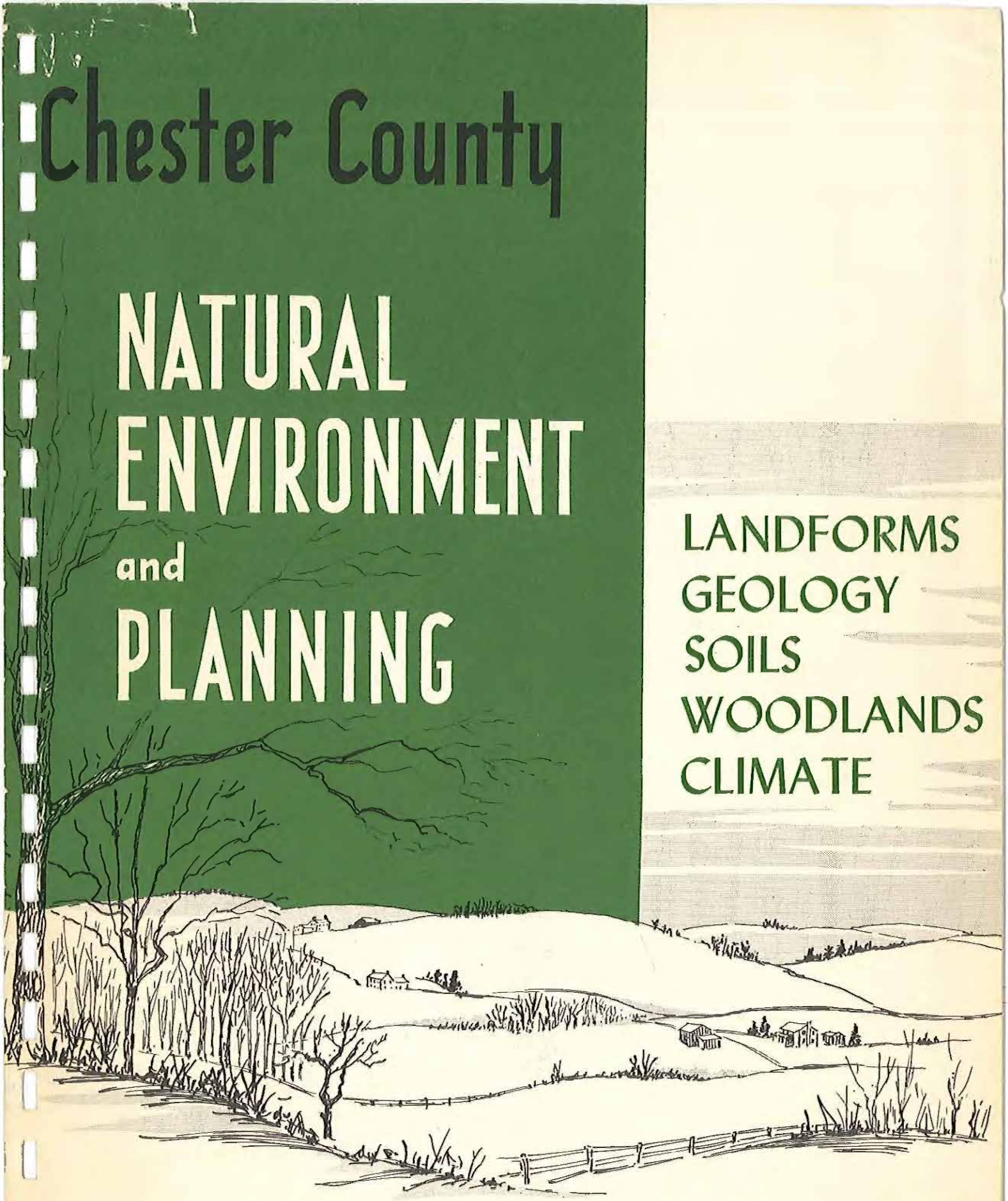
Chester County

NATURAL ENVIRONMENT and PLANNING

LANDFORMS
GEOLOGY
SOILS
WOODLANDS
CLIMATE



CHESTER COUNTY PLANNING COMMISSION
WEST CHESTER, PENNSYLVANIA

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Donald S. Rossman	Cartographic Draftsman

In addition, the following persons served on the staff during at least part of the period of preparation of this report: Howard Rice, Senior Planner; F. Robert Bielski, Cartographer (part-time); Paul Rodebaugh, Research Assistant; Mrs. Marcelyn Adkins, Cartographic Draftsman; and the following Student or Cartographic Assistants; Barbara Powell, Betty McCabe, Sue Ann Hoover, Ann Morrow, Rita Rice, and Nancy Monroe.

The Commission is particularly indebted to Mrs. William Spence, of Glenmoore, Chester County, illustrator, who contributed the covern design and the chapter heading drawings; and to Mr. E. T. Howell, of Chatham, who contributed the photographs on the back cover.

GENERAL

This report is one of a series of technical reports analyzing the basic characteristics of Chester County. The data is useful as factual information in itself; and as a partial basis for the preparation of both the County Comprehensive Plan and the local municipal plans.

CHESTER COUNTY:

NATURAL ENVIRONMENT and PLANNING

landforms

geology

soils

woodlands

climate

JULY 1963

CHESTER COUNTY
PLANNING COMMISSION

F & M BUILDING
WEST CHESTER, PENNSYLVANIA
696-9100 EXT. 251
ZIP 19380

A Prayer for Pennsylvania

This "countrie greene," our heritage,
Of field and stream and wood,
That Penn and his staunch followers
Once found so "wondrous goode;"
A trust it is, ours to preserve,
This wooded paradise,
So that our children, too, may know
Tall trees and open skies.

Where roads and houses once were seen
Towns have to cities grown;
On factories the chimneys show
How far the smoke is blown.
The green hills build up, one by one,
Ever with urgent stress,
While men forget that only God
Can build a wilderness.

Lord of each hill and valley stream,
Master of stone and wood,
Preserve this lovely land from men,
Help us to keep it "goode."

BERENICE BALL.

The gently rolling countryside and valleys of Chester County make it one of the most attractive in the eastern United States. It has inspired artists in both verse and brush as in the view of "Summer Along the Brandywine" by West Chester painter Barclay Rubicam here reproduced by courtesy of Mrs. Alexis I. duPont.

In such a county careful attention to planning development in relation to the lands, geology and soils is of particular importance.

CHESTER COUNTY PLANNING COMMISSION

COURT HOUSE ANNEX, WEST CHESTER, PENNSYLVANIA

Board of County Commissioners
Court House
West Chester, Pa.

Gentlemen:

Here is a major technical background report on the Natural Environment in terms of landforms, soils, geology, and climate that has shaped Chester County.

Chester County's development in the past has influenced and will continue to be sculptured by its landforms and the underlying rocks and soils.

The beauty, order, prosperity, economy, and general welfare of our County will depend in a major way upon using the land in accordance with the way Nature intended, for both rural and urban purposes.

Much of the natural beauty of Chester County has resulted from observance of this principle; but there have also been substantial departures in such a way as the severe erosion which has removed over 76% of the topsoil from over 20% of our land and 50% from over half the County.

Through the efforts of such organizations as the Brandywine Valley Association, the Chester County Soil Conservation District and others, there have been great gains in the better rural use of soil and water, so that in a few years a gradual correction of the past misuses and abuses of land, water, and soils has begun to take place.

Now we face the continuing problem of adapting the great wave of urban growth in accordance with basic natural conditions.

It is our hope and strong belief that in Chester County we can have a merger of the best - not the worst features of urban and rural life.

Yours respectfully,

Ellis Stern, Sr.
Acting Chairman

Acknowledgements

A report of this scope necessarily depends upon information and help provided by many others, as gratefully acknowledged below. Because this report is necessarily general, and partially preliminary, many special and more detailed interpretations will be necessary. Fortunately, most of the specialists are also available directly to users of this report for individual help. This will particularly be needed in complex interpretations of geology and soil, which do not lend themselves to easy generalizations.

In the Landforms chapter, Dr. Alvin S. Keinard, Physical Geographer and Chairman of the Geography Department, West Chester State College provided a preliminary manuscript and continuing advice.

The Geology chapter benefitted by information from Dr. Edward H. Watson, Chairman of the Geology Department at Bryn Mawr College; Dr. A. A. Socolow, the State Geologist, and Mr. Alan Geyer, Asst. State Geologist, South Office Building, Harrisburg, Pa.; and from Mr. Walter Satterwaith, Geologist, and Mr. Thomas Keyes, Chester County water drillers. Special indebtedness is due to Mr. Lawrence Dake, who gave extensive help in the revision of this manuscript.

The preliminary and specialized soil interpretations for urban and septic tank uses are entirely at the recommendation of Dr. F. Glade Loughry, State Soil Scientist, U. S. Soil Conservation Service (100 N. Cameron Street, Harrisburg, Pa.); and Dr. Raymond Shipp, Soil Scientist with the Pa. Dept. of Health, Harrisburg, Pa. Professor S. S. Obenshain, head of the Virginia Soil Survey (and pioneer in urban planning uses of soils and soil surveys) first provided encouragement and continuing assistance. The Chester County Health Center of the Pennsylvania Dept. of Health, provided information about their actual field experience with the soil.

Mr. Nelson M. Kauffman, State Climatologist for Pennsylvania, U. S. Weather Bureau (York-Harrisburg State Airport, New Cumberland, Pa.) provided a preliminary text and made available most of the factual climate data from official Weather Bureau records.

Mr. T. D. Fearnow, Assistant Regional Forester, and his associates at the Northeastern Regional Office of the U. S. Forest Service (6816 Market Street, Upper Darby, Pa.) reviewed the manuscript on Woodlands.

David B. Witwer, Chief Cartographer of the Montgomery County (Pa.) Planning Commission (Court House, Norristown, Pa.) provided continuing interest and advice, particularly on the major maps. Advice on the map was also received from the map printers Williams and Heintz Map Co.

The Commission is specially indebted to Mrs. William Spence, Chester County illustrator, for the cover design. Photographs were contributed by the Brandywine Valley Association, U. S. Soil Conservation Service and others.

Within the staff, Mr. Richard P. Byler, County Planner, wrote the text and provided overall supervision. Mr. Francis Bowne, Land and Soils Planner, supervised the 18-month tremendous, tedious, technical task of preparing the major soil interpretative maps. This involved mossaicing and reducing the 72 soil survey sheets into eight sub-county regional maps, hand coloring each for each interpretation, reducing and transferring the data to a single county map, and then finally scribing and inking each color separation in registered form. He was assisted by Betty McCabe, Ann Morrow, Barbara Powell, Sue Ann Hoover, Nancy Monroe, Rita Rice, and Marcelyn Adkins, all cartographic assistants at one time or another. Mr. Bowne also did much of the layout and final design of the book. The other maps were prepared by Mr. F. Robert Bielski, former Cartographer, Mr. Francis Bowne, Land Planner, and Donald Rossman, Cartographic Draftsman. Mrs. Clare E. Lilley edited the manuscript and helped in other ways. Mr. Howard Rice, former Senior Planner, designed some of the climate charts and other illustrations.

Despite this help, the errors and omissions, of course, are the responsibility of the author; and partially reflect the limitations of treating a complex subject with small resources and a tight deadline. Suggestions for improvements in future editions are welcomed.

Introduction

The Purpose of this Report is to Help Adjust Development to the Natural Environment.

In a major way the natural environment sets the limits of man's activities and his use of land. Large portions of the earth's land are too steep, too dry, too high, too hot, too cold, to support a vigorous agriculture and a high order of civilization. Chester County is within a relatively small area where conditions of temperature and humidity are highly favorable, but the area is not without problems. In order to realize the area potentialities, man must work in harmony with the natural environment to a greater extent than in the past.

Houses on flood plains, loss of over 75% of the topsoil from 20% of the County, destruction of valuable trees; new homes without adequate ground water supplies or inadequate soil ability to absorb septic tank effluent; pollution of surface and ground water; loss of valuable minerals by urban encroachment; misorientation of homes and communities to wind, sunlight and view; are a few of the more common failures to live in harmony with God's natural works.

The natural beauty of much of Chester County is a testamonial to the past successful consideration of natural forces.

As an important step toward Chester County's Comprehensive Plan, this report in text, maps, charts and photographs outlines the facts of the County's Physical Geography, and gives a preliminary interpretation of the facts of climate, landforms, rocks, soils, water and woods. It is a collaboration of many people and agencies. It is believed to be one of the most comprehensive efforts of this kind yet made by any planning agency, at least in this region.

A General Report — It Can Not Replace On Site Investigation.

The earth's soils and underlying rocks are very complex in Chester County — more so than in most parts of the world. Outcrops are not frequently exposed and rocks and soils may grade imperceptably from one type to another, or there may be considerable intermingling of types. The significant degree of weathering can not be known until tests or excavations are made. Learned geologists do not know the answers to many of the questions; but the answers here are believed valuable as a general picture. While soil survey interpretations for farming are well developed, soil interpretation for septic tanks and urban uses is still in an early stage.

The general report and interpretation is useful for preliminary screening and for indicating the most likely conditions, but is not sufficient to make predictions in confidence for the foundation and drainage characteristics of any specific site. Detailed on site investigation is still essential before any major investment is made.

Flora and Fauna Not Included.

This report does not include (other than a brief woodland discussion) flora and fauna generally, or specifically in terms of fish or game or wildlife; even though these are important to the ecology and amenity of life in Chester County. These features are less directly related to the Commission's prime task of shaping urban growth. If urban and rural uses are properly planned and balanced, then wildlife and plant life will tend automatically to have a favorable environment. Fortunately, also many conservation and education organizations are actively leading in this work. This report may help provide some additional tools and information.

Working Maps Are the Objective.

This report is a summary of materials available in other forms to serve actual working purposes. Most maps, particularly, the soil interpretation maps are available at larger, more detailed scales. Each map is on a registered overlay so that many combinations are possible for analysis. Almost all of the maps are available on slide projectuals, for talks to interested groups. It is hoped that these maps and their more detailed "big brothers" will be working guides to individuals and municipalities.

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Summary

The natural environment as the Lord made it is here analyzed in terms of landforms; soils; geology, woodlands and climate. These are major determinants of how the land surface above could or should be used and the activities that can be carried on.

Adaptation to the natural conditions and the use of the land in accordance with its natural capability is vital to the achievement of the highest degree of civilization, beauty, order, and economy and the avoidance of loss and disaster in the struggle with nature. Cooperation with nature is particularly the key to optimum development in a rural country. Chester County still has the time, space and opportunity to do better than in the past and to apply both new and old knowledge now available in the hope of making the best of both rural and urban way of life.

CLIMATE

The humid, modified continental climate of the Chester County area is favorable for a prosperous agricultural and high level of civilization. It is a climate of great daily and seasonal contrasts. Extremes of heat and cold are both present, but are not sufficiently prolonged to be limiting; and, in summary, produce an interesting, energizing climate. Rainfall is about 45 inches per year, evenly distributed and thus, supports crops not requiring a longer growing season than six months. Severe storms and winds are infrequent. Wind is from the northwest during the winter and the southwest during the summer. The County is upwind from major air pollution sources and is well ventilated. Air pollution is most likely in the autumn due to low winds and temperature inversions.

Planning implications include proper sun orientation of buildings to avoid strong northern winds and west wall sun avoidance of air pollution valley pockets, protection of residential areas from wind carried smoke and dust, and also of provision of adequate storm drainage, as well as protection of stream flood plains.

LANDFORMS

Chester County is part of the Piedmont Province of the Appalachian Highlands, which is a mature, well eroded and well-drained pereplain sloping in a southeastward direction to the Coastal Plain and the ocean. It is underlain, except for the Chester Valley and Schuylkill Valley lowlands, by deeply weathered old, hard, complex crystalline rocks. It is an area of gently undulating to steeply rolling country. It was shaped by differential weathering of rock with limestones eroded most and quartzite and diabase ridges least, coupled with stream valley erosion to cut often steeply eroded valleys. Most ridges run in a northeast — southwest direction and most major streams cross the ridges at right angles to flow southeasterly to the Coastal Plain.

Because some of the underlying rocks are more resistant than others, the landscape provides a series of natural planning regions based on slope as shown on the map in this summary. The slope of the land is the major land feature that permits or limits the type of growth that can take place. Over two-thirds of the County is in slope favorable for urban development, balanced with steeper land for an attractive, aesthetic framework.

GEOLOGY

The underlying rocks are deeply weathered and complex intermingling of granites, gneisses, quartzites, gabbros, and schists, with the mica schists covering the largest area. Exceptions are the softer, less resistant limestones and dolomites which were eroded to form the Great Chester Valley and the sandstones and shales in the Schuylkill Valley, generally east of the French Creek.

Ground Water.

Because the igneous and metamorphic rocks underlying most of Chester County are hard, solid rocks, there is relatively little space for ground water storage, thus making it necessary to rely upon surface water for large supplies. Water from these hard rocks is generally "soft" and ground water pollution fairly localized.

The limestones under the Chester Valley, if a solution channel is tapped, produce a substantial supply of hard water. Because of channel underground solution channels, ground water pollution over long distances is a hazard. There are also relatively great supplies of moderately hard ground water in the sandstones, and, to a lesser extent, in the shales found both east of French Creek.

Minerals and Building Stones.

Past mineral resources of iron, lead, zinc, chromium and graphite contributed to Chester County's early economic growth. But these deposits are no longer sufficiently rich or economically mined to be competitive. There is some possibility that in the distant future, that if better ores are exhausted or are unavailable, some of these minerals, particularly iron ore, might again be of economic value.

Attractive and available building stone in the past contributed to the beauty of the countryside; but at present, masonry building is too expensive for widespread use. Limestones and diabase are the best crushed stone for highway purposes. A serious deficiency is the lack of natural sand and gravel deposits in the County.

Engineering Properties.

Most of the underlying rocks that are solid bedrock, as contrasted with the weathered upper portion, are suitable for foundation and most engineering purposes. There may be foundation problems in limestone due to sinks and in the mica schist, due to deeply weathered layers of rotten rock before solid bedrock is reached. Generally, foundations are adequate for heavy buildings, dams, bridges, and other special engineering structures. But there must be detailed site investigation before heavy building is undertaken. Most of the metamorphic rocks are stronger in crushing strength than in shearing; there, the rock cleavage and tendency to split apart is a problem. Soils and rocks are susceptible to frost damage. Excavation in most of these crystalline rocks, unless in deeply weathered upper layers, may be difficult.

SOILS

Most of the soils were formed in place from weathering of crystalline rocks. Nearly 80% of the County is underlain by Glenelg Manor or Glenelg Neshaminy Soil Association formed from mica schists, gneisses and related meta-igneous rocks. About 8% is in Penn-Croton, Bucks Association in the sandstones and shales of the Schuylkill Triassic lowlands east of French Creek; and 5% under the limestones of Chester Valley.

These soils, where the slope is not excessive or erosion severe, are good farmland. Over 50% is good to excellent farmland; and only about 20% not suitable for cultivation.

The soil is subject to severe erosion, particularly those underlain by schist or shale; and conservation measures to control erosion are of the highest importance. Over 75% of the original topsoil has been lost in 20% of the County; and between 25% and 75% original topsoil lost in over 56%. Only 24% of the County's area has suffered little erosion. Most erosion is sheet or gully type, mostly from the more steeply sloping land misused for croplands.

Only 7.5% of the County is clearly "Suitable" for septic tanks; 42% is indicated as "Probably Suitable" with unpredictable variations requiring careful individual site evaluations. Further study is underway to refine this "Variable" category with some indication that the gabbroic type underlying rocks are less weathered and well drained than are underlying mica schists. Relatively, little of Chester County seems clearly suitable for long term satisfactory with septic tanks on small lots.

The soil interpretations and map show, with some reliability, those areas where the soils are generally unsuitable for septic tanks because they are: too wet (14%); too shallow (15%); too steep (12%) or on flood plains (6%), or on limestone soils which, although well drained, are subject to ground water pollution hazards (4%).

Soils that are generally deep and well drained tend to be better not only for septic tanks; but also for many other purposes, including foundations, sanitary landfills, farming, landscape plantings, and woodlands. By knowledge of which drainage and slope factors are most important, interpretations can be made for many other purposes.

WOODLANDS

The original native wood cover of the entire County was oak, tulip, poplar, chestnut and beech, with oak dominant. Except for isolated groves only second and third timber remain and occupies about 19% of the County's area, mostly on the steep slope and ridges in the northern part of the County.

Woodland preservation and additional reforestation are vital for more of the County in the future, particularly on steeply sloping areas. Woodlands check severe erosion, rebuild topsoil by root and humus deposits; reduce runoff and floods (except on frozen ground) and thus moderate floods, reduce temperature and increase rainfall within their immediate shelter and perhaps slightly for the overall area; definitely break up winds; filter dust and impurities from the air; foster birds and wildlife, and thus lessen the need for chemical pesticides and resulting "Silent Spring"; provide recreation; and create the green seasonal beauty of the Chester County landscape.

For steeper slopes, woodland is usually the most profitable as well as the most socially and ecological desirable land use. In residential subdivisions, as well as for landscaping industrial and commercial sites, tree planting should receive prime attention. Very few things add so much value in relation to cost as proper landscaping — and keeps growing in value.

REGIONAL GENERALIZATIONS

All of these natural features determinants in combination with such other factors as: location within the region, existing and proposed highways and public transit facilities, ability to provide water and sewers, existing land uses and access to employment, seem to suggest that Chester County's greatest future growth will — and should — continue to take place in the Chester Valley, the Upper Main Line, on the West-Chester Paoli Plain, and in the Schuylkill Valley. The steeper lands, and some of the better farming areas in the Honeybrook-Elverson area, and in the southern part of the County, particularly around Oxford, will best remain primarily in agriculture and rural uses.

Minimum safe lot size in areas without public water and/or public sewers is a very difficult question where responsible experts are still very reluctant to make any definite general recommendations. Research will continue, but it is unlikely that any generalizations will ever be able to replace detailed on site investigations. In some cases minimum lot sizes are controlled by safe ground water yields; in other cases by septic tank soil conditions; or usually by both in combination.

HONEYBROOK PLAIN

Agricultural Capability
Good productivity for most types of farm crops. Good commercial farm area.

Public Water and Sewer Possibilities
Area drained by the Brandywine. No significant excavation problems. Long range plans for public water should be through the Brandywine Plan.

Ground Water
Low yield, sufficient for rural development. Water is soft.

Soil Suitability for Septic Tanks
Variable. On site inspection needed to determine permeability of soil for sewerage systems. Many areas of seasonably wet soils.

General
A largely agricultural and related services area, remote from urban influences. Should remain permanent agriculture. Pennsylvania German farmers cherish their land and want to retain it for farming.

Transportation
No significant rail service in this area. An adequate highway system has been provided by Pa. Turnpike, U.S. Routes 10 & 322.

CHESTER VALLEY

Agricultural Capability
Limestone soils. Generally highest productivity. Not many farms due to urbanization. Estate type farms.

Public Water and Sewer Possibilities
The valley can be served by the Schuylkill River, Brandywine Creek and Octoraro Creek. Variable excavation problems. Intensely developed areas must have public water and sewerage systems.

Ground Water
Variable yield. High yield if underground solution channel is tapped. Water is very hard. Danger of pollution over extensive areas.

General
A really good balance of orientation and occupation to the communities within this valley and the surrounding region. Significant industrial and commerical development. The level land is on a transportation corridor.

Transportation
The valley is a transportation corridor and has excellent service provided by the main line of the Penna. R.R. East-west highway traffic movement is provided with a nearly adequate system. North-south traffic movements are not now adequate.

Soil Suitability for Septic Tanks
Well drained limestones are hazardous due to ground water pollution because of possible underground caverns.

OXFORD-KENNETT PIEDMONT

Agricultural Capability
Good productivity for all types of farm crops. This is the principal commercial farm area.

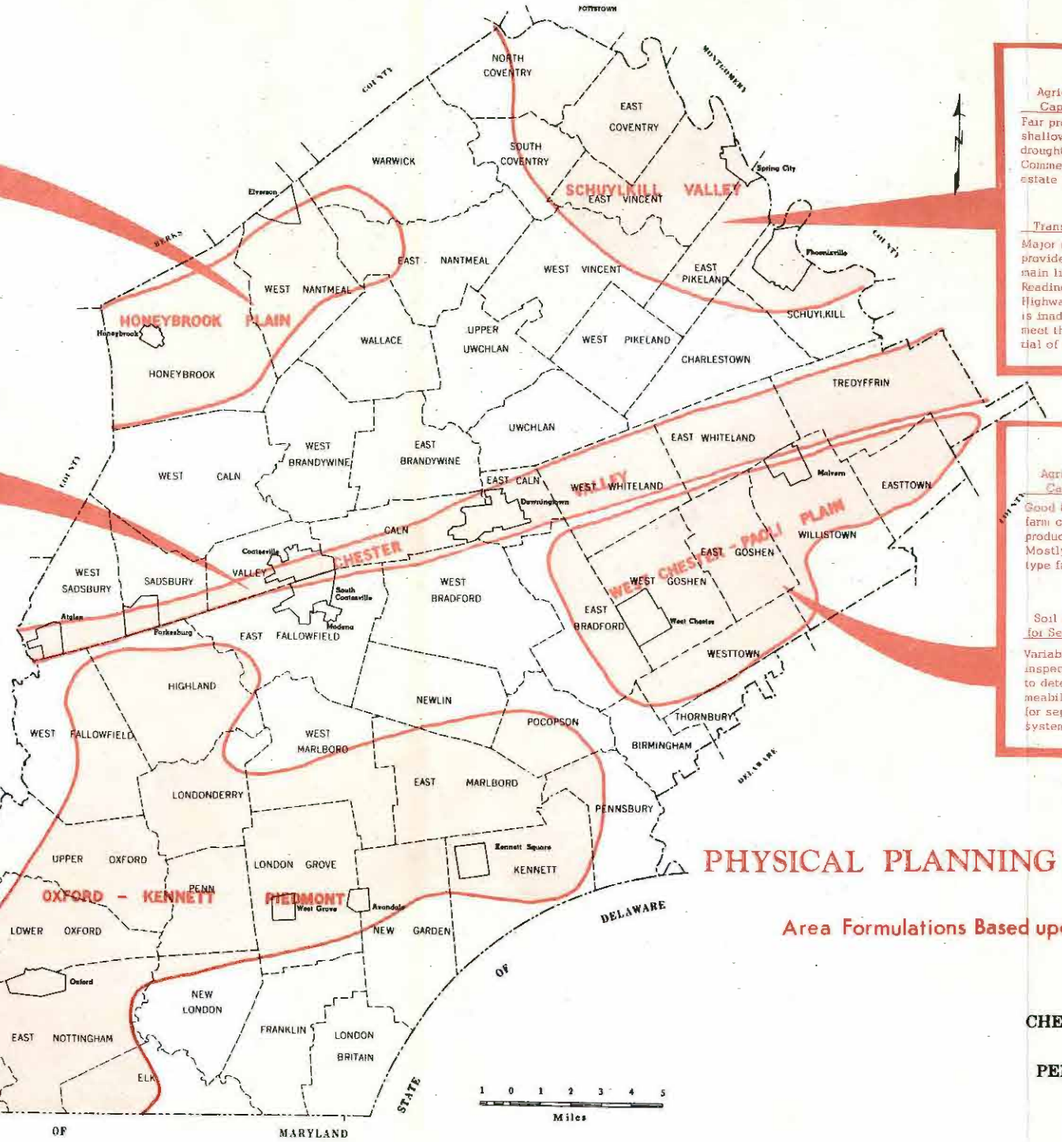
Public Water and Sewer Possibilities
The area drains to the Clay Creek or Elk River. No significant excavation problems for most of the area. Public water potential could come from the Brandywine, Clay, Octoraro Creeks and ground water.

Ground Water
Moderate yield, water is soft and pure. Little likelihood of ground water contamination.

Transportation
Modest rail service is provided by the B. & O. Railroad. This area is served by fair highway network.

General
This is an agricultural area with related market and service towns. This area is relatively far from major urban influence. Some growth from Wilmington area and along Route 1 corridor can be expected.

Soil Suitability for Septic Tanks
Variable. On site inspection needed to determine permeability of soil for sewerage systems.



PHYSICAL PLANNING REGIONS CHARACTERISTICS

Area Formulations Based upon Contiguous Areas less than 10% Slope

SCHUYLKILL VALLEY

Agricultural Capability
Fair productivity, shallow and droughty soils. Commercial and estate type farms.

Public Water and Sewer Possibilities
Good, natural drainage to a single collection point at the confluence of the Schuylkill River and Perkiomen Creek. Excavation difficulties due to nearness to bedrock, but bedrock is relatively easy to excavate. The Schuylkill River has an ample source of water.

Ground Water
Water contamination is local hazard. Relatively good yield, particularly from Stockton formation.

Transportation
Major rail service provided by the main line of the Reading Railroad. Highway service is inadequate to meet the potential of this area.

General
Area contains diversified industry. Predominant relationships with Montgomery County because of the unifying influence of the Schuylkill. This area is a major industrial reserve, because of level land, transportation, and water and sewer possibilities.

Soil Suitability for Septic Tanks
Shallow soils with bedrock near the surface are unsuitable for septic tank disposal.

WEST CHESTER-PAOLI PLAIN

Agricultural Capability
Good for general farm crops. Good productivity. Mostly estate-type farms.

Public Water and Sewer Possibilities
This area is in several drainage basins that would make a single collection system impractical. No significant excavation problems due to deep soil. Public water will be provided by the Brandywine Plan and the expansion of the Philadelphia Suburban Water Company System.

Ground Water
Low yield from hard gneissic rocks. Water is soft. Contamination is a local hazard.

Soil Suitability for Septic Tanks
Variable. On site inspection needed to determine permeability of soil for septic tank systems.

General
Diversified orientation to the area itself to Philadelphia and to Wilmington. Highest number of professional and kindred workers. Highway and regional position will stimulate growth.

Transportation
West Chester has fair railroad service and the Paoli area has significant commuter service. West Chester has been and will continue as a major center of highways.

CHESTER COUNTY

PENNSYLVANIA

PUBLISHED BY THE CHESTER COUNTY PLANNING COMMISSION
COURT HOUSE ANNEX WEST CHESTER, PENNSYLVANIA

LANDFORMS

Overall Land Forms

Land Forms Have Been and Will Be a Major Factor in Shaping Urban Growth in Chester County.

Past urban growth in Chester County has been directly related to and shaped by the basic landforms. For example, most boroughs are on relatively level land at stream or road junctions. The flat level Chester Valley has been the County's transportation corridor and contains some of its higher density urban settlements. The relation to streams at least partially determines feasibility of water supply, and particularly sewage disposal.

The slope of the land is of particular significance as this is the most direct limiting factor for both urban and agricultural uses.

Chester County is an Old Complex Mountain Area Well Worn Down by Water.

The origin and historical development of the land forms and rock structure of Chester County over the several billion years of the earth's history is a fascinating, complex, technical story that is beyond the scope of a planning study based upon making the best use of the land as it exists today. Further detailed description is given in some of the works listed in the geology bibliography, particularly those by Bascom and her many associates, and most standard references on historical geology.

Here, it can be mentioned only that Chester County was originally part of the old Appalachia land mass that was partly off the present coast. This land mass was worn away and eroded sediments collected in a trough within the present area of Chester County known as the Appalachian geosyncline. This Appalachian geosyncline collapsed under the weight of the accumulated sediments. The area was subsequently uplifted and folded in the process that created the present day folded Appalachian Mountains. The great heat and pressure of the Appalachian Revolution and earlier geologic disturbances altered most of the underlying bedrock to the complex metamorphic schists and gneisses underlying the areas today.

The County was under inland lakes several times and consequently received deposits of sedimentary rocks, most of which, except for the Triassic sedimentary deposits east of French Creek and the limestones in the Chester Valley, were subsequently eroded away.

The land was nearly washed down to a flat peneplain several times and subsequently uplifted to begin a new cycle of erosion. As a result of this erosion many of the igneous and metamorphic rocks normally buried are now on the surface; and thus, the Precambrian bedrock of Chester County is among the oldest rock found anywhere. They have been on the surface for a long time and have now become generally deeply weathered.

Rain and streams have been the major sculptors of the County's landscape. In general, the hilliness of the topography depends upon the difference in elevation and thus the amount of cutting needed in the eternal washing away of the "everlasting hills". The degree of the weathering is dependent upon the inherent resistance and structure of the rocks.

The stream valleys, particularly, the Schuylkill and the lower reaches of the Brandywine, are in a mature stage of development with flood plains and a tendency to meander.

The County was never buried beneath continental glaciation during the ice ages and thus lacks the many lakes, moraine deposits and broader gouged-out U-shaped

valleys that are characteristic of areas farther north. Thus, gently rounded, rolling landscape is the result. Nor has the wind been a major factor in sculptoring Chester County's landscape.

Chester County is Part of the Northern Piedmont Province of the Appalachian Highlands.

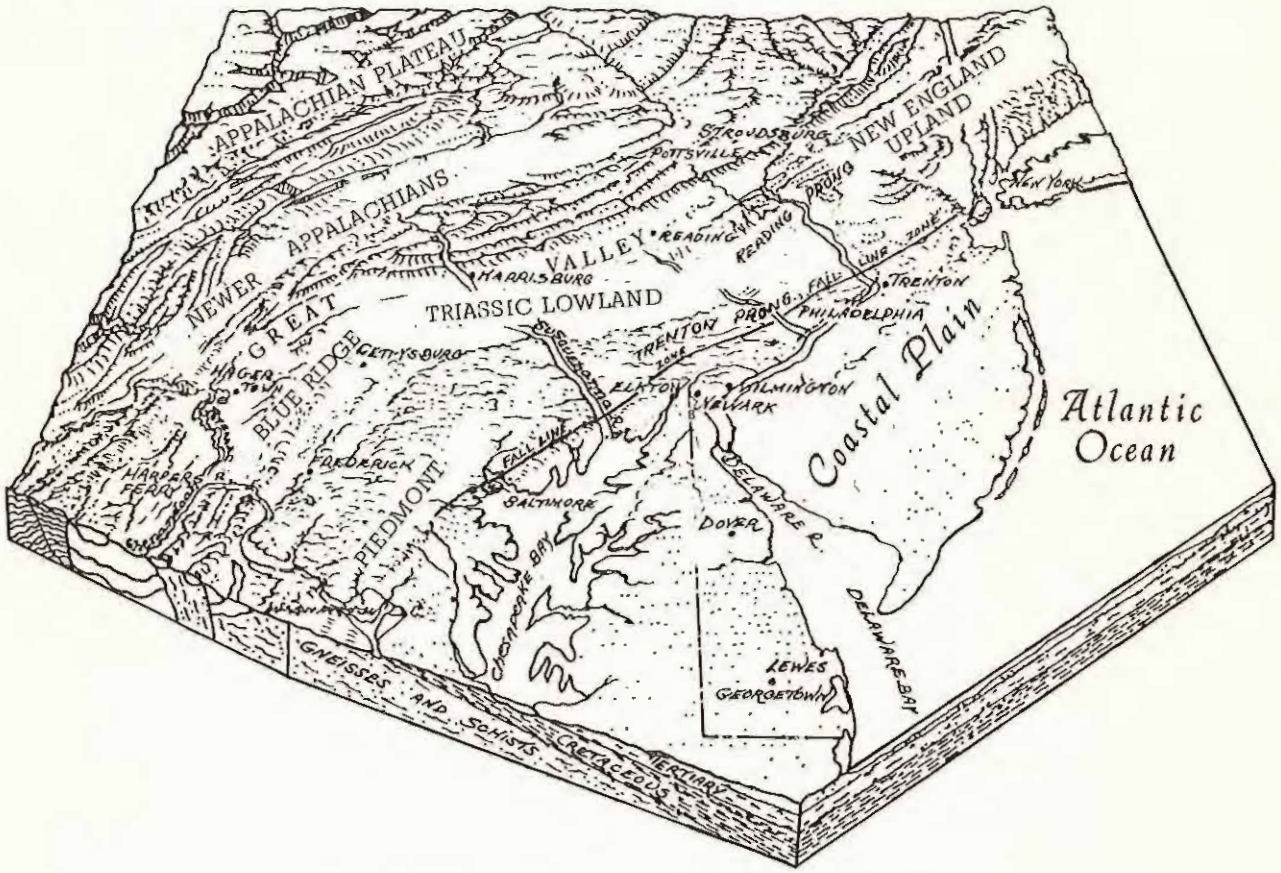
Chester County is wholly within the band of hard rock rolling lowlands known as the Piedmont (foot of the mountains) that stretches along the Atlantic Seaboard from the Hudson River to Georgia between the Atlantic Coastal Plain and the Blue Ridge of the Appalachian System. Its general slope is in a southeast direction to the coastal plain. The relation of Chester County to the larger Piedmont region is shown on Map L-1.

The main rock structure and thus most ridges tend to follow a northeast-southwest pattern. The general slope of the land and main streams trend to the southeast toward the Coastal Plain without regard to the strength and orientation of the rocks.

The Piedmont is an area generally of fairly deep, sharp valleys as the hard, crystalline rocks have resisted extreme eroding, forming gorges in an undulating to a steeply rolling topography.

The land surface in Chester County has undergone prolonged differential erosion. The hard resistant rocks, particularly the quartzites and diabase, have remained relatively intact and thus form ridges. Also, most of the gneisses and gabbroes have also resisted erosion and have tended to form rolling upland. Schists tend to weather

Map L-1



Block diagram of the geomorphic provinces of the central Appalachians and the Atlantic Coastal Plain. Adapted from an original by Raisz.

ATLAS OF CHESTER COUNTY

LAYER RELIEF

A layer relief map, sometimes called elevation or altitude tinting, is a widely used method of landform analysis. All area within selected contour lines is considered a category of relief and is shown in a single color or tonal pattern.

This technique shows graphically the high and low land in an area. When used with such maps as slope and stream valley maps one can identify ridges and valleys.

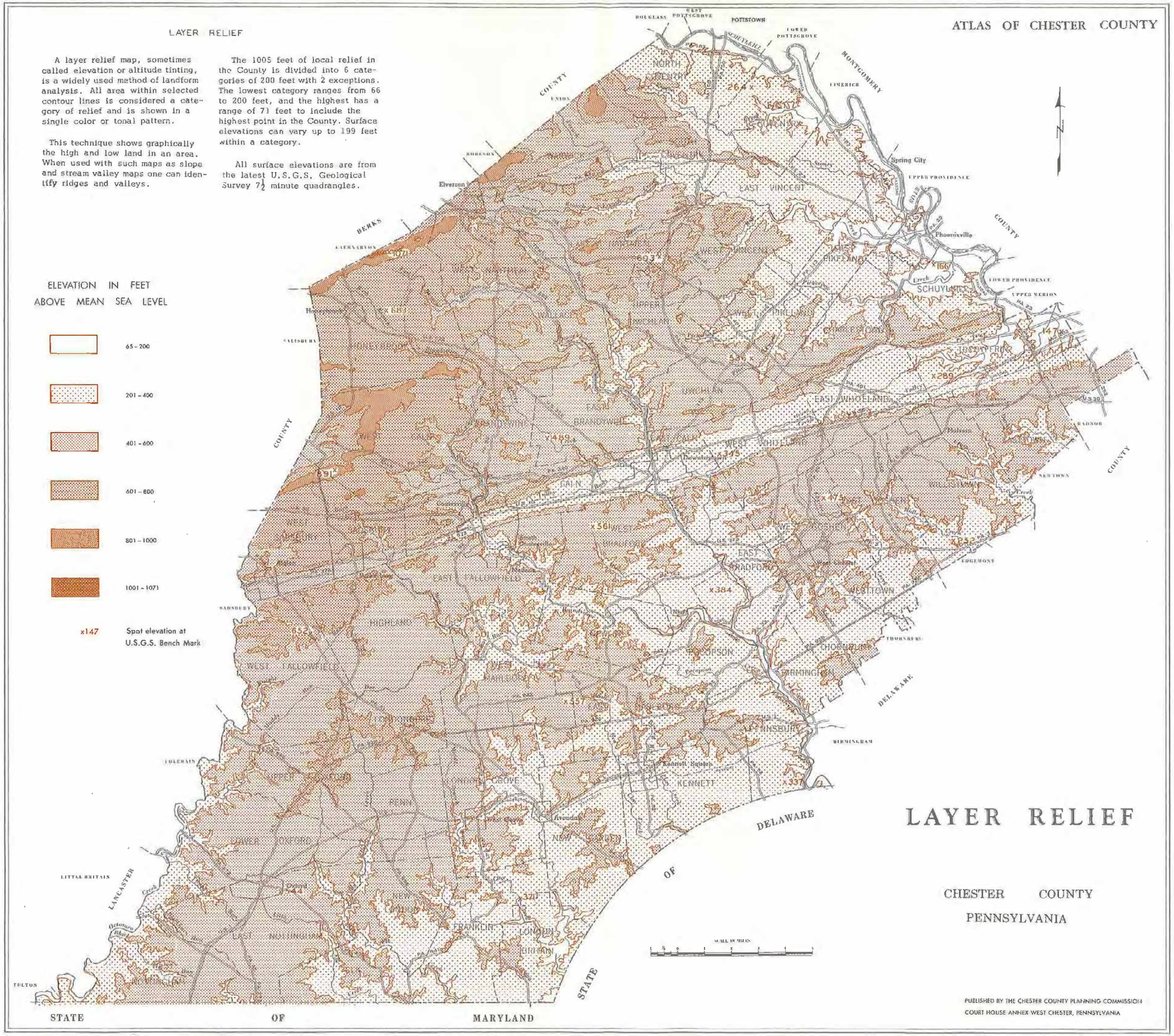
The 1005 feet of local relief in the County is divided into 6 categories of 200 feet with 2 exceptions. The lowest category ranges from 66 to 200 feet, and the highest has a range of 71 feet to include the highest point in the County. Surface elevations can vary up to 199 feet within a category.

All surface elevations are from the latest U.S.G.S. Geological Survey 7½ minute quadrangles.

ELEVATION IN FEET
ABOVE MEAN SEA LEVEL

- 65 – 200
- 201 – 400
- 401 – 600
- 601 – 800
- 801 – 1000
- 1001 – 1071

x147 Spot elevation at U.S.G.S. Bench Mark



LAYER RELIEF

CHESTER COUNTY
PENNSYLVANIA

PUBLISHED BY THE CHESTER COUNTY PLANNING COMMISSION
COURT HOUSE ANNEX WEST CHESTER, PENNSYLVANIA

more than gneiss. The softer limestones, sandstones, and shales have weathered into broad valleys or more gently rolling lowlands. The deeply weathered rock has been eroded primarily by alternate freezing and thawing (about 70 days a year), and by rainfall. The County land forms have never been shaped by glaciation during an ice age.

Relief and Elevations Taper from Northwest to Southeast Down the Piedmont

The "Layer Relief Map" (small foldout) shows the gradual southeastward slope in Chester County down the Piedmont to the sea level on the Coastal Plain. The highest land is in the northwestern part of the County in the Welsh Mountains and surrounding area. The total range of elevation varies from a high of 1071 feet at the crest of the Welsh Mountains to a low of 66 feet where the Schuylkill River leaves the County at the east-central boundary in Schuylkill Township near Perkiomen Junction.

The master streams, Schuylkill, Brandywine, Clay, Ridley, Crum, Darby, Chester, and Elk, all follow the main slope down the Piedmont in a southeasterly direction at approximately right angles to the general northeast strike of the rock. Thus, stream valleys, of course, are at lower elevations than the surrounding uplands.

When analyzed on a national basis, it is customary to classify all of Chester County as being in the Piedmont Uplands, except for the Chester Valley and the Triassic Lowlands. The Piedmont uplands are divided by the Chester Valley. The uplands north of the Valley are known as the Honeybrook Uplands, and the area south of the Valley as the Trenton Prong.

For local analysis, in order to better study the influence of topography on the past and future urban growth, a more refined local classification was developed. Within the complicated arrangement of land forms in Chester County, two generally distinct types of land forms stand out. A series of Piedmont uplands ranging between 400 to slightly over 1000 feet above sea level; and several distinct areas of Piedmont lowlands with elevations between 65 and 400 feet. The term, "upland", is more a geographic term than a descriptive one, although, in general, as used in this report, the uplands are also topographically higher.

The major locations of these local features are shown on the small, foldout Map, entitled, "Physiographic Regions".

Lowlands Were Formed from Less Resistant Rocks.

There are at least five major areas of Piedmont Lowland in Chester County. These generally are important areas of past or potential future urban development:

1. Schuylkill Valley and Triassic Lowland — This substantial area in the northern part of the County (generally east of French Creek) was formed by the wearing down of the less resistant red sandstones and shales. There are some higher ridges under the Lockatong argillite, or shale conglomerates. Generally, this is a relatively level gentle lowland with an excellent potential for development. The area has more ground water than most of the county and access to the Schuylkill River for both water supply and sewage disposal.

2. The Chester Valley — Chester Valley is the County's most outstanding topographic feature. It divides the County into two nearly equal parts and separates the northern Chester County (Honeybrook Upland) upland from those in the southern part (Trenton Prong). Chester Valley was formed by the solution and erosion of the easily weathered limestones. There is no major stream draining the Valley. The 55-mile long Chester Valley is a remarkable topographic feature that served as the first transportation corridor and gateway to the West.

3. The Brandywine Valley — The East and West branches cross Chester Valley at right angles and join to form the main stream about one mile north of

Lenape. This creates a forked north-south lowland, providing avenues of transportation in opposition to the general "graining" of the topography. Railroads and some highways follow the stream closely. The supply of water from the Brandywine and the crossing of these generally north-south extending natural highways with the important east-west corridor of Chester Valley gave rise to the industrial centers of Coatesville and Downingtown.

Rolling land is typical of Northern Chester County.

4. The Southern Chester County Low-Land is the lower section of the generally southeastward dipping Piedmont, just before it drops off beneath the sandy Coastal Plain. This area includes the Toughkenamon Valley, a lowland eroded out of less resistant crystalline marble.

5. The Octoraro Valley Lowland was worn through some of the less resistant schists along the southwestern border of the County.

Piedmont Upland Is Formed from Resistant Rock.

The major features of the Piedmont Upland in Chester County are areas underlain by more resistant igneous and crystalline rocks, mostly diabase, quartzites and granites. These features generally trend in a northeast-southwest direction with the major strike of the rock formations. The uplands generally form a more rugged topography with extensive areas of slope. (See fold-out Slope Map). This is most noticeable on the northern flanks of the County's most prominent landform feature, Chester Valley. Lining the Valley on its north side is a series of hills known as the North Valley Hills. These hills are underlain by resistant quartzites, and retain elevations ranging from 300 to 350 feet above the floor of the Valley to the south.

About midway between Chester Valley and the north boundary of the County is a series of even higher hills trending in the same northeast-southwest direction. Elevations between 800 feet and just short of 1,000 feet above sea level are found. Beginning at State Hill, near the western boundary, and continuing northeastward through the Baron Hills and rising again northeast of the headwaters of the East Brandywine, in the area of the East Nantmeal Hills, elevations between 800 and 1,000 feet are found.

An irregularly dissected upland continues northwestward, interrupted in the north central section by an arm of the Triassic Lowland, but rises again along the northwestern border in the area of the Welsh Mountains, where the elevation rises to a little over 1,000 feet, the highest in the County. Here, as in the Thomas Hill area to the northeast, hard, resistant quartzites comprise the upland. Further to the northeast, Buzzard's Mountain represents an upland of hard, diabase rock.

In the Southern Chester County Upland, the elevations are lower and alignment of features is not so noticeable, due to the more complete erosion of the softer mica schists. However, a series of hills beginning with the Londonderry Hills in the west central area, with elevations of over 645 feet, continues to the northeast, where a line of hills with elevations of approximately 500 feet are found at Upland, Wawaset, and Oakbourne Hill.

PHYSIOGRAPHY

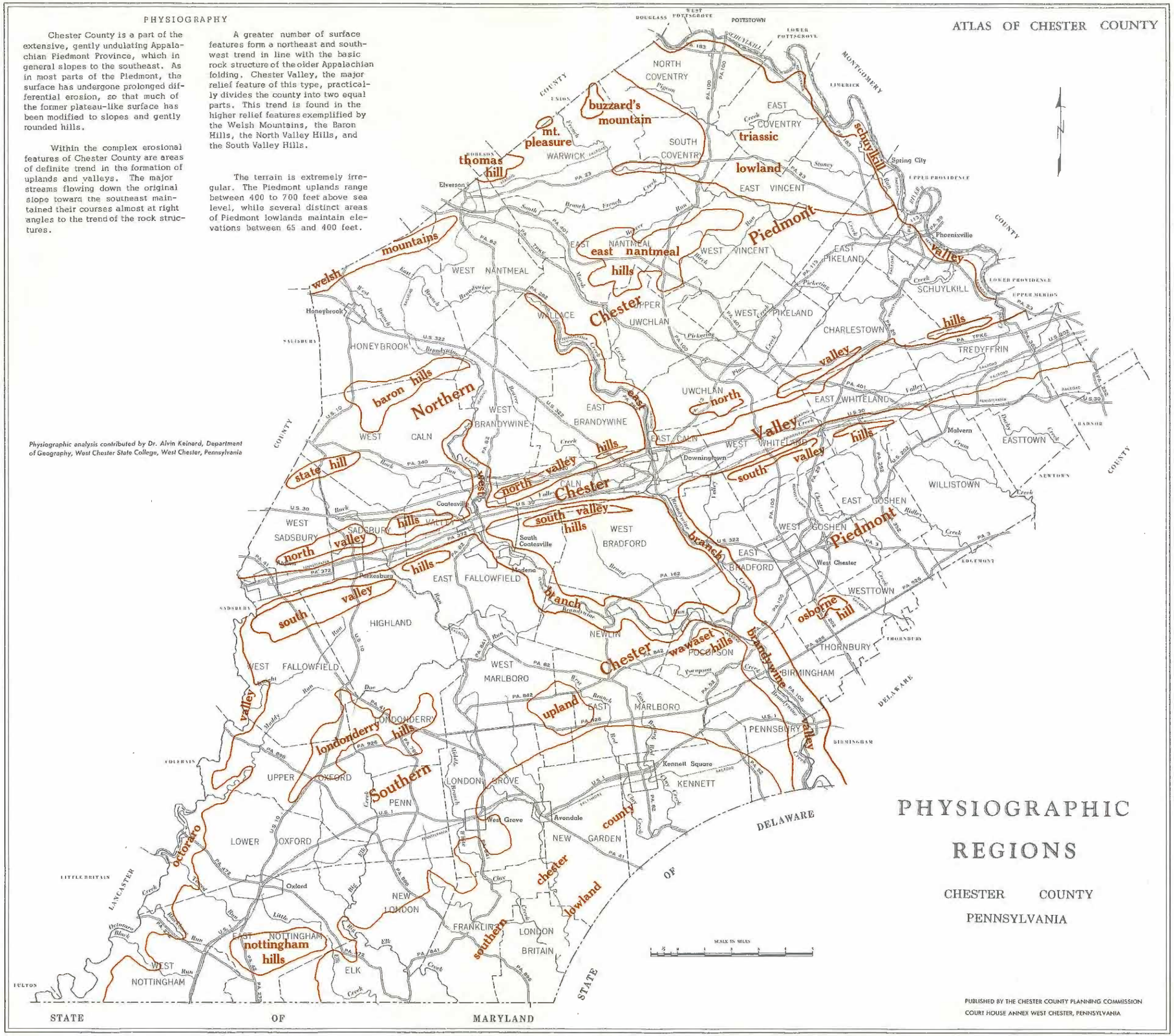
Chester County is a part of the extensive, gently undulating Appalachian Piedmont Province, which in general slopes to the southeast. As in most parts of the Piedmont, the surface has undergone prolonged differential erosion, so that much of the former plateau-like surface has been modified to slopes and gently rounded hills.

Within the complex erosional features of Chester County are areas of definite trend in the formation of uplands and valleys. The major streams flowing down the original slope toward the southeast maintained their courses almost at right angles to the trend of the rock structures.

A greater number of surface features form a northeast and southwest trend in line with the basic rock structure of the older Appalachian folding. Chester Valley, the major relief feature of this type, practically divides the county into two equal parts. This trend is found in the higher relief features exemplified by the Welsh Mountains, the Baron Hills, the North Valley Hills, and the South Valley Hills.

The terrain is extremely irregular. The Piedmont uplands range between 400 to 700 feet above sea level, while several distinct areas of Piedmont lowlands maintain elevations between 65 and 400 feet.

Physiographic analysis contributed by Dr. Alvin Keinard, Department of Geography, West Chester State College, West Chester, Pennsylvania



THE SHAPE OF THE ROCKS BELOW SHAPES THE LAND ABOVE

by

Dr. Seymour Greenberg of West Chester State College

Structural geology shows the arrangement of the rock layers. A geologic map shows the types of rock that are present below the soil; a map showing the geologic structural units (like this one) shows how the rock layers are arranged. An anticline means that the rock layers are folded or bent upwards ( ); a syncline means that the rock layers are folded or bent downwards ( ). A anticlinorium is an extensive anticline; a synclinorium is an extensive syncline. A prong is a complex mixture of metamorphic and igneous rocks that is an extension of a larger body of the same rock type.

Chester County has undergone much differential erosion, therefore the arrangement of the rock layers (the structural geology) influences the surface features (the physiography). In Chester County the hills and valleys generally trend northeast-southwest because the geologic structural units trend in this direction. In this area, anticlines generally form hills, and synclines generally form valleys. In general, a structural unit causes a particular physiographic feature. Compare this map with the physiographic and geologic maps of Chester County.

For example, the Chester Valley Syncline is a major cause of the Chester Valley because the bending down of the rocks exposes the soft limestone to greater erosion than if the rock were not bent.

The land surface over the West Chester Prong is relatively flat because in this prong there is little definite arrangement of the rocks or structural units that would hasten erosion.

The Welsh Mts., Mine Ridge, Avondale and other anticlines generally form hills because harder rock has been bent upwards and therefore are more difficult to erode.

Land surface over the Peach Bottom, Brandywine and other synclinoriums is generally undulating because of the many small synclines that occur here.

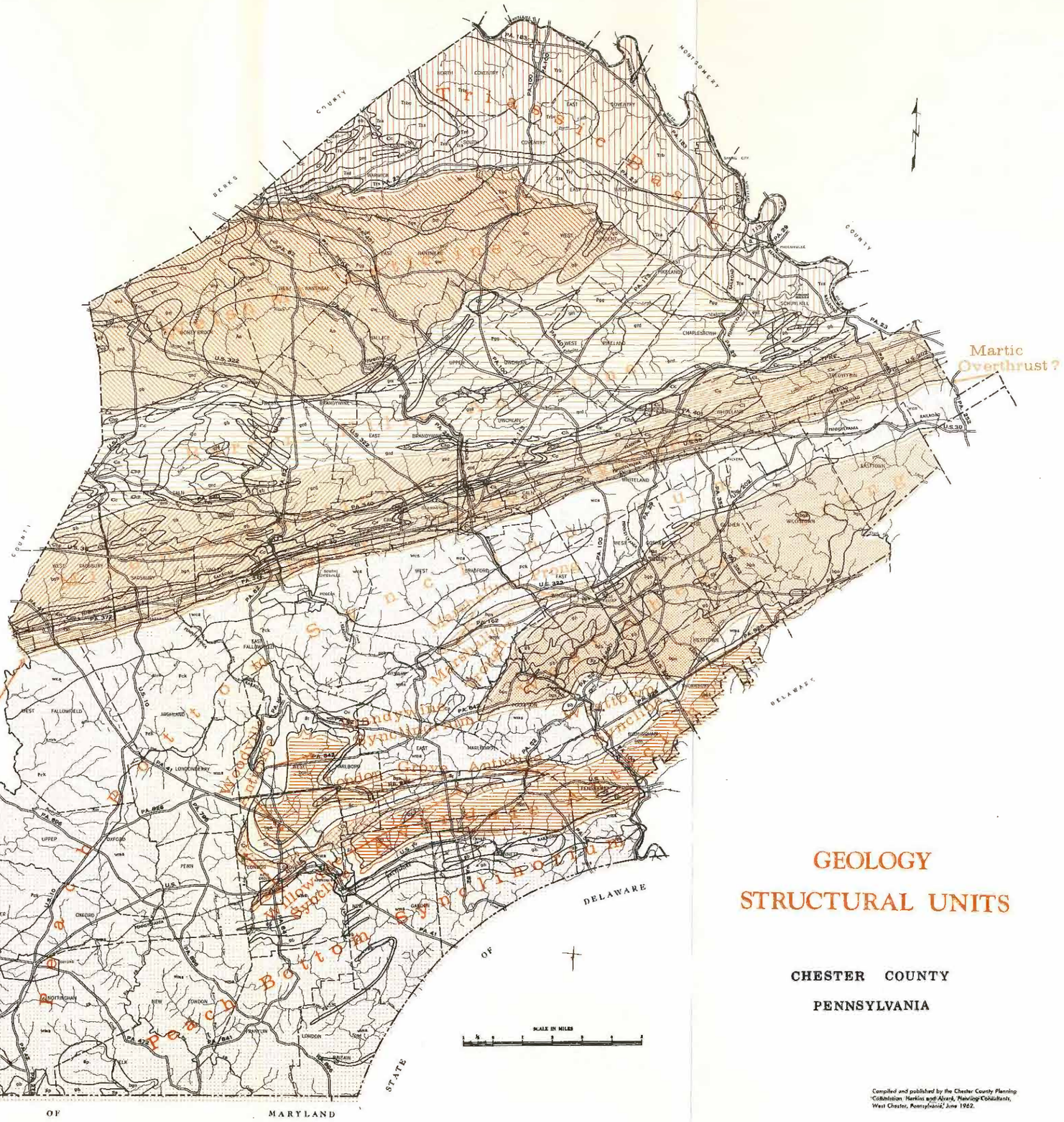
Within the Triassic Basin the land surface is relatively uniform in elevation because of the lack of bending of the rocks.

This map is compiled by Dr. Seymour Greenberg from the following two sources:

1. Bascom, F. and Stose, G.W., 1938, Geology and Mineral Resources of the Honeybrook and Phoenixville Quadrangles, Pa., U.S. Geological Survey Bull. 891, pp. 80-98.

2. McKinstry, Hugh, 1961, Structure of the Glenarm Series in Chester Co., Pa., Bull. of the Geological Society of America, vol.72, pp. 557-578.

Map Prepared
April, 1968



GEOLOGY
STRUCTURAL UNITS

CHESTER COUNTY

PENNSYLVANIA

Compiled and published by the Chester County Planning Commission, Harkins and Alvord, Planning Consultants, West Chester, Pennsylvania, June 1962.

Slope

The Steepness of Slope is a Determinant of Developmental Possibilities.

Of more direct control than elevation on developmental potentialities is the slope of the land, with steeper slopes severely limiting the amount and type of development that can take place, as they do for agriculture.

Industrial, commercial, educational, and business establishments are attracted to relatively level sites, in order to keep grading costs to a minimum. Residential developments can use areas with moderate sloping without much difficulty, but at higher costs. There is a tendency to build more on the more steeply sloping land than formerly, but this is not high density development. Agriculture can use land in all slope categories, if the land is used according to its capabilities, with proper erosion control. Parks and recreation facilities can use land that ranges from level to steep.

The steeper the slope, the greater the difficulty of building. Steeper lands usually have shallower soils, thus making excavation more costly because rocks are close to the surface. Soil erosion and rock close to the surface makes septic tank drainage fields more difficult. There are frequent problems of rock creep. Usually, the steep lands are on hard rock ridges, which is very poor for well water supply.

Steep lands also produce inconvenient and even hazardous approaches. If road grades are to be more level, then very costly excavation and retaining walls are needed. It is for these reasons that the steeper lands are not economically suitable for any sort of mass or large scale building.

Slope Standards Vary with Availability of Land.

Whether or not it pays to develop more steeply sloping land depends upon the amount of developable land available elsewhere. In the Pittsburgh and San Francisco areas, for instance, there is little flood free level land. Therefore, necessity requires the expense and inconvenience of building and living on steep slopes.

In the Philadelphia area and in Chester County, there are relatively large amounts of nearly ideal building land from the standpoint of slope. Therefore, there has been some tendency to by-pass excessive slope areas, since it is not necessary to go to the expense of building on steeper land.

Slope Categories Are Based upon the Soil Survey.

The slope categories shown on the large fold-out map, entitled "Slopes" are those determined and used by the United States Department of Agriculture, Soil Conservation Service. These categories are determined by detailed field examinations. The slopes are measured at the direction of the greatest declivity and the category break does not always follow regular contour intervals, but is shown where field observation indicates a significant change. Therefore, the categories may not correlate exactly with those measured on the U. S. Geological Survey Maps. The measurement of slope is difficult since slope is a continuum and runs in many directions. However, the concept is a useful one.

The slopes categories on the Map and this report are indicated in the so-called percentages of slope, which is the amount of vertical change per hundred feet horizontal distance. Thus, a 10% slope is a slope that increases or decreases ten feet vertically for every hundred feet horizontally. Percent slope is not the same as slope in degrees. More detailed slope information is available in the Chester-Delaware County Soil Survey Report published by the U. S. Soil Conservation Service.

Slope Standards Depend on the Use.

The Slope categories shown on the large fold-out map entitled "Slopes" and their use interpretation are as follows:

A — Nearly Level — 0-3% — This slope is suitable for nearly all types of industrial, commercial, institutional and residential uses. This is the very flat land of the County; and, unfortunately, much of the land in this category is found on flood plains. About 63,652 acres, or 13% of the County is in this category.

B — Gently Sloping — 3-8% — This slope is ideal for residential subdivisions. It permits good drainage and a more interesting and variable landscape without severe grading retaining walls and other problems of steeper slopes. It is well suited for most crop purposes. Most of this category is also suitable for industrial or commercial use. Nearly 253,160 acres, or about 52% of the County is in this favorable slope range.

C — Moderately Sloping — 8-15% — These slopes are suited for residential subdivisions with care in construction and installations of individual septic systems, but are too steep for most industrial commercial, and high density uses. This slope is also too steep for most cropland. About 112,224 acres, or 23.2% of the County is in this category.

D — Strongly Sloping — 15-25% — These slopes can be used for individual homes with care, but are generally too steep for residential subdivisions, and croplands. About 34,973 acres, or 7.2% of the County is in this category.

E — Steep and Very Steep Slopes — 25% and up — These slopes are best suited for wild life and forestry uses. About 19,477 acres, or 4% is in this category.

These slope standards can be modified slightly depending upon the direction of the slope. Slopes to the east and southeast are preferable in this climate and lattitude since they provide for winter and morning sunshine; and give some protection from the blistering afternoon summer heat and chilling northwest winter boreal blasts. Thus, it may be feasible, other things being equal, to build on slightly steeper southeast or southern slopes than on northern or western.

Slopes to the north tend to hold snow longer and thus create some danger of accelerated runoff and possible flooding in the event of a sudden thaw, as contrasted with the more gradual runoff from southern slopes.

The PJ Transportation Study has attempted to classify, in a general way, the types of development that are most or least affected by slope.

RELATION OF SLOPES TO TYPES OF DEVELOPMENT

	Urban and Suburban Uses	Rural Uses
Most Affected:	Row houses Low-rise apartments Factories Warehouses Rail and highway routes	Airports Hothouses
Moderately Affected:	Detached houses Commercial centers Streets Institutions Offices	Intensive recreation Horticulture Arable farms Feed lots
Least Affected:	Large-lot residences Roadside commerce High-rise apartments	Forestry Low intensity recreation Stock farms Summer resorts
Not Affected:	TV towers Water pressure tanks	Reservoirs Quarries

Source: PJ Paper No. 18

SLOPES - A MAJOR DETERMINANT OF LAND USE

The steepness of the slope is a major determinant of land use for both agricultural and urban purposes. Steep agricultural land is subject to severe erosion (and thus, shallow soils), and is not adaptable to farm machinery. Urban steep land has many problems such as: grades, costly retaining walls and danger of washing. These difficulties may be overcome; but at such high costs as to make steeper slopes unfeasible for typical small home subdivisions, or industrial or commercial purposes. In both cases, steep land should be used for pasture or woodland. Land that is excessively flat may not be well drained or subject to flooding.

The slope categories shown are those used and determined by detailed acre by acre field examination as part of the soil survey made by the U.S. Soil Conservation Service during the 1950's (and published July 1963). These categories may differ a little from those determined by attempting to measure contour distances on the U.S. Geological Survey topographic quads. The definition and limitation of each slope range is given below.

This map was prepared by the County Planning staff by hand coloring interpretative categories on 72 original field survey sheets and compositing and reducing them to a single map.

It can be seen that about 52% of the County is in the prime buildable (and farmable) 3-8% slope category. These areas seem to be particularly concentrated in the Schuylkill Valley, Chester Valley, the uplands between Paoli and West Chester, and along Routes 1 and 10 in southern Chester County.

In order to show the overall patterns of a large county on a single sheet, some of the categories had to be generalized. More detailed interpretative maps are on file at the Chester County Planning Commission, or are indicated on the raw data maps in the published soil survey report.

Source: Soil Survey, Chester and Delaware Counties, Pa., U.S. Soil Conservation Service, 1963

SLOPE

A - Nearly Level - 0 -3% - This slope is suitable for all types of commercial, industrial, institution and residential uses. This is the very flat land of the County, and, unfortunately, much of the land in this category is found on the flood plains. About 63,319 acres, or 13% of the County is in this category.

B - Gently Sloping - 3 - 8% - This slope is ideal for residential subdivisions. It permits good drainage off the landscape and a more interesting and variable landscape without severe grading problems; retaining walls and problems of steeper slopes. It is well suited for most crop purposes. Some of this category is also suitable for industrial or commerical use. Fortunately, nearly 249,000 acres, or about 52% of the County is in this category.

C - Moderately Sloping - 8 - 15% - These slopes are suited for residential subdivisions with care in construction and installations of individual septic systems. This slope is not too steep for cropland. About 107,455 acres, or 22% of the County is in this category.

D - Strongly Sloping - 15 - 25% - These slopes can be used for individual homes with care, but are generally too steep for residential subdivisions. About 33,487 acres, or 6.9% of the County is in this category.

E & F - Steep and Very Steep Slopes - 25% and up - These slopes are best suited for pasture, wild life and forestry uses. About 19,456 acres, or 4% is in this category.

Source: Chester County Soil Survey Report

SLOPE

CHESTER COUNTY

PENNSYLVANIA

SCALE IN MILES

1 INCH = 2 MILES

1:126,720

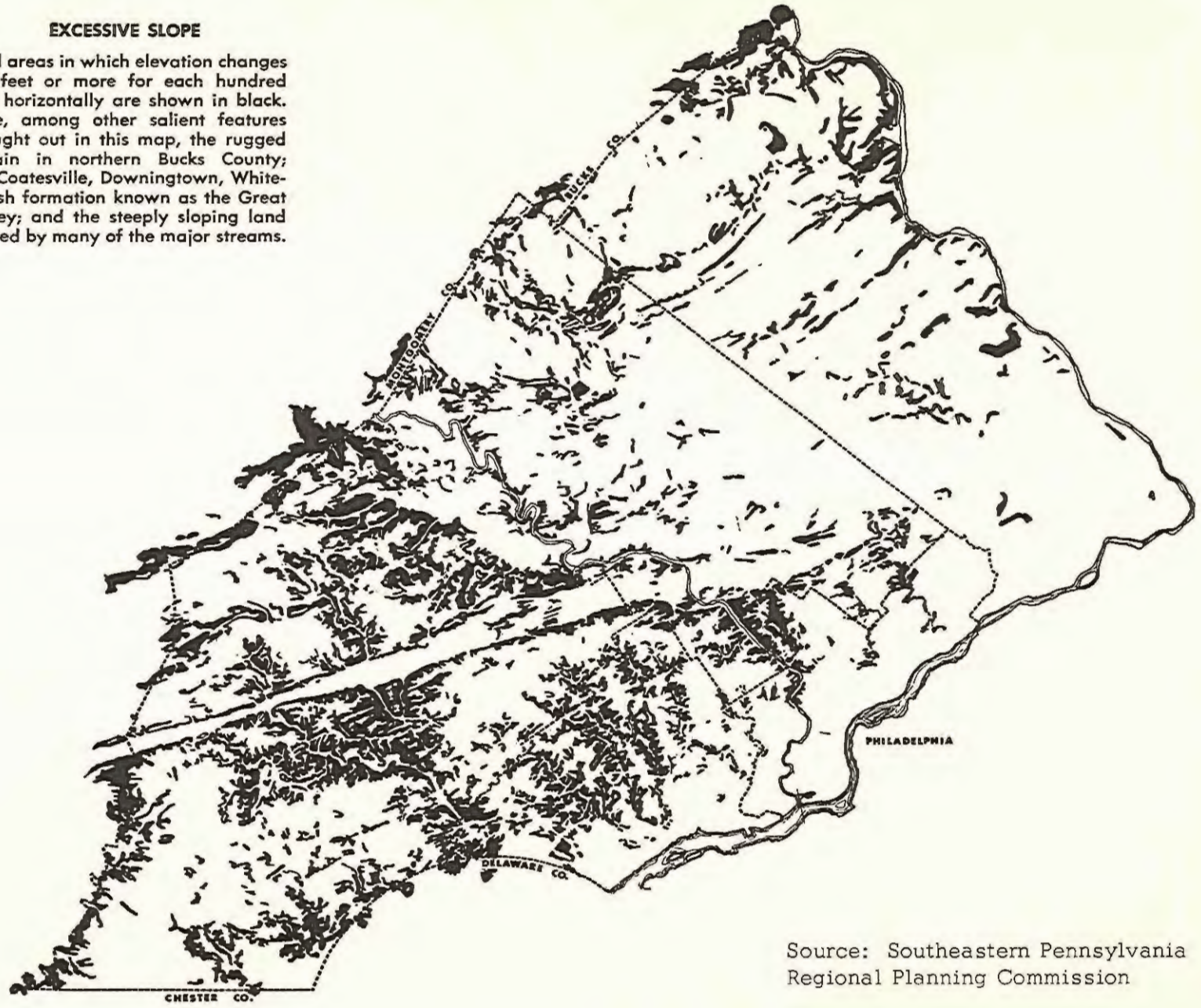
Compiled and published by the Chester County Planning Commission, West Chester, Pennsylvania

Printed October 1963 by Williams & Heintz Map Corporation, Washington 27, D.C.

Map L–2 SLOPE AREAS OVER 10% Philadelphia Area

EXCESSIVE SLOPE

Land areas in which elevation changes ten feet or more for each hundred feet horizontally are shown in black. Note, among other salient features brought out in this map, the rugged terrain in northern Bucks County; the Coatesville, Downingtown, Whitemarsh formation known as the Great Valley; and the steeply sloping land caused by many of the major streams.



Source: Southeastern Pennsylvania Regional Planning Commission

Table L-1

PAST TOPOGRAPHIC INFLUENCE DEVELOPMENT PATTERN

Borough	Topography	Elevation Range	Slope Range	Underlying Geology	Geographic Function
Oxford	On the ridge between the Octoraro and Elk Creeks.	400'-600'	4-8%	Wissahickon Mica Schist	Road junction and market center.
West Grove Avondale	On the relatively level Southern Chester Piedmont Plain in Toughkenamon Valley.	400'-600'	0-4%	Wissahickon Mica Schist Cockeysville Marble	Market and commercial centers for surrounding farm areas.
Kennett Square	On the rise between the East and West Branches of the Red Clay Creek.	200'-400'	4-15%	Setter's Formation	Agriculture service center plus limited industry.
West Chester	On a level hilltop of a rolling Piedmont Plain.	400'-600'	4-8%	Baltimore Gneiss & Gabbro	Marketing, cultural, civic and educational community developed at the hub of a sound transportation pattern.
Malvern	On an Upland Plain at the crest of the South Valley Hills.	400'-600'	4-8%	Wissahickon Chlorite Schist	Originally a railroad junction, now a dormitory community.
Downingtown Coatesville	On the narrow valley floor of the Chester Valley at the crossings of the East and West branches of Brandywine Creek.	200'-400' 200'-600'	0-4% 0-25%	Limestone	Industrial communities where a transportation corridor crosses the East and West branches of Brandywine Creek.
S. Coatesville Modena	On the south slopes of the South Valley Hills created by the incision of the West Branch of the Brandywine Creek. The stream valley narrows as it flows southward through Modena.	200'-600'	0-25%	Wis. Chlorite Schist	Municipal entities created from the Coatesville industrial community.
Parkesburg Atglen	In the narrow, western portion of the Chester Valley.	400'-600' 400'-600'	0-8% 0-8%	Limestone Limestone	Market communities located along the Penna. R.R. There is minor industrial activity in Parkesburg.
Honeybrook Elverson	On a rolling upland plain above the North Valley Hills.	600'-800' 600'-800'	4-8% 4-8%	Granodiorite Granodiorite	Agriculture & Transport Center. Marketing & Service community.
Phoenixville	On level land at the junction of French Creek and the Schuylkill River.	65'-200'	4-8%	Stockton Sandstone	River valley industrial community at stream juncture.
Spring City	A community created around a river crossing point up the Schuylkill from Phoenixville.	65'-200'	0-15%	Brunswick Shale	River valley industrial community at a river crossing.

Planning Application

Landforms and Slope Shape the County's Urban Growth.

More so than in most of its neighboring counties, the landforms and slope have shaped Chester County's past growth; and in much the same manner for the same reasons will continue to do so.

Map L-2, entitled "Excessive Slope" provides an overall regional picture of Slope Over Ten Percent in Southeastern Pennsylvania. It is apparent that Chester County has a larger percentage than its neighbors of land with slope over 10%. The natural area of lesser slopes as described below in the areas such as the Schuylkill and Chester Valleys, the West Chester – Paoli Plain are readily apparent.

Table L-1, "Past Topographic Influence on Urban Development" summarizes the topographic and geographic factors that have created the urban growth in the County.

Most urban centers have developed on level ground at stream or road junctions or at confluences of major streams with the Schuylkill River.

All these major natural features described in this report can be summarized and related to future development possibilities for the several planning regions with the slope areas the main criteria. The County lends itself to several major physical planning regions as follows: A map showing the general location of some of these areas is in the Summary.

Chester Valley — The County's most striking landform is the Chester Valley, which was the first gateway to the West bridging for about 50 miles the Philadelphia area with the Lancaster — Frederick lowlands. Here the first highway and the first railroad to the West was built. Later, main power lines and the first stages of the limited access highway also followed in this transportation corridor. The level, well drained land is the most valuable, both agriculturally and in mineral resources, due to the underlying limestones and dolomite. It has the greatest potential ground water yield, but at the risk of ground water contamination. Despite the value of the farmland, much of the Chester Valley should develop for relatively intense urban growth. Both public water and sewer services are needed and relatively easily supplied. The Valley Hills will provide an attractive framework and vista for urban development.

The manufacturing cities of Downingtown and Coatesville were located where the Valley was crossed by two branches of the Brandywine, thus providing a water supply, and in the early years, a limited power source. The small market towns of Atglen and Parkesburg are at the road junctions in the Valley.

The North and South Valley Hills, of course, tend to be steeper and less suited for large scale development; but are suited for large lot development. However, there are some relatively level sections near the top and these have been heavily developed, particularly in Tredyffrin Township, and its extension along Route 202 into Malvern. Elsewhere, the North and South Valley Hills become steeper westward and the Valley development in the South Hills is even less. Despite the water, excavation, and grading problems involved, the Valley Hills are attractive for some types of large lot hillside homes to take advantage of the vistas and views, but any sort of mass development should not be encouraged on the steeper slopes.

Schuylkill Valley Lowland — The Triassic lowlands of the Schuylkill Valley in the areas west of Phoenixville and Spring City seem to have development potential because of the gentle topography, relatively large ground water supplies, and availability of the Schuylkill River for water supply and sewage disposal. This area is also a transportation corridor — the first canal, early railroad, and future prospect of a great Schuylkill Valley Industrial Highway, all combine to indicate a favorable future as an urban reserve for this region. The soils here are physically suitable for cropping, but tend to be shallow, and less fertile than those in the Chester Valley or the Southern Piedmont Uplands.

West Chester — Paoli Plain — Another major area of relatively level land, here called the West Chester Plain, tends to run roughly along Route 202 from West Chester to Paoli and from the North Valley Hills to near the Delaware County boundary. It is the area of the headwaters of several streams (Darby, Ridgely, Crum, and Chester Creeks) that drain to Delaware County. Water can be supplied by the Philadelphia Suburban Water Co. and others, but sewage disposal would be more difficult. It is an area underlain by hard gabbroic gneiss, and thus has little ground water; the hard rock may also make excavation more difficult. The area has good transportation access, is adjacent to the outward sprawl of urban growth, and would seem to have considerable developmental possibilities.

The Southern Piedmont Uplands — Much of the Southern Chester County Piedmont has gently sloping uplands, between the Brandywine and Octoraro and between the North Valley Hills and the deeply carved stream valleys of the Elk and Clay Creeks. This area contains the U. S. Route 1 and the agricultural market towns that have developed along its corridor; and also the rich farm area along Route 10 from the Oxford area to the Chester Valley Near Parkesburg.

This area contains the largest amount of serious working farms in the County. While some urban development is likely around and near the existing urban centers, this region will probably remain the largest farming region in the County.

The Northern Chester Piedmont — There are several areas of relatively gentle slope in the Northern Chester Piedmont where either agricultural or urban growth could take place. The largest and most productive of these is Honeybrook — Elverson Upland, generally between the Welsh Mountains and the Baron Hills. This is an area of good farmlands that will probably remain in that use in the foreseeable future, since it is remote from urban centers and protected by steeper topography. There are also areas of relatively level land in Uwchland Township near the Lionville interchange that have encouraged substantial recent subdivisions based upon access to the Turnpike.

Highways and Railroads Follow Landforms on Ridges or Valleys.

Topography has determined, to a large part, the location of major highways. U. S. Route 1 follows the relatively level Southern Chester Piedmont. U. S. Route 30, for the most part, is confined to the south side of the Chester Valley. Its greatest terrain problems are encountered where it crosses the North Valley Hills (east of Coatesville) and the South Valley Hills (northern corner of Willistown Township). The Pennsylvania Turnpike enters the County from Berks County and follows the Valley of the Marsh Creek, skirts the gently undulating Northern Chester Piedmont near Lionville and follows the ridge of the North Valley Hills, until a gap occurs at Devault allowing the highway to follow the base of North Valley Hills into the Schuylkill Plain. North-South highways encounter the greatest terrain problems. Road locations following this general alignment will take advantage of stream valleys and breaks in topography.

The Pennsylvania Turnpike enters the Chester Valley near Devault.

The relatively rolling topography has made highway location and construction a more difficult problem than in the flatter, sandier areas, and thus contributes to the problems of narrow, winding, 18 ft.-wide cartways with poor sight distance.

Because railroad grades must be flatter than highways, topography dictates rail location to a greater extent. Most noticeable is rail alignment along streams and in major valleys. The "Main Line" of the Pennsylvania Railroad occupies the southside of the Chester Valley. The East and West branches of the Brandywine Creek are occupied by the Pennsylvania and Reading Railroads respectively. The Reading Railroad is also located in the Chester Valley and the Schuylkill Plain. The Octoraro Branch of the Pennsylvania Railroad traverses the Southern Chester Piedmont and roughly parallels U. S. Route 1.

ATLAS OF CHESTER COUNTY

DRAINAGE BASINS ARE NATURAL PLANNING UNITS.

Most citizens know their township, borough and other man-made political boundaries; but few know the natural watershed or drainage basin of their homes.

The watershed drainage basin is the principal nature-made unit. It is the vital unit for sanitary and storm sewer planning, and for most conservation planning. Recently watershed associations (such as the Brandywine Valley Association) have been formed to focus on land-use conservation problems.

The ridge lines shown are the drainage divides. Water flows downhill from each divide toward the stream indicated, and thence eventually to the sea.

The map was made by the controlled reduction of the twenty four $7\frac{1}{2}$' U.S.G.S. quadrangles covering Chester County (in whole or in part) from 1"=2000' to 1"=1 mile. A geologist determined the various divides.

Drainage patterns are similar to a tree with major and many minor branches. The heaviest lines on the map show the major divides separating major streams such as the Brandywine, with lighter weights for the minor and sub-minor basins. In general no basins of less than two square miles were shown.

Stream names are those shown on the U.S. Geological and Soil Survey maps. Minor run basins show blanks where unnamed. Name suggestions from local officials and watershed associations are welcome and will be added to future maps.

DRAINAGE DIVIDES

ELK — Major Basins

CRUM — Sub-Major Basins

PIGEON — Minor Basins

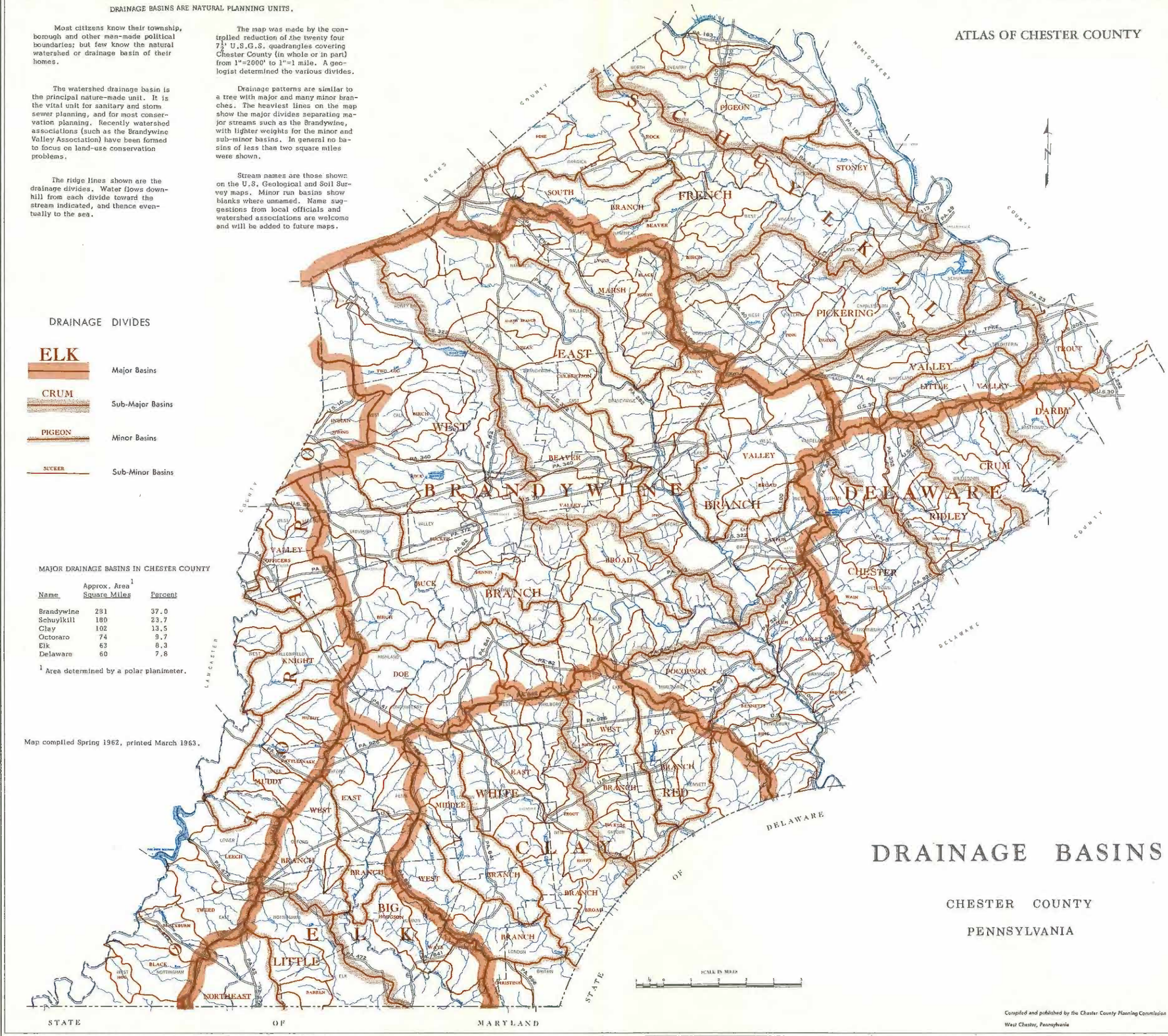
SUCKER — Sub-Minor Basins

MAJOR DRAINAGE BASINS IN CHESTER COUNTY

Name	Approx. Area[1] Square Miles	Percent
Brandywine	281	37.0
Schuylkill	180	23.7
Clay	102	13.5
Octoraro	74	9.7
Elk	63	8.3
Delaware	60	7.8

[1] Area determined by a polar planimeter.

Map compiled Spring 1962, printed March 1963.



DRAINAGE BASINS

CHESTER COUNTY

PENNSYLVANIA

Compiled and published by the Chester County Planning Commission
West Chester, Pennsylvania

Drainage

Most Streams Flow in a Southeasterly Direction Toward the Sea.

Drainage is the natural downward flow of all water to the sea and the mode by which it travels — whether through surface ditches, gullies, streams or rivers; or subsurface water tables and solution channels; or a combination of above or underground modes.

Most of the main streams — Brandywine, Elk, Clay Creeks — in Chester County, flow down the main southeastward trending slope at an approximate right angle to the main strike of the rock. They are known technically as consequent streams because they follow the initial slope of the land. The French, Pickering, Pigeon, and others in the Triassic lowlands — that flow to the Schuylkill — are exceptions. They start as consequent streams in the hard rock uplands; but then flow northeast to the Schuylkill by eroding channels down the weaker Triassic age rocks. Streams that take short cuts through weaker rocks are known technically as "subsequent streams". The drainage to the Octoraro which trends southwest, rather than southeast, may be termed a secondary consequent stream.

For greater ease of understanding, this report divides the County into six major drainage areas. The location and areal extent, as shown on the small fold-out map, entitled, "Drainage Basins".

Drainage Areas in Chester County

Name	Land Area Sq. Mi.	% of Land Area
Brandywine	281	37.0
Schuylkill	180	23.7
Clay Creek	102	13.5
Octoraro	74	9.7
Elk	63	8.3
Delaware	60	7.8
	760	100.0

Over 60 percent of Chester County is drained by two streams — the Brandywine Creek and the Schuylkill River. By adding the drainage area of the Clay Creeks, these three drainage systems comprise 663 square miles or nearly 75 percent of the County.

A drainage basin is that natural mold rimmed by sufficient topographic elevations from which one stream is fed. Drainage Basins are graded according to Major Basins, Sub-Major Basins, Minor Basins, and Sub-Minor Basins, as shown on the (fold-out) map entitled, "Drainage Basins". Examples of each are:

Major Basin — Delaware River
Sub-Major Basin — Brandywine Creek
Minor Basin — West Branch
Sub-Minor Basis — Birch Creek

82% of Chester County Drains to the Delaware (58%) and Schuylkill (24%) Rivers.

There are three major basins draining Chester County and they are:

Name	Sq. Mi. Area	% of Co.
Delaware and Schuylkill Rivers	623	82.0
Susquehanna (Octoraro)	74	9.7
Chesapeake Bay (Elk)	63	8.3
	760	100.0

The Stream Pattern Is Densely Spaced and Has a Dendritic Pattern

Most of the stream pattern of Chester County flows somewhat like the branches of a tree with successive smaller branches, which physiographers call a "dendritic" pattern. This is due to relatively uniform permeability of the underlying rock. There are small areas, particularly where the Brandywine crosses the North and South Valley Hills, where some of the streams assume a "trellis" pattern.

Because of the 45 inch average rainfall per year, and the small capacity of most of the underlying rock to absorb and store water, the drainage pattern is closely spaced with many streams per square mile.

Typical water shed–Birch Run.

Drainage Basins (Watersheds) Are the Natural Planning Units

Most citizens know their township, borough and other man-made political boundaries; but few know the natural watershed or drainage basin of their homes.

The watershed drainage basin is the principal nature-made unit. It is the vital unit for sanitary and storm sewer planning, and for most conservation planning. Recently, watershed associations (such as the Brandywine Valley Association) have been formed to focus on land-use conservation problems.

The ridge lines shown on the small fold-out map, entitled, "Drainage Basins" are the drainage divides. Water flows downhill from each divide toward the stream indicated.

Drainage patterns are similar to a tree with major and many minor branches. The heaviest lines on the map show the major divides separating major streams such as the Brandywine, with lighter weights for the minor and sub-minor basins. In general, no basin of less than two square miles was shown.

Urban Growth Makes Runoff and Flood Problems More Critical.

The original land cover found by the 17th century settlers was a virgin forest of hardwood (Oak, Chestnut, and Hickory). Heavy wood cover tended to absorb and moderate rainfall and coupled with natural ponding regulated runoff in a more natural way, and tended to hold back flash floods.

The clearing of land accelerated runoff and erosion, and on some of the steeper slopes carried off up to 75% of the original topsoil. Urban growth has greatly accelerated runoff problems and tends to create flash floods.

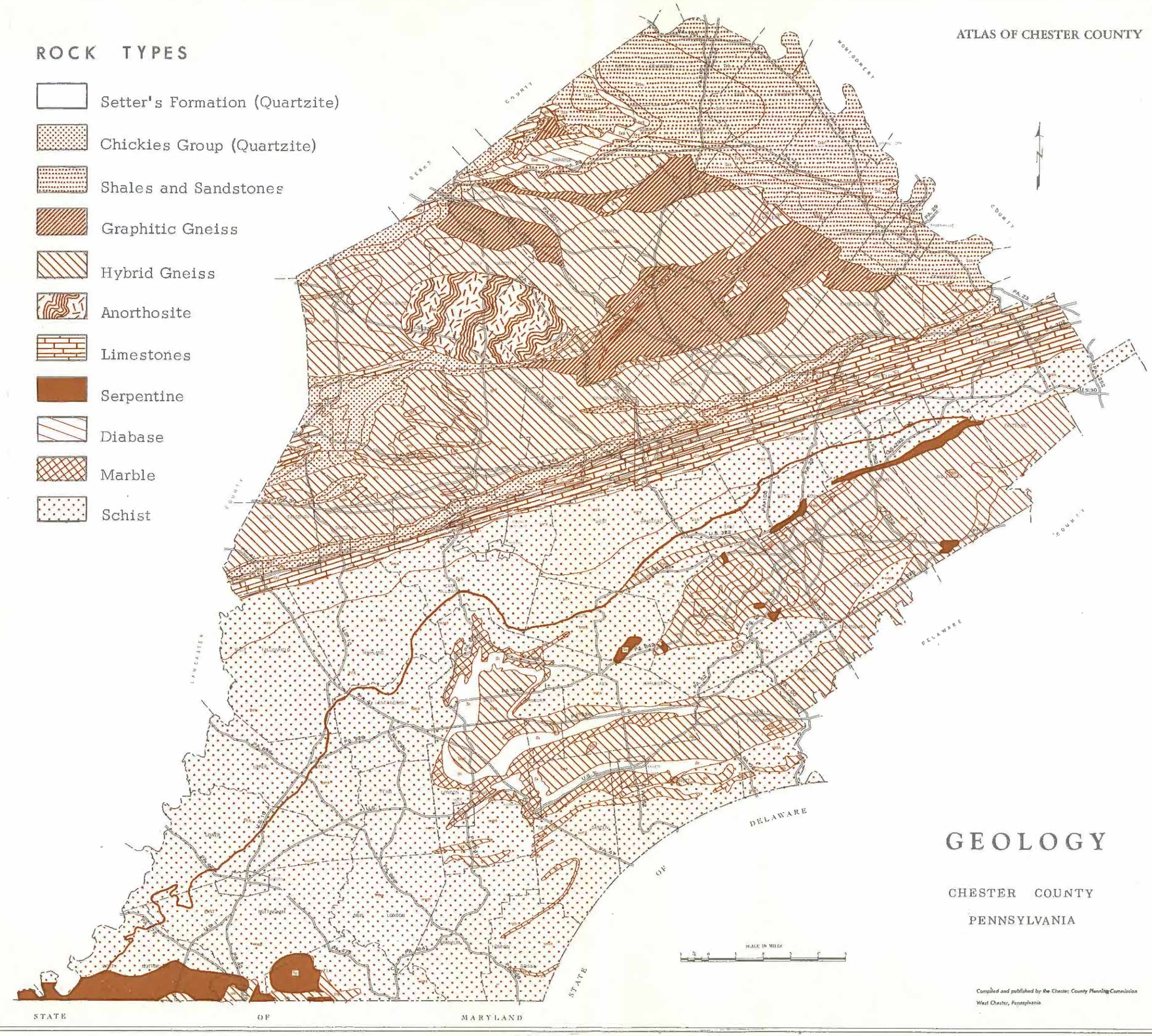
It is vital that building that would be damaged by flooding be kept off the flood plains. The soil survey indicates the area of alluvial soil flood plains, as maped in the soil section of this report, which is the minimum area subject to more or less regular flooding. In order to ascertain the areas subject to flooding at various frequencies more exactly, the Chester County Planning Commission and the Brandywine — Red Clay Valley Associations jointly applied in April 1963 for a detailed determination of relative flood frequencies by the Corps of Army Engineers.

Uusally of more frequent concern than too much water is the problem or too little during an occasional dry year. Fortunately, the Brandywine Valley Water Supply Plan of many small upstream flood control and water supply reservoirs coupled with increased use of sound conservation practices are the best tools now available to deal with the problems of too much or too little water.

Chester County, through the Brandywine Valley Association, has been a national pioneer in watershed conservation. The Association sponsored one of the first 566 Small Watershed Flood Prevention Programs in the Northeastern United States. The need now is to continue to support this work, and particularly, to extend watershed work to other parts of the County, especially to the French Creek and other basins draining into the Schuylkill River.

ROCK TYPES

- Setter's Formation (Quartzite)
- Chickies Group (Quartzite)
- Shales and Sandstones
- Graphitic Gneiss
- Hybrid Gneiss
- Anorthosite
- Limestones
- Serpentine
- Diabase
- Marble
- Schist

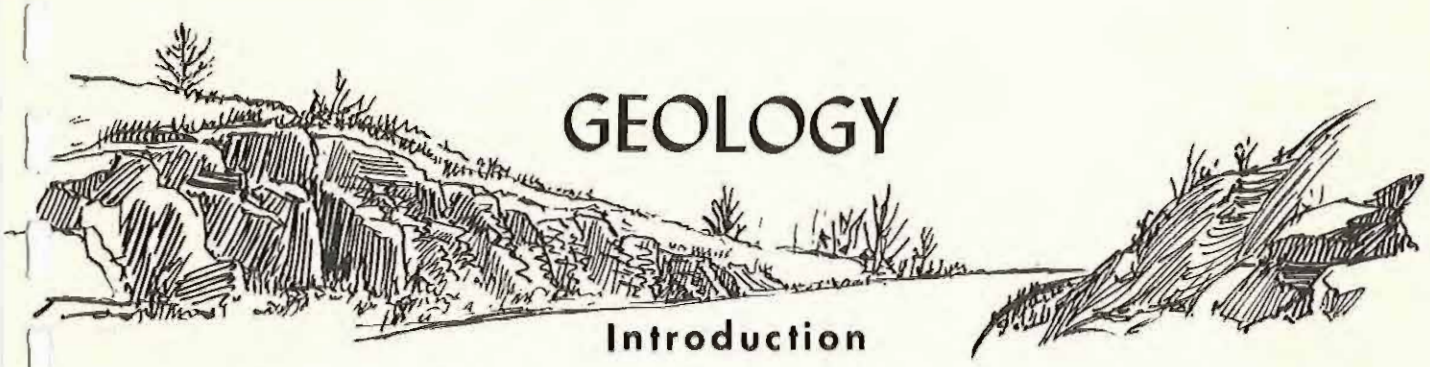


GEOLOGY

CHESTER COUNTY

PENNSYLVANIA

Compiled and published by the Chester County Planning Commission
West Chester, Pennsylvania



GEOLOGY

Introduction

Underlying Geology is of Major Practical Importance.

The type and structure of the rocks underlying Chester County are of major direct and indirect practical concern to the planner in determining the uses that could or should be made of the overlying land surface. They have been a major factor in determining the landforms and slopes described in the Landforms Section; and thus, directly and indirectly influence such aspects as transportation routes and the pattern of settlement. Rock properties are the major determinant of the quantity, quality, and contamination potential of ground water; the ease of difficulty of excavation; the soundness of foundations for buildings, highways, bridges, and dams; the possible hazards of earthquake, abnormal settling of foundations, rockslides and background radiations; the capacity to absorb or transmit explosion shocks; the nature and property of building stones and other earth products, and, in part, the type of soil found.

This Report is a Limited, Non-Technical, Generalized Report of a Few Geologic Factors Important to Planning Preliminary to More Detailed Studies.

Time and resources available for this report permited only basic generalizations in non-technical language of a few of the aspects of Chester County's underlying rocks and their structures that are important to an understanding of the existing land use patterns and of factors important in future land use planning.

Its emphasis is on practical applications — how the underlying rocks affect the uses that can and should be made of the land surface. Excellent technical analyses are available in the published reports listed in the bibliography; although some of these do not discuss the practical application to planning or necessarily reflect the latest knowledge. Most of these reports are out of print; but copies can usually be found in the larger reference libraries, and some are on file at the Chester County Planning Commission office. Many of the State Geological Survey Bulletins, such as M-15 on "Building Stones of Pa." (1930), and M-20 "Limestones of Pa." (1935) and Water Supply Report W-4 "Ground Water in Southeastern Pennsylvania" (1934), are still useful.

While, for the most part, generalizations pertaining to such factors as ground water yield, rock competency, mineral content, soil derivations, etc. are based upon competent sources, it must be understood that the indefinite nature of geology as a science introduces many exceptions and variations. Natural properties of rocks can and do vary greatly from formation to formation and from place to place within a formation. As a result, detailed studies of any specific site problem require the service of a competent geologist.

Fortunately, Chester County's geology has been closely studied and mapped by geologists in the past in greater detail than is true for most other areas. Additional studies in the nature of ground water analysis, of the crystalline rocks and airborne magnetometer mapping are still taking place. Much remains to be done, in more detailed surface mapping, as well as in detailed quantitative studies of mineral and ground water resources.

It is hoped that the services of a geologist can be obtained later to undertake a more detailed and technical approach to practical and applied aspects of geology in planning than is presently possible. One need is to be able to more definitely relate urban lot sizes and population densities to the underlying rocks and soils.

Areal Geology

The County Geology was Well Mapped During the 1920's and 1930's.

Geologically, Chester County is comprised of a highly complex area of folded and altered rocks of many ages where interpretation is difficult. Rocks of all three origins occur: igneous, metamorphic, and sedimentary, with most major rock types of each being present.

The basic areal geology of the County was relatively well mapped during the 1920's and 1930's by the pioneer geologist of the Philadelphia region, Professor Florence Bascom, then Chairman of the Geology Department of Bryn Mawr College, and her many associates. The Coatesville — West Chester 15' quadrangle was published in 1932 as U. S. Geological Survey Folio No. 223, and the Phoenixville — Honeybrook quadrangles in 1937 in U. S. Geological Survey Bulletin No. 891. These two publications are the basic specific technical reference sources for Chester County and include the most detailed geologic maps at a scale of 1:62,500 or about 1" = 1 mile. The maps are printed on the old 15 minute geological survey quadrangles published around the turn of the century and were then — and until the mid 1950's (when the present 7-1/2 minute topographic quadrangles were published) — the most accurate base maps available. Parts of the eastern end of the County are covered in the old Philadelphia Folio No. 162 (1909); and a piece of the extreme southwestern area is in the McCalls Ferry-Quarryville quadrangle published in 1929 as U. S. Geological Survey Bulletin No. 799. Chester County, of course, is also included in less detail in the new Geologic Map of Pennsylvania published in 1960 at a scale of 1:250,000 approximately four miles to the inch. This map also contains changes in terminology, and some previously unpublished changes in areal mapping.

These maps present the most recent information available. Owing to the soil covering, few rock outcrops are visible and contacts are often indefinite, and there is much intergrading of rock types. It is therefore usually impossible to indicate exact formation boundaries. Although there have been some changes in terminology and classification, these can be adjusted without remapping.

Since the detailed maps are out of print, it is anticipated that the Chester County Planning Commission will later reprint a large scale revised version showing all features and resources. Meanwhile, a small fold-out map entitled, "Geology", shows major rock type relationships used in this report in a generalized way. A larger scale version of the same map showing the details of the originally mapped rock types is available from the Planning Commission upon special request.

Rock Types Have Been Grouped for Simplicity and Practical Analysis.

Rock types are classified basically by origin, by rock type, and by age of formation. Of these, the rock type is the most important for this report. Technical differences in mineral or chemical composition, texture or structure, and age, not having major effects on practical applications are not treated in this report. These technical matters are described in the reports listed in the geology bibliography.

The basic rock types of most of Chester County are crystalline meta-igneous and metamorphic rocks. Sedimentary rocks of Triassic age are found in the Schuylkill Valley Lowlands generally east of French Creek; and meta-sedimentary limestones and dolomites of Cambrian and Ordovician age underly the Chester Valley.

The principal rock types, location, and their practical properties are described in the paragraphs that follow, and are shown on the small fold-out map entitled, "Geology".

Crystalline Igneous and Metamorphic Rocks Underly Most of the County.

Most of Chester County, except most of the Schuylkill Valley Lowlands, are under-

lain by metamorphic rocks. These are rocks that have been recrystallized and in many cases hardened by intense heat and pressure when they were far below the surface during one or more periods of great geologic disturbance. Original metamorphism took place in early geologic times with folding and faulting during the Appalachian Revolution.

The degree of metamorphism depends upon the original rock type before recrystallization and the relative intensity of heat and/or pressure. These are difficult technical considerations, far beyond the scope of this report other than to say that the original shales were foliated and hardened to schists and phyllites, sandstone to quartzites, limestone to marble, and granites to gneisses. There are many degrees of metamorphism found in the rocks.

All generally are fairly resistant to erosion and tend to form rolling uplands. As a group, metamorphic rocks are hard and dense, and thus have little ground water storage capacity, except in the fractures and fissures. They generally make excellent foundations, provided solid bedrock below the weathered area is reached. There is often, particularly overlying schists, a deeply layered zone of soft, strongly weathered "rotten rock" known as "saprolite". Where solid unweathered bedrock is involved excavation is difficult. Many types of metamorphic rocks have value as dimension stone and a few as crushed stone.

The overlying soils tend to be silty or clayey loams in the Glenelg Manor or Glenelg – Neshaminy Association. These soils are relatively susceptible to frost action and are not the best for engineering construction.

The major crystalline rocks, according to Dr. E. H. Watson, Charman of Geology of Bryn Mawr College, are:

Hybrid Granitic Gneisses – Most of the County between the North Valley Hills and the Triassic Lowlands and a large portion of the eastern part of the County are underlain with metamorphic rocks that were originally both sedimentary and igneous rocks. These rocks were originally mapped by Professor Bascom as gabbro (amphibolites), granodiorite, Baltimore gneiss and quartz-monzonite, but because of similar properties and much intergrading, the granoriorite, quartz-monzonite and Baltimore gneiss are lumped as granitic gneiss. They are light colored "felsic" rocks. The "gabbro" is really an amphibolite, is dark colored, and was originally probably gabbro or basalt.

They are hard rocks that have strong though varying resistance to erosion and in parts of the region form rolling uplands. The amount of relief present varies in different localities and depends upon the relative position of the uplands above local base level as well as local differences in rock hardness. In the northern part of the County, elevations are higher and stream gradients steeper; hence stream erosion has cut more deeply into the uplands with the result that they are more strongly dissected and include a number of moderately deep narrow valleys. At the head of the streams in the West Chester – Paoli areas, stream gradients are not as steep and downward erosion is not as rapid and thus a relatively level and undissected upland is present.

These rocks weather to a moderate depth. The gabbros (which technically are now recognized as amphibolites) and Baltimore gneisses weather rather evenly to an average depth of about eight feet, with the gabbros tending to form boulders. The granodiorites and quartz-monzonites, mostly occuring to the north of the Chester Valley, tend to weather more deeply to about 10 to 15 feet, and weather more irregularly. This uneven weathering makes test drilling necessary prior to construction of foundations and roads.

All of the above rock types are overlain by either the Glenelg-Manor or the Glenelg-Neshaminy Soil Association with some tendency for the Glenelg-Neshaminy Association to be more common over the rocks originally mapped as gabbro or Baltimore gneiss. This may be related to the greater uncertainty of proper functioning of septic tanks in the Glenelg and Neshaminy

soils formed from this parent material than those formed from mica schists, as discussed in the soils section. The Baltimore gneisses tend to be clayey.

Because the amphibolites are harder, denser, and less weathered, the fractures are fewer, and these types, along with the even denser diabases, are the poorest water sources in the County. Water yields range from 2 — 10 gallons per minute. The other gneisses, granodiorite, and quartz monzonite, particularly the latter two, tend to be more deeply weathered and may yield between 0 — 60 gpm with an average of between 5 and 10 gpm.

Some of the gabbro and amphibolite have value as crushed stone because of its hardness and toughness. The other granitic gneisses also have some possible use as crushed stone, but are not widely used because better sources are available. The Baltimore gneisses have had some use as a building stone, but more so from quarries in neighboring counties than from those in Chester County. The Cornog quarry near Glenmoore, producing crushed stone, mines granitic gneiss.

All these rocks are excellent for foundation support — generally being the strongest available — for heavy construction such as building and dams — provided sound unweathered rock is reached. All granitic gneiss may be subject to a slight amount of rock creep or downward slippage of massive jointed blocks; but this characteristic is measurable only over a period of many generations.

Pickering Gneiss — Pickering gneiss has properties similar to those of the hybrid granite gneisses. The chief difference is due to the possible presence of graphite and to a slightly larger supply of ground water. This rock is shown separately on the accompanying geology map; and is found primarily in the vicinity of Pickering Creek and in the area directly east of Elverson. It has not been used as a crushed or building stone.

Anorthosite — Anorthosite is found in an oval shaped area about six miles long and 3-1/2 miles wide in Honeybrook, West Nantmeal and Wallace Townships, as shown on the fold-out Geology map. It is an unaltered igneous intrusion with different mineral and chemical composition from granitic gneiss in that it contains much more plagioclase feldspar. This is an unusual rock type for this area. It is hard and similar to gabbro in that it weathers rather slowly to an average depth of five to eight feet. Neshaminy — Glenelg soils overly, has little space for ground water storage and has a yield range comparable to gabbro of 0 — 10 gpm with an average of 5 gpm. This rock may have value as a crushed or dimension stone, but is not now so used. Because it contains 25 — 30% alumina, the rock might have a long range future possibility as aluminum ore, when cheaper electric power is available and better sources elsewhere are exhausted.

Pegmatite — Pegmatite dikes are limited in extent in the County and have not been shown on the Geology map because of their small size. Pegmatite is found in granitic material in Schuylkill Township, in Valley Township, in the middle of Willistown Township, and in New Garden and Kennett Townships. Weathering is somewhat irregular, this being a very coarse granitic rock. This formation is found in a rolling topography and because of irregular weathering soils will frequently be thin to nonexistent on hilltops and as deep as 20 feet in valleys. The pegmatites will generally yield small quantities of water with a recovery ranging from 0 — 10 gpm with an average of between 5 and 8 gpm and have proved more reliable as a source than the rock diabase. Pegmatite contains feldspar and quartz and was quarried in the past for feldspar. Just over the State Line in Delaware, this formation is being quarried for kaolin. While pegmatite is a relatively hard rock, foundations will be reasonable to excavate.

Schists — The most abundant rock underlying most of Chester County south of the Chester Valley (except in the eastern portion) are schists, which are a result of the metamorphism of soft clay shales

originally present. They are moderately hard and tend to weather somewhat deeper than genisses or other hard rocks. Consequently, the landscape in the mica schist area tends to be less rolling than the granitic gneisses north of the Chester Valley, except where Clay Creek and Elk River steeply down-cut in their course to the Fall Line Zone and the Coastal Plain.

The deep weathering of this rock, occasionally as much as 100', tends to improve the percolation characteristic of the soil; but frequently presents foundation problems. The rock material in the deeply weathered zone is known as "saprolite" or "rotten rock". Foundation conditions for heavy buildings should be carefully checked in areas underlain by schist. Deep weathering is particularly a problem in some of the southern areas and in the South Valley Hills.

Because of the greater weathering, schists yield more ground water, the amounts ranging between 10 and 30 gpm to a maximum of 70 — 100 gpm. Some of the smaller boroughs, such as Oxford in southern Chester County, manage to obtain a precarious municipal water supply from wells, but are now facing shortages. The ground water from schists is of high quality of purity and softness.

The schists can be divided into two phases: the northern and the southern. Both form rolling uplands generally more gentle than the gneisses. The two are separated by a line on the small fold-out Geology map.

The northern phase is comprised of two formations: the Wissahickon albite chlorite schist and the Peters Creek schist. The albite chlorite schist underlies and forms the South Valley Hills while the adjoining Peters Creek schist forms the uplands to the south. Weathering of these rocks is deep, particularly in certain areas of the South Valley Hills. Foundation problems may occur because of the great depth of weathered rock. The rock itself has no significant commercial value. It is less metamorphosed than the southern phase.

The southern phase is comprised of Wissahickon oligoclase mica schists, which also form rolling uplands. It, too, is deeply weathered, with the weathered zone averaging 30 to 50 ft. to bedrock with occasional thicknesses as great as 100 ft. before fresh bedrock is reached. Precaution in detail foundation testing for heavy building is needed. Water yields are slightly better than the northern phase, with fewer dry wells. There is some possibility with drilled wells of mica flakes clogging the screen.

The mica schist has been extensively quarried for building stone in the Philadelphia region; however, there are few quarried in the Chester County area, perhaps because of excessive distance from building sites. The weathered upper portion of the mica schist has some possible value as a future source of low grade mica for insulation products; although in competition with the preferred white mica, it suffers the handicap of a yellow color (due to iron content).

Diabase and Quartzite are the Most Resistant Rocks and Thus are the Principal Ridge Makers.

Several of the hard rock types, primarily the diabases and quartzites, are particularly resistant to erosion and consequently form the major ridges in the County. The degree of relief depends in a large part upon the resistance of the surrounding rocks. Thus, where the hard, highly resistant Chickeis quartzites lie adjacent to the softer, more easily eroded limestones of the Chester Valley, very prominent ridges are present. Similar ridges occur in the vicinity of the contact of the diabase and the shales underlying the Triassic lowland.

The principal ridge makers are the diabase and the quartzite, with serpentine and related rocks, also forming uplands. All of these rock types are shown separately on the Geology Map.

Diabase — Diabase is a hard, tough, igneous, intrusive rock, the hardest and toughest in the County with the possible exception of localized areas of quartzite. Most of the diabase in the County is in the high ridge of the upper region of French Creek in Warwick Township. There are some areas of older pre-Cambrian diabase dikes scattered throughout Baltimore gneisses, but these are too small in areal extent to be shown on the Geology map.

Because of its hardness, compactness and resistance to fracturing and fissuring, diabase has a very low porosity and few voids. Consequently, there is little contained water, with wells yielding very low volumes that range from 0 — 5 gpm. As a rock type, it is the poorest source of ground water in the County and dry holes are frequent.

The rock is very resistant to weathering and tends to form into massive boulders with minimum amounts of fine material suitable for soil. Soils are thin (3 — 5 feet) or non-existent. Owing to its hardness, areas underlain by diabase are generally unsuitable for urbanization because excavations for foundations and rock cuts are extremely difficult and costly. Such areas should best remain in woodland.

The rock has some value as trap rock for non-abrasive crushed stone and paving stone and is the source of the famous "Belgium block" that paved and curbed the City of Philadelphia. Because it takes a high polish and is durable, its chief value is for monument stone and a building trim known as "black granite". Haulage over long distances to specialty market is feasible because of this special value. Diabase is generally not used for dimension stone, except locally, because of its somber black color.

Quartzite — Quartzite is a strongly metamorphosed sandstone that occurs as a hard, smooth rock. Its hardness, second only to diabase, resists erosion and weathers slowly. As a consequence it may, and frequently does, form high sharp ridges.

Most of these ridges, including part of the North Valley Hills, Welsh Mountains, Baron Hill, Thomas Hills, and State Hills, are Chickies quartzite areas north of the Chester Valley. The only quartzite areas south of the Valley are the Settler's quartite which forms lower ridges over the Toughkenamon Valley and the central ridge in Kennett Square.

Like other hard rocks, water yields are low, although slightly better than from diabase or gabbro. Average ranges are between 5 and 15 gpm.

Quartzite, particularly the Setter's quartzite, quarried near Avondale, is a valuable and beautiful stone. The Chickies quartzite elsewhere has been used as a blast furnace factory lining. Quartzite sometimes has been used as a crushed stone; but is not as desirable as other competing rock types because of its lack of cementing properties, a tencency to brittleness, and to undue wear of crushers due to its hardness.

Serpentine — Serpentine and related rock types are moderately hard ultra-basic metamorphic rocks formed from original igneous intrusions. It is found primarily in the area south of Oxford near the Maryland border. Small out-crops are also found in the West Chester and Willistown areas. It tends to weather slowly, but not as slowly as diabase. A thin, poor "Chrome soil", with little agricultural value, overlies it.

Depending upon the surrounding rock, serpentine tends to form low, flat uplands. Because of the poor quality of the soil and the difficulty of excavation, the area is known as the "Barrens". The Pennsylvania Department of Highways has reported that the soils formed from serpentine are the most difficult in the State for highway construction.

The rock tends to fracture more easily than does diabase and quartzite and thus ground water yield may average between 10 — 30 gpm which is sufficient for domestic use. It contains more dissolved salts than other rocks.

Serpentine stone, with its distinctive green color, was once widely used for building purposes. Many of the buildings at West Chester State College and the University of Pennsylvania are of serpentine. The stone lost favor when acid content in the air in urban areas caused deterioration. Serpentine was also the source of the chromite ore mined about a hundred years ago. It also contains small deposits of asbestos of no commercial value.

The best use for areas underlain by serpentine is woodland, parks, or very low density residential development. Most of the recently acquired Chester County Park at Nottingham is underlain with serpentine.

Sedimentary Sandstones and Shales Underly the Schuylkill Valley Lowlands.

In the general area east and north of French Creek and in the Phoenixville vicinity, as shown on the Geology map, other different rock types occur. These are sedimentary rocks — conglomerates, shales, argillites and sandstones formed much later in geologic time during the late Triassic era (the early part of the Age of Reptiles). They are comprised of sands and muds washed down from the highlands and deposited either in alluvial or lake environment that then covered much of the County. The deposits subsequently were cemented and hardened into rock.

These sedimentary rocks are a stratified series with bedding planes essentially parallel owing to initial depository of eroded material under water. Their thickness varies from a few to several hundreds of feet whereas the crystalline rocks are massive with thicknesses in the thousands. The sedimentary rock overly the deeper crystalline. They are generally much softer than the igneous and metamorphic rocks and their porosities are nearly always considerably greater.

The attitudes or position of the Triassic sedimentary series, present within the County, is essentially flat lying with a gentle northerly dip. However, uplift and compression of the beds, since deposition, has resulted in a series of relatively gentle folds striking east-northeast and forming a general landscape of elongated ridges and valleys parallel to and coincident with the folds.

The sedimentaries, being softer, are generally easier to excavate than are the crystalline rocks found in the remainder of the County. Foundation bearing strengths of the rock formations themselves, although generally weaker, are normally adequate for ordinary structures. Having greater porosities, they consequently have significantly greater yields of ground water in those instances where permeabilities are sufficiently high as in the sands and conglomerates. Water yields in rocks of this nature depend largely on porosities rather than on joints and fractures and that as a result the probabilities of drilling large numbers of dry holes are considerably less than in the crystalline areas. In respect to both metallic and non-metallic minerals, the sedimentary sandstones and shales occuring within Chester County usually are barren.

There are three formations of Triassic sedimentary rocks identified on the detailed state geologic map, which are not shown separately on the small fold-out map. They are, beginning with the oldest, the Stockton, Lockatong and the Brunswick formations. These are identified as formations since they are composed of successive layers of different types of rocks, mostly shale, arkosic, sandstone, argillite and conglomerates.

The Stockton Sandstone — The Stockton Formation is comprised of layers of arkosic sandstone, siltstones and conglomerate irregularly interbedded with layers of red shale as well as fine grained silicous sandstones. It is located in a narrow belt along French Creek and through much of Phoenixville and Schuylkill Townships. Because of its ease of erosion, the Stockton forms gently rolling or relatively flat lowlands.

It weathers evenly, although fairly slowly, and is overlain with thin soil, mostly of the Penn Lansdale series. Its foundation bearing strength is not as great as most of the crystalline rocks, but adequate for ordinary buildings. It is relatively easy to

excavate, and can often be removed with a power shovel. The Stockton has some value for building stone, but is too soft for crushed stone.

The Stockton sandstone is the best source of safe ground water in the County. Yields will range from 100 to 300 gpm, averaging about 130 gpm of moderately soft water.

Recently, detailed research by the Ground Water Branch of the U. S. Geological Survey has shown that for ground water purposes the Stockton should be subdivided into three units. The middle has the best yields of about 130 gpm, the lower arkose unit about 110 gpm, and the upper shale member only 20 gpm. These subdivisions are not shown on the geologic map, but in most of Chester County, the Stockton formation produces from the high yielding middle and lower units.

The Lockatong Argillite Formation — The Lockatong formation is comprised of dark gray to black, thick bedded argillite with occasional zones of thin bedded black shale. Locally there are thin layers of limestone and calcorgous shales and rare sandstones. The formation is partially metamorphized.

Because this formation is relatively harder than the surrounding sandstones and shales, it tends to form ridges trending in an east-northeast to west-southwest direction. The Lockatong is limited in Chester County to a narrow ridge more or less along Route 23, west of Phoenixville. It, however, is a principal ridge maker in Montgomery and Bucks Counties.

Because of the hard, impervious shale, with fractures, ground water yields are poor, averaging only 10 gpm, but along fault zones yields are occasionally as high as 100 gpm. The water is moderately hard. The formation is somewhat harder to excavate or to drill than are most ordinary shales and sandstones. It is used locally as crushed stone in Montgomery and Bucks Counties.

The Brunswick Formation — The Brunswick is a formation comprised largely of soft red shales with interbedded red to brown, fine to coarse grained quartzose sandstones. In places it carries minor interbedded shale and limestone conglomerates as well as major interbedded units or quartz pebble conglomerates.

The formation occupies the largest areal extent of the Schuylkill Valley Triassic lowlands generally from Spring City to Pottstown. The Brunswick red sandstone and shale phase is a fairly soft material and thus readily weathers to a low level plain.

Although it is relatively weak, it does have sufficient strength to support all but the heaviest buildings without special underpinning. Excavation is a comparatively simple matter with a power shovel although occasionally blasting may be necessary.

This rock has no value as crushed stone or building stone. It is a source of a moderate supply of ground water ranging from 20 — 40 gpm, depending upon variations of porosity and permeability.

The quartz pebble conglomerate phase is more prominent near the western edge of the Brunswick formation in Chester County. It is in this area that the generally recognized red sandstones and shales grade into and are interbedded with a poorly sorted series of quartz pebble conglomerate beds. These conglomerate beds are generally well cemented and hence resistant to erosion with a resultant formation of more extensive uplands than are present to the east.

The Limestones of the Chester Valley Define the County's Most Valuable Land, Soil and Minerals; But Have Special Problems.

The Chester Valley is the County's most distinctive topographic feature and contains its most valuable land. It bisects the County, running on a generally east-northeast west-southwest line from Tredyffrin Township to Atglen where it leaves the County. It is widest to the east, particularly in East and West Whiteland Townships and progressively narrows to less than one half mile at Atglen.

The Valley was formed not by a major stream, but by a sequence of limestones and dolomites down-dropped by a combination of folding and faulting to form a relatively narrow band of sediments lying between the igneous and metamorphic rocks on either side. Subsequent physical and chemical weathering, the latter at the surface as well as at the depth, has further reduced the general level to below that of the quartzites of the North Valley Hills and of the Wissahickon albite-chlorite schist of the South Valley Hills. The Valley is therefore defined by the limestone area.

The Hagerstown and Conestoga soils formed from limestone are deep and well drained; and they are the most valuable agricultural soils in the East.

The limestone — dolomite rocks are sedimentary in origin, having resulted from the deposition of countless billions of shells constructed by the microscopic animals which existed in the waters of the seas covering the area during the Cambrian and Ordovician times. Within the Valley, the beds are sharply contorted into a series of long parallel anticlines and synclines often overturned to the North-Northwest with both limbs frequently compressed together, and dipping steeply to the South-Southeast. Their trend is parallel to that of the Valley.

The most distinctive characteristic of these limestones is that the chemical interaction of air and water tends to form a weak carbonic acid solution which in conjunction with humic acid formed from the decay of vegetation, slowly dissolves the limestones and forms underground solution channels which frequently extend over long distances. These solution channels are significant for urban planning. They present the danger of sink holes and foundation collapse as well as the hazard of ground water pollution. Fortunately, some of the limestones of the Chester Valley appear to be more resistant to solution than others and none seem to have sinks or caves to any great extent. However, this condition does exist, predominantly in the Conestoga limestone.

There are two types of carbonate rock present in the Chester Valley: limestone, which is calcium carbonate and dolomite, which is magnesium carbonate. Many gradational phases between the two are present. All are metamorphosed to some degree. These types are not shown on the small scale Geology map, but are indicated on official geologic maps of the area. The limestones and dolomites are of varying degrees of purity, containing varying percentages of sand, shale and certain alteration products.

The five distinct carbonate formations present within the Valley occur in the Cambrian and Ordovician systems of rocks. Those formations which are Cambrian in age include, from oldest to youngest, the Vintage dolomite, the Kinzers limestone and marble, the Ledger dolomite and the Elbrook limestone. The formation occuring in rocks of Ordovician age is the Conestoga limestone.

The Vintage Dolomite — This formation is a dark gray, shaly dolomite with impure, light gray marble occuring at the base. It is a thin, thinly bedded formation overlying the Cambrian Harpers phyllite and is present on the north side of the Valley along with slopes of the North Valley Hills. The Vintage is exposed along the outcrop from Whitford P. O., just east of Downington, to southwest of Coatesville. Small exposures are found in the vicinity of Bacton and Mill Lane. The Vintage has little economic value, owing to its impurity and its small exposure over a limited area.

The Kinzers Limestone — This formation has a thin dark brown shale at its base overlain by a gray and white spotted limestone and marble with irregular bedding. It grades upward to a sandy limestone which weathers into a fine porous sandstone. The outcrops of Kinzers are thin and are found essentially in the same areas as those of the Vintage dolomite. It has no significant commercial value.

The Ledger Dolomite — Overlying the Kinzers formation is the Ledger Dolomite. This formation is comprised of a light gray, locally mottled, massively bedded, coarsely crystalline dolomite often silicous in the middle part. It is a thick formation, although

in places the thickness is partially due to repitition of beds due to both folding and faulting. Areally it extends from the County Line near Valley Forge southwest to the vicinity of Coatesville where it is overlapped by the Conestoga. Its maximum extent is present in both East and West Whiteland Townships and in the vicinity of Downington in East Caln Township. Soil cover over the beds varies from practically nothing to thicknesses over 100 feet and the rock surface, due to irregular weathering, presents a sawtooth like configuration.

The Ledger dolomites are economically the most valuable deposits in the Valley. Extensive quarrying operations are progressing at numerous locations in both Chester and Montgomery Counties. Outstanding in size of quarries and annual tonnages quarried are those located at Bradford Hills in E. Caln, Cedar Hollow in Whiteland Township, and Valley Forge Stone Co. near Malvern. The material quarried finds a ready market for metallurgical refractory linings, crushed stone, fluxing agents, soil conditioners, source of lime for plasters, and various chemical uses.

The value of these dolomites is such that considerable areas underlain by the Ledger formation should be held in reserve for future quarrying operations. Although land development has already removed extensive acreage, sufficient open land yet exists over Ledger deposits to justify efforts to prevent further urban encroachment.

The Elbrook Limestone — This formation is a light to yellowish grey impure, silicous, often shaly limestone. It is a finely laminated rock often interbedded with dolomite that weathers to an earthy buff soil. In extent, it covers much of the eastern part of the Valley in Tredyffrin Township and thin zones are present in the Downingtown area. It has no particular economic use.

The Conestoga Limestone — This formation, of Ordovician age, is a bluish gray, thin bedded, impure limestone with shale partings. In the Chester Valley it can be divided into two parts separated by a middle phyllite. The Upper Conestoga is relatively homogeneous and is micaceous in character, while the Lower Conestoga consists of alternating limestones and dolomites. The entire formation is moderately to extensively crumpled and contorted. The latter factor may help to explain the greater tendency of the Conestoga limestone to underground solution and consequent settling and sinking of localized surface areas.

The areal extent of the Conestoga is widespread. It extends the entire length of the Chester Valley from Abington in Montgomery County to beyond the Susquehanna River in Lancaster County. It lies along the south side of the valley against the South Valley Hills in a band varying in width from one-half to three quarters of a mile. West of Coatesville, it occupies all of the Valley.

Potentially the Upper Conestoga has use as a source of limestone for cement, and is similar in composition to the Lower Jacksonburg formation, the famed Lehigh Valley cement rock. Quarrying and milling of cement is proceeding at West Conshohocken. The Lower Conestoga is less useful although the rock is used as a "cement sweetener". An active quarry in the lower Conestoga is located near Howellville and the material is used for crushed stone, etc.

Marble — Marble is metamorphosed limestone and thus is often harder and usually capable of taking a polish. The chief marble in the County is the Cockeysville marble, as shown on the small Geology map. Marble underlies much of the Toughkenamon Valley, and reaches its greatest extent in the Avondale area. It also crops out in the Doe Run area. The Cockeysville marble has been widely used in the past for buildings and monuments; but most of the quarries have now been flooded.

The Franklin limestone (marble) is an ancient pre-Cambrian formation, probably the oldest rock in Chester County. It crops out in only a few places, and is of little economic or practical importance.

Water properties are similar to limestones.

Applications

The comparative applications of the geologic considerations important to planning are outlined and discussed below. These are general comparisons and considerations that can not replace detailed investigations at any given site.

Chester County is Mostly a Hard Rock Area with Small Ground Water Storage.

The quantity, quality, and reliability of supply of ground water available depends upon rainfall, vegetation, slope, and particularly upon the porosity and permeability of underlying soil and rock. All ground water in Chester County, with minor variations in the limestone areas, comes from rain or snow falling on the surface immediately above. It does not come from the Delaware River, Pocono Mountains, or other distant source.

Despite the relative abundance and even distribution of rainfall, Chester County has, for the most part, limited ground water resources owing to the low porosity and permeability of most of the underlying rocks, which thus cannot store and transmit large amounts of water. The quantity and quality of ground water available at specific locations depends upon which of the three basic rock provinces is involved: the crystalline rocks underlying most of the County, the Triassic sediments lying east of French Creek, and the limestones of Chester Valley.

Crystalline Rocks — Most of the crystalline granitic gneisses, schists, gabbros, amphibolites and anorthosites have low porosities and permeabilities and hence retard the storage and flow of ground water. In these rocks, ground water is found only in fractures, fissures and weathered zones within the rock mass. Rarely is any ground water found deeper than 300 feet and most is found above 100 feet. Confined (artesian) yields are small. The gabbros, diabases, granitic gneisses, quartzites and pegmatite dikes produce the poorest yielders of all the average predictable ranges between 0 — 10 gpm. Many wells are dry; but occasional wells, particularly when near streams may yield somewhat greater amounts. Location drilled on a basis of detailed geological study plus a little trial and error have occasionally found wells yielding up to 100 gpm, particularly near streams, but this is not an average expectation. Drilling is difficult and expensive in these hard rocks.

The Wissahickon schist underlying much of the southern part of the County, because it is more deeply weathered, tends to have slightly higher ground water yields ranging between 10 and 20 gpm, with occasional yields to greater than 100 gpm where a system of horizontal or master joints are tapped. The Setter's quartzite formation and the serpentine areas produce lower yields. These yields are generally adequate for domestic supplies at low residential densities. These yields, like most wells, do not supply volumes and pressures adequate for fire fighting.

Ground water obtained from the crystalline rocks is very soft, with some of the best quality to be found anywhere. Hardness of water may be higher where Pickering gneiss is associated with limestone lenses. Because of the lack of permeability, ground water pollution is relatively localized. Supplies within the yield limits generally are reliable throughout the year, unless extreme drought conditions prevail.

Triassic Sediments — The County's best ground water yields are in the Stockton Formation found in the vicinity of Phoenixville. Here, yields will average over 100 — 150 gpm. Smaller, although relatively substantial yields of 20-60 gpm, with an average of 40 — 50 gpm, may be obtained from the interbedded sandstones of the Brunswick Formation, in the region generally east of French Creek in the northern part of the County. Yields are usually larger in the valleys and away from heavily pumped wells. Well drilling is relatively easy.

There is likely to be mutual interference with wells spaced closer than 1000 feet apart. Confined artesian water is present in the Triassic rocks so that it generally pays to drill to depths of from 300 to 600 feet. There is some danger of ground water pollution, particularly in the more permeable sandstones. The chemical quality of the water is moderately hard, but is usually adequate for domestic purposes without treatment.

Limestones — The limestones underlying Chester Valley and the Cockeysville marble underlying the Toughkenamon Valley and the Doe Run area are variable in their ground water yields. In the limestone areas of Chester County, ground water is primarily found in solution channels, surface fractures and fissures.

In these areas, where a large solution channel is tapped, very large supplies may result. Otherwise yields are small. According to reports of a well driller, there are large diameter wells in the limestone in Tredyffrin Township yielding as high as 1400 gpm that could be pumped to 2000 gpm, and at Frazer yielding over 900 gpm. Often these large supplies present in the solution channels can be traced by following and connecting the sink collapses. The Philadelphia Suburban Water Company has employed consulting geologists to help locate large supplies.

Limestone water, because of the generally high content of dissolved minerals such as calcium and magnesium carbonates is often very hard, and should have softening treatment for many types of usage.

The ground water contamination hazard is great, because contaminants can get into the underlying water channels easily; can often be carried long distances in unpredictable ways; and because underground water is not easily self purifying due to a lack of air, sunshine and filtering material. At present, it is not believed there is serious contamination of the limestone ground waters. However, increasing urbanization with its attendant problems of disposal of ever increasing amounts of industrial and domestic wastes does make it a serious potential problem for the future.

Because of the ground water contamination danger, the Pennsylvania Dept. of Health has recommended strongly that septic tanks, and particularly, cess pools and seepage pits be prohibited in limestone areas; and that public water and sewerage systems be available for all urban development.

The small fold-out "Ground Water Resources" map shows general ranges of yield expectancies in overall terms, but it cannot predict accurate yields for individual wells. More detailed study with results appearing on a larger scale map is needed for more accurate predictions. Fortunately, during the summer of 1963, the Ground Water Branch of the U. S. Geological Survey, in cooperation with the Pennsylvania Geological Survey, Dept. of Internal Affairs, began a three year study that will attempt to obtain detailed data on yields, mutual interference of wells, and on other features pertinent to an understanding of the ground water resources of the area. A report by the same agencies on the Stockton Formation was recently published, and one is anticipated for the Brunswick Formation in 1964.

The Rock Structure is Generally Good for Foundations with Caution Needed in Limestone Areas or Where Rock is Deeply Weathered.

The underlying bedrock of Chester County is hard and generally introduces no major problems in regard to foundation suitability for support of buildings, hazard of rock slides and similar problems.

However, there are two areas where care must be taken and detailed studies based on core borings must be made before heavy construction is undertaken. One of these is the area underlain by limestone of the Chester Valley which may contain sink holes and other solution channels. The other

LOW (0-10 gpm*)

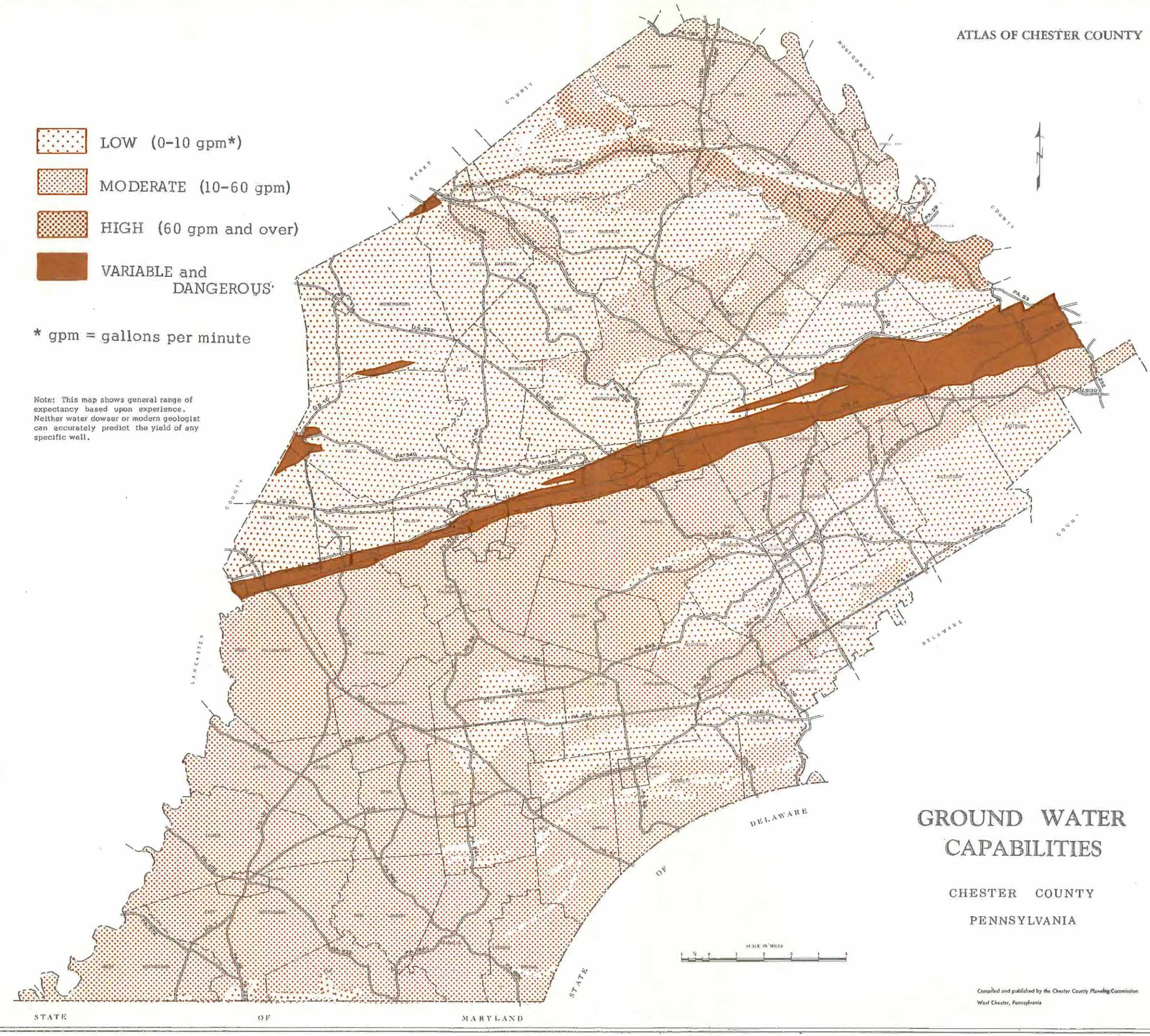
MODERATE (10-60 gpm)

HIGH (60 gpm and over)

VARIABLE and DANGEROUS

* gpm = gallons per minute

Note: This map shows general range of expectancy based upon experience. Neither water dowser or modern geologist can accurately predict the yield of any specific well.



GROUND WATER CAPABILITIES

CHESTER COUNTY

PENNSYLVANIA

Compiled and published by the Chester County Planning Commission
West Chester, Pennsylvania

is the hard, crystalline rock areas which are basically excellent for foundations. However, because of deep weathering in some of these rocks there is apt to be significant thicknesses of badly weathered material overlying sound bed rock. This condition is particularly likely in the deeply weathered mica schists which underly much of the area of the County south of Chester Valley, and in some parts of the South Valley Hills.

The suitability of any location where dams are to be constructed depends in part upon the ability of the rock to support the load of the dam and in part upon impermeability of the rock formations underlying the dam and the reservoir. Rocks heavily fractured and fissured, badly weathered, or of such type as to permit large amounts of seepage through pore spaces or channels are highly unsuitable. However, for the most part, all areas of Chester County are generally well suited for dam construction, provided that excavations are carried below the weathered zone. Exceptions to this are the limestone areas of the Chester Valley and the Triassic sandstone and shale areas of the north and northeast portions of the County. Because of the possibility of many hidden unknowns such as faults and uneven weathering, very detailed site exploration with core borings is recommended before any dam sites are finally located.

The cost and difficulty of excavation for building foundations, water and sewer lines and for grading depends upon the depth of soils, the degree of weathering of the rocks, and the hardness of the rock itself. Table S-1 in the Soils Section gives average range of depth to bedrock. In many places in the mica schists areas, the weathered upper layers are soft and can be removed with a power shovel without the costly use of explosives. Generally, most of the serpentines, gneisses, amphibolites, quartzites, and gabbros are hard and difficult to excavate once unweathered material has been removed. In general the relative depth of weathering of the crystalline rocks is in the following order of magnitude: diabase (least) (0-5 ft); quartzite (1-20 ft); amphibolite, granitic gneiss; and schist (greatest) (1 to 50 ft).

The County is not in a seismic belt and, as a result, the possible occurrance of earthquakes is so infrequent that no special care need be taken as a safeguard in building practices. Ordinary sound construction will provide feasible protection.

The ability of a rock to either transmit or absorb explosion shock wave seems to be related to the amount and percentage of water it contains. Thus, most of the hard crystalline rocks containing little water should be ready to absorb explosion shock within a short distance. Presumably the sandstones and the limestones are more susceptible to explosion shock.

There is always a very small amount of radioactivity from rocks. Whether or not this background radioactivity has any relation to human health or longevity is not known. The hybrid gneisses and amphibolites are believed to have the highest radiation, the schists and quartzites intermediate, and the sedimentary limestones, sandstones and shales the lowest. But in this area, the natural background radiation is lower than in many other places, particularly places with higher elevations.

The County is Well Favored with Building Stone.

One of the chief contributors to the past beauty of the Chester County countryside was the availability for barns and houses of attractive building stone, a resource that most Mid-West cities lack. Most of the County's granitic gneisses, schists, gabbros, limestones, sandstones and quartzites provide satisfactory and available sources of building stone. Of these, the Chickies and Setter's quartzites are considered to be the most attractive. The Wissahickon schists were also extensively used as building stone in the Philadelphia area, but often much of the weathered material must be removed before fresh, solid rock can be quarried.

The serpentine "greenstone" was formerly used in building the West Chester State College, University of Pennsylvania, and many local churches and stores. However, serpentine deteriorates rapidly owing

to reactions of some of its contained minerals with the impurities usually present in the air of industrialized cities, and hence has lost favor as a building stone.

Useful marble has been quarried both in the Chester Valley and from the Cockeysville marble quarries near Kennett Square.

The famous "Black Granite" or trap rock from the diabase dike near French Creek not only makes an excellent and durable monument stone but also is desirable for trim uses. However, it is usually too dark and somber in color for general building purposes. It appears to be the toughest, hardest rock available and thus is excellent for paving blocks and pier foundations.

Good Crushed Stone is Abundant.

Chester County can partially make up for its lack of good construction sand and gravel through the substitution of crushed stone aggregates of which ample supplies are available.

The best road metal and crushed stones are the limestones, the diabases and some gabbros. Schists and shales are not usually suitable for crushed stone. Quartzite is marginally suitable; although hard, it does have good cementing properties.

At present, the limestone quarries at Bradford Hills and Howellville are those approved by the Pennsylvania Dept. of Highways as a source of crushed rock.

Minerals Aided in the Early Economic Development of the County; But Only Limestone Deposits are Now of Principal Importance.

The early deposits of iron, chrome, and to a lesser extent lead, zinc, and graphite, were of importance to the early economic development of Chester County, but today only the limestones are of major importance.

The iron ore in the diabase ridges was the source of iron from which cannon balls were made and supplied to the Continental Army at Valley Forge. It provided the start of a steel industry at Coatesville and Phoenixville. By thus bringing primary employment, the minerals indirectly helped stimulate land clearance, industry, commerce, and transportation.

The general location of these mineral workings are shown on the small fold-out map, entitled "Mineral Resources". This map shows past workings, not necessarily the areal extent of the mineral resource.

Iron — The only iron deposits in Chester County are in the French Creek area in the northern part of the County. These deposits were created by contact metamorphism from the intrusion of igneous rocks. They were worked intermittently from 1717 to 1874 with occasional revival thereafter. The mines are now flooded and caved in.

There still are iron deposits in the northern Chester County Hills, but they presently have no commercial importance owing to the existence of better ores elsewhere and the small size of the deposits. They lie many hundreds of feet below the surface and cannot become profitable until either higher grade deposits are exhausted, or an economic method of recovery is discovered.

Chrome — The first chrome mines in the United States were found and operated in the serpentine intrusive areas near the Maryland-Pennsylvania state line. Mining commenced about 1810, reached its peak in the 1840's, and dwindled off after the Civil War as better ores elsewhere were discovered.

Because of the high quality of the early Maryland-Pennsylvania chrome deposits, the area was seriously prospected during and after World War II when chrome became scarce with the interruption of foreign supplies. However, as no new mining areas resulted, it is considered improbable that further workable chromite deposits exist, although this has not been conclusively proved.

Lead and Zinc — Lead and zinc deposits were discovered in the Pickering Creek

ATLAS OF CHESTER COUNTY

CHESTER COUNTY HAS MANY MINERAL RESOURCES; BUT ONLY LIMESTONES ARE NOW OF REAL ECONOMIC VALUE

This map designates the major mineral resources that were of economic importance in the past. It does not necessarily indicate, as explained in the text, that they will be important in the future, or that the resources will be only in the locations indicated.

The iron ore mines at French Creek are among the oldest in the nation (1717); they supplied cannon balls to the Continental Army at Valley Forge, and created a steel industry at Coatesville and Phoenixville. There is still magnetite ore under the hard rock hills of Northern Chester County, should it ever be economical to mine.

The lead and zinc mines produced sporadically between 1808 and 1870, but are no longer of economic importance. Graphite mining began about 1870, reached its peak about 1900, and continues with one small mine still operating today.

Chrome mining was important from 1810 to shortly before World War I. Corundum, talc, and feldspar had minor attempts at development.

The greatest mineral resources of Chester County now lies in its great limestone valley. Valuable ledger dolomites, cement rock, and crushed stone are still available, if urban encroachment can be prevented.

This map was compiled by study of aerial photographs, U.S. Geological Survey topographic quads, interviews with major producers, and particularly, by study of historical records, and geographic reports. Every minor quarry or mine is not necessarily indicated. The map was prepared during the Summer of 1962, and printed March 1963.

Mine

Major Quarry

Areal Extent of Resource Mined or Quarried

Diabase

IRON

GRAPHITE

Gabro

Limestone

LEAD & ZINC

Marble

Quartzite

CORUNDUM

Serpentine

Mica

CHROME

NORTH COVENTRY
EAST COVENTRY
SOUTH COVENTRY
EAST VINCENT
WEST VINCENT
EAST NANTMEAL
WEST NANTMEAL
UPPER UWCHLAN
WEST UWCHLAN
EAST PIKELAND
CHARLESTOWN
TREDYFFRIN
EAST WHITELAND
WEST WHITELAND
EASTTOWN
WILLISTOWN
EAST GOSHEN
WEST GOSHEN
WEST BRADFORD
EAST BRADFORD
WESTTOWN
THORNBURY
BIRMINGHAM
EAST MARLBORO
PENNSBURY
KENNETT
NEW GARDEN
WEST MARLBORO
NEWLIN
POCOPSON
LONDON GROVE
PENN
LOWER OXFORD
UPPER OXFORD
NEW LONDON
FRANKLIN
LONDON BRITAIN
EAST NOTTINGHAM
WEST NOTTINGHAM
ELK
EAST FALLOWFIELD
WEST FALLOWFIELD
HIGHLAND
LONDONDERRY
SADSBURY
WEST SADSBURY
VALLEY
WEST CALN
EAST CALN
WEST BRANDYWINE
EAST BRANDYWINE
HONEYBROOK
WALLACE
Phoenixville
Spring City
Downingtown
Coatesville
West Chester
Kennett Square
Avondale
West Grove
Oxford
Parkesburg
Modena
South Coatesville
Elverson
Honeybrook
Malvern

STATE OF MARYLAND

STATE OF DELAWARE

MINERAL RESOURCES

CHESTER COUNTY
PENNSYLVANIA

PUBLISHED BY THE CHESTER COUNTY PLANNING COMMISSION
COURT HOUSE ANNEX WEST CHESTER, PENNSYLVANIA

area south of Phoenixville and near Audubon in Montgomery County around 1808. Production reached a peak around 1855 and the mines generally were worked out around 1877. There was some attempt to revive production after World War I, but this was soon abandoned. There seems to be no feasibility of further profitable lead or zinc mining.

Graphite — The Pickering Graphite gneiss located south of Phoenixville has produced graphite intermittently since about 1870. One mine operated until recently was that of the Graphite Corporation of America at Chester Springs. These deposits are small and are not of major economic importance.

Brick and Clay Products — The only geological formation in Chester County suitable for brick manufacture is the shales of the Triassic lowland area. The McAvoy Brick Co., east of Phoenixville, is the chief brick producer within the County. It is not believed that local clays will produce a higher grade of clay product than brick. Some clays have come from feldspar in pegastite and other hard rocks.

Limestones and Dolomites — Limestone and dolomite plus crushed stone from Chester County's great limestone valley are now the County's principal mineral products. Their economic importance to the County now and in the future is great.

Limestone and dolomite are quarried at the Cedar Hollow Plant of the Warner Company at Devault for agricultural lime, blast furnace flux, manufacturing refractories, and lime hydrates for building purposes. The Cedar Hollow Plant, the Warner Johnston Plant near Howellville, and the Brandford Hills Quarry in East Caln are large producers of limestone aggregates for crushed stone and for road metal. There is also potential in the lower Conestoga formation for cement rock of a type comparable to the famous Lower Jacksonberg cement rock of the Lehigh Valley. The County presently has and in the future will have need for these earth products, particularly so, since haulage distances are reasonable.

Quarry Operations Require Much Planning, Large Land Reservations, and Reuse Considerations.

Limestone quarrying is necessarily a nuisance industry. It is space consuming, involves considerable truck traffic, and occasional blasting with the accompanying unpleasant dust and shock, and leaves a large hole. As a result it is not compatible with nearby residential uses and therefore careful planning is necessary for its integration into the community.

It is recommended that some of the limestone and Ledger dolomite reserves be preserved by appropriate exclusive industrial zoning, as well as by extensive ownership of large adjacent tracts by the industries involved, so that ample space to be used as buffer zones with appropriate plantings can be provided.

Sooner or later, the mineral resources of a quarry will become worked-out or flooded and will have to be abandoned. What use can be made of this big hole?

Reclamation of quarries has not been extensively practiced in Chester County or in Southeastern Pennsylvania; but several possibilities have been suggested:

Recreation — Several quarries, particularly the old Howellville Quarries, have been used by skin and scuba diving groups training in the area. Such quarries could be stocked for fishing, and perhaps used for limited boating or swimming under supervision. In most cases the precipitous drop makes general swimming and recreation dangerous without supervision; however, there may be a few areas with a more gradual approach to deep water.

Disposal of Refuse — Perhaps the best use of a quarry is for the disposal of refuse, particularly noncombustibles or

incinerator ash. Quarries could also be used for general refuse disposal, with some problems of securing adequate covering material.

Bulk Storage — Quarries might be useful for the storage of bulk commodities not susceptible to weathering, or even as low cost space that could house enclosures. In a few instances quarries have been used for storage of petroleum; however, this would not appear feasible in Chester County due to the great costs of making quarries leak proof, and in providing a roof to prevent evaporation.

Underground Oil and Gas Storage May be Possible Only in the Stockton Sandstones; But Does Not Appear Feasible in Chester County.

The increasing use of gas for winter heating has produced the need for storage capacity to meet peak demands on cold days. One of the possibilites is to store this gas, often in compressed form, in the voids of porous rocks.

The possibility of underground storage of oil and gas within Chester County appears to be very unlikely. The crystalline areas offer no possibility, because of the absence of the voids necessary for storage. The Chester Valley limestones appear to be little better due to the fact that these rocks also are generally compact and relatively impermeable. In addition, the folding and faulting that is present has probably fractured the beds to such an extent that leakage could not be controlled.

The only area that appears to offer any possibility is that of the Triassic sedimentaries. Storage is theoretically possible provided that the conditions of structure, suitable porosities and premeabilities of the storage beds themselves, and impermeable cover rock are present. In addition, an absence of significant fracturing and faulting is paramount. Attainment of this data is dependent on thorough study of the subsurface beds in question. It is doubtful whether sufficient subsurface information is available to determine the underground conditions and the presence of suitable storage reservoirs.

In the unlikely event all these natural requirements are met, such storage would probably be incompatible with the other more valuable urban uses of the land. For one thing, ground water would probably be contaminated. Therefore, such storage does not seem feasible.

More Scientific Study is Needed of Mineral Resources, Ground Water, and Practical Application to Planning.

Despite the complexity of Chester County's geology, and the absence of outcrops, thanks to the pioneering geologists, the County is relatively well-mapped geologically. However, considerable further study is needed if answers to important problems are to be obtained. High priority for additional study should be assigned as follows.

1. Ground Water Considerations — Much more needs to be known about the predictable yields of ground water, well spacing, areas of greatest yield, yield per acres and other quantitiative factors. It is expected that some answers to many of these considerations will be available upon completion of several studies by the Ground Water Branch of the U. S. G. S., mentioned previously. These reports should be of great value in preparing a comprehensive water supply plan for Chester County.

2. More Practical Studies on Geology in Planning and Engineering — Until comparatively recently, most of the effort in geology has been orientated to the study of chemical and mineralogical properties, historical geology and economic mineral surveys instead of toward planning and engineering considerations. As a result, there has been relatively little effort to apply geologic methods and principles to planning and engineering needs. This report is a first attempt at emphasizing the lack of such considerations and in calling attention to their increasing importance in planning in the future.

3. More Exact Scientific Studies of Future Mineral Resources — Another technical need is an exact scientific quantitive study of potential mineral resources of the County. This should include chemical analysis, estimates of depth of overburden, volumes of ore, strike and dip of mineral bearing rocks, and other data needed to provide a more accurate estimate of future possibilities. The recent airborne magnetometer survey of iron ore deposits is a beginning and a good example of scope and methods that should be used. It is likely that the steel companies and quarry interests in the area have made such studies, but these are not available to the public.

4. More Detailed Areal Mapping — The larger scale and more accurate topographic maps completed during the 1950's should make it possible to remap the general areal geology in a somewhat more detailed manner.

5. Need for Public Well Log Records — Since the underlying rocks are covered with overburden (except at a few surface outcrops, in stream valleys, in quarries, and road/railroad cuts) the main source of basic knowledge is from borings, of which the most common are wells.

Well log records, if accurately kept, not only provide essential information on rock composition, but also give vital data on water yields.

It is unfortunate that Pennsylvania, unlike most of its neighboring states, does not have a law requiring public filing of this most valuable data.

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*Indicates reports of particular practical value.

Gently rolling, well-worn landscape is good for farming and building.

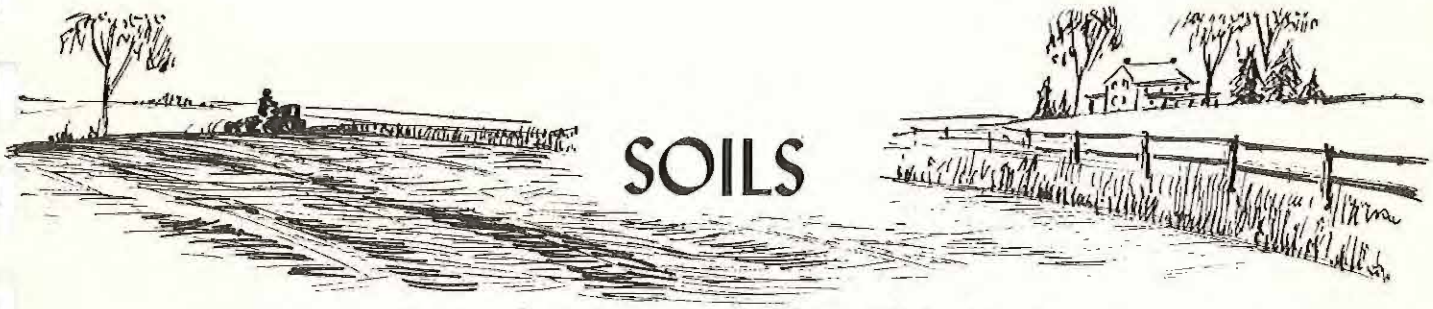
Even large lot subdivision sprawls may have water and sewage problems.

Chester Valley's Ledger dolomites and limestones are vital to the economy.

The few marsh areas are needed as a habitat for wildlife.

Urban growth must be prevented on areas subject to frequent flooding.

Serpentine soils and rocks are shallow and unproductive.



SOILS

Introduction and Classification

Soils — Like People — Vary Greatly.

The kinds of soils which develop in any area depend upon the parent materials, climate, landforms, vegetation, biological organisms, time and particularly, the slope of the land.

Most of the soils of Chester County belong to the Gray-Brown Podzolic great soil group of the Northeast and intergrade to the Red-Yellow Podzolic great soil group of the South. These soils were formed under the humid hardwood forests of the east coast where rainfall and evaporation are in reasonable balance so that leaching (washing out) of soil nutrients is not as severe as farther south.

Despite the relative uniformity of the great soil groups there are many soil variations resulting from local differences in slope, erosion, weather, parent material, vegetation, drainage, and other factors. Topography and parent material have been most significant in shaping the different soils within the County. Table S-1 from the Soil Survey of Chester and Delaware Counties shows the relation of soil to parent material.

In summary, there are as explained below: 36 soil series, 54 soil types, and 177 soil phases in Chester County.

Although to most persons most soils look alike, these differences in soils have tremendous consequences, both for farming and urban purposes. Many unsuspecting home buyers have suffered grievous expense and loss in buying homes with septic tanks that won't work in shallow or poorly drained soils. A soils check costs little and may save much.

Table S-1 *Soil series arranged to show the relationship of parent material, depth, and drainage*

Principal parent material	Well drained			Moderately well drained	Somewhat poorly drained	Poorly drained
	Shallow soils	Moderately deep soils	Deep soils			
Residuum from underlying rock:						
Serpentine	Chrome	Chrome	Neshaminy	Conowingo	Aldino	Calvert.
Gabbro, granodiorite		Glenelg	Neshaminy	Glenville		Worsham.
Schist and gneiss	Manor	Glenelg	Chester	Glenville		Worsham.
Anorthosite, quartz, monzonite	Brandywine	Glenelg	Chester	Glenville		Worsham.
Diabase (traprock)			Montalto	Mount Lucas		Watchung.
Limestone and dolomite	Hollinger		Hagerstown		Lawrence	Guthrie.
Micaceous limestone and Cockeysville marble.	Hollinger		Conestoga	Bedford	Lawrence	Guthrie.
Triassic red shale, sandstone, and conglomerates.	Penn	Penn	Bucks	Readington		Croton.
Triassic gray shale and sandstone	Penn	Lansdale	Lansdale	Readington		Croton.
Metamorphosed Triassic rock		Brecknock	Brecknock	Lehigh		Croton.
Quartzite		Edgemont		Glenville		Worsham.
Coastal plain deposits:						
Sand, silt, clay, and gravel			Sassafras	Woodstown		
Silt over sand, silt, clay, and gravel.				Butlertown, Beltsville	Beltsville	Othello.
Soils on flood plains:						
Alluvium from schist, gneiss, and metamorphic rocks.			Congaree	Chewacla		Wehadkee.
Alluvium from limestone				Lindside		Melvin.
Alluvium from Triassic red shale and sandstone.				Rowland		Bowmansville.

Source: Chester County Soil Survey Report

It is Convenient to Classify Soils into Great Soil Groups, Associations, Series, Types, and Phases.

A soil series consists of those soils which have similar characteristics in the kind, thickness and arrangement of soil layers. Soils that differ only in surface texture but are alike in other characteristics are defined as soil types. Soil types are further divided into soil phases because of differences in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they are shown on the map as one unit.

In order that soils can be shown on a small scale map, soil series that have a similar distribution pattern are grouped into soil associations. The areal distribution of these in Chester County is shown on the small fold-out map entitled, "Soil Associations". The map has each association identified by one, two or three soil series which occupy the greatest acreage within it. Other minor soil series are also present in each association and may exist side by side on an individual farm.

This general soils map showing patterns is useful to people who want a general idea of the soils, or want to compare different parts of the County. It does not show accurately the kinds of soil on single farms or small tracts.

The major soil associations in Chester County are as follows:

The Penn-Croton-Bucks Association (39,000 acres, 8.0% of the County) is found immediately south of the Schuylkill River in the northeastern part of Chester County, The principal soils are the Penn, Croton, and Bucks, with smaller areas of Bowmansville and Rowland found on flood plains. The principal parent material of the association is red shale and sandstone. The Penn soils are shallow to moderately deep and well drained. The Bucks soils are deep and well drained; and the Croton soils are deep and poorly drained. Bowmansville is a deep, poorly drained flood plain soil and Rowland is a moderately deep to deep, moderately well drained flood plain soil. Exclusive of the urban areas, dairy farms predominate with some producing general farm crops in combination with livestock raising. The sloping areas are subject to erosion.

Edgemont Association (29,000 acres, 6.0% of the County) is found chiefly in the northwestern part of Chester County and in the North Valley Hills adjacent to Chester Valley plus a few small areas scattered in the northern half of the County.

These soils are moderately deep, well drained soils on uplands, and are formed mainly in materials weathered from quartzite with some from quartz schist.

About a third of the acreage has been cleared and is used for crops and pasture. The rest is wooded.

The Glenelg — Manor — Chester Association (337,110 acres, 69.6% of the County) is the largest in Chester County. It occupies approximately 337,000 acres and is found in nearly all parts of the County. Glenelg, Manor, Chester, and Brandywine soils are found on uplands and the Glenville and Worsham soils are found in low lying areas. Wehadhee, Chewacla and Congaree Soils are flood plain soils. The principal parent materials for this association are Wissahickon and Peters Creek schist and Baltimore gneiss, and some gabbroes.

The Glenelg soils are moderately deep, mostly well drained upland soils that were developed from weathered granite, gneiss and mica schist. The Manor series consists of shallow, well drained soils on uplands that originated from similar parent material. The Chester soils are deep, well drained upland soils and are very productive. They are formed mainly from schist and gneiss but in some places other igneous rocks such as anorthosite, quartz monzonite, and granodiorite are the parent materials.

ATLAS OF CHESTER COUNTY

MAJOR SOIL GROUPS ARE RELATED TO UNDERLYING GEOLOGY

This map shows, in a general way, the main patterns of soils found in Chester County. Each kind of general soil area, or soil association, as a general rule, contains a few major soils and several minor soils in a pattern that is characteristic, although not strictly uniform. The soil associations are named for the major soil series in them, but some soils of other areas are also apt to be present.

The major soil associations are closely related to the underlying geology. Demarcations are particularly evident between Glenelg soils formed from underlying schists and gneiss rock; the limestones; and the clay soils formed from the traissic sandstones east of French Creek.

A general soil map showing patterns is useful to people who want a general idea of the soils, or want to compare different parts of a county. It does not show accurately the kinds of soil on single farms or small tracts.

The Chester County Planning Commission has made detailed interpretative soil maps of great value. These show suitability of soils for septic tanks and urban building, agricultural land capability, erosion, slope, and many other features. The more detailed data is available at the County Planning office, or the U.S. Soil Conservation Service Work Unit.

This map was prepared in Sept., 1962 by the Chester County Planning office from information supplied by U.S. Soil Conservation Service.

SOIL ASSOCIATIONS

- GLENELG-MANOR-CHESTER: Shallow to deep, silty and channery soils on grayish-brown schist and gneiss.
- EDGEMONT: Moderately deep, channery soils on grayish quartzite and phyllite.
- NESHAMINY-CHROME-CONOWINGO: Moderately deep and deep, silty soils on serpentine.
- MONTALTO-WATCHUNG-MOUNT LUCAS: Deep, silty and channery soils on dark-gray diabase.
- PENN-CROTON-BUCKS: Shallow to deep, silty soils on red shale and sandstone.
- NESHAMINY-GLENELG; Moderately deep and deep, well-drained, silty, channery, and gravelly soils on gabbro and granodiorite.
- HAGERSTOWN-CONESTOGA-GUTHRIE: Deep silty soils on limestone.

GENERAL SOILS

CHESTER COUNTY

PENNSYLVANIA

STATE OF MARYLAND

STATE OF DELAWARE

PUBLISHED BY THE CHESTER COUNTY PLANNING COMMISSION
COURT HOUSE ANNEX WEST CHESTER, PENNSYLVANIA

Exclusive of the urban areas, dairy farming and general livestock predominate in this association. These soils are subject to erosion and should be protected by intensive conservation practices. Most of the apple and peach orchards in Chester County are found in these soils.

The Hagerstown-Conestoga-Guthrie Association (22,000 acres, 4.5% of the Co.) are deep, silty soils on limestone. This soil association extends across Chester County from the County line near Atglen, east-northeast through Coatesville, Downingtown, and Exton to the eastern County line at Valley Forge State Park. Other areas are found near Doe Run and from near West Grove through Avondale to Kennett Square over the Cockeysville Marble.

The major soils in this association are the Hagerstown, Conestoga, Guthrie and Lawrence, with smaller areas of Bedford, Lindside, and Melvin Soils. The Hagerstown and Conestoga soils are deep and well drained; the Conestoga soils are lighter in texture due to the fine sandy loam in the substratum. The Bedford, Guthrie and Lawrence soils are deep, with moderate to poor drainage. The Lindside and Melvin soils are found on flood plains. Lindside soils are moderately well drained and Melvin soils are poorly drained.

The soils in this association are good agricultural soils with the exception of those that are poorly drained. However, much of the industrial and urban developments are on this association.

The Neshaminy-Glenelg Association (51,000 acres, 10.5% of the County) consists of a soil series that is moderately deep, and deep, usually well drained, silty; channery and gravelly, and are found principally on gabbro and anorthosite. The channery nature of these soils retards erosion. The major soils in this association are Neshaminy, Glenelg, Glenville and Worsham and small areas of Chewacla and Wehadkee. The Neshaminy soils are deep and well drained. The Glenelg series are moderately deep, well drained soils of uplands. The Glenville series are deep, moderately well drained soils on uplands. The Worsham series are deep, poorly drained soils on uplands. The Chewacla series are found on lower slopes and are deep and moderately well drained. The Wehadkee series are flood plain soils and are deep and poorly drained.

General farm crops grow well on this soil association, but hay pastures are the main crops.

The Neshaminy-Chrome-Conowingo Association (2500 acres, or 0.5% of the County) is found in the southeastern part of the County known as the barrens, and in two small areas north and northeast of West Chester. The parent material is primarily serpentine rock. The slopes range from level to very steep. The Neshaminy soils are deep, well drained upland soils, and the chrome soils are shallow to moderately deep, well drained upland soils. The Conowingo series consists of moderately deep to deep, moderately well to somewhat poorly drained soils. The Calvert soils are deep, poorly drained soils, and the Aldino soils are shallow, moderately well to somewhat poorly drained soils. Much idle and abandoned land is in this association. General farm crops are grown on a few farms, but the soils are better suited to hay and pasture crops.

The Montalto-Watchung-Mount Lucas Association (5,800 acres, 1.2% of the County) is found in the northwestern part of the County. The principal parent rock is dark gray diabase.

The major soil series in this association are Montalto, Watchung, Mount Lucas, Brecknock and Lehigh.

The Montalto soils are moderately deep to deep and well drained. The Watchung soils are deep, poorly drained upland soils. The Mount Lucas soils are moderately deep to deep and moderately well drained to somewhat poorly drained. Brecknock soils are moderately deep and well drained. The Lehigh series consists of moderately deep soils and are moderately well drained.

Careful Soils Analysis is Vital for Both Rural and Urban Planning.

Land use planning, whether for the County as a whole, for individual townships, or for a single building and farm, must consider the underlying soils.

For farmland planning, this has always meant evaluation of the basic capabilities of the land and environment as a determinant of the types of crop pastures or woodland that should be provided. Knowledge of the fertile, productive land is also important to guide growth in the hope that so far as possible urban growth can be kept away from the good crop lands and the available mineral resources.

In recent years soil science and mechanics have given emphasis to the use of soil survey information for guiding urban growth and for engineering purposes; in such ways as soil suitability for septic tanks, foundation strength, ease or difficulty of excavation, depth to water tables, depth to bedrock, and so forth, as further described in this report.

Most Soil Data and Interpretative Maps are Based Upon the Chester County Soil Survey.

Fortunately, through the work of the Brandywine Valley Association in the late 1940's, and the Chester County Soil Conservation District, a detailed acre by acre soil survey was conducted by the U. S. Soil Conservation Service during the 1950's and published in May 1963.

The Chester County Planning Commission acquired copies of these soil survey maps before publication and used the original basic outline maps to prepare the generalized interpretation in this report. There are also on file in the offices of the Chester County Planning Commission large scale maps showing the same information in complete detail. In general, this report seeks to produce interpretative maps based upon the soil survey, rather than to duplicate basic information.

Agricultural Uses

About Two-Thirds of the County is Suitable for Cropland.

The Agricultural Land Use Capability Classification is a grouping of soils that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on the limitations of the soils, on the risk of damage when they are used, and on the way they respond to treatment. It does not necessarily refer to soil fertility or productivity, since these factors vary greatly depending upon management practices. Chester silt loam and most of the limestone soils of Chester Valley are the most productive cropland. Other upland soils such as Neshaminy, Montalto, Bucks and Manor are next. In general, the Triassic soils are less productive than those from the crystalline rock. Detailed productivity ratings are given in the soil survey report.

The Soil Conservation Service of the United States Department of Agriculture classifies the soils in Chester County into eight agricultural land use capability classes. These classifications are shown on the large fold-out map, entitled, "Agricultural Land Capabilities". Detailed parcel by parcel information is available in the Soil Survey Report, and detailed interpretative maps are on file at the Chester County Planning Commission.

Land Suitable for Regular Cultivation:

Class I (5,022 acres, 1% of the County area) — These soils have few conditions that limit their use. They are deep, well drained soils and are level areas found on uplands and silty soils on flood plains. They can be cultivated safely without special conservation treatment.

Class II (255,529 acres, 52.5% of the County area) — These soils have some natural condition that limits the kind of plants that can produce or that, when cultivated, call for some easily applied conservation practices. The soils are found on gently sloping areas, are deep

SOIL SURVEY INTERPRETATIONS ARE THE KEY TO FARM AND CONSERVATION PLANNING

Use of land in accordance with its inherent capabilities is the basis of all farm and conservation planning, and the soil survey is the key. Soil suveys were originally devised to indicate the land that is suitable for cropland, for pasture, or for only woodland, and the conservation treatment needed for each.

Eight categories of agricultural land capability were designed by the U.S.Soil Conservation Service as defined below, although on this map categories V through VII (these are not suitable for cultivation) were lumped together.

Agricultural land capability classes are determined by parent material, slope, soil depth, drainage, and erosion. They are not necessarily the same as productivity. Estimated crop productivity under average and good management is given in the soil report.

This map was based entirely on the detailed Chester County Soil Survey made acre by acre during the 1950's (and published July 1963) by the U.S. Soil Conservation Service. The categories and even the colors are the same as used in the individual farm plans prepared by them.

The Chester County Planning Commision acquired (in 1962) advance copies of the 72 detailed soil maps and during 1962 and 1963 hand colored the eight categories of agricultural capabilities via the established standards. These 72 maps were reduced to a single County map and color separations prepared.

In order to show a large county on a single small sheet, and thus the overall relationships, some of the categories had to be generalized and may contain other categories within a single indicated category. More detailed interpretative maps vital for individual farm planning are on file at the Chester County Planning Commission, or may be learned from the raw data maps in the published soil survey. Further help and individual detailed farm plans are available without charge on application to the Chester County Soil and Water Conservation District.

AGRICULTURAL LAND CAPABILITIES

Land Suitable for Regular Cultivation

Class I (5,022 acres, 1% of the County area) - These soils have few or no conditions that limit their use. They are deep, well drained soils and are level areas found on uplands and silty soils on flood plains. They can be cultivated safely without special conservation treatment.

Class II (255,529 acres, 52.5% of the County area) - These soils have some natural condition that limits the kind of plants that can produce or that, when cultivated, call for some easily applied conservation practices. The soils are found on gently sloping areas, are deep to moderately deep and well drained to moderately well drained. There are also shallow soils in this class that are well drained and found on nearly level areas.

Class III (57,933 acres, 11.9% of the County area) - These soils have more serious or more numerous limitations than those in Class II. The limitations may be natural ones - such as steep slopes, sandy or shallow soils, or too little or too much water. Thus they are more restricted in the crops they can produce, or when cultivated, call for conservation practices more difficult to install or keep working efficiently.

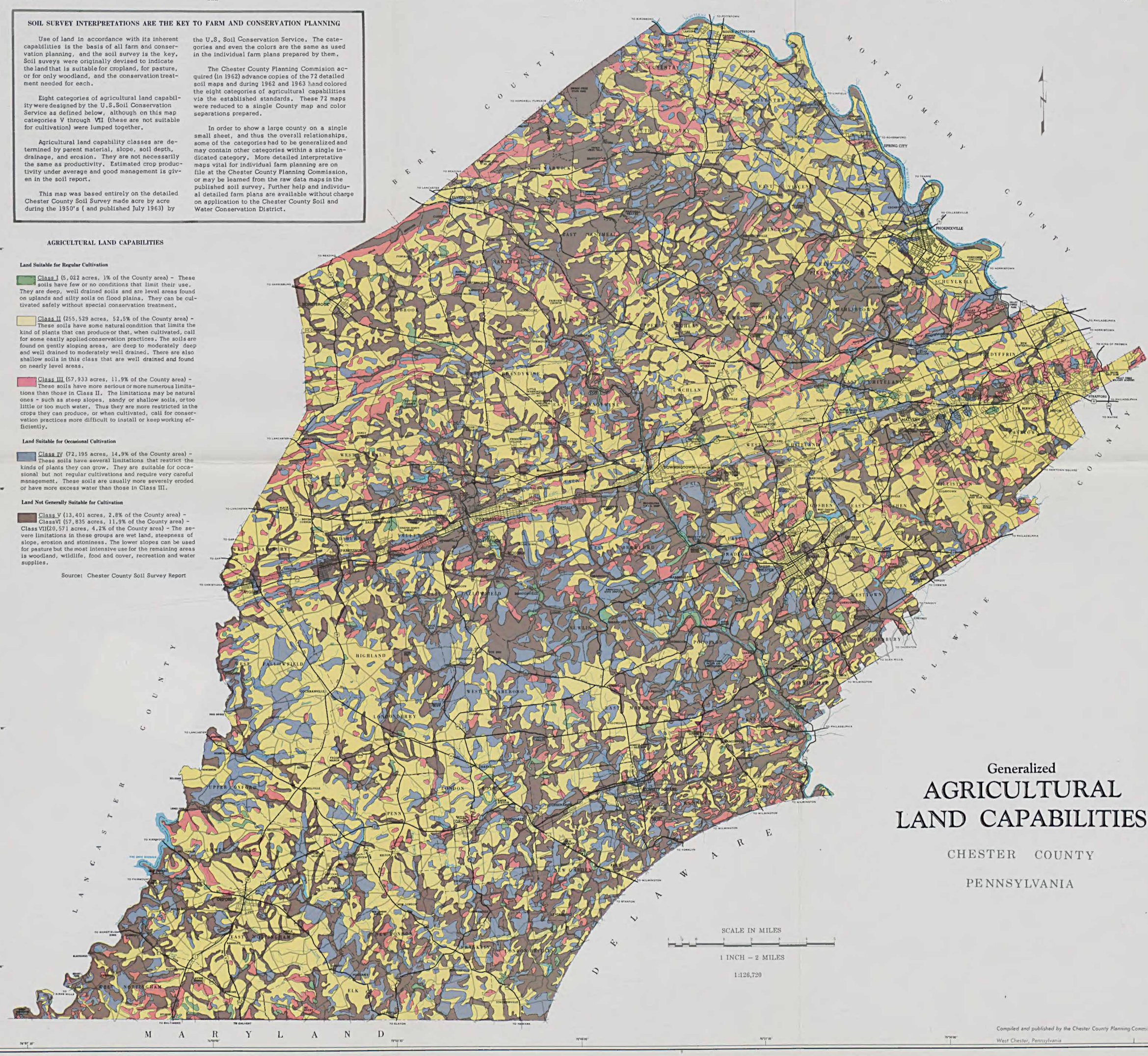
Land Suitable for Occasional Cultivation

Class IV (72,195 acres, 14.9% of the County area) - These soils have several limitations that restrict the kinds of plants they can grow. They are suitable for occasional but not regular cultivations and require very careful management. These soils are usually more severely eroded or have more excess water than those in Class III.

Land Not Generally Suitable for Cultivation

Class V (13,401 acres, 2.8% of the County area) - ClassVI (57,835 acres, 11.9% of the County area) - Class VII(20,571 acres, 4.2% of the County area) - The severe limitations in these groups are wet land, steepness of slope, erosion and stoniness. The lower slopes can be used for pasture but the most intensive use for the remaining areas is woodland, wildlife, food and cover, recreation and water supplies.

Source: Chester County Soil Survey Report



Generalized AGRICULTURAL LAND CAPABILITIES

CHESTER COUNTY

PENNSYLVANIA

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to moderately deep and well drained to somewhat poorly drained. There are also shallow soils in this class that are well drained and found on nearly level areas.

Class III (57,933 acres, 11.9% of the County area) — These soils have more serious or more numerous limitations than those in Class II. The limitations may be natural ones — such as steep slopes, sandy or shallow soil, or too little or too much water. Thus, they are more restricted in the crops they can produce or, when cultivated, call for conservation practices more difficult to install or keep working efficiently.

Land Suitable for Occasional Cultivation.

Class IV (72,195 acres, 14.9% of the County area) — These soils have severe limitations that restrict the kinds of plants they can grow. They are suitable for occasional but not regular cultivations and require very careful management. These soils are usually more severely eroded or have more excess water than those in Class III.

Land Generally Not Suitable for Cultivation.

Class V (13,401 acres, 2.8% of the County area) — These soils have little or no erosion hazard but have some condition impractical to remove that limits their use largely to pasture, woodland, recreation, water supply or wildlife food and cover. The predominant limitation of this class is a wet, poorly drained soil condition.

Class VI (57,835 acres, 11.9% of the County area) — These soils have very severe limitations that make them unsuited for cultivation and restrict their use largely to pasture, woodland, recreation, water supply or wildlife food and cover. The severe natural limitations in this class are steepness of slope, erosion, wetness or stoniness.

Class VII (20,571 acres, 4.2% of the County area) — These soils are unsuitable for cultivation and are usually not suitable or easy to use as pasture. Their use is restricted to woodland, recreation, water supply or wildlife food and cover with careful management.

Other Areas (3,914 acres, 0.8% of the County area) — These areas consist of made lands, quarries, and water as found in streams, rivers, lakes and ponds. There are 1,699 acres of made land and when conditions are right these acres can be utilized for buildings.

Almost two-thirds of the County is land that is physically suitable for crops. For the most part, the fertile lands are in the Chester Valley and in the Southern Piedmont agricultural area — the Kennett Square — Oxford area.

The predominant crops are hay, winter wheat, corn, and market garden crops, plus the mushroom specialty. The different agricultural regions of the County will be described in more detail in the forthcoming land use report.

Soil Erosion

Soil erosion is the loss of the original topsoil (Topsoil is the upper layer of soil that has, in addition to the minerals from which it originated, organic matter and soil organisms). When the early settlers cleared the forests they found topsoil ranging in depth from a few inches to several feet. Erosion began on the rolling hills as soon as the land was cleared. At first, erosion was not serious because of the high organic content of the soil and the small cleared areas; but the rate increased as these areas were enlarged and more intensive cultivation was practiced. Today, it is estimated that Chester County has lost approximately two-thirds of the original topsoil.

There are two principal natural methods of transporting soil — water and wind. Water is the one we are more concerned with since we have very little wind erosion in this area. The water that transports our soils comes from rainfall, and it varies greatly in intensity. The intensity and the time periods of these intensities plus the type of cover on the land (trees, grass, or cultivated crops), the types of mineral content of the soil and the slope of the land, affect the amount of soil that is transported from one place to another, resulting in what is termed erosion.

Certain soil series are more subject to erosion because of the type of parent materials. The Glenelg and Manor series that are underlaid with schist and the Penn series that are underlaid by shale and sandstone erode more easily than other series found in the County. These soils are formed from soft mica schist or shales. The map entitled "Severe Erosion" shows the areas where 75% or more of the original topsoil has been lost. This is mostly on the steeper slopes in the Brandywine Valley. Table S-2 gives a summary of the other types of erosion.

Fortunately, through the work of the Brandywine Valley Association and the Chester County Soil Conservation District, aided by the technical services of the U. S. Soil Conservation Service, great progress has been made in stopping severe erosion. Standard treatment includes strip cropping, terracing, crop rotations, and the use of land in accordance with its inherent capability, for example, using the steeper slopes for woodland or pasture.

Much still needs to be done. In order to meet local obligations most of the land above the dams in the Brandywine Valley Water Supply and Flood Control Plan must be under conservation agreement. It is important that home owners and builders recognize their part in preventing soil loss.

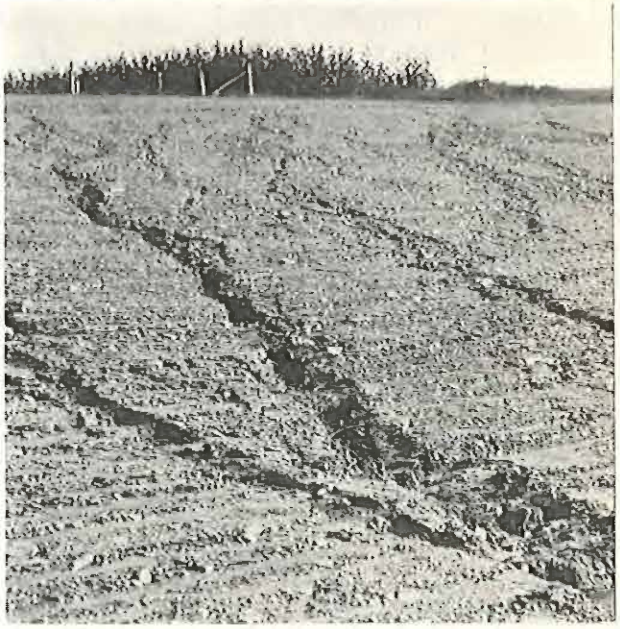
Some of the most serious and severe soil erosion comes, not from cropland, but from land stripped for building development. It is important to the home owner that good top soil be set aside for respreading, if a good lawn and foundation planting is to be hoped for. In order to save the soil and prevent silting of roads and streams, bare graded areas should be stabilized with quick growing cover grasses such as rye, which will also add soil fertility.

Table S-2

SOIL EROSION IN CHESTER COUNTY

Degree of Erosion	Acreage*	Percent
No Erosion	115,183	23.7
Moderate Erosion 25% to 75% of Original Topsoil Removed	272,739	56.1
Severe Erosion 75% of Original Topsoil Removed	98,584	19.4
Miscellaneous Areas	3,904	0.8

*Source: Soil Survey Report, Chester and Delaware Counties, Soil Conservation Service, Pennsylvania Department of Agriculture, and Pennsylvania State University.



Severe erosion can quickly develop on even moderate unprotected slopes.

ATLAS OF CHESTER COUNTY

SEVERE EROSION IS A PROBLEM

Severe erosion is a problem in Chester County because some of the County is fairly steeply sloping; and because many of the soils were formed from schist material with a cleavage structure that is easily erodible.

This map shows the areas where over 75% of the original topsoil has been lost. These severely eroded areas are mostly on the steeper slopes in the part of the County underlain by crystalline rocks.

Over 75% of the original topsoil (severe erosion) has been lost in 20% of the County; between 25% and 75% (moderate erosion) in 56% of the County; and less than 25% (slight or none) in only 24% of the County.

Severe erosion has been greatly reduced through such conservation measures as strip farming, terraces, crop rotation, improved pastures, and, most important, use of land in accordance with its abilities. This gain was achieved through the efforts of such organizations as: the Brandywine Valley Association, Extension Service, and the Chester County Soil Conservation District, aided by the soil survey and other technical services of the U.S. Soil Conservation Service. Advice and detailed plans are available without cost on application to the Chester County Soil Conservation District.

This map was prepared by coloring in all areas of severe erosion on the detailed soil maps; and then reducing them with some generalizations to the small scale map. It has value only as an indication of severe erosion problem areas.

More detailed information is available in the full scale intepretative maps in color on file at the Chester County Planning Commission; or in raw data form in the official Chester - Delaware County Soil Survey Report published by the U.S. Soil Conservation Service.

Source: Chester - Delaware County Soil Survey
Map compiled Spring 1963, printed November 1963

Areas With 75 Percent or More of Original Topsoil Eroded

SEVERE EROSION

CHESTER COUNTY

PENNSYLVANIA

Compiled and published by the Chester County Planning Commission
West Chester, Pennsylvania

Engineering and Urban Uses

Urban and Engineering Applications of Soil Surveys are of Great Potential Significance; but Technique and Knowledge are only in an Early Stage of Development.

Soil surveys were originally developed primarily for agricultural planning and it has only been in the last few years that their great potential application to urban and engineering purposes has been realized.

Soil surveys for engineering and urban purposes are more demanding and difficult than for agricultural planning. The field survey should be made in a more detailed manner at a larger original scale so differing properties should not be lumped or over generalized. Engineering analysis is also more difficult since not only the upper soil layers, but the underlying bedrock must be considered, and conditions of underlying rock are more difficult to determine.

Nevertheless, information of great value is now available on the relative suitability of soils for septic tanks, for highways and airports, for sanitary landfills, for basement excavation water problems, for farm ponds, and for helping to determine building foundation strengths.

Preliminary information and special purpose interpretative maps are presented in this report. More detailed technical information is contained in the Soil Survey Report and will not be duplicated here. The interpretations in this report are based upon the latest information from the U. S. Soil Conservation Service and the Pa. Dept. of Health.

Soil scientists, in cooperation with others such as sanitarians, planners, engineers, architects, landscape architects, and real estate men are working to develop more detailed and refined interpretations. The Chester County Planning Commission will try to keep informed on these changes so that revised interpretations can be made.

It is hoped that a more detailed supplementary report on urban uses of soil survey will be published later by the County Planning Commission as more information becomes available.

Engineering Properties Are Complicated.

The engineering behaviour of soils depends upon many complex factors including soil texture (proportions of sand, silt, and clay) permeability and porosity, shrink-swell potential, dry density, and general moisture holding capacity.

Two of the most vital factors for urban purposes are depth to bedrock and height of seasonal water table. These characteristics, in a general range, are shown in Chart S-1, made by the County Planning Staff from the data in the Soil Survey Report.

It is obvious that there would be difficulty in building drainage fields, or excavating for sewer lines on soil that is shallow to bedrock, even if the rocks were deeply weathered and easy to excavate. Similarly, soils with a high water table either perennially or in the wet winter and spring seasons would also be unsuitable.

Available summaries of the relative suitability of the soils in a general way for a variety of engineering purposes are indicated in Table 6 and 7 of the Soil Survey Report; which is reproduced in this report as Table S-3.

Unsuitable Soils for Septic Tanks are Indicated.

One of the most vital urban uses of soil surveys is to indicate in a general way the relative suitability of soils for the proper functioning of on-lot sewage disposal systems and to indicate soil suitability in other ways.

The soil survey can indicate in a general way most of the areas where the soils are clearly not suitable because the soils are too wet, too shallow, or are subject to flooding. Soil survey alone can not positively identify areas of suitable soils with the same confidence.

The most important factors that determine suitability for septic tanks, ability to support the weight of foundations, and urban development in general are: depth to bedrock, height and seasonal variation in water table, soil texture, internal soil drainage characteristics, presence or absence of impervious layers, danger of pollution of ground water, stoniness, depth to and nature of weathering of underlying bedrock and local experience with on-lot systems.

The soils of Chester County have been put into seven categories as shown on the large fold-out map entitled, "Urban Suitability". The information was based upon the soil survey, and is the latest interpretation of the U. S. Soil Conservation Service and the Pa. Dept. of Health. This replaces and supercedes those in the official published report.

The soils in each group are much alike in characteristics affecting their suitability for homes and community developments. The two characteristics of the soils given the most consideration are parent materials that are most suitable for satisfactory building foundations, and drainage factors affecting sewage disposal systems. The following groupings are in accordance with the best available information:

1. Suitable (36,635 acres — 7.5% of the County) — Deep, well drained soils with slopes of 0-15%. This group is suitable for all types of buildings on the more gentle slopes, and residences on all slopes. This group of soils is suited, so far as is known, for on site sewage disposal because they have good permeability and in most instances do not represent a hazard to ground water contamination. Excavation is rarely a problem.

These soils are also the best farmlands. They are deep, upland soils. While small areas are scattered throughout the County, the largest areas are in the upper Brandywine area near Honeybrook and Elverson.

Soil types in this group are:

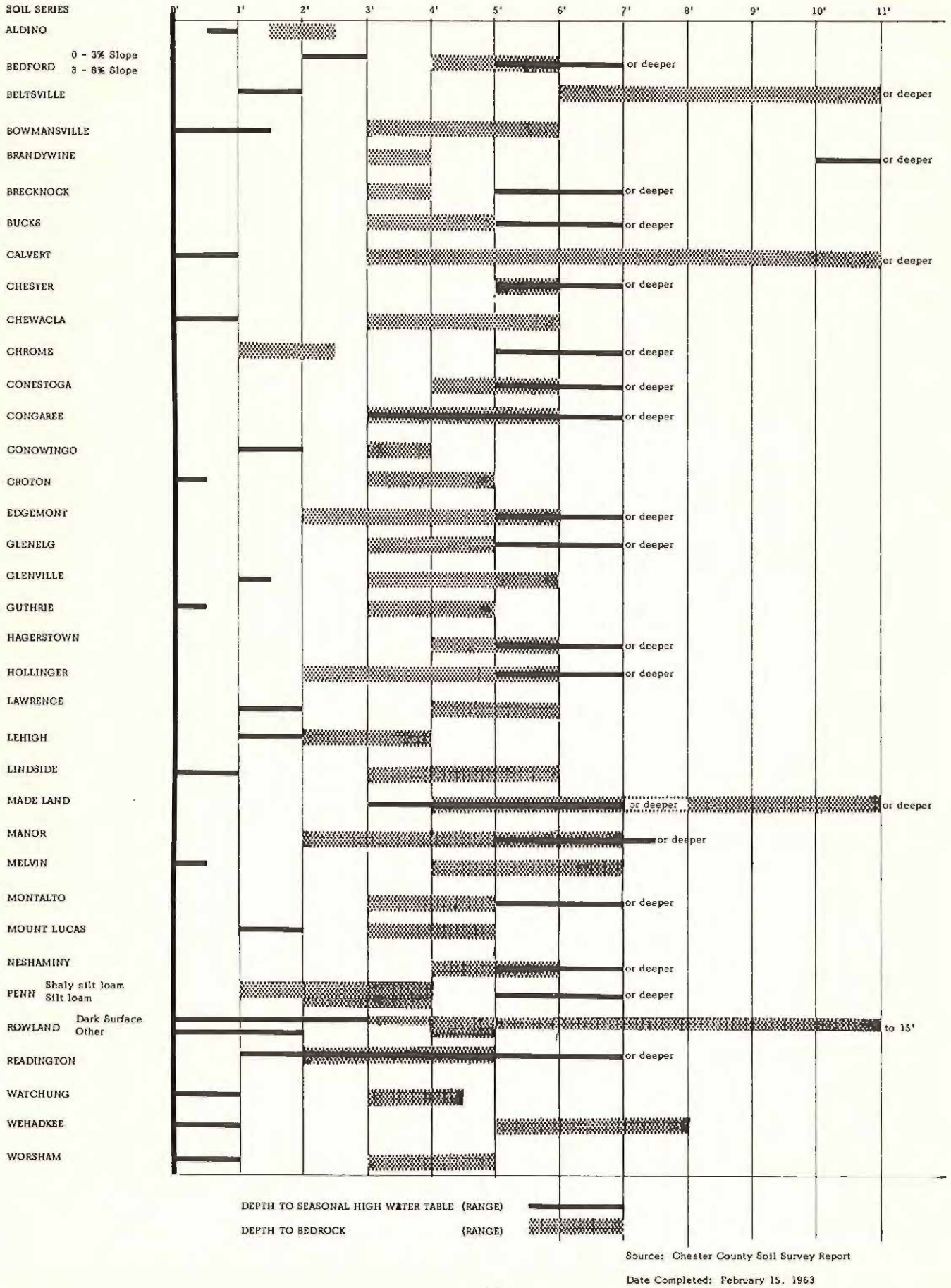
Bucks silt loam, 3-8% slopes.
Chester silt loam, 0-15% slopes.
Chester very stony silt loam, 0-15% slopes.
Edgemont channery loam, 3-15% slopes.
Edgemont very stony silt loam, 0-8% slopes.

2. Variable — Probably Suitable — Caution and Detailed Field Survey Required. (199,758 acres — 41.4% of the County) — Moderately deep, usually well drained soils with slopes 0-15%. This group is usually suitable for all types of buildings on the gentle slopes, and residences and small buildings on all slopes. The minor restrictions of these soils are the nearness to bedrock and clayey conditions. In many places the bedrock is partially weathered and soft, and in many places, rock of varying hardness is found in excavating. Detailed exploration should be made on the Glenelg soils, particularly those over mica schist bedrock in the southern part of the County, when considering a site for heavy buildings, since this soil is often underlain by saprolite (rotten) rock to a depth of 20 feet and is not stable under a heavy load. The Glenelg soils must be checked for permeability with a "percolation test" to determine feasibility of each site, even though these soils are classed as well drained and permeable and are usually suited for on-site sewage disposal systems. The Montalto and Neshaminy soils absorb water more slowly than the soils in group 1 and perched water table conditions are not uncommon.

In this group, the soil survey does not provide a definite answer so that further detailed on-site study is required.

Chart 8-1

DEPTH TO BEDROCK AND TO SEASONAL HIGH WATER TABLE



Source: Chester County Soil Survey Report

Date Completed: February 15, 1963

Table S-3

[The characteristics listed are those that cause difficulty in the stated kind of construction. Dashes indicate the soil generally has no special characteristics that interfere with the stated use]

Soil series and map symbols	Suitability for winter grading	Resistance to frost action	Suitability of material for—		Suitability as source of—		Characteristics that affect—		Characteristics that affect—Continued		Characteristics that affect suitability for—								
			Road subgrade	Road fill	Topsoil	Sand and gravel	Vertical alignment for highways		Infiltration of waste from septic tanks	Construction and maintenance of pipelines	Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building sites
							Materials[1]	Drainage				Reservoir area	Embankment					
Aldino (AgA, AgB2, AsB2)	Poor	Poor	Poor to fair.	Poor	Fair	Unsuitable	Instability.	Seasonal high water table.	Slowly permeable.	Shallow soil.		Shallow soil.	Lacks binder.	Heavy subsoil.	Shallow soil.	Shallow soil.	Shallow soil.	Wetness.
Bedford (BdA, BfB, BrB2)	Fair	Fair	Fair	Good	Good	Poor												
Beltsville (BeA, BeB2)	Fair	Fair	Poor to fair.	Fair	Good	Variable	Claypan.	Claypan.	Claypan.	Fluctuating water table.	Instability.	Claypan.	Claypan.	Restrictive claypan.	Claypan.	Claypan.	Claypan.	Claypan.
Bowmansville (Bo)	Poor	Poor	Poor to fair.	Poor	Fair	Unsuitable	Instability.	Seasonal high water table.	High water table.	High water table.	Instability.	Instability.	Instability.	Flooding.	Poor drainage; slow permeability.	Flooding.	Flooding.	Flooding.
Brandywine (BrB2, BrC, BrC2, BrC3, BrD, BrD2, BrD3, BrE, BrE, BrD, BrF).	Good	Fair	Good	Good	Fair	Unsuitable				Shallow soil.		Rapid permeability.	Rapid permeability.		Shallow soil.	Shallow soil.	Shallow soil.	
Brecknock (BtB2, BtC2, BtC3, BtD2, BtD3, BtE3, BtB, BtD, BtF).	Fair	Fair	Poor to fair.	Fair	Fair	Unsuitable			Hardpan.	Shallow soil.		Permeable substratum.	Permeability.		Stones.	Shallow soil.	Hardpan.	
Built (BuB2)	Fair	Fair	Poor to fair.	Fair	Good	Unsuitable												
Buttertown (BtA, BtB2)	Fair	Poor	Poor to fair.	Poor	Good	Variable	Claypan.		Substratum drainage.			Permeable substratum.	Instability.	Claypan.	Claypan.	Claypan.	Claypan.	Substratum drainage.
Calvert (CaA, CaB, CaB2)	Poor	Poor	Poor	Poor	Fair	Unsuitable	Instability.	Seasonal high water table.	Seasonal high water table.	High water table.	Instability.	Instability.	Instability.	Slowly permeable.	Wetness.	High water table.	Claypan.	Substratum drainage.
Chester (ChA, ChA2, ChB, ChB2, ChB3, ChC, ChC2, ChC3, ChE, ChE).	Good	Poor	Fair	Fair	Good	Unsuitable					Instability.	Permeable substratum.	Permeability.	Not needed.				
Chewacla (Ch)	Fair	Fair	Poor to fair.	Fair	Good	Unsuitable		Seasonal high water table.	Flooding.	Flooding.		Flooding.	Flooding.	Seasonal high water table.	Flooding.	Flooding.	Difficult to obtain outlets.	Flooding.
Chrome (CkB2, CkC2, CkC3, CkD2, CkD3, CkE2).	Fair	Poor	Poor	Poor	Fair	Unsuitable	Instability.		Shallow soil.	Shallow soil.	Shallow to bedrock.	Shallow soil.	Instability.		Shallow soil.	Shallow, stony soils.	Shallow soil.	Shallow soil.
Conestoga (CnA, CnA2, CnB2, CnC2, CnC3)	Fair	Fair	Fair	Fair	Good	Unsuitable					Permeability.	Rapid permeability.	Rapid permeability.					
Congaree (Cc)	Fair	Fair	Fair	Fair	Good	Unsuitable		Flooding.	Flooding.	Flooding.	Variable.	Flooding.	Flooding.		Flooding.	Flooding.	Flooding.	Flooding.
Conowingo (CoA, CoB2)	Fair	Fair	Fair	Fair	Fair	Unsuitable	Claypan.	Seasonal high water table.						Slow permeability.	Slow permeability.			Seasonal high water table.
Croton (CrA, CrB)	Poor	Fair	Poor to fair.	Poor	Fair	Unsuitable	Plastic soil material	Seasonal high water table.	High water table.	High water table.	Instability.	Instability.	Instability.	High water table; seeps.	Wetness.	High water table.	High water table.	Wetness.
Edgemont (EdB, EdB2, EdC, EdC2, EdC3, EdD, EdD2, EdD3, EdE, EdE2, EdE3, EdD, EdF).	Good	Fair	Fair to good.	Poor	Fair	Fair for sand.	Stones; slopes.		Shallow soil.	Shallow soil.	Rapid permeability.	Permeable substratum.	Permeability.		Shallow soil.	Shallow soil.		
Glenelg (GeA, GeA2, GeB, GeB2, GeC, GeC2, GeD, GeD2, GeE, G-D, G-E)	Good	Fair	Fair to good.	Fair to good.	Good	Unsuitable					Rapid permeability.	Permeable substratum.	Permeability.					
Glenelg, severely eroded (GgB3, GgC3, GgD3, GgE3, $G_2$43, G_2B3)	Fair	Fair	Fair	Fair to good.	Very poor.	Unsuitable			Shallow soil.		Rapid permeability.	Permeable substratum.	Permeability.		Low water-holding capacity.	Shallow soil.	Highly erodible.	
Glenville (GnA, GnB, GnB2, GnC2, GnB).	Fair	Poor	Poor to fair.	Poor	Good	Unsuitable		Seasonal high water table.	Claypan.	Fluctuating water table.	Instability.	Variable substratum.		High water table; seeps.	Restricted drainage.			Seasonal high water table.
Guthrie (Gu)	Poor	Fair	Fair	Poor	Fair	Unsuitable	Weak pan.	Seasonal high water table.	Seasonal high water table.	Fluctuating water table.	Instability.		Instability.	Weak claypan.	Slow permeability.	High water table.	High water table.	Wetness.
Hagerstown (HaA2, HaB2, HaC2, HaC3)	Fair	Fair	Good	Fair	Good	Unsuitable												
Hoffmeier (HcB2, HcC2, HcC3, HcD3, HcE3)	Good	Fair	Good	Fair to good.	Good	Unsuitable	Shallow soil.		Shallow soil.	Bedrock; stones.	Rapid permeability.	Shallow soil.	Shallow soil.		Shallow soil.	Shallow soil.	Shallow soil.	Bedrock.
Lawrence (LaA, LaB)	Fair	Poor	Fair	Fair	Fair	Unsuitable	Weak pan.	Seasonal high water table.	Seasonal high water table.	Fluctuating water table.	Instability.		Instability.	Weak claypan.	Slow permeability.	High water table.	Weak claypan.	Wetness.
Lehigh (LeB, LeB2, LeC3, LeB, LeD).	Fair	Fair	Fair	Fair	Fair	Unsuitable	Claypan.	Seasonal high water table.	Permeability of subsoil.	Wetness.	Instability.	Shallow soil.	Shallow soil.	Impermeable substratum.	Slow permeability.	Hardpan.	Weak claypan.	Hardpan; stones.
Linside (Ln)	Fair to poor.	Poor	Fair	Poor to fair.	Good	Unsuitable		High water table.	Flooding.	High water table.	Permeability.	Unsuitable; flooding.	Flooding.	Flooding; not enough slope.	Slow permeability.	High water table.	Flooding.	Flooding.
Made land (Ma, Mc, Md, Me)	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.	Variable.
Made land (Mf)	Poor.	Variable.	Poor.	Poor.	Poor.	Unsuitable.	Unsuitable.		Instability.	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Variable.	Unsuitable.	Unsuitable.	Unsuitable.	Instability.
Manor (MaA2, MaB2, MaB3, MaC, MaC2, MaC3, MaD, MaD2, MaD3, MaE, MaE3, MaF, MmB, MmD, MmF)	Good	Fair	Good	Good	Fair	Unsuitable	Instability.				Instability.	Permeable substratum.	Instability.				Shallow soil.	
Melvin (Mv)	Poor	Poor	Poor	Poor	Fair	Unsuitable		Seasonal high water table and flooding.	Flooding.	Flooding.	Variable.	Flooding.	Flooding.	Flooding.	High water table.	High water table.	Flooding.	Flooding.
Montalto (MoB2, MoC2, MoC3, MoD3, MoB, MoD, MoF)	Poor to fair.	Fair	Fair	Fair	Fair	Unsuitable	Stones.		Permeability of subsoil.									
Mount Lucas (MuB)	Fair to poor.	Poor	Fair	Fair	Fair	Unsuitable		Seasonal high water table.	Restricted drainage.	Wetness.	Instability.	Instability.		Weak claypan.	Slow permeability.	Slow permeability.	Weak claypan.	Wetness.
Neshaminy (NeA, NeB2, NeC2, NeC3, NeD, NeD3, NeB, NeD, NeF).	Good	Fair	Good	Fair to good	Fair	Unsuitable												
Othello (Oc)	Poor	Poor to fair.	Fair	Fair to good.	Fair	Variable		Occasional high water table.	Restricted drainage.	Wetness.	Instability.	Permeable substratum.		Weak claypan.	High water table.	High water table.	High water table.	Wetness.
Penn shaly silt loam (PeB2, PeC2, PeD3).	Good	Fair	Good	Fair	Poor	Poor			Shallow to bedrock.	Shallow soil.	Unsuitable.	Shallow soil.	Rapid permeability.		Shallow to hard shale.	Shallow soil.	Shallow to shale.	
Penn silt loam (PnB2, PnC2, PnC3, PnD, PnD2, PnE, PnD, PnF)	Fair	Fair	Fair to good.	Good	Fair	Poor			Impermeable subsoil.		Instability.							
Penn soils (PsE2, PsE3, PsF)	Good	Fair	Good	Good	Fair	Poor			Impermeable subsoil.	Slopes.	Instability; slopes.	Slopes; shallow soil.	Instability.		Shallow soil; slope.		Shallow soil; slope.	
Penn and Lansdale (PtB2, PtC2, PtC3, PtD2)	Good	Fair	Good	Good	Fair	Fair			Slow permeability.			Permeable substratum.			Shallow soil.			
Readington (RdA, RdB, RdB2)	Poor to fair.	Poor to fair.	Poor to fair.	Fair	Fair	Poor	Instability.	Seasonal high water table.	Slow permeability.	Seasonal high water table.		Permeable substratum.		Hardpan.	Hardpan.		Hardpan.	Wet substratum.
Rowland (Ro)	Poor	Poor	Fair	Fair to good.	Fair	Fair	Instability.	Flooding.	High water table; flooding.	Poor drainage.	Instability.	Flooding.	Flooding.	Difficult to obtain outlet.	Slow permeability.	Flooding.	Flooding.	High water table; flooding.
Rowland, dark surface (Rr)	Poor	Fair	Poor to fair.	Fair	Poor	Fair	Instability.	Flooding.	Flooding.	Flooding.	Instability.	Flooding; instability.	Instability.			Flooding.	Flooding.	Flooding.
Sassafras (SaA, SaB2)	Good	Fair to good.	Good	Good	Good	Fair to good.					Instability.	Permeable substratum.	Permeable substratum.					
Tidal marsh (Tm)	Poor	Poor	Unsuitable.	Unsuitable.	Poor	Unsuitable.	Marsh.	High water table.	High water table.	High water table.	Unsuitable.	High water table.		Impossible; no outlet.	High water table.	High water table.	High water table.	High water table.
Watchung (WaA, WaB2, WuB)	Poor	Poor	Poor	Poor	Poor	Unsuitable.	Instability.	High water table.	Slow permeability.	High water table.	Lacks binder.	Lacks binder.	Lacks binder.	Slow permeability.	High water table.			Wetness.
Wehadkee (We)	Poor	Poor	Poor to fair.	Poor to fair.	Fair	Poor	Instability.	High water table; flooding.	High water table.	Flooding; High water table.		Flooding.	Variable.	Flooding; difficult to obtain outlet.	Flooding; high water table.	Flooding.	Flooding; difficult to obtain outlet.	Flooding
Woodstown (WoA)	Poor to fair.	Poor	Fair	Fair	Fair	Fair	Instability.	Seasonal high water table.	Slow permeability.	Seasonal High water table.		Permeable substratum.		Slow permeability of subsoil.	Permeability of subsoil.			Wet substratum
Worsham (WoA, WoB, WoB2, WoC2, WuB).	Poor	Poor	Poor	Poor	Fair	Poor	Instability.	High water table; seeps.	Slow permeability.	Seasonal High water table.	Instability.	Permeable substratum.	Instability.	Seeps; slopes.	Wetness.		Difficult to obtain outlet.	Wetness

[1] Except for Beltsville, Buttertown, Made land, Othello, Rowland, Sassafras, Tidal marsh, and Woodstown, the soils are shallow to bedrock.

Source: Chester County Soil Survey Report

These soils are found in most parts of the County except the northeastern and the Chester Valley.

Soil types in this group are:

Brecknock channery silt loam, 3-15% slopes
Brecknock very stony silt loam, 0-8% slopes
Glenelg channery silt loam, 0-15% slopes
Glenelg silt loam, 0-8% slopes
Penn and Lansdale sandy loams, 3-15% slopes
Montalto channery silt loam, 3-15% slopes
Montalto very stony silt loam, 0-8% slopes
Neshaminy gravelly silt loam, 0-15% slopes
Neshaminy very stony silt loam, 0-8% slopes

In this Variable category, the soil survey gives less conclusive results. Its largest member is the Glenelg series, which occupies about 42% of the County. In Maryland and Virginia, Glenelg rates as highly suitable for septic tanks and urban purposes. In this area, experience indicates a less clear cut rating. In seemingly unpredictable ways, Glenelg is either shallow or tends to clog with clay. In other places, satisfactory results are obtained.

Efforts are underway to see whether this Variable category could be refined; and the most hopeful approach seems to be to see whether the underlying parent material might be the clue. There is some indication, although not conclusive proof, that the soils formed from gabbroic parent material tends to weather less deeply and contains a higher percentage of clay feldspar, and thus are less likely to be suitable for septic tanks than those formed from granitic material or from schists. Variable soils most likely to be suitable are those formed from the deeply weathered mica schists, which contain little feldspar and much quartz.

The underlying parent material is described in more detail in the Geology section. But for ready comparison of soil and bedrock characteristics the detailed geology is underprinted in black on the Urban Suitability Map. The gabbroic type rocks are those mapped as: gabbro (Gb), anorthosite (An), Baltimore Gneiss (Bgn), Baltimore Gneiss injected with gabbro (Bgb), and Serpentine (Sp). Most of the gabbroic area is in the West Chester region, or in the area north of Chester Valley between Coatesville and Atglen. The mica schists (wms) occupy most of the southwestern portion of the County.

The Neshaminy and Montalto soils are deep and well drained; and ordinarily would have been rated suitable. However, some recent laboratory tests have suggested that chemical detergents may clog these soils; hence they have been demoted to the "Variable" category. The Montalto soils are found only over the diabase ridge in the upper French Creek area. Neshaminy soils are found primarily over gabbro and anorthosite, and some serpentines.

3. Hazardous — Potential Ground Water Contamination (Soils over limestones) (20,613 acres, or 4.3% of the County) — These soils are deep and well drained, except the Hollinger which is shallow, with slopes 0-15%. These soils are suitable for most types of buildings; but care should be taken to determine if sinkholes or underground caverns are present under proposed building sites.

These soils have excellent permeability, but very often the effluent from on site sewage disposal systems reaches the underground channels and caverns, thereby polluting the ground water supply. Excavation problems are extremely variable due to "sawtooth" variation of the underlying limestone, and nearness of bedrock to the surface on the Hollinger soils. Limestone soils are found only in the Chester Valley and in a small area in the Toughkenamon Valley near Kennett Square.

Soil types in this group are:

Conestoga silt loam, 0-15% slopes.
Hagerstown silt loam, 0-15% slopes.
Hollinger silt loam, 3-15% slopes.

4. Conditional — Too Shallow — Bedrock and detergent problems. (72,495 acres, or 15.1% of the County) The major restrictions in this group are nearness of bedrock to the surface, difficulty in excavating for basements and sewage disposal systems, and the inability of the soils to absorb sewerage effluent because of shallow depth and low moisture holding capacity.

This group of soil ranges from shallow to moderately deep and is suitable for all building types on the more gentle slopes and residences on slopes of 0-15%. This group of soils is classified as well drained, but because of the shallowness, low moisture holding capacity, and density of bedrock, on site sewage disposal systems are not only difficult to install properly but they do not often function satisfactorily. Evacuation difficulty is usually encountered due to the proximity and hardness of the bedrock.

Most of the soils of the Triassic lowlands and many of the soils of the steeper areas are in this "too shallow" category.

Soil types in this category are:

Brandywine loam, 3-15% slopes.
Brandywine very stony loam, 0-8% slopes.
Chrome gravelly silty clay loam, 3-15% slopes.
Manor loam, 0-15% slopes.
Manor very stony loam, 0-8% slopes.
Penn shaly very shallow silt loam, 3-15% slopes.
Penn silt loam, 3-15% slopes.
Penn very stony silt loam, 0-8% slopes.

5. Unsuitable — Seasonably or Permanently Too Wet. (66,121 acres — 13.7% of the County) These soils are deep to moderately deep, moderately well drained to poorly drained on slopes 0-15%. The soils that are moderately well drained such as Bedford, Beltsville, Conowingo, Glenville, Lehigh, and Readington can be used with care for most types of buildings, but on the somewhat poorly to poorly drained soils, the land can be used for residences and other small buildings if the basements are sealed or fill is used to raise the basements above the water table.

This group is unsuitable for on site sewage systems, and if buildings are constructed on these soils, public sewage systems should be available.

The too wet group is subdivided into those that are moderately well drained and those that are poorly drained. It is not possible to make this separation on the map in this report; but the large scale interpretative maps available for inspection at the Planning Commission offices do show this separation.

The moderately well-drained soils (36,929 acres, or 7.6% of the County) are too wet primarily in the winter and spring. They may be suitable for limited septic tanks during the summer and fall. The moderately well drained soils are:

Bedford silt loam, 0-8% slopes.
Beltsville silt loam, 0-8% slopes.
Glenville silt loam, 0-15% slopes.
Glenville very stony silt loam, 0-8% slopes.
Lehigh silt loam, 3-15% slopes.
Readington silt loam, 0-8% slopes.

The poorly drained soils (29,192 acres, or 6.1% of the County) are wet at all times and are positively unsuitable for homes with basements (without very costly sealing) or for septic tanks at any season of the year. The poorly drained soils are:

Aldino silt loam, 0-8% slopes.
Calvert silt loam, 0-8% slopes.
Conowingo silt loam, 0-8% slopes.
Croton silt loam, 0-8% slopes.
Guthrie silt loam, 0-3% slopes.
Lawrence silt loam, 0-8% slopes.
Watchung silt loam, 0-8% slopes.
Watchung very stony silt loam, 0-8% slopes.
Worsham silt loam, 0-15% slopes.
Worsham very stony silt loam, 0-8% slopes.

URBAN SUITABILITY SOIL MAP HAS GREAT VALUE FOR MANY PURPOSES

Basic soil properties such as texture, depth to bedrock, depth to and seasonal variation in water table, slope and drainage have recently been found to have great value for many urban as well as farming purposes. Urban soil interpretation is a new field with much still to be learned; but soil surveys are useful for indicating relative suitability for septic tanks and cesspool sewage disposal, sanitary landfills, landscaping, and many engineering purposes such as airports and foundation suitability.

Deep, well drained soils that are suitable for septic tanks also tend to be suitable for many other uses such as sanitary landfills, golf courses, cemeteries, trees and shrubs, farmlands. Conversely, shallow, or wet, or flood plain soils tend to be unsuitable for most of these purposes. More detailed information is available in the text and in the official published soil survey report, although the septic tank information in the map and text of this report supersedes that in the official report.

The seven urban suitability categories as defined below, particularly for in ground sewage disposal by septic tanks and cess pools were developed on the basis of recommendation of the State Soil Scientist, U.S. Soil Conservation Service, and the Pennsylvania Department of Health, and is the latest information as of the summer of 1963. Continuing experience may result in more refined definitions.

This map is a composite and reduction of interpretations made from the original large-scale soil survey map essential for individual preliminary site evaluation, and may be slightly generalized. More detailed color interpretative maps are available at the Chester County Planning Commission Office, or in raw data form in the officially published soil survey report.

URBAN SUITABILITY

Suitable (36,635 acres, 7.5% of the County) - Deep, well drained soils with slopes of 0 - 15%. This group is suitable for all type of buildings, and is suitable for on site sewage disposal because it has good permeability and, in most instances, does not have a ground water pollution problem.

Variable - Probably Suitable (199,758 acres, 41.4% of the County) - Moderately deep, usually well drained soils with slopes 0 - 15%. This group is usually suitable for all types of buildings on the gentle slopes, and residences and small buildings on all slopes. The minor restrictions to these soils are the nearness to bedrock. Detail exploration should be made on the Glenelg soils, particularly those over mica schist bedrock in the southern part of the County, when considering a site for heavy buildings since this soil is often underlain by saprolite (rotten)rock. Even though these soils are classified as well drained and permeable and are usually suited for on site sewage disposal systems, the Glenelg soils must be checked for permeability with a "percolation" test to determine feasibility of each site. *

Hazardous - With Ground Water Problems (Soils over limestones - 20,613 acres, 4.3%) These soils are deep and well drained, except for the Hollinger which is shallow, with slopes 0 - 15%. These soils are suitable for most types of buildings but care should be taken to determine if sinkholes or underground caverns are present under proposed building sites.

These soils have excellent permeability, but very often the seepage from on site sewage disposal systems reaches the underground channels, thereby polluting the ground water supply. Excavation problems are extremely variable.

Conditional-Too Shallow (72,496 acres, 15.1% of the County). Major restrictions in this group are nearness of bedrock to the surface, difficulty in excavating for basements and sewage disposal systems.

This group of soils is shallow and suitable for all building types on the more gentle slopes and residences on slopes of 0 - 15%. This group of soils is classified as well drained, but because of the shallowness satisfactory on site sewage disposal systems are difficult to install properly so they will function satisfactorily.

Unsuitable - Too Wet (66, 121 acres, 13.7 % of the County area) These soils are deep to moderately deep, moderately well drained to poorly drained on slopes 0 - 15 %, The soils that are moderately well drained such as Bedford, Beltsville, Conowingo, Glenville, Lehigh, and Readington can be used with care for most types of buildings, but on the somewhat poorly to poorly drained soils, the land can be used for residences and other small buildings if the basements are sealed or fill is used to raise the basements above the water table.

This group is unsuitable for on site sewage systems, and if buildings are constructed on these soils, public sewage systems should be available.

Unsuitable - Flood Plain Soils (27,527 acres - 5.7% of the County) This group is subject to overflow of high waters from streams periodically, and should never be used for building sites.

Unsuitable - Excessive Slopes and Stoniness (59,327 acres, 12.3% of the County) Grouped in this category are all areas having slopes steeper than 15% regardless of the type of soil.

There may be many residences and small buildings on slopes up to 25%, and people will continue to build on these steep slopes. If buildings are constructed on these slopes, it should be confined to the deep well drained soils and extreme caution should be taken with the foundations and sewage disposal systems.

Source: Chester County Soil Survey Report

* Black tint over Variable soils indicates either areas of Neshaminy or Montalto soils which may influence the handling of detergents.

URBAN SUITABILITY

for

BUILDINGS and SEPTIC TANKS

For Undisturbed Soils

CHESTER COUNTY

PENNSYLVANIA

SCALE IN MILES

1 INCH – 2 MILES

1:126,720

Compiled and published by the Chester County Planning Commission, West Chester, Pennsylvania

Printed October 1963 by Williams & Heintz Map Corporation, Washington 27, D.C.

6. Unsuitable — Flood Plain Soils (27,527 acres, or 5.7% of the County) This group is subject to overflow of high waters from streams periodically, and should never be used for building sites. The area shown on the map is usually the minimum subject to flooding. The flood plain information studies petitioned for from the Corps. of Army Engineers may show more exact information.

Soil types in this category are:

Bowmansville silt loam, 0-3% slopes.
Chewacla silt loam, 0-3% slopes.
Congaree silt loam, 0-3% slopes.
Lindside silt loam, 0-3% slopes.
Melvin silt loam, 0-3% slopes.
Rowland silt loam, 0-3% slopes.
Rowland silt loam, dark surface, 0-3% slopes.
Wehadkee silt loam, 0-3% slopes.

7. Unsuitable — Excessive Slopes and Stoniness (59,327 acres — 12.3% of the County). Grouped in this category are all areas having slopes steeper than 15% regardless of the type of soil.

There may be many residences and small buildings on slopes up to 25% and some people will continue to build on these steep slopes, despite costs. If buildings are constructed on these slopes, it should be confined to the deep well drained soils and extreme caution should be taken with the foundations and sewage disposal systems. Steep slopes, in addition to all problems of grading access, are usually also shallow soils with problems of drainage and problems of building a septic system. Stony, shallow soils on slopes above 15% and all other soils found on slopes above 25% are considered unsuitable. Soil types in this group are those commonly found on the uplands.

Disturbing or Compaction of Soil May Make Septic Tanks Unworkable.

The soil suitability ratings discussed above and shown in the interpretative maps are only for undisturbed and uncompacted soils. If soils are disturbed or compacted, or sub-soils from excavations raised to the surface, different, and usually less suitable ratings may result. Indeed, disturbing of the soils may make otherwise suitable soils unsuitable.

Many On-Lot Sewerage Systems Fail Because of Inadequate Original Construction Rather Than Because of Soils.

The Pennsylvania Department of Health has made a few spot checks to help determine the reasons for the failure of many of the on-lot sewage disposal systems in the County. In many cases, it was found that on-lot sewage systems fail because of inadequate original construction, undersize systems, overloading beyond design capacity, excessive use of household detergents, and disturbance of soil.

It is hoped that further studies can be made that would result in definite answers as to why and how on-lot sewage disposal systems work or fail to work.

Soil Suitability for Sanitary Landfill Refuse Disposal is Similar to that for General Urban Suitability

The choice of a refuse disposal site is often based entirely on the proximity of the site to the refuse sources, the availability of low cost land, accessibility to the site, and land reclamation. These are important economic factors; however, consideration should also be given to soil and geology. The nature of the soil and underlying geology also have implications (amount of cover material and ease of excavation); but more important, they determine whether a satisfactory sanitary landfill operation is possible.

There are several soil and geologic aspects in site selection, one of the most important being the potential ground water contamination hazard. Therefore, soils derived from and underlaid by limestone are not considered satisfactory sanitary landfill sites. Landfills should not be located in soils where a normal or raised water

table exists because it is not only difficult to operate a landfill, but also may result in pollution of water supplies. Shallow soils are not suitable for landfilling because of insufficient soil cover material plus the fact that refuse will be in proximity to bedrock, thereby also representing a hazard to ground water contamination. Difficulty is often encountered with steeply sloping soil areas for landfill because the erosion and percolation of water through the refuse appears as an offensive surface seepage at the base of slopes and sometimes causes contamination of surface water supplies. Stony soils do not lend themselves to easy excavation nor do these soils contain enough fine textured soil material to provide the compaction needed to prevent the percolation of rain and melt waters through the refuse.

The preceding are a few examples of the criteria and reasonings used in evaluating a particular area for sanitary landfill suitability. Many of these same criteria are used in considering the suitability of soils for building and for subsurface sewage disposal; therefore, the preceding Urban Suitability groupings also lend themselves well to landfill site suitability. The soils in groups 1 and 2 are considered generally suitable for sanitary land fill operation; however, on-site evaluations are always needed to evaluate the local conditions of surface drainage, water supplies, etc. Soils in group 3 are not considered suitable because of the hazard of ground water pollution. Soils in group 4 are too shallow to provide sufficient cover and will not permit satisfactory landfill operation. Soils in groups 5 and 6 are not suitable because of: (1) proximity of ground water table and (2) periods of high water flooding. Soils in group 7 are not considered suitable because of steepness of the slopes, stoniness and shallowness of the soils.

Research is needed to more adequately define the suitability of different soil and geologic conditions for landfilling and relating these characteristics to the many kinds of refuse (organic and inorganic; domestic and industrial) being disposed of in sanitary landfills, their decomposition products, movement to ground water, etc. Therefore, with advance in technology, soil and geologic conditions now considered unsuitable, may become suitable. Nevertheless, the preceding evaluations of soil suitability for refuse burial are the best available considering the present status of landfill procedure.

Urban Suitability Map is Also Valid for Many Other Purposes.

The general Urban Suitability map in this report, by indicating the principal factors of soils that are too wet, too steep, too shallow, too permeable, is valid for many other urban purposes, where these basic factors are operable.

For example, cemeteries should not be built where soils are too wet, too shallow, or too steep, or in areas of ground water contamination danger.

Golf courses could be developed on a wider range of soils, but excessive steepness or wetness would be less desirable.

For general recreational purposes, the wet or steep soils are often an aesthetic asset and a shelter for wildlife. They also should be coupled with some area of dry soils. The area should also have a good stock of mature native trees for shade and aesthetic appeal.

Industry should be located on the flatter ground, with good drainage, deep soils, and good foundation conditions.

Small lot residential development requires relatively level, deep, well-drained soils. Estate type development prefers more rolling topography and presence of trees for aesthetic effect.

Chester County Soils are Only Fair to Poor for Highway Construction.

Most of Pennsylvania's Piedmont (including Chester County) soils are texturally silt loams or clay loams, and many have

Deep, well drained level soils are usually well suited for both farming and urban uses.

at least a seasonably high water table. As compared with a preferred, well drained, sandy or gravelly soil types, silt and clay loams are far less favorable for highway construction. This, of course, does not mean that highways can not be built satisfactorily in Chester County, but that costs are higher. More attention needs to be given to subbase, compaction, drainage, and flatter slopes in cuts. Without such care, the soils are relatively susceptible to frost and winter break-up, as evidenced every early spring on most of the less well built older Pinchot farm-to-market roads, resulting in high maintenance costs. Another factor raising costs is the lack of good natural sand and gravel.

For engineering purposes, soils are classified by either the AASHO for most highway purposes, or the Unified system preferred by some engineers. Both these systems classify soils according to size of particle — i.e. gravel, sand, silt, clay, permeability, available moisture capacity, shrink swell potential, and plasticity index. From these classifications and descriptions, interpretative tables for a variety of purposes can be made with caution. Detailed technical characteristics, determined by laboratory tests, are presented in Tables 5 and 6 of the Soil Survey Report. Table 7, giving general adjectival ratings, is reproduced in this report as Table S - 3.

Because these tables are based upon soil textures, they can give only a partial interpretation. Therefore, an additional statement was prepared by Dr. F. Glade Loughry, State Soil Scientist, relating to the engineering properties of Chester County soils:

"Either the AASHO or Unified Classification can serve as a guide to performance of soils as described on page 29 of the Chester-Delaware report. A low AASHO class or a coarse Unified class generally indicates good bearing strength and stability as foundation material. There are exceptions because of special properties of some soils which are not fully covered by the factors used in these systems. In these counties, the soils with a high proportion of mica or chlorite schist in their parent materials are the most important exceptions. These include soils of the Calvert, Chester, Chewacla, Chrome, Conestoga, Congaree, Glenelg, Glenville, Hollinger, Manor, Wehadkee series, and part of the Conowingo and Neshaminy series. Flakes of mica or chlorite are measured as coarse material but are thin and flexible. They give elasticity to the soil or substratum and do not stay compacted. Many of the compacted density tests for these soils give maximum dry densities of less than 100 pounds per cubic foot. Even when coarse fragments of rock raise the density of the whole soil to between 110 and 120 pounds the intervening material remains somewhat elastic and flexible.

"In summary, highway construction and maintenance are more difficult in the areas of the Neshaminy-Chrome-Conowingo and the Glenelg-Manor-Chester associations than would be predicted from the AASHO Classification alone. The same applies to the use of the Unified Classification for general construction."

WOODLANDS HAVE ECONOMIC AND AMENITY VALUE

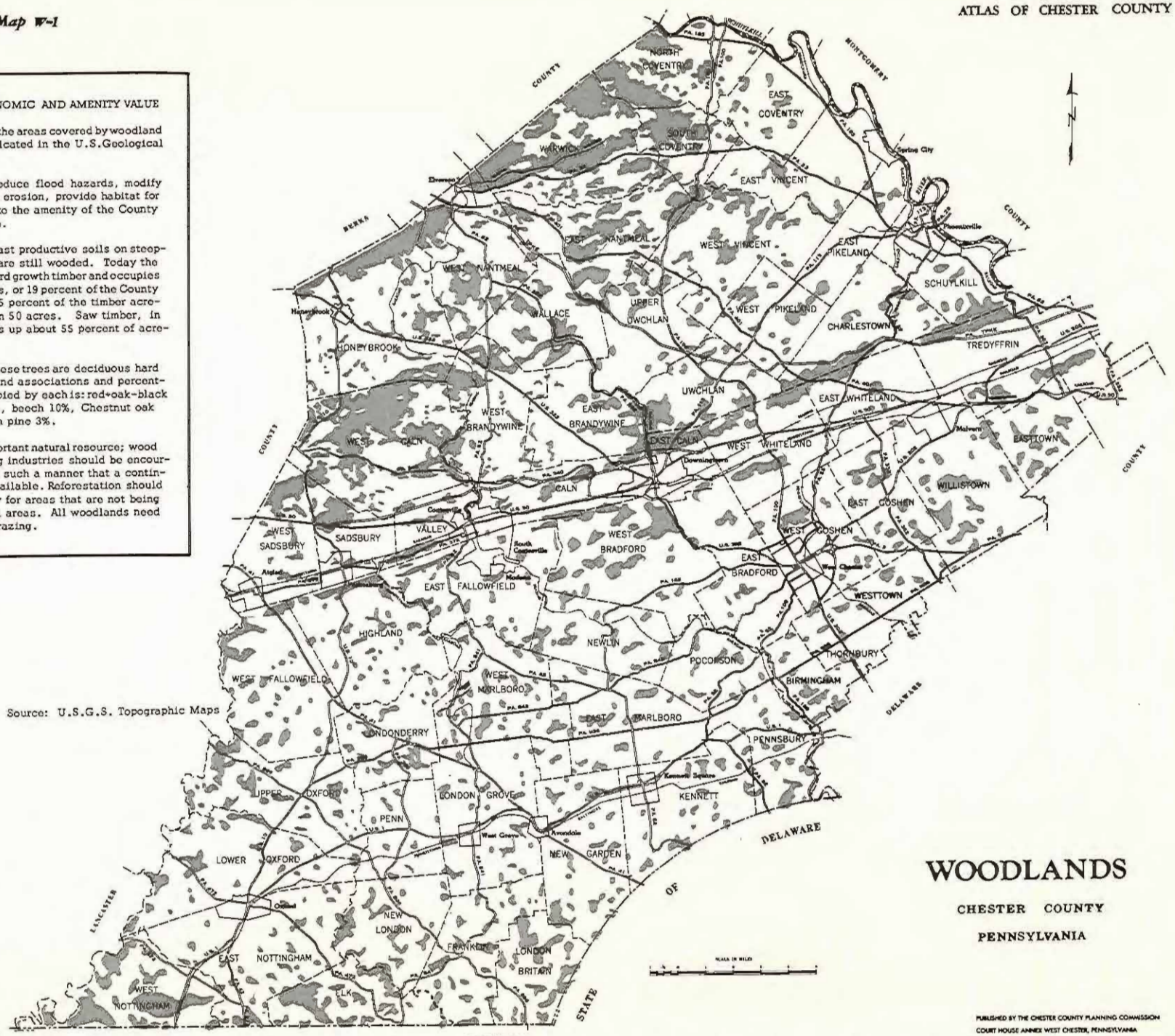
The map shows most of the areas covered by woodland in Chester County, as indicated in the U.S.Geological Survey Quads.

Woodland helps to reduce flood hazards, modify strong winds, reduce soil erosion, provide habitat for wild life, add generally to the amenity of the County and is a valuable resource.

Generally, only the least productive soils on steeper slopes of the County are still wooded. Today the woodland is second and third growth timber and occupies approximately 96,000 acres, or 19 percent of the County area; and approximately 65 percent of the timber acreage is in tracts larger than 50 acres. Saw timber, in commercial forests, makes up about 55 percent of acreage.

A high percentage of these trees are deciduous hard woods. The major woodland associations and percentage of County areas occupied by each is: red+oak-black oak 45%, tulip poplar 37%, beech 10%, Chestnut oak 5%, and Virginia and pitch pine 3%.

Woodlands are an important natural resource; wood lot owners and wood using industries should be encouraged to cut and replant in such a manner that a continuing supply of timber is available. Reforestation should be encouraged continually for areas that are not being used for other agricultural areas. All woodlands need protection from fire and grazing.



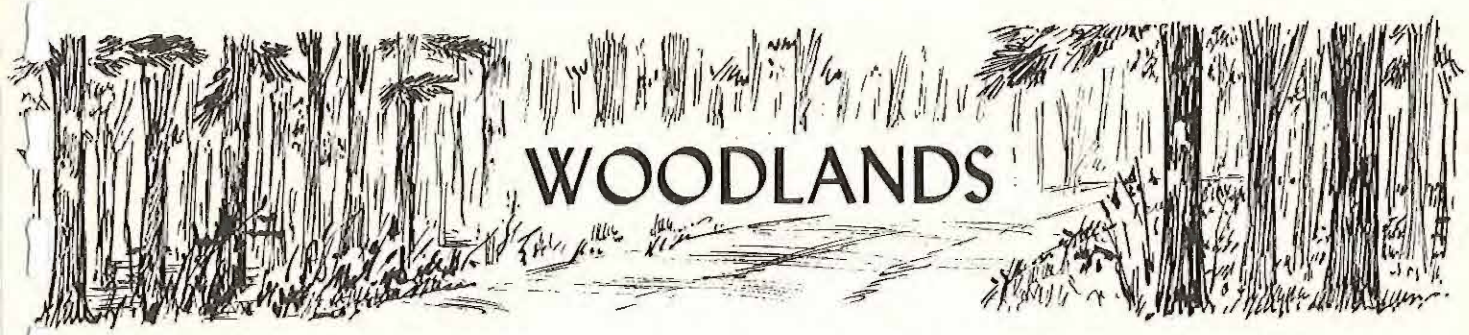
Source: U.S.G.S. Topographic Maps

WOODLANDS

CHESTER COUNTY

PENNSYLVANIA

PUBLISHED BY THE CHESTER COUNTY PLANNING COMMISSION
COURT HOUSE ANNEX WEST CHESTER, PENNSYLVANIA



WOODLANDS

The Natural Land Coverage is Deciduous Hardwood Oaks.

The early settlers of Chester County found a dense cover of trees, the mightiest deciduous forest in the world; and as the land was settled, trees were cut to clear the land for the growing of food, fuel, and fabricating material. Hardwood forest is the natural cover in Chester County because the soils are fertile with ample rainfall. If the land were abandoned, natural reforestation by hardwoods would take place eventually between 60 and 200 years.

Today's Second Growth Woodlands are Usually Found on Steeper, Poorer Soils.

Generally, only the least productive soils and steeper slopes of the County are still wooded. The better crop and pasture lands were long ago cleared, except as specified in William Penn's Charter dated 1681, which stated that one acre of woodland must be retained for every five acres cleared. This in one reason why many acres of good soil have not been cleared for agriculture.

Today the woodland is mainly second and third growth timber and occupies approximately 96,000 acres or 19 percent of the County area; and approximately 65 percent of the timber acreage is in tracts larger than 50 acres. Saw timber makes up approximately 55 percent of the acreage in commercial forests. Seedlings, saplings, and pole timber account for 40 percent. The "Woodland Map" (page size) shows the several areas of large continuous tracts, mostly in the northwestern part of the County, and many smaller groves scattered throughout the County.

The predominant forests in the County are a deciduous hardwood type and are made up of the following major woodland associations, and the percentage of County area occupied by each:

Red Oak — Black Oak — 45% of the County Woodland — These species are found on the uplands and scattered throughout the County. Red Oak and Black Oak predominate in this group and the associates growing among these forest stands are pin oak, scarlet oak, chestnut oak, white oak, tulip poplar, and beech.

Tulip Poplar — 37% of the County Woodland — These species are found in the more moist sites in the County. Tulip poplar predominates in this group; other species found in these forest stands are black locust, red maple, black birch, red oak, beech and gum.

Beech — 10% of the County Woodland — Beech predominates with varying mixtures of the following: black oak, red oak, red maple, hemlock, white ash, black cherry, basswood, black birch, and elm.

Chestnut Oak — 5% of the County Woodland — Chestnut Oak predominates, and the common associates are scarlet oak, white oak, red oak, black oak, black birch and red maple. These are found on the higher uplands in the northern part of the County.

Virginia Pine and Pitch Pine — 3% of the County Woodland — These species are found mostly on the barrens in the southwestern part of the County. Where Virginia pine predominates the principal associates are chestnut oak, black oak, white oak and bear oak. On the areas where Pitch Pine predominates the chief associates are chestnut oak and bear oak.

Other species of trees common, but less abundant, found in the County are hickory, ash, elm, red maple, black walnut, black Gum and Black Birch. Smaller trees that grow under the cover of the larger trees

are dogwood, sassafras and blue beech. In the abandoned fields next to woodlands such species as Virginia pine, locust, tulip poplar, elm, and ash tend to reclaim the land.

There is some tendency for the less desirable species to replace the more desirable as the better trees are cut, suffer from deer and animal grazing, or are destroyed by fire.

Trees are the Most Valuable Use of Steeper Sloping Marginal Land.

Land over 15% slope is too steep for crops and here, woodlands are the most appropriate and valuable use.

Woodland is recognized as a crop of the land and each growing tree increases its volume of board feet of timber each year by growing taller and increasing its trunk diameter. The longer a tree can be left to grow, the greater the return in board feet of timber, unless damaged by fire, insects or disease.

For example: Tulip Poplar on class 1 sites of fully stocked stands produce approximately 520 board feet per acre of timber, as compiled by the Pennsylvania Department of Forests and Water.

The Pennsylvania Department of Forest and Waters has developed recommendations for reforestation based on soil type, moisture, slope and exposure. Forest tree planting advice, silvicultural practices, and other items incident to the development and use of forest property may be obtained from the service forester whose headquarters are at Valley Forge, Port Kennedy.

Coniferous species are most frequently planted because of ease in planting, higher survival rate, and the availability of planting stock.

More Woodlands are Important in Future Planning.

The uses of woodland areas of the County are varied not only for woodland products produced and harvested; but others such as recreation, flood control and prevention of erosion. Land no longer used for agriculture can be planted to timber producing trees and, with care and good woodland management practices, can supply continuing lumber products from land which would not otherwise produce farm crops.

Woodlands are an important natural resource and the woodlot owners and wood using industries should be encouraged to cut and replant in such a manner that a continuing supply of timber is available. The Department of Forest and Waters has distributed 700,000 seedlings in Chester County during the past 10 years. Applications for seedlings and trees available can be secured from the service forester at Port Kennedy.

It is important to protect the existing wooded areas but it is more important to extend the woodland areas particularly in the regions above fresh water impoundments. Watersheds can provide more dependable water supplies of fresh water where forest cover is present to present to prevent rapid runoff, thereby reducing the possibility of floods. The planting of forest trees on the steeper hillsides will check severe erosion and over a period of time rebuild more top soil by increasing the organic matter content of the soil with the residue from the leaves and needles that fall from the trees and the root growth.

Large tracts of forest can reduce temperature within their immediate vicinity, and also tends to increase the rainfall slightly.

Forests make an important contribution to song birds and wild life by supplying adequate food and cover, thereby increasing the number of beneficial birds and other wild life to help to control insects and other damaging pests of the domestic crops.

Forest stands add to the aesthetic value of landscape by providing more picturesque scenery.

It is also important to protect the timber land from fire for the above reasons. Chester County has 41 forest fire wardens

whose principal job is to prevent and suppress forest fires. One forest fire tower adjoins and overlooks Chester County.

Soil Survey Gives Woodland Ratings

The Chester County Soil Survey provides detailed woodland ratings in their Table 3, reproduced in this report as Table W-1. These seventeen categories are based primarily upon slope and secondarily upon texture, drainage, depth, and type of parent material, with limestones and diabase considered separately from all the other soils. The full names of the soils abbreviated in this table are found in the engineering analysis table in the Soils Chapter.

The seventeen Woodland ratings were divided into four productivity groups based upon oak as follows:

Potential Productivity	Site Index Oak	Yield Per Acre
F-1	75	13,750 Board Feet
F-2	65-74	9,750 Board Feet
F-3	55-64	6,300 Board Feet
F-4	54 or less	3,200 Board Feet

The deep, well-drained level soils are as well suited for tree productivity as they are for crops. Steepness of slope, however, is not a barrier to good production if the soil is moderately deep. Yields can also be produced on steep shallow soils where other crops can not be safely or economically grown.

The Chester County Planning Commission has not yet prepared woodland productivity maps, but may do so later. However, as shown on that map, woodland productivity is very similar to the Agricultural Capabilities. The good cropland soils are also the best woodland soils, but crops are a more valuable use.

Soil Survey Data is Useful for Ornamental Landscape Planning, Provided Soils are not Disturbed.

The basic soils survey data is useful in indicating the soil suitability for various types of ornamental trees and shrubs. The key factors here are usually depth of soil, degree of wetness, soil texture, and degree of acidity (pH.); all of which are described in the detailed soil survey report. Knowledge of plant requirements from standard horticultural and landscaping guides, coupled with the soil ratings, will permit useful interpretations. The U. S. Soil Conservation Service is working in cooperation with Pennsylvania State University to prepare such ratings for later publication.

It is important to recognize that such ratings would be valid only for undisturbed soils. Where basement subsoil full of plaster and building refuse is on the surface, as is often the case around new homes, the ratings based upon undisturbed soil would not be valid.

The quality of the soil for grasses, shrubs, and trees when disturbed and exposed depends upon the depth and quality of the original undisturbed soil, and its drainage and water table characteristics.

The deep, well-drained soils shown as "Suitable" on the Urban Suitability Map (in the Soils Section) can usually support landscape plantings even though disturbed. The Bucks, Chester, Edgemont, and particularly most of the limestone soils of the Chester Valley are in this category. The Glenelg and most of the other soils of the "Variable" (probably suitable) category on the Urban Soil Map are also fairly good.

Those shown as "Too Shallow", such as the Manor and Penn Soils are shallow, droughty and thus, less suitable in a disturbed condition for trees and shrubs.

The soils of the "Too Wet" category are also generally not suitable after disturbance; in addition they have special problems of selection of plant varieties able to withstand the excessive seasonable or perennial wetness.

In all cases, mulching, fertilizer, lime, and new topsoil and planting at the proper season will help get vegatation established.

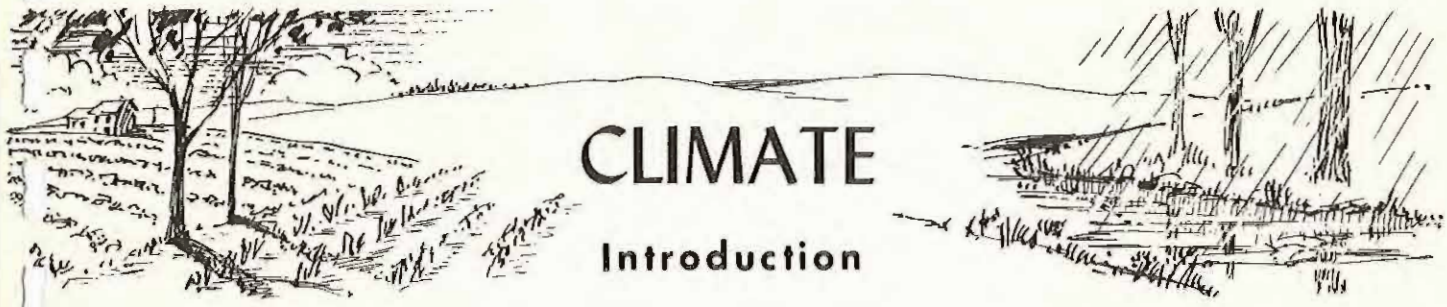
Table W-1

-Species priority and estimated ratings of woodland suitability groups for various factors important to woodland use and management

[F–1 soils are excellent for timber, the site index for oak is 75 or better, and the expected yield is 13,750 board feet per acre; F–2 soils are good for timber, the site index for oak is 65 to 74, and the expected yield is 9,750 board feet per acre; F–3 soils are fairly good for timber, the site index for oak is 55 to 64, and the expected yield is 6,300 board feet per acre; F–4 soils are poor for timber, the site index for oak is 54 or less, and the expected yield is less than 3,250 board feet per acre]

Woodland group and mapping symbols	Potential productivity	Species priority for—		Seedling mortality	Competition from other plants	Limitations to use of woodland equipment	Hazard of—	
		Native trees	Planted trees				Erosion	Windthrow
Group 1. Deep and moderately deep, well-drained soils on acid materials; 0 to 8 percent slopes (BtB2, BvB, BxB2, ByA, ByB2, CdA, CdA2, CdB, CdB2, CdB3, CgB, Cn, EcB, EcB2, EdB, GeA, GeA2, GeB, GeB2, GeB3, NaA, NaB2, NsB, PtB2, SaA, SaB2).	F–1	Yellow-poplar, red oak, white oak.	White pine, larch, Norway spruce, Austrian pine.	Slight	Severe	Slight	Slight	Slight.
Group 2. Deep and moderately deep, well-drained soils on limestone and diabase; 0 to 8 percent slopes (CmA, CmA2, CmB2, HaA2, HaB2, MoB2, MrB).	F–1	Yellow-poplar, red oak, white oak.	White pine, Austrian pine.	Slight	Severe	Slight	Moderate	Slight.
Group 3. Deep and moderately deep, well-drained soils on acid materials; 8 to 25 percent slopes (BtC2, BtC3, BtD2, BtD3, BvD, CdC, CdC2, CdC3, CgC, EcC, EcC2, EcC3, EcD, EcD2, EcD3, EdD, GeC, GeC2, GeC3, GeD, GeD2, GeD3, GmD, NaC2, NaC3, NaD, NaD3, NsD, PtC2, PtC3, PtD2).	F–1	Yellow-poplar, red oak, white oak.	White pine, larch, Austrian pine, Norway spruce.	Slight	Moderate	Moderate	Moderate	Slight.
Group 4. Deep and moderately deep, well-drained soils on limestone and diabase; 8 to 25 percent slopes (CmC2, CmC3, HaC2, HaC3, MoC2, MoC3, MoD3, MrD).	F–1	Yellow-poplar, red oak, white oak.	White pine, Austrian pine.	Slight	Moderate	Moderate	Severe	Slight.
Group 5. Deep and moderately deep, well-drained soils on acid materials; slopes steeper than 25 percent (BtE3, BvF, EcE, EcE2, EdF, GeE, GeE3, GmE, NsF).	F–2	Yellow-poplar, red oak, white oak.	White pine, larch, spruce, Austrian pine.	Moderate	Moderate	Severe	Severe	Moderate.
Group 6. Deep to moderately deep, well-drained soils on diabase; 25 to 45 percent slopes (MrF).	F–2	Yellow-poplar, red oak, white oak.	White pine, Anstrian pine.	Moderate	Moderate	Severe	Moderate	Slight.
Group 7. Deep, moderately well drained soils on acid materials; 0 to 25 percent slopes (BeA, BeB2, Ch, CoA, CoB2, GnA, GnB, GnB2, GnC2, GsB, LeB, LeB2, LeC3, LhB, LhD, RdA, RdB, RdB2, Ro, WnA).	F–2	Yellow-poplar, red oak, white oak.	White pine, larch, Norway spruce, white spruce.	Slight	Severe	Moderate	Slight	Slight.
Group 8. Deep, moderately well drained soils on limestone and diabase; 0 to 25 percent slopes (BdA, BdB, BdB2, Ls, MsB).	F–2	Yellow-poplar, red oak, white oak.	White pine	Slight	Severe	Moderate	Moderate	Slight.
Group 9. Somewhat poorly drained soils on acid materials; 0 to 8 percent slopes (AgA, AgB2, AsB2).	F–3	Yellow-poplar, red oak, white oak.	White pine, spruce, larch.	Moderate	Moderate	Moderate	Moderate	Moderate.
Group 10. Deep, somewhat poorly drained soils on limestone; 0 to 8 percent slopes (LaA, LaB).	F–3	Red oak, ash	White pine	Moderate	Moderate	Moderate	Slight	Moderate.
Group 11. Deep, poorly drained soils on acid materials; 0 to 15 percent slopes (Bo, CaA, CaB, CaB2, CrA, CrB, OtA, Rp, We, WoA, WoB, WoB2, WoC2, WsB).	F–4	Red maple, beech, pin oak.	White pine, white spruce.	Severe	Severe	Severe	Moderate	Severe.
Group 12. Deep, poorly drained soils on limestone and diabase; 0 to 8 percent slopes (Gu, Mn, WaA, WaB2, WcB).	F–4	Red maple, beech, pin oak.	White pine	Severe	Severe	Severe	Slight	Severe.
Group 13. Shallow, well-drained soils on acid materials; 0 to 8 percent slopes (BrB2, BsB, CkB2, GgA3, GgB3, MgA2, MgB2, MgB3, MmB, PeB3, PmB2, PnB).	F–3	Red oak, black oak, pitch pine.	White pine, Virginia pine, Austrian pine.	Moderate	Slight	Slight	Moderate	Moderate.
Group 14. Shallow, well-drained soils on limestone and diabase; 3 to 8 percent slopes (HoB2).	F–2	Red oak, black oak.	White pine, Austrian pine.	Moderate	Moderate	Slight	Moderate	Moderate.
Group 15. Shallow, well-drained soils on acid materials; 8 to 25 percent slopes (BrC, BrC2, BrC3, BrD, BrD2, BrD3, BsD, CkC2, CkC3, CkD2, CkD3, MgC, MgC2, MgC3, MgD, MgD2, MgD3, MmD, PeC3, PeD3, PmC2, PmC3, PmD, PmD2, PnD).	F–3	Red oak, black oak, pitch pine.	White pine, Virginia pine, Austrian pine.	Severe	Slight	Moderate	Moderate	Moderate.
Group 16. Shallow, well-drained soils on limestone; 8 to 25 percent slopes (HoC2, HoC3, HoD3).	F–2	Red oak, black oak.	White pine, Austrian pine.	Moderate	Slight	Moderate	Moderate	Moderate.
Group 17. Shallow, well-drained soils on acid materials; 25 percent slopes or more (BrE, BsF, CkE2, HoE3, MhE, MhE3, MkF, MmF, PnF, PsE2, PsE3, PsF).	F–3	Red oak, black oak, pitch pine.	White pine	Moderate	Slight	Severe	Severe	Moderate.
Group 18. Tidal marsh (Tm)	Not suitable for trees.							

Source: Chester County Soil Survey Report



CLIMATE

Introduction

Climate Details Important to Planning

Although climate is not a major factor affecting location of land uses within the County, climate does have important overall bearing upon the use that can be made of the land and the general amenity of an area.

Climate is the prime determinant of the of the natural vegatation pattern; and a major shaper of soils and landforms, and the type of agriculture and human activity that can thrive in an area. Climate details of temperature, rainfall, wind velocity and direction, and type of flooding, are of importance in agricultural and urban planning; and should receive greater attention in such ways as building and site orientation.

Chester County Has a Humid Continental "Long Summer" Climate with Some Moderating Influence from the Atlantic Ocean.

Climate is the aggregate of day-to-day weather such as precipitation, temperature, humidity, and wind over an extended period of time. Chester County is in an area best classified by climatologists as a modified humid continental — long summer and has the following general characteristics:

a) Frequent daily and seasonal temperature and weather changes,
b) Abundant and dependent precipitation,
c) A relatively long growing season,
d) Warm summer, and moderately cold winter.

The prevailing westerly winds carry most of the weather disturbances that affect Chester County, except for coastal storms, from the interior of the United States. Several important factors serve to moderate slightly the climate in Southeastern Pennsylvania.

1. The Appalachian Mountains act as a buffer from large, cold air masses.

2. The Atlantic Ocean somewhat moderates extreme temperatures, and serves as a moisture source.

3. The Atlantic Ocean also tends to increases precipitation via occasional coastal storms, particularly during winter, and thus provides a more uniform rainfall than in many interior continental climates.

It is a Variable Climate

Situated in Southeastern Pennsylvania in the Mid Atlantic States, the County is influenced primarily by the prevailing westerly winds that carry many of the major weather systems eastward across North America. Fluctuations in the day-to-day weather are frequent as individual weather systems seldom remain for more than a few days at a time. Frequency of change is greater during the winter and spring when noticeable variations are experienced almost daily. In contrast, summers are noted for somewhat slower weather changes as air masses may stagnate for a week to 10 days or so, during which time hot and humid conditions with only light winds prevail under the influence of a stagnant Bermuda High. Such "spells" are generally limited to one or two per year. The "golden days" of autumn are the most pleasant time of the year because the heat and humidity of summer are gone while warm, bright, sunny days with cool nights persist into November. September and October are also the months of lowest rainfall and greatest number of clear days. Autumn colors are more gorgeous in the East than in the Midwest or in most parts of the world. Autumn is also believed to be the season of highest climatic stimulation of human energies.

It is a Transitional Zone Climate Between Cold and Hot.

Culturally, and geographically, Chester County lies on the Mason-Dixon Line, which for many purposes has marked a transition between Northern and Southern cultures.

Climatically, it is in a border region between areas where cold winter is the key classification factor, and those where hot summers are the main influence; and thus shares some of both worlds.

On the widely used Koppen climate classification, Chester County is at the northern extreme of the humid subtropical (Caf) category — the same as much of the South. Trewartha's American modification, more appropriately, classes it as in the warm summer phase of humid continental (Daf), but still on the border. Others such as Thornthwaite and Von Volkenburg, also agree on a transitional classification.

It is an area where both many southern and northern plants and trees grow, although sometimes neither to best advantage.

The difficulty of growing good lawns is one result of the transitional climate. The summers are often too hot and too dry for cool weather grasses, such as the valued bluegrasses; yet the hot weather grasses, such as zoysia, turn an ugly brown with the cooler weather.

Temperature, Growing Season, and Heating Data

Temperature Extremes Are Less Severe Than Are Many Continental Climates.

Because of the protection of the Allegheny Mountains through Central Pennsylvania, temperatures in Chester County are milder than most areas in the State; in fact, more moderate than many other localities across the Country at the same 40° lattitude. Temperatures average 52° to 54° annually, with extremes below 0° and above 100° being rare. Normal daily and monthly, as well as extreme temperatures for the 1931 through 1960 period for Coatesville, Phoenixville and West Chester are shown on Table C-1, "Detailed Presentation Climatological Summary of West Chester, Phoenixville, and Coatesville".

Chart C-1 is a simplified presentation of major precipitation elements extracted from the data presented in Table C-1 and in further historical detail in the Appendix. It gives the average temperature, and precipitation monthly for the three Chester County Stations. Chart C-2 is a conventional Temperature Rainfall Graph for West Chester only.

These indicate an average annual temperature of 53.4°. The average annual maximum temperature reaches about 64° and the average annual minimum approximates 43°.

Chester County experiences a moderately mild winter, with January temperatures usually falling between a mean maximum of about 41° and mean minimum of about 24°. Summers can frequently become uncomfortable, with July temperature ranges between a mean maximum of 87° and a mean minimum of 64°.

Although comparisons within the County may be misleading because of the location and exposure of the weather stations, analysis of comparative data from the three stations at West Chester, Phoenixville and Coatesville, indicate that generally Phoenixville has temperature averages slightly higher and Coatesville lower than the County average. The two degrees typical lower temperature at Coatesville is probably due to cold air (heavier air) drainage from the North and South Valley Hills. Phoenixville seems to have both higher maximums and lower minimums than West Chester.

Chart C—1

LOCATION: Chester County

STATIONS: (average) Coatesville, Phoenixville, West Chester

CLIMATOLOGICAL SUMMARY

1931 - 1960

month	TEMPERATURE °F means: daily maximum	daily minimum	monthly	** mean degree days	TOTAL PRECIPITATION (inches) means: monthly	snow and sleet	MEAN NUMBER OF DAYS: precipitation: .10 inches or more	temperatures: maximum: 90° and above	32° and below	minimum: 32° and below	0° and below
(a)	30	30	30	30	30	30	10	10	10	10	10
Jan.	40.9	23.7	32.3	1023	3.34	5.9	6		5	26	*
Feb.	42.1	23.1	32.9	857	2.85	7.4	6		3	23	*
Mar.	51.0	30.2	40.6	784	4.13	5.5	8		1	20	
Apr.	63.3	39.9	51.9	364	3.48	.4	8			4	
May	74.1	50.2	62.3	147	4.15		7	1			
June	82.7	59.0	71.0	23	4.00		7	5			
July	87.2	63.8	75.6	1	4.49		6	11			
Aug.	84.9	61.3	73.3	4	5.07		7	7			
Sept.	78.3	55.0	66.7	73	3.61		5	2			
Oct.	67.5	43.9	55.8	309	3.18	.2	5	*		4	
Nov.	54.8	34.2	44.7	640	3.73	1.4	6		*	15	
Dec.	42.8	25.1	34.1	955	3.39	4.3	6		5	23	
Year	64.1	42.5	53.4	5180	45.42	25.1	77	26	14	115	*

Special tabulation from United States Weather Bureau official records by Chester County Planning Commission

Excessively high or low temperatures as well as prolonged periods of either hot or cold weather are relatively infrequent. During the summer months, readings of 90° or higher occur on an average of less than 30 days, and temperatures at 100° or higher are observed only about once a year. Since 1915 when records began at Phoenixville, 23 years were without 100° reading; however, in 1943, 100° and higher were reported on 11 days, with 100° as late as September 6th or 7th. The highest temperature ever reported in Pennsylvania was observed at Phoenixville July 9 and 10, 1936, when the mercury climed to 111°. During the colder half of the year, temperatures drop below freezing on an average of 100 to 130 days while 0° readings are normally experienced only once a year. The lowest temperature ever reported at any of the official weather stations in the County was -19° January 14, 1912.

Average hourly temperature data for Philadelphia indicates that 317 hours per year (or 4%) are over 85° F; 2747 (31%) between 65° and 85° F; 2809 hours (32%) between 45° and 65°; 2565 (29%) between 25° and 45°; and 330 hours (4%) below 25%. Thus, about 4% of the year is definitely too hot, and the same number of hours too cold.

Table C—1

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU
IN COOPERATION WITH The Chester County Planning Commission
CLIMATOGRAPHY OF THE UNITED STATES NO. 20 --

CLIMATOLOGICAL SUMMARY

LATITUDE 39° 58'
LONGITUDE 75° 36'
ELEV. (GROUND) 440 ft.

STATION West Chester

MEANS AND EXTREMES FOR PERIOD 1931 - 1960

Month	Temperature (°F) Means: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	** Mean degree days	Precipitation Totals (Inches): Mean	Greatest daily	Year	Snow, Sleet: Mean	Maximum monthly	Year	Greatest daily	Year	Mean number of days: Precip. .10 inch or more	Temperatures Max. 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Month
(a)	30	30	30	30		30	30	10	30	30		30	30		30		10	10	10	10	10	
Jan.	40.5	25.4	33.0	73	1950	-5	1936	995	3.43	3.41	1936	5.5	23.0	1935	16.0	1935	6	0	4	26	*	
Feb.	44.7	25.2	33.5	74	1949	-15	1934	827	2.90	3.10	1936	7.8	20.8	1947	17.0	1958	6	0	3	21	0	
Mar.	50.3	31.6	44.0	87	1945	5	1943	757	4.18	2.56	1952	6.8	36.0	1958	23.0	1958	8	0	1	17	0	
Apr.	61.6	41.2	52.1	91	1960	21	1950+	339	3.43	2.04	1943	0.3	4.0	1940	2.5	1944	8	*	0	2	0	
May	73.6	51.5	62.5	94	1941+	29	1947	129	4.17	3.07	1943						7	1	0	0	0	
June	81.6	60.0	71.0	98	1959+	40	1938	17	3.85	4.54	1938						6	5	0	0	0	
July	86.1	64.7	75.5	105	1936	48	1943	1	4.73	3.43	1935						6	10	0	0	0	
Aug.	84.0	69.2	73.5	101	1953	46	1949	2	5.13	5.60	1939						7	7	0	0	0	
Sept.	77.4	56.4	66.9	101	1953	32	1956	60	3.80	3.90	1944						5	2	0	0	0	
Oct.	66.8	46.0	56.4	97	1941	21	1936	271	3.16	2.95	1932	T	2.0	1940	T	1960	5	*	0	2	0	
Nov.	54.2	36.0	45.2	84	1950	13	1938+	600	3.88	5.94	1950	1.3	14.0	1938	7.0	1938	6	0	*	12	0	
Dec.	42.2	26.7	34.7	71	1946	-1	1942	938	3.37	2.40	1952	4.6	16.0	1935	13.3	1957	6	0	5	21	0	
Year	63.3	43.8	53.8	105	July 1936	-15	Feb 1934	4936	46.03	5.94	Nov. 1950	26.3	36.0	Mar. 1958	23.0	Mar. 1958	76	25	13	101	*	Year

LATITUDE 40° 07' 18"
LONGITUDE 75° 29' 40"
ELEV. (GROUND) 105 ft.

STATION Phoenixville

MEANS AND EXTREMES FOR PERIOD 1931 - 1960

Month	Temperature (°F) Means: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	** Mean degree days	Precipitation Totals (Inches): Mean	Greatest daily	Year	Snow, Sleet: Mean	Maximum monthly	Year	Greatest daily	Year	Mean number of days: Precip. .10 inch or more	Temperatures Max. 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Month
(a)	30	30	30	30		30		10	30	30		30	30		30		10	10	10	10	10	
Jan.	42.5	22.8	32.6	77	1950	-14	1935	1017	3.36	2.16	1948	6.6	27.0	1935	9.3	1945	7	0	3	26	1	
Feb.	43.8	21.7	33.5	77	1949	-16	1934	850	2.82	2.16	1950	7.9	23.0	1934	13.8	1947	6	0	3	24	*	
Mar.	53.3	30.0	41.5	90	1948	-2	1960	772	4.22	2.66	1958	5.3	21.0	1958	18.0	1958	8	0	1	21	*	
Apr.	66.5	39.0	52.8	94	1942	20	1943	363	3.50	1.99	1940	0.3	0.7	1943	6	1943	8	0	0	7	0	
May	77.1	49.3	63.2	98	1942	28	1956	140	4.17	2.95	1931						7	1	0	0	0	
June	84.3	58.1	71.7	103	1934	35	1945	19	3.82	4.37	1938						7	7	0	0	0	
July	89.1	63.5	76.3	111	1936	45	1957+	*	4.47	4.37	1935						6	13	0	0	0	
Aug.	86.6	61.1	74.1	104	1933	38	1949	8	4.88	5.82	1942						7	8	0	0	0	
Sept.	80.3	54.4	67.5	100	1944+	28	1947	70	3.55	5.19	1960						6	2	0	0	0	
Oct.	69.5	42.5	56.4	100	1941	18	1936	316	3.21	5.96	1932	0.1	2.5	1940	2.5	1940+	6	*	0	5	0	
Nov.	56.9	33.3	45.7	77	1953	-1	1938	652	3.77	5.98	1950	1.9	14.6	1938	9.5	1938	6	0	0	14	0	
Dec.	44.6	24.4	34.8	74	1946	-8	1951	927	3.40	1.86	1936	4.8	13.0	1957	9.0	1935	6	0	4	24	0	
Year	66.3	41.7	54.2	111	July 1936	-16	Feb. 1934	5129	45.27	5.96	Oct. 1960	26.9	27.0	Jan. 1935	18.0	Mar. 1958	80	24	11	121	1	Year

LATITUDE 39° 58' 20"
LONGITUDE 75° 49' 42"
ELEV. (GROUND) 342 ft.

STATION Coatesville

MEANS AND EXTREMES FOR PERIOD 1931- 1960

Month	Temperature (°F) Means: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	** Mean degree days	Precipitation Totals (Inches): Mean	Greatest daily	Year	Snow, Sleet: Mean	Maximum monthly	Year	Greatest daily	Year	Mean number of days: Precip. .10 inch or more	Temperatures Max. 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Month
(a)	30	30	30	30		30		10	30	30		30	30		30		30	10	10	10	10	
Jan.	39.7	23.0	31.4	75	1950	-8	1935	1056	3.23	2.09	1948	5.6	16.5		10.0	1945	6		7	28	*	
FFeb.	40.8	22.3	31.6	75	1949	-14	1934	895	2.83	1.48	1951	6.5	2458	1934	13.0	1958	6		3	25	1	
Mar.	49.3	29.0	39.2	85	1948	5	1943	822	4.00	3.15	1958	4.4	22.5	1958	17.0	1958	8		1	23		
Apr.	61.7	39.4	50.7	91	1960	21	1950	391	3.51	2.35	1940	0.6	1.0	1959+	1.0	1959+	7			5		
May	71.6	49.7	61.3	95	1941+	25	1947	173	4.12	2.00	1931						8	1				
June	81.6	58.9	70.4	100	1934	37	1938	33	4.33	3.91	1946						7	4				
July	86.3	63.3	74.9	104	1936	43	1952	2	4.27	4.04	1946						6	10				
Aug.	84.0	61.7	72.4	102	1954	41	1952	6	5.11	5.57	1942						8	7				
Sept.	77.2	54.2	65.7	102	1953	30	1947	90	3.49	3.90	1945						5	2				
Oct.	66.3	43.2	54.7	94	1941	17	1936	341	3.16	2.35	1943	0.3	1.0	1940	1.0	1940	5		*			
Nov.	53.3	33.3	43.3	84	1950	5	1938	667	3.53	3.40	1935	1.0	10.0	1938	8.6	1953	6					
Dec.	41.5	24.2	32.9	70	1953	-1	1960	1000	3.41	2.29	1957	3.5	14.0	1945	10.0	1957	6					
Year	62.9	44.9	52.4	104	July 1936	-14	Feb. 1934	5476	44.99	5.57	1942	21.9	24.8	Feb. 1934	17.0	1958	78	24	17	129	1	Year

(a) Average length of record, years.

T Trace, an amount too small to measure.

** Base 65°F

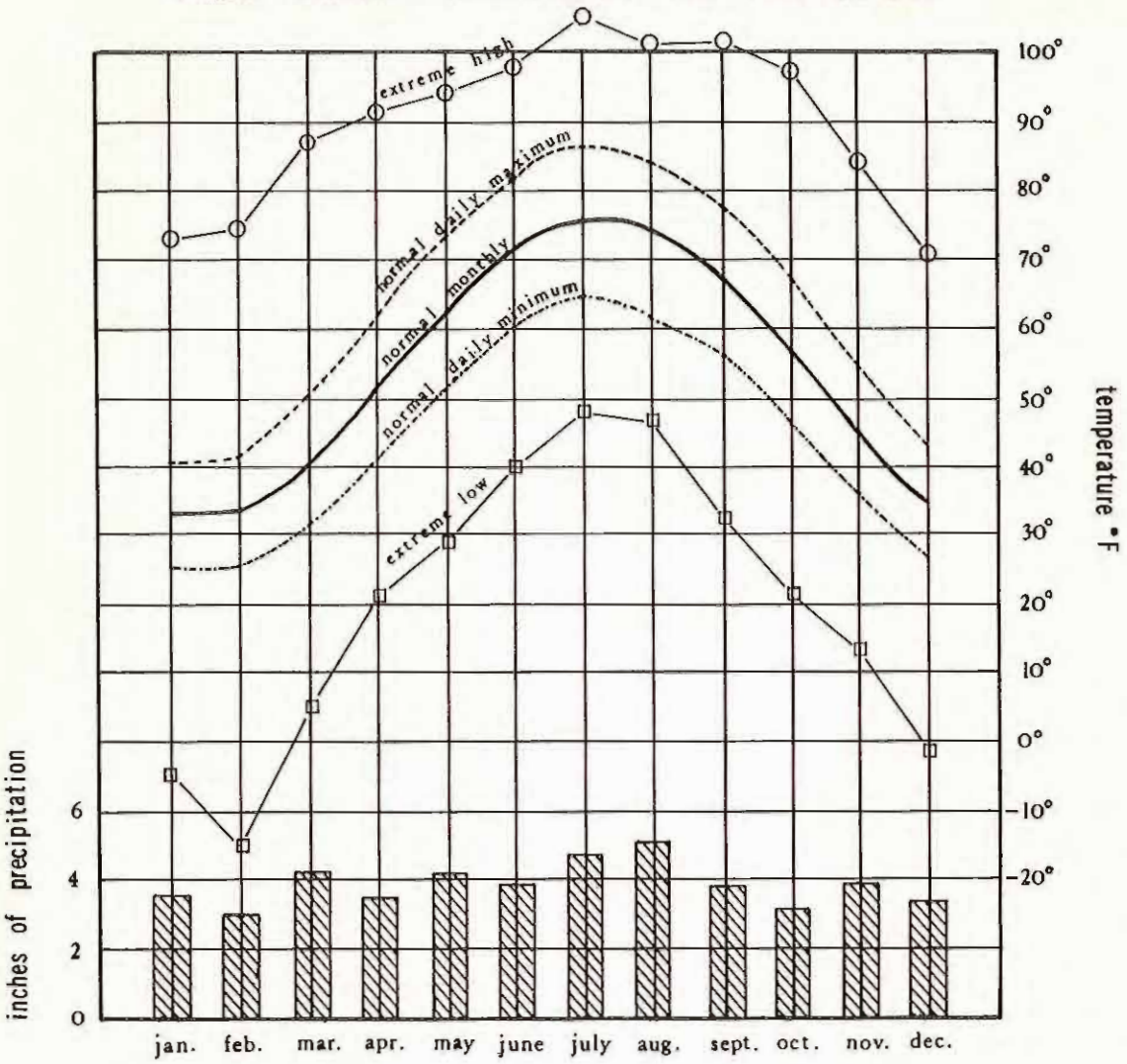
\+ Also on earlier dates, months, or years.

* Less than one half.

Special tabulation from United States Weather Bureau official records by Chester County Planning Commission

Chart C — 2 west chester

NORMAL MONTHLY TEMPERATURES AND PRECIPITATION



Special tabulation from United States Weather Bureau official records by Chester County Planning Commission

Micro-Climate Shows Variation.

The climate data presented in this report are the average recordings at the location of the weather instruments. Of course, actual weather conditions vary somewhat from one location to another, sometimes within short distances.

Because cold air is heavier than warm, cold air seeks valley locations. Thus, particularly on clear windless nights in the summer, the valley low spots may be as much as 10-15 degrees cooler than the surrounding hill sides. This is the reason for the cooler temperature at Coatesville.

These micro-climate variations need to be studied in detail at any given site. Sometimes even three dimensional models may be useful to show sun angles, wind pattern, and general orientation.

Freeze-Free Growing Season Averages About 180 Days with Variation Due to Topography.

The freeze-free growing season will vary slightly in different parts of the County due to topographic differences. West Chester, located on a relatively high level upland, generally has the longest growing season in the County with an average of about 189 days. Coatesville, in a frost pocket formed by the heavier cold air drainage from the North and South Valley Hills, averages 170 growing days. Phoenixville, also in a river valley, surprisingly reports the shortest freeze-free growing season of only 161 days; but perhaps this is due to the location of the instruments.

In general, the length of the growing season will range upward to 190 days in Southern Chester County on south slopes to approximately 170 days in Northern Chester County on northern slopes, and perhaps less in valley frost pockets. The date of the last freezing temperatures varies from April 10 to April 30, with an occasional light May frost.

The first freezing temperature of autumn will generally occur sometime between October 10 and October 31, the average being October 19. Certainly, these dates represent averages, and freezing could occur in late May or early September.

However, the growing season is not always measured only by the freeze-free period. Plants and animals vary in their environmental needs. But, in general, many plants can start to show signs of growth and activity when the average daily temperature reaches 43 degrees. This ranges from about March 15th to November 15th.

Also of interest is the hardiness zone based upon the average lowest extreme winter temperature. Because of the moderating effect of the Atlantic Ocean and Appalachian Mountains, extreme winter temperatures are not as great as the more inland continental climates in the same 40 degree north latitude.

Anti freeze should be installed by November 1, and left in to about April 15th. Freeze occurs during about 13% of October nights, 50% of November nights, about 50% of December nights, about 75% of January nights, 82% in February, and 65% in March, for a total of about 115 nights per year with frost or freezing temperatures.

Average Depth of Frost Penetration less than a Foot

The average depth of frost penetration is only about one foot or less, with an extreme frost penetration depth of about 32 inches. This minimizes problems of laying water pipes.

The alternate freezing and thawing, which breaks up roads and many masonry structures, occurs on about 70 days per year. The large number of freezing and thawing days, coupled with abundant rainfall, has created the deeply weathered underlying rocks. Unfortunately, most of the silt clay soils of the County are relatively susceptible to frost action.

Heating Season Averages Over 5000 Degree Days.

The past 30 year record shows an average total of about 4936 degree days at West Chester; Phoenixville 5129, and Coatesville, probably because of down-drainage, a significantly cooler 5476.

A degree day is the difference between the average temperature on a given day and 65 degrees. The degree day data is the basis for estimating heating and fuel consumption, including the automatic refilling of oil tanks.

The average total number of "cooling degree days" which is the average total number of days that the average temperature exceeds 70, was not computed specifically for any Chester County weather station. Based on the interpretation of national charts, however, the number would seem to be between 400 and 500 annually.

Precipitation and Cloudiness

Chester County's 46" of Annual Rainfall is Evenly Distributed Throughout the Year.

A prime requirement for industry, agriculture, and the general public is an adequate and dependable water supply. Chester County has both, provided by moderate precipitation distributed rather uniformly throughout the year. Amounts normally total about 45 inches annually. Differences between the wettest month (August) and the driest month (February) are normally less than 2.5 inches. Variations from any one particular month to the next as well as between years for a given month, however, may be sizeable as shown in the table in the Appendix, and in the climatological summary previously presented.

Complete rain and snow fall data by month for the years 1931-1960 are presented in the Appendix from the records of each of the three reporting weather stations in West Chester, Coatesville, and Phoenixville.

In addition to the official rainfall data, the Brandywine Valley Association has sponsored a program of 10 local weather gauge stations that are used to predict possible flood changes along that stream. Their data on rainfall was close to that of the official stations.

From May through September rainfall is produced principally from showers and thundershowers, the latter numbering 25 to 30 per year. These are of a localized nature so that a single or even a given set of thunderstorms may not affect the entire county. Thunderstorms occur most frequently in the late afternoon and evening and are usually of brief duration. Associated rainfall, however, may be intense measuring up to several inches in a short period of time. Severe damage from lightning is rare and hail at measurable size is infrequent. Maximum precipitation data for Coatesville and Phoenixville and West Chester are shown in a Table in the Appendix. During the colder half of the year, precipitation is produced primarily from more extensive storm systems. Winter precipitation is less intense than summer rain but of longer duration, and is generally more widespread. The season of greatest freedom from rainfall is during the autumn. It is for this reason, as well as the natural beauty of the season that Chester County Day is always the first Saturday in October.

Records for the past 100 years for West Chester show that 1941 was the driest year with only about 31 inches of precipitation, while in the wettest year, 1889, there was 73 inches of precipitation. In most years, rainfall is ample for crop growth, but occasionally, there are local periods of drought. A resulting long dry spell will likely cause considerable crop damage, particularly on shallow, well-drained soils. The growing season, ranging up to 190 days in length (April 16th to October 23rd) receives over 55% of the annual rainfall.

Within the County, West Chester, perhaps because of its relatively plateau-like location, has received a slightly higher rainfall than the other two stations in the County; the mean rainfall of 45-46 inches is higher than the 41" at Philadelphia and generally is somewhat greater than in most other areas of Southeastern Pennsylvania.

Severe, Intense Rainfalls Not Common

Compared with many parts of the South, intense flood producing rainfalls in Chester County occur only occasionally, and are most commonly a product of summer thunderstorms or early fall hurricanes.

But because of the relatively rolling nature of the countryside and lack of substantial water holding capacity of the soils and underlying rocks, the flood producing effects of a heavy, intense rainfall may tend to be more severe in the stream valley due to accelerated runoff. On the other hand, the flooding tendency in the streets and basements may be less severe due to slopes and resulting rapid runoff to streams.

Up stream flood control reservoirs and flood plain zoning will prevent this type of problem.

Maximum observed precipitation data for 1, 2, 3, 6, 12 and 24 hours as recorded at Coatesville and Phoenixville are shown in Table C-2[1]. For the design of such things as storm sewers, culverts, roads and the like, the need for knowing how often rainfalls of these and other intensities may be expected to occur is obvious. Such information for Chester County is given in Table C-3[2] in terms of return periods of 1 to 100 years for rainfall intensities of 30 minutes to 24 hours. Interpreting the 1 year 30 minute value in the table means that 0.9 inch of precipitation in 30 minutes may be expected on an average of once a year while a 7.1 inch rainfall in 24 hours may be expected once every 100 years, or more accurately a one percent chance, which could occur two years in a row.

Floods may occur during any month of the year although they occur with greater frequency in the spring months of March and April due to a combination of heavy rain and snowmelt. In addition to local

Table C-2

MAXIMUM STATION PRECIPITATION FOR 1, 2, 3, 6, 12, and 24 HOURS
(Values all in inches)

Month	Duration (hours) 1	2	3	6	12	24
Coatesville						
Jan.	0.50	0.75	0.90	1.00	1.37	1.78
Feb.	0.50	0.87	0.97	1.11	1.23	1.39
Mar.	0.50	0.76	1.01	1.43	1.94	2.09
Apr.	0.55	0.94	1.16	1.62	2.22	2.37
May	0.79	0.99	1.10	1.69	2.01	2.38
June	1.95	2.70	2.80	3.70	3.83	4.67
July	2.00	2.44	2.56	3.07	3.53	4.90
Aug.	2.15	2.65	3.47	4.63	5.80	5.97
Sept.	1.43	2.68	2.97	3.54	4.02	4.25
Oct.	0.70	0.98	1.14	1.50	1.71	2.38
Nov.	0.70	1.18	1.50	2.32	3.38	3.74
Dec.	0.39	0.71	0.91	1.26	1.67	1.90
Annual	2.15	2.70	3.47	4.63	5.80	5.97
Phoenixville						
Jan.	0.36	0.58	0.92	1.51	2.14	2.73
Feb.	0.42	0.49	0.58	1.09	1.43	1.51
Mar.	0.60	0.93	1.16	1.37	1.86	2.15
Apr.	0.60	0.79	0.97	1.23	1.76	1.88
May	2.10	2.21	2.21	2.34	2.49	2.73
June	3.95	4.23	4.23	4.35	4.35	4.35
July	1.55	1.92	2.44	2.90	3.02	4.27
Aug.	3.60	4.00	4.05	4.18	5.15	5.36
Sept.	1.14	2.14	2.14	2.92	3.00	3.95
Oct.	0.51	0.84	1.18	1.69	1.97	2.28
Nov.	1.40	2.20	3.00	5.30	7.49	7.70
Dec.	0.47	0.69	0.89	1.31	1.66	2.00
Annual	3.95	4.23	4.23	5.30	7.49	7.70

flooding from severe thunderstorms during the summer and fall, storms of tropical origin sometimes deposit flood producing rains. Such was the case with hurricanes Connie and Diane in August 1955 when the Schuylkill River and Brandywine Creek each rose five to six feet above bankfull.

Table C-3

RAINFALL FREQUENCY FOR DURATIONS FROM 30 MINUTES TO 24 HOURS AND RETURN PERIODS FROM 1 TO 100 YEARS FOR CHESTER COUNTY
(Values all in inches)

Return Period	Duration						
	30 Min.	1 Hr.	2 Hrs.	3 Hrs.	6 Hrs.	12 Hrs.	24 Hrs.
1 Year	0.9	1.2	1.5	1.6	2.0	2.3	2.6
2 Years	1.2	1.5	1.8	2.0	2.4	2.8	3.2
5 Years	1.5	1.9	2.3	2.5	3.0	3.6	4.2
10 Years	1.7	2.2	2.7	3.0	3.5	4.2	5.0
25 Years	2.0	2.6	3.0	3.5	4.1	5.0	5.8
50 Years	2.3	2.8	3.5	3.9	4.7	5.7	6.3
100 Years	2.5	3.2	4.0	4.4	5.0	6.1	7.1

There is about 25" of Snow Per Year.

Snow accounts for a considerable portion of the colder season precipitation. Amounts normally total 20 to 30 inches per year, however, that much and more have occured in individual months. (See Appendix tables) Most of the snow occurs during December through March, although measurable amounts have been observed as early as mid October and as late as mid April.

Heavy wet snow from individual storms frequently occurs in March causing inconvenience due to closed roads but under moderating temperatures the snow quickly melts. In March 1958 heavy wet snow accumulated to depths of up to 40 inches in 48 hours in the northwestern part of the County.

Cultivated row crops are a riskier use of flood plains than pasture, which will recover after being flooded.

Although snowfall within the county, varies from place to place, somewhat greater amounts are normally found in the northern and western sections especially on the higher elevations. The ground is usually snow-covered about one-quarter of the time during the winter season with amounts of one inch or more covering the ground normally about 20 to 25 days annually. Measurable snow may be expected on about 20 days per year. The lowest recorded seasonal amount in the last thirty years at West Chester was only 2.2 inches, the greatest being 74 inches in the memorable winter of 1957-58. West Chester tends to have more snow than Coatesville.

The number of Clear Days is Greatest During the Autumn; the Number of Cloudy Days is Grestest in the Winter and Spring.

There are about eight completely clear days each month. The average number of clear days per month ranges from a low of only five or six in May and June to a high of 10 or 11 in September and October. Partly cloudy days range from a low of 7 — 8 per month during the winter to a maximum of 11 — 13 during the summer months. The number of cloudy days is greatest during the winter and spring with a range of 14 to 17 per month, and fewest during the summer and autumn with a range of 11 to 13 each month.

Chart C—3

philadelphia international airport

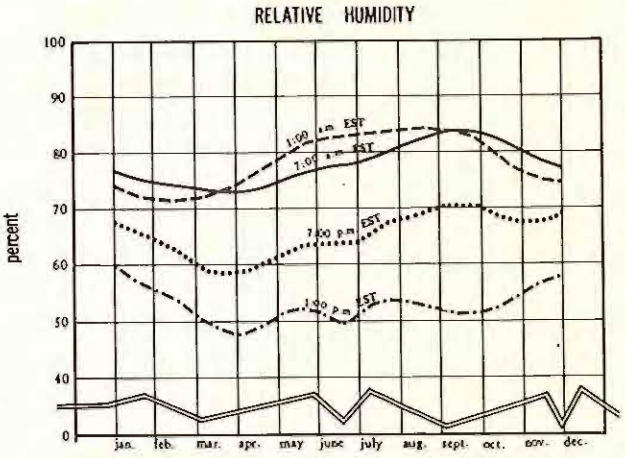


Table C—4

philadelphia international airport

month	Relative Humidity 1:00 a.m. EST	Relative Humidity 7:00 a.m. EST	Relative Humidity 1:00 p.m. EST	Relative Humidity 7:00 p.m. EST	Wind mean hourly speed	Wind prevailing direction	Wind fastest mile speed	Wind fastest mile direction	Wind fastest mile year
(a)	17	17	17	17	17	17	17	17	
J	75	77	60	68	10.3	WNW	51	NW	1956
F	72	75	56	65	11.0	NW	59	NW	1956
M	72	74	52	61	11.6	WNW	56	NW	1955
A	74	73	48	59	11.1	SW	55	W	1952
M	79	75	51	62	9.6	WSW	56	SW	1957
J	82	77	52	64	8.9	SW	46	W	1948
J	83	78	51	64	8.2	WSW	47	NNW	1954
A	84	81	54	68	7.8	SW	67	E	1955
S	84	83	52	70	8.2	SW	47	NE	1956
O	82	83	52	70	8.9	SW	66	SSW	1954
N	77	80	55	68	9.7	WNW	56	SW	1957
D	75	77	58	69	10.1	WNW	45	N	1953
Year	78	78	53	66	9.6	SW	67	E	Aug. 1955

Special tabulation from United States Weather Bureau official records by Chester County Planning Commission

The number of days with measurable precipitation averages about 10 to 12 per month during the winter, spring, and summer and is fewest (only eight to nine per month) during autumn.

Fog can occur at any time of year, and averages from three to five days per month. Heavy traffic crippling fog is more apt to occur during the late fall and winter.

Chester County Climate Has a Relatively High Humidity.

Relative humidity is one of the most important weather factors affecting personal comfort. This data is not gathered or recorded at any of the weather stations in Chester County and is only available from a major weather bureau station. The nearest and most representative of Chester County is located at Philadelphia's International Airport. Table C-4 is for the Weather Bureau at Philadelphia International Airport and depicts information on Relative Humidity and Wind.

Relative humidity varies inversely with temperature so that on days with wide ranges between maximum and minimum temperatures, there are also wide variations in relative humidity. When the air temperature is low, air is unable to hold as much moisture as when the temperature is high. Consequently, if the amount of moisture in the air remains constant, the relative humidity is highest at the coolest time of day and lowest at the warmest time of day. Before sunrise, temperatures are usually lowest and when they drop to the dew point (the temperature at which saturation or 100% relative humidity occurs) moisture precipitates onto exposed surfaces in the form of dew. Chart C-3 entitled "Daily Variation in Relative Humidity" shows the averages at Philadelphia International Airport.

Winds

Prevailing Winds Come from the Northwest in Winter; West-Southwest in Summer.

Although recorded official wind data is not available for Chester County, data from Philadelphia and surrounding observation points indicates the general pattern, as shown on Chart C-4, "Mean Wind Direction and Velocity".

The prevailing winds are from the northwest during winter and from the west — southwest from May through October, at an average speed of eight miles per hour; with the winter boreal blasts of greater intensity than the summer zephyrs. Sustained wind velocities are usually highest during March although peak gusts can occur anytime. Normally wind is least intense about 6:00 p.m., reaching its greatest intensity in the early afternoon. Wind, of course, is influenced by local topography and the general weather pattern so that conditions at any one place or specific time may vary considerably from the general flow pattern.

The general pattern suggests that such practical conclusions as house orientation be to the southwest, that windows be smaller on the west — northwest and north, and that evergreen planting barriers be on the northwest. Airport main runways are usually orientated in the direction of the prevailing winds.

The County is Upwind from Major Regional Air Pollution; and Has Few Special Local Problems.

Chester County is upwind (and upland) from the major air pollution sources in the Philadelphia region, such as those along the Delaware River. It thus, except for its own existing and future pollution, should be able to enjoy relatively clean air increasingly recognized as important to health and longevity. Recent public opinion surveys indicate that "pure air" is high among the benefits sought from suburban and rural living.

Within the County there do not seem to be any topographic basins that would create special air pollution problems. The hills bordering the Chester Valley are not high enough to be major barriers. The east-west trending Valley is well vented by the prevailing westerlies. Thermal inversions which trap pollutents, however, may occur.

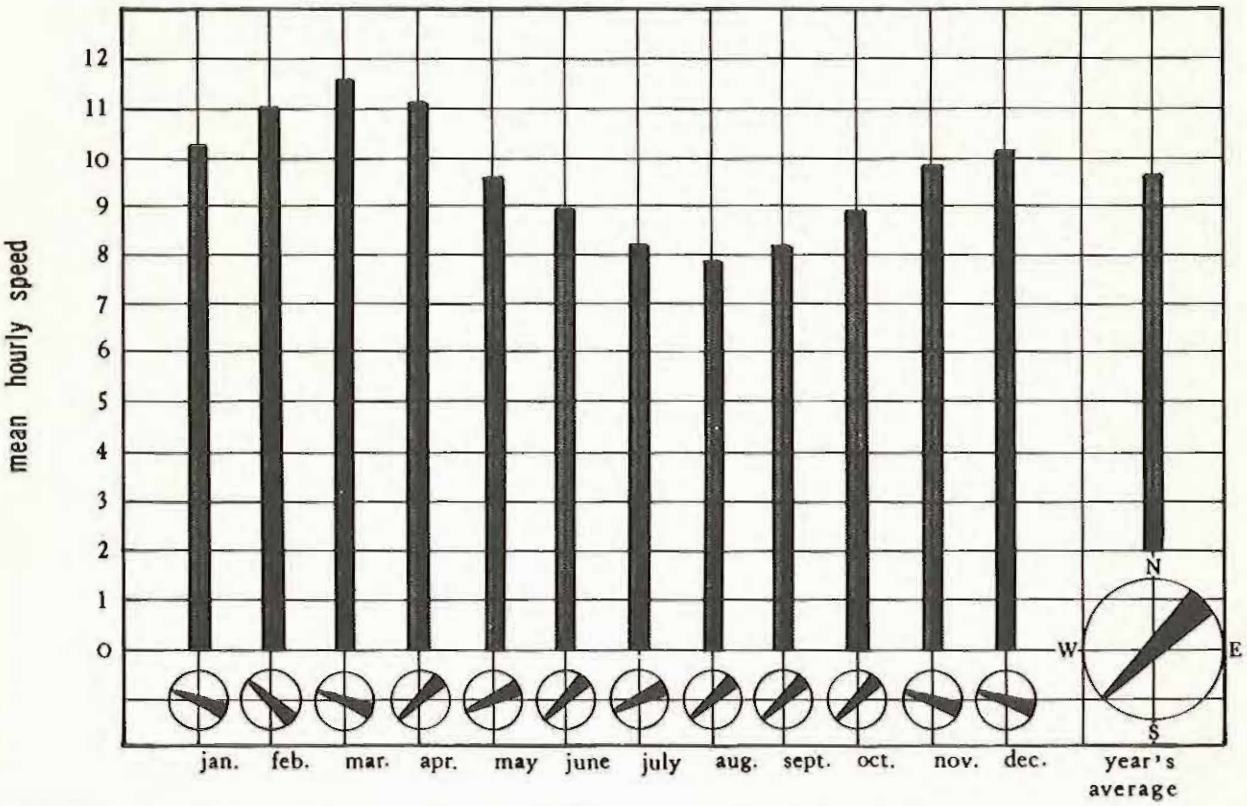
Destructive Winds Are Infrequent.

Winds of destructive force that affect Chester County are generally produced from one of three types of storms; thunderstorms, tornadoes and hurricanes. Wind velocities from any of these may reach 50 to 60 m.p.h. or more but, with the exception of hurricanes or the remnants of same, relatively small areas of the County are affected at any one time. Destructive winds from thunderstorms sometimes occur although destruction by fire from lightening is considered more frequent and costly. Tornado activity is unusual, as less than six have ever been reported in the County. June and July are the most likely months for a possible tornado. Winds from hurricanes and tropical storms seldom reach destructive speeds in Chester County, although widespread minor damage sometimes results from a combination of heavy rain and fresh to strong winds. For the

Chart C—4

philadelphia
international airport

MEAN WIND DIRECTION AND VELOCITY



Special tabulation from United States Weather Bureau official records by Chester County Planning Commission

most part, winds from such storms greatly diminish in intensity in their passage over land. The hurricane season lasts from August to October. Fortunately, winds in this area are moist, and we are spared, the hot, searing winds.

Evaporation Is Greater than in Other Sections of Pennsylvania.

Since evaporation inevitably extracts a portion of the available water supply from lakes, reservoirs, rivers and streams, an estimation of this loss is an important factor to be considered when planning future water storage projects.

No evaporation measurements are made within the county but generalized estimates supplied by the U. S. Weather Bureau indicate that the mean lake evaporation is about 35 inches annually in Chester County. This is several inches less than at eastern seaboard locations farther south, but eight to 10 inches greater than in New England. About 72% of the annual evaporation takes place between May and October.

During the late winter and early spring there is considerable runoff of water that the land can not absorb, to the sea; while during the summer and early fall evapotranspiration frequently exceeds rainfall. During dry periods wooded areas are the chief suppliers of streams.

Summary

Chester County is in a Climatically Stimulating Area.

Some climatologists, particularly the late Ellsworth Huntington, and the historian, Arnold Toynbee, in his doctrine of challenge and response, have offered evidence that climate is an important factor in the development of civilization. These studies tend to show, generally, that Chester County lies in the southern range of a belt from New England to the Lower Great Lakes region, plus the West Coast, that have the highest "climatic energy". It is these areas that tend to have the lowest death rates, and indications of activity such as highest factory worker output. Optimum stimulation occurs, according to their theories, where the climate is sufficiently rigorous to offer a challenge, but not severe enough to be debilitating. Chester County lies within an area slightly on the too warm side.

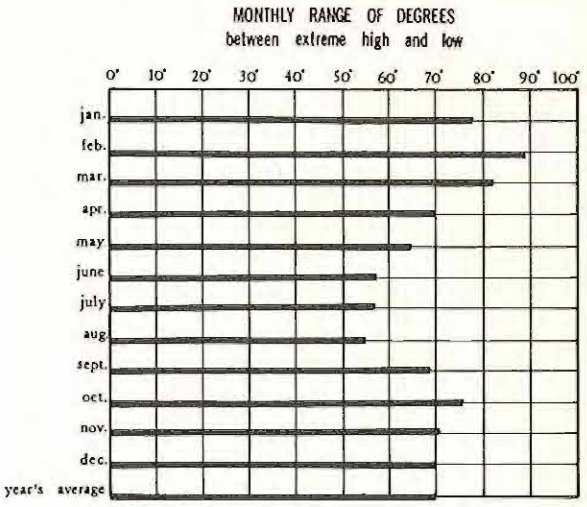
While it is unsound to link cause and effect in this way, it is true that Chester County is in a belt of conducive climate energies and that there are no major climate handicaps to a high level of civilization and economic development.

Chester County Residents Require "Three Suits".

Chart C-5 shows the "Monthly Range of Temperature between Extreme Highs and Lows over Period of Record". Although the extremes in weather are not severe or prolonged, Chester County is in an area where the children's doggerel proclaims, "We unfortunates live in a clime requiring three suits — a thick one and thin one for days cold and hot, and a medium weight for days that are not".

The scope of this report does not permit an analysis for applied climate purposes. Rather, it attempts to present fully the available data, including a mean, mean extremes and all-time extremes for the benefit of those having need of this data.

Chart C—5 west chester



Special tabulation from United States Weather Bureau official records by Chester County Planning Commission

For some purposes, the mean is most useful; but for many design purposes, either the mean, extreme or the all-time extreme is the critical figure. For heating or cooling, the average maximum or minimum is usually used, since slight discomfort on a few days can be tolerated in order to avoid the great cost of protecting against rare extremes. For other purposes, such as safety of buildings in windstorms or snow loads on roofs, all-time extremes are of concern.

In general, in Chester County, designs should withstand wind velocities up to 80 m.p.h. and temperatures as low as 0° F. or as high as 100° at ground level. In valleys, or where sun exposure is great, actual temperature extremes may be even greater.

For practical purposes, the range of temperatures means that buildings should be thoroughly insulated for winter cold; and of even greater importance, for summer heat, since it costs more per unit to reduce temperature and humidity than to warm or dry it.

Chester County Has a Favorable, Hospitable Climate, if Allowances are Made for Occasional Extremes; But is Facing Competition from Southern Climes.

If reasonable adaptations are made, particularly by appropriate dress and in the more universal adoption of summer air conditioning, the overall climate is highly suited to agricultural activity and a high level of urban civilization.

Many people do find, as Huntington suggested, that the march of the seasons and variations in daily weather, activity vegegation patterns, indeed is stimulating and interesting and preferable to the more mild climates. A winter season kills off most insects and many tropical diseases and pests that otherwise would be troublesome.

The climate will support pasture, winter wheat, most market garden crops, tobacco, many fruits and specialty crops and most crops not requiring longer than six months growing season, and is a major factor in the County's position as Pennsylvania's second most important agricultural county. Adequate rain, rather than natural soil fertility, underlies the agricultural prosperity.

Northeastern United States is undoubtedly facing competition from the South, in which climate is only one aspect. Air conditioning has made southern, and even tropical, climates more liveable and modern public health measures have overcome many of the health hazards. While it costs more per degree to lower than to raise temperatures, the total number of cooling degree days is far less than heating degree days, thus on net balance favoring southern climates in the overall heating — cooling costs. Of course, the South has economic climatological advantages in other ways, such as saving on winter clothing, building construction, snow removal, and operation of motor vehicles.

In summary, while the climate of this area is not a special selling point, neither is it a drawback to a high level of development. Indeed, it is more favorable than most parts of the United States, and large parts of the world. Thus, the climate, in combination with other variable factors such as soils and landforms, sets the stage for a high level of civilization and economic development.

Further Research Should Be on Applications.

Further effort in the climate aspect of County planning should be upon the greater application of available knowledge, particularly in the design and orientation of buildings and communities, rather than in further detailed data collection. It is much more satisfactory to design with the climate than to rely upon artificial heating and cooling.

Chester County's climate is basically similar to that of much of Northeastern United States, and so differences in data are not critical for many purposes. Much is known about such topics as sun angles at various times of the year (which at 40° N. latitude at noon range from 26° in December to 73° in June) which influence roof color and solar heating possibilities; and wind patterns and slope of land as they influence both individual buildings and communities.

It is important in community planning to have as much green planting and desirable shade trees as possible. Trees greatly lower extreme summer ground temperatures, help stem rapid evaporation, runoff, and erosion, and help a little in cleaning the air.

In agriculture, progress is being made in relating the growth rates and maturity of individual crops more precisely to temperature, rainfall and sunlight factors. This research with the aid of computers is able to recognize accurately how much more valuable a warm, moist day in June is in stimulating growth than a cool April day.

Climate Data Appendix

Complete Available Weather Data.

The detailed available weather data for the recent 1930-1960 thirty year period from the official U. S. Weather Bureau Cooperating Stations reporting within Chester County is presented in this Technical Data Appendix. The station histories are outlined below:

STATION HISTORY OF COATESVILLE

There has been a weather station near Coatesville since February 1888. Prior to September 1930 the instruments, consisting of an instrument shelter, maximum and minimum thermometers and a standard rain gage were located at the residence of Professor T. W. Gordon, 547 East Main Street, 587 East Chestnut Street, and 1219 East Lincoln Highway, respectively. Dates of relocations are unknown. From September 1930 to January 1946 the observational site was 131 Chestnut Avenue, the residence of Mr. Howard L. Pyle, who then served as observer. A recording rain gage was added July 26, 1937. In January 1946 the weather instruments were moved to the Philadelphia Electric Company, 920 East Lincoln Highway, where they remain with observations taken by employees of the electric company.

STATION HISTORY OF PHOENIXVILLE

Although fragmentary weather records for Phoenixville date back to 1869, it was not until January 18, 1915, that daily observations began on a regular basis. At that time an instrument shelter, maximum and minimum thermometers, and a standard rain gage were installed 1.4 miles southeast of the Phoenixville Post Office along Route 23 on the property of the Philadelphia Suburban Water Company, then known as the North Springfield Water Company. In May 1938 a recording rain gage was added, all of which has remained at virtually the same site since original installation. Observations have been maintained by employees of the water company.

STATION HISTORY OF WEST CHESTER

Weather records at West Chester date back to January 1823 when Dr. William Darlington began taking observations and continued until Dec. 1827. It wasn't until January 1855, however, that the present program began. The instrument shelter, maximum and minimum thermometers and standard rain gage were installed on the property of the observer, Dr. Jesse C. Green, who provided weather records for more than 65 years, until July 1920 when the instruments were moved to 127 East Chestnut Street, the residence of Mr. Arthur M. Hay. He served as observer through October 1927. Prior to this time exact locations of instruments are unknown. In March 1927 the instruments were moved to 205 South High Street, the residence of Mr. Joseph W. Belt, who served as observer through February 1936. When Mr. Clyde T. Saylor became official observer in March 1936 the instruments were moved to 237 Dean Street, where they remained until May 1955. At that time employees of "Daily Local News" took over the observing program and the instruments were relocated to the present site over a grass plot behind police headquarters in downtown West Chester.

In addition to the official stations, weather records are kept by a number of private observers such as Star Roses, Longwood Gardens, the Philadelphia Electric Company, and other fuel dealers.

These Chester County weather stations, however, do not record hourly observations; or data on winds, sunlight, and relative humidity. The nearest complete weather station is at Philadelphia International Airport, which tends to be a little warmer than in Chester County. Also, more complete data is available from the weather stations at Lancaster, Wilmington, and Reading, which may give approximate indications for the southern and western parts of the County.

The area has lacked upper air readings which among other porposes, are useful for indicating temperature inversions. Temperature inversions when combined with low winds may produce air pollution hazards. It is hoped that shortly some of the tall television transmission towers may soon be equipped for temperature readings.

For specific subdivision or other site planning it may be desirable to make special site studies of micro-climate temperature and wind differences. Charts and tables indicating sum angles at different times of the year, are available in architectural design handbooks.

Table C-5

COATESVILLE

Average Temperature (°F)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	32.2	34.2	38.7	50.4	61.6	70.3	77.2	73.2	71.4	58.0	50.1	39.6	54.7
1932	42.4	36.6	35.9	48.6	60.8	70.8	74.8	74.0	67.1	55.3	41.2	35.6	53.6
1933	38.5	32.8	38.4	51.6	64.1	72.8	73.8	73.0	68.4	53.4	40.2	32.2	53.3
1934	34.0	19.3	36.4	50.5	63.8	74.2	76.7	70.6	67.5	51.8	46.6	32.1	52.0
1935	28.2	30.2	43.8	49.4	58.0	70.0	77.3	73.4	63.4	54.5	46.9	28.1	52.0
1936	25.8	23.2	45.2	48.6	64.0	70.0	74.6	73.0	66.4	54.0	37.7	35.7	51.5
1937	38.2	32.8	36.2	47.4	58.0	71.4	75.0	74.0	69.1	51.8	41.9	31.2	51.8
1938	30.2	34.8	41.6	52.7	59.6	69.0	75.0	76.0	63.4	54.8	44.1	33.6	52.9
1939	30.4	35.6	39.2	47.6	62.2	71.2	72.8	74.4	65.6	52.7	39.9	33.9	52.1
1940	20.0	29.9	33.6	44.6	59.7	68.6	74.4	69.2	60.3	49.8	42.6	36.3	49.1
1941	28.4	28.4	34.2	56.0	63.6	70.4	75.6	74.4	69.4	60.0	46.6	37.2	53.6
1942	29.2	29.6	42.6	55.6	66.4	72.2	76.8	72.4	66.2	55.6	44.4	29.7	53.4
1943	30.4	33.2	40.0	46.7	63.5	78.0	77.8	76.5	66.2	53.0	42.7	31.6	53.3
1944	33.4	32.4	37.8	49.3	68.5	73.4	78.7	75.8	67.8	53.7	44.3	30.2	53.8
1945	24.6	32.4	51.4	55.4	60.0	72.4	75.3	72.4	69.3	54.6	45.4	28.7	53.4
1946	32.4	32.2	48.2	49.5	60.6	67.3	73.4	67.6	66.4	58.6	46.7	35.8	53.2
1947	36.4	26.0	34.8	50.9	59.8	66.6	72.4	74.2	65.2	59.0	40.0	30.4	51.2
1948	22.8	38.2	41.0	50.4	59.9	69.6	73.7	71.7	64.3	51.8	47.6	34.0	51.2
1949	36.6	35.2	40.3	49.3	60.7	70.9	77.0	72.8	62.3	58.4	41.3	35.2	53.3
1950	39.5	30.6	34.9	46.6	58.1	67.2	71.3	71.2	62.3	56.2	43.5	30.4	51.0
1951	32.9	33.0	39.8	50.4	61.1	69.2	72.6	71.7	64.8	56.7	38.8	34.0	52.1
1952	34.5	34.5	37.7	52.3	58.9	70.9	75.8	72.2	65.0	50.4	42.4	34.5	52.4
1953	34.7	36.2	41.1	50.7	63.7	69.9	74.2	72.2	66.1	56.2	43.4	35.8	53.7
1954	28.2	36.7	39.4	53.2	57.6	70.6	73.7	70.9	66.0	57.5	40.7	32.5	52.2
1955	28.9	30.3	40.9	53.1	62.7	67.1	78.9	75.8	66.4	55.5	41.2	27.6	52.4
1956	29.7	34.4	35.8	47.8	57.7	69.7	71.5	70.7	62.2	53.6	42.2	38.7	51.2
1957	23.7	35.4	39.7	52.6	60.9	72.3	73.6	70.4	66.5	51.2	44.4	36.2	52.5
1958	28.8	25.5	38.0	52.1	59.1	65.3	75.1	71.1	64.1	52.3	44.0	25.4	50.1
1959	28.6	30.2	39.3	53.4	64.4	70.9	75.2	74.8	68.2	57.5	42.5	34.9	53.3
1960	33.5	34.3	31.3	55.7	59.5	69.7	72.3	74.8	66.2	53.4	44.5	25.5	51.7

Total Precipitation (inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	2.49	1.92	5.55	2.73	7.04	2.99	7.80	5.20	2.03	1.58	0.74	2.30	42.39
1932	4.70	1.64	6.27	1.72	4.08	2.47	2.56	4.66	1.09	5.88	7.42	3.09	45.50
1933	2.08	3.11	6.06	5.37	5.81	3.66	6.23	13.29	4.21	1.01	0.98	2.31	55.02
1934	4.01	2.61	5.31	3.54	4.73	6.15	4.34	3.87	0.96	1.24	4.73	3.05	50.54
1935	4.65	2.59	2.53	4.57	1.86	5.47	6.70	1.57	5.56	2.99	6.39	2.31	47.19
1936	6.88	2.66	7.06	3.21	1.91	4.80	2.45	4.53	1.19	3.24	1.15	7.10	46.18
1937	6.09	2.71	1.59	5.61	3.91	3.31	2.62	6.46	1.02	7.21	3.66	1.36	45.55
1938	3.09	2.60	2.79	1.81	2.79	12.18	8.23	3.93	6.39	2.35	2.48	3.71	52.53
1939	3.29	6.08	3.29	4.88	1.11	7.27	3.05	8.37	2.16	5.29	0.65	2.28	47.72
1940	1.32	3.06	4.95	5.79	3.87	3.03	1.52	4.28	3.98	2.71	4.98	3.59	43.08
1941	3.03	1.62	2.27	2.31	1.70	3.81	3.29	3.21	0.37	1.54	2.41	3.74	29.30
1942	2.56	2.44	5.39	1.39	4.96	2.43	4.26	11.56	3.26	4.69	3.96	4.75	51.65
1943	3.24	1.64	3.50	3.44	5.30	4.12	2.41	1.25	0.98	7.62	3.32	1.40	38.22
1944	3.50	1.95	5.76	4.79	3.19	3.09	0.74	2.74	2.31	4.18	2.38	4.00	40.22
1945	2.95	3.14	1.96	2.91	4.45	4.42	6.37	2.99	6.71	1.93	5.13	5.07	48.03
1946	1.41	2.34	3.25	1.42	5.84	8.49	6.56	6.66	2.70	2.01	1.14	2.51	44.33
1947	3.19	1.93	2.41	2.62		missing				1.08	6.29	1.87	
1948	4.83	3.19	3.13	3.18	9.29	6.21	5.38	3.78	3.57	2.12	4.43	5.18	54.29
1949	5.70	3.93	2.17	3.37	4.73	0.53	6.80	2.57	2.06	3.13	1.00	3.55	39.54
1950	1.85	3.91	5.38	1.54	5.58	2.66	4.08	5.88	4.59	2.98	4.61	3.01	46.07
1951	2.81	4.32	3.58	3.15	3.46	6.39	2.93	4.27	1.45	3.17	7.22	5.73	48.48
1952	5.07	2.16	5.44	7.10	6.87	2.78	7.31	4.10	5.03	0.71	5.59	4.07	56.23
1953	5.95	2.75	6.24	4.07	5.78	2.45	3.98	0.74	1.63	4.23	2.02	4.58	44.42
1954	1.80	1.16	4.25	2.67	3.01	0.40	1.06	6.04	2.05	2.37	4.45	3.05	33.21
1955	0.41	2.61	5.12	2.61	0.77	7.07	0.24	17.15	2.02	3.96	0.62	0.23	42.81
1956	2.34	3.96	4.75	2.64	2.12	5.26	5.71	3.27	4.06	3.48	5.22	3.09	45.90
1957	1.31	2.73	1.77	4.69	1.83	4.91	1.31	2.68	5.65	2.12	2.50	7.27	38.76
1958	4.34	3.68	6.16	5.19	3.80	3.41	6.87	6.49	2.16	3.92	3.14	1.16	50.26
1959	1.98	2.60	3.73	3.40	1.74	3.36	4.60	3.85	4.99	4.45	3.53	4.85	42.48
1960	2.86	4.43	2.10	3.54	7.05	3.30	4.50	3.30	9.21	2.40	2.16	2.21	47.06

PHOENIXVILLE

Average Temperature (°F)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	31.8	34.5	41.3	52.8	63.9	72.2	78.6	75.0	71.8	58.1	49.9	39.7	55.8
1932	43.2	37.6	38.9	51.2	62.2	71.2	77.0	75.6	69.0	58.5	42.8	36.4	55.3
1933	39.4	34.8	40.7	54.4	66.2	74.2	75.9	75.6	70.7	56.3	41.6	33.0	55.2
1934	35.0	20.2	38.4	52.2	65.7	75.9	79.0	72.4	69.5	56.4	--	--	--
1935	28.5	30.6	46.0	50.8	59.9	71.6	79.0	75.0	65.6	57.3	49.2	29.6	53.6
1936	26.6	24.2	47.9	50.4	67.5	73.0	79.0	77.5	70.2	56.9	41.2	36.8	54.2
1937	40.0	34.6	37.2	51.2	63.0	73.0	75.8	76.2	63.8	54.2	43.6	33.0	53.8
1938	32.1	35.8	44.4	54.6	61.1	71.2	76.6	65.0	65.0	56.0	45.7	35.1	54.5
1939	31.2	37.8	41.8	50.1	65.2	73.0	74.4	76.4	68.0	55.2	41.9	36.1	54.3
1940	22.0	32.6	37.0	47.9	61.4	70.4	75.2	70.7	63.2	51.1	45.5	38.2	51.2
1941	30.4	30.6	35.3	57.0	64.4	71.6	75.9	71.4	69.2	60.9	46.4	38.7	54.3
1942	30.0	32.4	44.3	56.2	67.1	73.2	77.6	75.0	69.0	58.1	47.4	32.0	55.2
1943	33.7	36.2	44.7	51.2	--	76.5	77.2	76.2	66.4	55.4	44.1	33.6	--
1944	33.6	34.3	39.3	50.4	67.6	71.8	78.1	75.6	69.2	55.0	--	31.2	--
1945	27.8	33.1	51.4	56.4	60.7	71.6	76.6	73.2	72.4	55.1	46.4	29.8	54.5
1946	33.4	34.1	48.6	52.1	63.9	70.2	74.6	69.6	67.8	58.2	47.6	36.6	54.7
1947	37.2	28.0	38.4	55.0	64.2	70.0	76.0	77.2	69.2	61.6	44.1	34.2	54.7
1948	28.2	32.5	46.6	55.4	63.4	71.4	76.0	-	-	54.6	49.7	35.7	-
1949	-	38.7	43.9	51.6	62.0	71.6	76.8	72.1	-	56.5	-	36.6	
1950	42.2	32.3	38.0	48.6	61.3	70.1	73.3	72.4	63.7	58.2	48.3	31.8	53.4
1951	33.7	35.1	42.2	51.4	62.1	69.9	-	72.5	66.3	57.5	40.6	35.6	-
1952	36.3	36.5	40.7	54.4	66.0	72.7	77.9	73.5	66.6	57.6	44.9	36.3	54.3
1953	36.5	38.1	43.3	51.9	64.9	71.6	75.4	73.3	68.1	56.3	44.4	38.1	55.2
1954	30.3	39.3	41.9	55.6	59.3	71.2	74.5	72.3	66.8	-	-	34.1	-
1955	29.3	32.1	42.4	54.4	63.4	67.3	79.6	76.2	65.1	56.8	41.9	28.6	53.1
1956	30.8	35.5	37.1	47.9	60.6	71.0	72.6	72.4	63.9	55.7	45.4	41.8	52.9
1957	29.0	37.1	42.5	55.2	64.4	73.6	75.9	71.7	67.3	52.0	45.3	37.3	54.3
1958	30.4	27.6	38.2	52.8	60.9	67.0	76.2	72.9	65.2	53.7	-	27.3	-
1959	30.3	32.2	40.9	54.4	65.7	71.7	75.6	75.1	69.1	59.2	43.5	35.5	54.5
1960	33.6	35.9	31.4	55.6	59.7	69.8	72.9	74.3	66.3	53.4	45.2	-	-

Total Precipitation (inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	2.20	2.03	3.95	3.21	7.55	3.46	8.58	5.60	1.98	1.89	0.72	1.88	43.05
1932	4.55	1.03	6.37	1.74	3.33	2.63	2.61	4.52	1.25	6.17	8.82	2.89	45.93
1933	2.19	2.88	5.88	4.88	6.04	1.47	5.45	13.54	4.84	1.90	0.68	2.65	52.40
1934	3.47	2.39	4.01	3.80	4.73	4.69	7.04	4.50	7.61	1.79	3.97	2.69	50.69
1935	3.61	2.57	2.18	3.21	1.86	4.43	8.84	3.96	6.82	3.69	5.89	2.15	49.21
1936	6.95	2.82	6.76	3.02	1.64	3.29	1.79	6.32	1.92	2.73	1.14	7.15	45.53
1937	6.44	2.32	2.33	4.60	4.11	3.60	3.17	3.91	1.59	4.79	3.22	1.53	41.61
1938	3.25	2.70	2.30	1.82	2.60	11.51	8.18	6.78	7.90	3.05	2.86	3.10	56.23
1939	4.02	6.03	3.81	4.25	3.40	4.70	3.26	6.21	1.40	5.87	1.14	2.35	46.44
1940	1.65	3.16	5.79	6.71	5.30	1.90	3.38	5.42	4.01	2.82	5.32	3.31	48.77
1941	3.35	1.97	2.66	2.29	1.23	4.45	7.24	2.58	0.24	1.05	3.12	4.00	34.18
1942	2.19	2.75	4.97	1.71	1.73	6.05	3.77	8.38	2.07	3.60	4.71	5.37	48.18
1943	3.42	1.67	3.07	3.52	7.46	4.87	1.83	1.07	0.18	8.82	3.25	1.36	40.32
1944	3.49	2.03	5.74	5.38	2.60	3.66	0.59	2.60	5.70	2.26	4.30	3.63	41.98
1945	4.13	2.93	2.19	3.56	5.55	3.70	6.29	3.03	4.97	1.38	5.45	4.40	47.58
1946	1.12	2.61	3.75	0.85	7.90	6.40	4.62	3.13	3.05	2.05	1.05	2.49	39.02
1947	3.71	1.79	2.55	2.49	6.88	3.35	2.77	2.98	2.81	1.42	8.05	2.39	41.19
1948	4.86	2.41	3.72	3.02	8.02	5.25	6.18	3.88	4.93	0.97	-	4.98	-
1949	-	3.62	2.49	3.24	3.90	1.03	5.38	2.50	2.75	2.05	0.85	4.17	
1950	2.11	4.62	5.72	1.13	4.42	2.25	3.67	4.85	4.19	2.28	8.20	3.63	47.07
1951	3.94	3.51	-	2.25	2.90	7.41	4.90	1.62	1.51	3.54	7.66	4.43	
1952	5.21	2.42	5.72	8.01	5.42	2.66	4.37	6.96	4.86	1.35	5.93	5.40	58.30
1953	5.53	2.79	6.94	4.77	8.10	3.21	2.43	2.24	2.72	4.06	2.04	4.56	49.39
1954	1.56	1.32	4.16	2.82	3.40	2.57	1.78	9.34	2.24	3.10	4.68	3.43	40.40
1955	0.54	2.74	5.52	2.62	1.61	4.59	0.83	14.37	2.27	5.57	1.33	0.35	42.34
1956	2.99	3.98	5.75	3.43	2.20	2.34	3.86	3.27	3.26	3.60	3.84	3.76	42.28
1957	1.45	2.79	2.52	5.17	1.13	1.85	1.26	1.67	3.68	1.85	3.95	6.34	33.65
1958	1.04	1.96	3.22	2.89	2.05	2.83	6.58	5.82	2.24	5.33	2.82	3.63	41.21
1959	4.13	4.69	5.80	5.18	3.64	2.28	7.86	3.53	2.36	4.77	2.67	1.48	48.39
1960	3.68	4.01	2.43	3.39	4.30	2.08	5.66	4.75	10.24	2.78	1.79	2.32	47.43

WEST CHESTER

Average Temperature (°F)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	34.0	34.6	39.4	50.8	61.6	70.2	76.8	73.2	71.1	59.0	51.2	41.2	55.3
1932	43.8	37.8	36.2	50.2	61.2	70.1	74.8	74.0	67.2	55.7	43.2	37.4	54.3
1933	40.6	34.5	39.2	52.0	64.2	71.9	72.8	72.6	68.2	54.4	41.8	33.5	53.8
1934	35.8	20.2	37.2	50.6	63.8	73.7	76.1	70.0	67.2	53.1	47.2	34.2	52.4
1935	29.7	31.7	45.1	49.4	58.5	69.5	75.8	72.3	63.6	55.5	48.6	29.6	52.4
1936	27.4	25.7	46.8	48.9	63.4	69.6	75.6	74.7	67.8	56.8	42.0	37.9	53.0
1937	40.0	34.4	37.0	50.2	62.8	71.4	75.7	75.4	64.0	53.8	43.9	33.7	53.5
1938	32.2	36.1	44.4	53.7	60.0	70.2	76.0	76.8	64.5	56.4	45.8	34.6	54.2
1939	32.2	36.9	41.2	49.0	64.6	72.4	74.2	76.4	67.4	55.8	42.6	35.6	54.0
1940	22.4	32.4	35.9	46.7	61.0	69.6	75.2	70.2	63.8	57.0	44.0	38.2	50.9
1941	29.7	29.6	35.2	56.8	64.3	70.4	74.6	72.0	68.8	60.4	47.0	37.8	53.9
1942	29.6	29.8	43.6	54.9	65.4	70.4	74.1	74.8	66.8	56.2	45.3	30.5	53.3
1943	30.8	34.2	41.5	47.2	63.3	74.6	75.3	74.8	66.0	53.3	43.4	32.6	53.1
1944	33.8	33.4	38.8	49.2	67.0	71.2	76.2	74.2	67.8	54.8	44.6	30.8	53.4
1945	25.4	33.1	52.0	55.2	59.2	70.2	73.8	71.7	69.3	54.9	46.3	29.6	53.4
1946	33.4	33.0	49.6	51.2	62.3	68.3	74.0	69.4	68.4	59.7	48.6	37.4	54.6
1947	37.4	28.4	37.0	52.4	61.7	68.4	73.8	75.7	67.8	62.2	42.1	33.0	53.3
1948	25.2	31.6	44.0	51.4	61.1	69.8	74.7	73.7	66.5	53.6	49.7	36.0	53.1
1949	38.2	38.4	43.3	52.1	63.0	73.0	77.9	74.0	65.5	60.8	44.3	37.7	55.7
1950	42.1	32.9	37.5	48.9	60.7	70.2	73.9	72.0	63.4	58.5	46.0	32.5	53.7
1951	39.4	35.4	41.7	52.1	62.8	69.9	74.8	73.3	67.2	58.6	41.3	36.9	54.1
1952	36.0	36.6	39.8	54.1	66.3	73.2	78.2	73.6	67.4	52.3	45.3	36.4	54.4
1953	36.9	37.9	43.7	51.5	65.2	71.5	76.1	74.0	68.3	58.3	45.8	38.4	55.6
1954	31.4	40.2	41.6	55.8	59.8	71.5	75.9	72.7	68.2	59.7	43.1	34.3	54.5
1955	30.7	34.0	43.1	55.3	66.4	69.5	80.8	75.9	65.8	58.0	43.0	29.6	54.3
1956	30.2	37.7	38.9	50.7	60.4	72.8	73.0	74.6	65.0	57.3	43.3	39.5	53.6
1957	28.2	36.3	42.2	56.3	64.3	75.5	78.4	73.5	68.1	53.5	46.9	38.4	
1958	31.1	27.9	39.6	54.3	60.0	68.3	77.0	73.9	66.4	54.5	47.2	28.9	52.5
1959	30.7	32.9	40.1	54.1	66.0	72.6	76.6	76.2	69.1	59.3	44.4	37.4	55.0
1960	35.3	36.7	33.1	57.9	61.5	71.6	73.7	74.5	66.2	55.3	47.1	27.0	53.3

Total Precipitation (inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	1.73	2.17	3.69	2.56	6.15	4.73	9.16	6.75	1.56	1.54	1.50	1.86	43.40
1932	5.59	1.63	7.48	1.65	4.26	2.49	1.68	2.98	2.90	6.60	7.64	2.99	47.07
1933	2.49	2.81	5.29	4.99	6.35	1.97	7.12	12.59	5.79	2.14	0.83	3.06	55.43
1934	3.40	2.55	3.34	2.50	4.54	5.63	5.86	4.21	6.66	1.32	4.32	2.61	46.94
1935	3.61	2.77	3.07	4.23	2.16	4.84	8.90	3.54	7.91	6.09	6.33	2.84	56.29
1936	7.44	5.00	7.54	3.22	2.12	3.37	2.46	6.14	1.94	3.28	1.13	5.94	49.50
1937	6.42	2.85	2.36	5.42	2.96	4.11	3.72	7.25	1.29	5.79	3.98	1.51	47.66
1938	3.00	2.58	2.51	2.14	2.84	9.33	9.47	3.29	6.64	2.59	2.85	2.94	50.28
1939	4.14	6.82	3.69	5.43	1.39	3.88	2.05	7.16	1.67	4.26	0.79	2.09	43.37
1940	1.83	3.67	6.17	6.13	5.24	2.57	2.61	5.17	3.68	2.59	5.11	3.77	48.54
1941	3.07	2.25	2.24	2.36	1.60	3.71	3.88	2.83	0.78	1.57	2.79	3.78	30.86
1942	2.74	2.26	5.33	1.30	1.80	4.33	6.18	9.58	4.14	3.64	3.77	4.88	49.95
1943	2.63	1.92	2.82	3.50	7.66	2.68	2.90	0.91	0.53	7.10	3.14	1.38	37.26
1944	3.66	1.92	5.77	4.67	3.73	3.51	0.69	3.08	6.29	2.11	4.19	3.69	43.31
1945	3.64	3.13	2.21	3.75	4.99	5.66	10.23	3.85	4.98	1.98	5.40	4.49	54.31
1946	1.43	2.46	3.60	1.37	5.31	7.86	4.73	5.83	3.30	2.12	0.94	2.43	41.38
1947	3.63	1.68	2.73	2.69	6.94	3.05	5.04	3.46	3.43	1.08	9.02	1.90	44.65
1948	4.09	2.41	3.43	2.99	8.91	7.19	3.46	4.11	4.95	1.31	4.58	5.51	52.94
1949	6.51	3.28	2.42	2.98	4.99	0.83	6.16	4.84	2.47	3.13	0.91	3.04	41.56
1950	1.81	3.24	4.77	1.49	4.52	2.62	3.19	6.54	4.93	3.16	7.91	3.23	47.41
1951	3.77	3.66	3.64	2.26	2.86	3.86	2.87	1.99	1.32	3.12	7.71	6.09	43.15
1952	5.06	2.23	6.55	6.52	6.92	2.79	4.09	5.76	5.31	0.39	5.94	4.96	57.41
1953	5.75	2.67	7.41	4.20	5.40	2.83	4.15	1.07	2.80	4.24	2.48	3.69	46.69
1954	1.26	1.40	4.21	2.85	3.41	0.96	0.91	5.73	1.77	2.71	4.49	3.01	32.71
1955	0.47	2.56	5.78	2.25	0.22	4.38	1.26	15.58	2.17	4.66	1.21	0.27	40.81
1956	3.07	4.22	5.62	2.71	4.35	4.81	6.46	2.95	2.83	2.83	4.02	3.73	47.60
1957	1.59	3.35	1.66	5.08	1.82	2.73	1.23	1.42	6.52	1.54	4.80	6.64	38.30
1958	4.05	4.63	5.03	5.24	4.21	4.72	9.05	6.50	2.37	3.21	2.68	1.13	52.82
1959	1.93	1.42	3.21	2.96	1.59	3.20	3.47	4.07	3.67	5.77	3.38	4.94	39.61
1960	3.05	3.53	1.94	3.53	5.97	0.76	7.06	4.85	10.06	2.80	2.52	2.57	49.44

Special tabulation from United States Weather Bureau official records by Chester County Planning Commission

Table C-6

TOTAL SNOWFALL*

coatesville

Year	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Season
1930-31	T	1.5	2.0	0.8	12.5	0	16.8
1931-32	2.0	T	T	1.0	6.0	T	9.0
1932-33	T	10.0	T	10.7	3.0	0	23.7
1933-34	T	7.8	T	24.8	11.3	T	43.9
1934-35	T	0.3	15.5	7.4	1.0	T	24.2
1935-36	0.5	10.3	10.2	12.5	0.5	T	34.0
1936-37	1.0	3.5	1.2	6.5	10.2	T	22.4
1937-38	1.0	2.0	2.3	2.0	3.3	T	10.6
1938-39	10.0	1.0	13.5	0.5	4.0	T	29.0
1939-40	T	3.9	3.7	13.0	3.7	1.0	25.3
1940-41	0.3	3.5	12.0	7.2	9.0	0	32.0
1941-42	0	T	4.0	2.0	3.0	T	9.0
1942-43	0	7.3	7.1	3.5	4.8	T	22.7
1943-44	T	T	2.0	5.2	11.5	0	18.7
1944-45	T	3.0	16.5	7.5	0	0	27.0
1945-46	T	14.0	1.5	8.5	0	T	24.0
1946-47	0	1.0	3.0	21.2	3.3	0	28.5
1947-48	T	5.1	9.9	13.4	1.5	0	29.9
1948-49	0	5.0	5.2	8.5	2.2	0	20.9
1949-50	0	1.0	0.4	1.0	T	0	2.4
1950-51	T	1.2	0.6	2.8	0.5	0	5.1
1951-52	T	9.5	3.0	0	1.4	0	13.9
1952-53	1.5	1.0	6.9	1.3	8.0	T	18.7
1953-54	8.6	0	12.3	3.3	0.8	0	25.0
1954-55	T	T	3.3	9.8	0	0	13.1
1955-56	4.0	2.0	8.1	0	14.4	0	28.5
1956-57	0	0	2.0	3.8	0	T	5.8
1957-58	0	0	4.3	16.7	22.5	0	43.5
1958-59	0	0.5	3.1	T	0	1.0	4.6
1959-60	0	11.2	14.4	0	0	0	25.6

* in inches

Source: Official Weather Bureau Records tabulated by the Chester County Planning Commission

west chester

Year	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Season
1930-31	0	1.3	1.8	1.9	4.5	0	9.5
1931-32	3.0	T	1.0	1.0	8.5	0	12.5
1932-33	0	14.0	T	14.0	4.5	0	32.5
1933-34	0.2	9.5	T	25.5	12.0	0	47.0
1934-35	T	0.2	23.0	11.0	2.0	T	36.2
1935-36	0.5	16.0	8.5	19.0	1.5	T	45.5
1936-37	0.3	1.2	1.3	6.3	12.2	T	21.3
1937-38	T	0.5	2.8	6.2	3.0	0	12.5
1938-39	14.0	0.8	12.3	1.5	3.5	1.0	37.1
1939-40	1.0	3.8	4.2	14.0	4.5	4.0	31.5
1940-41	T	4.5	10.8	9.5	12.1	0	36.9
1941-42	0	0.5	8.0	3.0	4.0	T	15.5
1942-43	T	9.5	5.9	6.5	9.8	T	31.7
1943-44	1.5	T	6.0	5.0	13.4	2.5	28.4
1944-45	0.5	6.1	15.2	8.8	0	0	30.6
1945-46	0.8	14.0	2.0	8.0	0	T	24.8
1946-47	0	1.0	3.8	20.8	5.0	0	30.6
1947-48	T	6.5	13.1	14.0	2.5	0	36.1
1948-49	0	1.0	6.4	10.3	4.0	T	21.7
1949-50	0	1.0	0.2	1.0	T	T	2.2
1950-51	2.0	2.0	2.7	1.5	T	0	8.2
1951-52	T	9.0	4.0	T	11.0	0	24.0
1952-53	1.5	3.0	4.5	1.5	7.0	T	17.5
1953-54	11.0	T	11.5	1.0	1.0	T	24.5
1954-55	T	0.5	2.0	7.0	3.0	0	12.5
1955-56	-	1.9	-	-	19.6	1.0	-
1956-57	T	T	4.0	2.8	0.7	0	7.5
1957-58	0	15.3	2.1	20.5	36.0	0	73.9
1958-59	0	T	2.0	1.0	5.0	1.8	9.8
1959-60	0	9.0	T	3.0	13.0	0	25.0

* in inches

Source: Official Weather Bureau Records tabulated by the Chester County Planning Commission

phoenixville

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Season
1930-31	0	T	1.0	2.0	1.4	2.7	0	7.1
1931-32	0	4.0	T	T	2.0	3.5	T	9.5
1932-33	0	0	11.0	T	11.1	2.9	T	25.0
1933-34	0	T	7.8	T	23.0	9.5	0	40.3
1934-35	0	T	1.5	27.0	8.3	1.6	T	38.4
1935-36	0	T	11.5	8.2	13.2	2.3	T	35.2
1936-37	0	T	T	2.0	4.0	8.5	T	14.5
1937-38	T	T	T	3.8	4.2	1.5	0	9.5
1938-39	0	14.0	T	12.1	T	1.7	0.4	28.2
1939-40	0	1.0	3.9	2.3	17.0	2.5	0.2	26.9
1940-41	2.5	T	3.5	9.1	6.0	16.0	0	36.1
1941-42	0	0	0.4	5.0	-	0.4	T	-
1942-43	0	T	5.5	5.1	T	3.5	0.7	14.8
1943-44	T	T	T	-	6.0	12.8	T	-
1944-45	0	0.2	5.0	20.6	7.0	0	0	32.8
1945-46	0	T	12.0	3.0	8.5	0	0	23.5
1946-47	0	0	1.4	4.8	17.2	6.1	0	29.5
1947-48	0	T	4.5	18.5	10.8	4.6	0	38.4
1948-49	0	0	-	-	3.0	3.5	0	-
1949-50	0	T	-	-	0.8	0.5	T	-
1950-51	0	1.8	2.5	-	-	-	T	-
1951-52	0	T	-	0.5	-	11.0	0	-
1952-53	0.4	1.5	4.3	1.9	T	2.0	0	10.1
1953-54	0	1.0	-	10.5	T	T	0	-
1954-55	0	0	0	1.0	-	T	0	-
1955-56	0	3.0	2.0	6.0	0.1	-	-	-
1956-57	0	0	0	1.2	-	-	0	-
1957-58	0	0	13.0	2.0	14.5	21.0	0	50.5
1958-59	0	0	1.2	-	-	0.5	0.3	-
1959-60	0	0	2.0	-	-	6.3	0	-

* in inches

Source: Official Weather Bureau Records tabulated by the Chester County Planning Commission

Table C-7

NORMALS, MEANS, AND EXTREMES

LATITUDE 39° 53' N
LONGITUDE 75° 15' W
ELEVATION (ground) 7 feet

PHILADELPHIA, PENNSYLVANIA
INTERNATIONAL AIRPORT

Month	Temperature: Normal: Daily maximum	Temperature: Normal: Daily minimum	Temperature: Normal: Monthly	Temperature: Extremes: Record highest	Temperature: Extremes: Year	Temperature: Extremes: Record lowest	Temperature: Extremes: Year	Normal degree days	Precipitation: Normal total	Precipitation: Maximum monthly	Precipitation: Year	Precipitation: Minimum monthly	Precipitation: Year	Precipitation: Maximum in 24 hrs.	Precipitation: Year	Snow, Sleet: Mean total	Snow, Sleet: Maximum monthly	Snow, Sleet: Year	Snow, Sleet: Maximum in 24 hrs.	Snow, Sleet: Year	Relative humidity: 1:00 a.m., EST	Relative humidity: 7:00 a.m., EST	Relative humidity: 1:00 p.m., EST	Relative humidity: 7:00 p.m., EST	Wind: Mean hourly speed	Wind: Prevailing direction	Wind: Fastest mile: Speed	Wind: Fastest mile: Direction	Wind: Fastest mile: Year	Pct. of possible sunshine	Mean sky cover	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Sleet 1.0 inch or more	Thunderstorms	Heavy fog	Temperatures: Max.: 90° and above	Temperatures: Max.: 32° and below	Temperatures: Min.: 32° and below	Temperatures: Min.: 0° and below
(a)	(b)	(b)	(b)	16		16		(b)	(b)	16		16		11†		15	15		11†		17	17	17	17	17	17	17		17	14	17	17	17	17	17	16	17	17	17	17	17	1
J	40.9	25.4	33.2	74	1950	2	1945	886	3.37	6.06	1949	0.45	1955	1.67	1953	5.0	13.3	1934	9.8	1954	75	77	60	68	10.3	WNW	51	NW	1958	46	6.9	7	7	17	13	2	*	4	0	5	24	
F	41.8	25.3	33.6	74	1949	3	1943	879	3.02	4.64	1956	1.37	1954	1.39	1958	4.5	17.8	1947	4.4	1944	72	75	58	65	11.0	NW	59	NW	1958	53	6.2	7	8	13	9	1	*	2	0	3	21	0
M	53.0	33.5	43.3	87	1945	7	1943	704	3.32	6.27	1953	1.72	1945	1.74	1952	2.3	10.9	1958	8.3	1958	72	74	52	61	11.8	WNW	58	NW	1955	57	6.2	6	8	15	12	0	1	2	0	1	14	0
A	63.2	43.9	53.6	93	1941	24	1950	402	3.38	6.58	1947	1.14	1942	1.82	1952	T	T	1957+	T	1957+	74	73	48	59	11.1	SW	55	W	1952	58	6.5	6	9	15	11	*	2	2	*	0	2	
M	74.1	52.0	63.1	88	1941	33	1947	104	3.58	7.41	1948	0.81	1955	2.09	1956	0.0	0.0		0.0		70	75	51	62	9.6	WSW	58	SW	1957	58	6.6	5	11	15	12	0	5	2	1	0	0	
J	82.6	61.5	72.1	100	1957+	44	1957+	0	3.87	6.69	1946	0.11	1949	2.29	1954	0.0	0.0		0.0		82	77	52	64	8.9	SW	46	W	1948	63	6.2	6	13	11	11	0	6	2	7	0	0	
J	86.5	68.0	76.3	102	1954	52	1943+	0	4.20	7.16	1941	0.84	1957	2.84	1950	0.0	0.0		0.0		83	78	51	64	8.2	WSW	47	ENE	1954	64	6.0	7	13	11	9	0	6	1	11	0	0	
A	84.0	65.9	74.0	101	1953	50	1957	0	4.58	9.70	1953	0.65	1943	4.81	1955	0.0	0.0		0.0		84	81	54	68	7.8	SW	67	E	1955	61	5.9	8	12	11	9	0	5	2	0	0	0	
S	77.8	57.5	67.7	100	1953	38	1947	47	3.46	5.82	1944	0.88	1941	2.80	1944	0.0	0.0		0.0		84	83	52	70	8.2	SW	47	NE	1955	59	6.2	10	9	11	8	0	2	2	2	0	0	
O	67.1	45.0	55.8	88	1941	18	1952	269	2.60	5.31	1943	0.49	1952	3.22	1953	T	T	1957+	T	1957+	83	83	52	70	8.9	SW	66	SSW	1954	58	5.8	11	8	12	9	*	1	5	*	0	1	0
N	54.9	36.8	45.9	79	1948	15	1955	573	3.08	5.83	1951	1.08	1949	3.46	1950	1.0	8.8	1953	8.7	1953	77	80	55	68	9.7	WNW	58	SW	1957	53	6.1	8	10	12	9	*	1	3	0	*	9	0
D	44.4	27.4	35.9	72	1951	1	1942	902	2.67	5.48	1951	0.23	1955	1.77	1951	3.1	13.4	1945	5.8	1957	75	77	58	69	10.1	WNW	45	N	1953	50	6.4	7	10	14	10	1	*	4	0	3	21	0
Year	64.0	44.6	54.3	102	July 1954	1	Dec. 1942	4868	41.13	9.70	Aug. 1955	0.11	June 1949	4.81	Aug. 1953	16.9	17.8	Feb. 1947	9.8	Jan. 1954	78	78	53	66	9.6	SW	67	E	Aug. 1955	57	6.2	90	118	157	120	5	29	32	27	12	92	

Means and extremes in the above table are from the existing or comparable location(s). Annual extremes have been exceeded at prior locations as follows: Highest temperature 106 in August 1918; lowest temperature -11 in February 1934; maximum monthly precipitation 12.10 in August 1911; minimum monthly precipitation 0.09 in October 1924; maximum precipitation in 24 hours 5.89 in August 1898; maximum monthly snowfall 31.5 in February 1899; maximum snowfall in 24 hours 21.0 in December 1909; fastest mile of wind 88 from North in July 1931.

LATITUDE 40° 20' N
LONGITUDE 75° 58' W
ELEVATION (ground) 265 Feet

READING, PENNSYLVANIA
209 POST OFFICE BUILDING

Month	Temperature: Normal: Daily maximum	Temperature: Normal: Daily minimum	Temperature: Normal: Monthly	Temperature: Extremes: Record highest	Temperature: Extremes: Year	Temperature: Extremes: Record lowest	Temperature: Extremes: Year	Normal degree days	Precipitation: Normal total	Precipitation: Maximum monthly	Precipitation: Year	Precipitation: Minimum monthly	Precipitation: Year	Precipitation: Maximum in 24 hrs.	Precipitation: Year	Snow, Sleet: Mean total	Snow, Sleet: Maximum monthly	Snow, Sleet: Year	Snow, Sleet: Maximum in 24 hrs.	Snow, Sleet: Year	Relative humidity: 7:00 a.m., EST	Relative humidity: 1:00 p.m., EST	Relative humidity: 7:00 p.m., EST	Wind: Mean hourly speed	Wind: Prevailing direction	Wind: Fastest mile: Speed	Wind: Fastest mile: Direction	Wind: Fastest mile: Year	Pct. of possible sunshine	Mean sky cover	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Sleet 1.0 inch or more	Thunderstorms	*	Heavy fog	Temperatures: Max.: 90° and above	Temperatures: Max.: 32° and below	Temperatures: Min.: 32° and below	Temperatures: Min.: 0° and below
(a)	(b)	(b)	(b)	60		10		(b)	(b)	60		60		53		53	53		53		45	8	29	45	45	45			45	45	53	53	53	78	14	45	45	60	60	60	6
J	39.1	25.3	32.2	77	1950	-14	1912	1017	3.15	6.51	1915	0.57	1935	2.85	1915	8.5	38.8	1925	15.5	1925	73	54	69	9.5	NW	84	SE	1939	44	6.5	7	9	15	12	2	*	2	0	8	24	
F	40.2	25.3	32.8	77	1930	-13	1899	902	2.68	6.78	1902	0.54	1892	3.26	1915	8.3	22.3	1926	14.2	1940	73	53	66	10.4	NW	79	NW	1934	50	6.2	8	8	12	10	2	*	2	1	0	7	22	*
M	50.2	32.9	41.6	87	1907	2	1900	725	3.31	7.19	1918	0.66	1910	2.51	1932	4.9	17.6	1941	12.2	1941	70	49	62	10.9	NW	65	NW	1937	54	5.9	9	10	12	12	1	1	1	0	1	15	0
A	60.9	41.7	51.3	94	1915	12	1923	411	3.24	8.23	1952	0.66	1946	2.43	1913	0.8	10.0	1924	10.0	1924	67	44	58	10.2	NW	80	E	1944	54	6.1	8	10	12	11	*	2	1	*	*	3	0
M	72.6	52.4	62.5	95	1923	31	1907	123	3.69	13.34	1894	0.55	1903	4.32	1942	T	T	1923	T	1923	69	48	58	8.5	NW	95	NW	1933	58	5.9	8	11	12	12	0	5	*	1	0	*	0
J	81.0	61.5	71.3	102	1952	43	1913	11	3.76	8.31	1889	0.54	1923	4.16	1948	0.0	0.0		0.0		72	50	63	7.8	SE	62	NW	1933	61	5.7	8	12	10	11	0	7	1	4	0	0	0	
J	85.2	66.1	75.7	103	1898	48	1898	0	4.43	12.41	1916	0.93	1944	5.28	1916	0.0	0.0		0.0		74	49	64	7.1	NW	63	N	1934	62	5.7	9	12	10	11	0	9	*	8	0	0	
A	82.8	64.0	73.4	105	1918	48	1904	5	3.88	14.85	1955	0.28	1888	5.45	1919	0.0	0.0		0.0		78	49	67	6.9	SE	63	E	1933	61	5.5	10	11	10	10	0	6	1	5	0	0	
S	76.5	57.6	67.1	102	1953	32	1904	57	3.28	8.65	1907	0.37	1895	3.83	1924	0.0	0.0		0.0		79	49	68	7.2	SE	63	NE	1936	58	5.3	11	9	10	8	0	3	1	2	0	*	0
O	65.7	46.5	56.1	94	1941	24	1938	285	2.75	9.49	1889	0.04	1924	3.61	1939	T	1.1	1925	1.1	1925	78	49	66	7.8	NW	72	SE	1934	58	5.2	12	8	11	9	0	*	2	*	0	1	0
N	53.0	37.7	45.4	84	1950	10	1908	588	3.05	8.88	1889	0.38	1931	6.08	1950	1.3	13.4	1938	11.8	1938	75	51	67	9.1	NW	69	E	1950	58	6.2	8	9	13	9	*	2	0	*	9	0	*
D	41.4	28.1	34.8	71	1948	- 6	1917	938	2.80	7.10	1902	0.17	1955	3.15	1953	5.4	22.6	1909	12.5	1914+	74	55	65	9.4	NW	64	S	1938	42	6.6	7	9	15	11	2	*	2	0	6	21	*
Year	62.4	44.9	53.7	105	Aug. 1918	-14	Jan. 1912	5080	40.02	14.85	Aug. 1955	0.04	Oct. 1924	6.08	Nov. 1950	29.2	38.8	Jan 1925	15.5	Jan. 1925	74	50	64	8.7	NW	95	NW	May 1933	54	5.9	105	118	142	126	7	33	14	20	22	95	

LATITUDE 39° 40' N
LONGITUDE 75° 36' W
ELEVATION (ground) 78 Feet

WILMINGTON, DELAWARE
NEW CASTLE COUNTY AIRPORT

Month	Temperature: Normal: Daily maximum	Temperature: Normal: Daily minimum	Temperature: Normal: Monthly	Temperature: Extremes: Record highest	Temperature: Extremes: Year	Temperature: Extremes: Record lowest	Temperature: Extremes: Year	Normal degree days	Precipitation: Normal total	Precipitation: Maximum monthly	Precipitation: Year	Precipitation: Minimum monthly	Precipitation: Year	Precipitation: Maximum in 24 hrs.	Precipitation: Year	Snow, Sleet: Mean total	Snow, Sleet: Maximum monthly	Snow, Sleet: Year	Snow, Sleet: Maximum in 24 hrs.	Snow, Sleet: Year	Relative humidity: 1:00 a.m., EST	Relative humidity: 7:00 a.m., EST	Relative humidity: 1:00 p.m., EST	Relative humidity: 7:00 p.m., EST	Wind: Mean hourly speed	Wind: Prevailing direction	Wind: Fastest mile: Speed	Wind: Fastest mile: Direction	Wind: Fastest mile: Year	Pct. of possible sunshine	Mean sky cover	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Sleet 1.0 inch or more	Thunderstorms	Heavy fog	Temperatures: Max.: 90° and above	Temperatures: Max.: 32° and below	Temperatures: Min.: 32° and below	Temperatures: Min.: 0° and below
(a)	(b)	(b)	(b)	10		10		(b)	(b)	10		10		10		10	10		10		10	10	10	10	9	10				10	10	10	10	10	10	10	10	10	10	10	10	10
J	41.8	24.7	33.3	75	1950	- 4	1957	983	3.56	5.55	1949	0.59	1955	1.58	1948	6.0	13.0	1948	7.3	1956	75	77	62	71	9.0	NW						7.0	6	7	18	13	2	*	5	0	5	25	*
F	42.8	24.6	33.7	74	1954+	2	1948	876	2.98	4.21	1956	1.82	1954	1.90	1952	3.9	14.8	1948	9.7	1948	76	77	59	69	9.4	NW						6.4	7	7	14	10	1	*	5	0	2	21	
M	53.0	32.0	42.5	88	1948	10	1950	698	3.61	5.72	1953	2.64	1957	1.65	1956	3.0	12.3	1956	7.7	1956	73	75	54	65	10.8	NW						6.2	9	8	14	13	1	2	4	0	1	16	
A	63.2	40.4	51.8	88	1957	23	1950	398	3.64	5.57	1952	1.81	1950	1.67	1957	T	T	1957+	T	1957+	77	74	52	65	10.0	WNW						6.6	7	8	15	12	0	3	3	0	0	3	
M	74.6	51.0	62.8	93	1958+	34	1957	110	3.81	7.35	1948	1.18	1955	2.01	1952	0.0	0.0		0.0		82	77	54	68	8.6	NW						6.7	5	12	14	13	0	6	3	1	0	0	
J	83.1	60.4	71.8	99	1952	45	1957+	6	4.02	8.34	1955	0.44	1954	2.67	1955	0.0	0.0		0.0		85	78	53	69	8.3	S						5.8	8	11	11	10	0	6	3	6	0	0	
J	86.7	65.0	75.8	102	1957+	50	1952	0	4.49	7.40	1952	0.16	1955	6.24	1952	0.0	0.0		0.0		86	79	51	65	7.5	NW						5.9	7	13	11	9	0	5	2	11	0	0	0
A	84.8	62.9	73.8	101	1955+	48	1952+	0	5.28	12.09	1955	1.89	1953	4.00	1955	0.0	0.0		0.0		88	84	55	72	7.3	NW						5.8	9	11	11	9	0	6	4	6	0	0	0
S	78.8	57.1	68.0	100	1953	37	1957+	47	3.80	7.08	1950	1.16	1951	2.29	1950	0.0	0.0		0.0		87	88	55	74	7.5	WNW						5.7	10	8	12	9	0	3	4	1	0	0	0
O	67.2	45.2	56.2	91	1951	28	1952	282	2.99	3.87	1953	0.46	1952	2.94	1953	T	T	1957	T	1957	85	85	54	74	7.8	NW						5.4	12	7	12	8	0	1	5	*	0	1	
N	55.3	35.7	45.5	85	1950	14	1955	585	3.33	7.32	1951	1.15	1949	3.83	1958	1.9	11.9	1953	11.9	1953	80	82	57	72	8.5	NW						6.1	9	7	14	10	*	1	5	0	*	12	
D	43.9	28.2	35.1	71	1951	6	1951+	927	2.99	5.79	1951	0.19	1955	1.99	1948	3.0	11.2	1957	10.3	1957	77	78	60	72	8.5	NW						6.5	7	9	15	11	1	0	4	0	4	22	
Year	64.6	43.8	54.2	102	July 1957+	- 4	Jan. 1957	4910	44.50	12.09	Aug. 1955	0.16	July 1955	6.24	July 1952	17.8	14.8	Feb. 1948	11.9	Nov. 1953	81	79	56	70	8.6	NW						6.2	98	108	161	127	5	32	47	24	11	100	*

Means and extremes in the above table are from the existing or comparable location(s). Annual extremes have been exceeded at prior locations as follows: Highest temperature 107 in August 1918; lowest temperature -15 in February 1934; maximum monthly precipitation 14.91 in August 1911; minimum monthly precipitation 0.06 in October 1924; maximum precipitation in 24 hours 6.53 in August 1945; maximum monthly snowfall 27.0 in January 1935; maximum snowfall in 24 hours 22.0 in December 1909.

REFERENCE NOTES APPLYING TO ALL "NORMALS, MEANS, AND EXTREMES" TABLES.

(a) Length of record, years.
(b) Normal values are based on the period 1921-1950, and are means adjusted to represent observations taken at the present standard location.
* Less than one-half.

\- No record.
† Airport data.
‡ City Office data.
\+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3 tenths; partly cloudy days on 4-7 tenths; and cloudy days on 8-10 tenths. Monthly degree day totals are the sum of the negative departures of average daily temperatures from 65°F. Sleet was included in snowfall totals beginning with July 1948. Heavy fog also includes data referred to at various times in the past as "Dense" or "Thick". The upper visibility limit for heavy fog is 1/4 mile. Data in these tables are based on records through 1957.

The Chester County Planning Commission

The Chester County Planning Commission is a staff agency of the Board of County Commissioners, as provided by the County Code. It serves as a research and service arm to the County Government, the municipalities and the citizens of the County. A technical staff started work during 1962.

Major services of the Commission are, or will be:

1. Preparation of a Comprehensive Plan of Chester County indicating recommendations for the best use of land, major transportation and community facilities, and other specialized aspects, including a capital budget.

2. Providing technical planning advice, information and direct assistance to the seventy-three municipalities.

3. Maintaining a county data center of basic facts about the physical, social, governmental and economic characteristics; and publishing maps and reports of the findings.

4. Review of all subdivisions of three or more lots in townships.

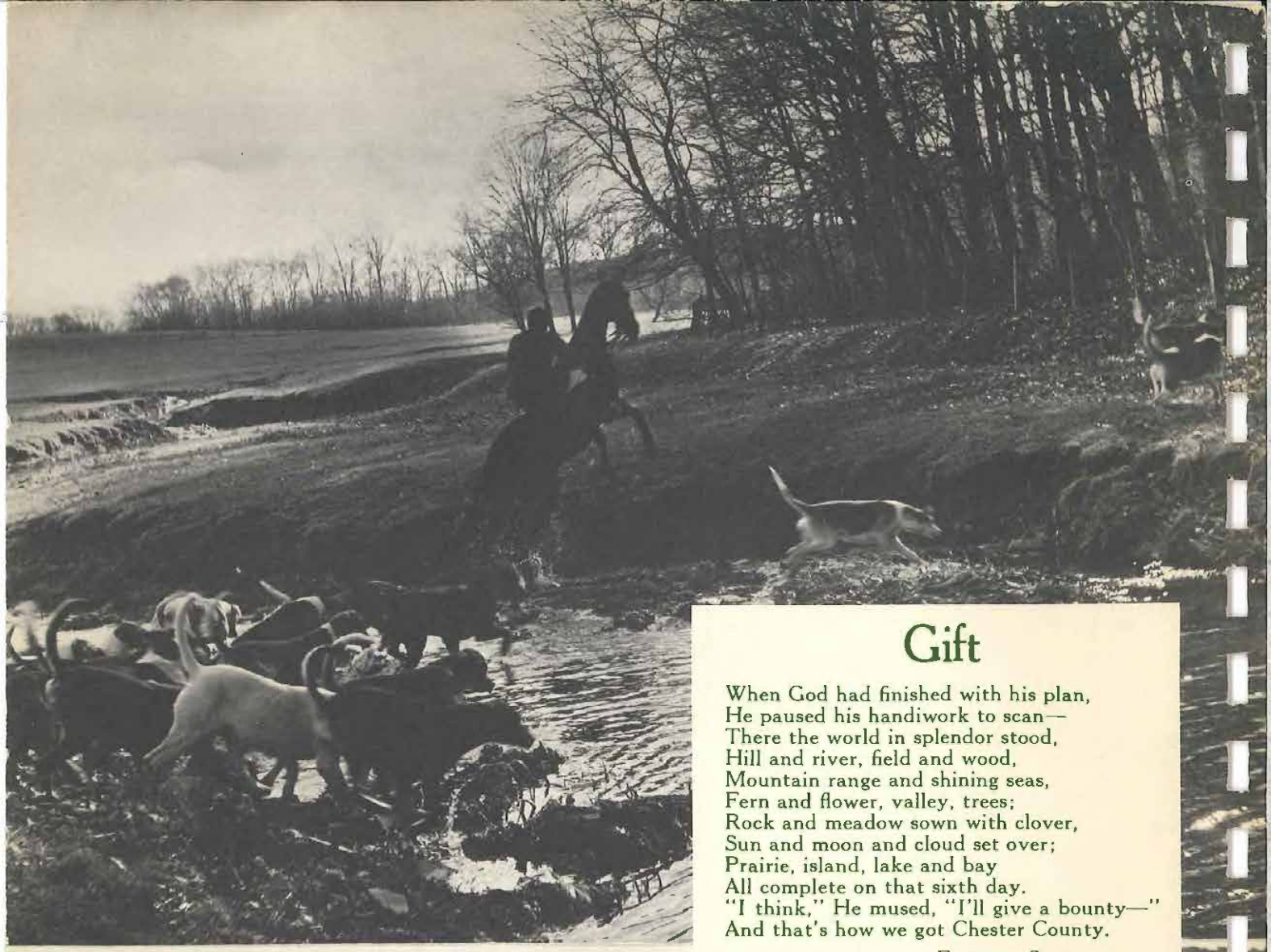
5. Mapping the county and municipalities, and serving as the cartography center of the County.

6. Representing the County with other agencies and planning groups, such as the Penn-Jersey Transportation Study, and with the state and federal government.

7. Stimulating and coordinating general land development of the County, including encouragement and help to local planning, and creation of specialized planning groups.

8. Serving as a source of information and advice to civic groups on the general development of the County, including publication and lecture services upon request.

The relative emphasis among these varying objectives changes with the stage of the planning process, size of staff and other resources. During 1962 greatest emphasis has been on functions 1, 3, 4, and 6.



Gift

When God had finished with his plan,
He paused his handiwork to scan—
There the world in splendor stood,
Hill and river, field and wood,
Mountain range and shining seas,
Fern and flower, valley, trees;
Rock and meadow sown with clover,
Sun and moon and cloud set over;
Prairie, island, lake and bay
All complete on that sixth day.
"I think," He mused, "I'll give a bounty—"
And that's how we got Chester County.

EDWARD SHENTON