Chapter Four
4.0 ENVIRONMENTAL RESOURCES

GOAL: To ensure a continued high quality environment for residents of Pennington County and seasonal tourists through the preservation and conservation of all of the County's natural resources.

POLICIES:

1. Retain runoff with open natural drainage systems.

2. Carefully review development on steep slopes, any slopes exceeding 15% grade.

3. Limit development in areas with poor soils and high water table.

4. Protect areas of special flood hazards along creeks, rivers, ponds and lakes.

5. Carefully review development over the Madison Aquifer area to determine that soils are adequate for on-site wastewater disposal systems.

6. Design subdivisions and other improvements around significant wetlands.

7. Promote greenways and linear open spaces within floodplain areas.

8. Protect water quality and ensure an adequate quantity for existing and future development.

9. Support local initiatives for fire control and prevention, establish fire prevention requirements and standards for development within forested areas.

10. Encourage wise forest management to protect the forest from insect, disease, wildfire and noxious weeds.

11. Protect wildlife corridors and habitat areas.

4.1 Introduction

The natural environment of Pennington County consists of over 2,700 square miles of land and water surfaces and provides residents and visitors opportunities for open space enjoyment and a scenic back drop in which to live or visit. The natural environment must be considered when developing and managing land. As natural resources become more scarce and endangered, it is critical that environmental issues be addressed in the land use decision-making process to ensure that even greater problems and costs are not passed on to succeeding generations. Management of ground and surface waters, wastewater,

wetlands, and storm water runoff should be important considerations in the development review process.

Determining resource availability varies with the resource. Timber, for example, is a natural resource that can be seen. We know how much is there, the approximate quantity of board feet. Proper resource management includes thinning to provide for better growth and fire protection. The abundance of mineral resources, on the other hand, cannot be as readily determined. Exact quantities available are not known. Water resources change periodically with weather patterns. Times of severe drought can change the availability of ground water.

In the past, poor or no planning has lead to significant environmental problems, such as drainage issues in the Rapid Valley area. For example, Pennington County has invested considerable time and resources attempting to correct and manage drainage issues in the Rapid Valley area. The quality of the environment can be eroded in many ways including the destruction of natural features such as drainage ways and wetlands during development, runoff of chemicals and fertilizers from farms and residential homes into lakes and streams, and improper treatment of human and animal wastes. The potential for hazardous waste spills and leaks exists and could cause extensive damage to Pennington County's natural resources. The general public has recognized the importance of the benefits of clean water and air, access to outdoor recreational opportunities and the cost saving measures that avoid mitigation of environmental impacts, such as flooding.

4.2 Water Resources

Available sources of water are derived from two basic categories, groundwater and surface supply. Groundwater supplies are those obtained from subsurface bedrock formation. Surface supplies include rivers, tributaries, streams, lakes and artificial reservoirs.

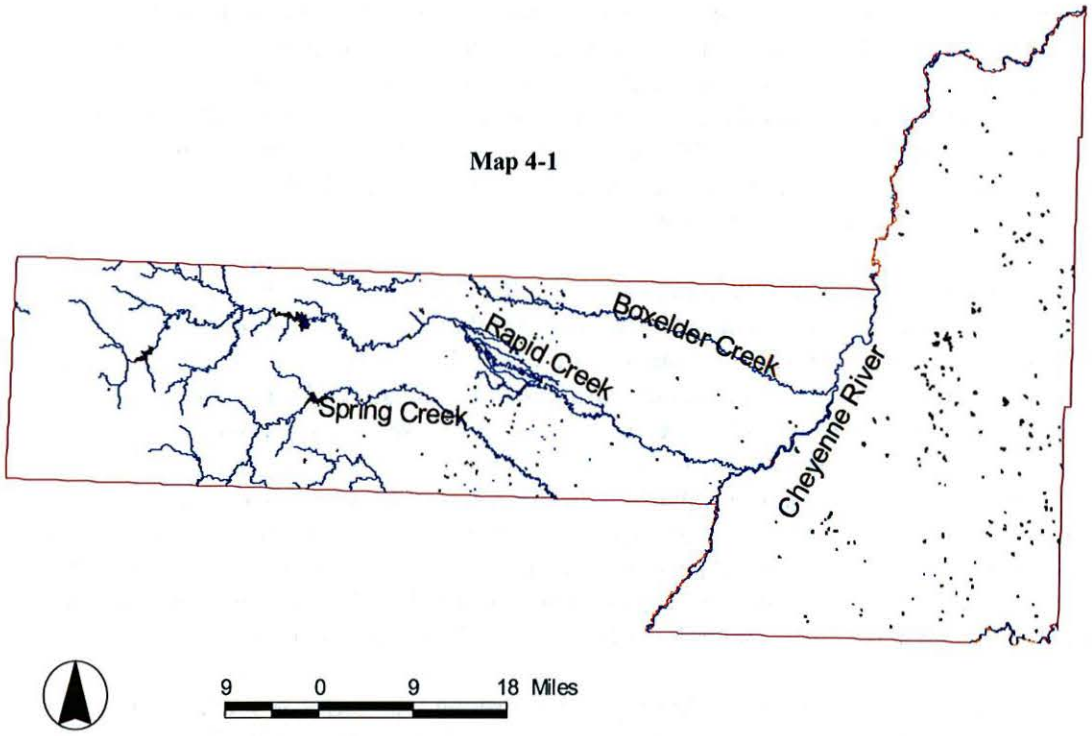
Pennington County is drained by the Cheyenne River and its tributaries: Spring Creek, Rapid Creek, Box Elder Creek and Battle Creek. The Cheyenne River begins in Wyoming, flows around the southern Black Hills and then turns and flows toward the northeast where it empties into the Missouri River north of Pierre. The Cheyenne River has a highly variable stream flow, regulated by Angostura Reservoir, with an average discharge of 267,000 acre-feet per year near Wasta.

Most of the creeks and small streams which drain the Black Hills and surrounding prairie flow in direct response to rainfall with many of their channels running intermittently throughout the year. Though the streams of the Black Hills have less variation than the prairie streams, both flows follow the rain pattern with greatest runoff during April, May and June.

There are three major reservoirs located in Pennington County. Pactola, Deerfield and Sheridan Reservoirs were all formed of earth and rock filled dams in the Black Hills and

have a combined surface area of 1,669 acre with a total capacity of 83,610 acre-feet. The primary purpose of these reservoirs is for flood control; however, they also provide recreational opportunities, irrigation and municipal water supplies. The prairie areas east of the Black Hills are dotted with hundreds of small reservoirs that provide water for livestock, fish and wildlife.

Map 4-1



Groundwater constitutes a large and reliable source of water for domestic, stock and municipal use in the County. Depths of wells range from 100 feet to over 2000 feet. Most of Pennington County is underlain with one or more aquifers yielding various amounts of water of varying quality. While not all of the rock formations discussed here may be major water suppliers for the County, each produces a certain amount of water and must be considered a source. There are several aquifers within Pennington County that are capable of supplying sufficient quantities of water that could support municipal and industrial growth. These are the Deadwood, Madison, Minnelusa, Minnekahta, and Inyan Kara aquifers. The Precambrian rocks can also provide water under local conditions due to secondary porosity brought on by weathering and fracture systems.

The underlying Precambrian rocks, often referred to as the Precambrian basement, have low permeability and serve as the confining layer for the overlying sedimentary aquifers. Localized wells within the Precambrian rocks vary in depth from about 5 m (18 ft) to about 265 m (870 ft). The water levels vary from less than 0.6 m (2 ft.) to over 149 m

(488 ft) below the surface[1]. Above the Precambrian basement lays the Deadwood aquifer, which is made up of sands, gravels, shales, and conglomerates. This aquifer serves domestic and municipal uses near the outcrop area. In localized areas there may be connections between the Deadwood aquifer and the Precambrian rocks, however this is generally not the case. Above the Deadwood Formation is the Whitewood and Winnipeg Formations. They can also have connection in local areas with the Deadwood aquifer, and can therefore produce sufficient water to local areas. Although these formations can produce water locally they are not considered aquifers regionally. They generally act as a semi-confining layer for the Deadwood aquifer. The Englewood Formation can be in contact with the Deadwood aquifer when the Whitewood and Winnipeg Formations are not present. Many geologist include the Englewood Formation as the lower part of the Madison aquifer.

The Madison aquifer is mostly contained within the upper karstic portion of the Madison (Pahasapa) Limestone, but generally also includes the underlying Englewood Formation. The Madison aquifer consists of a massive dolomitic limestone and the base is a lavender limestone created by the Englewood Formation. Caverns, sinkholes, and fracture sets consistent with karst solution features provide extensive secondary porosity, which is the primary recharge mechanism for the Madison Aquifer. The overlying Minnelusa Aquifer is generally in contact with the Madison Aquifer, however where shales and evaporites are present the Minnelusa Formation acts as a confining layer over the Madison Aquifer. The Minnelusa is diverse in the type of rocks that make up the formation. It consists of sandstones, dolomite, gypsum and shales. The Opeche shale lies on top of the Minnelusa Formation and acts as a confining layer between the Minnelusa and Minnekahta aquifers.

The Minnekahta Formation is a thin-layered limestone that varies in thickness from area to area. This variation in thickness affects the water that can be yielded from the aquifer. Mostly the aquifer provides water for domestic use in areas where the formation is thicker. The confining layer for the Minnekahta Formation is the Spearfish Formation, which separates the Minnekahta Aquifer from aquifers contained within the Inyan Kara Group. Aquifers within the sandstones of the Inyan Kara Group are used extensively, where aquifers in other parts of the formation are generally limited to local regions.

Most sedimentary layers within the Black Hills area serve as whole or in part as groundwater aquifers. They gain the largest percent of their recharge from precipitation and stream flow over the outcrop areas. They may also gain recharge from hydraulic connections with other aquifers to a lesser extent. Aquifers within Pennington County and the Black Hills area are extremely sensitive to human influences, which include mining, ranching, septic systems, forestry practices, residential growth, and industrial development. Human influences have been directly linked to increased nutrients, phosphates, and sediment loading that have changed the water quality within the Black Hills Region. Metal concentrations are higher in the northern and central portions of the Black Hills. Dissolved-constituents in the ground water that is used for drinking water

[1] Hydrology of the Black Hills 2000.

remains within EPA contaminant and secondary contaminant levels, however sulfates within the water have exceeded these levels.

Water Protection

The quality of water, either ground or surface, depends upon several factors such as dissolved solids, sediment and pollution. Both dissolved solids and sediment are influenced by climate, stream flow, geology and topography. With these variables, surface water is highly responsive to change. Typically the surface water in the Black Hills is subject to less sedimentation as this area is composed of granite and metamorphic rock, which is resistant to erosion. In the area east of the Black Hills, most sediment is transported during spring and summer thunderstorms.

Other pollution such as domestic, municipal and industrial waste can severely lower water quality in the County. With the exception of headwaters, nearly every stream is affected by pollution. Increased pollution may be noted as a stream passes a community or dense rural development where it is used as a drain for the sewage system. The aquifers and streams are at risk of contamination by a variety of sources – inadequate wastewater treatment and disposal attributed to both on-site and municipal sources, mismanagement of waste from agricultural facilities, overuse of fertilizers and pesticides, and solid waste sites.

Aquifers and shallow ground waters are easily polluted by many sources and must be considered in any water pollution control program. Preventive measures are most essential in preserving groundwater since an aquifer does not recover for many years from pollutions due to the slow movement of waters underground. During 2001 and 2002, Pennington County has investigated implementing a ground water protection ordinance. The proposed ordinance was not adopted.

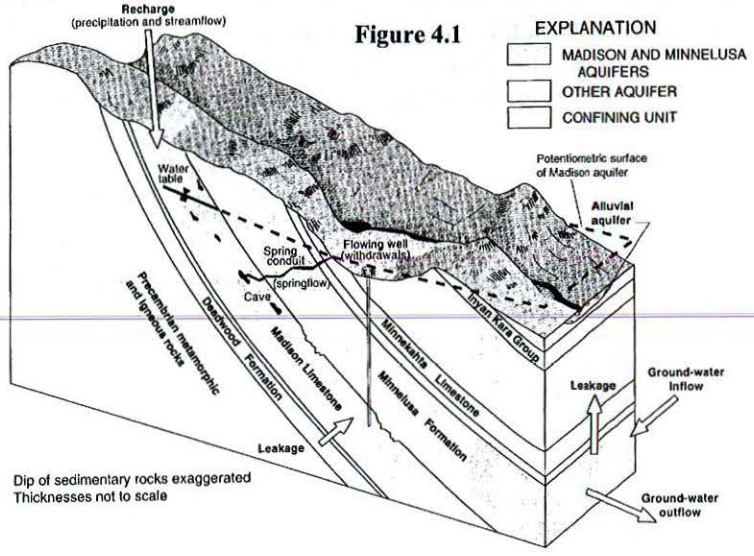


Figure 4.1

4.3 Flood Plain Areas

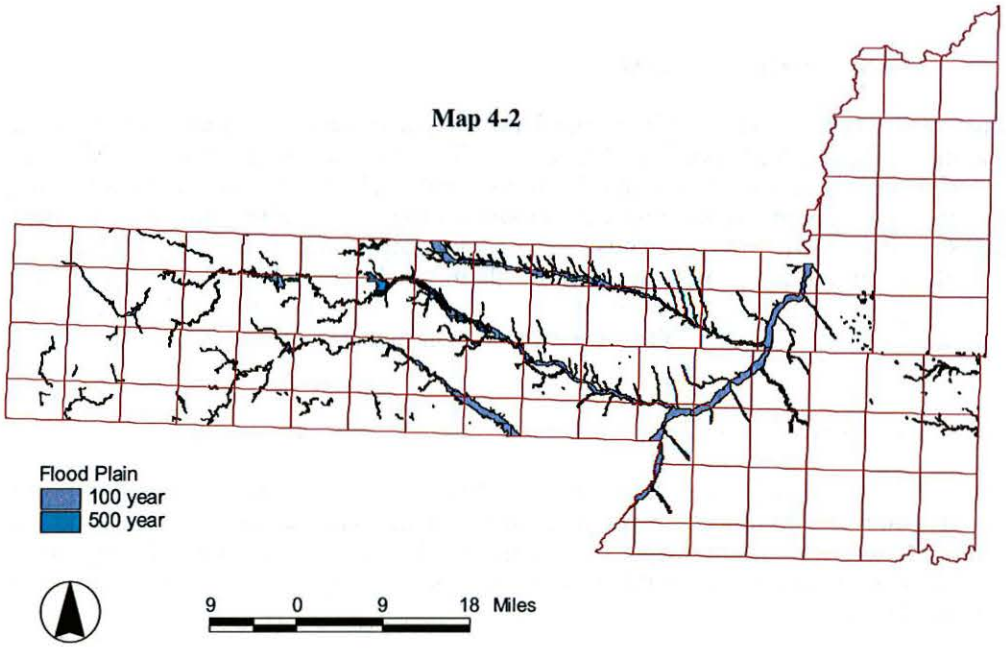
Pennington County has significant areas of flood hazard. The 1972 Flood serves as a poignant example of the danger flooding poses to the public. The steep and varied terrain in Pennington County has the potential to cause significant damage during storm water runoff. As a result new and existing development needs to consider the overall effects of storm water runoff both on site and downstream of the specific site.

Flood plains are lowlands adjacent to the channel of rivers, streams and other watercourses where inundation periodically occurs due to extreme natural events. Unaltered flood plain systems reduce flood velocities and flood peaks by providing space for the dispersal and temporary storage of flood waters until natural drainage can carry away the water. One acre of flood plain inundated to a depth of one foot can store approximately 325,000 gallons of water.

Aquifers underlie many of the flood plains in Pennington County. These aquifers benefit from the natural infiltration, purification and groundwater recharge. Flood plains have been historically tied to the settlement of the Black Hills for it was within the many creeks that gold was first discovered. Flood plains also offer varied landscapes, productive wetlands, fertile soils, wildlife habitat, and valuable historic features in the County. Settlement patterns have historically been influenced by rivers and creeks, which provided transportation, drinking water and commerce. Encroachments into the flood plain, however, threatened life and property and often waterways became disposal system for human and industrial waste.

The Federal Emergency Management Agency (FEMA) has development maps which indicate areas of specific flood hazard. These maps represent some of the main creeks, rivers and drainages than can produce flooding conditions under certain storm and runoff conditions. While these maps are not perfect, they do serve as a general guide to the areas of flood hazard found within Pennington County. While it is not possible to include the 80 plus maps with this Comprehensive Plan, a map showing the general location of the areas of flood hazard has been included.

Map 4-2



Pennington County maintains eligibility in FEMA's National Flood Insurance program by enforcing the Flood Damage Prevention Ordinance. Participation in the program enables residents of flood plain areas to purchase special insurance at subsidized rates. The ordinance requires the lowest floor of residential structures to be constructed to the base flood elevation. Construction, which includes fill, is prohibited unless engineering certification demonstrates that the activity will not result in an increase of flood levels.

4.4 Soil Resources

Soils are often not considered a resource, however once depleted, they can not easily be replaced. To prevent the loss of soil resources, proper planning to promote land use patterns that conform to modern soil conservation practices should be considered. The selection of sites for various uses such as residential development, agricultural uses and commercial or industrial uses all should consider soil properties and tendencies.

With a county as large as Pennington County, there are many variations of soils. The following is a description of the major soil types located in Pennington County. The attached exhibit shows the general location of the major soil groups in Pennington County. In addition a brief description of each soil follows.

In describing the soils, several symbols are used that need some explanation. ML refers to silty soils with low water content; ML-Cl to Cl refers to soils that are silty-clay to clay soil with low water content; SM refers to sandy silty soils; CH refers to clay soils with a high water content; and CL is a clay soil with a low water content.

Rough Mountainous Land

Most of the area would be ML in the Unified Classification Scheme for soil materials. The limestone areas are possibly ML-CL to CL. There are local areas of SM where soil materials are from sandstones and the more sandy schists. On-site wastewater disposal systems may be suitable in most valleys and on the lower valley side slopes where soils are formed in loose stony detritus. The rocky ridges and points are severely limiting because of topography and the shallow depth to hard rock. The recharge rate into shallow groundwater in the core of the Hills is relatively rapid and contamination of groundwater is quite possible. Permeable soil materials limit suitability for lagoon systems.

Haverson Association

These are alluvial soils subject to flooding. Shallow water tables are found in portions of Rapid Valley. The alluvial soils range from loamy sand along the Cheyenne River to clays. On-site wastewater disposal systems may be suitable in loam to loamy sand areas, but shallow groundwater could be contaminated. Clay alluviums in some areas are suitable for lagoons.

Pierre Samsil Association

Shallow to deep clays mostly with CH and some CL. The slow permeability and depth to shales less than six feet in most areas severely limits on-site wastewater disposal systems. Slight to moderate limitations for lagoons; unstable fill material.

Caputa-Farmingdale Association

Loamy to clay-type soils formed in ancient alluvium of varying thickness, mostly more than six feet over shale. This soil type has moderate to severe limitations for on-site wastewater disposal systems, but more favorable than the Pierre-Samsil association. Slight to moderate limitations for lagoons, moderate permeability.

Ree Association

Loamy soils formed in old alluvium over sand and gravel mostly at depths of three feet or more. Near Scenic there are some areas of SM in upper three feet. There are only slight limitations for septic tank fields with some chance of polluting shallow groundwater. Lagoon suitability ranges from not suitable to materials requiring a seal blanket.

Morton-Bainville-Regent Association

This soil type poses moderate limitations for on-site wastewater disposal systems and lagoons with variable depths to underlying loamy to clayey fields. Seal blanket needed in most areas for lagoons.

Penrose – Menniqua Association

This soil type has moderate to severe limitations for on-site wastewater disposal systems. There are slight to moderate limitations for lagoons.

Samsil-Pierre Association

The slow permeability, shallow depth to clay shale, and rough broken topography severely limits suitability for on-site wastewater disposal systems and lagoons. Generally these soils are not satisfactory for on-site wastewater disposal systems

Badlands Association

Except for a few sandy to loamy mesas, these soils are not suitable for on-site wastewater disposal systems. Clay filled badland basins in places is satisfactory for lagoons.

Wanblee Association

Slow permeability severely limits on-site wastewater disposal systems. Nearly level clay pan and clayey flats may be suitable for lagoons.

The variety of soils in Pennington County, except for the mountainous and forested areas, generally lend themselves to agricultural uses. As noted, there are several areas that severely limit the installation of individual on-site wastewater disposal systems. For this reason, land use controls and subdivision regulations may require soil testing and regulation of lot sizes and on-site wastewater disposal systems to prevent ground water pollution.

4.5 Slope And Topography

The steepness of slopes or the location of such physical features as mountains and valleys is an important factor in determining the land use potential of an area. While the tops of mountains might provide the best views of the Black Hills or out onto the prairie, the placement of infrastructure to those areas becomes difficult. Several problems arise when considering any development on steep slopes. Road construction and maintenance is foremost. The Pennington County Subdivision Regulations precludes almost all roads exceeding 15% grade.

The influence of landforms on development is readily apparent in the alignment of highways that follow valley floors rather than attempt the crossing of large hills. When looking at a topographic map, it also becomes evident that the physical pattern of development in urban areas is somewhat influenced by the location of hills and valleys. Pennington County will continue to see development requests that involve road construction into steep and rugged terrain.

In order to determine the effect which slopes and land forms have, or will have on the utilization and development of land in Pennington County, it is necessary to identify significant topographic features and then to apply standards of degree of slopes which will give a relationship between land use and slope.

The following slope standard can be used as a guide in reviewing future development requests. For the purpose of analyzing the relationship between degree of slope and land use, a three-category system can be utilized.

Low	0-10% Slope. Suitable for all uses; however, caution should be exercised in the location of commercial, industrial and institutional uses on slopes between 5 and 10 percent.
Moderate	10-20% Slope. Suited for low density residential use, limited agriculture and recreation.
Extreme	Over 20% Slope. Suited only for open space, limited recreational use and grazing purposes.

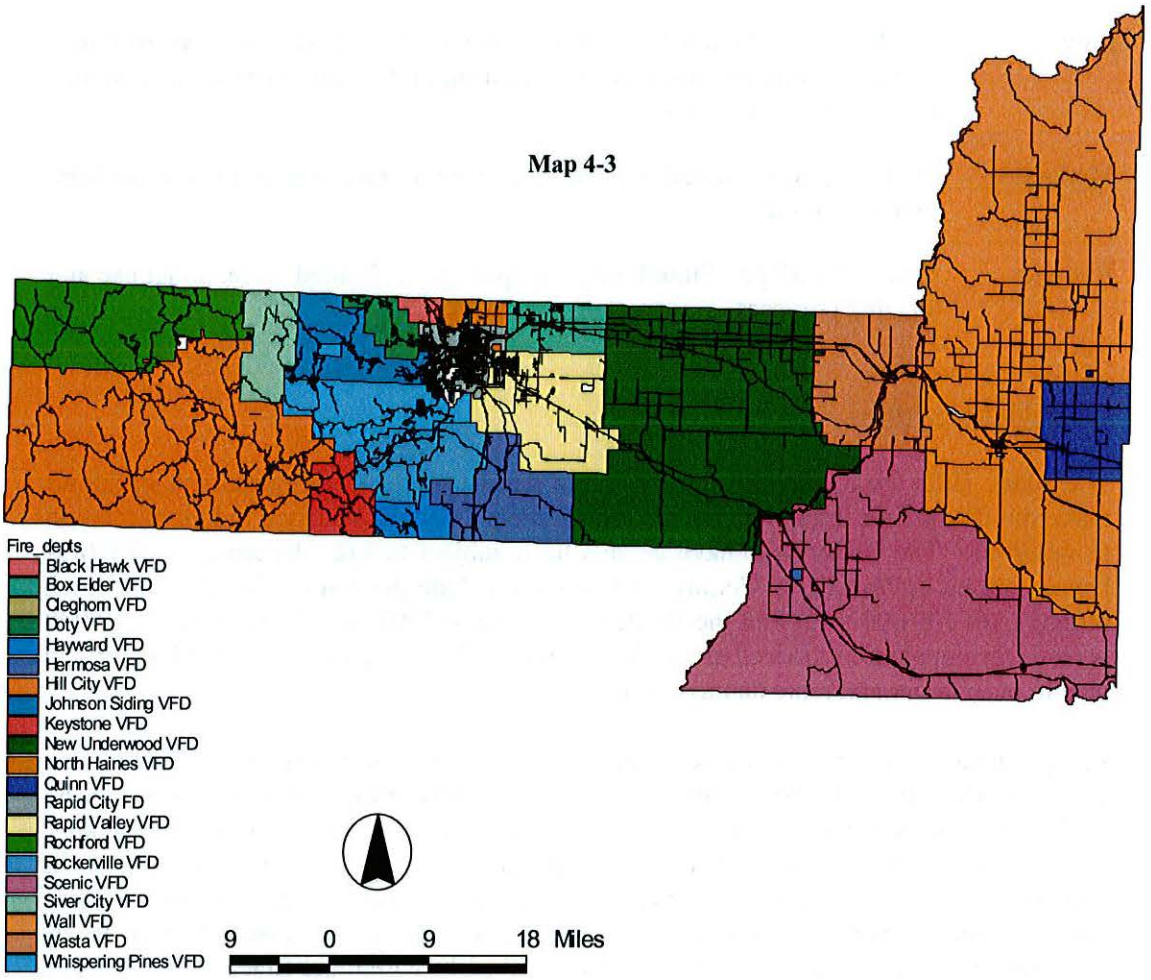
4.6 Wildfire Interface

The Black Hills are a beautiful and desirable place to live. The forests and meadows make the Black Hills attractive, but also make them a dangerous place to live in relation to wildfires. The Black Hills have always been subject to fire. Recently, major fires have occurred in Pennington County. These fires include the Jasper Fire in 2000, which burned over 100,000 acres and the Battle Creek Fire in 2002, which burned over 12,000 acres. Development in forested areas alters the natural ecosystem. Fuels build which can lead to even larger and more damaging fires.

Fire protection in rural, forested developments is not the same as fire protection within a city. Response times to the fire are slower, the road network may not allow easy access to the fire, and substandard roads may not accommodate current fire fighting apparatus. Development in the forested area will continue and efforts should be made to mitigate the fire danger. This effort could include advocating the use of fire resistant building materials and promoting vegetation management. Other ways to promote fire safety are to review new residential and commercial developments within the Black Hills to ensure that the infrastructure is in place to aid in future firefighting efforts. This would include roads that are wide enough to provide for emergency vehicles, roads that are not too steep and the construction of adequate water systems.

The Fire Fighting Districts Map shown as Map 4-3 indicates the major fire boundaries in Pennington County. Development in these areas should consider the impact and ability to fight a major fire within the district. The district maps combined with the road classification and slope information can help initially indicate areas that may require special consideration for road location and grades in regard to fire fighting. In addition, the County may wish to consider requiring developments to meet certain fire reduction goals, such as no wood shake shingles, thinning of timber and defensible space around dwelling units.

Map 4-3



4.7 Wildlife Interface

Pennington County is home to a wide variety of wildlife including elk, mountain lions, bighorn sheep, whitetail and mule deer, antelope, turkey, coyotes, pheasants, grouse and numerous other small animals and birds. Artificial feeding and landscaping practices that cause deer and turkeys to congregate around homes will increase the likehood of unwanted mountain lion encounters.

While Pennington County does not have the well-defined wildlife migration corridors that exist in other western states, care and forethought must be given to the needs and welfare of wild animals when re-zoning and platting large tracts of undeveloped land, especially in the forested areas of western Pennington County. Ideas that should be considered include the clustering of home sights to allow for large areas of undisturbed forest and the use of conservation easements to permanently protect sensitive calving and fawning areas and critical winter habitat.