Soils of Albany County, Wyoming

A Digital County Map at 1:100,000-Scale

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Background

The soils map of Albany County, Wyoming, depicts process-based soil categories found in the county. Representative soils in the mapping units for this map are classified at the family level of soil taxonomy (Soil Survey Staff, 1975; Soil Survey Staff, 1998). Technical soil terminology follows definitions in the Glossary of Soil Science Terms (Soil Science Society of America, 1996). The map was generated primarily for a statewide study of groundwater vulnerability to pesticide contamination. It was designed to assist in the development of an estimated surficial aquifer recharge map and to serve as one of the individually rated layers required within a DRASTIC-based aquifer sensitivity analysis (Hamerlinck and Arneson, 1998).

This map provides a generalized description of soils within Albany County. Soils are highly variable, both on a regional basis (plains, mountains, basins) and locally, with changes in topography (northern versus southern slopes, side slopes versus ridge crest or foot slope positions), vegetation, climate, and geology. The map should be used for broad scale planning and general assessment of large land areas. It should not be used for site specific interpretations such as site selection for an underground fuel storage tank or the development of individual farm field management plans. Site-intensive land use requires much more detailed soils information than is provided at 1:100,000-scale.

The Albany County soils map and the generalized soils maps of the other Wyoming counties are based on the five soil forming factor model first proposed by the Russian soil scientist Doukachev in the 1880s. His model was introduced to American soil scientists by Hans Jenny (Jenny 1941). The five factors of soil formation are soil parent material, climate, biota, topography, and time. As Hudson (1992) pointed out, soil surveying is an activity that conforms well to theories of paradigm-based science. During detailed soil surveys, field mapping is based on the projection of soil map unit concepts onto the landscape, after which map unit composition and boundary placement are subject to immediate field checking in the form of soil pit excavation(s). Often times, generalized soils maps are based on either a process of detailed soil map consolidation or on projection of limited data from direct observation across a broad area using soil-landscape models. In the United States, the model used to describe soil-landscape relationships is most commonly the soil forming factor model.

The maps for this project were prepared using a current understanding of soil-landscape models and available data in the form of published soil surveys, maps, and reports from the Natural Resource Conservation Service (NRCS), Forest Service (FS), and the Bureau of Land Management (BLM), in addition to numerous theses and scientific papers pub-

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lished by the Wyoming Agricultural Experiment Station and the University of Wyoming.

The map scale of 1:100,000 was specified by the Wyoming Ground Water Vulnerability Mapping Project (Hamerlinck and Arneson, 1998). The maps are based on a simplification of the five soil forming factor model. Climate is proxied by elevation and is derived from the 3-arc-second USGS Digital Elevation Model (DEM) for the state. There is a strong relationship between elevation and precipitation in the state, and temperature regimes can generally be characterized by elevation. Vegetation also is closely tied to elevation through its effect on precipitation and temperature. Two temperature regimes are mapped in Albany County: cryic in the higher mountains and frigid in the foothill basins. (See Appendix for definitions of temperature regimes.) There is a third temperature regime (pergelic) at elevations above 10,000 feet in the Snowy Range. Soil parent material is derived from the digital version of the state geology map (Green and Drouillard, 1994) and the state surficial geology map (Case, Arneson, and Hallberg, 1998). Vegetation is inferred from climate, slope, and parent material; time, or soil age, is inferred from elevation and surficial geology. The topographic factor is inferred from elevation, surficial geology, and bedrock geology. The analysis of these layers was conducted using ARC/INFO Geographic Information System software on a Silicon Graphics UNIX workstation.

The boundary between cryic and frigid temperature regimes is at approximately 7,800 feet elevation in Albany County. In mountains, surface age relationships are controlled by slope gradient and glacial history. Slopes with steep gradient (greater than 25 percent) are commonly occupied by Entisols (Cryorthents) and Inceptisols (Dystrocryepts). Glacial deposits of Pinedale age usually are occupied by Inceptisols under forest (Dystrocryepts) and Mollisols under grasslands (Haplocryolls). Soils will be Humic Dystrocryepts above 9,500 feet under alpine turf. Soils in mountain riparian areas are typically Entisols (Cryofluvents) or Inceptisols (Cryaquepts) with small areas of organic soils (Histisols). Glacial deposits of Bull Lake age or older commonly are occupied by Alfisols (Haplocryalfs) under continuous spruce, fir, and pine forest or Mollisols (Haplocryolls) under grassland. Non-glaciated surfaces with gradients less than 15 percent are usually Haplocryalfs under forest or Haplocryolls under grass.

In foothills and lower mountains, steep south-facing slopes are commonly occupied by Entisols (Torriorthents) and Inceptisols (Ustochrepts). Hillslopes under sagebrush and grasses are frequently Mollisols, most commonly without argillic (clay accumulation) horizons (Haploborolls). Where grassland is intermingled with forest, the grassland sites are often on either warmer aspects or finer textured (less rocky) soils. Mountain mahogany (*Cercocarpus montanus*) is a reliable indicator of high, coarse fragment contents and of a deep-rooting environment, albeit in fractured bedrock or skeletal materials.

In foothill settings, Idaho fescue (*Festuca idahoensis*) and Ponderosa pine (*Pinus ponderosa*) are plant indicators of the break between frigid and cryic temperature regimes. Ponderosa pine normally does not reproduce successfully in areas with the cryic temperature regime, while the presence of significant amounts of Idaho fescue in the plant community usually indicates the soil temperature regime is cryic. Cacti grow at high elevations on dry slopes where the aridic moisture regime extends into areas with cryic soil temperature regime. Aspect effects are strong in this elevation zone, and it is not uncommon to have cold Alfisols (Haplocryalfs) on north facing canyon walls matched by noticeably warmer (frigid), dry Entisols (Torriorthents) on south facing canyon walls.

The Laramie Basin presents a mixture of old, tilted sedimentary rock, which is Cretaceous in age or older in bands along margins of basins, along with younger Tertiary (65 million to 2 million years old), Pleistocene (2 million to 10,000 years old) and Holocene (less than 10,000 years old) sediments in the basin interior. The younger sediments show varying degrees of incision by erosion. A quick view of Albany County topographic maps provides ready separation of these two zones. Because basins are drier than mountains, vegetation cover may be limited on some slopes in the basins (many of the south aspects) where plant cover is too sparse to prevent erosion. Associations of soils include Entisols (Torriorthents) on slopes of 15 percent or more and on south and west facing slopes. On low-relief surfaces, the soils will be Aridisols, usually either Haplocalcids, Haplocambids, or Haplargids on most Cretaceous-age parent materials. On Tertiary parent materials high in clay, the soils may be a complex of Aridisols, some of which are strongly affected by sodium (Haplargids and Natrargids). On stabilized sand dunes, the soils are Entisols (Torripsamments). On playas with clayey textures and the frequently associated clay dunes, soils are commonly salt-affected Aridisols (Calcigypsids or Gypsisalids). Soils along ephemeral channels are usually Entisols (Torrifluvents) on surfaces younger than approximately 6,000 years old, with wet Mollisols (Haplaquolls) occurring along streams with permanent high water tables. Early Holocene surfaces are commonly occupied by moderately developed Inceptisols (Haplocambids) or Aridisols (Haplocalcids), depending upon soil texture and source of carbonates. Like many of the high Wyoming basins, the Laramie Basin had permafrost environments during the late Pleistocene, and these old surfaces are often covered with low-relief mounds. The soils are typically Aridisols with clay-enriched subsoils (Haplargids) on intermound areas and Aridisols with only moderate development (Haplocambids) on mound areas. There are several dune fields in the county, along the eastern and southern boundaries of the Laramie Basin. Playas occur locally in the basin; some are saline and others are periodic, temporary freshwater wetlands.

Overall, because of the relatively harsh climate in the state, Wyoming soils show a close relationship to geologic parent materials and vegetation communities under which they form. Landscape stability and age relationships are quite important in understanding soil occurrence throughout the state.

Albany County land use is affected by soils in both direct and subtle ways. Most of the county is used as grazing land for domestic livestock and wildlife. Hay production is limited by both water availability and soil constraints relative to summer range carrying capacity. Plus many cattle are brought into the area for summer grazing but wintered or finished fed for market elsewhere. Early attempts to develop commercial grain and produce crops failed because of problems with climate, soils, and transportation. To a large degree, tree growth and timber production in the county forests depend upon the soil's water-holding capacity, as well as growing season constraints. Suburban development in the county presents problems relative to foundation construction and lawn establishment and maintenance due to salts and other soil conditions.

Soil Map Unit (SMU) Descriptions: Albany County Soils Map

AL01 Fluventic Haplaquolls, fine-loamy over sandy or sandy skeletal, mixed (calcareous), frigid; Aquic Torriorthents, sandy-skeletal, mixed, frigid

AL02 Ustic Haplocambids, loamy-skeletal, mixed, frigid; Ustic Haplocambids, sandy-skeletal, mixed, frigid; Ustic Haplargids, fine-loamy, mixed, frigid

AL03 Ustic Haplocalcids, loamy-skeletal, mixed, frigid; Aridic Argiustolls, fine-loamy, mixed, frigid; Ustic Haplargids, loamy-skeletal, mixed, frigid

AL04 Ustic Haplargids, fine-loamy, mixed, frigid; Ustic Haplocalcids, loamy, mixed, shallow, frigid; Ustic Haplocalcids, coarse-loamy, mixed, frigid

AL05 Typic Haplogypsids, fine, montmorillonitic, frigid

AL06 Ustic Natrargids, fine, montmorillonitic, frigid; Ustic Natrargids, fine-loamy, mixed, frigid; Ustertic Torriorthents, fine, montmorillonitic (calcareous), frigid

AL07 Ustic Haplargids, fine, mixed, frigid; Ustic Haplargids, fine-loamy, mixed, frigid; Ustic Haplargids, loamy-skeletal, mixed, frigid

AL08 Ustic Lithic Haplocalcids, loamy-skeletal, mixed, frigid; Rock Outcrop; Ustic Haplargids, coarse-loamy, mixed, frigid

AL09 Aridic Argiustolls, loamy-skeletal, mixed, frigid, shallow; Rock Outcrop; Typic Haplustalfs, fine-loamy, mixed, frigid; Typic Argiustolls, fine-loamy, mixed, frigid

AL10 Ustic Haplargids, fine-loamy, mixed, frigid; Ustic Torriorthents, fine-loamy, mixed (calc), frigid

AL11 Lithic Haplocryolls, loamy-skeletal, mixed; Rock Outcrop; Typic Argicryolls, fine-loamy, mixed

AL12 Lithic Haplocryolls, loamy-skeletal, mixed; Rock Outcrop; Lithic Mollic Haplocryalfs, loamy-skeletal, mixed

AL13 Lithic Haplocryolls, loamy-skeletal, mixed; Rock Outcrop; Typic Haplocryalfs, loamy-skeletal, mixed

AL14 Typic Dystrocryepts, loamy-skeletal, mixed; Typic Haplocryalfs, loamy-skeletal, mixed; Lithic Cryorthents, sandy-skeletal, mixed

AL15 Lithic Cryorthents, loamy-skeletal, mixed; Humic Dystrocryepts, loamy-skeletal, mixed; Histic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed

AL16 Typic Dystrocryepts, loamy-skeletal, mixed; Humic Dystrocryepts, loamy-skeletal, mixed; Rock Outcrop; Histic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed

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Appendix I

Soil Moisture and Soil Temperature Regimes

Soil moisture and soil temperature regimes are defined in terms of field measurements and are important characteristics of soils. Besides the direct effect of climate, they are also influenced by such factors as slope, aspect, plant cover, permeability, and water table. These regimes are used at different levels of taxonomy to define the classes of soils. For some soils, these climatic-related criteria define classes of orders, suborders, and great groups as indicated by formative elements of many soil names used in the legend. Soil moisture and soil temperature regimes are used as one basis for separating different map units. Therefore, the legend is presented under subheadings that group the units according to ranges of soil moisture and temperature. Brief definitions of the temperature and moisture regimes in Wyoming are given below; the complete definitions are given in Soil Taxonomy (Soil Survey Staff 1975; Soil Survey Staff 1998).

Soil Moisture Regimes

The seasonal incidence and amounts of water that enter the soil profile and percolate through, or are held and used by plants, are important properties of the soil affecting its use. Through geologic time, they have been controlling determinants of processes that have formed the soil. The moisture regimes generally are related to climate and usually are estimated from climatic data. The definitions, however, are given in terms of long-term average seasonal soil moisture conditions within an upper portion of the profile called the **soil moisture control section**. The control section is intended to indicate equivalent amounts of soil moisture, and its upper and lower boundaries vary with soil water holding capacity. It is roughly between depths of 10 and 30 cm (4 and 12 in) for most soils, and at greater depths for moderately coarse and coarse textured soils. The moisture regimes are generally definitive criteria of the higher categories of soil taxonomy and are indicated by formative elements in names of many of the great groups. The aridic moisture regime is one of the criteria that defines the Aridisol Order.

The aridic, ustic, udic, aquic, and xeric moisture regimes are recognized in Wyoming. Abbreviated definitions of the moisture regimes as they apply in Wyoming are given in the following paragraphs. In these definitions, reference is to moisture levels within the control section. "Dry" means too dry for most plant growth, or above 15 bars moisture tension; "moist" means soil water present at less than 15 bars tension; "prolonged summer dry period" means the control section is dry for more than 45 consecutive days after June 21; "saturated" means the profile is subject to a high water table for a significant part of the year; “warm enough for plant growth” means above 5°C at a soil depth of 50 cm; “above 8°C” refers to temperatures at this same depth. The moisture regimes describe the moisture conditions that prevail in most years (6 out of 10 for xeric soils; 7 out of 10 for others).

Soils with the **aridic** (or **torric**) soil moisture regime are dry more than half of the time when they are warm enough for plant growth and are never moist in any part for 90 consecutive days when they are warmer than 8°C. Aridic soils are described here as arid and semiarid. They generally have annual precipitation of less than 36 cm (14 in.). These soils are too dry for annual cropping and many require irrigation for crop production. “Torri-” is a formative element indicating aridic great groups of orders other than Aridisols (e.g., Entisols-Torriorthents).

Soils of the **aquic** soil moisture regime are saturated by a seasonal or permanent high water table and subject to reducing conditions reflected by mottled and grayish subsoil colors (called redoximorphic features). When the whole soil (from the surface down) is saturated for sufficient time, aquic suborders are used. Aquic subgroups are used for soils when saturated conditions prevail lower in the profile. When the water table in the soil is contiguous with the ground water table, the soil is said to have “endosaturation.” When the water table in the soil is perched above a non-saturated layer (within 2 meters of the surface), the soil is said to have “episaturation.” When a soil has a water table as the result of irrigation or other human activity, the soil is said to have “antric saturation.” Except for Aridisols, aquic suborder classes are used in all orders in Wyoming. These classes are designated by the formative element “aqu-” in the name. Such soils are commonly described as wet.

Soils of the **udic** soil moisture regime are usually moist. They are not dry in any part for as long as 90 cumulative days and do not have a prolonged summer dry period. They are never wet except for short periods. These soils have sufficient moisture for annual cropping or good forest and range production. They are commonly described as humid. Nearly all soils with udic moisture regimes in Wyoming are in mountains and most are cold. The formative element “ud-” does not appear in group names of these cold soils (e.g., Haplocryalfs). Temperature is given precedence.

Soils with a **ustic** soil moisture regime are dry in some or all parts for 90 or more cumulative days but not dry in all parts more than half of the time when they are warm, and they do not have a prolonged summer dry period. These soils have limited soil moisture, but the moisture normally occurs mainly during the growing season. They are described as semiarid or sub-humid. In years of average or above average rainfall with favorable distribution, these soils can be annually cropped. “Ust-” is the formative element used in ustic great groups of Entisols and Inceptisols.

Soil Temperature Regimes

Soil temperature regimes are defined in relation to the mean summer soil temperatures and the mean annual soil temperatures measured at a depth of 50 cm (20 in) or at the contact with bedrock, if shallower. Only the frigid, cryic, and mesic temperature regimes occur extensively in Wyoming. The formative element “bor-” is used in frigid or cryic Mollisols suborders (except Aquolls) and Alfisol suborders (except Aqualfs); “cry-” is used in names for cryic great groups of all orders in Wyoming except Aridisols.

The **frigid** soil temperature regime has mean annual soil temperatures below 8°C (47°F) but above 0°C (32°F). The Borolls are suborders of Mollisols, and Boralfs are suborders of Alfisols that are frigid or colder. In other suborders and orders, frigid temperatures are recognized at the family level. Frigid soils are described as cool.

The **cryic** soil temperature regime also has mean annual soil temperatures between 0°C and 8°C (32°F and 47°F), but, in addition, cool summer temperatures. Specifically, mean summer soil temperatures (June, July, and August) are below 15°C (59°F). They are below 8°C (47°F) if a surface organic layer (forest floor) is present and below 13°C (55°F) if the soil is saturated and has no surface organic layer. These somewhat complicated limits are designed to group equivalent soil temperatures that differ because of the insulating effect of surface organic layers or the extra heat absorption by excess water. Cryic soils are described as cold.

The **mesic** soil temperature regime has mean annual soil temperatures between 8°C (47°F) and 15°C (59°F). This temperature regime is typical of the middle latitudes, including the midwest corn belt. Major areas of soils with mesic temperature regimes occur in the Bighorn Basin and in eastern Wyoming from the Black Hills (low elevations) to the Colorado state line. Smaller areas occur around Casper and Rock Springs.

In addition to the three temperature regimes discussed above, which occur extensively in Wyoming, the following temperature regimes are recognized:

Pergellic: Mean annual soil temperature (MAST) <0°C (32°F). Permafrost occurs in moist soils with this temperature regime. Patterned ground is common as a result of frost action. In Wyoming, small areas at high elevations in the alpine have this temperature regime.

Thermic: MAST is >15°C (59°F) but <22°C (72°F) and the difference between mean summer and mean winter soil temperatures at 50 cm is 5°C.

Hyperthermic: MAST is >22°C (72°F) and the difference between mean summer and mean winter soil temperatures is >5°C.

The pergellic regime is typical of Arctic and Antarctic regions. The thermic regime is typical of the cotton belt in the United States, and the hyperthermic zone is typical of the tropics. The prefix “iso-” is used with mesic, thermic, and hyperthermic regimes when the difference between mean summer and mean winter soil temperatures at 50 cm is <5°C (9°F).

Appendix II

Descriptions of the Soil Orders

Alfisols: Alfisols are light colored, slightly to moderately acid soils with brownish subsoil horizons of clay accumulation. They are somewhat leached, but they are usually moderate to high in bases. Alfisols have formed under coniferous or mixed forests with moderately low to high precipitation and cool or cold climates (frigid Udalfs and Cryralfs). They are primarily on mountains and foothills or in forested intermountain valleys. In western Wyoming valleys, some Alfisols are dry for extended periods of the summer, though moist most of the year (Xeralfs).

Aridisols: Aridisols are light-colored soils of dry regions that are depleted of plant-available soil moisture for most of the summer. They are unleached and are alkaline in reaction. Some Aridisols have developed horizons of clay accumulation (Argids), mainly on older and more stable surfaces. These may also be sodium affected. Others have only some redistribution of clay and weak-to-strong accumulations of calcium carbonate or more soluble salts (Calcids, Gypsids, Cambids). Aridisols are common in the Wyoming plains and basins. They have shrub-grass or shortgrass prairie vegetation with a few juniper and stunted ponderosa pine in places. In Wyoming, many Aridisols are considered to be intergrading to Mollisols with somewhat more available moisture than typical and are dry farmed in some areas (e.g., Ustic Haplargids).

Entisols: Entisols are very young soils. Some are developing in recently deposited parent materials, while others are on steep slopes, are actively eroding, and show little, if any, alteration or development of horizons. Entisols can be in any climate and may be alkaline or acid in reaction. Those developing in recent alluvial deposits are stratified (Fluvents) or wet (Aquents). Most are on steep and very steep slopes (Orthents), and some are on sandy, often wind-reworked materials (Psamments).

Histisols: Histisols are organic soils formed in bogs, wet meadows, and some backwater floodplain areas with a high water table. They include the peat and muck soils. These soils are of minor extent in Wyoming and are mostly found at high elevations.

Inceptisols: Inceptisols include light-colored soils (Ochrepts) that have had slight to moderate alteration during formation. They lack horizons of clay accumulation but have subsoil horizons differentiated by color, structure, and some leaching of carbonates. Inceptisols occur under cool and cold temperatures and moderately low to high precipitation. They have formed either under grass or forest vegetation and are alkaline or acid in reaction. They are common in the forested mountains of Wyoming.

Inceptisols in the Wyoming mountains have formed under the influence of high precipitation, cold temperatures, and coniferous forest. They are common on Late Wisconsin (Pinedale) and younger surfaces. Some Inceptisols along streams and in wet mountain meadows have high water tables and mottled grayish subsoils (Aquepts).

Mollisols: Mollisols are dark colored, base-rich soils formed under grass and, in some places, under open forest vegetation. They may or may not have subsoil horizons of clay accumulation. Typically, they have prismatic and blocky subsoil structure. Most have lower subsoil horizons of calcium carbonate accumulation. Some are calcareous to the surface, and some are sodium affected. Mollisols occur under moderate to low precipitation and cool to cold temperatures (frigid Udolls and Cryolls) throughout Wyoming. Generally, the Mollisols of foothills and mountains with moderate precipitation have a relatively thick, nearly black surface horizon and are deeply leached of carbonates. Those formed on the plains and in basins under low precipitation are associated with Aridisols. They usually have thinner and lighter colored surface horizons and are less deeply leached of carbonates. Mollisols of low-lying areas with high water tables have mottled or grayish subsoils (Aquolls). In western Wyoming valleys, some Mollisols are dry for extended periods of time in the summer, though moist most of the year (Xerolls).

Spodosols: Spodosols are light-colored, acid, brownish soils found occasionally under coniferous forests in the Wyoming mountains. Precipitation is relatively high and temperatures are cold. They are characterized by having brownish or reddish brown, loamy or sandy, thin subsoil horizons with amorphous humus, aluminum, and iron accumulation. Typically, these soils have a thin, light gray subsurface horizon beneath a dark organic duff layer of decomposing plant litter. Spodosols are common in the taiga of Eurasia and North America but are rare in the Rockies.

Vertisols: Vertisols are very clayey soils that have deep, wide cracks when dry, and that swell tightly when wet. Expanding clays of this type are common in intermountain basins in Wyoming in clayey soils derived from shale. Vertisols have "slickensides" and wedge-shaped peds. Many soils that are vertic intergrades in other orders also occur.

Andisols: Andisols are soils which have developed on rather young (geologically) volcanic ejectra (ash, cinders, pumice, etc.). They typically have low bulk densities compared to other mineral soils (0.4 to 0.9 g cm^{-3}). These soils are often fertile, with high water-holding capacities and are highly productive for forestry and crops. They may be thixotropic, however, and generally have poor engineering properties. They are common in the Pacific Northwest but rare in Wyoming (some are found in the Yellowstone Park area).

Other Orders

Ultisols, Oxisols, and Gelisols: These are the remaining three soil orders. Soils in these orders are not recognized in Wyoming, although soils fitting these concepts developed in what is now Wyoming under previous climatic (tropical) conditions. Some of the red colors seen in the Wyoming badlands are relict Ultisols, dating from a time and climate when crocidiles and flamingos lived in what is now Wyoming.

Ultisols are forest soils similar to Alfisols except they are more highly leached. Base saturation is low (<35%) and the argillic or kandic horizon is normally dominated by 1:1 (Kaolinitic) type clays. Ultisols are common in the southeastern United States, in the Pacific Northwest, and in the tropics. A few Ultisols occur in Wyoming, but the combination of argillic horizons and < 35% base saturation is rare.

Oxisols are soils of great age found on stable land surfaces in the tropics and subtropics. They are highly leached and contain mostly iron and aluminum sesquioxides and 1:1 type silicate clays in the clay particle size fraction. In the United States, oxisols occur only in Hawaii and Puerto Rico. Relicts of oxisols have been identified in California and Texas, representing past tropical climates.

Gelisols are soils with permafrost (i.e., pergellic temperature regimes). Gelisols are common in the arctic and antarctic regions, and they also occur at high elevation in the northern and central Rocky Mountains. Plant root growth in Gelisols is restricted to the active layer, the shallow surface layer that thaws during the growing season. Gelisols are sensitive to disturbance since removal of the vegetation canopy or soil litter layer may result in thawing of the permafrost layer.

Appendix III

Albany County Soil Data Layer – Decision Rules

The soils in each zone were assigned to particular combinations of surficial geology and bedrock. Surficial geology units were grouped into three major types, with four special categories. A third classification element is elevation. Throughout most of Wyoming, the break between frigid and cryic temperature regimes occurs at approximately 7,800 ft. The break between Mesic and Frigid occurs at 5,000 ft in northern Wyoming and at 6,500 ft in southern Wyoming.

Landforms (from Surficial Geology Map of Wyoming 25 Element Classification; Case, Arneson, and Hallberg, 1998):

Residual: aR, bi, bdi, mi, tre, ri, ui, Ri, Ki, ki, xi, Ti

Alluvial: Ai, ai, ti, tdi, oai

Colluvial: fi, fdi, li, sci

Special: eolian (ei); glacial (gi); playas (pea); mined (Mi)

Bedrock geology (Love and Christiansen, 1985) was either keyed on the first letter of the code from the state bedrock geology map or an individual unit is named specifically.

As areas are designated to a particular SMU, they should not be changed by a later ID line.

If landform is ai, SMU is AL01.

If bedrock is Qa, SMU is AL02.

If bedrock is Qt, SMU is AL03.

If bedrock is Trc or Pfs and landform is residiual or colluvial, SMU is AL04.

If landform is pea, SMU is Al05.

If bedrock is any K unit, SMU is AL06.

If bedrock is Twr or Twdr, SMU is AL07.

If bedrock is any Pre-Cambrian rock and elevation is less than 7,800 ft, SMU is AL09.

If elevation is less than 7,800 ft and bedrock is PPm, PPc or PPcf, SMU is AL10.

If elevation is less than 7,800 ft, default SMU is Al08.

If elevation is greater than 10,000 ft, SMU is AL16 (CR16).

If elevation is greater than 7,800 ft and bedrock is PPm, PPc, or PPcf, then SMU is AL1.

If bedrock is Yla and elevation is greater than 7,800 ft., SMU is AL12.

If bedrock is Ys and elevation is greater than 7,800 ft, SMU is AL13.

If elevation is greater than 7,800 ft and landform is Residual, SMU is AL15.

If elevation is greater than 7,800 ft, default SMU is AL14.

Common Bedrock Types in Albany County

Quaternary

Qa: Alluvium and colluvium

Qt: Gravels, pediments, and terraces

Tertiary

Tha: Hanna formation; brown and gray sandstone; boulder beds; paleocene

Twr: White River formation; Tuffaceous claystone, lenticular arkosic conglomerate

Twrb: White River formation, Brule member; Tuffaceous claystone and lenticular sandstone; locally contains a conglomerate

Twdr: Wind River formation; varigated claystone and sandstone; Eocene

Twb: Wagon Bed formation; green and gray tuffaceous clay and sandstone; Eocene

Tmu: Ogalalla formation; tuffaceous claystone, sandstone and conglomerate

Tmo: Arikaree formation; porous sandstone and underlying tuffaceous claystone and siltstone

Cretaceous

Kf: Frontier formation; gray sandstone and shale

Kmt: Mowry shale; gray shale with fish scales

Kn: Niobrara formation; limestone and limey shale

Kp: Pierre Shale; dark-gray concretionary marine shale; bentonite beds

Kft: Knt: Frontier and Mowry Shales; gray sandstone and sandy shale; siliceous shale

Ks: Steele shale; gray marine shale (bentonite)

Kle: Lewis shale; gray marine shale; concretionary sandstone beds

Kmb: Medicine Bow formation; brown and gray sandstone and shale

Cretaceous-Jurassic

Kjs, Kj: Cloverly formation and Morrison formation; sandstone over bentonitic shale; pebble conglomerate

Js: Sundance formation; glautonic sandstone and shale over non-glautonic sandstone and shale

Older Sedimentary Rocks

TrPg, TrPcg: Goose Egg formation; red sandstone and siltstone; purple dolomite and limestone

Ppc, PPcf: Casper formation; sandstone (calc)

MzPz: Chugwater formation; red siltstone and sandstone

Metamorphic and Old Igneous Rock

Ys: Sherman granite (1.4 Ba)

Xsv: Mafic intrusive rock; peltic schist, marble, layered amphibole and fells gneiss

Wan: Granite gneiss; late Archean (2.6 to 3.1 Ba)

PW: Mafic intrusive rocks

Wag: Granite, amphibole, and metasedimentary rocks; late Archean

Wvsv: Metasedimentary and Metavolcanic; Phantom Lake suite (> 2.6 Ba)

Wp: Periotite intrusive rocks; Laramie Mountains; late Archean