

2.2 Soils and Alluvial Valley Floors

2.2.1 Key Issues

The key issues related to soils and alluvial valley floors include:

- The maintenance of long-term soil productivity; and
- The maintenance of long-term hydrologic function of alluvial valley floors (AVFs) for the continuation of important subirrigation and flood irrigation practices for agricultural production.

2.2.2 Study Area

The baseline study area for the resources of soils and AVF includes all or portions of Sheridan, Johnson, Campbell, and Converse counties (**Figure 1-1**). It includes all of the area administered by the BLM Buffalo Field Office, a portion of the area administered by the BLM Casper Field Office, and a portion of the TBNG, which is administered by the USFS (**Figure 1-2**). State and private lands also are included in the study area (**Figure 1-3**). In addition, the study area encompasses 18 subwatersheds (fourth order) (**Figure 1-4**).

2.2.3 Current Conditions

2.2.3.1 Soils

Soils in the PRB can be classified into three main soil orders: Entisols, Aridisols, and Mollisols. The most extensive soils are Entisols, which are recent soils occurring mainly on sloping topography where geologic erosion outpaces soil profile development or organic matter accumulation. The physical and chemical characteristics of Entisol soils largely depend on the soil parent materials and the bedrock on which they occur. These soils generally are low in plant nutrients and commonly have clay textures.

The PRB also has extensive areas of gently sloping to nearly flat, more stable, topography. Soils on these surfaces commonly are identified as Aridisols. These soils commonly have low to moderate organic matter content and plant nutrients in the surface layer. They also have moderate to strong structural development within the surface and subsoil layers. This generally means that carbonates and salts have been leached by water to depths of 1 to 2 feet, or more. This produces a more fertile rooting zone, particularly when soil textures are loamy rather than sandy or clayey.

The third and least extensive group of soils is the Mollisols. These soils are the most fertile and have higher levels of organic matter and nutrients, particularly in the surface layer. Mollisols are the best source of soil for reclaiming project disturbance.

There also are fluvial soil types in the PRB, which are found on gently sloping to flat drainage bottoms. Fluvial soils vary considerably in fertility, depending on the source of alluvium. Fluvial soils low in salts and sodium tend to be very fertile and are the most productive in the basin (BLM 1984).

2.0 Description of Current Conditions

Soil survey information is available, at different levels of intensity and scales of mapping, for soils in the PRB. County soil surveys have been completed and published by the Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service) for Sheridan County (Lupcho 1998), southern Johnson County (Stephens 1975), southern Campbell County (Westerman and Prink 2004), northern Campbell County (Prink et al. 2004), and northern Converse County (Reckner 1986). Soils mapping currently is being conducted for northern Johnson County but is incomplete at this time.

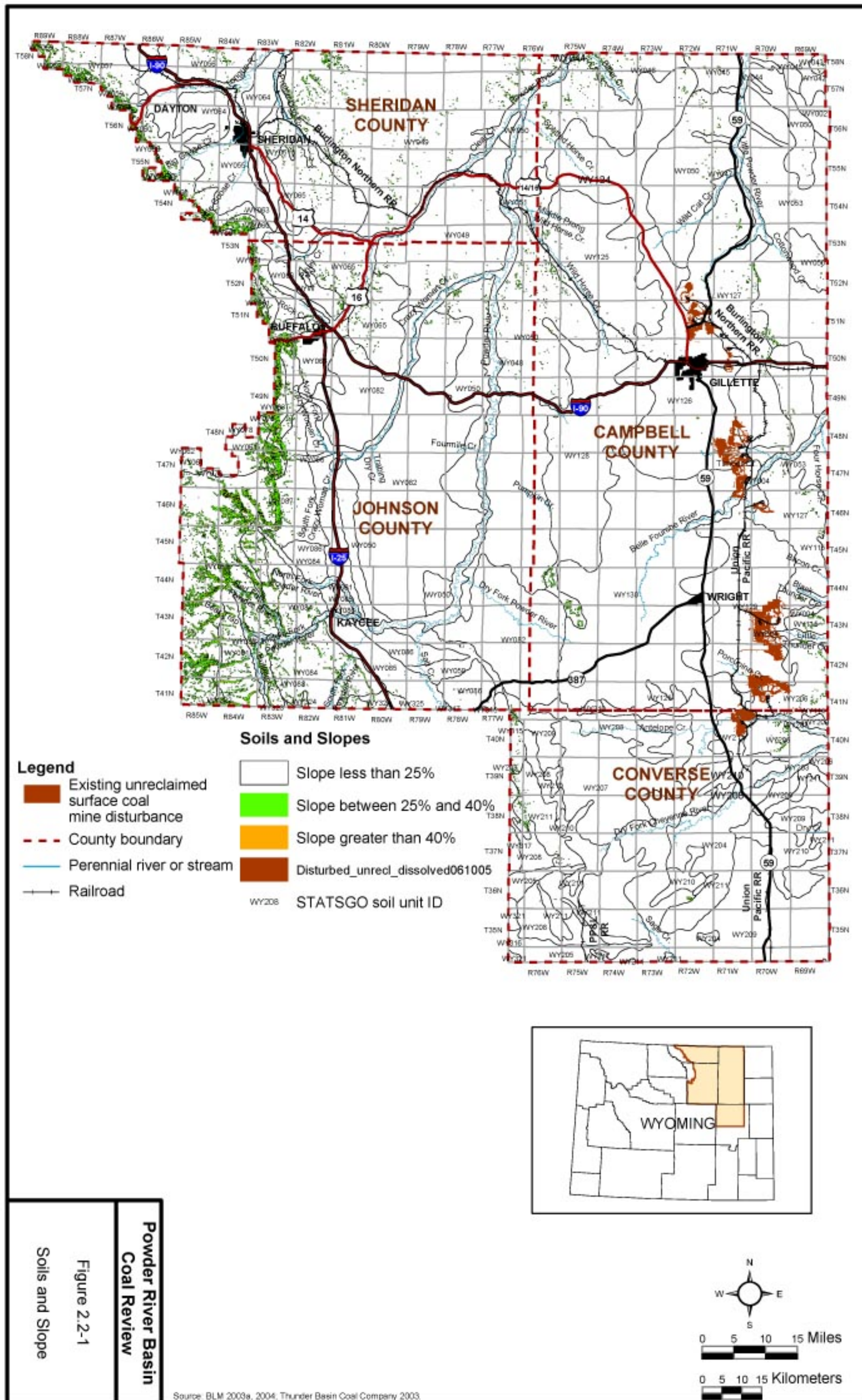
These county soil surveys generally are mapped at the order 3 level of intensity on a photo base at the scale of the USGS 7.5-minute topographic quadrangle maps (1 inch equals 2,000 feet). Approximately 80 or more individual soil series in the PRB have been mapped and described. The NRCS maintains current files for all of these soils, and Official Soil Series Descriptions are available on the NRCS web site.

More detailed soils information is available for the 20 major coal mine permit areas, located primarily in a line beginning north of Gillette and continuing southward to northern Converse County, as well as in the area northeast of Sheridan. The soils mapping for these coal permit areas was done at a more detailed (Order 1-2) level of intensity on photo base maps at a scale of approximately 1 inch equals 400 feet. These surveys also included substantial soil sampling for laboratory analysis and interpretation. These surveys were reviewed and approved by the Wyoming Department of Environmental Quality (WDEQ), Land Quality Division (LQD) as part of the mine permitting process.

More general soils information is available from the state soil geographic (STATSGO) database mapping for the State of Wyoming. This NRCS product is being used for this study to describe the soils of the PRB because of the basin's large size and the lack of complete coverage by the county soil surveys. STATSGO provides an all inclusive, general description of the soils of the basin, but it is too general for use in project-specific impact evaluations.

Soil associations are used in the STATSGO mapping. Each association is named for the three dominant soil series within the association. The geographic distribution of soil associations in the PRB, as well as three slope gradient categories, is presented in **Figure 2.2-1**. The slope categories are: less than 25 percent slope, between 25 and 40 percent slope, and greater than 40 percent slope. The 60 soil association map units in the PRB are listed in **Table 2.2-1**, which also includes the percent that each association occupies in the basin. Thirty-three of these map units occupy less than 1 percent each in aerial extent in the basin.

Table A-1 in Appendix A lists the dominant soil series for each STATSGO map unit, and provides general characteristics for the soils. The soils information was based on current published and unpublished NRCS surveys and includes surface texture and slope range for each soil. The slope information was used in combination with the soils information to assess areas with high potential for water erosion. **Table A-1** also identifies the soils that have severe wind and water erosion hazards, high compaction potential (based on clay type and content and high shrink swell capacity), high salinity and sodicity, poor revegetation potential, and prime or otherwise valuable agricultural soils.



Powder River Basin
 Coal Review
 Figure 2.2-1
 Soils and Slope

Source: BLM 2003a, 2004; Thunder Basin Coal Company 2003.

2.0 Description of Current Conditions

**Table 2.2-1
Soil Associations and Areal Extent in the Study Area**

STATSGO Map Unit	Soil Association Map Unit Name	Percent of Study Area
WY002	Midway - Samday - Rock Outcrop	0.20
WY004	Haverson - Glenberg - Bone	0.46
WY042	Cabbart - Yawdim - Hesper	0.20
WY043	Ridge - Broadus - Reeder	0.05
WY044	Havre - Hanly - Glendive	0.16
WY045	Cabbart - Yawdim - Thurlow	0.49
WY046	Cabba - Ringling - Yawdim	0.55
WY047	Draknab - Arvada - Bidman	0.41
WY048	Riverwash - Haverdad - Clarkelen	2.50
WY049	Shingle - Renohill - Forkwood	8.12
WY050	Shingle - Taluce - Kishona	11.47
WY051	Wyarno - Hargreave - Moskee	0.72
WY053	Shingle - Cushman - Taluce	3.22
WY055	Haverdad - Havre - Zigweid	2.08
WY056	Samday - Shingle - Rock Outcrop	0.56
WY057	Doney - Shaak - Wayden	0.92
WY058	Abac - Peritsa - Rock Outcrop	<0.01
WY059	Rock Outcrop - Starley - Woosley	2.69
WY060	Tolman - Abac - Rock Outcrop	0.67
WY061	Agneston - Rock Outcrop - Granite	0.55
WY062	Owen Creek - Tongue River - Gateway	<0.01
WY063	Wolf - Platner - Platsher	1.48
WY064	Plashter - Recluse - Parmleed	0.99
WY065	Baux - Bauxson - Harlan	2.50
WY066	Moskee - Hargreave - Shingle	1.20
WY078	Frisco - Troutville - Teewinot	0.04
WY081	Barnum - Haverdad - Rock Outcrop	0.40
WY082	Reno - Shingle - Parmleed	8.17
WY084	Keyner - Samday - Rock Outcrop	1.93
WY085	Samday - Badland - Rock Outcrop	0.81
WY086	Cambria - Shingle - Kishona	1.44
WY087	Shingle - Cambria - Renohill	0.83
WY088	Sunup - Rock Outcrop - Spearfish	1.55
WY114	Tassel - Turnercrest - Terro	0.01
WY115	Shingle - Samday - Absted	0.21
WY124	Plashter - Kishona - Hiland	1.98
WY125	Shingle - Theedle - Wibaux	2.40
WY126	Hiland - Vonalee - Maysdorf	4.27
WY127	Kishona - Shingle - Theedle	4.10
WY128	Renohill - Cushman - Cambria	3.15
WY129	Bidman - Parmleed - Renohill	2.70
WY130	Renohill - Bidman - Ulm	6.29
WY203	Clarkelen - Draknab - Haverdad	0.25
WY204	Hiland - Ustic Torriorthents - Bowbac	1.50
WY205	Dwyer - Orpha - Hiland	0.61
WY206	Wibaux - Rock Outcrop - Shingle	1.40
WY207	Hiland - Bowbac - Tassel	3.02

2.2 Soils and Alluvial Valley Floors

Table 2.2-1 (Continued)

STATSGO Map Unit	Soil Association Map Unit Name	Percent of Study Area
WY208	Shingle - Samday - Hiland	1.53
WY209	Hiland - Shingle - Tassel	5.52
WY210	Ulm - Renohill - Shingle	1.33
WY211	Shingle - Tassel - Rock Outcrop	1.74
WY315	Rock Outcrop - Hazton - Redsun	0.20
WY316	Hiland - Bowbac - Keyner	<0.01
WY317	Shingle - Taluce - Amodac	0.10
WY321	Hiland - Orpha - Bowbac	0.08
WY322	Roughlock - Rock Outcrop - Rekop	0.08
WY323	Lolite - Hiland - Vonalee	0.01
WY324	Hiland - Forkwood - Zigweid	0.11
WY325	Lolite - Rock Outcrop - Keyner	0.06
WYW	Surface Water	0.02

Source: BLM 2003a.

2.0 Description of Current Conditions

Wind erosion hazard is represented by the wind erosion group number for each soil, and is based on physical characteristics including soil texture (percent sand, silt, and clay), structure, and coarse fragment content. Soils in the study area range from fine sand with severe wind erosion hazard to very wet or stony soils with only slight or no erosion hazard. Soils with severe wind erosion hazard are present from the Wyoming/Montana state line south down the center of Campbell County to approximately 14 miles south of Gillette and along the Little Powder River. They also are present in much of Converse County (BLM 2003a).

Slope hazards are dependent on slope gradient. Slopes from 0 to 25 percent are rated as minimal hazards. Slopes between 25 and 40 percent have moderate hazards, and slopes greater than 40 percent have severe hazards. For project disturbance, soils often are not recommended for salvage on slopes greater than 40 percent. In the PRB, moderate and severe slope hazards occur primarily along the southwestern corner of Johnson County and as small scattered areas throughout the basin (BLM 2003a).

Water erosion hazard is determined by several factors including organic matter content, K factor (the higher the number the higher the hazard), permeability class, and slope. Soils on slopes of 25 to 40 percent often have moderate water erosion hazards; soils on slopes greater than 40 percent have severe hazards. Severe and moderate water erosion hazard soils occur primarily along the southwestern corner of the basin in Johnson County where slopes of 25 to 40 percent and greater than 40 percent occur. Severe water erosion hazard soils also occur along the northern and eastern borders of the basin as well as down the center along the Powder River and into Converse County (BLM 2003a).

Compaction and shrink/swell potential are related to the amount and type of clay in a soil and affect the soil's ability to support construction and be reclaimed. In soils with a high shrink/swell potential, rapid changes in volume can damage structures and roads. Soils with 35 percent or greater clay content are classified as high clay. Soils with montmorillonite (smectite or bentonite) clays are considered to have a high shrink/swell potential. Soils with severe shrink/swell potential occur along the northern and western borders of the basin, on both sides of the Powder River, down the center of Sheridan and Johnson counties, in the eastern portion and entire southern half of Campbell County, and in small scattered areas of Converse County (BLM 2003a).

Soil salinity and sodicity are measured by electrical conductivity (EC) and sodium adsorption ratio (SAR), respectively. Salinity impacts a plant's ability to take in water, whereas sodicity slows the movement of water through the soil. Soils with an EC of 0 to 8 are considered slightly saline, soils with an EC from 8 to 16 are considered moderately saline, and soils with an EC greater than 16 are strongly saline. Soils with an SAR greater than 15 are considered sodic. Approximately 40 percent of the soils in the PRB are considered saline and/or sodic. Saline soils are located near the confluence of the Powder River and the South Fork of the Powder River and along the Belle Fourche River, Black Thunder Creek, and Little Black Thunder Creek (BLM 2003a).

Soils with poor revegetation potential are identified by two methods. The first method uses the land capability classification contained in the county soil surveys. Soils are given a number between one and eight depending on limitations for agriculture and response to management. Classes VII and VIII were determined to have poor revegetation potential for reclamation of disturbances associated with energy development projects. Soils with poor revegetation potential are located throughout the PRB except in the central portion of Campbell County (BLM 2003a).

2.2 Soils and Alluvial Valley Floors

The second method for evaluating reclamation/revegetation potential uses site-specific soil sampling and description, laboratory analysis of soil samples, and a subsequent suitability evaluation and salvage depth recommendation (WDEQ 1994). This method is appropriate for project-specific land areas and usually requires the completion of a detailed (Order 1-2) soil survey.

Prime agricultural soils in the PRB were determined by the NRCS State Office in Casper, Wyoming. Portions of Sheridan County, Converse County, and the central portion of Campbell County contain prime agricultural soils. These soils also extend into Johnson County along the Powder River and Clear Creek (BLM 2003a).

Based on GIS analysis, as of the end of 2003, the existing development-related soil disturbance in the PRB study area was approximately 121,890 acres, of which approximately 51,107 acres of disturbance was related to coal mining activity (see **Table 2.2-2**). The primary soil associations impacted as a result of coal mine development have included the Renohill – Bidman – Ulm, Hiland – Vonalee – Maysdorf, Kishona – Shingle – Theedle, Bidman – Parmleed – Renohill, Wibaux – Rock Outcrop – Shingle, Shingle – Tassel – Rock Outcrop, and Haverson – Glenberg – Bone.

Table 2.2-2
Existing Soil Disturbance in the PRB Study Area¹

Subwatershed	Total Disturbance ²	Coal Mine-related Disturbance
Antelope Creek	19,807	13,785
Clear Creek	4,405	0
Crazy Woman Creek	494	0
Dry Fork Cheyenne River	1,684	0
Lightning Creek	2,900	0
Little Bighorn River	64	0
Little Missouri River	163	0
Little Powder River	17,896	8,018
Middle North Platte River	561	0
Middle Powder River	2,297	0
Middle Fork Powder River	259	0
North Fork Powder River	0	0
Salt Creek	1,225	0
South Fork Powder River	313	0
Upper Belle Fourche River	37,148	15,578
Upper Cheyenne River	16,656	13,726
Upper Powder River	12,444	0
Upper Tongue River	3,574	0
Total	121,890	51,107

¹Based on GIS analysis of existing development-related disturbance as of end 2003.

²Inclusive of coal mine-related disturbance.

Source: ENSR 2005b.

2.0 Description of Current Conditions

2.2.3.2 Alluvial Valley Floor

The Federal Office of Surface Mining (OSM) 1977 Surface Mining Control and Reclamation Act (SMCRA) regulations define AVFs as unconsolidated stream-laid deposits where water availability is sufficient for subirrigation or flood irrigation agricultural activities (Public Law 95-87). The WDEQ administers these AVF regulations for coal mining activities in Wyoming. Before leasing and mining can proceed, AVFs must be determined, because their presence can restrict mining activities. Coal mine-related impacts to designated AVFs generally are not permitted if the AVF is determined to be significant to agriculture. Conversely, if the AVF is determined not to be significant to agriculture, or if the permit to affect the AVF was issued prior to the effective SMCRA date, the AVF can be disturbed during mining but must be restored during reclamation.

WDEQ/LQD determines significance to agriculture based on specific calculations related to the production of crops or forage on the AVF and the size of the existing agricultural activities on the land of which the AVF is part. In addition, for any designated AVF, regardless of its significance to agriculture, it must be demonstrated that the essential hydrologic functions of the valley would be protected.

The determination of AVFs is done in accordance with the OSM and WDEQ/LQD guidelines that require detailed studies of soils, geomorphology, hydrology, vegetation, and land use. Three items must be determined as limiting criteria: 1) the possibility for artificial flood irrigation, 2) past and/or present flood irrigation, and 3) apparent subirrigated areas and the possibility for natural flood irrigation. Areas that meet these criteria are then studied for their practical use for agriculture.

The following information summarizes the current conditions for AVFs within the coal mining areas in the Wyoming PRB. Essential hydrologic functions and their restoration are not part of this discussion.

The coal mines have been grouped into four areas based on geographic distribution within the basin including: 1) Subregion 1, those mines near Gillette and extending to the north; 2) Subregion 2, mines south of Gillette and north of Wright; 3) Subregion 3, mines east of Wright and extending to the south into the northern part of Converse County; and 4) Subregion 4, former mines northeast of Sheridan to the Wyoming/Montana state line (see **Figure 1-1**).

AVF information obtained from various NEPA documents as well as the State Decision Documents (SDDs) prepared for each mine by the WDEQ/LQD with their attendant permit numbers is presented below. Recently issued LBAs and pending LBAs are considered future actions and are not considered part of current conditions.

Subregion 1

The Subregion 1 area includes the Buckskin, Dry Fork Mine, Eagle Butte Mine, Rawhide Mine, and Wyodak Mine. AVF areas were identified on the Buckskin Mine, Eagle Butte Mine, (former Fort Union Mine [now part of Dry Fork]), and Rawhide Mine permit areas. AVFs were not identified on the Hay Creek Amendment Area of the Buckskin Mine, or on the Wyodak Mine permit area. AVF information was not available for the Dry Fork Mine. Mine plan and reclamation features to prevent

2.2 Soils and Alluvial Valley Floors

long-term impacts and the maintenance of essential hydrologic functions for declared AVF areas are contained in various sections of each mine's permit document.

Buckskin Mine Including Hay Creek Amendment (SDD, Permit 500-T6-A1, Change No. 4). Declared AVF areas were identified along Rawhide Creek and Spring Draw, and are shown on Map D11-1 of the Buckskin Mine permit. Previous disturbance to the Rawhide Creek AVF is delineated on Map D11-2 of the Buckskin permit. AVF areas were identified along Rawhide Creek and lower Spring Draw, with disturbance proposed along portions of the Rawhide Creek AVF. The entire Spring Draw AVF within the permit area will be mined out. Neither of these AVF areas were determined to be significant to farming, and no AVF was identified in association with the Hay Creek Amendment. At the end of the third permit term (T3), all identified AVFs proposed to be disturbed were disturbed. Reconstruction work has been completed on the Rawhide Creek AVF, and natural flow was returned to the channel in year 2000. Work on the Little Draw AVF and the Spring Draw AVF replacement feature was completed in year 2001 at the confluence of Little Draw and Rawhide Creek. Reclamation work on the Little Draw AVF (the Spring Draw AVF replacement feature) was completed in 2001 at the confluence of Little Draw and Rawhide Creek.

Eagle Butte Mine Including the Eagle Butte LBA (SDD, Permit No. 428-T4-A1, Change No. 13, and Final Eagle Butte EA [BLM 1994]). Much of Little Rawhide Creek has been declared an AVF non-significant to farming as it diagonally traverses the northern part of the permit area from west to east. Other portions of Little Rawhide Creek and its tributaries coming from the south within and adjacent to the permit area also have been declared AVF. AVF declarations are documented in Section 2.10 and Appendix 2.10-4 of the Eagle Butte mine permit. Monitoring, mitigation, and reclamation plans are presented in Subsections 3.5.8.7, 4.6.1, and 4.6.2 of the permit and are designed to prevent material damage to water supplies for the declared AVF. Reclamation features to prevent long-term impacts and to restore essential hydrologic functions to AVF areas adjacent to mining operations appear in Subsection 4.6.2.4 of the permit.

Former Fort Union Mine (now part of Dry Fork) (SDD, Permit No. 659-T2). The Fort Union Mine currently is subject to a Temporary Cessation of Operations. The Dry Fork of the Little Powder River is an AVF not significant to agriculture from a southwest point 1,320 feet south of the northwest corner of T50N, R72W, Section 1 to a point at least 660 feet southwest of its confluence with the Little Powder River in T51N, R71W, Section 6. Only a very short reach of the AVF is located within the permit area. The permit application describes how the essential hydrologic functions will be adequately restored for the AVF if it is mined through in the future.

Rawhide Mine (SDD, Permit No. 240-T4-R4, Change No. 6). AVFs were identified in four locations within the permit area: 1) the Dry Fork Little Powder River; 2) the Little Rawhide Creek north of the section line between T51N, R73W, Sections 4 and 9; 3) Rawhide Creek downstream from the Buckskin Mine eastern permit boundary; and 4) Rawhide Creek in T51N, R72W, Section 6 from U.S. Highway 14/16 to the Buckskin Mine access road. Both upper Rawhide Creek and Little Rawhide Creek will be mined through during life-of-mine operations. As a result of revision during the third permit (T3) term, Rawhide Creek will not be mined through near its confluence with Little Rawhide Creek. In addition, the lower reaches of Little Rawhide Creek will not be mined near its confluence with Rawhide Creek.

2.0 Description of Current Conditions

The significance to farming has been “grandfathered” for the AVFs within the Rawhide Mine permit area. Caballo Coal Company is allowed to mine the AVFs but is required to restore the essential hydrologic functions associated with the AVFs that are disturbed.

Wyodak Mine (SDD, Permit No. 232-T5). The Wyodak Mine permit area is adjacent to an AVF on a portion of Donkey Creek located east of the permit area in the north one-half of T50N, R71W, Sections 26 and 27. The AVF begins about 0.25 mile east of the permit boundary, and extends to at least 0.5 mile into Section 26 downstream of the permit area. No other drainages within or adjacent to the permit area contain AVFs.

The significance to farming has been “grandfathered” for any AVFs within the Wyodak Mine permit area. The AVF on Donkey Creek is not projected to be disturbed. However, should it be affected, Wyodak would be required to restore all essential hydrologic functions associated with the Donkey Creek AVF.

Subregion 2

The Subregion 2 area includes the Belle Ayr, Caballo, Cordero-Rojo, and Coal Creek mines. AVFs were identified on the Belle Ayr and Caballo mines and on the Caballo Rojo portion of the Cordero-Rojo Mine. No AVFs were identified on the Cordero portion of the Cordero-Rojo Mine, or on the Coal Creek Mine permit area.

Belle Ayr Mine (SDD, Permit 214-T6). Two areas along Caballo Creek were designated as AVFs, although no specific determinations were made regarding significance to farming. Belle Ayr contended that unsuitable soils and water quality rendered the areas insignificant to farming. More recent information included new potential AVF areas on Bone Pile, Caballo, and Duck Nest creeks within the 214-T4 permit boundary. WDEQ has concluded, however, that no significant areas of AVFs exist within the Belle Ayr permit area. There is an area of 134 acres to the east of active mining that historically has been used as subirrigated hayland. However, the high groundwater levels in the alluvium in this area are artificially sustained by stock dams in the Caballo Creek channel and thus do not meet the natural subirrigation criterion of WDEQ guidelines.

Caballo Mine (SDD, Permit 433-T1 and T-5). There are two major alluvial systems within the Caballo Mine permit area; however, neither area will be mined under existing permits. The confluence area where Tisdale, North Tisdale, and Gold Mine draw converge has been designated as an AVF. The AVF in Gold Mine Draw in T48N, R71W, Sections 13 and 24 is considered significant to farming. Existing disturbance in this area is confined to a railroad loop and sedimentation pond. Both of these structures, “grandfathered” under a previous state permit, will be removed at the end of mining. The long-term impacts to this AVF are expected to be minimal once reclamation is complete.

Cordero-Rojo Mine (Caballo Rojo SDD, Permit No. 511-T6-R1-Change No. 2, and Cordero SDD, Permit No. 237-T6). The Caballo Rojo Mine and the Cordero Mine previously were combined into the Cordero-Rojo Mine. The individual permits for the two mines have not yet been integrated into one permit document. No AVFs exist within the Caballo Rojo permit area. Two AVFs do exist, however, along Caballo Creek to the north of the Caballo Rojo permit area. These AVFs, known as the western and eastern Caballo Creek AVFs, are located within and adjacent to the Belle Ayr Mine. The potential effects of mining within the Caballo Rojo permit area on these somewhat distant

2.2 Soils and Alluvial Valley Floors

AVFs are discussed in the Caballo Rojo Mine Plan, and are expected to be mitigated. For the Cordero permit area, no AVFs have been identified. The valleys of Kicken and Bengal Draws, Coal Creek, and the Belle Fourche River in the vicinity of the Cordero Mine are not AVFs, because they are not capable of supporting subirrigation or flood irrigation agricultural activities.

Subregion 3

The Subregion 3 area includes the Antelope, Black Thunder, Izita, Jacobs Ranch, North Antelope/Rochelle, and North Rochelle mines. AVFs were identified on mines in Subregion 3 including the Antelope, Black Thunder, Jacobs Ranch, and the North Antelope/Rochelle mines. No AVFs were identified on the North Rochelle Mine. The former Dave Johnston Mine (Glenrock Coal), currently in final reclamation, is located to the southwest of Subregion 3. No AVFs were identified on this mine.

Antelope Mine (SDD, Permit 525-T7). An area along Antelope Creek originally was designated an AVF. The area subsequently was refined to include only those areas which are delineated as "Possible Subirrigated AVF of Minor Importance to Agriculture." An additional AVF along Horse Creek was designated and contained 61.2 acres, with 50.6 acres permitted to be disturbed by mining. The approved reclamation for this area will require replacement of the alluvial materials and restoration of the hydrologic function of the AVF.

Black Thunder Mine (SDD, Permit No. 233-T6). AVFs within the original State Program Permit area are "grandfathered," because the mine was sited prior to the passage of SMCRA in 1977. AVFs disturbed by mining will be restored to their hydrologic functions. There is a large confluence area between the North Prong of Little Thunder and Little Thunder Creek immediately adjacent to the eastern permit boundary. Future mining is not expected to materially damage the quantity or water supply of the AVFs. Those AVFs that exist off site, outside the permit boundary, will not be mined, and the operation is not expected to materially damage the quantity of water supplying them. A recent change, approved by WDEQ, removed the AVF assessment for the North Prong of the Little Thunder Creek.

Izita Mine (SDD, Permit No. 676-T1). Thunder Basin Coal Company received a regular mining permit for an area that would serve as an equipment transportation corridor between its Black Thunder Mine (Permit No. 233) and Coal Creek Mine (Permit No. 483), a distance of approximately 23 miles. Because no surface mining is authorized under this permit, WDEQ/LQD did not require a formal AVF study and did not make a formal declaration

Jacobs Ranch Mine (SDD, Permit No. 271-T4-R2). A designated AVF exists within the permit area in T43N, R70W, Sections 22 and 23. Appendix D-11 of the Jacobs Ranch permit describes the AVFs within and adjacent to the permit area. The AVF is "grandfathered" with regard to significance to farming. The mine will not materially damage the quality or quantity of surface or subsurface waters which supply the North Prong or Little Thunder Creek.

North Antelope/Rochelle Mine (SDD, Permit No. 569-T5-A2, Change 28). Four AVF studies have been completed on the North Antelope/Rochelle Mine Complex permit area over time including: 1) the Rochelle Mine, Permit No. 569-T1; 2) the North Antelope Mine, Permit No. 532-T1; 3) the North Antelope 1995 amendment, Permit No. 532-T5; and 4) the North Antelope/Rochelle Mine Complex amendment, Permit No. 569-T5.

2.0 Description of Current Conditions

WDEQ/LQD determined that an AVF did not exist in the original Rochelle Mine permit area. They determined that a 622-acre AVF did exist within the original North Antelope Mine permit area based on the presence of unconsolidated streamlaid deposits and presumably enough water to potentially flood irrigate these deposits. This AVF was determined not to be significant to farming. North Antelope's T-5 permit amendment area was determined not to contain an AVF due to the presence of an incised channel, limited availability of water due to the relatively flat topography, and relatively narrow cross sectional area which would be inundated by the predicted peakflow for the 2-year event. The North Antelope/Rochelle Mine Complex amendment area was determined not to contain an AVF because of the incised channel morphology and minimal extent of streamlaid deposits.

Dave Johnston Mine (SDD, Permit No. 291-T6). Coal mining was completed at the Dave Johnston Mine on September 28, 2000, and the mine currently is in final reclamation. An AVF located along a portion of Sage Creek occurs approximately 3.5 miles east of the permit area. No mining activities took place within the Sage Creek watershed, and, therefore, there were no surface water impacts. However, groundwater impacts may be induced by mining geologic units supplying discharge to the AVF.

Subregion 4

The Subregion 4 area, in the northwest portion of the Wyoming PRB, contains the former Public Service Company of Oklahoma (PSO) Ash Creek, Big Horn Coal, and Welch No. 1 North mines. None of these mines currently are active. The Ash Creek Mine currently is in field reclamation, and the Big Horn Mine is in final reclamation. The Welch No. 1 Mine was never developed beyond a small test pit. All of these mines contained AVFs.

PSO Ash Creek Mine (SDD, Permit No. 407-T1). Within the former PSO Ash Creek Mine permit area, one AVF was identified along Little Youngs Creek. The AVF extends across the northeastern portion of the permit boundary and across adjacent areas 0.5 mile upstream and downstream of the permit area. There are approximately 54 acres of streamlaid deposits underlying the channel, floodplain, and terraces of Little Youngs Creek. The areal extent of the alluvial gravel aquifer is approximately 66 acres. This 66-acre areal extent of potentially irrigable farmland will be restored during reclamation in accordance with permit requirements. The AVF is "grandfathered" in regard to significance to farming.

Big Horn Mine (SDD, Permit No. 213-T5). AVFs are present within the former mine's permit area, and are described on page MP-14 of the Mine Plan. Appendix D-11 of the permit application contains a detailed discussion of the location and characteristics of these AVFs. Portions of the alluvial systems in T57N, R84W, Sections 13 and 14 were projected to be disturbed by the Pit 3 mine plan. The permanent loss of the AVF area was addressed in the Reclamation Hydrology section of the Reclamation Plan.

Welch No. 1 North Mine (SDD, Permit No. 497-T3). There was a pre-application determination that an AVF significant to farming was present within and adjacent to the historic permit boundary. Addendum 2.11-A contains the WDEQ/LQD Administrator's June 17, 1985, pre-application determination. The associated Figure 2.11-A shows the "AVF Significant to Farming as Determined on 5-25-85." The permit boundary subsequently was reduced, resulting in the majority of the AVF residing adjacent to and outside the T3 permit area boundary.

The T3 permit has no approved Mine Plan. The Reclamation Plan details permanent reclamation or stabilization of the approximately 10 acres of surface disturbance that occurred outside of the AVF area. None of the reclamation activities have the potential to detrimentally affect the AVF within or adjacent to the permit area boundary.

2.2.4 Comparison to Previous Predictions

Soils within the study area have been disturbed by various development activities associated with coal mines, other mines, power plants, transmission lines, pipelines, reservoirs, coal technology plants, railroads, CBNG, and conventional oil and gas. Reclamation has been completed within some of these disturbance areas, thereby reducing the overall level of long-term disturbance to soils.

Predictions made in earlier EISs (BLM 1979, 1981) for development-related disturbance and reclamation activities in the PRB were compared in the Coal Development Status Check (BLM 1996) to actual 1990 and 1994 disturbance and reclamation data. Based on the data in the 1996 document, actual disturbance and reclamation acreages affecting soils in 1994 were 73,321 and 21,964, respectively. In comparison, the existing disturbance acreage affecting soils at the end of 2003 (based on GIS analysis) was 121,890 (ENSR 2005b). Based on the Task 2 database, at the end of 2003, a total of approximately 127,495 acres of previously disturbed land had been reclaimed (ENSR 2005a). Information relative to disturbance and reclamation of AVFs was not presented in these earlier documents.