04	2.203E-04	2.180E-04	2.177E-04	2.142E-04	2.123E-04	2.107E-04	2.088E-04
	2.103	2.114	2.137	2.138	2.192	2.200	2.208	2.223	2.230	2.571
	2.10296	2.11446	2.13745	2.13806	2.19173	2.19955	2.20789	2.22322	2.22953	2.57067
0	2.088E-04	2.083E-04	2.074E-04	2.057E-04	2.045E-04	2.027E-04	2.023E-04	1.988E-04	1.983E-04	1.974E-04
	2.577	2.584	2.618	2.687	2.699	2.737	2.741	2.768	2.776	2.814
	2.57721	2.58376	2.61825	2.68725	2.69875	2.73708	2.74135	2.76818	2.77584	2.81417
0	1.962E-04	1.957E-04	1.931E-04	1.927E-04	1.917E-04	1.914E-04	1.900E-04	1.879E-04	1.870E-04	1.847E-04
	2.815	2.819	3.279	3.291	3.314	3.433	3.440	3.456	3.482	3.486
	2.81545	2.81929	3.27925	3.29075	3.31375	3.43257	3.44024	3.45557	3.48240	3.48623
0	1.836E-04	1.814E-04	1.813E-04	1.799E-04	1.782E-04	1.768E-04	1.751E-04	1.712E-04	1.686E-04	1.671E-04
	3.502	3.594	3.624	3.625	3.644	3.648	3.656	3.694	3.759	4.089
	3.50157	3.59356	3.62422	3.62493	3.64410	3.64793	3.65560	3.69393	3.75909	4.08873
0	1.662E-04	1.659E-04	1.648E-04	1.646E-04	1.645E-04	1.644E-04	1.636E-04	1.635E-04	1.627E-04	1.614E-04
	4.231	4.246	4.334	4.365	4.376	4.522	4.545	4.572	4.614	4.721
	4.23055	4.24589	4.33404	4.36471	4.37621	4.52186	4.54486	4.57169	4.61386	4.72118
0	1.604E-04	1.602E-04	1.591E-04	1.586E-04	1.578E-04	1.571E-04	1.565E-04	1.558E-04	1.545E-04	1.539E-04
	4.760	4.836	4.875	4.878	4.913	4.914	4.930	4.979	5.428	5.435
	4.75951	4.83617	4.87450	4.87834	4.91283	4.91419	4.92952	4.97935	5.42782	5.43548
0	1.534E-04	1.531E-04	1.520E-04	1.503E-04	1.498E-04	1.496E-04	1.481E-04	1.469E-04	1.461E-04	1.456E-04
	5.451	5.554	5.600	5.604	5.612	5.635	5.688	5.742	5.744	5.786
	5.45082	5.55431	5.60031	5.60414	5.61180	5.63480	5.68846	5.74213	5.74381	5.78597

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

0	1.451E-04	1.434E-04	1.433E-04	1.420E-04	1.416E-04	1.416E-04	1.408E-04	1.407E-04	1.393E-04	1.392E-04
	5.809	5.811	5.853	5.887	5.937	6.002	6.006	6.007	6.009	6.154
	5.80897	5.81074	5.85290	5.88740	5.93723	6.00239	6.00622	6.00710	6.00863	6.15428
0	1.389E-04	1.382E-04	1.377E-04	1.376E-04	1.375E-04	1.371E-04	1.361E-04	1.343E-04	1.326E-04	1.322E-04
	6.155	6.163	6.167	6.209	6.213	6.236	6.377	6.378	6.397	6.409
	6.15514	6.16281	6.16664	6.20881	6.21264	6.23564	6.37746	6.37817	6.39733	6.40883
0	1.308E-04	1.304E-04	1.288E-04	1.284E-04	1.284E-04	1.278E-04	1.276E-04	1.265E-04	1.253E-04	1.253E-04
	6.428	6.436	6.654	6.738	6.876	6.892	6.922	7.133	7.137	7.156
	6.42800	6.43566	6.65415	6.73847	6.87646	6.89179	6.92246	7.13328	7.13711	7.15627
0	1.250E-04	1.246E-04	1.246E-04	1.236E-04	1.233E-04	1.224E-04	1.223E-04	1.221E-04	1.216E-04	1.210E-04
	7.168	7.172	7.551	7.693	7.980	7.984	7.992	8.069	8.092	8.218
	7.16777	7.17161	7.55108	7.69290	7.98038	7.98421	7.99187	8.06853	8.09153	8.21802
0	1.209E-04	1.203E-04	1.201E-04	1.191E-04	1.188E-04	1.179E-04	1.168E-04	1.167E-04	1.159E-04	1.147E-04
	8.237	8.318	8.506	8.509	8.574	8.601	8.686	8.747	8.770	8.774
	8.23719	8.31768	8.50550	8.50933	8.57450	8.60133	8.68565	8.74698	8.76998	8.77381
0	1.139E-04	1.129E-04	1.129E-04	1.126E-04	1.121E-04	1.119E-04	1.102E-04	1.090E-04	1.088E-04	1.085E-04
	8.793	8.801	8.804	8.812	8.820	8.843	8.946	8.962	9.130	9.149
	8.79298	8.80064	8.80448	8.81214	8.81981	8.84280	8.94630	8.96163	9.13028	9.14945
0	1.068E-04	1.062E-04	1.052E-04	1.052E-04	1.044E-04	1.044E-04	1.037E-04	1.029E-04	1.027E-04	1.023E-04
	9.157	9.295	9.395	9.399	9.464	9.502	9.517	9.563	9.682	9.694
	9.15711	9.29510	9.39476	9.39859	9.46376	9.50209	9.51742	9.56341	9.68224	9.69374

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

0	1.014E-04	1.012E-04	9.988E-05	9.969E-05	9.942E-05	9.935E-05	9.887E-05	9.871E-05	9.866E-05	9.784E-05
	9.732	9.943	9.970	10.357	10.391	10.395	10.495	10.702	11.028	11.047
	9.73207	9.94288	9.96972	10.35685	10.39135	10.39518	10.49484	10.70182	11.02763	11.04680
0	9.765E-05	9.758E-05	9.750E-05	9.709E-05	9.683E-05	9.657E-05	9.633E-05	9.626E-05	9.609E-05	9.586E-05
	11.120	11.131	11.139	11.396	11.583	11.737	11.852	11.940	12.078	12.097
	11.11962	11.13112	11.13879	11.39560	11.58342	11.73674	11.85173	11.93989	12.07788	12.09705
0	9.568E-05	9.552E-05	9.470E-05	9.465E-05	9.445E-05	9.443E-05	9.396E-05	9.348E-05	9.171E-05	9.134E-05
	12.132	12.247	12.254	12.427	12.442	12.615	12.618	12.752	12.902	12.906
	12.13155	12.24654	12.25420	12.42669	12.44202	12.61451	12.61834	12.75250	12.90198	12.90582
0	9.070E-05	9.067E-05	8.908E-05	8.894E-05	8.842E-05	8.814E-05	8.755E-05	8.693E-05	8.663E-05	8.558E-05
	12.982	13.013	13.163	13.193	13.301	13.362	13.534	13.623	13.642	13.718
	12.98248	13.01314	13.16263	13.19330	13.30062	13.36195	13.53444	13.62259	13.64176	13.71842
0	8.493E-05	8.431E-05	8.395E-05	8.308E-05	8.239E-05	8.222E-05	8.173E-05	8.157E-05	8.137E-05	8.069E-05
	13.826	13.941	13.987	14.240	14.320	14.604	14.623	14.646	14.723	14.872
	13.82575	13.94074	13.98673	14.23971	14.32021	14.60385	14.62302	14.64602	14.72268	14.87216
0	8.022E-05	8.008E-05	7.965E-05	7.947E-05	7.892E-05	7.828E-05	7.790E-05	7.706E-05	7.602E-05	7.491E-05
	14.914	14.945	14.949	14.956	15.148	15.275	15.367	15.497	15.512	15.547
	14.91433	14.94499	14.94882	14.95649	15.14814	15.27463	15.36662	15.49695	15.51228	15.54678
0	7.403E-05	7.345E-05	7.282E-05	7.164E-05	7.126E-05	7.121E-05	7.098E-05	7.082E-05	7.078E-05	7.074E-05
	15.907	15.968	16.474	16.800	16.946	16.953	17.344	17.655	17.774	17.946
	15.90708	15.96841	16.47437	16.80018	16.94583	16.95350	17.34447	17.65494	17.77377	17.94625

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

0	7.060E-05	7.004E-05	6.999E-05	6.977E-05	6.954E-05	6.878E-05	6.803E-05	6.716E-05	6.674E-05	6.670E-05
	17.954	18.383	18.422	18.425	18.636	18.901	18.962	19.092	19.104	19.200
	17.95392	18.38322	18.42155	18.42538	18.63620	18.90068	18.96201	19.09233	19.10383	19.19966
0	6.623E-05	6.540E-05	6.500E-05	6.426E-05	6.422E-05	6.419E-05	6.380E-05	6.336E-05	6.323E-05	6.316E-05
	19.219	19.223	19.257	19.295	19.391	19.437	19.449	19.453	19.560	19.698
	19.21882	19.22266	19.25715	19.29548	19.39131	19.43731	19.44880	19.45264	19.55996	19.69795
0	6.314E-05	6.313E-05	6.297E-05	6.262E-05	6.255E-05	6.244E-05	6.240E-05	6.231E-05	6.211E-05	6.179E-05
	20.005	20.070	20.097	20.292	20.369	20.376	20.476	20.714	20.718	20.821
	20.00459	20.06976	20.09659	20.29207	20.36873	20.37640	20.47606	20.71370	20.71754	20.82103
0	6.166E-05	6.143E-05	6.117E-05	6.103E-05	6.089E-05	6.052E-05	6.050E-05	6.031E-05	6.016E-05	6.006E-05
	21.239	21.258	21.308	21.396	21.446	21.768	21.806	21.971	22.082	22.117
	21.23883	21.25800	21.30783	21.39598	21.44581	21.76779	21.80612	21.97094	22.08210	22.11659
0	5.993E-05	5.973E-05	5.961E-05	5.938E-05	5.933E-05	5.923E-05	5.915E-05	5.897E-05	5.895E-05	5.893E-05
	22.201	22.504	22.531	22.722	22.929	23.370	23.378	23.489	23.696	23.703
	22.20092	22.50373	22.53056	22.72221	22.92920	23.37000	23.37766	23.48882	23.69580	23.70347
0	5.872E-05	5.852E-05	5.842E-05	5.836E-05	5.825E-05	5.822E-05	5.795E-05	5.788E-05	5.773E-05	5.750E-05
	23.715	23.826	24.029	24.401	24.880	24.919	25.122	25.133	25.168	25.179
	23.71497	23.82613	24.02928	24.40108	24.88021	24.91854	25.12169	25.13319	25.16769	25.17919
0	5.737E-05	5.731E-05	5.703E-05	5.697E-05	5.679E-05	5.666E-05	5.635E-05	5.597E-05	5.591E-05	5.537E-05
	25.455	25.835	25.842	25.854	26.241	26.666	26.747	26.870	26.873	26.896
	25.45517	25.83464	25.84231	25.85381	26.24094	26.66641	26.74690	26.86956	26.87339	26.89639

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

0	5.509E-05	5.502E-05	5.442E-05	5.363E-05	5.341E-05	5.336E-05	5.308E-05	5.304E-05	5.261E-05	5.225E-05
	27.015	27.230	27.253	27.491	27.586	27.763	28.131	28.150	28.338	28.445
	27.01522	27.22987	27.25286	27.49051	27.58634	27.76266	28.13063	28.14979	28.33761	28.44494
0	5.218E-05	5.140E-05	5.093E-05	5.069E-05	4.995E-05	4.994E-05	4.982E-05	4.969E-05	4.968E-05	4.943E-05
	28.663	29.166	29.258	29.269	29.311	29.392	29.472	29.495	29.618	29.629
	28.66342	29.16555	29.25754	29.26904	29.31120	29.39170	29.47219	29.49519	29.61785	29.62935
0	4.936E-05	4.894E-05	4.875E-05	4.855E-05	4.834E-05	4.816E-05	4.785E-05	4.776E-05	4.735E-05	4.732E-05
	30.078	30.174	30.323	30.649	30.653	30.814	30.898	31.255	31.393	31.669
	30.07781	30.17364	30.32313	30.64893	30.65277	30.81376	30.89808	31.25455	31.39254	31.66852
0	4.723E-05	4.722E-05	4.698E-05	4.694E-05	4.596E-05	4.585E-05	4.567E-05	4.454E-05	4.447E-05	4.421E-05
	31.776	32.082	32.094	32.098	32.266	32.420	32.496	32.864	33.052	33.508
	31.77584	32.08249	32.09398	32.09782	32.26647	32.41979	32.49645	32.86442	33.05224	33.50837
0	4.395E-05	4.378E-05	4.347E-05	4.313E-05	4.273E-05	4.273E-05	4.243E-05	4.224E-05	4.211E-05	4.204E-05
	33.589	34.651	35.314	35.341	35.525	35.540	35.559	35.563	35.590	35.812
	33.58886	34.65061	35.31373	35.34056	35.52454	35.53988	35.55904	35.56287	35.58971	35.81202
0	4.198E-05	4.162E-05	4.120E-05	4.078E-05	4.042E-05	4.034E-05	3.982E-05	3.981E-05	3.974E-05	3.946E-05
	36.188	36.226	36.230	36.326	36.333	36.337	36.345	36.383	36.594	36.858
	36.18766	36.22599	36.22982	36.32565	36.33332	36.33715	36.34482	36.38315	36.59396	36.85844
0	3.915E-05	3.914E-05	3.900E-05	3.828E-05	3.788E-05	3.780E-05	3.778E-05	3.768E-05	3.746E-05	3.727E-05
	36.904	37.579	37.824	37.943	38.139	38.158	38.277	39.147	39.450	41.443
	36.90444	37.57906	37.82437	37.94320	38.13868	38.15784	38.27667	39.14677	39.44958	41.44276

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

0	3.727E-05	3.702E-05	3.698E-05	3.692E-05	3.662E-05	3.654E-05	3.641E-05	3.599E-05	3.582E-05	3.561E-05
	41.477	42.413	43.785	43.789	43.984	44.045	44.647	44.666	45.214	45.441
	41.47725	42.41251	43.78474	43.78857	43.98406	44.04539	44.64717	44.66634	45.21446	45.44061
0	3.558E-05	3.549E-05	3.541E-05	3.536E-05	3.521E-05	3.450E-05	3.439E-05	3.418E-05	3.416E-05	3.405E-05
	46.150	46.660	47.062	47.066	47.070	47.081	47.257	47.269	47.338	48.047
	46.14972	46.65952	47.06199	47.06582	47.06965	47.08115	47.25747	47.26897	47.33796	48.04708
0	3.358E-05	3.354E-05	3.341E-05	3.335E-05	3.319E-05	3.319E-05	3.312E-05	3.294E-05	3.291E-05	3.279E-05
	48.576	48.603	49.676	50.240	50.274	51.616	51.903	53.666	54.559	54.970
	48.57603	48.60287	49.67612	50.23957	50.27407	51.61563	51.90311	53.66631	54.55940	54.96954
0	3.250E-05	3.245E-05	3.237E-05	3.201E-05	3.190E-05	3.178E-05	3.168E-05	3.157E-05	3.156E-05	3.152E-05
	55.211	56.089	56.629	56.687	56.809	56.813	56.852	57.032	57.473	57.695
	55.21102	56.08878	56.62924	56.68674	56.80939	56.81323	56.85156	57.03171	57.47251	57.69483
0	3.148E-05	3.138E-05	3.136E-05	3.130E-05	3.122E-05	3.090E-05	3.087E-05	3.068E-05	3.059E-05	3.045E-05
	57.756	58.615	58.634	59.006	59.067	59.094	59.650	59.903	60.117	60.198
	57.75616	58.61476	58.63392	59.00573	59.06705	59.09388	59.64967	59.90265	60.11730	60.19780
0	3.031E-05	3.029E-05	3.026E-05	3.024E-05	3.012E-05	3.002E-05	2.989E-05	2.981E-05	2.980E-05	2.936E-05
	60.225	60.800	60.803	60.976	60.999	61.467	61.926	61.938	62.084	62.202
	60.22463	60.79958	60.80342	60.97590	60.99890	61.46653	61.92649	61.93799	62.08365	62.20247
0	2.934E-05	2.904E-05	2.873E-05	2.871E-05	2.868E-05	2.847E-05	2.817E-05	2.809E-05	2.805E-05	2.795E-05
	62.287	63.843	64.107	64.272	64.399	64.479	64.483	64.648	64.740	64.778
	62.28680	63.84301	64.10749	64.27231	64.39880	64.47929	64.48312	64.64793	64.73993	64.77826

Table 2.7-12 PAVAN Results for χ/Q Values at the LPZ

Plant Name: North Anna ESP
Data Period: 1996–1998 JFD
Type of Release: Ground-Level Release
Source of Data: Onsite
Comments: Data period: 1/1/96 - 12/31/98
Program: PAVAN, 10/76, 8/79 Revision, Implementation of RG 1.145
Low Population Zone Calculations:
Five Percent Overall Site Limit.
Building wake credit is not included.
Correction factors used in the annual average calculations.

Meteorological Instrumentation
Wind Sensors Height: 32.8 ft
ΔT Heights: 32.8 ft–158.9 ft

Below are printed the ordered values of χ/Q and the frequency with which that value is reached or exceeded.
The top number is the χ/Q. The middle number is the frequency normalized to this sector.
The third number is the frequency with respect to all time.

0	1.237E-04	8.410E-05	5.981E-05	5.607E-05	4.205E-05	4.067E-05	3.364E-05	2.803E-05	2.711E-05	2.701E-05
	.061	.353	.406	1.108	2.307	2.656	3.714	4.190	5.136	5.198
	.06133	.35264	.40630	1.10775	2.30749	2.65629	3.71421	4.18951	5.13627	5.19759
0	2.102E-05	2.033E-05	1.837E-05	1.776E-05	1.627E-05	1.492E-05	1.356E-05	1.256E-05	1.225E-05	1.017E-05
	5.493	7.241	7.735	7.781	9.406	9.410	10.468	10.487	12.166	13.350
	5.49274	7.24060	7.73506	7.78106	9.40626	9.41009	10.46801	10.48718	12.16604	13.35045
0	9.185E-06	8.543E-06	7.847E-06	7.348E-06	6.341E-06	6.123E-06	5.695E-06	5.303E-06	4.592E-06	4.550E-06
	16.574	16.647	17.149	20.710	20.752	23.634	24.102	24.114	29.292	29.319
	16.57403	16.64686	17.14898	20.70987	20.75204	23.63448	24.10211	24.11361	29.29204	29.31887
0	4.271E-06	3.417E-06	3.375E-06	2.848E-06	2.668E-06	2.482E-06	2.206E-06	2.136E-06	1.880E-06	1.493E-06
	30.814	33.443	39.703	42.390	44.915	44.935	45.839	52.961	53.226	66.932
	30.81375	33.44321	39.70255	42.38952	44.91549	44.93466	45.83926	52.96103	53.22552	66.93244

Table 2.7-12 PAVAN Results for χ/Q Values at the LPZ

0	1.410E-06	1.245E-06	1.151E-06	1.128E-06	1.026E-06	9.388E-07	9.339E-07	7.932E-07	7.471E-07	6.366E-07
	67.113	67.120	75.844	75.894	75.917	80.632	80.705	82.610	82.824	82.828
	67.11259	67.12025	75.84424	75.89405	75.91705	80.63168	80.70450	82.60951	82.82416	82.82799
0	6.226E-07	5.949E-07	4.759E-07	4.670E-07	4.327E-07	4.244E-07	3.183E-07	3.113E-07	2.546E-07	2.335E-07
	83.089	84.070	84.323	85.189	85.231	85.247	85.342	86.868	87.182	88.114
	83.08863	84.06989	84.32287	85.18914	85.23130	85.24663	85.34245	86.86799	87.18228	88.11370
0	2.122E-07	1.868E-07	1.592E-07	1.557E-07	1.167E-07	1.061E-07	9.339E-08	8.490E-08	7.958E-08	6.366E-08
	88.512	89.221	90.789	91.234	91.506	95.143	95.182	95.239	97.581	98.758
	88.51231	89.22141	90.78912	91.23375	91.50589	95.14342	95.18176	95.23925	97.58121	98.75794
0	5.305E-08	3.979E-08	3.183E-08	2.894E-08						
	99.494	99.889	99.969	100.000						
	99.49386	99.88866	99.96915	99.99981						

Table 2.7-13 ESP Application Nearby Sensitive Receptors

	Nearest Resident		Nearest Site Boundary		Milk* Cow	Meat Animal		Milk* Goat	Veg. Garden 500 ft^2	
Sector	(mile)	(km)	(mile)	(km)		(mile)	(km)		(mile)	(km)
N	1.48	2.38	0.87	1.40		2.18	3.51		1.78	2.86
NNE	0.96	1.54	0.88	1.42		1.56	2.51		1.66	2.67
NE	0.94	1.51	0.90	1.45		1.44	2.32		0.94	1.51
ENE	2.18	3.51	0.91	1.47		2.58	4.15		2.18	3.51
E	1.38	2.22	0.89	1.43		3.58	5.76		1.38	2.22
ESE	1.77	2.85	0.88	1.42		None	None		3.57	5.74
SE	1.37	2.20	0.83	1.34		1.37	2.20		1.37	2.20
SSE	0.91	1.46	0.73	1.17		2.71	4.36		1.21	1.95
S	1.01	1.63	0.62	0.99		None	None		1.11	1.79
SSW	1.1	1.77	0.57	0.92		1.90	3.06		1.50	2.41
SW	2.78	4.47	0.54	0.87		None	None		2.78	4.47
WSW	1.22	1.96	0.55	0.88		1.22	1.96		1.52	2.45
W	1.30	2.09	0.54	0.87		4.20	6.76		4.80	7.72
WNW	0.98	1.58	0.56	0.90		3.98	6.40		None	None
NW	0.88	1.42	0.62	0.99		None	None		0.98	1.58
NNW	0.93	1.50	0.72	1.16		1.93	3.11		1.13	1.82

Note: No milk cow or goats within a 5-mile radius of the NAPS.
Source: Reference 35.

Table 2.7-14 XOQDOQ Predicted Maximum χ/Q and D/Q Values at Specific Points of Interest

Type of Location	Direction from Site	Distance (miles)	χ/Q (No Decay)	χ/Q (2.26 Day Decay)	χ/Q (8 Day Decay)	D/Q
Residence	NNE	0.96	2.4E-06	2.4E-06	2.1E-06	7.2E-09
EAB	ESE	0.88	3.7E-06	3.7E-06	3.3E-06	1.2E-08 [a]
Meat Animal	SE	1.37	1.4E-06	1.4E-06	1.2E-06	3.1E-09 [b]
Veg. Garden	NE	0.94	2.0E-06	2.0E-06	1.8E-06	6.0E-09

Notes:
χ/Q – sec/m^3
D/Q – $1/m^2$

a. direction = south

b. direction = north-northeast

Table 2.7-15 XOQDOQ Predicted Maximum Annual Averages (Ground-Level Release)

No Decay Undepleted

	Distance in Miles From the Site										
ESE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
χ/Q (s/m^3)	2.685E-5	8.740E-6	4.697E-6	3.103E-6	1.742E-6	1.163E-6	8.527E-7	6.634E-7	5.373E-7	4.482E-7	3.822E-7
	Distance in Miles From the Site										
ESE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
χ/Q (s/m^3)	3.317E-7	1.934E-7	1.325E-7	7.833E-8	5.418E-8	4.079E-8	3.239E-8	2.668E-9	2.257E-8	1.948E-8	1.709E-8
	Segment Boundaries in Miles From the Site										
ESE	0.5 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10 – 20	20 - 30	30 - 40	40 - 50	
χ/Q (s/m^3)	4.887E-6	1.787E-6	8.596E-7	5.394E-7	3.831E-7	1.971E-7	7.964E-8	4.100E-8	2.675E-8	1.951E-8	

2.26 Day Decay, Undepleted

	Distance in Miles From the Site										
ESE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
χ/Q (s/m^3)	2.681E-5	8.712E-6	4.674E-6	3.083E-6	1.725E-6	1.148E-6	8.388E-7	6.504E-7	5.251E-7	4.365E-7	3.711E-7
	Distance in Miles From the Site										
ESE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
χ/Q (s/m^3)	3.210E-7	1.841E-7	1.241E-7	7.095E-8	4.750E-8	3.462E-8	2.662E-8	2.124E-8	1.740E-8	1.455E-8	1.237E-8
	Segment Boundaries in Miles From the Site										
ESE	0.5 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10 – 20	20 - 30	30 - 40	40 - 50	
χ/Q (s/m^3)	4.864E-6	1.770E-6	8.458E-7	5.272E-7	3.719E-7	1.878E-7	7.233E-8	3.485E-8	2.131E-8	1.459E-8	

Table 2.7-15 XOQDOQ Predicted Maximum Annual Averages (Ground-Level Release)

8.0 Day Decay, Depleted

	Distance in Miles From the Site										
ESE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
χ/Q (s/m^3)	2.540E-5	7.974E-6	4.180E-6	2.711E-6	1.475E-6	9.592E-7	6.875E-7	5.240E-7	4.166E-7	3.415E-7	2.866E-7
	Distance in Miles From the Site										
ESE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
χ/Q (s/m^3)	2.450E-7	1.344E-7	8.739E-8	4.735E-8	3.047E-8	2.153E-8	1.614E-8	1.261E-8	1.015E-8	8.357E-9	7.007E-9
	Segment Boundaries in Miles From the Site										
ESE	0.5 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50	
χ/Q (s/m^3)	4.370E-6	1.521E-6	6.945E-7	4.187E-7	2.874E-7	1.381E-7	4.874E-8	2.176E-8	1.268E-8	8.388E-9	
Relative Deposition/Area											
	Distance in Miles from Site										
NNE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
D/Q (1/m^2)	6.2570E-8	2.116E-8	1.086E-8	6.671E-9	3.326E-9	2.017E-9	1.364E-9	9.882E-10	7.514E-10	5.920E-10	4.793E-10
	Distance in Miles from Site										
NNE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
D/Q (1/m^2)	3.964E-10	1.943E-10	1.219E-10	6.161E-11	3.729E-11	2.500E-11	1.792E-11	1.345E-11	1.046E-11	8.355E-12	6.820E-12
	Segment Boundaries in Miles From the Site										
NNE	0.5 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50	
D/Q (1/m^2)	1.129E-8	3.487E-9	1.388E-9	7.583E-10	4.820E-10	2.070E-10	6.420E-10	2.544E-11	1.359E-11	8.410E-12	

Table 2.7-16 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Specific Points of Interest (1996-98 Meteorological Data)

	Ground-Level Release - No Purge Releases											
			χ/Q (sec/m^3)						χ/Q (sec/m^3)			
Dir. From Site	Type of Location	Dist. (Mile)	No Decay Undepleted	2.26 Day Decay Undepleted	8.0 Day Decay Depleted	D/Q (1/m^2)	Type of Location	Dist. (Mile)	No Decay Undepleted	2.26 Day Decay Undepleted	8.0 Day Decay Depleted	D/Q (1/m^2)
S	Residences	1.01	1.10E-06	1.10E-06	9.40E-07	5.00E-09	S. B.	0.62	2.40E-06	2.40E-06	2.10E-06	1.20E-08
SSW	Residences	1.1	7.50E-07	7.50E-07	6.50E-07	2.90E-09	S. B.	0.57	2.10E-06	2.10E-06	1.90E-06	8.70E-09
SW	Residences	2.78	1.60E-07	1.60E-07	1.30E-07	4.80E-10	S. B.	0.54	2.10E-06	2.10E-06	1.90E-06	7.80E-09
WSW	Residences	1.22	5.40E-07	5.30E-07	4.60E-07	1.70E-09	S. B.	0.54	1.90E-06	1.90E-06	1.70E-06	6.70E-09
W	Residences	1.3	6.00E-07	5.90E-07	5.10E-07	1.80E-09	S. B.	0.54	2.30E-06	2.30E-06	2.10E-06	8.00E-09
WNW	Residences	0.98	8.00E-07	7.90E-07	7.00E-07	2.70E-09	S. B.	0.56	1.90E-06	1.90E-06	1.80E-06	7.00E-09
NW	Residences	0.88	9.70E-07	9.70E-07	8.60E-07	3.00E-09	S. B.	0.61	1.70E-06	1.70E-06	1.50E-06	5.40E-09
NNW	Residences	0.93	7.70E-07	7.70E-07	6.80E-07	2.00E-09	S. B.	0.72	1.10E-06	1.10E-06	1.00E-06	3.00E-09
N	Residences	1.48	9.70E-07	9.60E-07	8.20E-07	2.30E-09	S. B.	0.87	2.20E-06	2.20E-06	1.90E-06	5.80E-09
NNE	Residences	0.96	2.40E-06	2.40E-06	2.10E-06	7.20E-09	S. B.	0.88	2.70E-06	2.70E-06	2.40E-06	8.30E-09
NE	Residences	0.94	2.00E-06	2.00E-06	1.80E-06	6.00E-09	S. B.	0.9	2.10E-06	2.10E-06	1.90E-06	6.40E-09
ENE	Residences	2.18	3.50E-07	3.50E-07	2.90E-07	7.50E-10	S. B.	0.92	1.30E-06	1.30E-06	1.10E-06	3.40E-09
E	Residences	1.38	1.30E-06	1.30E-06	1.10E-06	2.30E-09	S. B.	0.89	2.60E-06	2.50E-06	2.30E-06	5.00E-09
ESE	Residences	1.77	1.40E-06	1.40E-06	1.20E-06	2.00E-09	S. B.	0.88	3.70E-06	3.70E-06	3.30E-06	6.70E-09
SE	Residences	1.37	1.40E-06	1.40E-06	1.20E-06	2.90E-09	S. B.	0.83	2.80E-06	2.80E-06	2.50E-06	6.70E-09
SSE	Residences	0.91	1.30E-06	1.30E-06	1.20E-06	5.10E-09	S. B.	0.72	1.90E-06	1.90E-06	1.70E-06	7.50E-09

Note: S. B. – Site Boundary; M. A. – Meat Animal; V. G. – Vegetable Garden

Table 2.7-16 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Specific Points of Interest (1996-98 Meteorological Data)

	Ground-Level Release - No Purge Releases											
			χ/Q (sec/m^3)						χ/Q (sec/m^3)			
Dir. From Site	Type of Location	Dist. (Mile)	No Decay Undepleted	2.26 Day Decay Undepleted	8.0 Day Decay Depleted	D/Q (1/m^2)	Type of Location	Dist. (Mile)	No Decay Undepleted	2.26 Day Decay Undepleted	8.0 Day Decay Depleted	D/Q (1/m^2)
S	M. A.	-	-	-	-	-	V. G.	1.11	9.30E-07	9.20E-07	8.10E-07	4.30E-09
SSW	M. A.	1.9	3.20E-07	3.20E-07	2.70E-07	1.10E-09	V. G.	1.5	4.60E-07	4.60E-07	3.90E-07	1.70E-09
SW	M. A.	-	-	-	-	-	V. G.	2.78	1.60E-07	1.60E-07	1.30E-07	4.80E-10
WSW	M. A.	1.22	5.40E-07	5.30E-07	4.60E-07	1.70E-09	V. G.	1.52	3.80E-07	3.80E-07	3.20E-07	1.20E-09
W	M. A.	4.2	1.00E-07	1.00E-07	7.70E-08	2.30E-10	V. G.	4.8	8.40E-08	8.20E-08	6.20E-08	1.80E-10
WNW	M. A.	3.98	9.50E-08	9.30E-08	7.30E-08	2.40E-10	V. G.	None	-	-	-	-
NW	M. A.	None	-	-	-	-	V. G.	0.98	8.20E-07	8.20E-07	7.20E-07	2.50E-09
NNW	M. A.	1.93	2.50E-07	2.50E-07	2.10E-07	5.60E-10	V. G.	1.13	5.70E-07	5.70E-07	4.90E-07	1.40E-09
N	M. A.	2.18	5.40E-07	5.30E-07	4.40E-07	1.20E-09	V. G.	1.78	7.30E-07	7.30E-07	6.10E-07	1.70E-09
NNE	M. A.	1.56	1.10E-06	1.10E-06	9.50E-07	3.10E-09	V. G.	1.66	1.00E-06	1.00E-06	8.60E-07	2.80E-09
NE	M. A.	1.44	1.00E-06	1.00E-06	8.90E-07	2.90E-09	V. G.	0.94	2.00E-06	2.00E-06	1.80E-06	6.00E-09
ENE	M. A.	2.58	2.80E-07	2.70E-07	2.20E-07	5.60E-10	V. G.	2.18	3.50E-07	3.50E-07	2.90E-07	7.50E-10
E	M. A.	3.58	3.40E-07	3.40E-07	2.70E-07	4.40E-10	V. G.	1.38	1.30E-06	1.30E-06	1.10E-06	2.30E-09
ESE	M. A.	None	-	-	-	-	V. G.	3.57	5.20E-07	5.10E-07	4.10E-07	5.90E-10
SE	M. A.	1.37	1.40E-06	1.40E-06	1.20E-06	2.90E-09	V. G.	1.37	1.40E-06	1.40E-06	1.20E-06	2.90E-09
SSE	M. A.	2.71	2.60E-07	2.50E-07	2.10E-07	7.70E-10	V. G.	1.21	8.60E-07	8.60E-07	7.40E-07	3.10E-09

Note: S. B. – Site Boundary; M. A. – Meat Animal; V. G. – Vegetable Garden

Table 2.7-17 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles No Decay, Undepleted

Ground Level Release - No Purge Releases

Annual Average χ/Q (sec/m^3) **Distance in Miles from the Site**

Sector	0.250	0.500	0.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	9.892E-06	3.343E-06	1.737E-06	1.099E-06	5.804E-07	3.710E-07	2.630E-07	1.990E-07	1.573E-07	1.285E-07	1.076E-07
SSW	7.733E-06	2.642E-06	1.380E-06	8.743E-07	4.630E-07	2.965E-07	2.105E-07	1.594E-07	1.262E-07	1.031E-07	8.641E-08
SW	6.892E-06	2.360E-06	1.235E-06	7.838E-07	4.158E-07	2.667E-07	1.896E-07	1.437E-07	1.139E-07	9.320E-08	7.815E-08
WSW	6.435E-06	2.194E-06	1.149E-06	7.299E-07	3.879E-07	2.491E-07	1.773E-07	1.346E-07	1.067E-07	8.740E-08	7.334E-08
W	7.894E-06	2.665E-06	1.399E-06	8.926E-07	4.777E-07	3.083E-07	2.203E-07	1.678E-07	1.335E-07	1.096E-07	9.221E-08
WNW	6.843E-06	2.320E-06	1.217E-06	7.739E-07	4.128E-07	2.660E-07	1.899E-07	1.446E-07	1.150E-07	9.437E-08	7.937E-08
NW	6.822E-06	2.367E-06	1.253E-06	7.999E-07	4.290E-07	2.776E-07	1.988E-07	1.517E-07	1.209E-07	9.942E-08	8.374E-08
NNW	5.763E-06	2.029E-06	1.080E-06	6.897E-07	3.706E-07	2.402E-07	1.723E-07	1.316E-07	1.050E-07	8.641E-08	7.284E-08
N	1.469E-05	5.213E-06	2.778E-06	1.771E-06	9.494E-07	6.142E-07	4.399E-07	3.357E-07	2.675E-07	2.200E-07	1.853E-07
NNE	1.868E-05	6.567E-06	3.500E-06	2.234E-06	1.198E-06	7.757E-07	5.558E-07	4.242E-07	3.382E-07	2.782E-07	2.344E-07
NE	1.523E-05	5.352E-06	2.854E-06	1.826E-06	9.817E-07	6.364E-07	4.564E-07	3.487E-07	2.782E-07	2.290E-07	1.930E-07
ENE	9.350E-06	3.256E-06	1.748E-06	1.126E-06	6.118E-07	3.995E-07	2.881E-07	2.211E-07	1.771E-07	1.463E-07	1.237E-07
E	1.774E-05	6.092E-06	3.305E-06	2.154E-06	1.188E-06	7.835E-07	5.696E-07	4.400E-07	3.543E-07	2.940E-07	2.497E-07
ESE	2.685E-05	8.740E-06	4.697E-06	3.103E-06	1.742E-06	1.163E-06	8.527E-07	6.634E-07	5.373E-07	4.482E-07	3.822E-07
SE	1.932E-05	6.168E-06	3.268E-06	2.151E-06	1.202E-06	8.001E-07	5.855E-07	4.548E-07	3.678E-07	3.064E-07	2.611E-07
SSE	1.049E-05	3.458E-06	1.807E-06	1.158E-06	6.243E-07	4.053E-07	2.910E-07	2.225E-07	1.776E-07	1.463E-07	1.234E-07

Table 2.7-17 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles No Decay, Undepleted

Ground Level Release - No Purge Releases

Annual Average χ/Q (sec/m^3) **Distance in Miles from the Site**

Sector	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	9.185E-08	5.021E-08	3.285E-08	1.820E-08	1.203E-08	8.748E-09	6.752E-09	5.430E-09	4.499E-09	3.814E-09	3.291E-09
SSW	7.380E-08	4.043E-08	2.649E-08	1.469E-08	9.713E-09	7.062E-09	5.450E-09	4.381E-09	3.629E-09	3.076E-09	2.653E-09
SW	6.680E-08	3.671E-08	2.412E-08	1.342E-08	8.899E-09	6.484E-09	5.013E-09	4.037E-09	3.348E-09	2.841E-09	2.453E-09
WSW	6.274E-08	3.459E-08	2.277E-08	1.272E-08	8.461E-09	6.180E-09	4.788E-09	3.863E-09	3.209E-09	2.727E-09	2.358E-09
W	7.905E-08	4.398E-08	2.916E-08	1.646E-08	1.103E-08	8.108E-09	6.314E-09	5.116E-09	4.267E-09	3.638E-09	3.156E-09
WNW	6.805E-08	3.789E-08	2.514E-08	1.422E-08	9.558E-09	7.041E-09	5.493E-09	4.458E-09	3.723E-09	3.177E-09	2.759E-09
NW	7.188E-08	4.017E-08	2.672E-08	1.515E-08	1.018E-08	7.497E-09	5.847E-09	4.743E-09	3.960E-09	3.379E-09	2.932E-09
NNW	6.257E-08	3.506E-08	2.336E-08	1.327E-08	8.922E-09	6.572E-09	5.126E-09	4.158E-09	3.471E-09	2.961E-09	2.570E-09
N	1.591E-07	8.890E-08	5.911E-08	3.347E-08	2.246E-08	1.652E-08	1.286E-08	1.042E-08	8.691E-09	7.407E-09	6.422E-09
NNE	2.012E-07	1.126E-07	7.492E-08	4.248E-08	2.854E-08	2.100E-08	1.637E-08	1.327E-08	1.108E-08	9.446E-09	8.194E-09
NE	1.658E-07	9.287E-08	6.186E-08	3.512E-08	2.362E-08	1.739E-08	1.357E-08	1.101E-08	9.187E-09	7.837E-09	6.802E-09
ENE	1.065E-07	6.033E-08	4.050E-08	2.325E-08	1.575E-08	1.167E-08	9.148E-09	7.451E-09	6.242E-09	5.342E-09	4.650E-09
E	2.158E-07	1.239E-07	8.400E-08	4.888E-08	3.344E-08	2.496E-08	1.968E-08	1.611E-08	1.356E-08	1.165E-08	1.017E-08
ESE	3.317E-07	1.934E-07	1.325E-07	7.833E-08	5.418E-08	4.079E-08	3.239E-08	2.668E-08	2.257E-08	1.948E-08	1.709E-08
SE	2.264E-07	1.317E-07	9.011E-08	5.318E-08	3.676E-08	2.767E-08	2.198E-08	1.810E-08	1.531E-08	1.322E-08	1.160E-08
SSE	1.061E-07	5.969E-08	3.991E-08	2.281E-08	1.545E-08	1.144E-08	8.972E-09	7.312E-09	6.130E-09	5.250E-09	4.573E-09

Table 2.7-17 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles No Decay, Undepleted

Ground Level Release - No Purge Releases

χ/Q (sec/m^3) for each segment — **Segment Boundaries in Miles from the Site**

Direction From Site	0.5–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
S	1.810E-06	6.025E-07	2.662E-07	1.583E-07	1.080E-07	5.175E-08	1.871E-08	8.825E-09	5.453E-09	3.823E-09
SSW	1.436E-06	4.804E-07	2.130E-07	1.269E-07	8.669E-08	4.165E-08	1.510E-08	7.124E-09	4.400E-09	3.083E-09
SW	1.285E-06	4.313E-07	1.918E-07	1.145E-07	7.841E-08	3.780E-08	1.379E-08	6.540E-09	4.053E-09	2.848E-09
WSW	1.195E-06	4.022E-07	1.794E-07	1.073E-07	7.358E-08	3.559E-08	1.306E-08	6.232E-09	3.878E-09	2.733E-09
W	1.455E-06	4.946E-07	2.228E-07	1.342E-07	9.249E-08	4.519E-08	1.687E-08	8.170E-09	5.135E-09	3.646E-09
WNW	1.265E-06	4.278E-07	1.921E-07	1.156E-07	7.962E-08	3.893E-08	1.458E-08	7.093E-09	4.473E-09	3.184E-09
NW	1.299E-06	4.441E-07	2.010E-07	1.215E-07	8.399E-08	4.124E-08	1.551E-08	7.553E-09	4.760E-09	3.386E-09
NNW	1.117E-06	3.836E-07	1.741E-07	1.055E-07	7.306E-08	3.598E-08	1.358E-08	6.620E-09	4.173E-09	2.967E-09
N	2.872E-06	9.831E-07	4.447E-07	2.689E-07	1.859E-07	9.126E-08	3.428E-08	1.664E-08	1.046E-08	7.422E-09
NNE	3.619E-06	1.241E-06	5.618E-07	3.399E-07	2.351E-07	1.155E-07	4.349E-08	2.116E-08	1.332E-08	9.465E-09
NE	2.952E-06	1.016E-06	4.613E-07	2.796E-07	1.936E-07	9.529E-08	3.595E-08	1.752E-08	1.104E-08	7.854E-09
ENE	1.807E-06	6.318E-07	2.910E-07	1.779E-07	1.240E-07	6.179E-08	2.375E-08	1.175E-08	7.475E-09	5.353E-09
E	3.413E-06	1.223E-06	5.748E-07	3.558E-07	2.503E-07	1.266E-07	4.982E-08	2.511E-08	1.616E-08	1.167E-08
ESE	4.887E-06	1.787E-06	8.596E-07	5.394E-07	3.831E-07	1.971E-07	7.964E-08	4.100E-08	2.675E-08	1.951E-08
SE	3.416E-06	1.234E-06	5.904E-07	3.693E-07	2.617E-07	1.343E-07	5.409E-08	2.782E-08	1.815E-08	1.324E-08
SSE	1.885E-06	6.456E-07	2.941E-07	1.785E-07	1.238E-07	6.122E-08	2.334E-08	1.152E-08	7.336E-09	5.260E-09

Table 2.7-18 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles 2.260-Day Decay, Undepleted

Ground Level Release - No Purge Releases

Annual Average χ/Q (sec/m^3) **Distance in Miles from the Site**

Sector	0.250	0.500	0.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	9.882E-06	3.336E-06	1.732E-06	1.094E-06	5.768E-07	3.679E-07	2.603E-07	1.964E-07	1.550E-07	1.263E-07	1.055E-07
SSW	7.724E-06	2.636E-06	1.375E-06	8.704E-07	4.598E-07	2.938E-07	2.081E-07	1.572E-07	1.241E-07	1.013E-07	8.462E-08
SW	6.884E-06	2.355E-06	1.231E-06	7.800E-07	4.128E-07	2.641E-07	1.873E-07	1.417E-07	1.120E-07	9.140E-08	7.644E-08
WSW	6.427E-06	2.189E-06	1.145E-06	7.262E-07	3.849E-07	2.466E-07	1.750E-07	1.325E-07	1.048E-07	8.560E-08	7.164E-08
W	7.884E-06	2.658E-06	1.394E-06	8.880E-07	4.739E-07	3.051E-07	2.174E-07	1.651E-07	1.310E-07	1.073E-07	9.001E-08
WNW	6.834E-06	2.315E-06	1.213E-06	7.700E-07	4.097E-07	2.633E-07	1.875E-07	1.423E-07	1.129E-07	9.244E-08	7.754E-08
NW	6.814E-06	2.361E-06	1.248E-06	7.960E-07	4.258E-07	2.748E-07	1.963E-07	1.494E-07	1.187E-07	9.741E-08	8.183E-08
NNW	5.755E-06	2.023E-06	1.075E-06	6.859E-07	3.675E-07	2.375E-07	1.698E-07	1.294E-07	1.029E-07	8.446E-08	7.099E-08
N	1.467E-05	5.198E-06	2.767E-06	1.762E-06	9.415E-07	6.074E-07	4.338E-07	3.301E-07	2.623E-07	2.151E-07	1.807E-07
NNE	1.866E-05	6.550E-06	3.486E-06	2.222E-06	1.189E-06	7.675E-07	5.484E-07	4.175E-07	3.319E-07	2.723E-07	2.288E-07
NE	1.521E-05	5.339E-06	2.843E-06	1.816E-06	9.740E-07	6.298E-07	4.505E-07	3.432E-07	2.731E-07	2.242E-07	1.885E-07
ENE	9.337E-06	3.247E-06	1.741E-06	1.120E-06	6.065E-07	3.949E-07	2.840E-07	2.173E-07	1.735E-07	1.429E-07	1.205E-07
E	1.772E-05	6.073E-06	3.289E-06	2.140E-06	1.177E-06	7.738E-07	5.608E-07	4.318E-07	3.466E-07	2.868E-07	2.427E-07
ESE	2.681E-05	8.712E-06	4.674E-06	3.083E-06	1.725E-06	1.148E-06	8.388E-07	6.504E-07	5.251E-07	4.365E-07	3.711E-07
SE	1.929E-05	6.149E-06	3.253E-06	2.137E-06	1.191E-06	7.898E-07	5.761E-07	4.460E-07	3.595E-07	2.985E-07	2.535E-07
SSE	1.048E-05	3.450E-06	1.800E-06	1.152E-06	6.194E-07	4.010E-07	2.871E-07	2.189E-07	1.743E-07	1.432E-07	1.204E-07

Table 2.7-18 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles 2.260-Day Decay, Undepleted

Ground Level Release - No Purge Releases

Annual Average χ/Q (sec/m^3) **Distance in Miles from the Site**

Sector	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	8.989E-08	4.859E-08	3.144E-08	1.702E-08	1.100E-08	7.823E-09	5.903E-09	4.641E-09	3.760E-09	3.117E-09	2.630E-09
SSW	7.211E-08	3.904E-08	2.528E-08	1.368E-08	8.832E-09	6.268E-09	4.723E-09	3.707E-09	2.999E-09	2.481E-09	2.091E-09
SW	6.518E-08	3.538E-08	2.295E-08	1.245E-08	8.048E-09	5.717E-09	4.310E-09	3.384E-09	2.737E-09	2.265E-09	1.908E-09
WSW	6.112E-08	3.325E-08	2.160E-08	1.175E-08	7.604E-09	5.407E-09	4.078E-09	3.203E-09	2.591E-09	2.144E-09	1.806E-09
W	7.696E-08	4.223E-08	2.761E-08	1.516E-08	9.882E-09	7.064E-09	5.351E-09	4.219E-09	3.423E-09	2.840E-09	2.398E-09
WNW	6.631E-08	3.644E-08	2.386E-08	1.314E-08	8.600E-09	6.169E-09	4.688E-09	3.706E-09	3.015E-09	2.508E-09	2.122E-09
NW	7.006E-08	3.865E-08	2.537E-08	1.401E-08	9.174E-09	6.583E-09	5.003E-09	3.955E-09	3.218E-09	2.677E-09	2.265E-09
NNW	6.081E-08	3.359E-08	2.206E-08	1.217E-08	7.957E-09	5.697E-09	4.320E-09	3.408E-09	2.766E-09	2.295E-09	1.938E-09
N	1.547E-07	8.524E-08	5.588E-08	3.077E-08	2.008E-08	1.436E-08	1.088E-08	8.579E-09	6.961E-09	5.774E-09	4.873E-09
NNE	1.959E-07	1.081E-07	7.096E-08	3.916E-08	2.561E-08	1.835E-08	1.392E-08	1.099E-08	8.934E-09	7.421E-09	6.272E-09
NE	1.614E-07	8.924E-08	5.865E-08	3.242E-08	2.122E-08	1.522E-08	1.157E-08	9.140E-09	7.433E-09	6.179E-09	5.226E-09
ENE	1.035E-07	5.772E-08	3.818E-08	2.128E-08	1.400E-08	1.007E-08	7.667E-09	6.067E-09	4.938E-09	4.107E-09	3.473E-09
E	2.091E-07	1.182E-07	7.888E-08	4.449E-08	2.950E-08	2.135E-08	1.632E-08	1.296E-08	1.058E-08	8.819E-09	7.474E-09
ESE	3.210E-07	1.841E-07	1.241E-07	7.095E-08	4.750E-08	3.462E-08	2.662E-08	2.124E-08	1.740E-08	1.455E-08	1.237E-08
SE	2.191E-07	1.253E-07	8.436E-08	4.816E-08	3.222E-08	2.348E-08	1.805E-08	1.440E-08	1.180E-08	9.866E-09	8.385E-09
SSE	1.032E-07	5.726E-08	3.774E-08	2.096E-08	1.379E-08	9.931E-09	7.568E-09	5.995E-09	4.886E-09	4.069E-09	3.446E-09

Table 2.7-18 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles 2.260-Day Decay, Undepleted

Ground Level Release - No Purge Releases

χ/Q (sec/m^3) for each segment	Segment Boundaries in Miles from the Site									
Direction From Site	0.5–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
S	1.805E-06	5.989E-07	2.634E-07	1.559E-07	1.059E-07	5.015E-08	1.755E-08	7.903E-09	4.666E-09	3.127E-09
SSW	1.431E-06	4.773E-07	2.106E-07	1.249E-07	8.492E-08	4.027E-08	1.410E-08	6.334E-09	3.727E-09	2.490E-09
SW	1.280E-06	4.284E-07	1.895E-07	1.126E-07	7.670E-08	3.647E-08	1.283E-08	5.776E-09	3.402E-09	2.272E-09
WSW	1.191E-06	3.993E-07	1.771E-07	1.054E-07	7.188E-08	3.426E-08	1.209E-08	5.461E-09	3.220E-09	2.151E-09
W	1.450E-06	4.909E-07	2.199E-07	1.317E-07	9.029E-08	4.345E-08	1.558E-08	7.130E-09	4.239E-09	2.849E-09
WNW	1.261E-06	4.247E-07	1.897E-07	1.135E-07	7.780E-08	3.748E-08	1.350E-08	6.225E-09	3.723E-09	2.515E-09
NW	1.295E-06	4.409E-07	1.985E-07	1.194E-07	8.209E-08	3.973E-08	1.439E-08	6.642E-09	3.974E-09	2.685E-09
NNW	1.113E-06	3.805E-07	1.717E-07	1.034E-07	7.121E-08	3.451E-08	1.250E-08	5.749E-09	3.424E-09	2.302E-09
N	2.860E-06	9.753E-07	4.386E-07	2.637E-07	1.813E-07	8.762E-08	3.160E-08	1.450E-08	8.621E-09	5.792E-09
NNE	3.605E-06	1.231E-06	5.544E-07	3.336E-07	2.295E-07	1.111E-07	4.020E-08	1.851E-08	1.105E-08	7.444E-09
NE	2.941E-06	1.008E-06	4.554E-07	2.745E-07	1.890E-07	9.169E-08	3.327E-08	1.536E-08	9.183E-09	6.198E-09
ENE	1.800E-06	6.265E-07	2.869E-07	1.744E-07	1.208E-07	5.920E-08	2.180E-08	1.016E-08	6.094E-09	4.118E-09
E	3.397E-06	1.212E-06	5.660E-07	3.482E-07	2.433E-07	1.209E-07	4.547E-08	2.151E-08	1.301E-08	8.842E-09
ESE	4.864E-06	1.770E-06	8.458E-07	5.272E-07	3.719E-07	1.878E-07	7.233E-08	3.485E-08	2.131E-08	1.459E-08
SE	3.401E-06	1.223E-06	5.810E-07	3.610E-07	2.541E-07	1.280E-07	4.912E-08	2.364E-08	1.445E-08	9.890E-09
SSE	1.878E-06	6.407E-07	2.902E-07	1.752E-07	1.208E-07	5.880E-08	2.150E-08	1.002E-08	6.022E-09	4.081E-09

Table 2.7-19 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles 8.000-Day Decay, Depleted

Ground Level Release - No Purge Releases

Annual Average χ/Q (sec/m^3) **Distance in Miles from the Site**

Sector	0.250	0.500	0.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	9.360E-06	3.051E-06	1.547E-06	9.606E-07	4.921E-07	3.065E-07	2.124E-07	1.575E-07	1.223E-07	9.819E-08	8.091E-08
SSW	7.316E-06	2.411E-06	1.228E-06	7.643E-07	3.924E-07	2.448E-07	1.699E-07	1.261E-07	9.799E-08	7.876E-08	6.495E-08
SW	6.521E-06	2.154E-06	1.100E-06	6.851E-07	3.524E-07	2.202E-07	1.530E-07	1.137E-07	8.845E-08	7.115E-08	5.872E-08
WSW	6.088E-06	2.002E-06	1.023E-06	6.380E-07	3.287E-07	2.057E-07	1.431E-07	1.064E-07	8.285E-08	6.670E-08	5.508E-08
W	7.468E-06	2.432E-06	1.245E-06	7.802E-07	4.048E-07	2.546E-07	1.778E-07	1.327E-07	1.036E-07	8.364E-08	6.924E-08
WNW	6.474E-06	2.117E-06	1.083E-06	6.764E-07	3.498E-07	2.196E-07	1.533E-07	1.143E-07	8.924E-08	7.202E-08	5.962E-08
NW	6.454E-06	2.160E-06	1.115E-06	6.992E-07	3.636E-07	2.292E-07	1.605E-07	1.200E-07	9.385E-08	7.588E-08	6.290E-08
NNW	5.452E-06	1.851E-06	9.612E-07	6.028E-07	3.140E-07	1.983E-07	1.390E-07	1.040E-07	8.145E-08	6.591E-08	5.468E-08
N	1.390E-05	4.756E-06	2.473E-06	1.548E-06	8.044E-07	5.070E-07	3.549E-07	2.653E-07	2.076E-07	1.678E-07	1.391E-07
NNE	1.767E-05	5.993E-06	3.115E-06	1.952E-06	1.015E-06	6.404E-07	4.485E-07	3.354E-07	2.625E-07	2.123E-07	1.760E-07
NE	1.441E-05	4.884E-06	2.541E-06	1.596E-06	8.319E-07	5.254E-07	3.683E-07	2.757E-07	2.159E-07	1.747E-07	1.450E-07
ENE	8.845E-06	2.971E-06	1.556E-06	9.843E-07	5.183E-07	3.297E-07	2.324E-07	1.748E-07	1.374E-07	1.116E-07	9.283E-08
E	1.679E-05	5.558E-06	2.941E-06	1.882E-06	1.006E-06	6.465E-07	4.594E-07	3.477E-07	2.748E-07	2.241E-07	1.873E-07
ESE	2.540E-05	7.974E-06	4.180E-06	2.711E-06	1.475E-06	9.592E-07	6.875E-07	5.240E-07	4.166E-07	3.415E-07	2.866E-07
SE	1.828E-05	5.628E-06	2.909E-06	1.879E-06	1.018E-06	6.601E-07	4.721E-07	3.592E-07	2.852E-07	2.335E-07	1.958E-07
SSE	9.928E-06	3.156E-06	1.608E-06	1.012E-06	5.291E-07	3.346E-07	2.348E-07	1.759E-07	1.379E-07	1.116E-07	9.268E-08

Table 2.7-19 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles 8.000-Day Decay, Depleted

Ground Level Release - No Purge Releases

Annual Average χ/Q (sec/m^3) **Distance in Miles from the Site**

Sector	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	6.805E-08	3.507E-08	2.180E-08	1.110E-08	6.849E-09	4.687E-09	3.426E-09	2.620E-09	2.071E-09	1.679E-09	1.389E-09
SSW	5.465E-08	2.822E-08	1.756E-08	8.952E-09	5.520E-09	3.776E-09	2.758E-09	2.108E-09	1.665E-09	1.349E-09	1.115E-09
SW	4.945E-08	2.561E-08	1.597E-08	8.170E-09	5.050E-09	3.461E-09	2.531E-09	1.937E-09	1.532E-09	1.242E-09	1.027E-09
WSW	4.642E-08	2.411E-08	1.507E-08	7.733E-09	4.793E-09	3.291E-09	2.411E-09	1.848E-09	1.463E-09	1.188E-09	9.832E-10
W	5.848E-08	3.065E-08	1.929E-08	9.997E-09	6.243E-09	4.312E-09	3.175E-09	2.443E-09	1.941E-09	1.581E-09	1.313E-09
WNW	5.036E-08	2.642E-08	1.664E-08	8.645E-09	5.416E-09	3.751E-09	2.768E-09	2.134E-09	1.698E-09	1.385E-09	1.152E-09
NW	5.319E-08	2.801E-08	1.769E-08	9.211E-09	5.771E-09	3.996E-09	2.949E-09	2.272E-09	1.808E-09	1.475E-09	1.226E-09
NNW	4.627E-08	2.442E-08	1.544E-08	8.051E-09	5.043E-09	3.491E-09	2.574E-09	1.983E-09	1.577E-09	1.285E-09	1.067E-09
N	1.176E-07	6.193E-08	3.908E-08	2.032E-08	1.270E-08	8.781E-09	6.467E-09	4.976E-09	3.953E-09	3.219E-09	2.672E-09
NNE	1.489E-07	7.846E-08	4.956E-08	2.581E-08	1.616E-08	1.118E-08	8.243E-09	6.348E-09	5.048E-09	4.113E-09	3.417E-09
NE	1.227E-07	6.473E-08	4.094E-08	2.135E-08	1.338E-08	9.264E-09	6.834E-09	5.267E-09	4.190E-09	3.416E-09	2.839E-09
ENE	7.876E-08	4.200E-08	2.676E-08	1.410E-08	8.894E-09	6.191E-09	4.586E-09	3.546E-09	2.829E-09	2.312E-09	1.925E-09
E	1.595E-07	8.619E-08	5.543E-08	2.959E-08	1.884E-08	1.320E-08	9.835E-09	7.639E-09	6.119E-09	5.017E-09	4.191E-09
ESE	2.450E-07	1.344E-07	8.739E-08	4.735E-08	3.047E-08	2.153E-08	1.614E-08	1.261E-08	1.015E-08	8.357E-09	7.007E-09
SE	1.672E-07	9.154E-08	5.941E-08	3.214E-08	2.067E-08	1.461E-08	1.095E-08	8.553E-09	6.884E-09	5.669E-09	4.753E-09
SSE	7.849E-08	4.159E-08	2.639E-08	1.385E-08	8.732E-09	6.079E-09	4.505E-09	3.485E-09	2.783E-09	2.276E-09	1.897E-09

Table 2.7-19 Long-Term Average χ/Q (sec/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles 8.000-Day Decay, Depleted

Ground Level Release - No Purge Releases

χ/Q (sec/m^3) for each segment — **Segment Boundaries in Miles from the Site**

Direction From Site	0.5–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
S	1.620E-06	5.137E-07	2.155E-07	1.231E-07	8.127E-08	3.650E-08	1.159E-08	4.759E-09	2.641E-09	1.688E-09
SSW	1.285E-06	4.095E-07	1.724E-07	9.870E-08	6.523E-08	2.936E-08	9.340E-09	3.834E-09	2.125E-09	1.356E-09
SW	1.150E-06	3.676E-07	1.552E-07	8.907E-08	5.897E-08	2.663E-08	8.518E-09	3.513E-09	1.952E-09	1.248E-09
WSW	1.070E-06	3.428E-07	1.451E-07	8.343E-08	5.531E-08	2.505E-08	8.057E-09	3.340E-09	1.862E-09	1.193E-09
W	1.302E-06	4.214E-07	1.802E-07	1.043E-07	6.952E-08	3.179E-08	1.039E-08	4.372E-09	2.461E-09	1.588E-09
WNW	1.132E-06	3.645E-07	1.554E-07	8.985E-08	5.986E-08	2.739E-08	8.987E-09	3.802E-09	2.149E-09	1.391E-09
NW	1.163E-06	3.784E-07	1.626E-07	9.447E-08	6.315E-08	2.902E-08	9.566E-09	4.050E-09	2.289E-09	1.481E-09
NNW	9.996E-07	3.267E-07	1.408E-07	8.198E-08	5.489E-08	2.528E-08	8.356E-09	3.538E-09	1.997E-09	1.291E-09
N	2.569E-06	8.375E-07	3.596E-07	2.089E-07	1.397E-07	6.416E-08	2.111E-08	8.902E-09	5.012E-09	3.234E-09
NNE	3.238E-06	1.057E-06	4.544E-07	2.642E-07	1.767E-07	8.126E-08	2.680E-08	1.133E-08	6.394E-09	4.132E-09
NE	2.642E-06	8.654E-07	3.732E-07	2.173E-07	1.455E-07	6.703E-08	2.216E-08	9.389E-09	5.304E-09	3.432E-09
ENE	1.616E-06	5.381E-07	2.353E-07	1.382E-07	9.317E-08	4.340E-08	1.460E-08	6.269E-09	3.570E-09	2.322E-09
E	3.052E-06	1.041E-06	4.646E-07	2.763E-07	1.879E-07	8.880E-08	3.055E-08	1.336E-08	7.687E-09	5.037E-09
ESE	4.370E-06	1.521E-06	6.945E-07	4.187E-07	2.874E-07	1.381E-07	4.874E-08	2.176E-08	1.268E-08	8.388E-09
SE	3.055E-06	1.050E-06	4.771E-07	2.866E-07	1.964E-07	9.408E-08	3.311E-08	1.476E-08	8.602E-09	5.690E-09
SSE	1.687E-06	5.500E-07	2.379E-07	1.388E-07	9.304E-08	4.303E-08	1.436E-08	6.157E-09	3.509E-09	2.286E-09

Table 2.7-20 Long-Term Average D/Q (1/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles

Ground Level Release - No Purge Releases

********** Relative Deposition per Unit Area (M**-2) at Fixed Points By Downwind Sectors **********

Distances in Miles

Direction From Site	0.250	0.500	0.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	4.819E-08	1.630E-08	8.367E-09	5.138E-09	2.561E-09	1.553E-09	1.050E-09	7.611E-10	5.787E-10	4.559E-10	3.691E-10
SSW	3.194E-08	1.080E-08	5.546E-09	3.405E-09	1.698E-09	1.030E-09	6.961E-10	5.045E-10	3.836E-10	3.022E-10	2.446E-10
SW	2.633E-08	8.902E-09	4.571E-09	2.807E-09	1.399E-09	8.486E-10	5.738E-10	4.158E-10	3.161E-10	2.491E-10	2.016E-10
WSW	2.286E-08	7.732E-09	3.970E-09	2.438E-09	1.215E-09	7.371E-10	4.983E-10	3.611E-10	2.746E-10	2.163E-10	1.751E-10
W	2.691E-08	9.101E-09	4.673E-09	2.869E-09	1.430E-09	8.676E-10	5.866E-10	4.251E-10	3.232E-10	2.546E-10	2.061E-10
WNW	2.495E-08	8.438E-09	4.333E-09	2.660E-09	1.326E-09	8.044E-10	5.439E-10	3.941E-10	2.997E-10	2.361E-10	1.911E-10
NW	2.242E-08	7.583E-09	3.893E-09	2.391E-09	1.192E-09	7.229E-10	4.887E-10	3.542E-10	2.693E-10	2.122E-10	1.718E-10
NNW	1.628E-08	5.504E-09	2.826E-09	1.735E-09	8.652E-10	5.247E-10	3.548E-10	2.571E-10	1.955E-10	1.540E-10	1.247E-10
N	4.309E-08	1.457E-08	7.481E-09	4.594E-09	2.290E-09	1.389E-09	9.391E-10	6.805E-10	5.175E-10	4.077E-10	3.300E-10
NNE	6.257E-08	2.116E-08	1.086E-08	6.671E-09	3.326E-09	2.017E-09	1.364E-09	9.882E-10	7.514E-10	5.920E-10	4.793E-10
NE	5.046E-08	1.706E-08	8.761E-09	5.379E-09	2.682E-09	1.627E-09	1.100E-09	7.969E-10	6.059E-10	4.774E-10	3.865E-10
ENE	2.720E-08	9.199E-09	4.723E-09	2.900E-09	1.446E-09	8.769E-10	5.929E-10	4.296E-10	3.267E-10	2.574E-10	2.084E-10
E	3.824E-08	1.293E-08	6.640E-09	4.077E-09	2.033E-09	1.233E-09	8.335E-10	6.040E-10	4.593E-10	3.618E-10	2.929E-10
ESE	5.097E-08	1.724E-08	8.849E-09	5.434E-09	2.709E-09	1.643E-09	1.111E-09	8.050E-10	6.121E-10	4.822E-10	3.904E-10
SE	4.574E-08	1.547E-08	7.942E-09	4.877E-09	2.431E-09	1.475E-09	9.970E-10	7.225E-10	5.493E-10	4.328E-10	3.504E-10
SSE	4.085E-08	1.381E-08	7.092E-09	4.355E-09	2.171E-09	1.317E-09	8.902E-10	6.451E-10	4.905E-10	3.865E-10	3.129E-10

Table 2.7-20 Long-Term Average D/Q (1/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles

Ground Level Release - No Purge Releases

********** Relative Deposition per Unit Area (M**-2) at Fixed Points By Downwind Sectors **********

Annual Average χ/Q (sec/m^3) **Distance in Miles**

Direction From Site	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	3.053E-10	1.496E-10	9.388E-11	4.745E-11	2.872E-11	1.926E-11	1.380E-11	1.036E-11	8.056E-12	6.435E-12	5.252E-12
SSW	2.024E-10	9.917E-11	6.222E-11	3.145E-11	1.904E-11	1.276E-11	9.145E-12	6.867E-12	5.339E-12	4.265E-12	3.481E-12
SW	1.668E-10	8.174E-11	5.129E-11	2.592E-11	1.569E-11	1.052E-11	7.538E-12	5.660E-12	4.401E-12	3.515E-12	2.869E-12
WSW	1.449E-10	7.099E-11	4.454E-11	2.251E-11	1.363E-11	9.136E-12	6.547E-12	4.916E-12	3.822E-12	3.053E-12	2.492E-12
W	1.705E-10	8.356E-11	5.243E-11	2.650E-11	1.604E-11	1.075E-11	7.706E-12	5.786E-12	4.499E-12	3.594E-12	2.933E-12
WNW	1.581E-10	7.748E-11	4.861E-11	2.457E-11	1.487E-11	9.971E-12	7.145E-12	5.365E-12	4.171E-12	3.332E-12	2.720E-12
NW	1.421E-10	6.962E-11	4.369E-11	2.208E-11	1.336E-11	8.961E-12	6.421E-12	4.821E-12	3.749E-12	2.994E-12	2.444E-12
NNW	1.031E-10	5.054E-11	3.171E-11	1.603E-11	9.701E-12	6.504E-12	4.661E-12	3.500E-12	2.721E-12	2.174E-12	1.774E-12
N	2.730E-10	1.338E-10	8.394E-11	4.243E-11	2.568E-11	1.722E-11	1.234E-11	9.264E-12	7.203E-12	5.754E-12	4.697E-12
NNE	3.964E-10	1.943E-10	1.219E-10	6.161E-11	3.729E-11	2.500E-11	1.792E-11	1.345E-11	1.046E-11	8.355E-12	6.820E-12
NE	3.197E-10	1.567E-10	9.830E-11	4.968E-11	3.007E-11	2.016E-11	1.445E-11	1.085E-11	8.435E-12	6.738E-12	5.500E-12
ENE	1.724E-10	8.446E-11	5.300E-11	2.679E-11	1.621E-11	1.087E-11	7.789E-12	5.849E-12	4.548E-12	3.633E-12	2.965E-12
E	2.423E-10	1.187E-10	7.451E-11	3.766E-11	2.279E-11	1.528E-11	1.095E-11	8.223E-12	6.393E-12	5.107E-12	4.168E-12
ESE	3.229E-10	1.583E-10	9.929E-11	5.019E-11	3.038E-11	2.037E-11	1.459E-11	1.096E-11	8.520E-12	6.806E-12	5.555E-12
SE	2.898E-10	1.420E-10	8.912E-11	4.504E-11	2.726E-11	1.828E-11	1.310E-11	9.835E-12	7.647E-12	6.108E-12	4.986E-12
SSE	2.588E-10	1.268E-10	7.957E-11	4.022E-11	2.434E-11	1.632E-11	1.170E-11	8.782E-12	6.828E-12	5.454E-12	4.452E-12

Table 2.7-20 Long-Term Average D/Q (1/m^3) for Routine Releases at Distances Between 0.25 to 50 Miles

Ground Level Release - No Purge Releases

********** Relative Deposition per Unit Area (M**-2) at Fixed Points By Downwind Sectors **********

χ/Q (sec/m^3) for each segment **Segment Boundaries in Miles**

Direction From Site	0.5–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
S	8.694E-09	2.686E-09	1.069E-09	5.841E-10	3.712E-10	1.594E-10	4.944E-11	1.960E-11	1.046E-11	6.477E-12
SSW	5.762E-09	1.780E-09	7.084E-10	3.871E-10	2.460E-10	1.057E-10	3.277E-11	1.299E-11	6.936E-12	4.293E-12
SW	4.749E-09	1.467E-09	5.839E-10	3.191E-10	2.028E-10	8.710E-11	2.701E-11	1.071E-11	5.717E-12	3.538E-12
WSW	4.125E-09	1.274E-09	5.071E-10	2.771E-10	1.761E-10	7.565E-11	2.346E-11	9.298E-12	4.965E-12	3.073E-12
W	4.855E-09	1.500E-09	5.969E-10	3.262E-10	2.073E-10	8.905E-11	2.761E-11	1.094E-11	5.844E-12	3.617E-12
WNW	4.502E-09	1.391E-09	5.534E-10	3.024E-10	1.922E-10	8.256E-11	2.560E-11	1.015E-11	5.419E-12	3.354E-12
NW	4.045E-09	1.250E-09	4.973E-10	2.718E-10	1.727E-10	7.420E-11	2.301E-11	9.119E-12	4.870E-12	3.014E-12
NNW	2.937E-09	9.072E-10	3.610E-10	1.973E-10	1.254E-10	5.386E-11	1.670E-11	6.619E-12	3.535E-12	2.188E-12
N	7.773E-09	2.402E-09	9.557E-10	5.222E-10	3.319E-10	1.426E-10	4.421E-11	1.752E-11	9.357E-12	5.792E-12
NNE	1.129E-08	3.487E-09	1.388E-09	7.583E-10	4.820E-10	2.070E-10	6.420E-11	2.544E-11	1.359E-11	8.410E-12
NE	9.103E-09	2.812E-09	1.119E-09	6.115E-10	3.887E-10	1.669E-10	5.177E-11	2.052E-11	1.096E-11	6.782E-12
ENE	4.908E-09	1.516E-09	6.033E-10	3.297E-10	2.095E-10	9.001E-11	2.791E-11	1.106E-11	5.907E-12	3.656E-12
E	6.899E-09	2.132E-09	8.482E-10	4.635E-10	2.946E-10	1.265E-10	3.924E-11	1.555E-11	8.305E-12	5.140E-12
ESE	9.195E-09	2.841E-09	1.130E-09	6.177E-10	3.926E-10	1.686E-10	5.230E-11	2.073E-11	1.107E-11	6.851E-12
SE	8.252E-09	2.550E-09	1.015E-09	5.544E-10	3.524E-10	1.514E-10	4.693E-11	1.860E-11	9.934E-12	6.149E-12
SSE	7.369E-09	2.277E-09	9.059E-10	4.950E-10	3.146E-10	1.351E-10	4.191E-11	1.661E-11	8.870E-12	5.490E-12

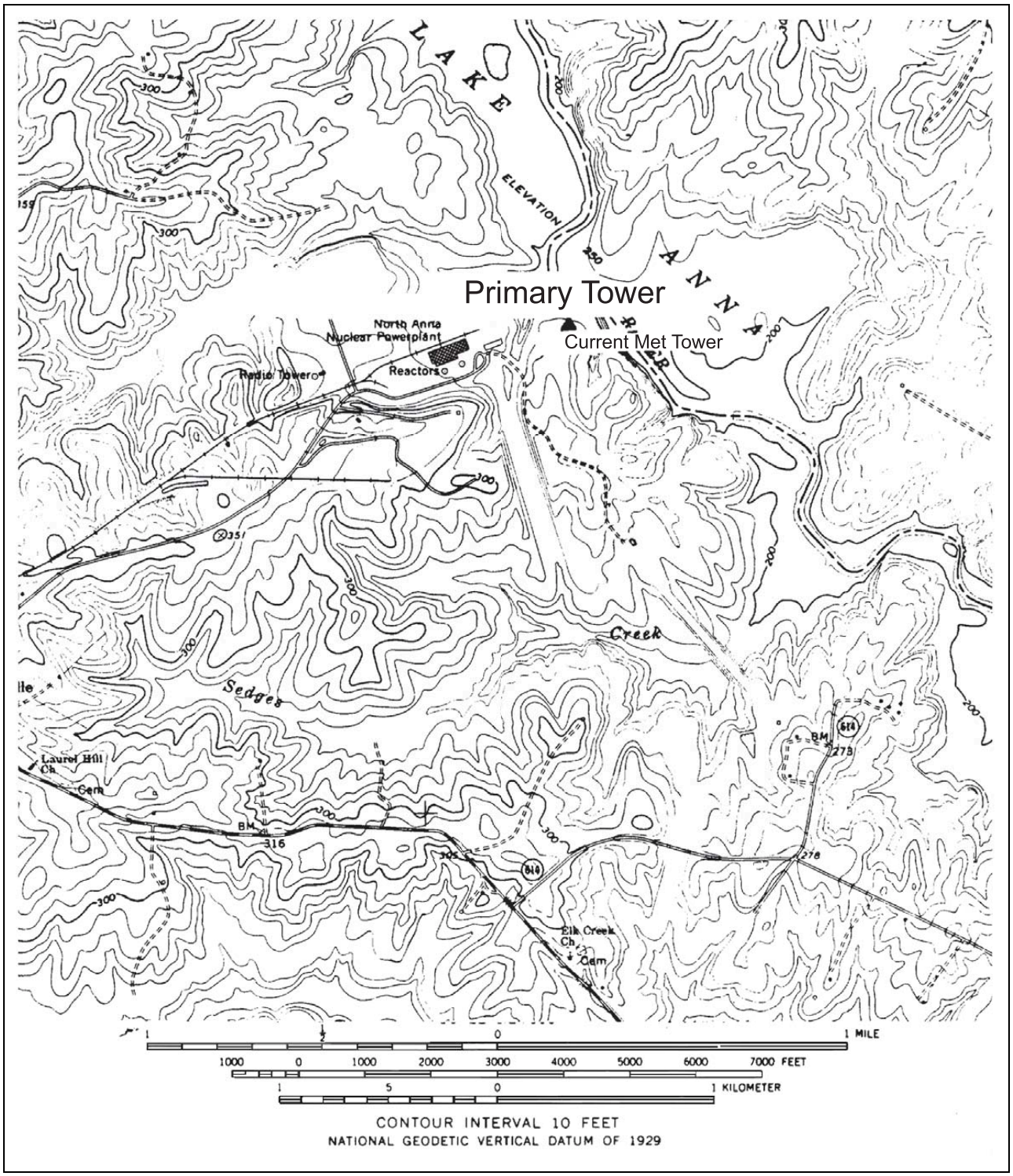
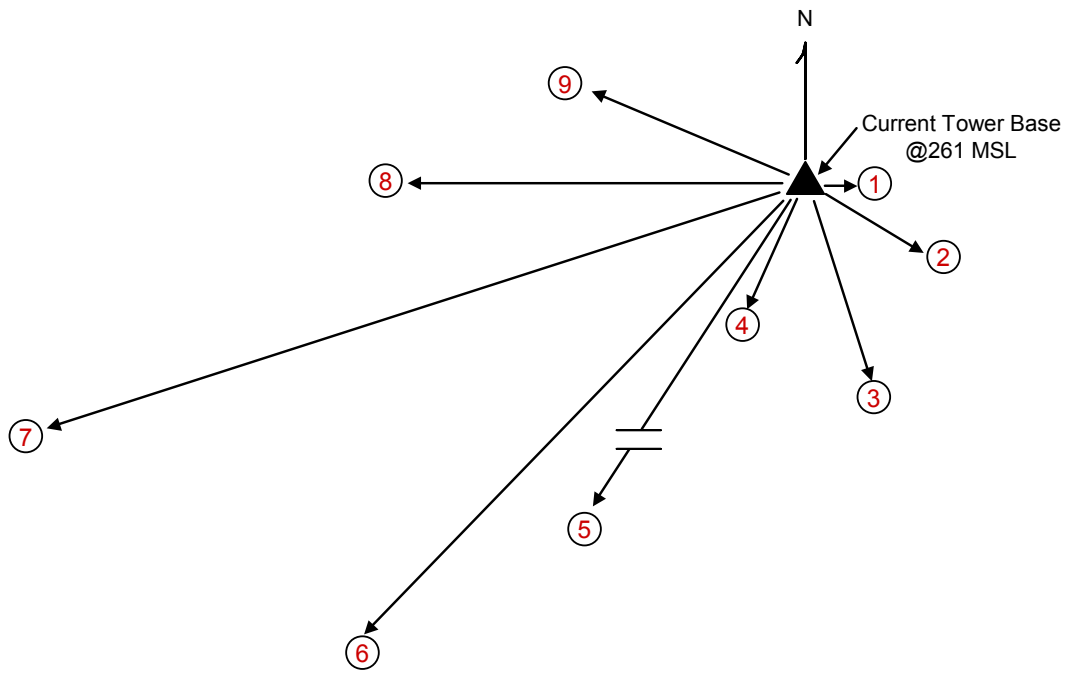


Figure 2.7-1 Location of Meteorological Tower



Approximated Directions and Distances

1	Basketball Backboard	095°	100'
2	30 x 50 Pavilion	122°	222'
3	20 x 30 Pavilion	160°	294'
4	Softball Backstop	200°	203'
5	Nearest Contiguous Tree Line		>500'
6	Training Center	205°	740'
7	Unit 1 Containment	250°	1750'
8	Original Tower	272°	1020'
9	Back-up Tower	–	–

Figure 2.7-2 Location of Meteorological Tower Relative to Local Ground Features

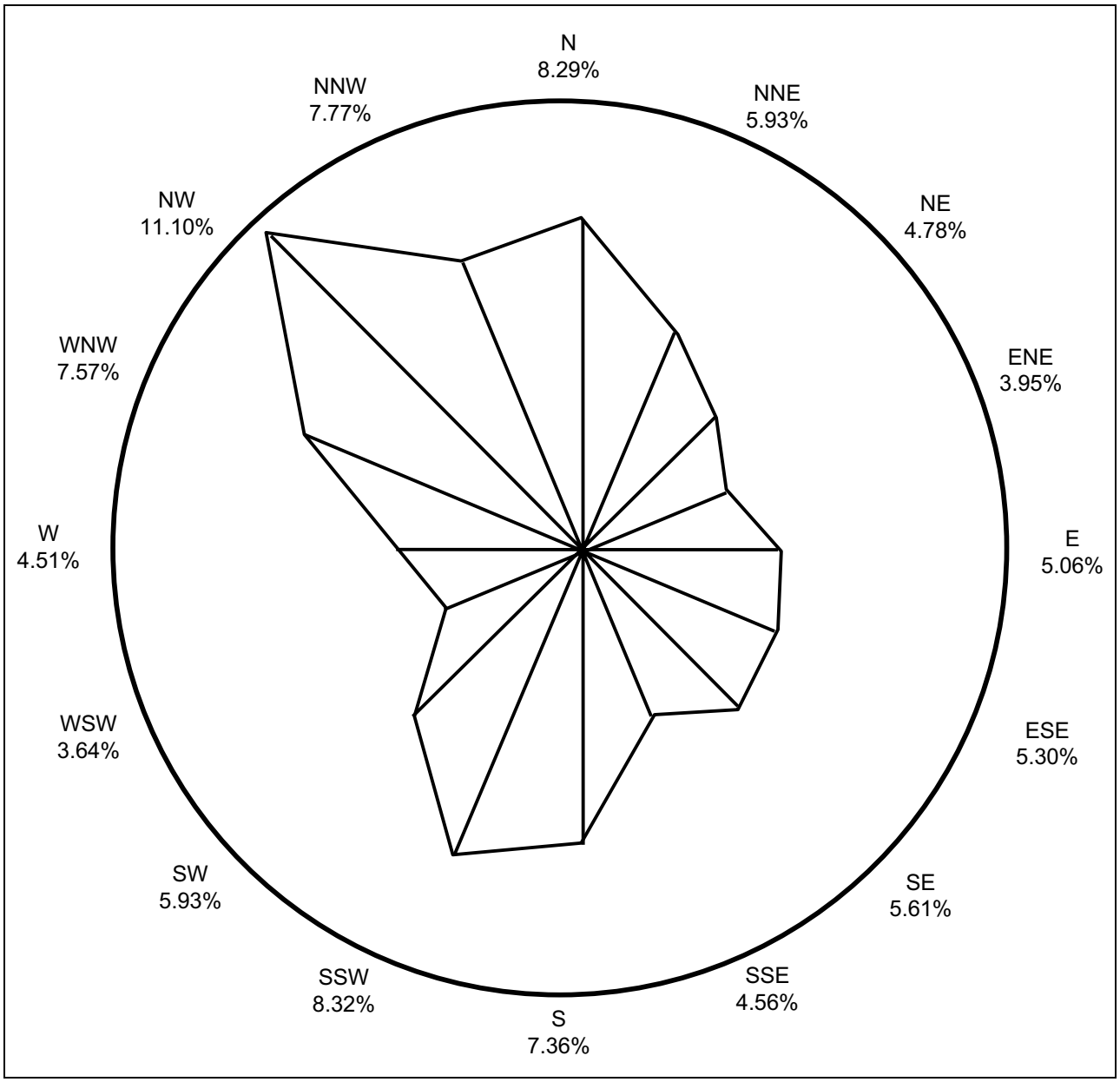


Figure 2.7-3 North Anna Seasonal Wind Direction Roses: Low-Level Winds: 1974–1987: Season = Spring

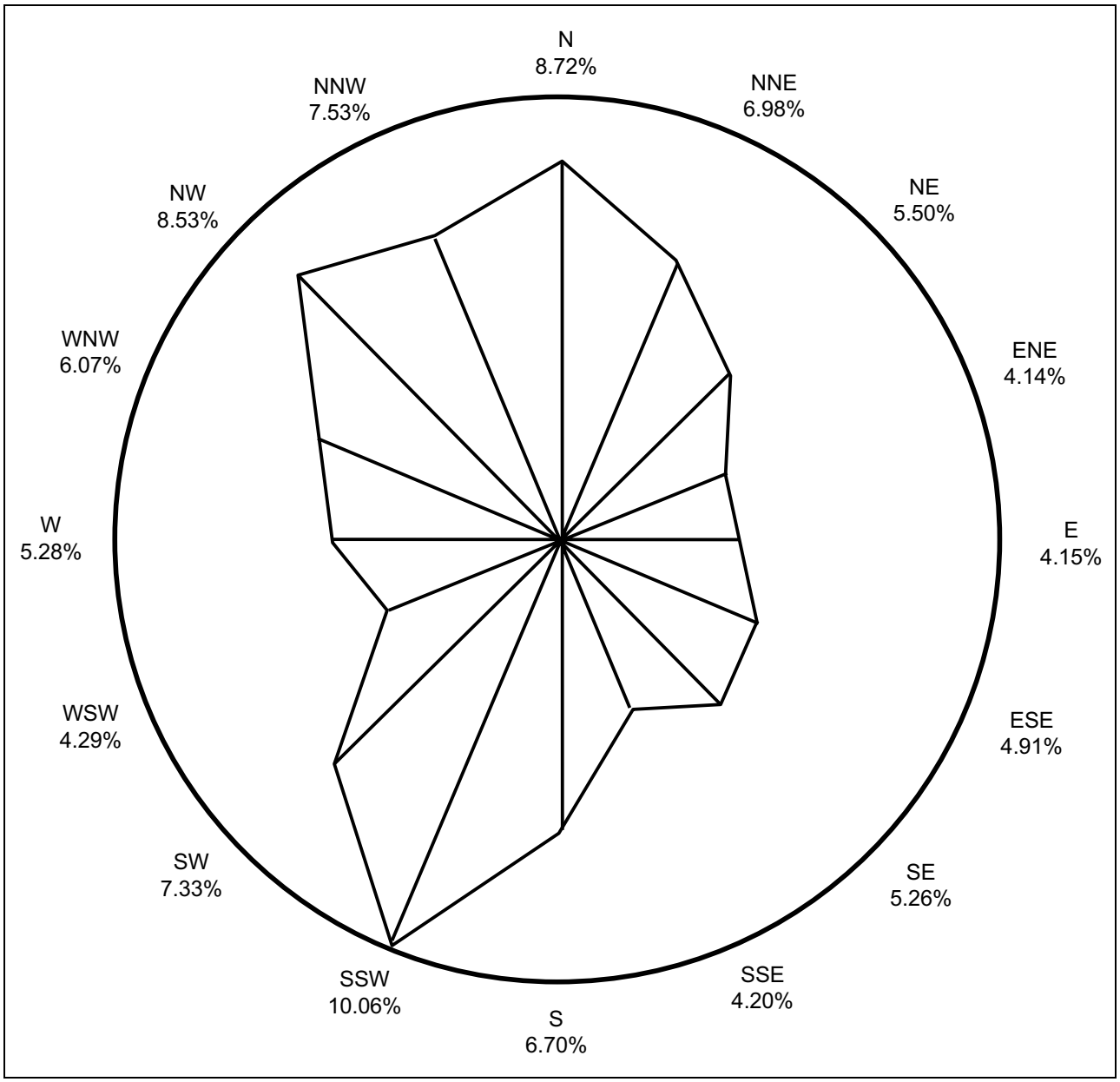


Figure 2.7-4 North Anna Seasonal Wind Direction Roses: High-Level Winds: 1974–1987: Season = Spring

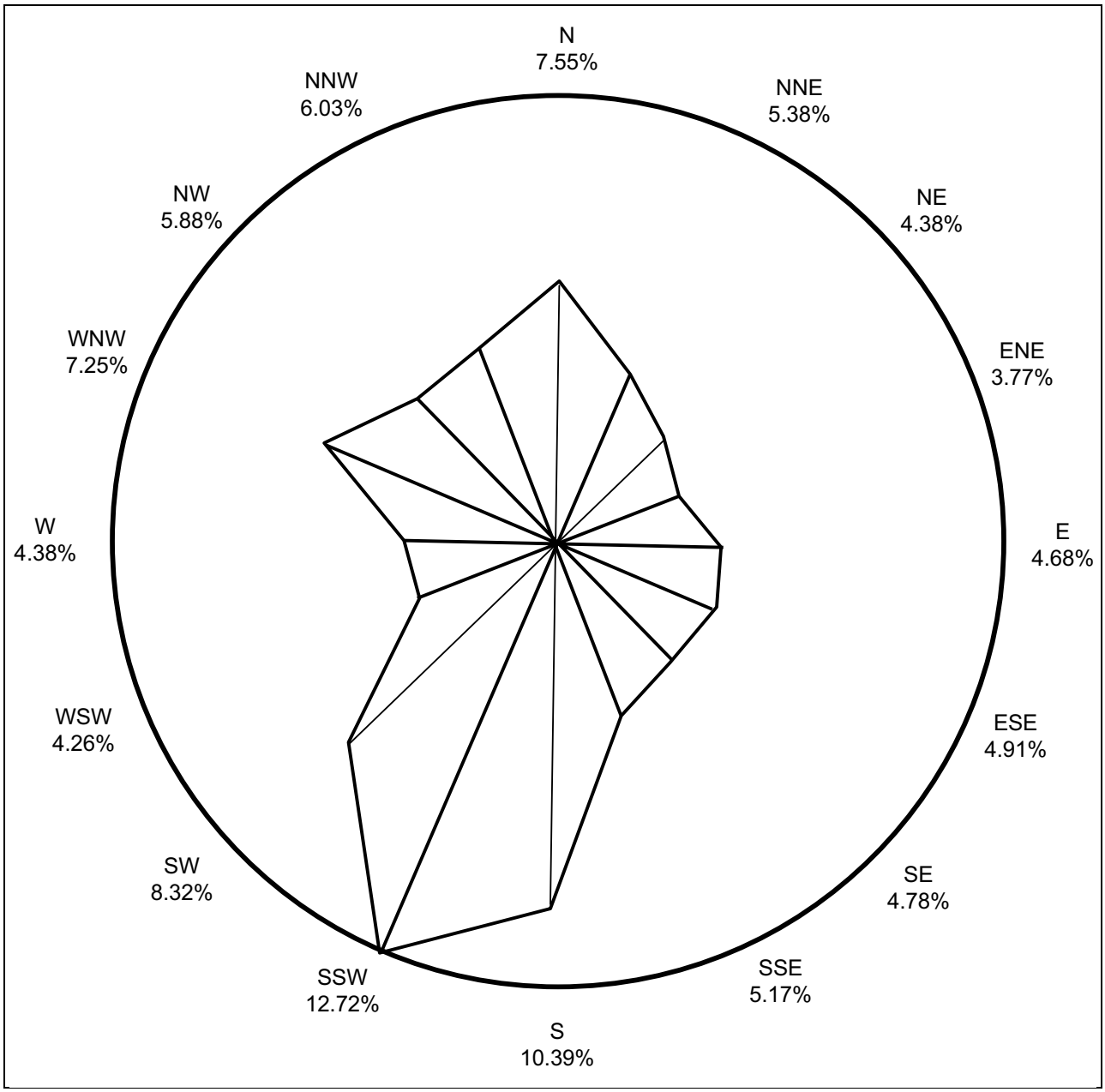


Figure 2.7-5 North Anna Seasonal Wind Direction Roses: Low-Level Winds: 1974–1987: Season = Summer

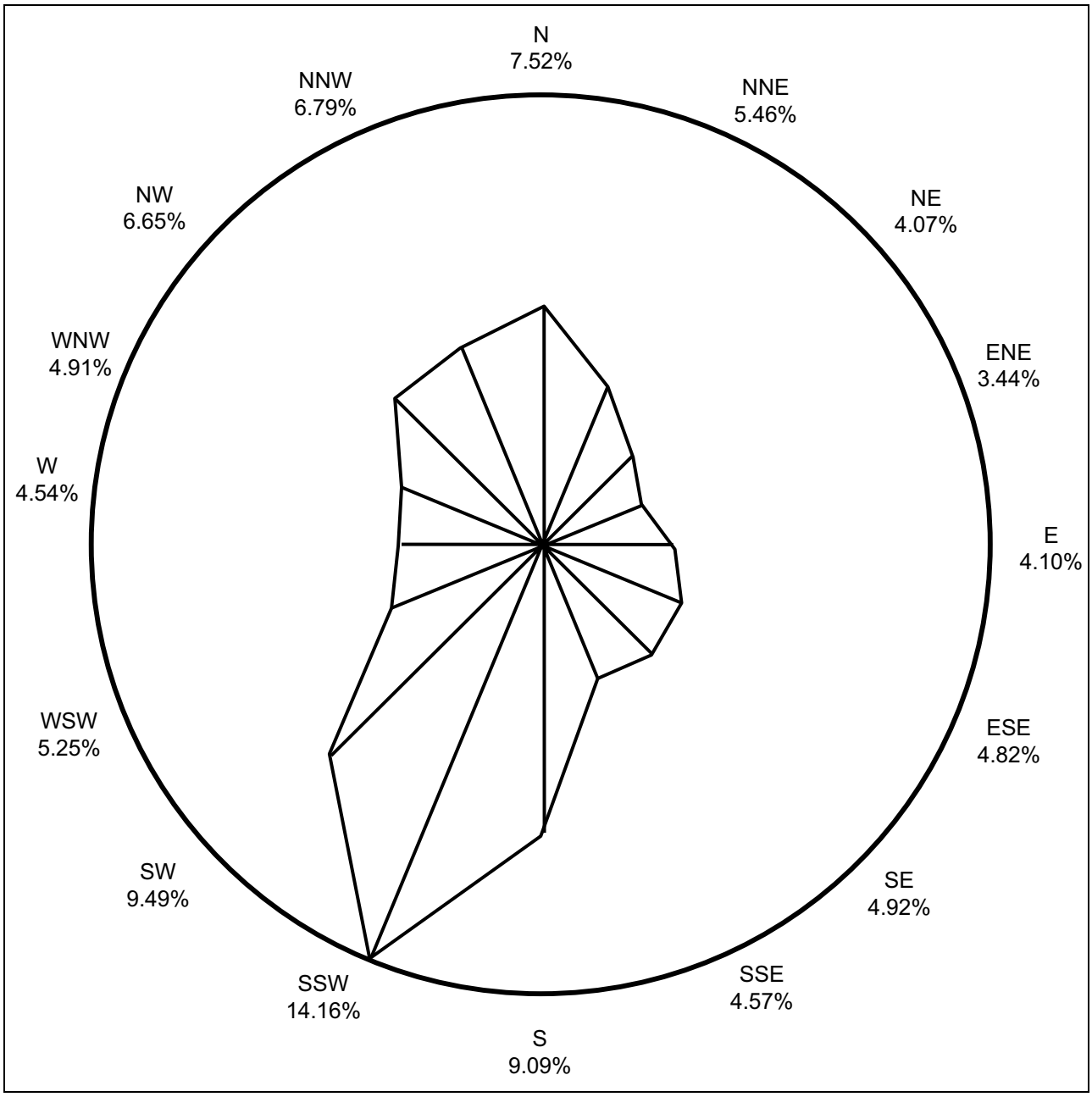


Figure 2.7-6 North Anna Seasonal Wind Direction Roses: High-Level Winds: 1974–1987: Season = Summer

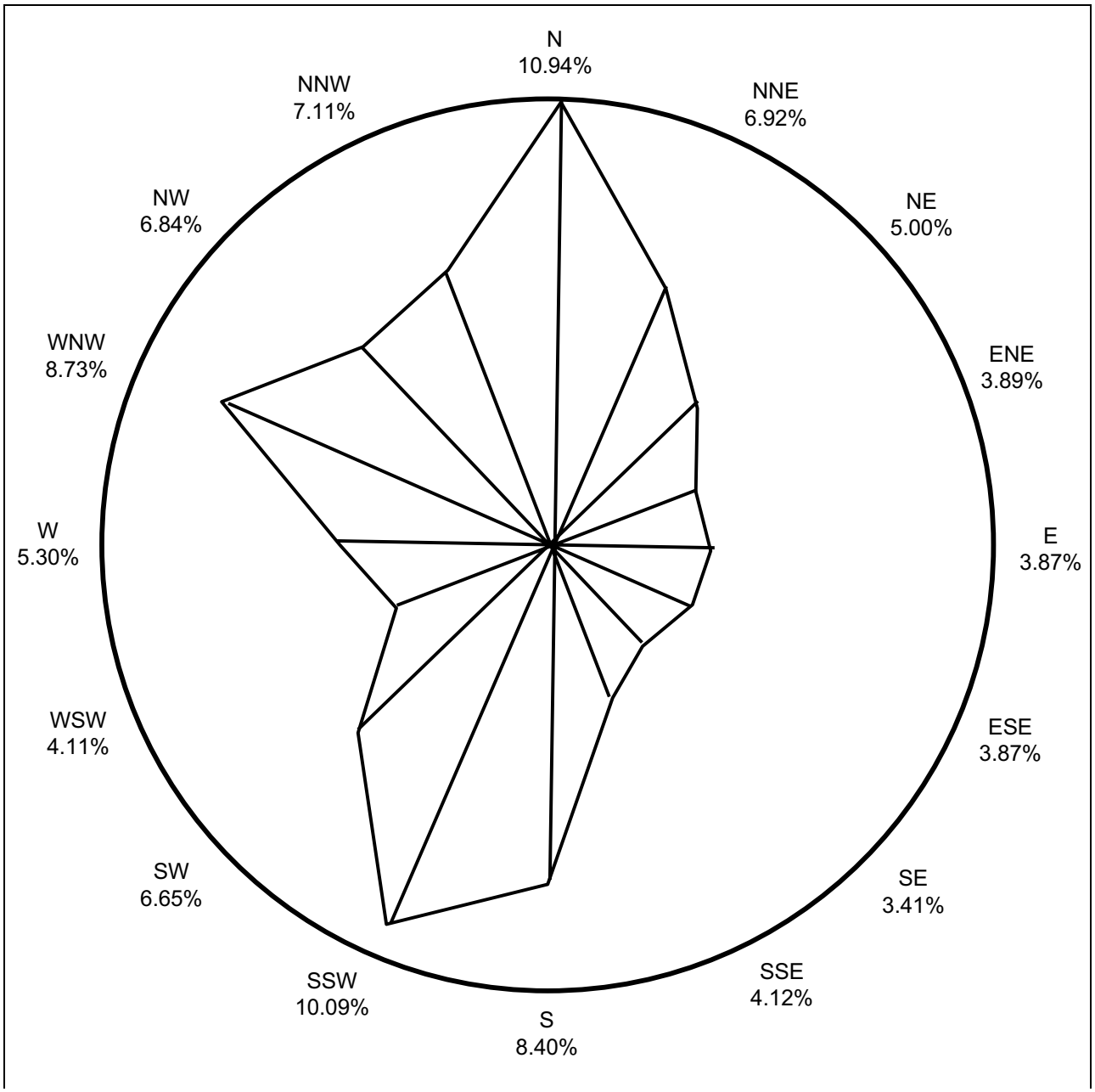


Figure 2.7-7 North Anna Seasonal Wind Direction Roses: Low-Level Winds: 1974–1987: Season = Fall

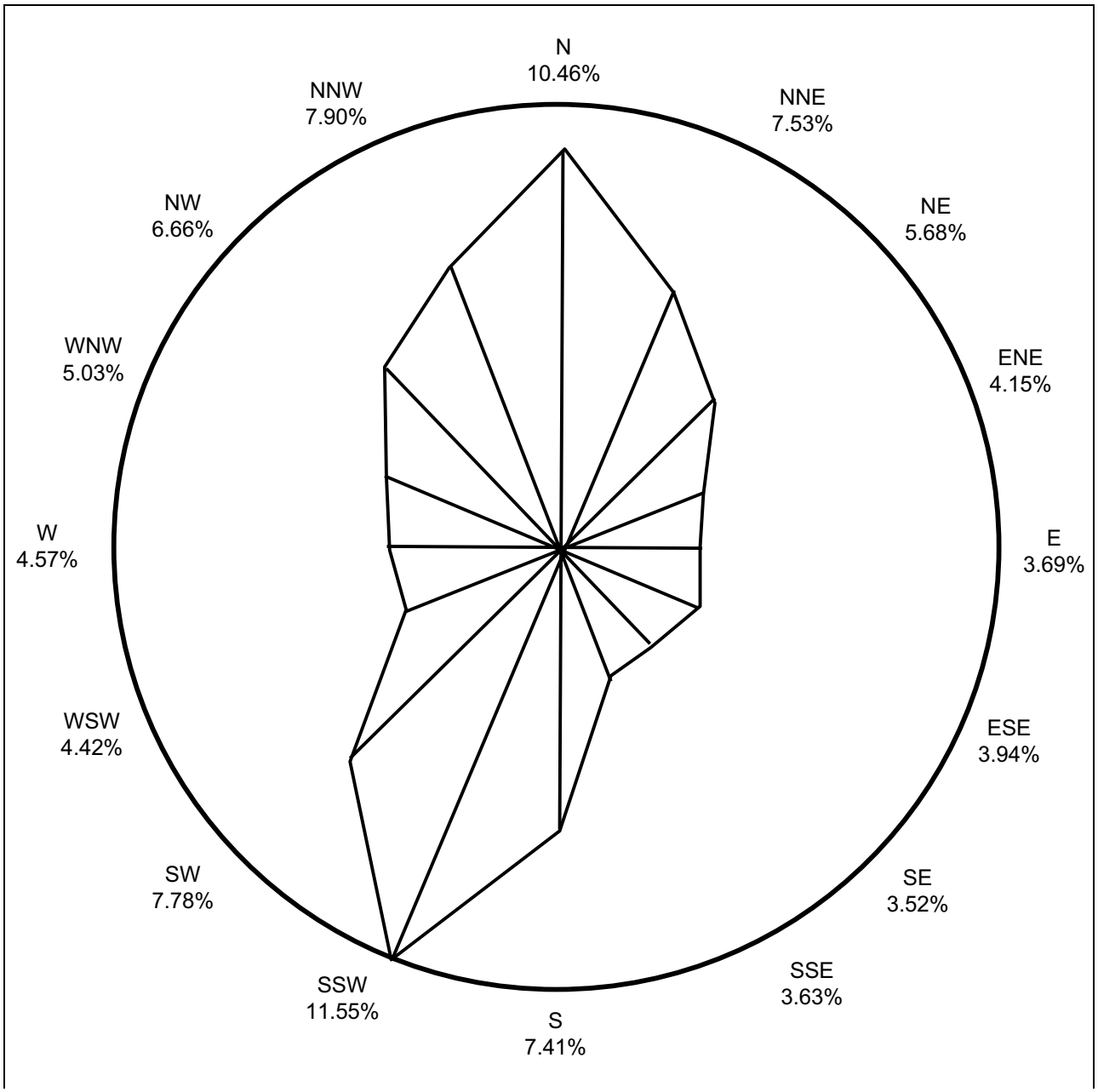


Figure 2.7-8 North Anna Seasonal Wind Direction Roses: High-Level Winds: 1974–1987: Season = Fall

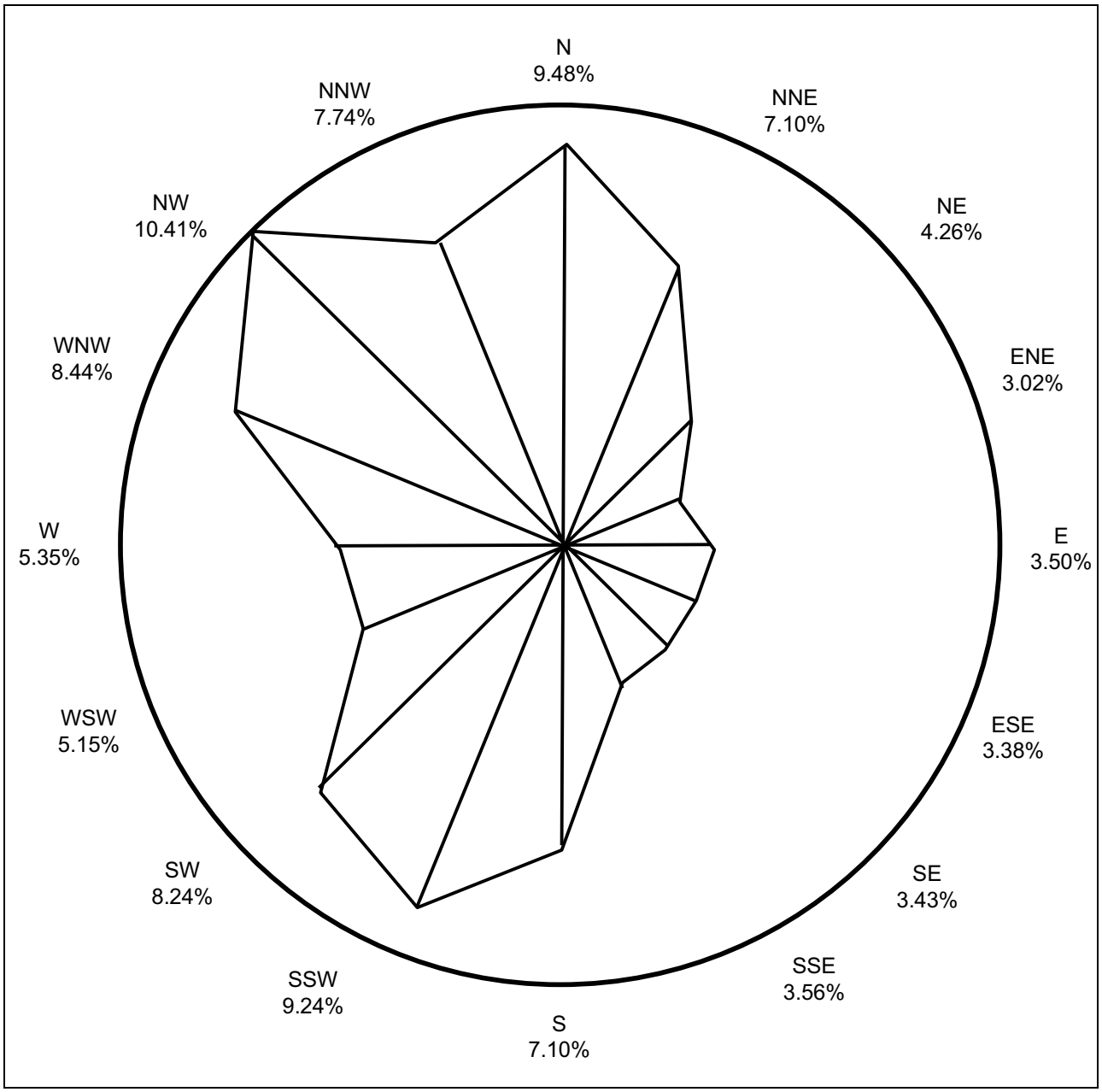


Figure 2.7-9 North Anna Seasonal Wind Direction Roses: Low-Level Winds: 1974–1987: Season = Winter

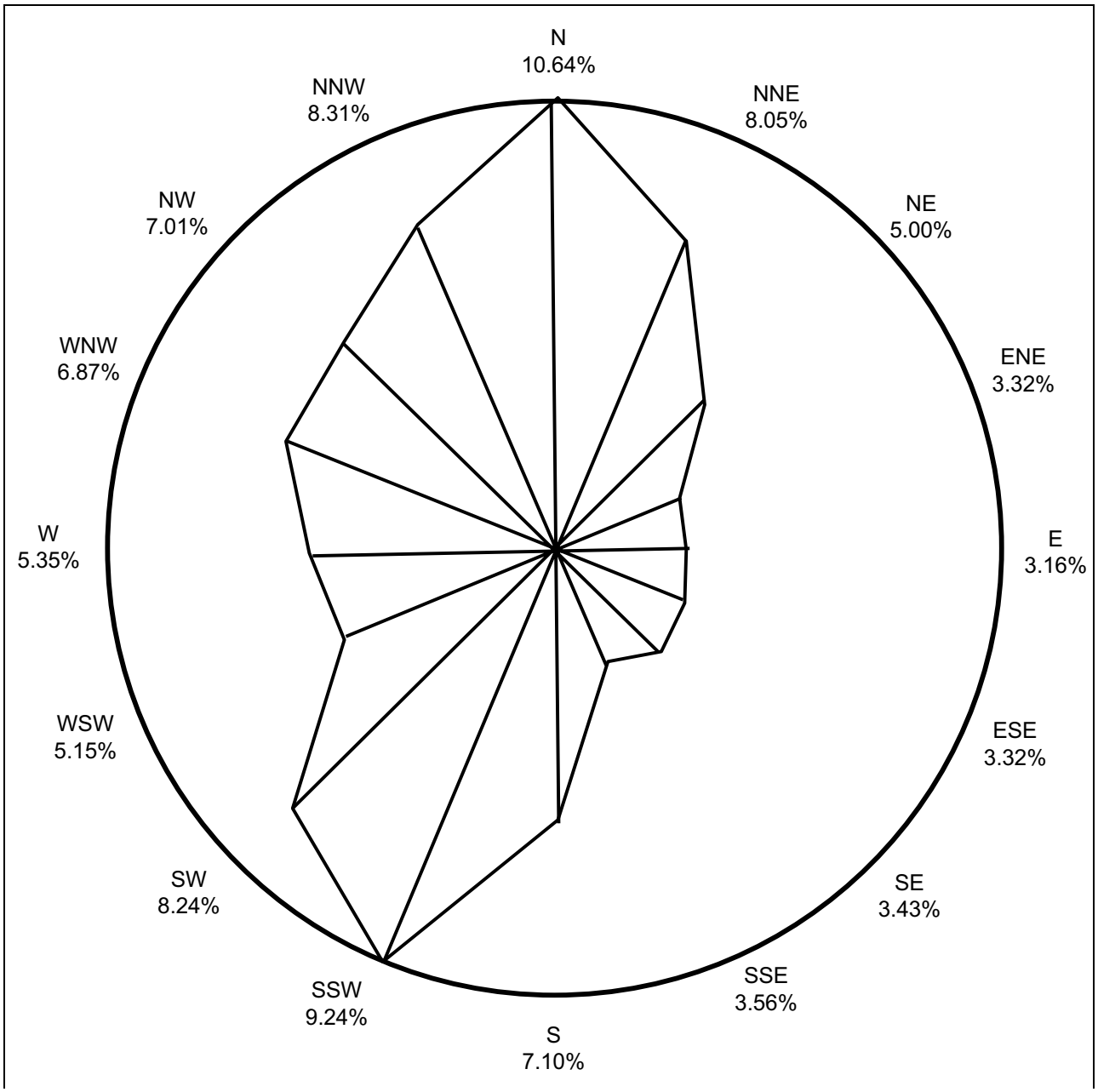


Figure 2.7-10 North Anna Seasonal Wind Direction Roses: High-Level Winds: 1974–1987: Season = Winter

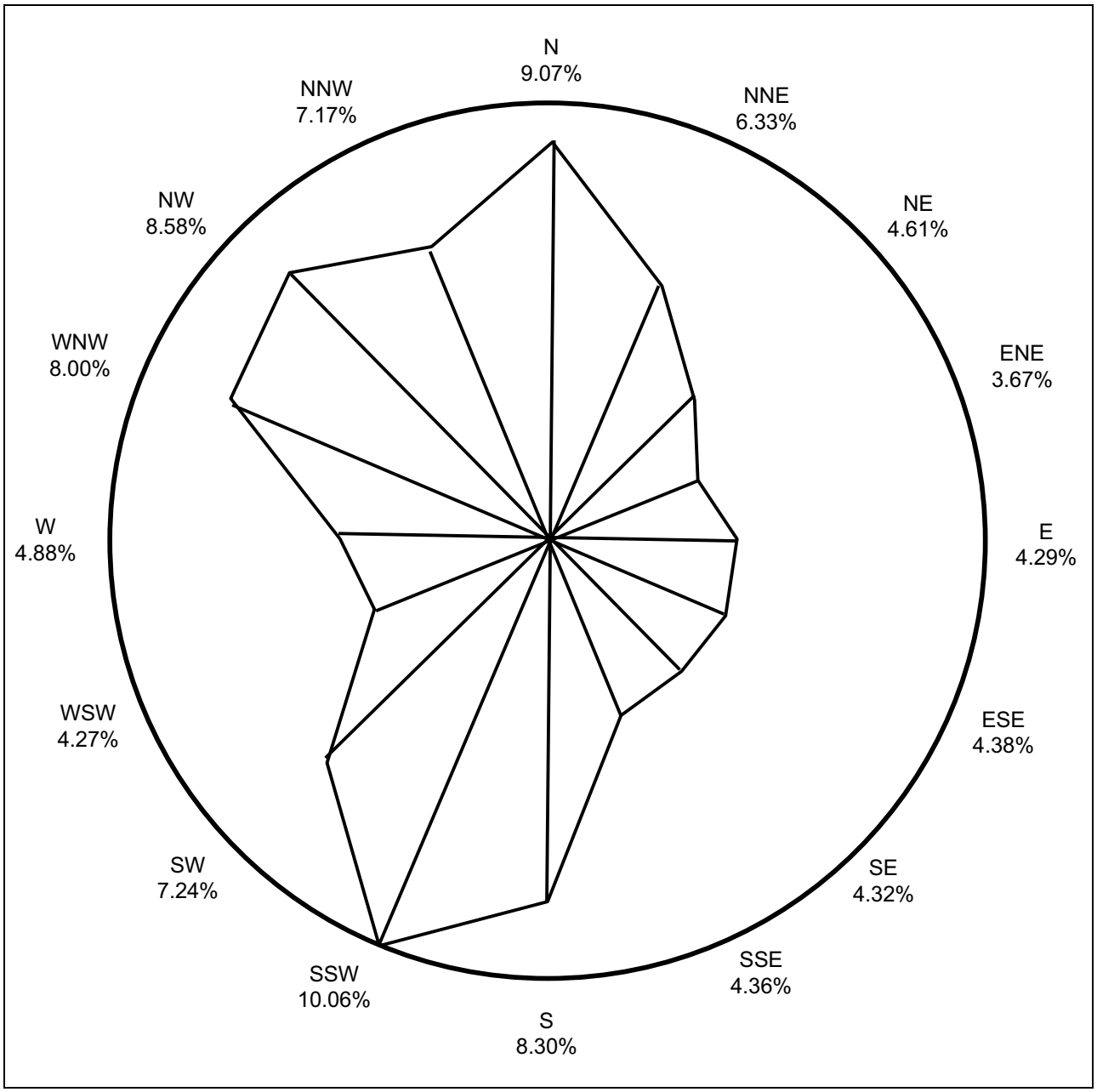


Figure 2.7-11 North Anna Seasonal Wind Direction Roses: Low-Level Winds: 1974–1987: Season = Overall

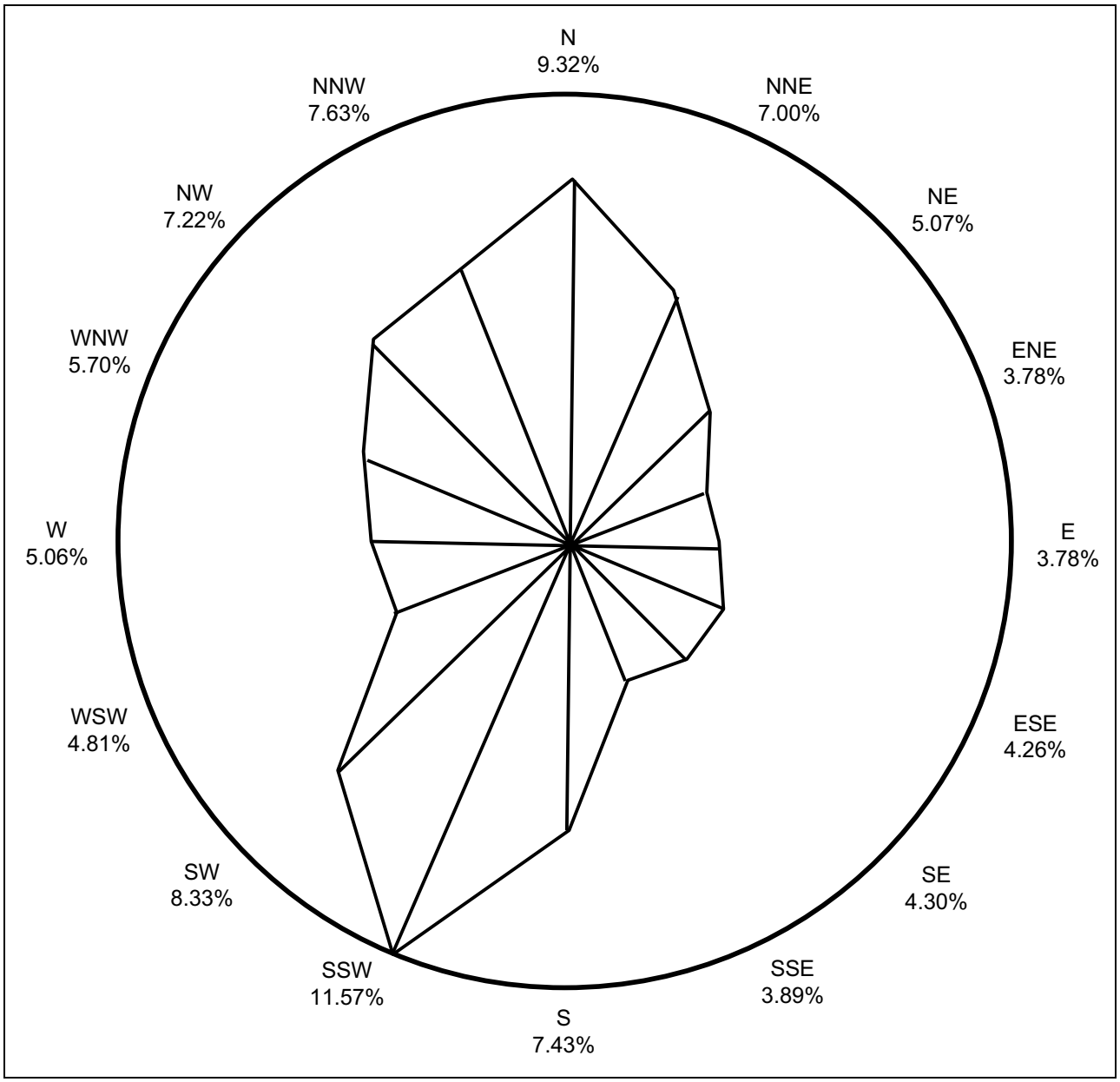


Figure 2.7-12 North Anna Seasonal Wind Direction Roses: High-Level Winds: 1974–1987: Season = Overall

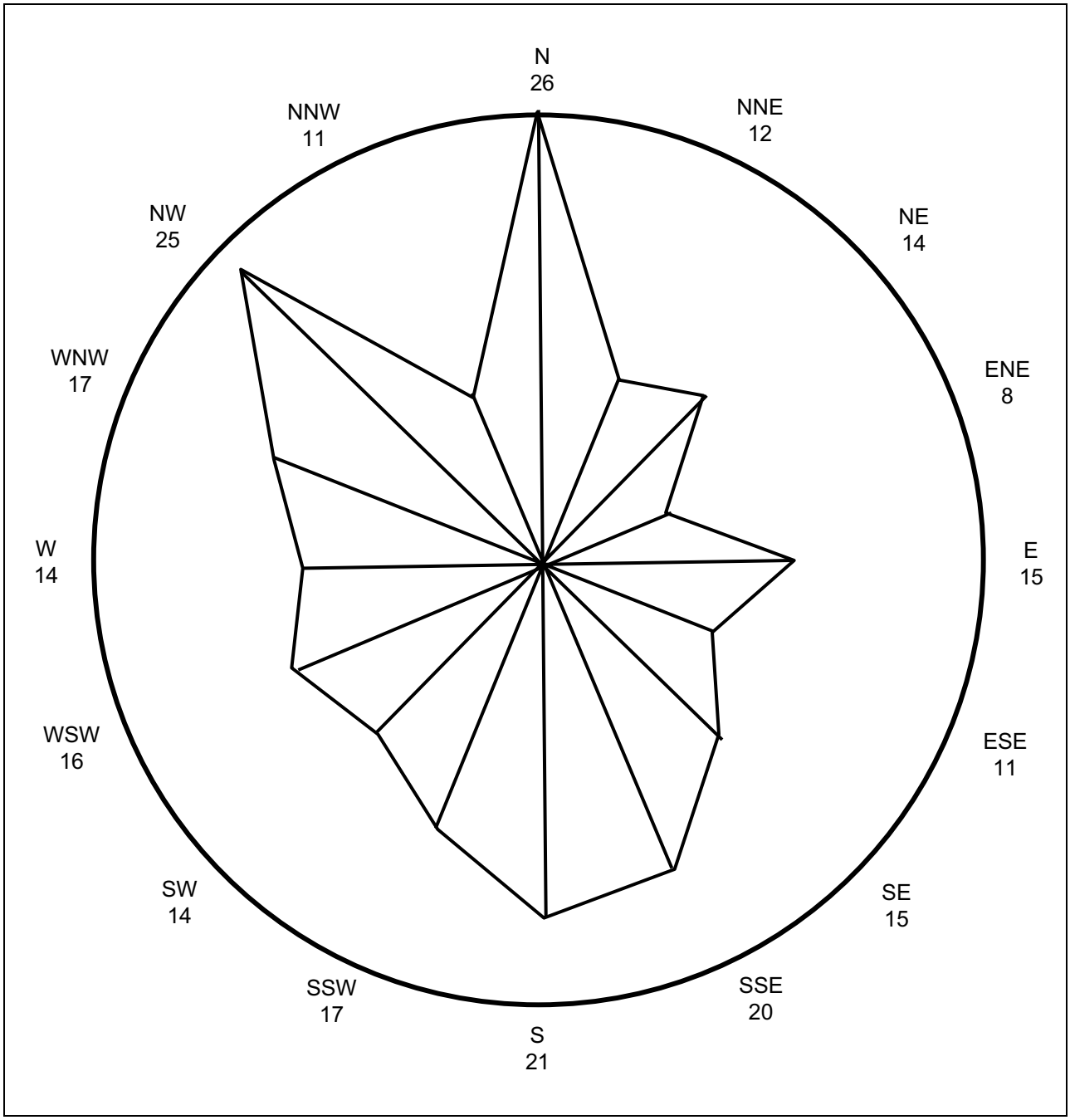


Figure 2.7-13 North Anna Seasonal Wind Persistence Roses: Low-Level Winds: 1974–1987: Season = Spring

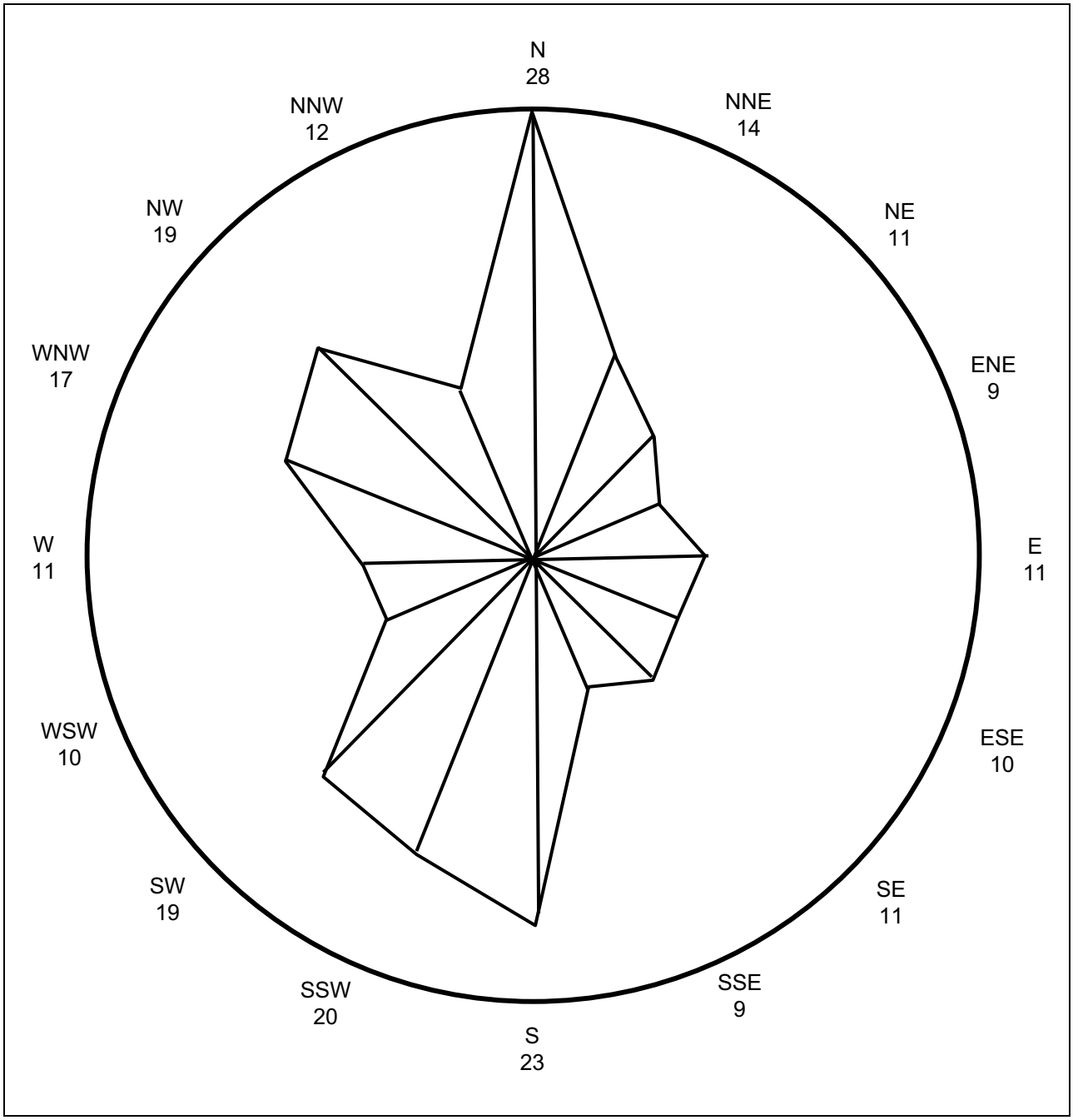


Figure 2.7-14 North Anna Seasonal Wind Persistence Roses: High-Level Winds: 1974–1987: Season = Spring

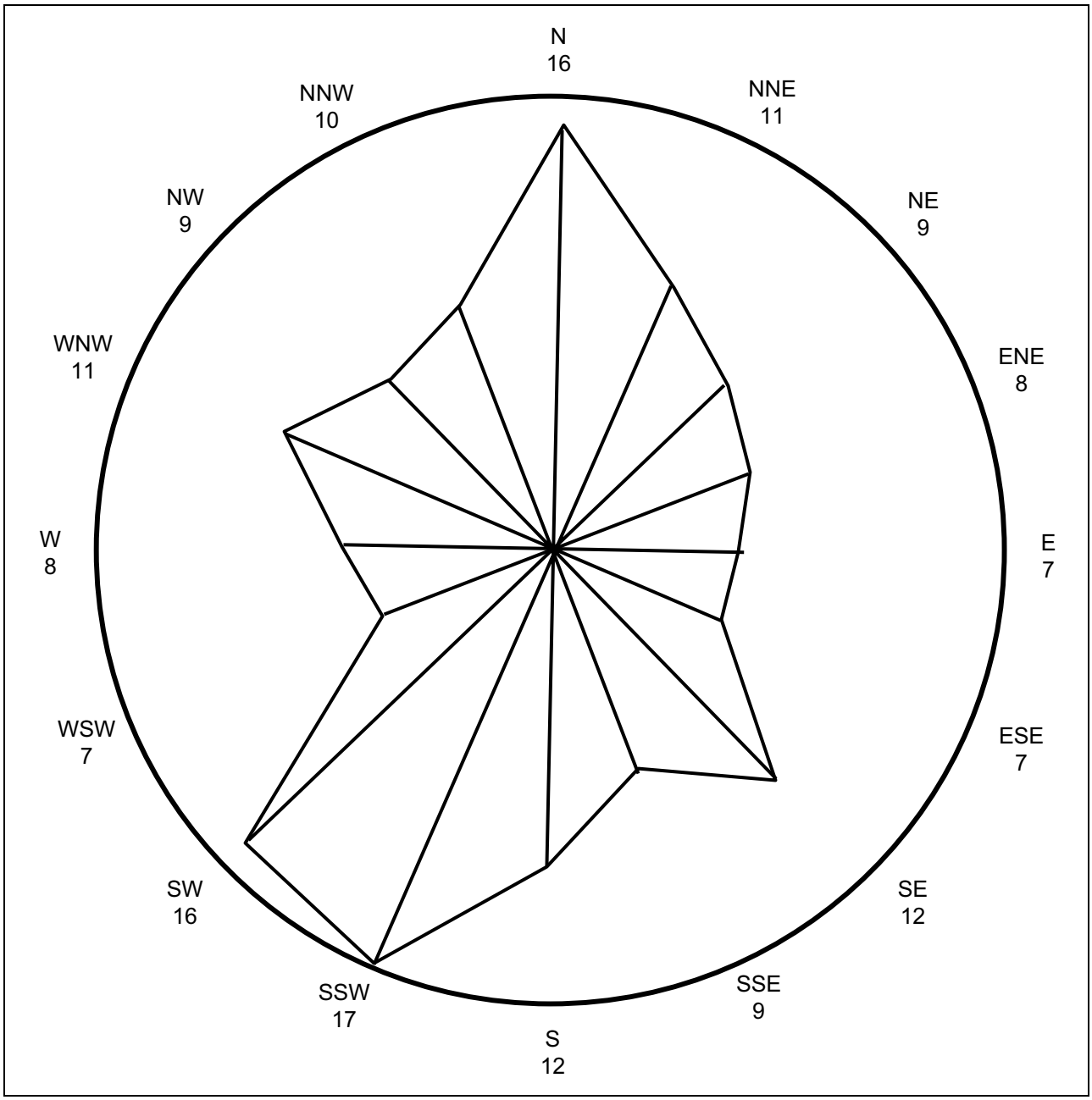


Figure 2.7-15 North Anna Seasonal Wind Persistence Roses: Low-Level Winds: 1974–1987: Season = Summer

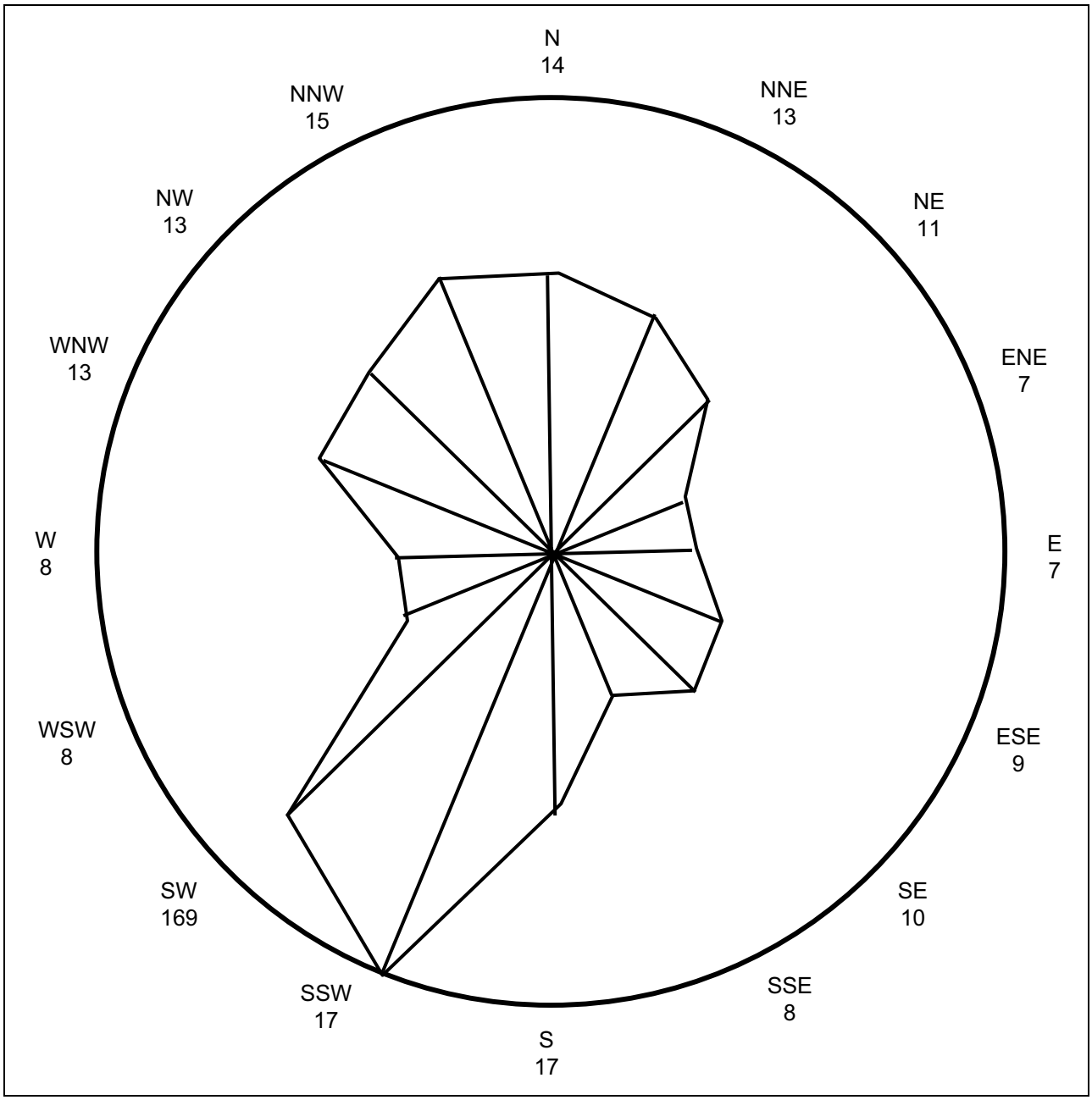


Figure 2.7-16 North Anna Seasonal Wind Persistence Roses: High-Level Winds: 1974–1987: Season = Summer

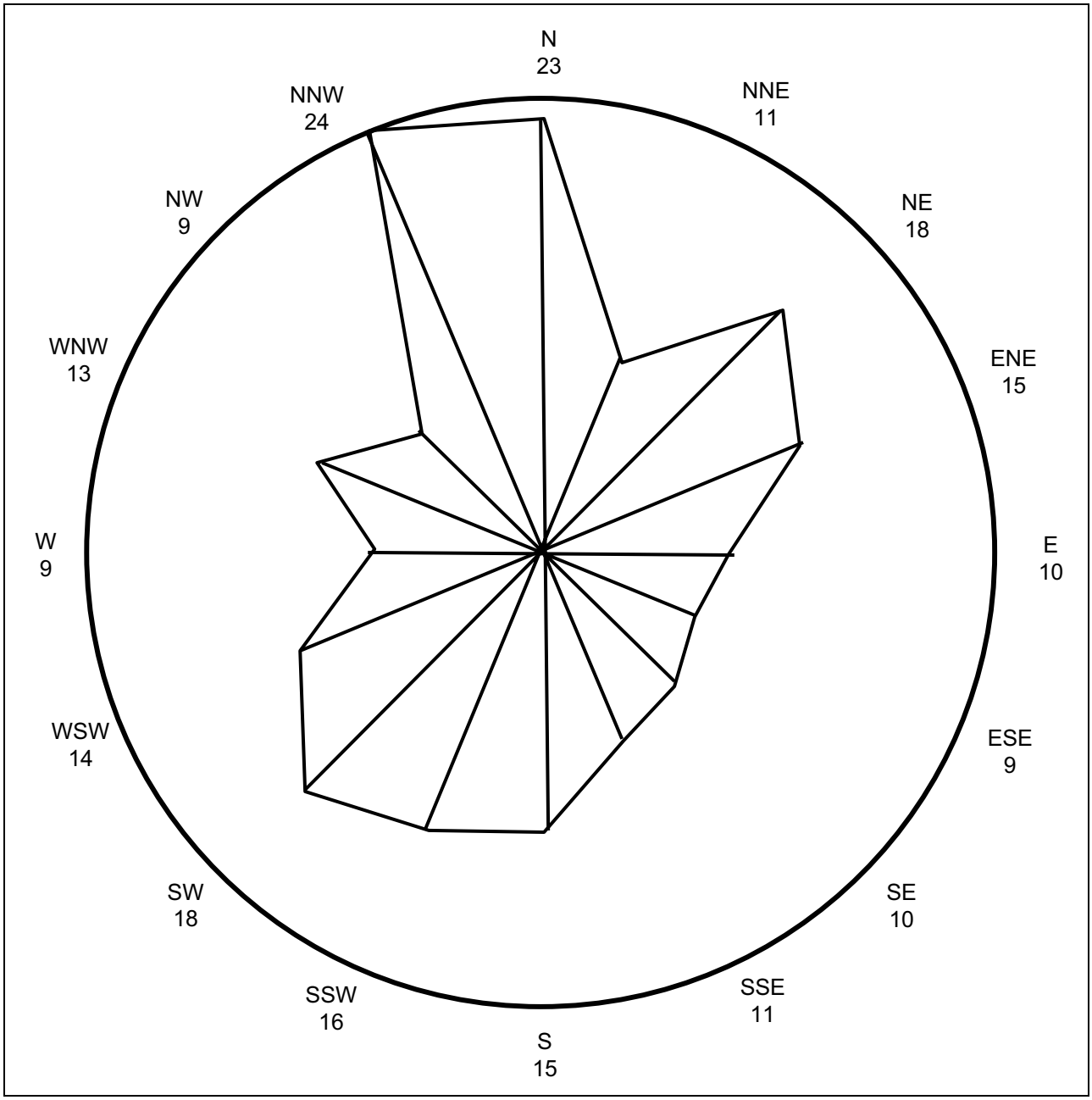


Figure 2.7-17 North Anna Seasonal Wind Persistence Roses: Low-Level Winds: 1974–1987: Season = Fall

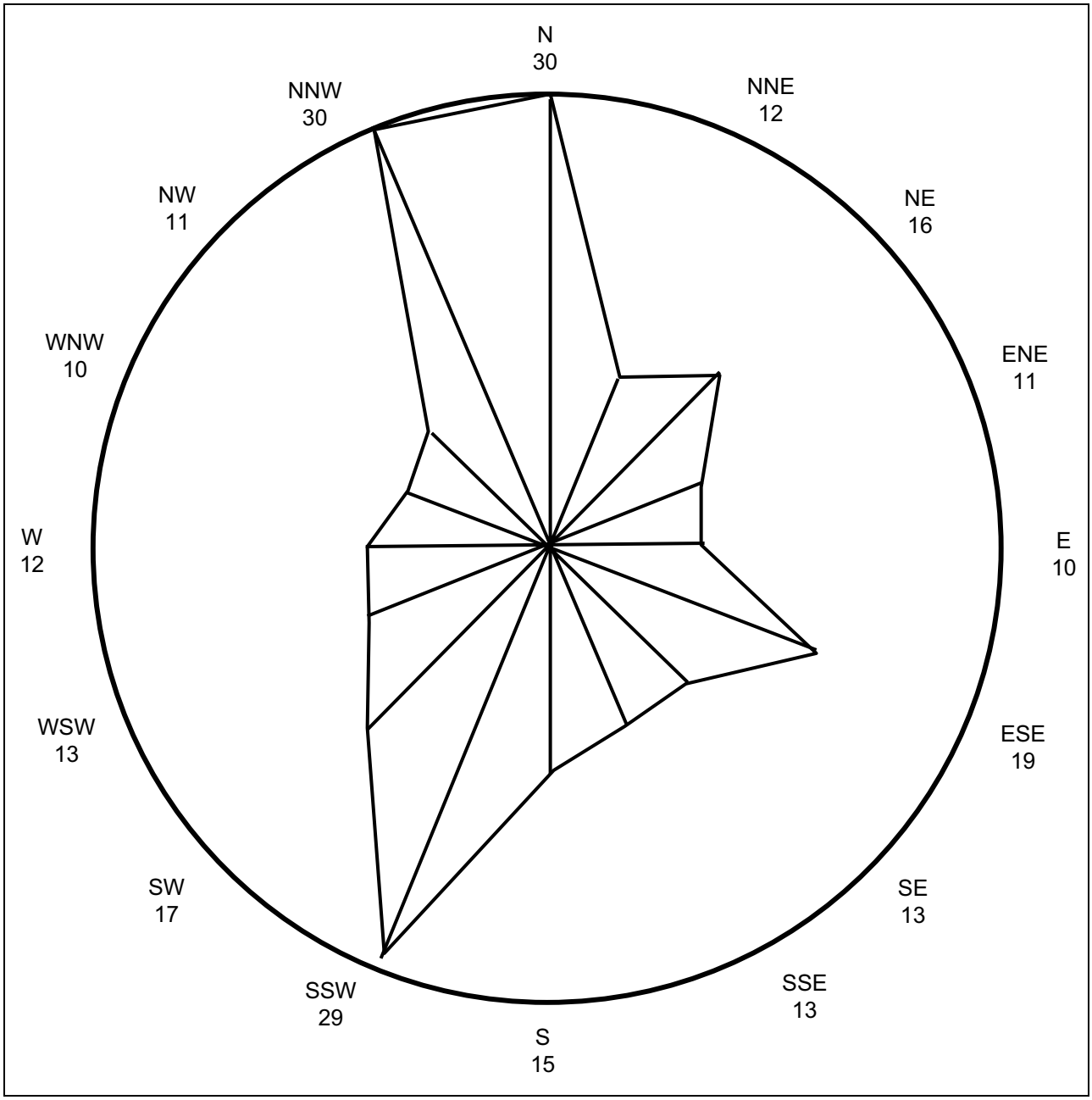


Figure 2.7-18 North Anna Seasonal Wind Persistence Roses: High-Level Winds: 1974–1987: Season = Fall

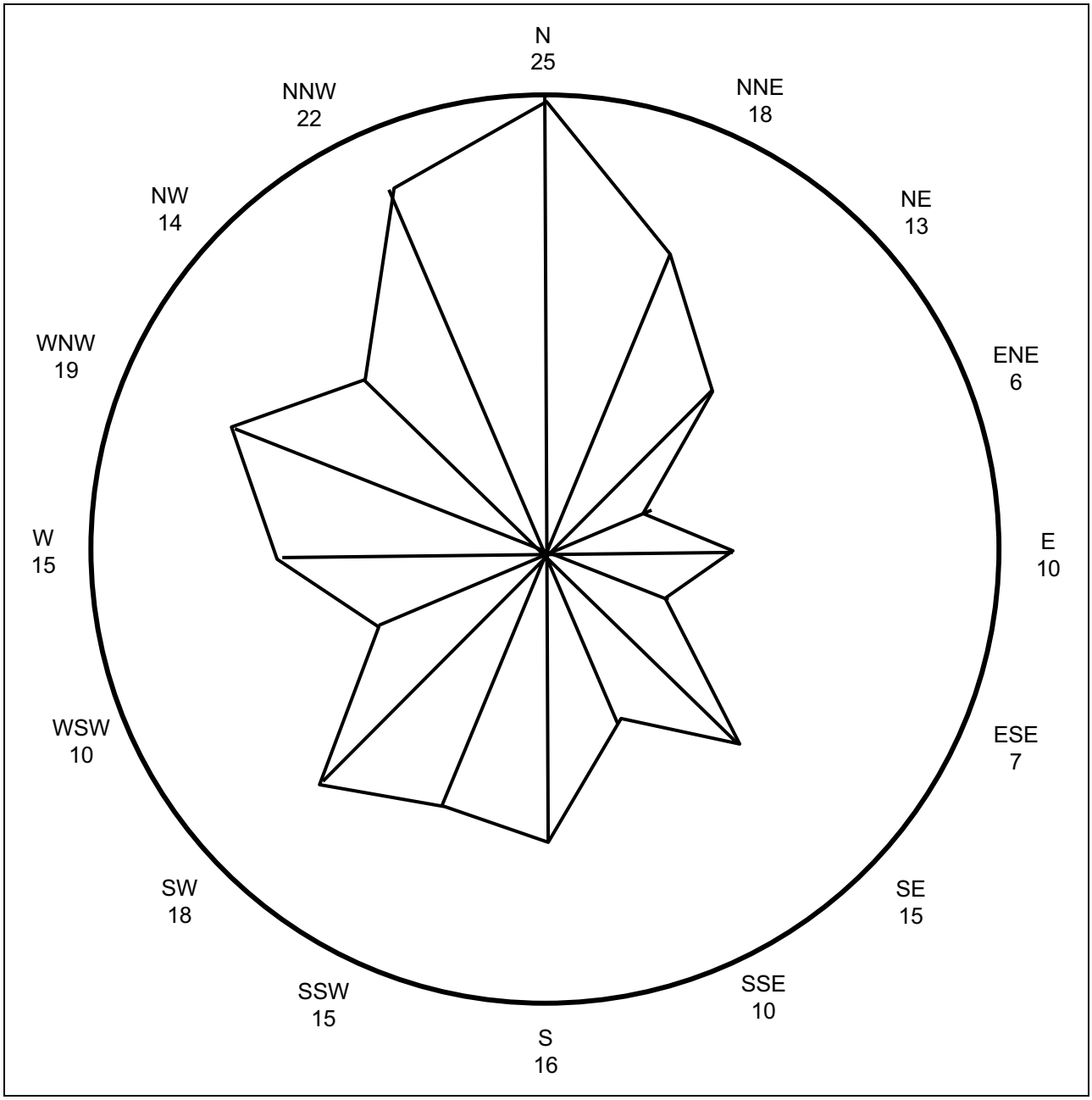


Figure 2.7-19 North Anna Seasonal Wind Persistence Roses: Low-Level Winds: 1974–1987: Season = Winter

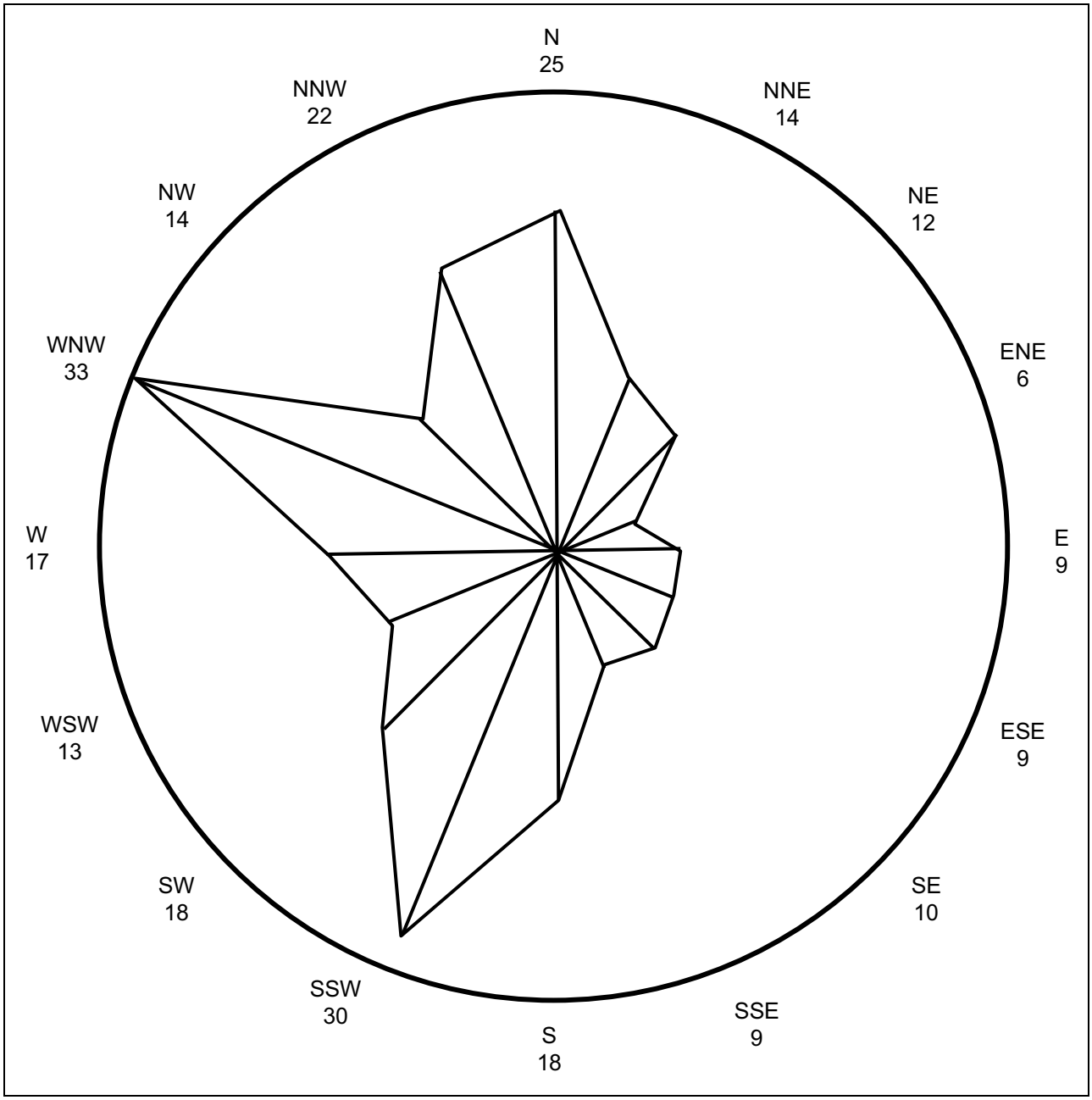


Figure 2.7-20 North Anna Seasonal Wind Persistence Roses: High-Level Winds: 1974–1987: Season = Winter

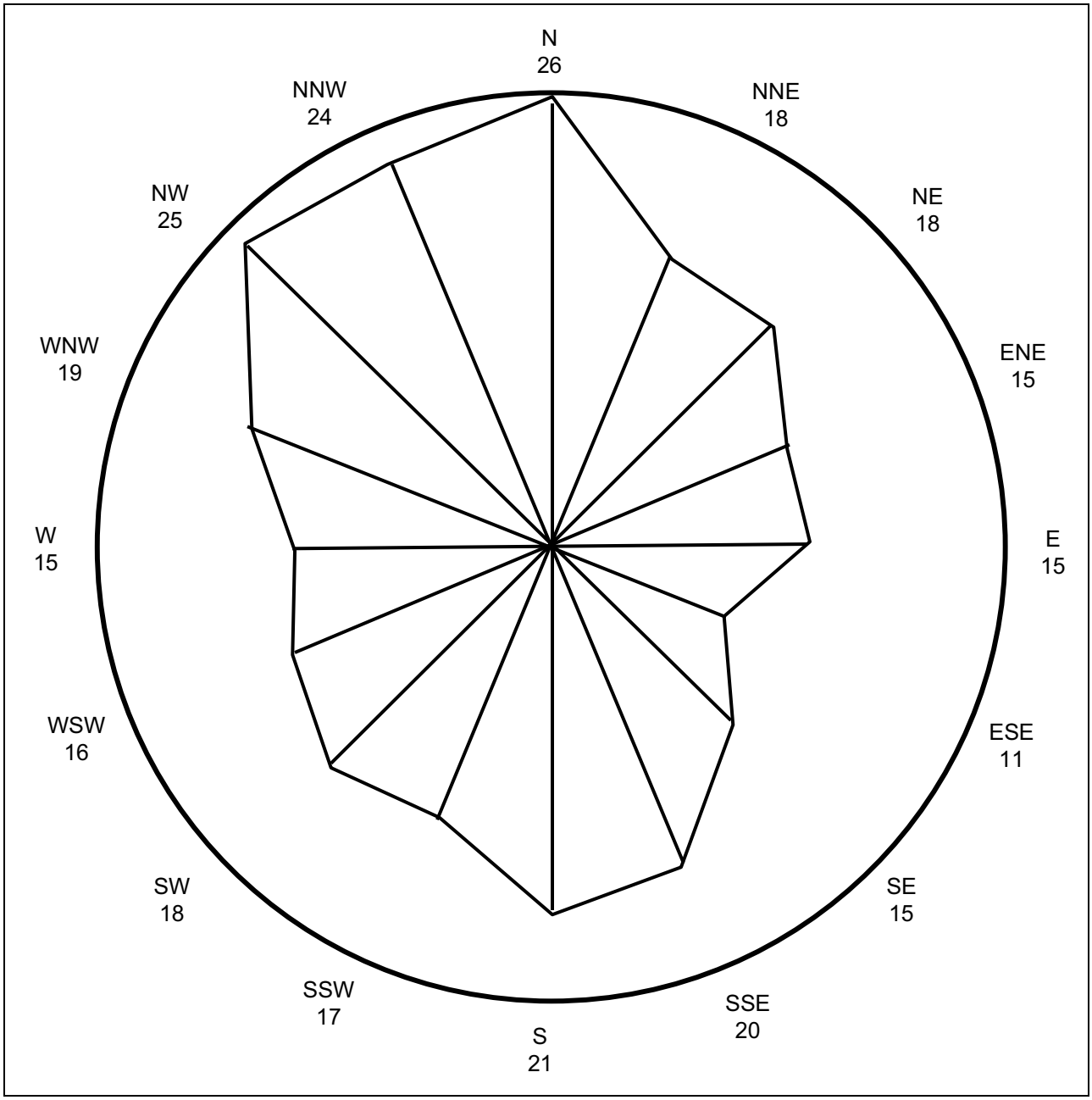


Figure 2.7-21 North Anna Seasonal Wind Persistence Roses: Low-Level Winds: 1974–1987: Season = Overall

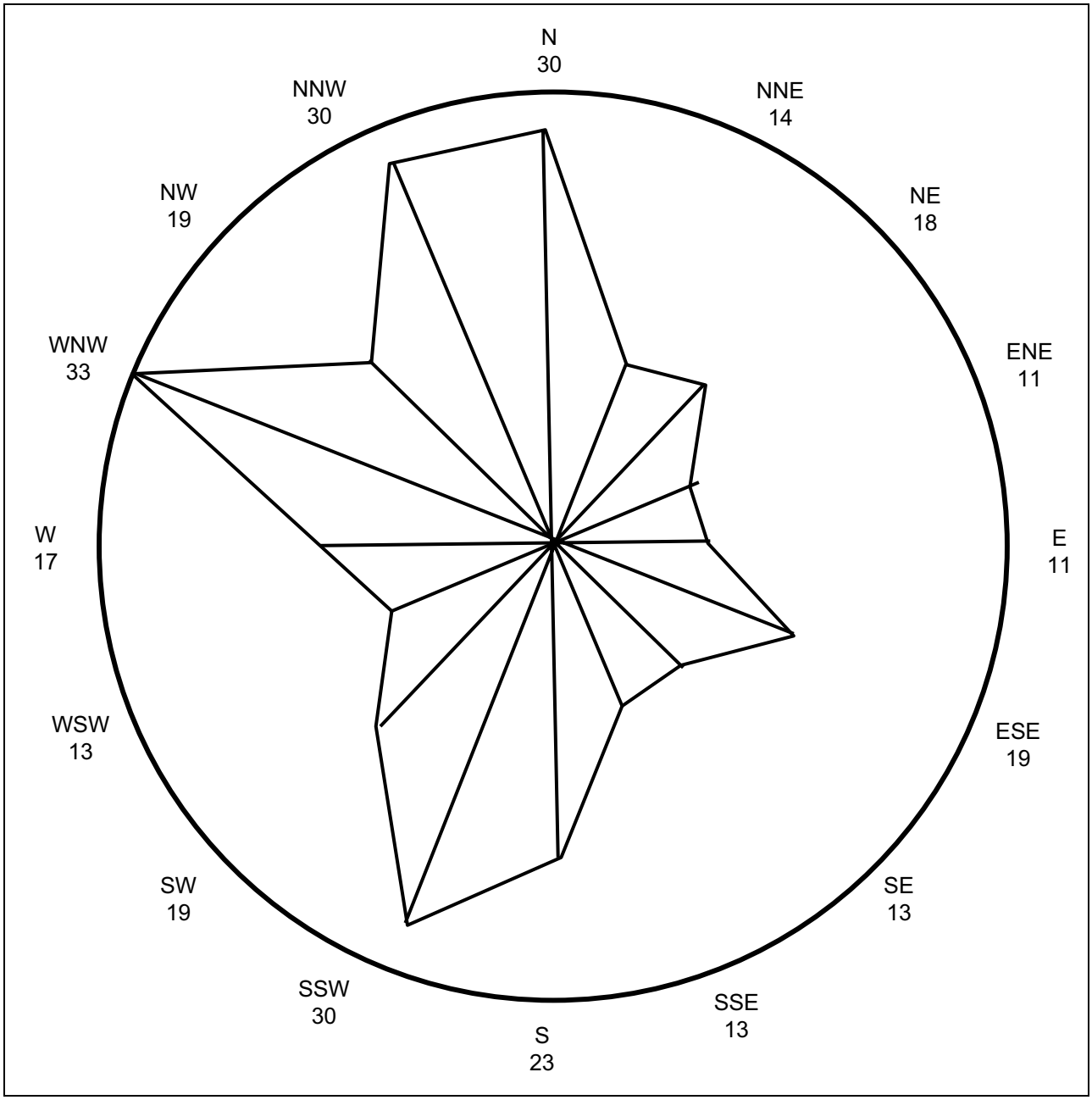


Figure 2.7-22 North Anna Seasonal Wind Persistence Roses: High-Level Winds: 1974–1987: Season = Overall

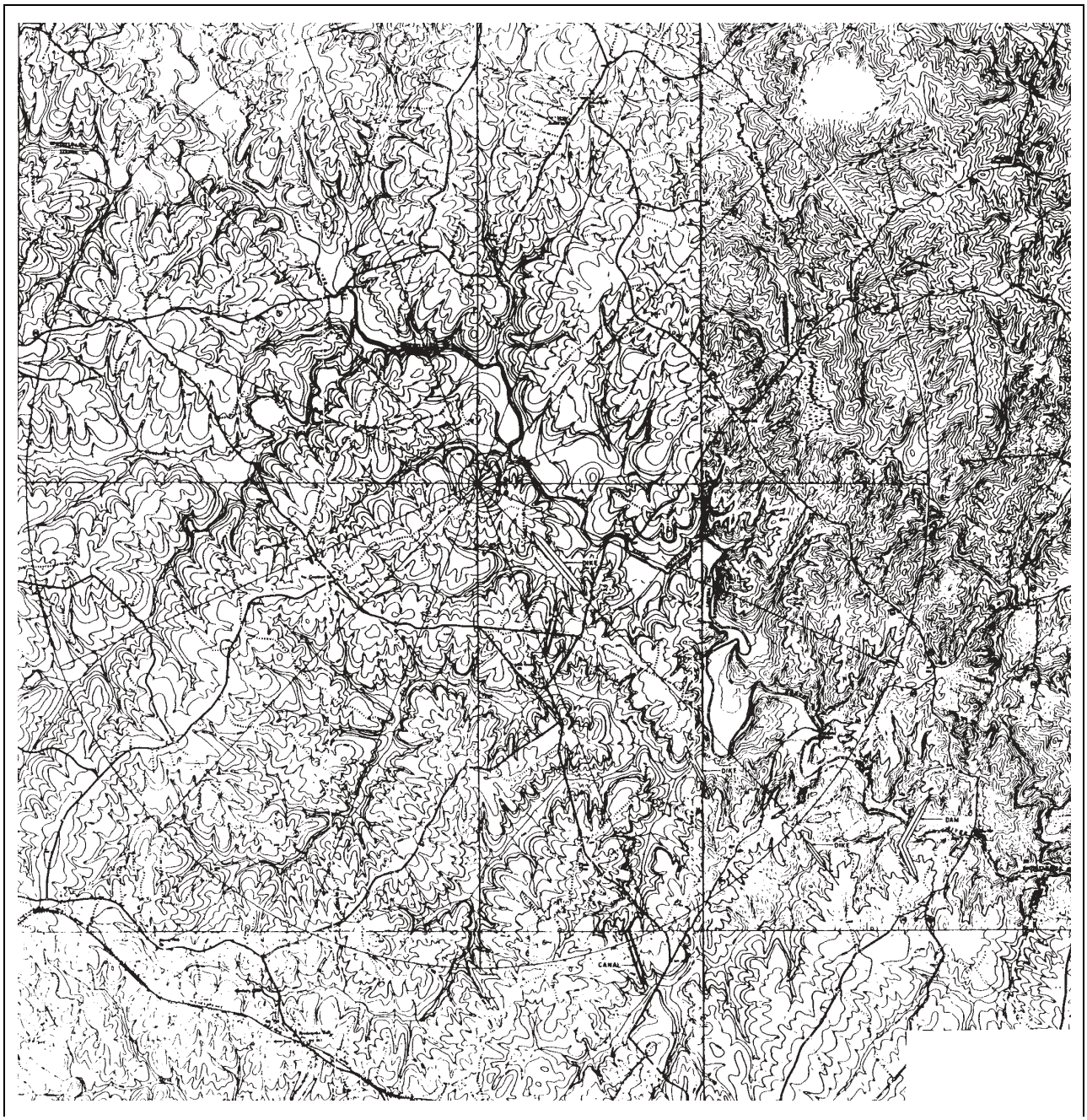
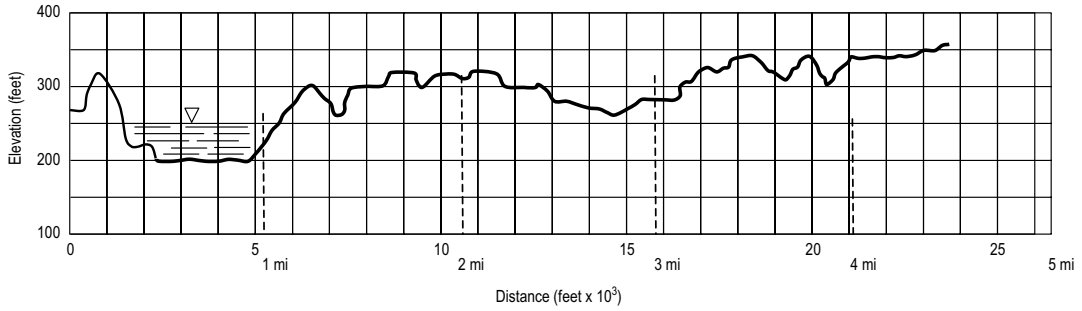
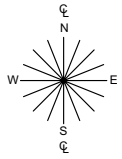
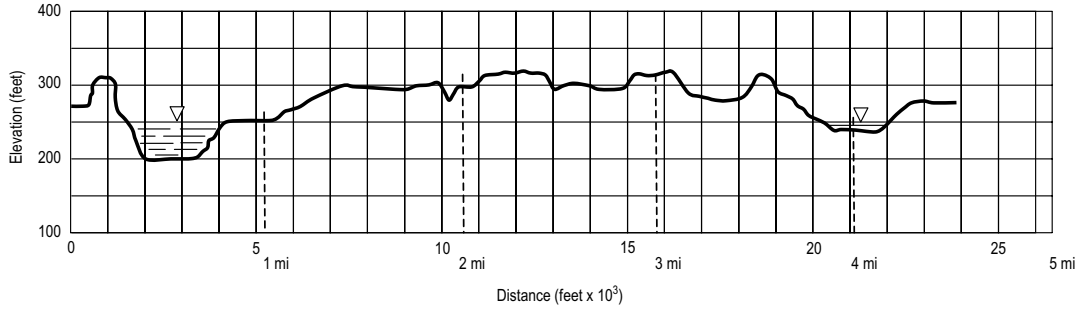


Figure 2.7-23 Topographic Map
Source: Reference 2

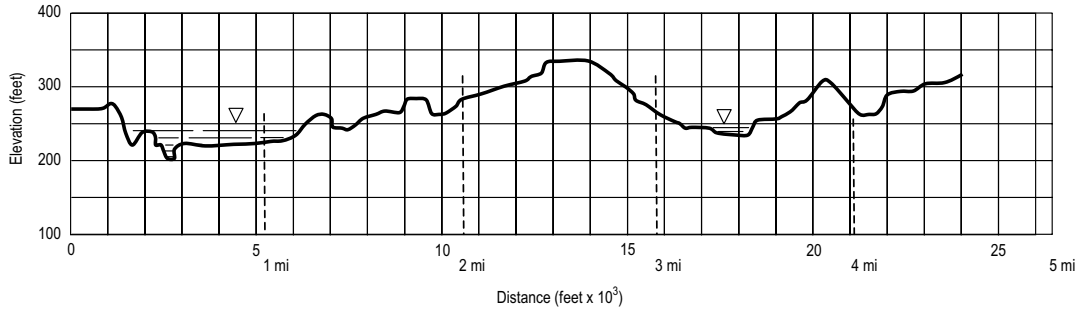




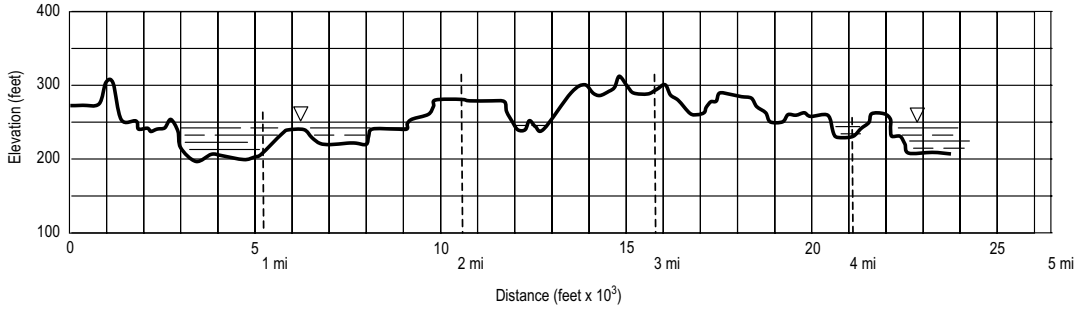
From Reactor 3 to Reference Point (Lat. 38°-07'-12", Long. 77°-04'-20")



From Reactor 3 to Reference Point (Lat. 38°-04'-20", Long. 77°-43'-57")



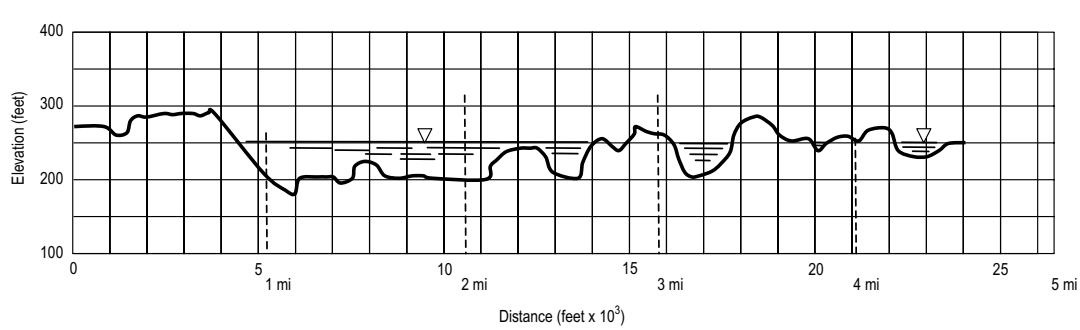
From Reactor 3 to Reference Point (Lat. 38°-03'-02", Long. 77°-42'-51")

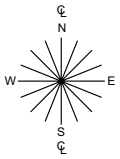


From Reactor 3 to Reference Point (Lat. 38°-03'-03", Long. 77°-42'-30")

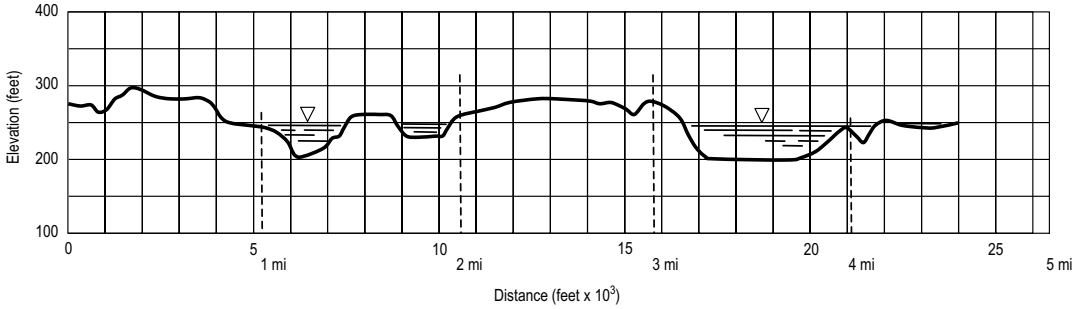
Figure 2.7-24 Vertical Profiles (Sheet 1 of 4)

Source: Reference 2

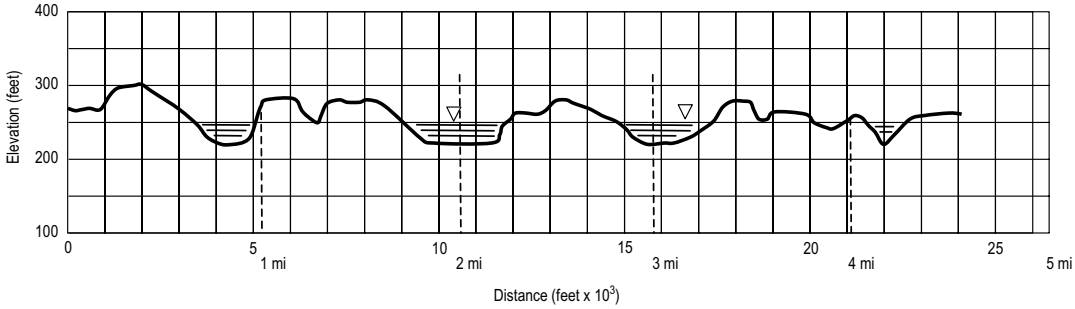




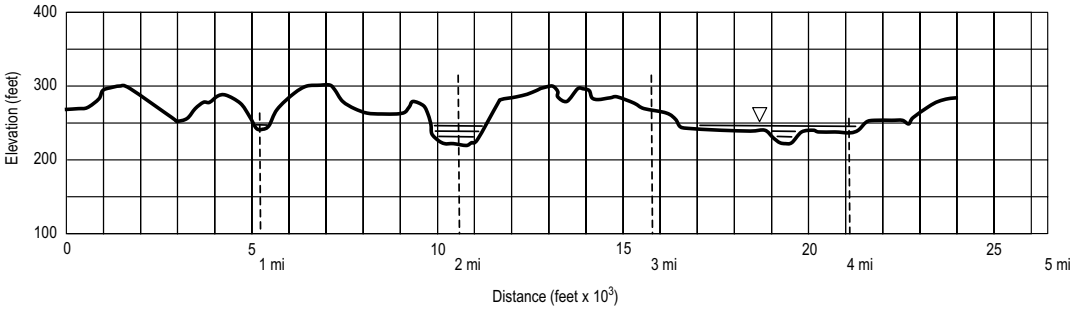
From Reactor 3 to Reference Point (Lat. 38°-01’-37”, Long. 77°-42’-51”)



From Reactor 3 to Reference Point (Lat. 38°-00’-40”, Long. 77°-43’-57”)



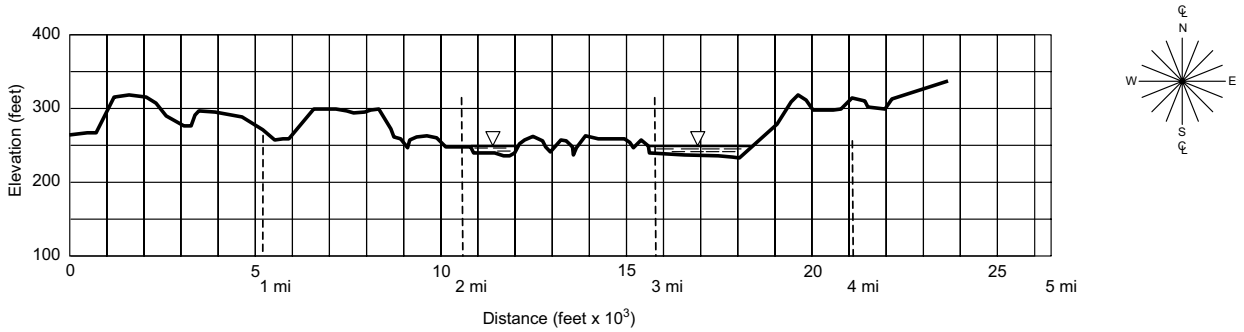
From Reactor 3 to Reference Point (Lat. 38°-00’-00”, Long. 77°-45’-30”)



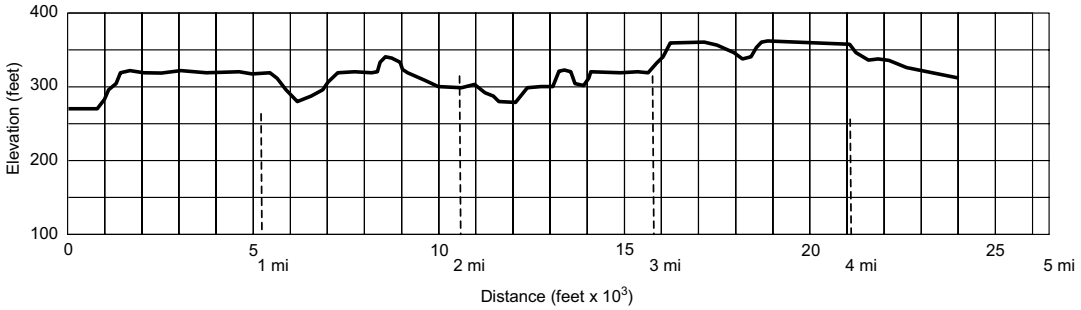
From Reactor 3 to Reference Point (Lat. 37°-59’-59”, Long. 77°-47’-28”)

Figure 2.7-24 Vertical Profiles (Sheet 2 of 4)

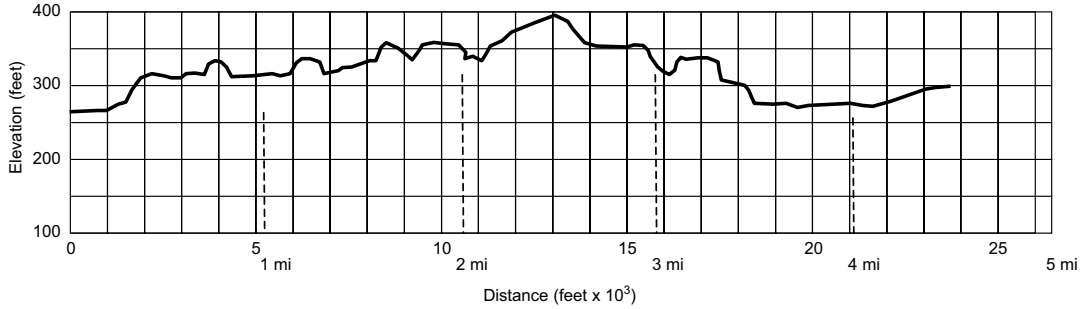
Source: Reference 2



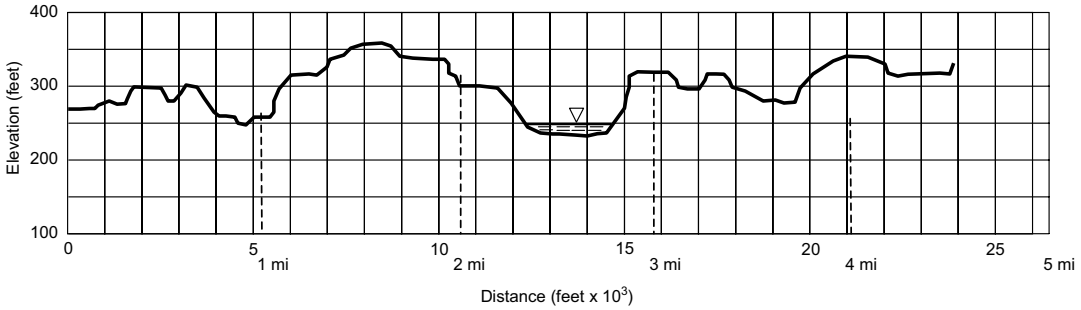
From Reactor 3 to Reference Point (Lat. 38°-00'-00", Long. 77°-49'-28")



From Reactor 3 to Reference Point (Lat. 38°-00'-00", Long. 77°-30'-39")



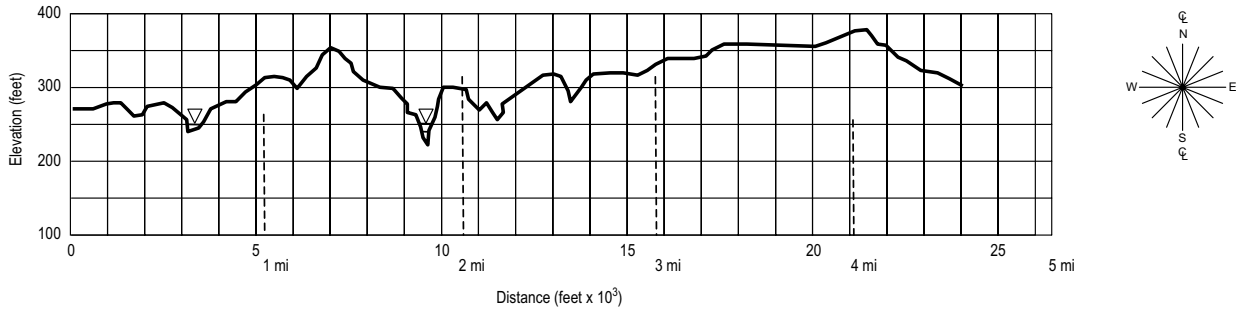
From Reactor 3 to Reference Point (Lat. 38°-01'-37", Long. 77°-32'-03")



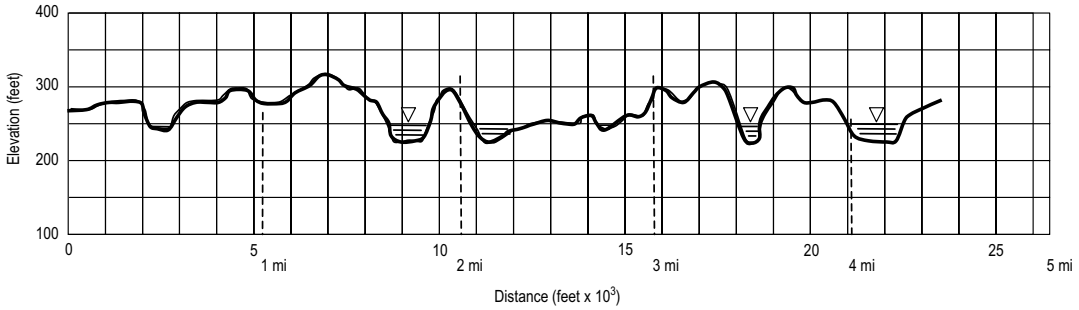
From Reactor 3 to Reference Point (Lat. 38°-03'-30", Long. 77°-52'-28")

Figure 2.7-24 Vertical Profiles (Sheet 3 of 4)

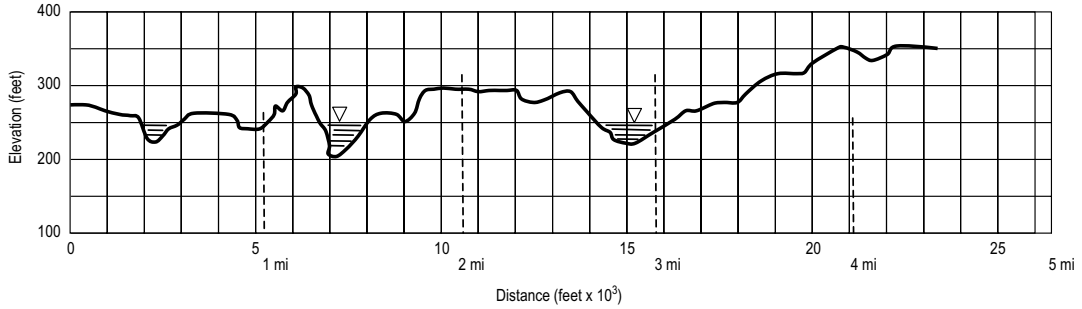
Source: Reference 2



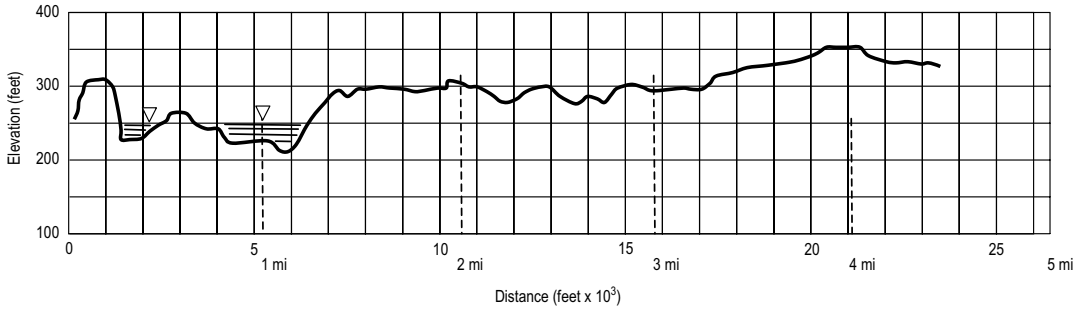
From Reactor 3 to Reference Point (Lat. 38°-05’-02”, Long. 77°-52’-05”)



From Reactor 3 to Reference Point (Lat. 38°-06’-20”, Long. 77°-50’-59”)



From Reactor 3 to Reference Point (Lat. 38°-07’-12”, Long. 77°-47’-23”)



From Reactor 3 to Reference Point (Lat. 38°-07’-30”, Long. 77°-47’-23”)

Figure 2.7-24 Vertical Profiles (Sheet 4 of 4)

Source: Reference 2

2.8 Related Federal Project Activities

The purpose of this section is to identify any federal activities related to this ESP application and to highlight the possible need for federal agencies to participate in the preparation of the environmental impact statement as cooperating agencies.

In summary, there are no known federal activities or projects associated with early site permitting at the ESP site.

Specifically:

- No known federal projects (e.g., water supply pipelines) are planned that would provide additional cooling water for the new units.
- No known federal actions are planned regarding the acquisition and/or use of the ESP site.
- No known federal projects are planned that must be completed as a condition of construction or operation of the new units.
- No known federal projects are contingent on construction or operation of the new units at the ESP site.

Section 2.8 References

None