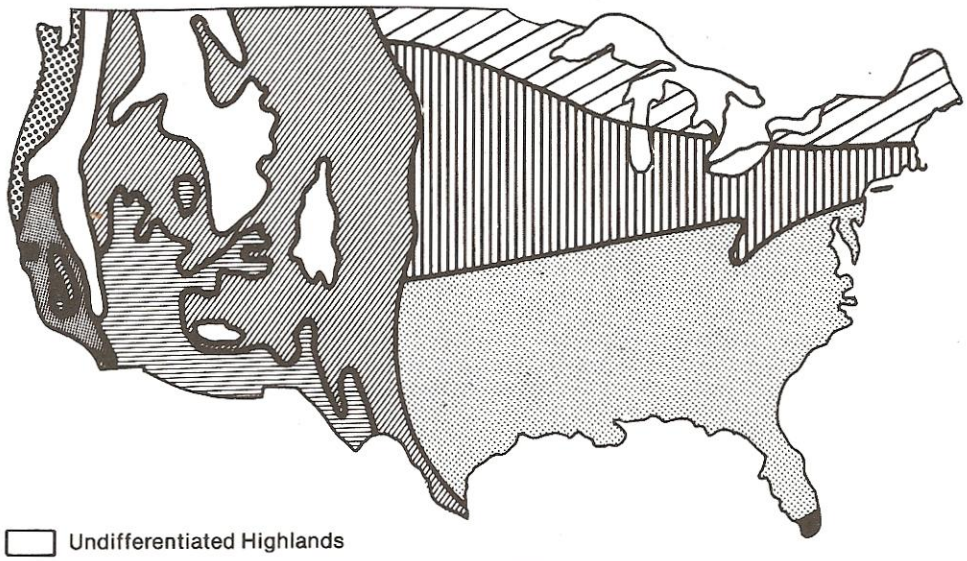
Climate

Climate, the characteristic long-term weather pattern of an area, affects all components of the natural environment and human activities. Temperature, winds, humidity, precipitation, and other climatic factors continually shape land and water resources and their uses.

Dutchess County is located in the north temperate climatic zone. Its climate is humid continental (see Figure 1.1), characterized by strong seasonal contrasts and highly variable weather. Major weather systems that move up the Atlantic Coast or across the continental United States contribute to this variety. Ample year-round precipitation is supplemented in late summer by tropical maritime air masses. Polar air masses from Canada move southeast through the area to dominate the winters.

Climatic Regions



Redrawn and adapted from Trewartha, Elements of Physical Geography, 1957.

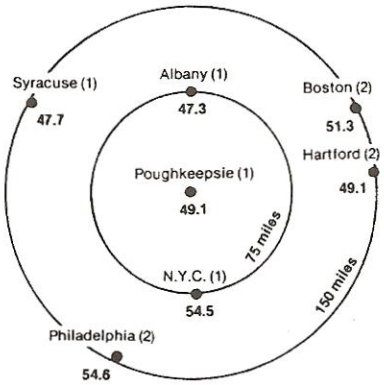
Figure 1.1

Continental areas are the source of the predominant air flow, but Dutchess County and the entire Hudson Valley also enjoy the moderating effects of air masses from the Atlantic Ocean. This maritime influence results

in milder winter temperatures and longer freeze-free seasons than those found at the same latitude farther inland. The Catskill Mountains to the west and northwest also partly shield the county from cold polar air.

Moderate temperatures and sufficient precipitation make Dutchess County an excellent location for farming, while seasonal variations help to attract tourists and recreational users. The county's relatively warm summers and cold winters result in substantial heating and cooling costs for homes and businesses.

Average Annual Temperatures
Major Cities near Poughkeepsie



Source: U.S. Dept of Commerce, NOAA
(1) 1951 - 1980 Data
(2) 1975, 1976, or 1977 Data

Figure 1.2

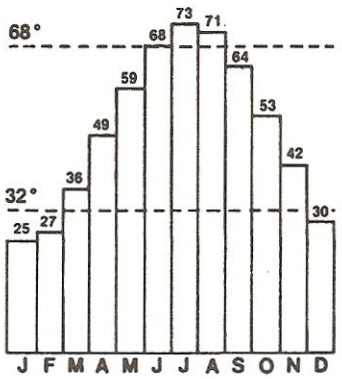
Temperature

Temperature is a measure of the intensity of heat. The county's average annual temperatures for the four coldest months, December through March, and four warmest months, June through September, are 30.8 and 70.6 degrees Fahrenheit, respectively. The lowest and highest temperatures ever recorded at the Poughkeepsie weather station were 21 degrees below zero in February 1897, and 107 degrees in July 1966. The average annual temperatures of Poughkeepsie (49.1 degrees), and of six major cities within 150 miles of Dutchess County can be compared in Figure 1.2.

The temperature in Dutchess County usually exceeds 90 degrees between 25 and 30 days a year. Cool summers may have fewer than 15 days of 90 degree temperatures, while hot summers may have more than 40 such days. Brief hot spells with uncomfortably high humidity occur during most summers.

Four to seven days of zero or below zero degree weather usually occur between mid-December and early March. During unusually mild winters, temperatures may fall to zero only once. Temperatures colder than 15 below zero are recorded approximately once in 20 years.

Normal Temperatures
Dutchess County
(Degrees Fahrenheit)



Temperatures are averaged for four weather stations in the County. Data from each station are listed in the Appendix.

Source U.S. Dept. of Commerce, NOAA.

Figure 1.3

County weather information has been gathered only at the four locations listed above, and in Millerton. It is difficult to assess accurately the local micro-climates of areas whose topographic features differ from these locations. It is apparent, however, that fruit orchards

and vineyards thrive in the relatively mild temperatures along both sides of the Hudson River. Cooler temperatures prevail in the higher elevations and the northeastern section of the county. The Harlem Valley is also usually colder than western Dutchess County because of the valley's distance from the moderating influence of the Hudson River and from the leeward protection of the Catskill Mountains.

Heating Degree Days

Heating degree days are a measure of the number of days the average daily temperature is below 65 degrees. This measure is important to homeowners and the heating industry because space heating is normally required at temperatures below this level. A day with an average temperature of 65 degrees or more is said to have zero heating degree days, while a day with an average temperature of 50 degrees has 15 heating degree days (65-50=15 degrees). As the number of heating degree days increases, so does the use of energy to heat homes and businesses.

The number of heating degree days in Dutchess County ranges from 5,000 in the south to 7,000 in the north and northeast. Poughkeepsie has an annual average of 6,366 heating degree days. As shown in Figure 1.4, the summer months of June, July, and August require little or no heat. Each of the months of December, January, and February has more than 1,000 heating degree days.

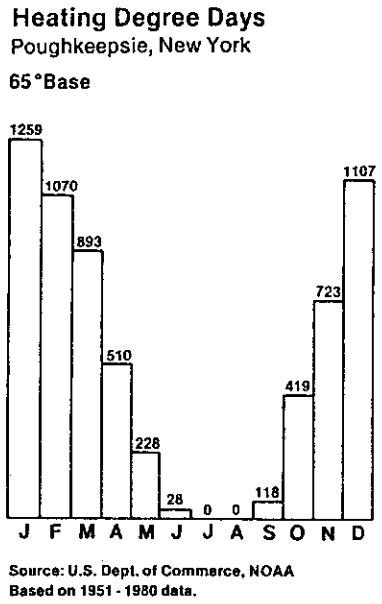
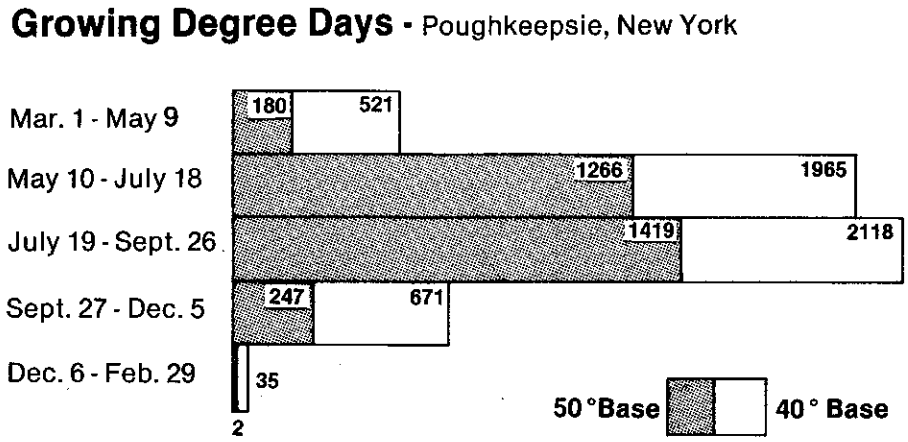


Figure 1.4

Growing Degree Days

Growing degree days are a measure of the amount of solar energy an area receives, based on temperature accumulations above a selected threshold temperature. They relate plant development and insect emergence to environmental air temperature to indicate which plants may be grown in a particular area. For example, most varieties of peas need 1,200 to 1,800 growing degree days (based on a 40-degree threshold) to reach maturity, so they can usually be grown only in areas that accumulate that many growing degree days or more.

The most common threshold temperatures for measuring growing degree days are 40 degrees and 50 degrees. These are generally accepted as temperatures required for growing economically important plants. Using a 40-degree base, annual growing degree days total approximately 5,300 near the Hudson River and 4,750 in the eastern part of the county. Using a 50-degree base, the total is about 3,100 near the Hudson River and 2,850 to the east. Average weekly growing degree day totals are listed in the appendix and summarized in Figure 1.5.



Source: Dethier and Vittum, "Growing Degree Days in New York State," 1967.

Figure 1.5

Information about growing degree days is useful to farmers, nurseries, research and extension specialists, and home gardeners. It is especially helpful in crop selection and in determining schedules for planting, pesticide application, and harvesting.

Freeze Data

Freeze data include the dates of the latest spring and earliest fall freezing temperatures (32 degrees F), and the period between them, known as the freeze-free season. This information is valuable in determining what types of plants are most suitable for an area and when freeze-sensitive crops can be planted.

The freeze-free season along Dutchess County's Hudson River shoreline is between 163 and 183 days long, and usually begins sometime between mid-April and early May. Farther east of the river, the season is shorter. Generalized maps of first frost and last frost for New York State are shown in Figures 1.6 and 1.7. Table 1.1. gives more specific freeze data for three locations in the county.

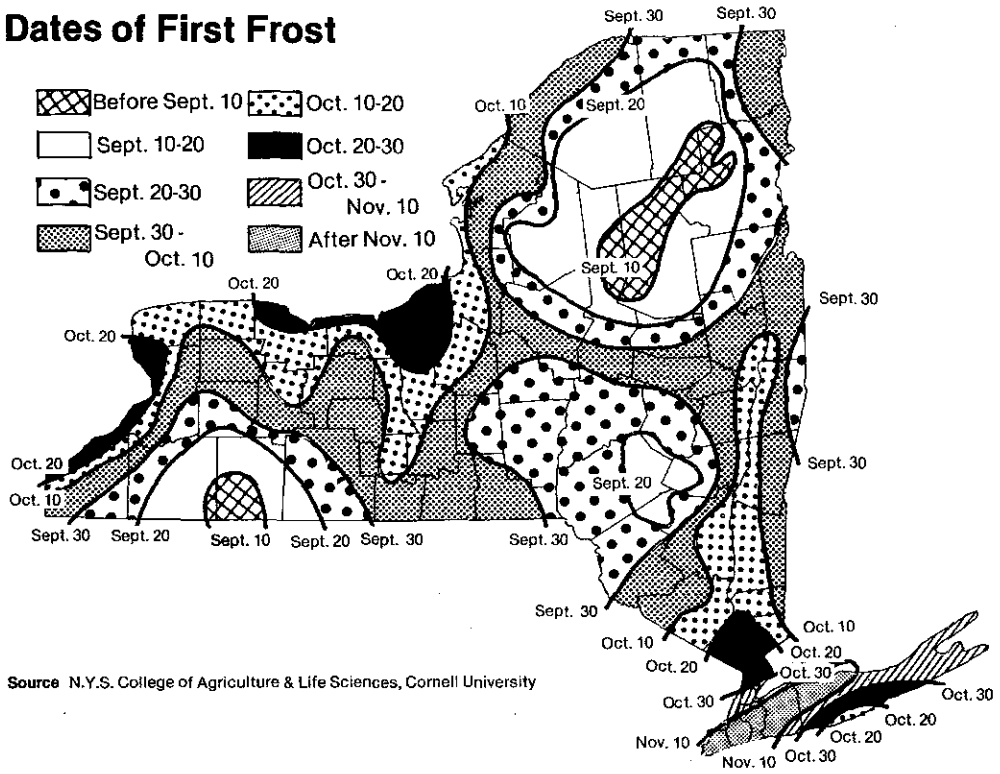


Figure 1.6

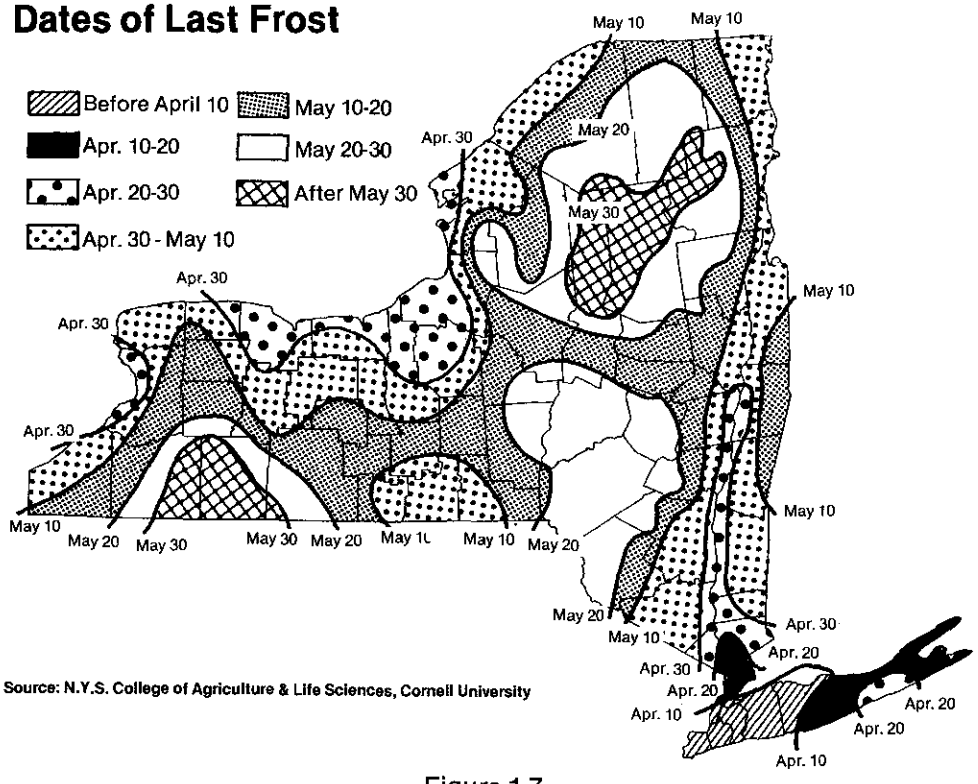


Figure 1.7

Table 1.1 Freeze Data
Dutchess County, New York

Station	Mean Date of Last Frost	Mean Temp.	Mean Date of First Frost	Mean Temp.
Glenham	April 13	27°	Oct. 12	28°
Millbrook	May 19	28°	Sept. 25	30°
Poughkeepsie	May 9	32°	Oct. 11	30°

Source: U.S. Department of Commerce, NOAA

Winds

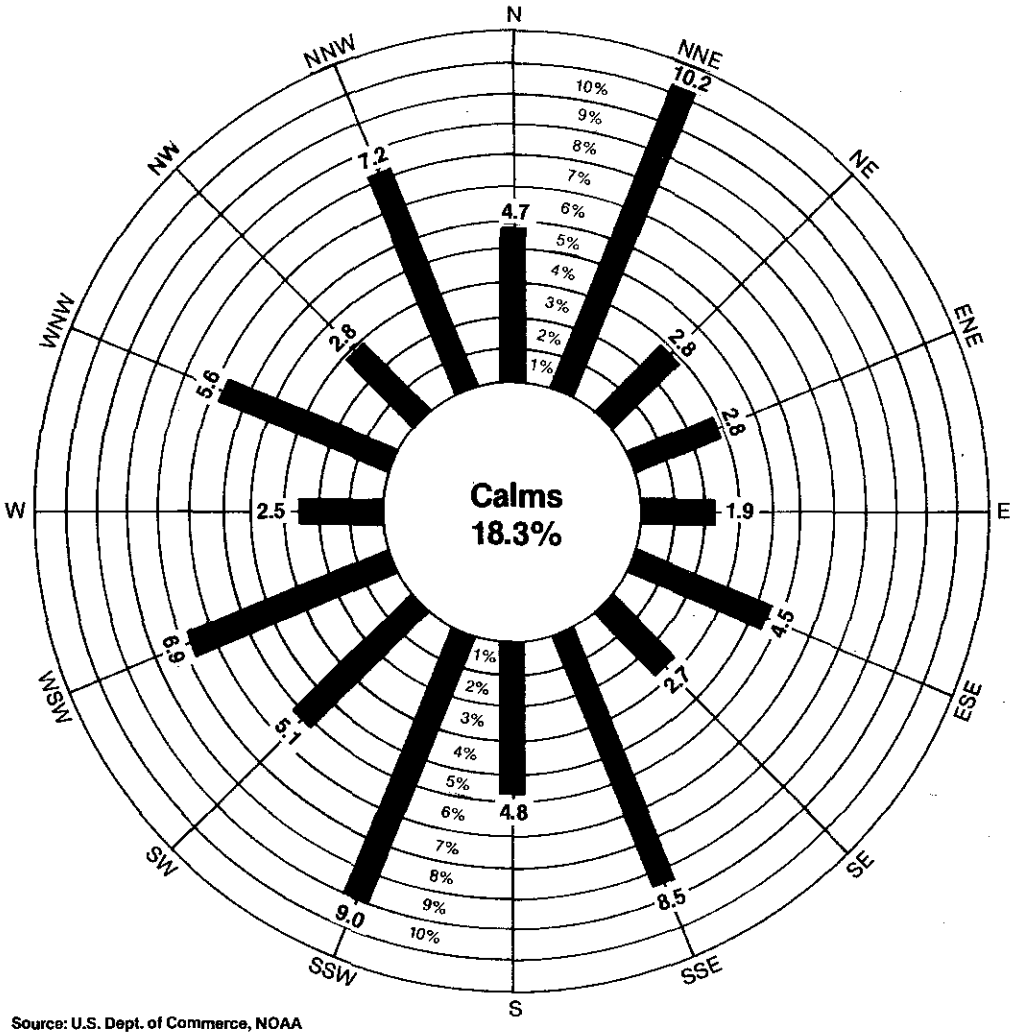
Wind patterns are produced by the rotation and solar heating of the earth and the buoyancy of warm air. Westerly and northerly winds prevail in Dutchess County in the winter and early spring, with average speeds ranging from 9 to 11 miles per hour (mph). Summer winds come from a more southerly direction with average velocities between 5 and 6 mph.

During a five-year testing period that ended in 1954, 70 percent of wind measurements fell in the 1 to 11.5 mph range. Wind speeds greater than 11.5 mph were recorded only 12 percent of the time, while 18 percent of the time the air was calm.

Wind speeds are generally higher during the day, and they begin to decrease as sundown approaches unless a storm system is passing through. Severe winds are not a common hazard in Dutchess County, but they occasionally occur in association with thunderstorms and other storm systems. The strongest winds blow predominantly from the west with speeds ranging from 25 to 30 mph and gusts of 40 to 65 mph or more. Wind speeds exceed 24 mph less than 0.5 percent of the time. Small tornadoes have struck the county, but such occurrences are rare.

The windrose in Figure 1.8 shows the distribution of surface wind directions in Poughkeepsie, as recorded at Dutchess County Airport from 1950 through 1954. The length of each black bar reflects how often wind came from a particular direction during that five-year testing period. For example, wind came from the north-northeast (NNE) 10.2 percent of the time, and from the east (E) only 1.9 percent of the time.

Windrose: Surface Wind Direction Frequencies
Poughkeepsie, New York



Source: U.S. Dept. of Commerce, NOAA

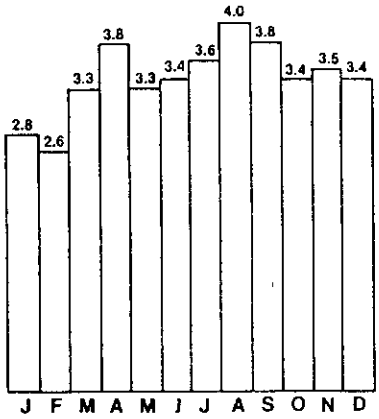
Figure 1.8

Figure 1.8 shows that the most common wind directions are north-northeast, north-northwest, south-southeast, and south-southwest. Winds come from the general direction of the west more frequently than from the east, and from the southwest quarter more than any other. Monthly wind direction and velocity data are included in the appendix.

Precipitation

Precipitation is condensed water vapor that falls to earth as rain, sleet, snow, or hail. Annual precipitation in Dutchess County normally ranges from 36 to 44 inches. Extremes of 27 and 60 inches have been recorded.

Normal Precipitation in Dutchess County
(inches)



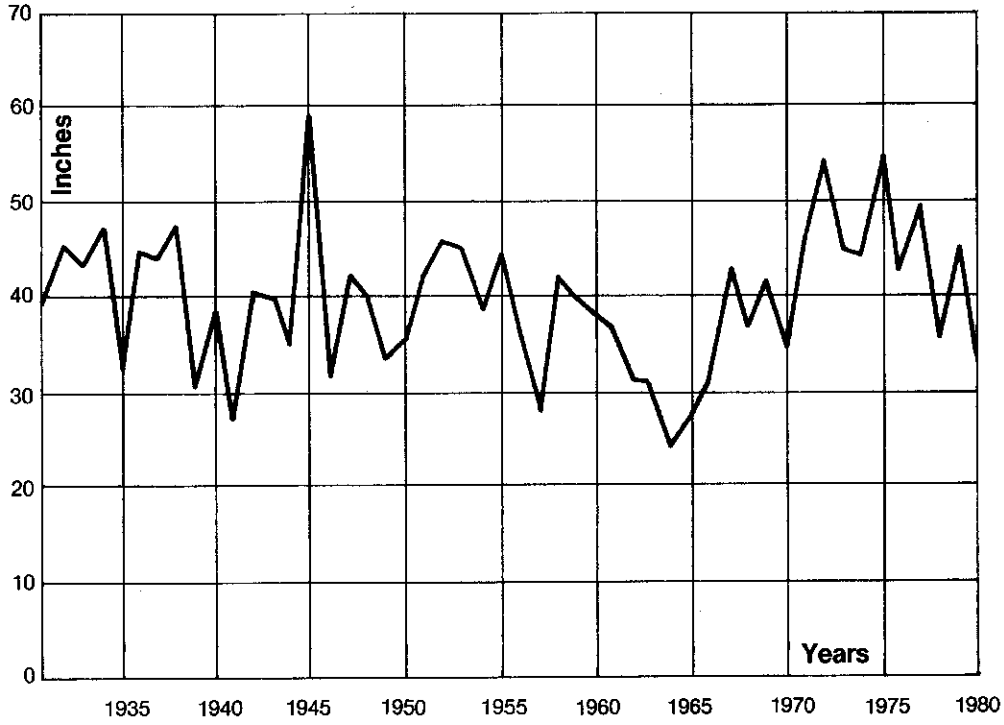
Source: U.S. Dept of Commerce, NOAA
Precipitation is averaged for five weather stations in the County.

Figure 1.9

During the May to September growing season, total precipitation is usually between 15 and 25 inches, with extremes of 9 and 35 inches recorded. Precipitation during these months is generally sufficient to support crops, home gardens, lawns, flowers, and shrubs. One or more short periods of no rainfall occur during most summers. Total monthly precipitation in the county, calculated by averaging data from five locations, is shown in Figure 1.9. The actual precipitation totals for each of the five weather stations are listed in the appendix.

The graph in Figure 1.10 traces the pattern of annual precipitation in Poughkeepsie since 1931. Precipitation for this period is also listed in the appendix. The graph clearly shows the extended drought that affected the county from 1963 through 1966. This is the only drought in the 50 years shown that persisted for several consecutive growing seasons and reached severe levels before normal rainfall returned.

Annual Precipitation - Poughkeepsie, New York



Source: U.S. Dept. of Commerce, NOAA
1931 to 1959 Data collected in Poughkeepsie, 1960 to 1980 Data collected at the Dutchess County Airport.
1977 and 1978 Data collected in Millbrook.

Figure 1.10

Much of the precipitation in the Northeast comes from the Gulf of Mexico and the Atlantic Ocean, and is transported by major atmospheric storm systems. These systems develop less frequently during the summer, but local convective activity in the form of thunderstorms produces significant amounts of summer rain. Local topographic variations also influence precipitation.

Most of Dutchess County receives moderately heavy amounts of snow from late November through March, with 40 to 50 inches falling each year. The northeast section of the county may receive 60 inches of snow annually. Few winters have fewer than 30 inches or more than 60 inches of snow. During most winters, at least one storm will leave more than six inches. The ground is usually snow-covered from mid-December to mid-March.

Evaporation rates must be considered in designing reservoirs and other open water storage systems. Oceans are the main supply of atmospheric moisture through evaporation, but lakes, rivers, moist soil, and vegetation also make important contributions. Most of the lakes in Dutchess County lose 28 to 30 inches of water a year due to evaporation; this amount decreases slightly at higher elevations.

Relative humidity is the ratio of the amount of moisture present in the atmosphere to the amount that the air can hold at any given temperature. A combination of high relative humidity and high temperatures is uncomfortable. Relative humidity at mid-afternoon during summer months in Dutchess County usually ranges from 50 to 60 percent, with maximum humidity in the morning and minimum humidity in the afternoon. Relative humidity is generally lowest during the late winter and early spring and highest during the summer.

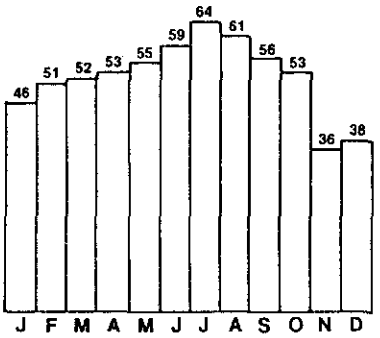
Sun/Cloud Cover

Total possible sunshine is the amount of sunshine that an area would receive annually or monthly if clouds never interfered. Dutchess County and the Hudson Valley enjoy among the highest percentages of total possible sunshine in New York State. The annual county average is between 56 and 58 percent, increasing from 45 percent during November and December to approximately 65 percent in the summer and early fall.

Within the Hudson Valley the amount of sunshine is greatest in the south. Albany annually receives 54 percent of the total possible sunshine, while the average in New York City is 59 percent. The monthly percentages for Albany are given in Figure 1.11.

Average Monthly Sunshine
Albany, New York

Percentage of Possible Sunshine



Source: U.S. Dept. of Commerce, NOAA
Based on 37 years of record through 1975, for the Albany County Airport.

Figure 1.11

The annual hours of sunshine in Dutchess County range from 2,400 to 2,600. The county averages 90 clear days, 120 partly cloudy days, and 150 cloudy days each year. At least 15 cloudy days occur during each December, January, and February.

Severe Weather Events

Thunderstorms, hurricanes, blizzards, tornadoes, floods, and droughts are all severe weather events that have struck or affected Dutchess County. They result from the interactions of temperature, wind, and precipitation.

Thunderstorms

Thunderstorms occur an average of 30 days a year, most of them during the summer. They may be accompanied by hail, strong winds, and heavy rains, which in turn can cause flooding and soil erosion, crop and tree damage, and local blackouts. Dense fog sometimes follows thunderstorms. Independent of thunderstorms, dense fog occurs between 25 and 30 days a year, most often during September and October.

Hurricanes

Dutchess County is not in the normal path of hurricanes, but at least three major hurricanes have affected the county in the past 50 years. Occasional hurricanes passing Long Island cause local high winds and heavy rains, but these storms rarely move inland through New York State.

Blizzards and Freezing Rain

Blizzards of the type common to the Midwest are rare in Dutchess County, but heavy snowstorms are not unexpected. Storms with freezing rain usually occur at least once a year, and they may precede snowstorms.

Tornadoes

Tornadoes do occur in the county. Although none have been reported in the Poughkeepsie urban area, several small tornadoes of limited duration have passed through the county's rural sections.

Floods

Each major stream in Dutchess County has a significant number of floodprone areas, shown on the Floodplains Map discussed in Chapter Four. Certain areas are known for annual flooding.

The probability of flooding is greatest from December to April. Runoff from melting snow and ice often causes minor spring floods. Ice flows and heavy rainfall sometimes aggravate spring runoff conditions, producing severe floods in low-lying areas.

Floods can also occur during the summer and early fall, when severe rainstorms are most likely to strike. Storms that shed more than one inch of rain in 24 hours are expected between 6 and 12 days a year, and are most common from May to October. Accumulations exceeding two inches per day have been responsible for several major county floods.

Three of the largest floods ever recorded in Dutchess County were triggered by coastal storms in September 1938, August 1955, and October 1955. In 1955, Hurricane Diane inundated major portions of the Wappinger Creek, the Tenmile River, and the Fishkill Creek basins with a severe flood that caused millions of dollars in damage. Some reports state that this was an 80-year flood, while others indicate that it was a 100-year flood.

Another significant flood developed when four to seven inches of rain fell on the county between June 28 and 30, 1973. On June 30, the Wappinger Creek between Rochdale and Pleasant Valley rose at the rate of six inches per hour, closing roads, washing out bridges, and causing local property damage amounting to hundreds of thousands of dollars. Flood damage was reported in 12 towns, and more than 1,000 acres of cropland were severely damaged by top soil losses from gullying and erosion. The county was subsequently declared a flood disaster area.

The most recent major flood occurred May 29 to 31, 1984. Up to eight inches of rain fell in a three-day deluge that caused a 25- to 30-year flood in the Tenmile River Valley. Significant flooding also occurred along the Fishkill, Sprout, and Wappinger Creeks. The county was declared a State Disaster Emergency area after

suffering an estimated five million dollars worth of damage to crops, private property, and public facilities.

Droughts

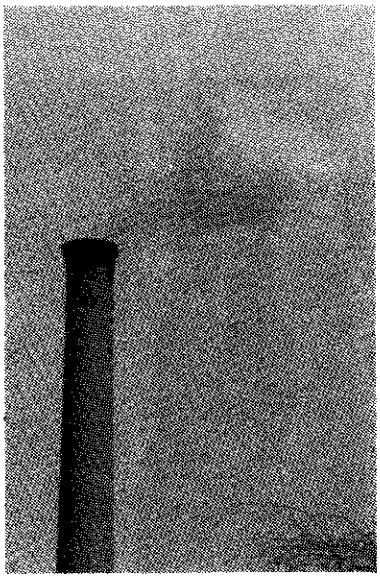
The county's major drainage basins have sufficient capacity to sustain some flow even during severe droughts, such as those of the early 1960s. Serious droughts are rare; brief dry spells are far more common. Dry periods temporarily place crops under stress and often force restrictions in the recreational uses of forested lands because of fire hazards.

Air Resources

The quality of air resources is determined by human activities and natural climatic factors. Air pollution seriously affects human, plant, and animal health. It also causes economic losses by accelerating the deterioration of materials, structures, and machines.

Natural air pollution resulting from volcanic eruptions, fires, forest fires, and dust storms, is usually dispersed before reaching the county, and rarely causes significant problems by itself. The long-term effects of combining natural pollution with emissions from industry, automobiles, and electric power plants, and other human activities are not completely understood.

Air Quality Monitoring



Dutchess County is included in the Hudson Valley Air Quality Control Region for the measurement of national air quality levels. Four air monitoring stations were operated in the county until 1978, in Poughkeepsie, Rhinebeck, Fishkill, and LaGrange. They collected data on levels of sulfur dioxide and carbon monoxide, total suspended particulates, and dustfall to determine whether the County's air met federal Ambient Air Quality Standards (AAQS). The Poughkeepsie station is still in use.

The results of the AAQS monitoring show that Dutchess County's air quality is generally good. The level of total suspended particulates (TSP) recorded in Poughkeepsie has been well below the AAQS of 65 milligrams per cubic meter since 1968. According to the New York State Department of Environmental Conservation (DEC), which is responsible for administering the state's air quality program, carbon monoxide, sulfur dioxide, and dustfall levels also meet the federal standards. The concentrations of these pollutants are well within the

federal standards, in part, because utilities, soil mining, cement manufacturing, and quarrying are the only heavy industries in the county's airshed.

Elsewhere in the Hudson Valley, concentrations of ozone and total suspended particulates still occasionally exceed state and federal air quality standards. In most cases they present much less of a problem than in years past, but continued vigilance is necessary to ensure that air quality continues to improve.

Ozone is of particular concern because it is a poisonous form of pure oxygen. As the major component of smog, ozone is created when hydrocarbons and nitrogen oxides produced by fossil fuels combine in the presence of sunlight. Ozone irritates eyes, air passages, and lungs, makes breathing difficult, and causes headaches. It is also toxic to plants and weakens materials such as rubber and fabric.

Airborne Toxics

Few standards exist for airborne toxic pollutants. Ambient concentrations of asbestos, beryllium, mercury, vinyl chloride, and arsenic are regulated by the federal Environmental Protection Agency. New York State DEC guidelines for the control of hazardous ambient air contaminants cover 40 high toxicity substances, such as benzene, polychlorinated biphenyls (PCB's), and nickel, and 150 compounds of moderate toxicity. The guidelines are used in reviewing emission permit applications under the state's air quality program; they do not, however, serve as strict limits on toxic emissions. For many of these contaminants, no recommended limits have been established.

The total number of compounds covered by the New York State guidelines--approximately 200--represents a fraction of the number of toxic pollutants that enter the air. Little is known about the ambient concentrations of many of these substances, how they combine and interact, or the long-term health and environmental problems their presence may cause.

Acid Rain

Acid rain is a major air and water quality problem that affects Hudson Valley residents. The term "acid rain" applies to acidic rain, snow, sleet, and dry falling particles. The acids are formed when sulfur dioxide and nitrogen oxide gases, both products of fossil fuel combustion, are oxidized in the atmosphere and react with water to form sulfuric and nitric acid. These acids can travel great distances before falling to earth.

The average pH of rainfall in much of the northeastern United States is 4.3. Normal rain has a slightly acidic pH of 5.6; distilled water is neutral, with a pH of 7.0. Each change of one unit on the pH scale represents a 10-fold change in acidity, so the difference between 5.6 and 4.3 means northeastern rain is often more than 10 times as acidic as it should be.

Rain as much as 50 times more acidic than normal rain has been officially recorded in many locations in New England and New York. At the Mohonk Preserve in Ulster County, the average pH of rain has ranged from 4.0 to 4.2 in recent years. Rainfall measured by Scenic Hudson, Inc. in Poughkeepsie in late 1983 averaged pH 3.95.

There are many questions about the health and environmental effects of acid rain. It is widely believed that acid rain has been responsible for the disappearance of all plant and animal life from hundreds of lakes and streams in Canada and the Adirondacks. It has also been documented that acid rain and other air pollutants are causing millions of dollars worth of corrosion damage to buildings, monuments, and other structures in the northeast. Acid rain is implicated in the declining health of forests in New York, New England, the Appalachian Mountains, and eastern Canada. It is also feared that acid rain's tendency to leach nutrients, such as calcium and magnesium, and toxic metals, such as aluminum, from the soil poses a threat to drinking water quality and soil fertility in sensitive areas.

Soils and bedrock that are rich in lime can help buffer the effects of acid rain on surface waters and soils. High lime concentrations are characteristic of much of the Hudson Valley. How long lime can be counted on to shield such areas from the effects of acid rain is unknown. Some scientists believe that the buffering capacity of many areas may be nearly exhausted.

The Hudson Highlands, like the Adirondacks, have no lime buffer to protect them. In addition, preliminary studies have indicated that 25 percent of the lakes tested in Dutchess, Orange, Putnam, and Rockland counties are highly sensitive to acid and have no natural buffering capacity.

Noise Pollution

Pollution in the form of annoying noise levels can result in physical and psychological damage. Low noise levels constitute an annoyance; louder noise levels

affect home, work, and community activities, reduce recreation and relaxation values, cause hearing damage, and interfere with sleep. In Dutchess County, traffic, vehicles, lawnmowers, and household appliances are the most common sources of noise pollution.

Research has shown that prolonged exposure to sound levels higher than 80 decibels causes hearing damage. The noise produced by lawn mowers, snowmobiles, and chainsaws ranges from 95 to 110 decibels at the operators' ears; freeway traffic and vacuum cleaners produce close to 80 decibels. Background noise levels in a quiet residential area may equal 40 decibels, while in offices and department stores levels of 60 decibels are typical.

Noise can often be limited at the source by designing and using quieter products and restricting the use of noisier ones. Its impact can be reduced by using sound insulating materials, buffer zones, acoustical barriers, and other devices to limit noise transmission, and by using appropriate protective gear when noise cannot be avoided.

Resource Management Implications

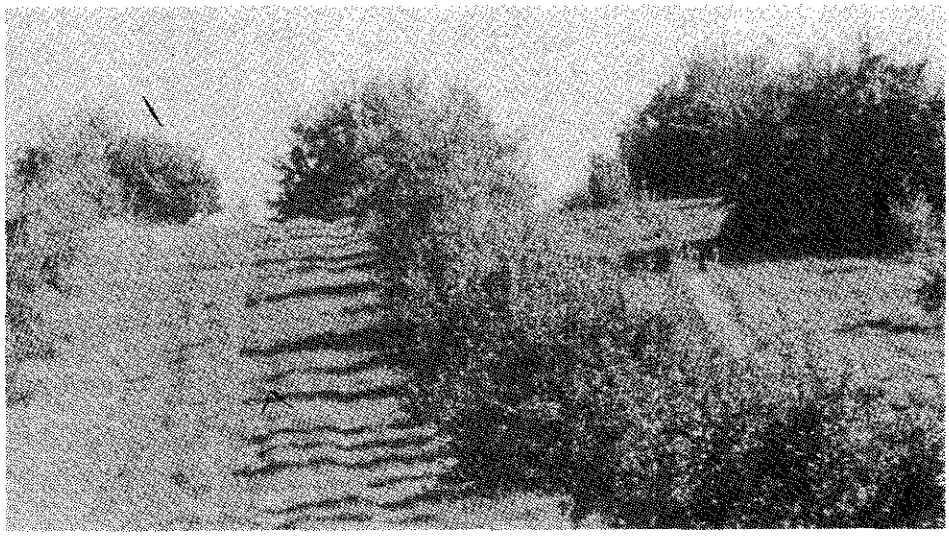
Climate affects all natural resources and land uses. Precipitation, wind, temperature, sunshine, and weather extremes determine water supply abundance, agricultural viability, energy costs for heating and cooling, and patterns of development. Climate also shapes the land, affecting topography, drainage, soils, and vegetation. Despite its significance, however, climate is usually overlooked in land use decisions. Often viewed only as a large-scale phenomenon that affects all areas of a community equally, climate actually can vary a great deal within a small geographic region. Differences in temperature, rainfall absorption, wind exposure, humidity, and access to sunlight are among the climatic factors that should be considered in the land use decision-making process.

Agriculture

Agriculture is one land use that obviously depends on local and regional climate conditions. At the regional level, Dutchess County's humid continental climate usually provides ample rainfall, sunshine, and warmth for a variety of farm uses. Short-term weather patterns, however, are less predictable; drought years, exceptionally wet seasons, and late spring frosts or winter storms occasionally disrupt growing cycles.

The western part of the county is slightly warmer and more moist than the eastern part because of the moderating influence of the Hudson River and the shielding effect of the Catskill Mountains. The milder climate is conducive to fruit farming, which is concentrated in the towns of Red Hook and Rhinebeck. Dairy and field crop farming is prevalent in the cooler portions of the county, where commercial orchards are limited by climatic constraints.

Good farmland is an irreplaceable resource. If farming is to thrive in the county, land use policies must recognize that climate restricts the amount and location of orchard and fertile cropland available, and that urban encroachment on that land permanently takes it out of agricultural production. Zoning laws, open space preservation programs, development rights transfers, and taxation policies that discourage the development of good orchard lands and prime agricultural soils should be adopted throughout the county.

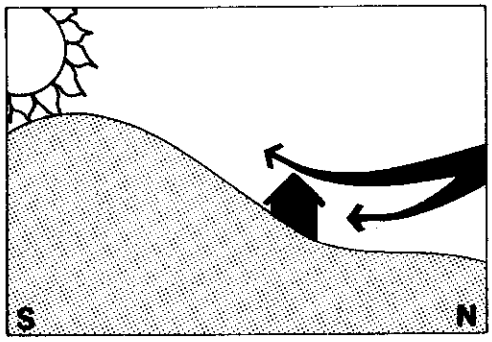


Energy Conservation

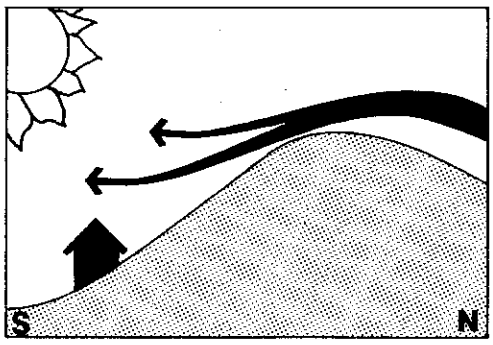
Energy use is directly related to climate. Cool winters and warm summers are typical of the entire county, but local conditions vary considerably with such factors as elevation, slope, and orientation.

Energy costs, conservation options, and access to renewable energy resources should be major considerations in selecting development sites, designing site plans, orienting buildings, and choosing construction techniques and materials. Site plan review procedures and zoning regulations should encourage energy efficient design. Prevailing winds, airsheds, and solar orientation should be considered during the design phase of each project.

Climate and Building Site Suitability



Buildings on north-facing slopes receive less sunlight and face the cold northerly winds that prevail during the winter. This combination can add substantially to heating bills.



Buildings on south - facing slopes can benefit from the southerly winds of summer while being shielded from winter's cold north winds. They also receive more sunlight, which can be collected as solar energy and used for heating purposes.

Figure 1.12

Residential developments, for example, as shown in Figure 1.12, should take advantage of prevailing winds for summer cooling, while relying on slopes, vegetative buffers, and insulation for protection from northwestern winter winds.

The proper use of sunlight could greatly reduce heating costs. In the summer, deciduous trees and overhangs can be used to shade buildings oriented to catch the winter sun. Taking better advantage of the county's 2,400 to 2,600 annual hours of sunshine by maximizing solar access in new development projects could measurably reduce dependence on fossil fuels.

Air Quality

The county's relatively good air quality should not be taken for granted. Almost 40 percent of the wind recorded in the county comes from the western half of the compass. These winds can carry pollution eastward into Dutchess from as far away as the midwest, as well as from neighbors such as Ulster and Orange counties. Dutchess County should, therefore, participate in regional planning efforts and review industrial or energy development

proposals to prevent activities outside the county from causing air quality to deteriorate. At the same time, Dutchess should cooperate with the air quality protection efforts of neighboring states to the east. The establishment and enforcement of comprehensive state and federal standards for the emission of toxic air pollutants should be encouraged.

It is becoming increasingly clear that acid rain is damaging critical components of the ecosystem over a vast area. The effects of acid rain on Dutchess County are not well documented, but it is known that rainfall pH in the county, as in most of the northeast, is abnormally low. Dutchess County's air cannot be considered clean until the nationwide emission of the sulfur dioxide and nitrogen oxide gases that form acid rain is drastically reduced, and normal rainfall returns. The county should, therefore, support national and state efforts to reduce power plant emissions that produce acid rain, and should monitor acidity levels and their impacts in the Hudson Valley.

Air pollution concerns are equally relevant at a site-specific level. Prevailing winds should be considered, for example, in siting industrial projects. Heavy industries which may produce smoke, dust, odor, or noise should be situated on the leeward side of residential areas.

Water Resources and Flooding

The county is fortunate to receive an annual average of 40 inches of precipitation, and to have enough groundwater and surface water storage capacity to sustain most land uses during moderate droughts. Such droughts are not infrequent, and severe droughts have been known to occur.

As discussed in more detail in Chapter Four, land use and water management policies should be designed to preserve the water retention capacity of the county's drainage basins. Drainage systems, for example, should permit stormwater to filter back into the groundwater supply instead of discharging runoff into streams and rivers. Measures such as these can enable the county to cope with continued growth and existing land use patterns without increasing the damage droughts cause, and without jeopardizing the balance between water demand and supply.

Although severe floods are rare, floods significant enough to cause considerable damage are not infrequent. To minimize this damage, floodplains along the county's streams and rivers should not be developed for residential purposes or for other uses that floods would harm.

The obstruction or extensive filling of floodplains should also be prevented, to avoid increasing flood damage on adjacent or downstream properties.

Upland Areas

The wooded uplands of eastern Dutchess County are cooler and drier than other areas, making them attractive sites for seasonal homes, camps, and recreational facilities. These areas are often environmentally sensitive because of steep slopes, erodible or shallow soils, and aesthetic features discussed in subsequent chapters. Their use for resort purposes can preclude other land uses, such as timber production, year-round residential settlements, or wildlife habitat, while overdeveloping them can destroy the resources and community characteristics that are responsible for their popularity. Local decision makers should be mindful of the economic and environmental trade-offs involved in the development of these upland areas, and of the destructive consequences of allowing them to be inappropriately used.

Recreation and Tourism

Developers of recreation areas should consider the moderating influence of the Hudson River in evaluating potential outdoor recreation sites. For example, the northeastern part of the county receives more snowfall than the western part, making it a potentially more attractive location for winter sports facilities. Sunlight access, rainfall, and wind exposure are other locally-variable climatic features that should play a part in siting recreation areas, farms, seasonal homes, and other weather-dependent uses.

Seasonal Variations

Seasonal changes contribute immeasurably to Dutchess County's beauty and quality of life, and enhance its tourism, recreational, and residential potential. Autumn colors, for example, provide a stunning backdrop for the historic sites along the Hudson River, and for the farmlands and forests of the rural towns. Summers are warm and long enough to support many forms of outdoor recreation as well as agricultural activities. Spring rains usually provide enough water to replenish needed supplies. Winters are seldom severe enough to limit transportation for long periods.

The seasons help keep Dutchess County's environment interesting, productive, and enjoyable. Promotional efforts, land use plans and resource management strategies should reflect an awareness of these climatic assets.