Chapter 3: Natural Resources

The natural features and resources of Page County have determined past settlements and will continue to influence future development throughout the county-Topography, soils, water, air, and vegetation cover must be considered when planning future land uses. General land use suitability and potential development problems related to the existing physical environment must be identified to assure harmony between the county's future development and the capabilities of the land.

This section of the Page County Comprehensive Plan deals with the major land, air and water resources of the county. The natural features examined include:

- Geography
- Geology
- Soils
- Woodland Resources
- Water Resources
- Air Quality
- Climate
- Critical Environmental Areas

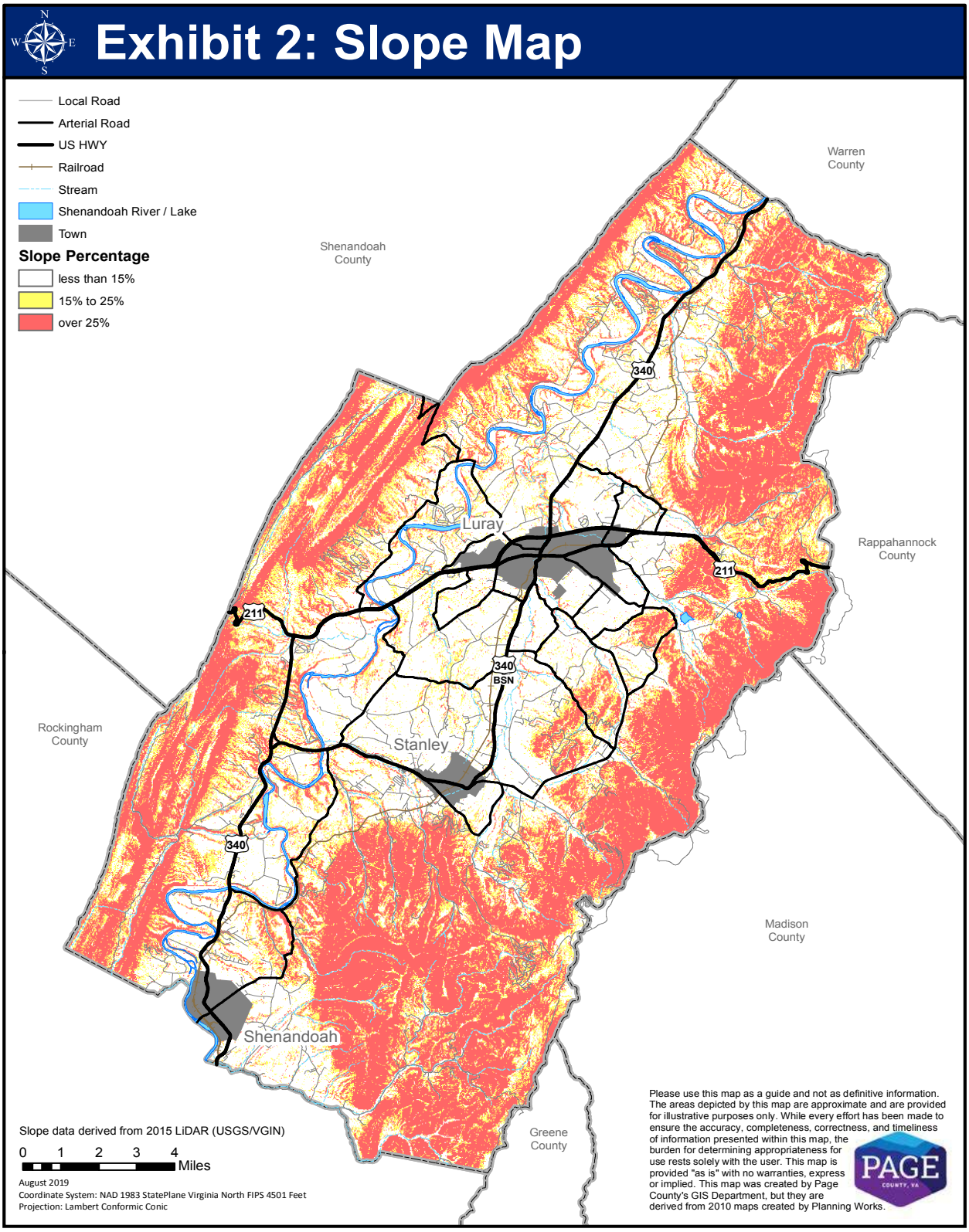
The natural features examined on the following pages are outlined, discussed, and mapped as general background for land use planning. This material is not specific enough for local site planning.

3.1 Geography

Page County is part of two geographic regions, the Blue Ridge Province and the Ridge and Valley Province. Locally, the Blue Ridge Province is a long, narrow spine of mountains extending along the eastern border of the county. The Blue Ridge reaches its highest elevation on Hawksbill Mountain at 4,055 feet. Several other peaks rise a little over 4,000 feet, notably Stony Man at 4010 feet. The Blue Ridge Mountains extend six to eight miles westward from the Page-Greene-Madison boundary almost to the South Fork of the Shenandoah River at Ingham.

The Ridge and Valley geographic province extends along the central and western sections of the county. This province is divided into two distinct areas; the central section, or lowland, is known as the Shenandoah Valley, and the western section characterized by high ridges and intervening valleys, known as the Appalachian Mountains. The easternmost extension of the Ridge and Valley province, the Massanutten Mountains, splits the Shenandoah Valley and forms the western border of Page County. The Massanutten Mountains are particularly prominent and occupy a width of slightly over two miles along the county's western boundary. The Shenandoah Valley is a part of a larger valley known as the "Great Valley" running from New England southward.

Exhibit 2: Slope Map



The central part of the county is a valley floor drained by the South Fork of the Shenandoah River. The valley widens to seven miles just north of Stanley and narrows to one mile near Overall. The valley floor, generally 100 to 125 feet above the river elevation, is primarily covered with a gravel veneer and good agricultural soils.

Topographic features of any area ultimately affect the cost and type of development, soil erosion, direction and rate of storm water runoff, landscape variety and visual quality, climate, and the types of vegetation and wildlife. Steep-walled valleys and heavily wooded slopes characterize the topography of the extreme eastern and western parts of the county.

3.1.1 Limiting Effects of Slope on Development

The amount of slope associated with the mountains that surround Page County has direct ramifications on land use planning. The spectacular scenery of the steep mountainous terrain, with mixed hardwood and pine forests, encourages the development of cottages and second home subdivisions. However, the same areas that might provide residential development are vulnerable to erosion, difficult to access by road and are unsuitable for septic drain field installation.

Based on slope only, approximately 45 percent of the county has severe limitations for general residential, industrial, and commercial development. Agricultural uses in much of this land are also restricted. These areas include the Blue Ridge and Massanutten Mountains and immediately adjacent lands.

About thirty percent of the total county land area is suited (slight limitations) for non-farm uses, and thirty percent is well suited for farm use. These areas of undulating land (2 to 7 percent slope) are found in the county's central valley area.

Most of the moderately sloping land is found in belts along the eastern and western portions of the county. The upper ranges of this category approach the maximum slope for normal wheeled traffic. A smaller amount is level (less than 2 percent slope) and is located along the South Fork of the Shenandoah River in northern Page County.

The following list defines four slope categories and characterizes the development potential of each:

- **Flat Terrain:** Land with no slope or minimal slope (0- 3%). Development in these areas should be prohibited in most cases because of drainage problems and vulnerability to flooding.
- **Gentle Slopes:** Land with slopes ranging from three to eight percent (3-8%). Such land is suited for all forms of development and agriculture. The gentle slopes provide good drainage without posing construction problems. This slope predominates in the central, most developed, part of the county. Most of the land within this slope range is limited to areas east of the Shenandoah River and west of the Blue Ridge.

- **Moderate Slopes:** Land with slopes ranging from eight to fifteen percent (8-15%). These areas are ideally suited for single-family, detached residential development. However, in areas with steeper slopes (especially over 12 percent), greater problems will be encountered during construction and site development. The amount of land in the county within this slope range is limited mostly to areas west of the Shenandoah River and east of the Massanutten Mountains.
- **Steep and Excessive Slopes:** Land with slopes greater than fifteen percent (15%). This category comprises a large portion of the county's land where plats for summer homes and vacation home subdivisions have been approved. Provision of public services such as roads, water and sewer are prohibitively expensive in these areas. These lands should be developed only at very low density under strict regulations that include erosion control, ground water protection, minimum lot size, storm water controls and a complete site plan. On-site sewer systems must be strictly regulated regarding slope, soil percolation rate, and the shallow depth to bedrock. Intensive residential development in these areas must be discouraged in order to better protect precious water resources from further deterioration. No residential structures should be built on slopes greater than 15% without meeting special standards and fully considering environmental problems that may arise.

Much as the county's hillsides may be admired, they are becoming progressively more threatened. Construction in areas with lesser slope is easier, less expensive and more secure from the threat of landslides and severe drainage and erosion problems. However, as valley and upland sites available for development become scarcer and more people are able to afford "view" properties, pressure will increase to allow development on the steeper slopes and hillcrests. The county needs to develop measures to avoid the environmental problems and the degradation of the dramatic visual character of the wooded hillsides that such development will cause.

3.2 Geology

Page County is divided into four belts of similar geology underlain with bedrock. **Exhibit 3** The bedrock generally becomes younger going from east to west across the county. The oldest rocks, dating from about 1,150 million years ago, occur in a 30-mile area in the southeastern part of the county. Page County contains eight primary rock types that make up its four geologic belts. These belts are known as follows:

- **The Appalachian Sandstone/Shale Belt:** This belt is located in two general areas in the western side of the county and makes up the Massanutten Mountains. Sandstone and shale are the major rock types in the division that is made up of eight separate geologic groups and formations.
- **The Valley Carbonates:** This group is found in the middle of the county. This belt is composed of 11 different rock formations and groups, the most common of which are limestone and dolomite. In areas of carbonate rocks, the construction of buildings requiring high load-bearing bedrock strength is severely limited and ground subsidence can form sinkholes unexpectedly when the ground is disturbed for construction.

- **Central Valley Shale:** This section is a wide belt running through the center of the county. It is made up of a single rock unit, the Martinsburg Formation. Shale is the major rock type in this belt.
- **The Blue Ridge Complex:** This section extends along the county's eastern boundary. The most common of the many rock types found are granite, gneiss (altered granite), and greenstone (metamorphosed lava) and basaltic soils.

3.2.1 *Commercial Value of Rocks and Minerals*

One effect of the geology on man's use of the land is the presence or possibility of commercially valuable rocks and minerals. Mineral resources consist of a wide variety of materials.

In the past, limestone and dolomite were quarried at varied sites for crushed stone, dimensioned stone, lime manufacturing, and for flux used in early iron furnaces. Iron and manganese ores were mined at numerous sites. A small quantity of copper also was mined. Today, only deposits of sand, gravel and stone are being quarried at various sites within the county, chiefly for construction and paving.

3.2.2 Limiting Effects of Karst Topography on Development

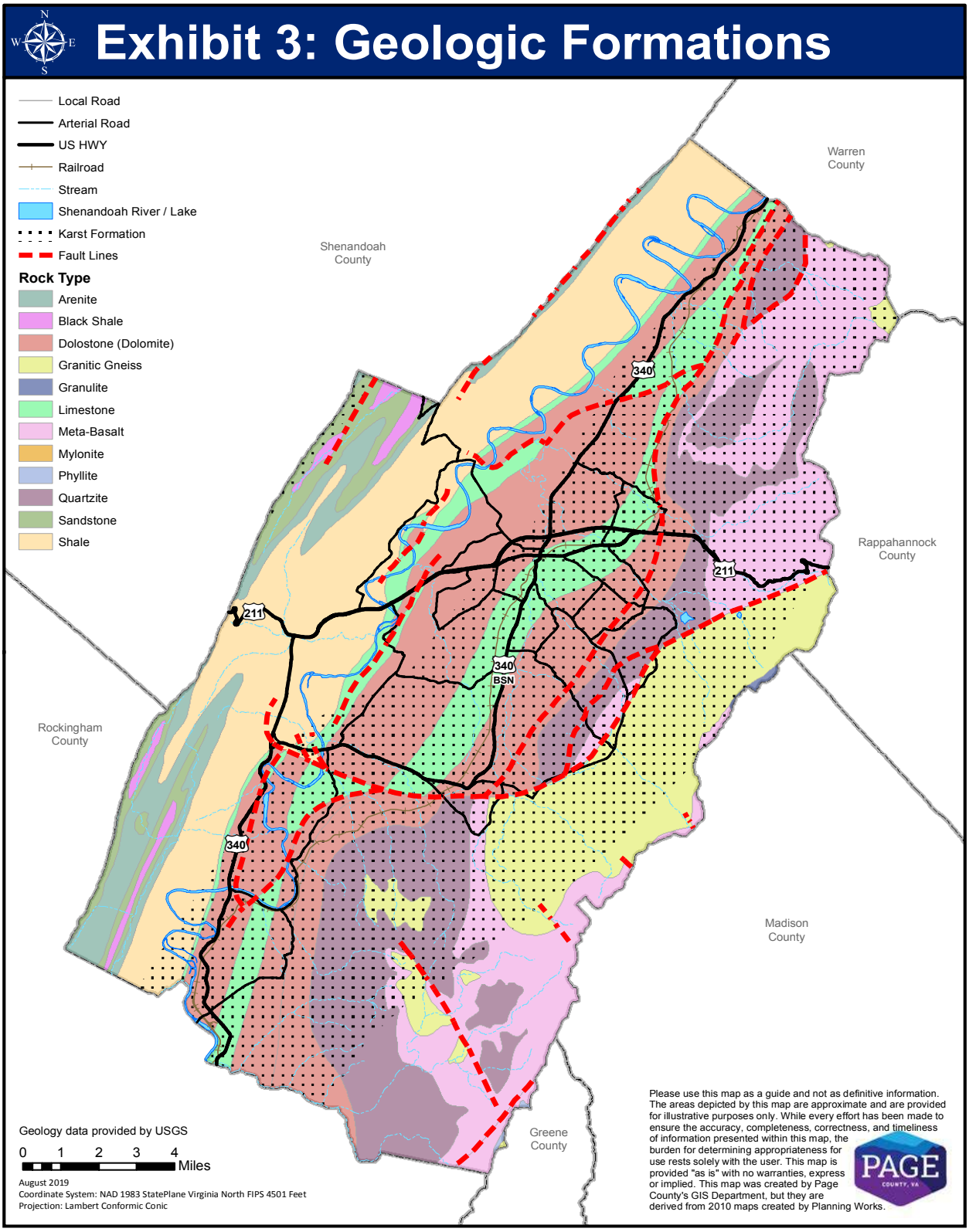
A key factor of Page County's geology is its Karst topography. Karst is defined as a landscape with sinkholes, springs and streams that sink into subsurface caverns and conduits. The word "Karst" was developed in Europe, where early geologists first studied the nature of groundwater flowing through limestone hills and valleys. In Karst areas, the fractured limestone rock formations have been dissolved by groundwater to form cavities, pipes and conduits that make up the underground drainage systems in karst lands. Common geological characteristics of karst regions that influence human use of its land and water resources include ground subsidence, sinkhole collapse, groundwater contamination, and unpredictable water supply. (www.karstwaters.org)

Approximately 10% of the earth's surface and 20% of the United States is composed of Karst. However, approximately 25% of the world's population lives on these areas. As noted above, the center of Page County is made up of carbonate rocks, principally limestone and dolomite, in which Karst topography predominates. The abundance of caverns in the area enclosed by Leakesville, Hamburg, and Luray are characteristic of Karst topography. Large areas of Page County's land surface and a significant portion of the population rests on Karst topography.

Karst topography is inherently unstable and susceptible to settlement and surface collapse. The placement of impervious coverage, grade changes or increased loads from site improvements can lead to the alteration of drainage patterns, which, in turn, can lead to settlement and sinkholes. Fractures, fissures and openings in the bedrock makes water sources in Karst areas especially susceptible to groundwater contamination from solid and liquid wastes, sediment, contaminated surface water, septic tank effluent or other hazardous substances moving through fractures, fissures and solution openings within the bedrock.

Because the hollow nature of Karst terrain results in a very high pollution potential, watersheds in Karst areas must be protected. Because streams and surface runoff enter sinkholes and caves directly and bypass natural filtration through soil and sediment, the direct connections between the surface and the subsurface must be monitored to avoid threatening the quality of drinking water. Because groundwater can travel quite rapidly through these underground networks transmitting contaminants to wells and springs across large areas, septic drain field construction in karst areas should be carefully regulated.

Exhibit 3: Geologic Formations Map



The safest watersheds are those in which all residents understand the Karst landscape and work together to reduce soil erosion, high-density development, agricultural and storm water runoff, improper waste disposal, and other sources of pollution. In order to prevent further exposure of the county's sources of clean water to high risks of pollution, measures should be adopted to stop current trends of building, digging, earth removal and well-drilling in areas of the county where Karst topography is the dominant geological feature.

The effects of Karst topography must be considered in the placement of on-site sewage disposal facilities and in the management of groundwater resources.

3.3 Soils

The General Soil Map (**Exhibit 4**) shows broad areas that have distinctive patterns of soils, relief and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. Each map unit is named for one of the eleven major soils which are described below.

The components of one map unit can occur in another but in different patterns. The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of if its small scale, the map is not suitable for planning the management of a farm or field, for selecting a road-building site, or for building structures. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management strategies.

Soils Map Resources:

USDA Natural Resources Conservation Service: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

3.3.1 Major Soil Types

- **LODI-CARBO-OAKLET**
  Moderately deep and very deep, gently sloping to steep, well drained soils that have a clayey subsoil.
  Setting
  Topography: Broad, moderately dissected uplands
  Location: Limestone valleys
  Vegetation: Cultivated crops, pasture, and woodland
  Slope range: 2 to 35 percent
  Elevation: 800 to 1,000 feet
  Flooding: None
  Drainage pattern: Dendritic (branching like a tree)

  Composition

Percent of survey area: 10

Lodi soils—64 percent

Carbo soils—15 percent

Oaklet soils—12 percent

Minor soils—9 percent

Soil Properties and Qualities

Lodi

Depth: Very deep

Drainage class: Well drained

Parent material: Residuum derived from limestone

Permeability: Moderate

Texture class: Clayey

Carbo

Depth: Moderately deep

Drainage class: Well drained

Parent material: Residuum derived from limestone

Permeability: Slow

Texture class: Clayey

Oaklet

Depth: Very deep

Drainage class: Well drained

Parent material: Residuum derived from limestone

Permeability: Slow

Texture class: Clayey

Minor soils

Limestone rock outcrops

Well drained Timberville soils

Pits, bedrock

- **DEKALB-MASSANUTTEN-ROCK OUTCROP**

Rock outcrop and moderately deep, strongly sloping to very steep, well drained soils that have a loamy subsoil.

Setting

Topography: Ridge summits and side slopes

Location: Massanutten Mountains

Vegetation: Mixed hardwoods and pines

Slope range: 2 to 70 percent

Elevation: 1,400 to 2,500 feet

Flooding: None

Drainage pattern: Dendritic

Composition

Percent of the survey area: 8

Dekalb soils—27 percent

Massanutten soils—27 percent

Rock outcrop—17 percent

Minor soils—29 percent

Soil Properties and Qualities

Dekalb

Depth: Moderately deep

Drainage class: Well drained

Parent material: Residuum derived from sandstone

Permeability: Rapid

Texture class: Loamy-skeletal

Massanutten

Depth: Moderately deep

Drainage class: Well drained

Parent material: Residuum derived from sandstone

Permeability: Rapid

Texture class: Sandy-skeletal

Minor soils

Excessively drained Drall soils

Well drained Jefferson and Zepp soils

- **LAIDIG-WEIKERT-BERKS**

Shallow to very deep, gently sloping to very steep, well drained soils that have a loamy subsoil.

Setting

Topography: Side slopes and foot slopes

Location: Side slopes and foot slopes of the Massanutten Mountains

Vegetation: Mixed hardwoods and pines

Slope range: 2 to 55 percent

Elevation: 600 to 1,400

Flooding: None

Drainage pattern: Dendritic

Composition

Percent of survey area: 14

Laidig soils—35 percent

Weikert soils—31 percent

Berks soils—25 percent

Minor soils—9 percent

Soil Properties and Qualities

Laidig

Depth: Very deep

Drainage class: Well drained

Parent material: Colluvium derived from shale and sandstone

Permeability: Moderate or moderately rapid above the pan; slow or moderately slow in the pan

Texture class: Fine-loamy

Weikert

Depth: Shallow

Drainage class: Well drained

Parent material: Residuum derived from shale and sandstone

Permeability: Moderately rapid

Texture class: Loamy-skeletal

Berks

Depth: Moderately deep

Drainage class: Well drained

Parent material: Residuum derived from shale and sandstone

Permeability: Moderately rapid

Texture class: Loamy-skeletal

Minor Soils

Well drained Gilpin, Chilhowie, and Edom soil

- **THURMONT**

Very deep, gently sloping to moderately steep soils that have a loamy subsoil.

Setting

Topography: Alluvial and colluvial fans, benches, and side slopes

Location: Terraces and foot slopes of the Blue Ridge Mountains

Vegetation: Mixed hardwoods and pines

Slope range: 2 to 25 percent

Elevation: 900 to 1,200 feet

Flooding: None

Drainage pattern: Dendritic

Composition

Percent of survey area: 6

Thurmont soils—100 percent

Soil Properties and Qualities

Thurmont

Depth: Very deep

Drainage class: Well drained

Parent material: Colluvium derived from quartzite and granite

Permeability: Moderate

Texture class: Fine-loamy

- **EDGEMONT-DEKALB**

Moderately deep and deep, strongly sloping to very steep, well drained soils that have a loamy subsoil.

Setting

Topography: Side slopes and foot slopes

Location: Quartzite ridges of the Blue Ridge Mountains

Vegetation: Mixed hardwoods and pines

Slope range: 2 to 55 percent

Elevation: 1,400 to 2,600 feet

Flooding: None

Drainage pattern: Dendritic

Composition

Percent of survey area: 7

Edgemont soils—54 percent

Dekalb—42 percent

Minor soils—4 percent

Soil Properties and Qualities

Edgemont

Depth: Deep

Drainage class: Well drained

Parent material: Residuum derived from quartzite

Permeability: Moderate

Texture class: Fine-loamy

Dekalb

Depth: Moderately deep

Drainage class: Well drained

Parent material: Residuum derived from quartzite and sandstone

Permeability: Rapid

Texture class: Loamy-skeletal

Minor Soils

Rock outcrops

- **SYLVATUS-SYLCO**

Shallow and moderately deep, moderately steep to very steep, well drained soils that have a loamy subsoil.

Setting

Topography: Side slopes

Location: Quartzite ridges of the Blue Ridge Mountains

Vegetation: Mixed hardwoods and pines

Slope range: 2 to 55 percent

Elevation: 1,400 to 2,600 feet

Flooding: None

Drainage pattern: Dendritic

Composition

Percent of survey area: 7

Sylvatus soils—60 percent

Sylco soils—40 percent

Soil Properties and Qualities

Sylvatus

Depth: Shallow

Drainage class: Well drained

Parent material: Residuum derived from metasedimentary rock

Permeability: Moderate

Texture class: Loamy-skeletal

Sylco

Depth: Moderately deep

Drainage class: Well drained

Parent material: Residuum derived from metasedimentary rock

Permeability: Moderate

Texture class: Loamy-skeletal

- **EDNEYTOWN-PEAKS**

Very deep and moderately deep, gently sloping to very steep, well drained soils that have a loamy subsoil.

Setting

Topography: Ridge summits and side slopes

Location: Blue Ridge Mountains

Vegetation: Mixed hardwoods and pines

Slope range: 2 to 70 percent

Elevation: 1,250 to 2,800 feet

Flooding: None

Composition

Percent of survey area: 8

Edneytown soils—71 percent

Peaks—29 percent

Soil Properties and Qualities

Edneytown

Depth: Very deep

Drainage class: Well drained

Parent material: Residuum derived from granite

Permeability: Moderate

Texture class: Fine-loamy

Peaks

Depth: Moderately deep

Drainage class: Well drained

Parent material: Residuum derived from granite

Permeability: Moderate

Texture class: Loamy-skeletal

- **SHERANDO**

Very deep, gently sloping and strongly sloping soils that have a loamy subsoil.

Setting

Topography: Alluvial and colluvial fans, and benches and side slopes

Location: Terraces and foot slopes of the Blue Ridge Mountains

Vegetation: Mixed hardwoods and pines; pasture

Slope range: 2 to 15 percent

Elevation: 700 to 1,100 feet

Flooding: None

Drainage pattern: Dendritic

Composition

Percent of survey area: 2

Sherando soils—100 percent

Soil Characteristics

Sherando

Depth: Very deep

Drainage class: Well drained

Parent material: Colluvium derived from quartzite and granite

Permeability: Rapid

Texture class: Loamy-skeletal

- **CATOCTIN-FAUQUIER-MYERSVILLE**

Moderately deep to very deep, gently sloping to steep, well drained soils that have a clayey and loamy subsoil.

Setting

Topography: Ridge summits and side slopes

Location: Blue Ridge Mountains

Vegetation: Mixed hardwoods and pines

Slope range: 2 to 70 percent

Elevation: 1,500 to 2,600 feet

Flooding: None

Drainage pattern: Dendritic

Composition

Percent of the survey area: 12

Catoctin soils—39 percent

Fauquier soils—31 percent

Myersville soils—30 percent

Soil Properties and Qualities

Catoctin

Depth: Moderately deep

Drainage class: Well drained

Parent material: Residuum derived from greenstone

Permeability: Moderately rapid

Texture class: Loamy-skeletal

Fauquier

Depth: Very deep

Drainage class: Well drained

Parent material: Residuum derived from greenstone

Permeability: Moderate

Texture class: Clayey

Myersville

Depth: Deep

Drainage: Well drained

Parent material: Residuum derived from greenstone

Permeability: Moderate

Texture class: Fine-loamy

- **BRADDOCK-MONONGAHELA-UNISON**

Very deep, gently sloping to moderately steep, well drained soils that have a clayey and loamy subsoil.

Setting

Topography: Broad terraces and alluvial and colluvial fans and benches

Location: Terraces along the South Fork of the Shenandoah River and Hawksbill Creek

Vegetation: Cultivated crops and pastures

Slope range: 2 to 25 percent

Elevation: 600 to 1,000 feet

Flooding: None

Drainage pattern: Dendritic

Composition

Percent of survey area: 20

Braddock soils—56 percent

Monongahela soils—15 percent

Unison soils—13 percent

Minor soils—16 percent

Soil Properties and Qualities

Braddock

Depth: Very deep

Drainage class: Well drained

Parent material: Alluvium and colluvium derived from crystalline rock

Permeability: Moderate

Texture class: Clayey

Monongahela

Depth: Very deep

Drainage class: Moderately well drained

Parent material: Alluvium derived from acid sandstone and shale

Permeability: Moderate above the fragipan, moderately slow in the fragipan

Texture class: Fine-loamy

Unison

Depth: Very deep

Drainage class: Well drained

Parent material: Alluvium and colluvium derived from acid, crystalline rock

Permeability: Moderate

Texture class: Clayey

Minor Soils

Well drained Dyke soils

Moderately well drained Cotaco and Zoar soils

Somewhat poorly drained Tygart soils

Poorly drained Maurertown and Purdy soils

Urban land

- **CRAIGSVILLE-HUNTINGTON**

Very deep, nearly level, well-drained soils that have a loamy subsoil.

Setting

Topography: Meandering flood plains and stream channels

Location: Flood plains along streams in the Valley and Ridge province

Vegetation: Mixed hardwoods or cultivated crops

Slope range: 0 to 4 percent

Elevation: 400 to 600 feet

Flooding: Occasional

Drainage pattern: Open ditches

Composition

Percent of survey area: 6

Craigsville soils—35 percent

Huntington soils—20 percent

Minor soils—45 percent

Soil Properties and Qualities

Craigsville

Depth: Very deep

Drainage class: Well drained

Parent material: Alluvium derived from soils that formed in limestone, shale, and sandstone

Permeability: Moderately rapid

Texture class: Coarse-loamy

Huntington

Depth: Very deep

Drainage class: Well drained

Parent material: Alluvium derived from soils that formed in limestone, sandstone, and shale

Permeability: Moderate

Texture class: Fine-silty

Minor Soils

Well drained Biltmore, Combs, and Wheeling soils

Moderately well drained Sindion soils

Exhibit 4: Soils Maps

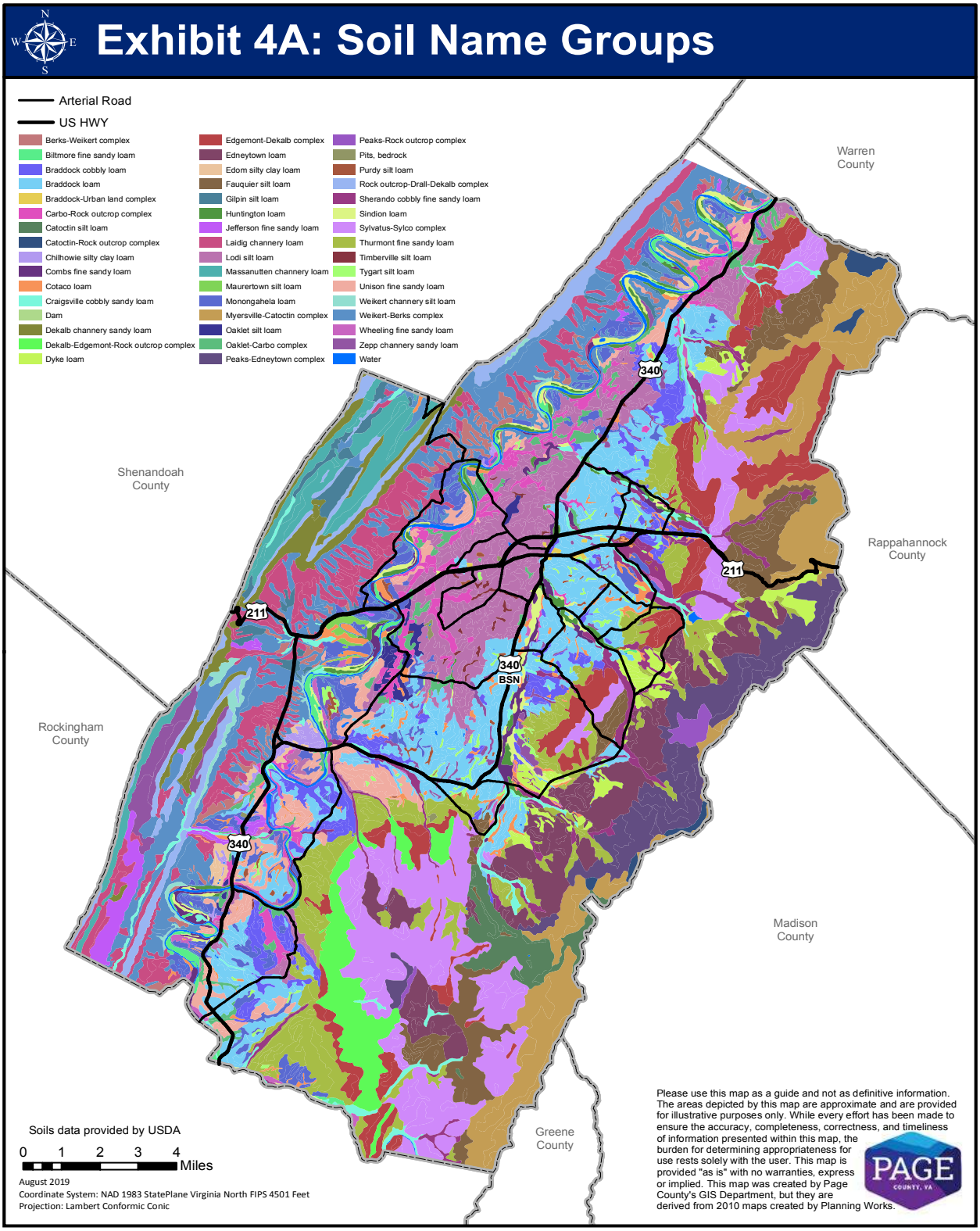


Exhibit 4B: Soils Parent Material

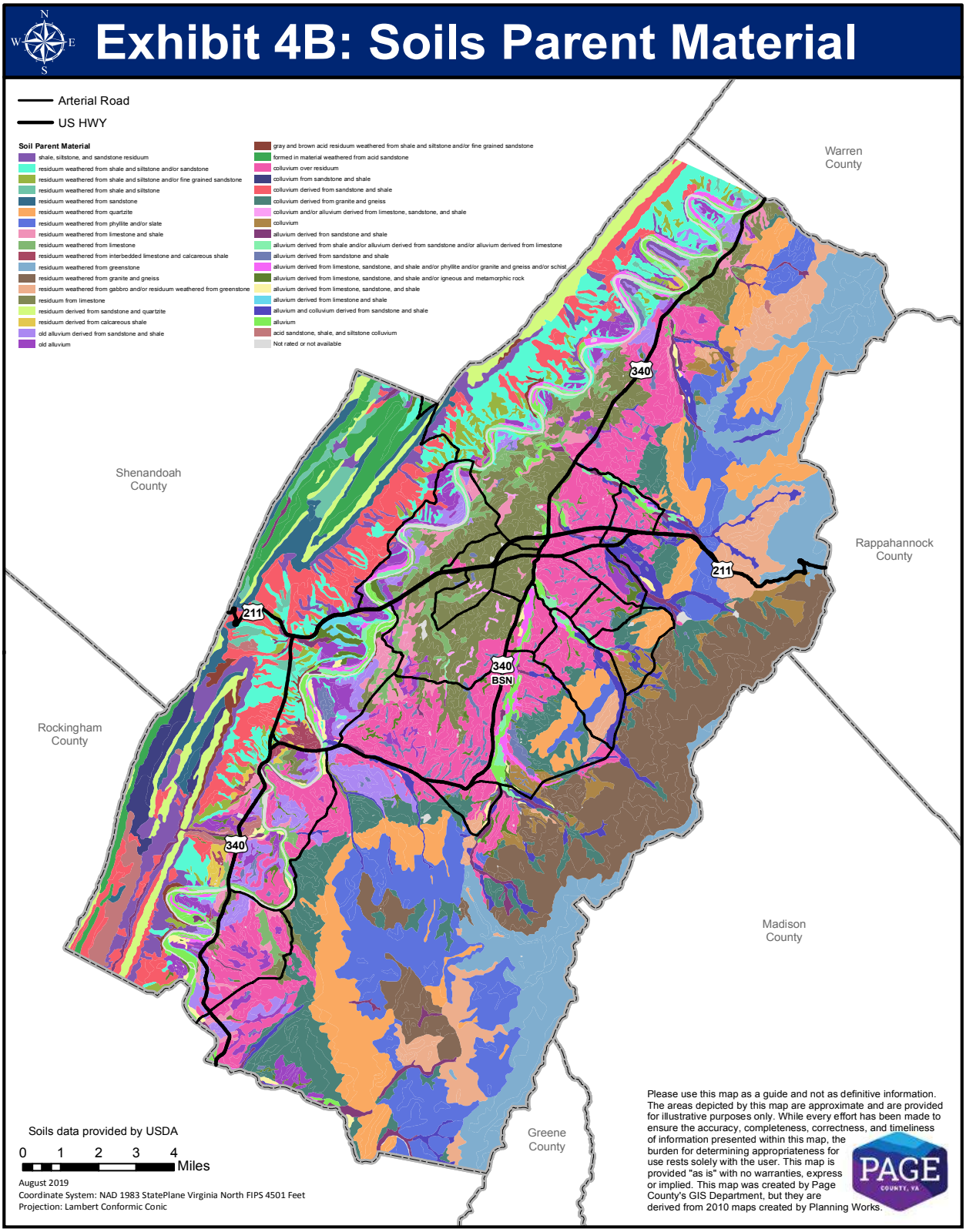
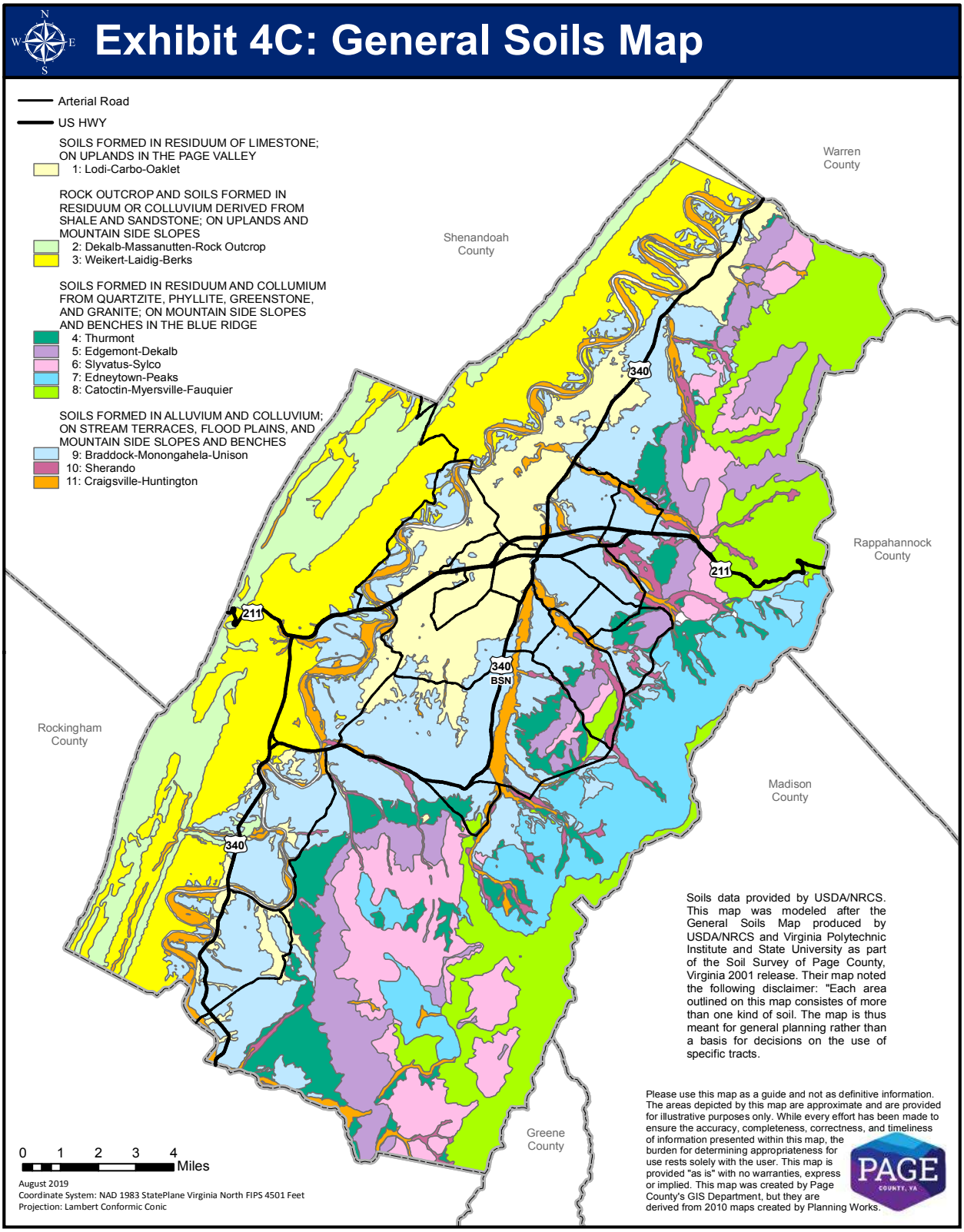


Exhibit 4C: General Soils Map



3.3.2 Prime Agricultural Soils

Approximately 14.8 percent, or 29,750 acres, may be classified as Prime Farmland soils, one of several kinds of important farmland, defined by the U.S. Department of Agriculture (USDA) Soil Classes I and II. The percent of Page County's Prime Farmland has dropped from 21.9 percent since 2009. The majority of Prime Farmland has slight limitations for farming. An additional 19.4 percent (38,832 acres) of Page County is designated "Farmland of Statewide Importance".

The best agricultural lands in the county are located in the central parts of the county. They run north to south between the Blue Ridge and Massanutten Mountains. These deep, well-drained soils are suited to a wide variety of agricultural uses but presently most are intensively used for livestock production. Some of the land could be irrigated from the South Fork of the Shenandoah River to produce a high volume of corn or truck crops.

Very little good cropland is found in the Blue Ridge Mountain foothills of the eastern part of the county and most of that area's potential cropland would require intensive treatment for profitable use. Hay and grazing are the most suitable agricultural uses. Its present use is mostly wood land. There is only limited crop production on the gentle slopes and flat areas along the river. Grazing is the most prevalent use of the area.

3.3.3 Building Development Constraints

Several soil conditions lead to development constraints. Soil suitability for septic systems is very limited throughout 167,400 acres (83.5% of the county) and somewhat limited throughout 25,740 acres (12.9% of the county).

Excavations for dwellings without basements are very limited in 127,086 acres (63.4% of the county) and somewhat limited in 62,992 acres (31.4% of the county). Dwellings with basements are very limited in 138,620 acres (69.2% of the county) and somewhat limited on 53,893 acres (30% of the county).

Small commercial development is limited on 165,085 acres (82.4% of the county).

Development constraints are outlined as follows:

- Too shallow a depth to the water table
- Frequency of flooding
- Excessive slope
- Too shallow a depth to bedrock
- Excessive stoniness of the soil
- Coarse fragments in the soil
- Poor percolation rate because of slow permeability of the soil
- Karst

1. Excavation Limitations – Excavation limitations arise because of the shallow depth to bedrock, a high percentage of large rock fragments in the soil, frequent rock surface outcrops, and so forth. Shallow soils, which lie close to bedrock, make excavations of all kinds difficult and expensive, depending on the bedrock's depth and hardness. Excavating for basements and underground utilities, including sewers is difficult. Water and drainage systems can be built at greater excavation costs. Since these soils tend to occur on moderate to steeply sloping lands, erosion problems are likely to be severe. This feature usually occurs in conjunction with a seasonal high water table. Such development constraints exist in most places in the western portion of the county, from one-half to two miles east of the George Washington National Forest. In the east, the main constraints are located in the Shenandoah National Park and in the Tanner's Ridge area south of Stanley.
2. Costly basement construction, road building, drainage systems, seasonal high water table are common problems in the eastern and western parts of the county. A high water table is defined as land areas where the water supply lies less than three feet from the surface. Its existence makes the construction of basements difficult and costly. Unless a drainage system is provided to dry out the soils, yards may also flood at certain times during the ear. Road building, earth moving and other construction raise costs that are passed on to the homebuyers.
3. Limited Suitability for On-Site Sewage Disposal – Multiple soil conditions and other factors all contribute limited on-site sewage disposal (see above list). These severe limitations arise because of slow permeability (liquid absorbing rate), seasonally high water table, flooding, rock fragments, and shallow depth to bedrock, steep slopes, a high shrink-swell potential, danger of well contamination, rock surface outcrops, danger of seepage from surrounding areas, potential of soil creep or landslides and karst.

   As shown on **Exhibit 5-7,** 167,400 acres (83.5%) are very limited for on-site sewage systems and approximately 13 percent of Page County's land area, or almost 26,000 acres, is somewhat limited for on-site sewage systems. Land with severe limitations for on-lot sewage is located along the eastern and western flanks of the county. Generally, these areas correspond to the Blue Ridge and Massanutten Mountain sections of the county.

   The best areas for easily constructing septic systems are those underlain by limestone and terrace gravel. These areas generally occur in the eastern and western sides of the county's valley lowlands. However, as noted in some of the individual soil and geographical reports, the karst topography throughout these areas greatly increases the potential for ground water pollution and the danger of well contamination from septic systems.

3.3.4 Policy Implications of Development Constraints

Public Policy should not encourage non-farming development in areas of severe limitations for excavations and on-site sewage. If permitted, building should be at low density.

Soils with seasonal high water tables and shallow depth to bedrock should be left in their natural state. Even low density residential uses are unsuitable for these soils. Because on-site sewer systems will not function when bedrock is near or at the surface, any development would require sewer lines and municipal treatment. Since existing sewer treatment systems in the county are not located near these areas, installation of such systems would be costly.

The steep and moderate slopes usually associated with shallow depth to bedrock and seasonal high water tables preclude industrial and commercial development as well. As a general development policy, these soils should be preserved as open space and parks or used for grazing or forest culture.

Based on soil limitations for excavation and sewer systems, the best land for development is in central Page County. This area overlies predominately limestone and dolemite bedrock formations.

The limiting factor is karst topography which can result in potential ground water pollution. Central Page County is also the area with the best agricultural soils suitable for prime farming. Prime Farm land declined from 21.9% to 14.8% between 2009 and 2015. Farmland of Statewide Importance is also located in this area.

Exhibit 5: Page County Soil Limitations

Farmland Classifications	Acres	Percent
Prime Farmland*	29,750.4	14.8%
Farmland of Statewide Importance**	38,832.2	19.4%
Farmland of Local Importance	0.0	0.0%
Unique Farmland	0.0	0.0%
Not Prime Farmland	131,834.0	65.8%

Building Construction	Acres	Percent
Septic Systems		
Very Limited	167,400.00	83.50%
Somewhat Limited	25,740.40	12.80%
Not Limited	0	0.00%
Not Rated	7,276.20	3.60%
Excavations		
Dwellings w/o Basements		
Very Limited	127,075.80	63.40%
Somewhat Limited	62,992.80	31.40%
Not Limited	3,071.70	1.50%
Not Rated	7,276.20	3.60%
Dwellings w/ Basements		
Very Limited	138,619.50	69.20%
Somewhat Limited	53,893.30	30%
Not Limited	627.6	0.30%
Not Rated	7,276.20	3.60%
Small Commercial		
Very Limited	165,084.70	82.40%
Somewhat Limited	28.055.7	14.00%
Not Limited	0	0.00%
Not Rated	7,276.20	3.60%

Source: USDA Natural Resources Conservation Service Page County Web Soil Survey

*"Prime Farmland", as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food and feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland or forest land. Slope ranges mainly from 0 to 6 percent.

**" Farmland of statewide importance" is defined as land that nearly meets the criteria for "Prime Farmland" when treated and managed according to acceptable farming methods.

Exhibit 6: Septic Tank Absorption Fields Map

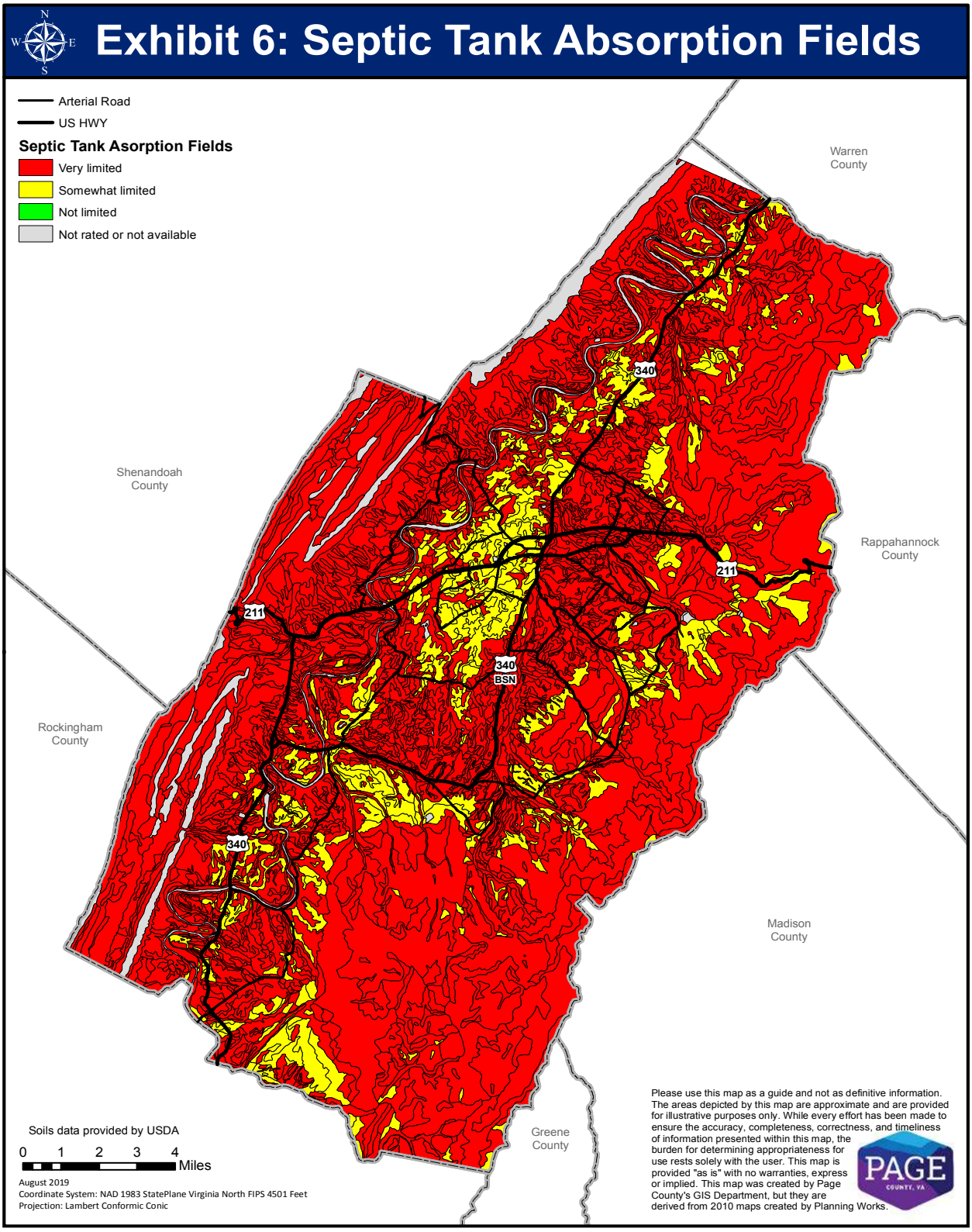
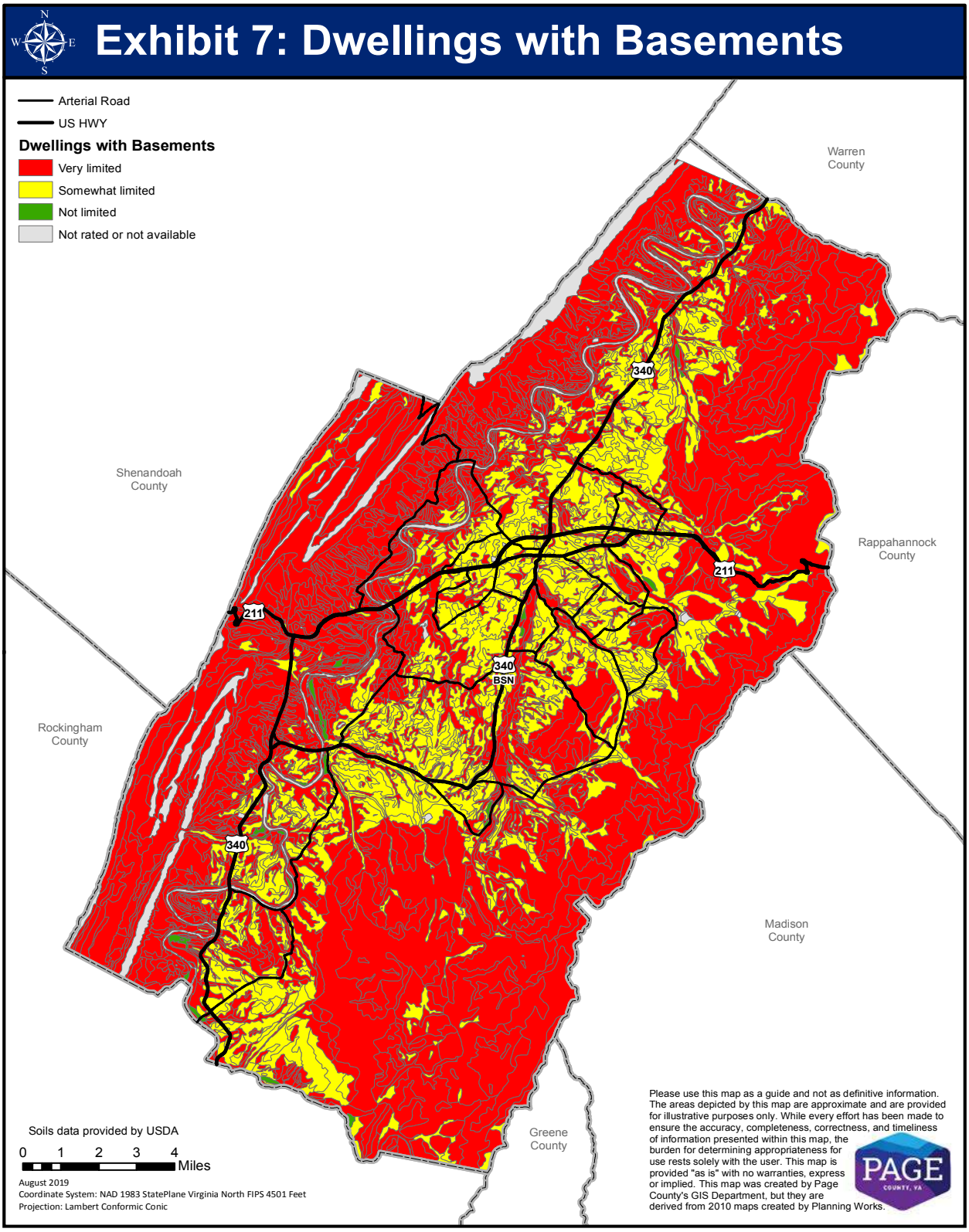


Exhibit 7: Dwellings with Basements



3.4 Woodland Resources

The forests of Page County are one of its most precious resources. These woodlands add to the economic vitality of the county, its natural beauty, and to the resident's quality of life. The county's woodlands are used for recreation, watershed and wildlife management, and for a variety of wood products.

There are 129,683 acres of forestland in Page County. These acres are distributed as follows:

Land Type	Acreage	Percent
Private Ownership	64,359	49.60%
County/Towns	320	0.20%
State	159	0.10%
Federal	64,436	49.70%
Subtotal	**129,275**	
Unclassified Area	408	0.30%
Total	**129,683**	**100%**

Exhibit 8: Page County Forest Characteristics

Forest Type	Acres	Stand Size Class	Acres
Pine Hardwoods	8,534	Saw Timber	65,711
Oak-Hickory	74,672	Pole Timber	40,536
Mixed Hardwoods	23,468	Saplings	427
Total	106,674	Total	106,674

Source: Joe Lehner, Area Forester, Woodstock, VA

Exhibit 8 provides information on the characteristics of Page County's forest resources. The Upland Hardwood – Southern Pine forest type dominates the woodlands. The most common species in this forest type include white oak, black oak, chestnut oak scarlet oak, northern red oak, pignut hickory, butternut hickory, mockernut hickory, tulip tree, Virginia pine, shortleaf pine, pitch pine, tablemountain pine, white pine and black gum.

The commercial quality of these trees varies greatly depending upon the soil types that underlay the woodland. Many acres of forest grow on shale derived soils that are of very low quality and value. Conversely, trees growing on limestone soils, or on river bottom alluvial soils, are of very high quality. It is these better quality soils that make the county a leader in the world market of fine hardwood products.

The County's forest resources are a valuable economic resource. At least 343 workers depend upon the forest products industry. Because the forest resources are not being utilized to their fullest extent and because the land management objectives in the federally held lands preclude timber harvesting, Page County's forest products economy ranks only 90th in the state. The total annual forest economic impact is $27,163,177 broken down as follows:

Direct Economic Impact (Primary and secondary Industries) $20,430,308

Indirect Impact (Service industry: trucking, supplies, etc.)	$ 2,879,529
Induced Impact (employee spending)	$ 3,853,341

From 1986 through 1992, cumulative harvest revenues for county landowners averaged about 140,000 per year. However, beginning in 1993, and through the end of 2001, annual harvest revenues increased to $326,666. This increase is attributable to an improved global hardwood market, an increased demand for hardwood products, a decrease in lumber harvested from the National Forests and the recognition of the superior quality of Shenandoah Valley hardwoods. Trends in the county land use have been increasing fragmentation and parcelization of forest acreage. This loss of productive forestland equates to a decline in the county's economic viability due to decreased revenues generated by traditional forest products and eco-tourism (hiking, fishing, hunting, bird watching, and nature study). The annual harvest revenue for county landowners was $141,726.

The county should seek a balance between managed growth and the protection of productive forestland. A serious concern is the loss of prime forestland to development. Many of the most productive sites, which grow some of the world market's finest hardwoods are presently being subdivided for development, rendering the remaining included wooded areas "unmanageable". The remaining woodland parcels are too small to practice good management techniques and economic harvesting. The public needs to understand the value of well-managed forests.

3.5 Water Resources

Page County is located in the Shenandoah River Basin. The county is drained by the South Fork of the Shenandoah River and its major tributaries; Naked Creek, Cub Run, Stony Run, Mill Creek, Hawksbill Creek, East Hawksbill Creek, Jeremiah's Run, Dry Run and Pass Run.

Six major watersheds are located in Page County:

South Fork, Shenandoah River/Gooney Run	37,550 acres
South Fork, Shenandoah River/Mill Creek	36,056 acres
Hawksbill Creek	56,833 acres
South Fork, Shenandoah River/Cub Run	40,896 acres
Naked Creek	23,558 acres
Jeremy's Run	5,436 acres

3.5.1 Drainage and Flood Plains

The major surface water body is the South Fork of the Shenandoah River. The volume of the South Fork at Luray averages 1,264 cubic feet per second (CFS). The minimum flow is 70 CFS and the maximum is 100,000 CFS. The headwaters of Passage Creek a tributary of the North Fork, provides drainage for the western area of the county.

The waters of the Shenandoah River reach 20 feet over normal levels about every five years and over this amount about every 10-16 years. Management of development within the 100-year flood plain would be appropriate. **(Exhibit 9)**

Development in the flood plain hinders the already poor drainage in such areas, increases the chance of flooding downstream and results in extensive property damage. By allowing these areas to remain in their natural state, stream valleys will absorb a large portion of the rainfall, replenish the ground water supply and release the storm water into the streams at a more gradual rate.

3.5.2 Surface Water Resources

Approximately 4,600 residents use public water systems with a surface and spring water supply.

According to reports in the mid-seventies, noticeable traces of deadly mercury (released decades ago upriver by the Dupont Plant at Waynesboro) raised concerns over the South Fork's water

quality. Today, the amount of mercury in the water and sediments results in health advisories against eating fish from the river. Although reports from the State Water Control Board since 1992 consider the quality of the South Fork's water good, they also cite alkalinity and high levels of nitrates and phosphates. In 1998-99, DEQ reported increases in fecal coliform bacteria levels and the levels of these bacteria remain a problem in the South Fork and many of its tributaries.

There is no current scarcity of usable surface water in the South Fork of the Shenandoah River. However, as the water demand approaches the volume of total flow available, increasing difficulty with water quality and quantity can be expected. Three impoundments created for power generation are located on the South Fork near Luray, Newport and Shenandoah.

Lake Arrowhead is a potential surface water supply reservoir in the county. It is located near and serves Luray as a town park but is not currently connected to Luray's drinking water system.

Page County needs to be aware of development plans in Augusta and Rockingham Counties whose watersheds form the headwaters of the South Fork of the Shenandoah River. Augusta County uses ground

water for all municipal, agricultural and private water sources and is growing much more rapidly than Page County. Rockingham County also uses a large amount of ground water for large agricultural users, some municipalities and for private residences. The City of Harrisonburg has a DEQ Water Withdrawal Permit #98-1672 for using up to 8.0 MGD (million gallons per day) from a South Fork water intake facility near McGaheysville. Because ground water provides the base flow of Valley streams, this upstream development will eventually result in lower flows in the South Fork during drought conditions. Extreme low flows in the South Fork may limit the viability of recreational uses such as river outfitters and fishing guides.

Virginia has required all localities to develop Water Supply Plans that include drought management options. Page County decided to meet this requirement by working with the Northern Shenandoah Valley Regional Planning District Commission which serves Clark, Frederick, Page, Shenandoah and Warren Counties, which jurisdictions are mostly downstream from Page County. Page County would be wise to also coordinate Water Supply issues with the Central Shenandoah Planning District which serves Augusta, Rockingham and the City of Harrisonburg.

3.5.3 Ground Water Resources

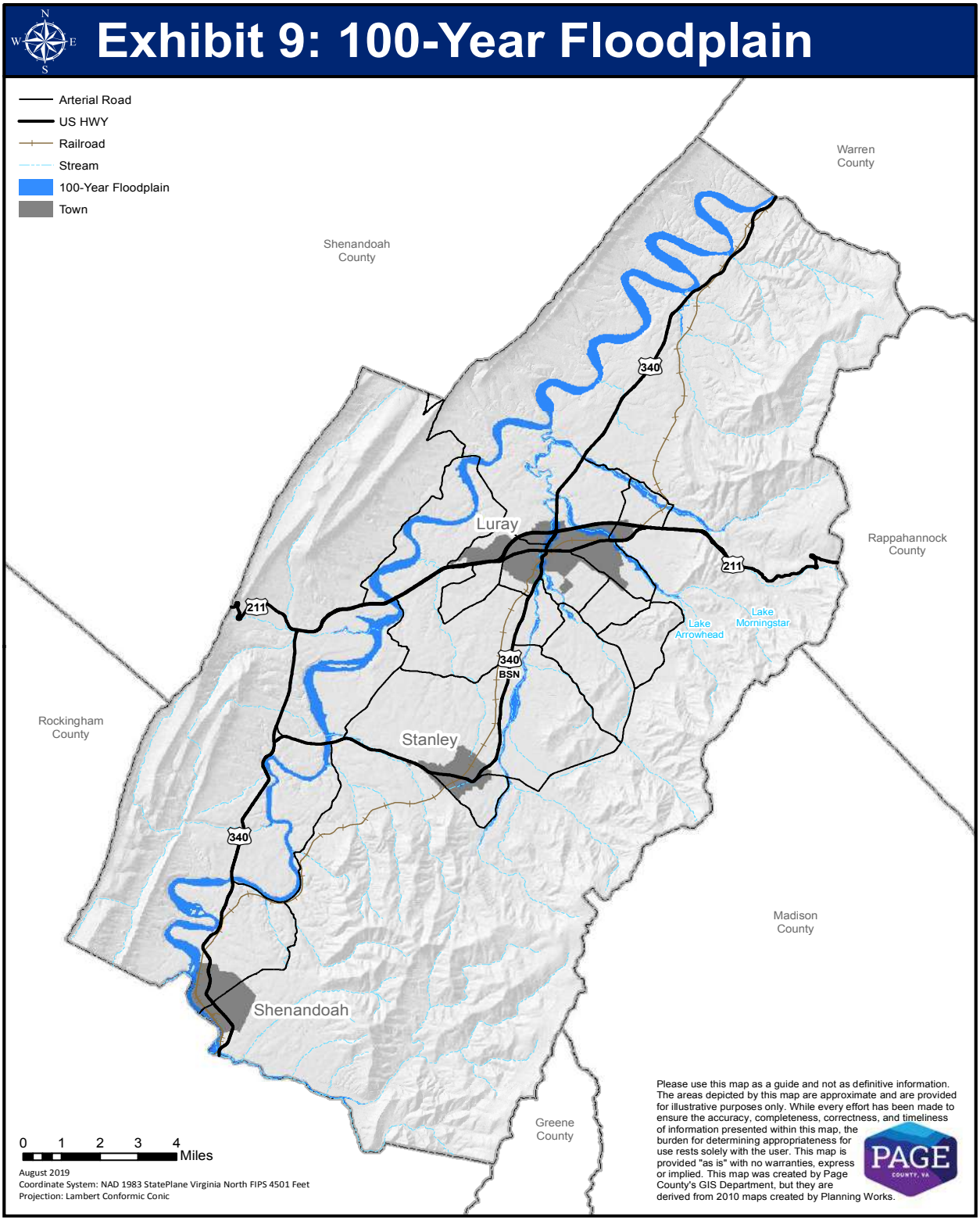
Page County is fortunate to have forests on the mountain slopes surrounding the Page Valley. The forested slopes help to slow precipitation runoff and sediment transport into the valley streams and aquifers.

In the valley's karst geology (sedimentary carbonate rocks such as limestone) surface water and ground water mix frequently. Ground water springs provide the base flow of the streams and rivers, while relatively thin soils and sink holes allow surface water to enter the ground water. The result of these conditions is that the Page Valley has significant quantities of good quality ground water that can be easily influenced by the way we use the valley's land surface.

Ground Water studies by the US Geological Survey and the Friends of the Shenandoah River show that the concentrations of nitrogen compounds are increasing in the Karst geology aquifers of the Shenandoah Valley. Nitrate and nitrite levels are still below levels that the US EPA regulates for drinking water, but we need to find ways to reverse this trend. One strategy that is being employed by the US Department of Agriculture, Virginia Soil and Water Conservation Districts and Virginia Cooperative Extension agents is promoting practices that farmers can use to make more efficient use of fertilizers.

About 5,500 residents use municipal water supplies with ground water sources. The remaining residents draw ground water from individual wells. Ground water quality is commonly hard to very hard (a measure of calcium and magnesium) and can have a high concentration of iron and nitrate. Many of the geologic formations with the highest potential ground water yields underlie the center of the county. Public officials and citizens should be aware of the great pollution hazard to ground water in the Karst topography of the limestone and dolomite formations under-girding the center of the county.

Exhibit 9: 100-Year Floodplain



The volume of water stored in the ground is many times greater than in the surface bodies. Only two geologic formations, the Beekmantown and the Shady, can be considered as important sources of ground water.

Three sections of Page County are described below in relation to ground water characteristics:

1. Eastern Section

   Because the igneous and metamorphic rocks along the crest and west slope of the Blue Ridge are fairly impermeable, wells drilled there generally have low yields. Most of the wells along the west slope of the Blue Ridge are from 50 to 300 feet deep. About half of the wells in this area have yields ranging from 0 to 10 gallons per minute (gpm), and about one-third yield 10 to 35 gpm. These wells produce sufficient water for domestic use. In the Skyland area, wells that penetrate the Swift Run formation between Little Stony Man and Bushytop generally have good yields.

2. Central Valley

   The wells in this area tend to be deeper than those in the eastern section, ranging from 60 to 600 feet. Of the 76-recorded wells in this area, most yield less than 10 to 20 gpm. Five have yields greater than 100 gpm. The water from most of these wells is hard due to the limestone geology.

3. Western Section

   The wells in much of this area are fairly shallow (75 to 100 feet deep) and generally yield less than 10 gallons per minute. However, along the eastern front of the Massanutten Mountain, wells in deep gravel yield from 10 to 20 gallons per minute. The water is generally soft. Wells in the sandstone and shale of Massanutten Mountain are generally less than 75 feet deep and furnish enough water (3 to 5 gpm) for domestic use.

3.5.4 Policy Implications of Ground Water Characteristics

Two major factors influence the use of ground water in the county. The first is the absence of major water-bearing rock formations over much of the land area. The few good aquifers present significant limitations to a future land use pattern of scattered development.

The second factor is the presence of Karst topography in the areas of the greatest ground water yields. As noted on pages 32 and 33, carbonate rocks have numerous open channels from the surface (sinkholes) that connect to an underground stream network. Sinkholes are the primary access for the recharge of ground water into the network. The presence of septic tank systems draining directly into the bedrock and the sub-surface streams, or any activity that pollutes this recharge, could affect a large land area.

Ground water pollution caused by industry, scattered developments, and run off from dense development will increase the future potential for ground water deterioration. Increased development throughout the county will

increase the problems of storm water management and non-point source pollution. Agriculture, forestry, recreation, and low-density development pose minimal danger to the groundwater resources in areas of limestone and dolomites. Industry and urbanization pose high risks of ground water contamination.

Stronger Policies should be developed for storm water management, flood and erosion control, riparian buffer zones and on-going surface and groundwater management. Preservation of the county's water quality is recommended through local adoption and use of the State's Water Quality Best Management Practices Handbooks, and compliance with the State Water Control Board's standards and regulations, the Page County Sedimentation, and Erosion and Storm Water Controls.

In addition, all prospective land uses should be examined and evaluated against the degree to which they may pollute groundwater resources. Those that have the highest potential for pollution should be prohibited or carefully regulated. It is wiser and less costly to guard against contamination of the ground water resource in the first instance than have to engage in long, expensive rehabilitation measures after the damage has been done.

3.6 Climate and Air Quality

Climate and air quality have influenced land use in the county in several different ways. The length of the growing season, the normal temperatures and precipitation conditions encourage the growth of a wide variety of crops. The county's cooler annual average temperatures (54.8 degrees versus 57.5 degrees in the Washington Metropolitan area)[3], natural beauty of the mountains and vast wooded areas attract tourists and second-home residents. Future emissions from industrial development and greater traffic will increase the potential for air quality deterioration and health risks.

3.6.1 Climate

Page County has a modified continental (four seasons) climate. The Blue Ridge and other Appalachian Mountain ridges modify the effects of storms and air movements and lower temperatures in their vicinity. Average weather factors in the county include an annual precipitation of over 42 inches an average seasonal temperature variation of between 34 degrees in January and 74 degrees in July[3] and prevailing winds from the south to southwest at 8 miles per hour. About 18 inches of snow fall annually in the valley and twice as much at higher elevations. Based on average dates of the last freeze in the spring and the first freeze in the fall, the growing season is about 185 days. The trend in the past 20 years has been a gradual lengthening of the growing season and more variability in annual precipitation.

Floods, drought, and damaging storms occur periodically. Flooding can occur in any month, but happens most frequently in early fall from tropical storms and during late winter from a combination of precipitation and snow

[3] Golden Gate Weather Services, © 2011, Climate Normals 1981-2010 (http://ggweather.com/normals/VA.html#P)

melt. Thunderstorms and low-pressure movements not associated with hurricanes or tropical depressions are the most common types of damaging storms. However, they may not be the most severe or costly storms.

3.6.2 Air Quality

Monitoring by Shenandoah National Park at the Big Meadows air quality monitoring station has been the primary source for air quality data. Virginia Department of Environment Quality also collects air quality data at the Luray-Page airport. Concerns over threats to air quality in Page County have surfaced in recent years. Air-born contaminants are believed to be partly responsible for the pollution of some surface and ground water sources in the county. Major emissions sources impacting the park are found in the Ohio River Valley, northeastern West Virginia, southwestern Pennsylvania and central and eastern Virginia.[4] Emission sources within 125 miles cause greater visibility and acidic deposition impacts at the park on a per ton basis than the more distant sources.[4]

Shenandoah National Park has seen improvements in air quality attributed largely to the 1990 amendments to the Clean Air Act. While most of the data still warrant significant concern, most trends are improving.

Visibility is a measure of how far we can see varied scenes in detail and color. Visibility is impaired by particles in the atmosphere. These particles come from both natural and human caused sources (such as dust, vehicle and power plant emissions) and they scatter and absorb light, creating a haze that obscures scenery. Skyline Drive provides an array of views that are often obscured by haze. The haziest days usually occur during the summer months and clearest days in the winter.

Ammonium sulfate particles are responsible for most of the haze in the Shenandoah region. Ammonium nitrate and organic carbon particles are the next largest contributors to haze. The current visibility condition at the park warrants significant concern but is showing an improving trend. The haziest days are becoming clearer and the clearest days are slowly improving. While conditions are improving they still have a way to go to achieve real natural conditions.

Since the Shenandoah National Park began monitoring the Park's air quality in the 1980s their findings point to some harmful effects generated by deteriorating air quality.

[4]Assessmentt of Air Quality and Related Values in Shenandoah National Park, May 2003

Increased Ground-Level Ozone Levels

Exposure to unhealthy levels of ground-level ozone reduces lung function, aggravates asthma, increases the severity and incidence of respiratory infections, and decreases exercise capacity.[5] Between 1990 and 2014 ozone continued to be higher than 70 parts per billion (ppb) per hour on many summer days. The Park's Air Quality from 1997 – 2014 did not meet the 8-hour ground-level ozone standard set in 1997 by the U.S Environmental Protection agency to protect public health and welfare. The portions of the Park that are in Page and Madison Counties were designated as non-attainment zones under the 8-hour ozone standard in 2004. Under the 1977 amendments to the Clean Air Act, Shenandoah National Park is designated as a Class I area and as such it is afforded the greatest degree of air quality protection.

The Virginia Department of Environmental Quality (VA-DEQ) has responsibilities to regulate air emissions and achieve compliance with the Clean Air Act in Virginia. The Class I designation and the non-attainment area status can influence the allowable quantity and type of air emissions from any new air emissions sources that would significantly influence air quality in the park.

Although daily maximum 8-hour average ozone levels at the Luray-Page Airport Ozone Monitoring Station did not exceed 80 ppb in 2004 (highest value 79 ppb), ozone 8-hour average levels did exceed 80 ppb in 1999, 2001 and 2003.[6] However, as of 2016, Shenandoah National Park and the Page Valley meet the National Ambient Air Quality Standards (NAAQS) human health standards currently set by the EPA at 70 ppb of ground level ozone.

In humans, ground level ozone can irritate lung airways, causing sunburn-like inflammation, and can induce symptoms such as wheezing, coughing, and pain when taking a deep breath. Although people with existing respiratory problems, such as asthma and emphysema, are most vulnerable, young children and otherwise healthy people can also suffer respiratory problems from ozone exposure. Scientific studies have shown that even at low levels, ozone can trigger breathing problems for sensitive individuals.

Because of these local conditions and the Park's Class I designation and non-attainment area status, air quality impacts should be considered when planning development and recruiting industries to Page County. In addition, the county should work cooperatively on a regional basis to improve air quality.

[5] "Health Effects of Outdoor Air Pollution", Am. J. Respir. Crit. Care Med. Vol. 153, pp.3-50, 1996

[6] Ambient Air Monitoring Report, DEQ, August 2005

Vegetation Damage

Ozone's interference with photosynthesis reduces the growth rates of plants and weakens the ability of plants to withstand pests and disease.[5] Ground level ozone has been determined to slow the growth of several species of trees[3] and to reduce crop yields.[5]

Reduced Visibility

The view shed from the park has declined 80% over the past 80 years from about 115 miles to 23 miles.[6] Under natural conditions, atmospheric water vapor scatters light and reduces visibility. This water vapor induced natural haze gives the Blue Ridge Mountains their name. The increased haze developed over the past three-quarters of a century stems from sulfates and nitrates attaching to the water molecules that then become more effective in scattering the light.

Variations in the concentration of atmospheric ammonium sulfate causes the seasonal variations in visibility and the poorest visibility occurs in the summer.3 Between March 1998 and February 2000 the haziest 20% of days showed a moderately improving trend. Coal burning power plants are the most significant source of the pollution causing this problem.5 Changes in regulations in the Clean Air Act and changes in electricity generation using less expensive natural gas instead of coal have helped clean up the air. There is still much work that needs to be done but recent trends are encouraging.

Stream Acidification

When sulfate and nitrate particle emissions from old coal burning power plants, transportation vehicles and other sources combine with water molecules, the result is acid rain. As of 1997, the rate of acid deposition in Virginia's mountain streams was among the highest in the country.[7] Because of the underlying bedrock with low acid buffering capacity, many streams in Shenandoah National Park are moderately to extremely sensitive to acidifying effects of acidic deposition.[8] DEQ has listed two Page County streams, Rocky Branch and Jeremy's Run, as impaired due to excessive acidity.

By 1993, 50 percent of Virginia's native brook trout streams had reduced capacity to host trout populations due to acid rain, and 6 percent were incapable of supporting trout or other fish populations because of their chronic acid state.[9] Severe reductions in acid deposition will be required to preserve Virginia's native brook trout streams.[10] Concentrations of Sulfur have decreased at Big Meadows over the past 15 to 20 years and currently are about 3.4 kg/hectare/year.[3] 2016 nitrogen deposition has declined slightly at Big Meadows and is

[7] U.S. EPA, National Air Quality and Emissions Trends Report, 1997

[8] Resource Brief: Acid Rain: Progress and Problems Shenandoah National Park, National Park Service, Department of Interior, August 2017

[9] A.T. Hurley, et al, *The Effects of Acidic Deposition on Streams in the Appalachian Mountain and Piedmont Region of the Mid-Atlantic Region of the United States*, Water Resources Research. August 1993

[10] Art Bulger, et al, *Acid Rain: Current and Projected Status of Coldwater Fish Communities in Southeastern U.S. in the Context of Continues Acid Deposition*, Trout Unlimited, July 1998

estimated at 4.9 kg/hectare/year, but needs to decline to less than 1 kg/hectare/year to protect sensitive ecosystems.[6] Despite significant emissions reductions, acidic deposition continues to impact Shenandoah NP. Fortunately, when the acidic streams leave the mountains and mix with the carbonate geology of the valley, acidity decreases as the pH levels increase. Unfortunately, the warmer water of the Valley Streams is mostly too warm to support native brook trout year round.

3.7 Critical Environmental Areas

In 1972, the Virginia General Assembly directed the Division of State Planning and Community Affairs to define and locate those land areas that – because of location, physical features, historical character, natural production, scenic significance, or unique animal or floral life – contribute to the well-being of society and that, because of their particular qualities, are in limited supply.

Two general locations in Page County were noted and should be protected as critical environmental areas by criteria noted in the study. The first area designated was the South Fork of the Shenandoah River in Page and Warren Counties. This scenic and natural area contains pastoral scenery, forests and cliffs. It has extraordinary potential for recreation and wildlife habitats. The second critical area designated was The Massanutten Mountain Range in Page, Shenandoah and Warren Counties. This mountain range is a unique geologic formation under intense pressure for development. It is partially government-owned by the US Forest Service.

Designation of criteria for and the selection of critical environmental areas does not complete the task. Standards should be developed for controlling development in these designated areas and buffer zones established to protect these areas.

3.8 Policy Implications of Natural Resources on Economic and Development Potential

The county's, natural resources provide scenic beauty in abundance. Page County attracts many tourists interested in seeing the scenic beauty and many historic and natural attractions located in this area. These tourists provide economic benefits to the county. Shenandoah National Park policy supports the retention of Page County's rural character as an essential component of the scenic Page Valley view shed enjoyed by the 1.6 million tourists who visit the Park annually.

Some of the county's many tourist attractions include Shenandoah National Park, The George Washington National Forest, Luray Caverns, the Shenandoah River, historic sites, and the towns of Luray (The Luray-Hawksbill Greenway), Stanley (the Hawksbill Recreation Park) Shenandoah (Big Gem Park) and Shenandoah River Park. Activities available in the county include canoeing, hiking, horseback riding, biking, hunting and fishing. Bed and Breakfasts, short-term rental cabins, motels, hostel and local restaurants provide accommodations for visitors. Lists of available activities and accommodations are available through the Luray-Page County Chamber of Commerce (540-743-3915). The scenic beauty and accessibility of these areas, however, also attract recreational home development. Greater

access and better roads to major metropolitan centers to the east are combining to exert strong pressure to develop scenic parts of the county.

As discussed above under specific natural resource components, natural resources also bring development constraints. In the east and west much of the land adjacent to the Blue Ridge and Massanutten Mountains

has considerable development constraints. These constraints include excessive slopes, unsuitability for on-site sewage disposal, shallow depth to bedrock, seasonal high water tables, inadequate ground water resources, and flood-prone areas. In the center of the county, areas of severe development restriction are

found along sections of the Shenandoah River and throughout the valley lowlands where Karst topography predominates and flood-prone areas are numerous. Because of these constraints, approximately 57 percent of the land in Page County is not suitable for development.