2.3 Vegetation Including Wetlands and Riparian Areas

2.3.1 Key Issues

Key issues for vegetation resources include:

- Temporary and permanent loss of vegetation;
- Displacement of native vegetation by noxious and invasive plant species as a result of surface disturbance;
- Potential long-term loss of wetlands and riparian areas as a result of groundwater drawdown; and
- Potential decrease in floristic diversity within wetland and riparian areas in the long-term as a result of increased soil salinity related to the discharge of groundwater to drainages.

2.3.2 Study Area

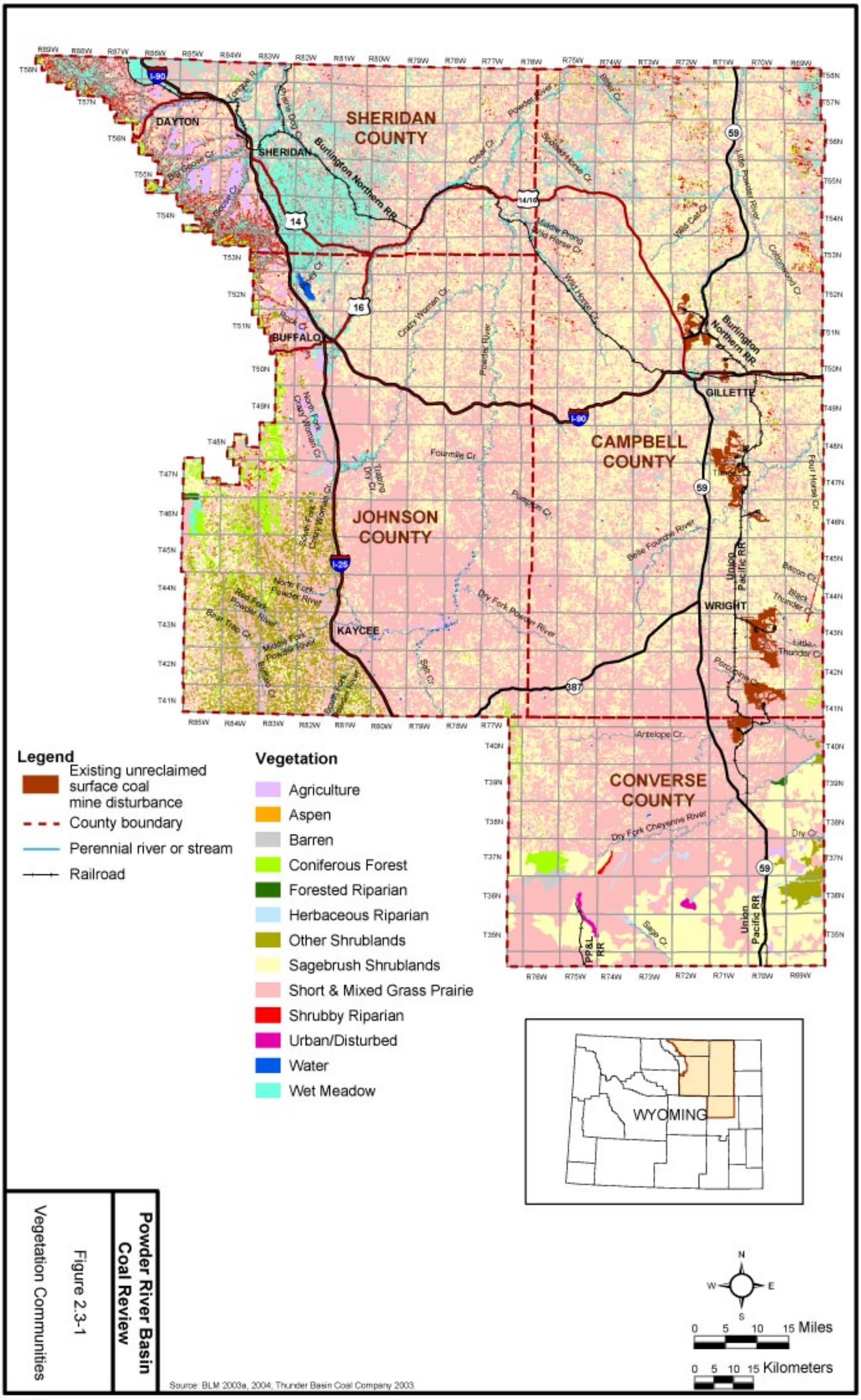
The study area for vegetation (including wetlands and riparian areas) includes all or portions of Sheridan, Johnson, Campbell, and Converse counties (**Figure 1-1**). It includes all of the area administered by the BLM Buffalo Field Office, a portion of the area administered by the BLM Casper Field Office, 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**).

2.3.3 Current Conditions

The PRB study area is characterized as a mosaic of general vegetation types, which include prairie grasslands, shrublands, forested areas, and riparian areas. These broad categories often represent several vegetation types that are similar in terms of dominant species and ecological importance. Wyoming Game and Fish Department (WGFD) land cover classifications mapping and Gap Analysis Project (GAP) resources generated by the USGS Biological Resources Division were used to identify specific vegetation types within the PRB study area. Fourteen vegetation types were identified, of which ten primarily consist of native vegetation and are collectively classified as rangeland. These vegetation types include short-grass prairie, mixed-grass prairie, sagebrush shrubland, other shrubland, coniferous forest, aspen, forested riparian, shrubby riparian, herbaceous riparian, and wet meadow. The remaining vegetation types support limited or non-native vegetation and include cropland, urban/disturbed, barren, and open water.

2.3.3.1 General Vegetation

Figure 2.3-1 illustrates the vegetation types within the PRB study area and primarily was derived from detailed WGFD land cover classifications mapping data and GAP data. **Table 2.3-1** provides the approximate acreages of pre-disturbance vegetation types present within the PRB study area by subwatersheds. **Tables 2.3-2** and **2.3-3** provide approximate total existing disturbance acreages of vegetation types from past and present development and approximate existing coal mine-related disturbance of vegetation types, respectively, within the subwatersheds in the PRB study area.



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

Powder River Basin Coal Review

Figure 2.3-1
Vegetation Communities

6/20/05

Table 2.3-1
Pre-disturbance Vegetation Types by Subwatershed
(acres)

Subwatershed	Cropland	Aspen	Barren	Coniferous Forest	Forest Riparian	Herbaceous Riparian	Mixed-grass Prairie	Other Shrubland	Sagebrush Shrubland	Short-grass Prairie	Shrubby Riparian	Urban/ Disturbed	Open Water	Wet Meadow	Total
Little Bighorn River	683	0	0	4,497	601	0	22,088	190	4,331	1,093	10,607	0	44	5,450	49,584
Upper Tongue River	59,054	12	4,121	15,268	3,172	67	303,681	538	119,743	124,204	32,931	0	1,106	75,985	739,883
Middle Fork Powder River	584	3	16,300	50,714	1,767	5	107,780	106,068	61,800	117,613	173	0	202	1,441	464,450
North Fork Powder River	0	0	0	3,060	1,628	0	8,583	643	4,788	109	0	0	0	1,864	20,674
Upper Powder River	5,958	0	25,154	6,715	0	0	108,273	13	424,945	1,020,637	582	0	1,385	9,857	1,603,52
South Fork Powder River	1	0	1,803	2,545	48	0	24,744	30,090	12,255	42,727	0	0	145	0	114,355
Salt Creek	0	0	186	3,562	0	0	3,892	779	42,588	101,205	0	0	148	0	152,360
Crazy Woman Creek	8,567	56	9,114	33,127	636	46	112,690	15,892	124,132	237,516	1,059	0	426	5,021	548,283
Clear Creek	27,184	0	4,754	11,510	1,033	41	170,380	1,799	128,218	156,872	9,347	0	3,607	32,732	547,476
Middle Powder River	1,143	0	3,265	10,636	0	0	72,552	0	47,363	81,888	547	0	0	6,835	224,230
Little Powder River	998	0	9,447	26,102	0	0	172,184	0	375,460	267,547	1,750	0	636	11,359	865,482
Little Missouri River	320	0	144	567	0	0	20,842	0	7,175	5,853	550	0	0	3,078	38,528
Antelope Creek	398	0	5,095	6,750	948	0	15,336	387	124,618	506,336	0	0	430	0	660,298
Dry Fork Cheyenne River	795	0	8,827	9,040	1,518	5,198	105,618	1,340	58,898	116,898	771	384	29	0	309,316
Upper Cheyenne River	108	0	2,771	4,477	141	114	6,147	0	87,729	104,629	169	0	419	99	206,803
Lightning Creek	7,085	0	2,093	0	0	4,263	95,124	20,143	166,207	11,710	0	1,698	0	0	308,321
Upper Belle Fourche River	764	0	18,302	3,355	0	0	85,962	0	353,206	377,016	432	0	612	5,215	844,863
Middle North Platte	0	0	4,147	260	0	2,604	112,635	0	90,647	0	0	2,280	0	0	212,573
Total	**113,643**	**71**	**115,524**	**192,184**	**11,491**	**12,337**	**1,548,511**	**177,880**	**2,234,103**	**3,273,850**	**58,917**	**4,362**	**9,189**	**158,937**	**7,911,00**

Source: BLM 2003a.

Table 2.3-2
Total Existing Vegetation Disturbance from Development by Subwatershed[1]
(acres)

Sub-watershed	Cropland	Aspen	Barren	Coniferous Forest	Forest Riparian	Herbaceous Riparian	Mixed-grass and Short-grass Prairie[2]	Other Shrublands	Sagebrush Shrublands	Shrubby Riparian	Urban /Disturbed	Open Water	Wet Meadow	Total
Little Bighorn River	1	0	0	0	0	0	54	0	4	5	0	0	<1	64
Upper Tongue River	298	0	75	12	2	0	1,906	0	732	117	0	11	421	3,574
Middle Fork Powder River	0	0	16	0	2	0	192	35	14	0	0	0	0	259
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	94	0	167	24	0	0	8,164	<1	3,745	4	0	5	241	12,444
South Fork Powder River	0	0	3	42	0	0	160	54	54	0	0	0	0	313
Salt Creek	0	0	1	19	0	0	1,003	7	195	0	0	0	0	1,225
Crazy Woman Creek	39	0	4	0	<1	0	367	27	47	<1	0	0	10	494
Clear Creek	193	0	13	3	<1	0	1,620	0	607	41	0	1,552	376	4,405
Middle Powder River	23	0	33	35	0	0	1,566	0	522	7	0	0	111	2,297
Little Powder River	31	0	433	147	0	0	9,017	0	7,740	168	0	123	237	17,896
Little Missouri River	3	0	0	1	0	0	119	0	21	1	0	0	18	163
Antelope Creek	5	0	241	127	7	0	16,463	0	2,838	0	0	126	0	19,807
Dry Fork Cheyenne River	5	0	65	4	0	25	1,043	11	522	3	6	0	0	1,684
Upper Cheyenne River	6	0	135	123	2	3	8,772	0	7,551	2	0	58	4	16,656
Lightning Creek	38	0	8	0	0	37	898	119	1,800	0	<1	0	0	2,900
Upper Belle Fourche River	14	0	1,440	47	0	0	19,120	0	16,107	56	0	180	184	37,148
Middle North Platte River	0	0	0	0	0	6	271	0	271	0	13	0	0	561
Total	**750**	**0**	**2,634**	**584**	**13**	**71**	**70,735**	**253**	**42,770**	**404**	**19**	**2,055**	**1,602**	**121,890**

[1]GIS analysis of development-related vegetation disturbance through 2003 (inclusive of coal mine-related disturbance).
[2]The GIS files do not distinguish between mixed-grass and short-grass prairie communities; they are combined.

Source: ENSR 2005b.

Table 2.3-3
Total Existing Vegetation Disturbance from Coal Mine Development by Subwatershed
(acres)

Sub-watershed	Cropland	Aspen	Barren	Coniferous Forest	Forest Riparian	Herbaceous Riparian	Mixed-grass and Short-grass Prairie[1]	Other Shrublands	Sagebrush Shrublands	Shrubby Riparian	Urban /Disturbed	Open Water	Wet Meadow	Total
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crazy Woman Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clear Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Powder River	12	0	346	58	0	0	3,717	0	3,537	164	0	118	66	8,018
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	0	0	203	101	0	0	11,526	0	1,831	0	0	124	0	13,785
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	0	0	93	114	0	0	7,249	0	6,216	0	0	54	0	13,726
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	0	0	1,036	26	0	0	6,625	0	7,629	48	0	175	39	15,578
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**12**	**0**	**1,678**	**299**	**0**	**0**	**29,117**	**0**	**19,213**	**212**	**0**	**471**	**105**	**51,107**

[1]The GIS files do not distinguish between mixed-grass and short-grass prairies; they are combined.

Source: ENSR 2005b.

Short-grass Prairie

The short-grass prairie vegetation community accounted for 41 percent of the pre-disturbance vegetation in the PRB study area. This vegetation community represents very sparse, sparse, and thin dry herbaceous rangeland types, as defined by the WGFD. Short-grass prairie occurs on drought-prone, mildly alkaline, medium- and fine-textured soils. Few shrubs grow consistently in short-grass prairie, because the soils are too dry and compacted to support them. Precipitation is an important determinant of the composition of plant species in grasslands. Average annual precipitation for short-grass prairie is between 10 and 16 inches per year (Colorado Natural Areas Program 1998). In Wyoming, short-grass prairie occurs primarily in the southeastern portion of the state and southward into Colorado. Within the PRB study area, short-grass prairie areas are most common in the south, occurring as the dominant vegetation community from the southern foothills of the Big Horn Mountains to the eastern PRB study area boundary. The two dominant plant species are blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*). Other plant species common to the short-grass prairie include western wheatgrass (*Pascopyrum smithii*), sand dropseed (*Sporobolus cryptandrus*), needle-and-thread (*Stipa comata*), scarlet globemallow (*Sphaeralcea coccinea*), and four-wing saltbush (*Atriplex canescens*).

Mixed-grass Prairie

The mixed-grass prairie vegetation community accounted for 20 percent of the pre-disturbance vegetation in the PRB study area. This vegetation community is a combination of low, medium, and high herbaceous rangeland types, as defined by WGFD. Low, medium, and high refer to the chlorophyll content of the vegetation, as determined by remote sensing that was used to generate the vegetation type maps. The measure of chlorophyll content provides a rough approximation of the density of the vegetation. Mixed-grass prairie can be divided into several types and is characterized by several common species including needle-and-thread, western wheatgrass, blue grama, prickly pear cactus (*Opuntia* spp.), and scarlet globemallow. Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*) is a common shrub of this grass community in the PRB (Knight 1994). Within the PRB study area, mixed-grass prairie areas are most common along the eastern foothills of the Big Horn Mountains and sporadically occur throughout much of the northern and central portions of the PRB study area.

Sagebrush Shrubland

The sagebrush shrubland vegetation community accounted for 28 percent of the pre-disturbance vegetation in the PRB study area. This vegetation community includes a combination of sparse, moderately dense, and dense Wyoming big sagebrush crown closure with a variety of understory grasses and forbs. The sagebrush shrubland is widely distributed and occupies a large proportion of the PRB study area. Plant species that typically occur in this vegetation type may include Wyoming big sagebrush, silver sagebrush (*Artemisia cana*), western wheatgrass, junegrass (*Koeleria macrantha*), needle-and-thread grass, Sandberg bluegrass (*Poa secunda*), prickly pear cactus, scarlet globemallow, and rabbitbrush (*Chrysothamnus* spp.). Sagebrush shrublands occur throughout the entire PRB study area, with the Big Horn Mountains and associated foothills as the only exceptions. Larger, more contiguous tracts of sagebrush occur in the northeastern, central, and eastern portions of the PRB study area.

Other Shrubland

The other shrubland vegetation type accounted for 2 percent of the pre-disturbance vegetation in the PRB study area. This vegetation type is composed of three distinct shrub-dominate plant communities: mountain-mahogany shrubland, mixed foothill shrubland, and greasewood shrubland. The mountain-mahogany shrubland community is the largest component of the other shrubland vegetation type and has two species-dominated sub-classes. The first community occurs primarily in the foothills of the Big Horn Mountains in southwestern Johnson County and is dominated by curl-leaf mountain mahogany (*Cercocarpus ledifolius*). The second community, occurring in the southern portion of the PRB study area, is dominated by true mountain-mahogany (*Cercocarpus montanus*). The two mountain-mahogany shrubland communities occur on poorly developed soils derived from sandstone, limestone, and shale (Knight 1994). Plant species found in the undergrowth of this community include fringed sage (*Artemisia frigida*), sulfurflower buckwheat (*Eriogonum umbellatum*), bluebunch wheatgrass (*Elymus spicatum*), and junegrass.

The other two components of the other shrubland vegetation type are intermingled among the mountain-mahogany communities. The mixed foothill shrubland community is dominated by mountain big sagebrush (*Artemisia tridentata* var. *vaseyana*) interspersed with antelope bitterbrush (*Purshia tridentata*), serviceberry (*Amelanchier alnifolia*), skunkbush sumac (*Rhus trilobata*), common chokecherry (*Prunus virginiana*), and snowberry (*Symphoricarpos* spp.). Common forbs and grasses found in the mixed foothill shrubland may include lupine (*Lupinus* spp.), arrowleaf balsamroot (*Balsamorhiza sagittata*), hairy goldenaster (*Heterotheca villosa*), basin wildrye (*Elymus cinereus*), and junegrass. The greasewood shrubland community, dominated by greasewood (*Sarcobatus vermiculatus*), exhibits limited distribution on saline soils near seeps or perched water tables.

Coniferous Forest

The coniferous forest vegetation community accounted for 2 percent of the pre-disturbance vegetation in the PRB study area. This vegetation community, as defined by WGFD, includes Engelmann spruce (*Picea engelmannii*), Douglas fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta* var. *latifolia*), ponderosa pine (*Pinus ponderosa*), limber pine (*Pinus flexilis*), and juniper (*Juniperus* spp.). These species tend to form associations based on elevation, exposure, and soil moisture. Typically, these species are segregated according to elevation. Juniper and pine forests tend to be lower in elevation, while spruce and fir forests occur at higher elevations. This vegetation community occurs primarily along the western edge of the PRB study area, where the upper-elevation conifer species are more common and in the northeastern corner where the lower elevation species are more common.

Aspen

The aspen vegetation community accounted for less than 1 percent of the pre-disturbance vegetation in the PRB study area. Aspen communities typically occur in depressions, ravines, valley bottoms, or on the lee sides of ridges. Aspen seedlings are intolerant of drier conditions, and, therefore, this community distribution typically is dictated by the availability of soil moisture. The understory of the aspen vegetation community has greater productivity and species diversity than any other forested upland vegetation type in the PRB study area (Mueggler 1985). Quaking aspen (*Populus tremuloides*) is the dominant species in the aspen vegetation community. Common plant

species in aspen stands include common snowberry (*Symphoricarpos albus*), serviceberry, Woods' rose (*Rosa woodsii*), western yarrow (*Achillea millefolium* var. *lanulosa*), wild geranium (*Geranium* spp.), mountain brome (*Bromus marginatus*), and elk sedge (*Carex geyeri*). Many stands of aspen are a seral (i.e., transitional) community that would have conifers of various ages growing within them. In the PRB study area, this vegetation type is limited to the Big Horn Mountains.

Cropland

The agricultural vegetation type accounted for 1 percent of the vegetation cover in the PRB study area. This land cover type is defined as croplands that are plowed or planted. These areas also may include wooded or shrubby draws and riparian areas. Agricultural areas are most common along the eastern edge of the Big Horn Mountains, along the major drainages, and near Wright and Gillette.

Urban/Disturbed

The urban/disturbed category accounted for less than 1 percent of the surface area in the PRB study area. This category includes lands covered by homes, businesses, streets, and a portion of the unvegetated surface mining areas present in the PRB. It is most common around cities and towns and along the eastern edge of the PRB study area where many coal mines are located. A detailed description of the areas disturbed by surface mining is included below in the Existing Disturbance subsection.

Barren

The barren category accounted for 1 percent of the surface area in the PRB study area. This cover type includes rock outcrops, roads, sandbars, eroded gullies, and areas with less than 10 percent ground cover and perennial snow and ice areas, as defined by WGFD. It occurs as small, scattered areas throughout the PRB study area, and as several large blocks in the southwest portion.

Open Water

The water category accounted for less than 1 percent of the surface area in the PRB study area. This category includes lakes, ponds, streams, and open water in wetlands, as defined by WGFD, and is scattered throughout the PRB study area.

Existing Disturbance

Because of past and present human activities in the PRB study area, substantial areas of vegetation have been altered from their natural condition. The primary sources of surface disturbance to vegetation types have resulted from: oil and gas development; coal mining; uranium, sand, gravel, and scoria mining; ranching; agriculture; road and railroad construction; and rural and urban housing and business development. Some of these alterations are included in the previous discussion of vegetation types, particularly in the agriculture, urban/disturbed, and barren land cover types. The total of existing disturbance acreage (as of end 2003) in each vegetation type by subwatershed have been estimated based on the past and present development activities defined in the Task 2 Report for the PRB Coal Review (ENSR 2005) (**Table 2.3-2**). Coal mine-related vegetation disturbance by subwatershed is presented in **Table 2.3-3**.

Based on GIS analysis, as of the end of 2003, the existing development-related disturbance to vegetation communities (less riparian and wetland vegetation) in the study area was 119,800 acres, of which 50,790 acres of disturbance was related to coal mining activity (see **Tables 2.3-2** and **2.3-3**, respectively). (See Section 2.3.3.2, Riparian and Wetland Vegetation, relative to riparian/wetland vegetation impacts.) The primary vegetation communities impacted as a result of coal mine development have included mixed-grass and short-grass prairie and sagebrush shrublands. Based on the Task 2 database, as of the end of 2003, approximately 127,495 acres of previously disturbed vegetation had been reclaimed, inclusive of approximately 21,238 acres of vegetation disturbance in previously mined areas (ENSR 2005a). It is assumed that the species composition on the reclaimed land is different than surrounding undisturbed lands, particularly in regard to the percent of woody shrub species during the early years following reclamation. Reclaimed mine land is defined by WDEQ as affected land that has been backfilled, graded, topsoil reapplied, and permanently seeded according to approved practices specified in the reclamation plan (Christensen 2002).

The figures showing vegetation (**Figure 2.3-1**) and land use (**Figure 2.7-2**) depict differing distribution of agricultural land within the PRB study area. The extent of agricultural land on these two figures varies because of the different sources used to derive the data. The figure for vegetation was derived from WGFD land cover and GAP data. BLM land use mapping data was the source for the figure for land use.

Other human disturbances to native vegetation typically are smaller in scale and are difficult to quantify in terms of affected acres. One such form of disturbance is damage to vegetation caused by fugitive dust that settles on plants primarily along the periphery of gravel roads. The source of fugitive dust is usually passing vehicles, but also may result from winds blowing across previously disturbed areas such as road corridors or over-grazed land. Fire suppression is another human-induced alteration of native vegetation. By suppressing wildland fires, humans have caused shifts in the vegetation types that are present in the PRB study area. Grazing presents another form of widespread disturbance within the PRB study area, although no solid quantification of impacts to native vegetation can be ascertained. Finally, quantification of the impacts of species such as grasshoppers, Mormon crickets, and prairie dogs presents similar difficulties. Disturbance to native vegetation that results from the above factors is not included in the analysis of the PRB study area vegetation types.

2.3.3.2 Riparian and Wetland Vegetation

Wetland and riparian areas are highly important water-related features in the arid landscape of northeastern Wyoming. Wetland and riparian areas occur throughout the PRB study area in all 18 subwatersheds and typically are restricted to the lands immediately surrounding major and minor rivers, streams, creeks, draws, topographical depressions, lakes, and ponds. Many plant and wildlife species are found in no other habitat types (e.g., certain plant and bird species, amphibians, and turtles), while other wildlife species such as shorebirds, waterfowl, and weasels frequent these habitat types. These small, but important, ecosystems represent a vegetation structure, soil, and hydrology that is unique relative to the vast expanses of sagebrush and prairie grass that dominate the landscape of the region.

Four riparian and wetland vegetation types have been identified in the PRB study area, including forested riparian, shrubby riparian, herbaceous riparian, and wet meadow. These riparian

vegetation types are described below. The acres of occurrence of pre-disturbance riparian and wetland vegetation types within the PRB study area are presented by subwatershed in **Table 2.3-1**.

Forested Riparian

The forested riparian vegetation community accounted for less than 1 percent of the pre-disturbance vegetation in the PRB study area. Areas covered by forested riparian vegetation are more common along some drainages today than in pre-settlement times due to the reduced frequency of tree-damaging floods as a result of reservoir construction and lateral drainage from irrigated uplands (Knight 1994). Forested riparian areas may be shrinking in other locations, particularly where cottonwoods are dominant, because of low cottonwood regeneration rates. This vegetation community is characterized by a variety of deciduous and coniferous tree species that occur along riparian areas, as defined by WGFD. Coniferous forested riparian areas are rare, occurring only in the foothills of the Big Horn Mountains along the western edge of the PRB study area. Deciduous forested riparian areas are much more common and occur throughout the PRB study area. Some common species include plains cottonwood (*Populus deltoides*), narrow-leaf cottonwood (*Populus angustifolia*), quaking aspen, boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), Russian olive (*Elaeagnus angustifolia*), and willow (*Salix* spp). This vegetation community occurs along the major drainages throughout the PRB study area.

Shrubby Riparian

The shrubby riparian vegetation community accounted for less than 1 percent of the pre-disturbance vegetation in the PRB study area. This vegetation community includes a variety of shrub and herbaceous plant species that exist adjacent to draws, gullies, and streams. Within the PRB study area, plant species in this vegetation type may include hawthorn (*Crataegus* spp.), chokecherry (*Prunus virginiana*), peachleaf willow (*Salix amygdaloides*), sandbar willow (*Salix exigua*), other willow species (*Salix* spp.), silver sagebrush, bluejoint reedgrass (*Calamagrostis canadensis*), and tufted hairgrass (*Deschampsia cespitosa*). This vegetation type occurs in small, scattered locations throughout the PRB study area.

Herbaceous Riparian

The herbaceous riparian vegetation community accounted for less than 1 percent of the pre-disturbance vegetation in the PRB study area. This vegetation community consists of a variety of riparian moist grasses, sedges, and rushes. Herbaceous riparian vegetation occurs near drainages including rivers, streams, and creeks. This vegetation community includes plant species common to the wet meadow vegetation type and may include woolly sedge (*Carex lanuginosa*), common spike-rush (*Eleocharis palustris*), foxtail barley (*Hordeum jubatum*), wild licorice (*Glycyrrhiza lepidota*), and Canada goldenrod (*Solidago canadensis*). Very similar to the wet meadow vegetation type, this vegetation cover type often occurs in similar environments. Herbaceous riparian communities occur throughout the PRB study area with most occurrences associated with streams, rivers, and other aquatic habitats.

Wet Meadow

The wet meadow vegetation community accounted for 2 percent of the pre-disturbance vegetation in the PRB study area. This vegetation community is a combination of green and very green

herbaceous rangeland types, as defined by WGFD. Wet meadow is a grassland vegetation community that typically occurs on fine-textured soils in valley bottoms where the water table is high enough to saturate the soil during a portion of the growing season. In addition, this vegetation community commonly occurs where springs emerge, along reservoirs, and in irrigated pastures (Knight 1994). Depending on salinity and water table, common species include Baltic rush (*Juncus balticus*), Nebraska sedge (*Carex nebrascensis*), prairie cordgrass (*Spartina pectinata*), and redtop bentgrass (*Agrostis stolonifera*). Species composition in the proximity of human activity, such as reservoirs and irrigated pasture, tends to exhibit dominance by introduced species such as Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), and smooth brome (*Bromus inermis*). Within the PRB study area, wet meadow habitats are widely distributed and often insular in their occurrence. Wet meadows are more common in the northern and western portions of the PRB study area than in the southern and eastern portions. Wet meadows tend to exist as island habitats surrounded by dominant plant communities such as grasslands or shrublands.

The extent and distribution of these four wetland/riparian vegetation types is shown in **Figure 2.3-1**. However, many of the riparian areas in the PRB study area are too small to be plotted on a map of this scale, including the riparian corridors of nearly all of the major rivers and streams. Approximately 3 percent of the PRB study area consists of riparian and wetland vegetation. Almost 47 percent (112,156 acres) of the approximately 242,000 acres of riparian areas and wetlands in the PRB study area is contained in the Upper Tongue River subwatershed. The dominant type of riparian area and wetland is the wet meadow that constitutes approximately 66 percent (approximately 160,000 acres) of all riparian areas and wetlands within the PRB study area. The subwatershed with the greatest proportion of riparian areas and wetlands, approximately 34 percent, is the Little Bighorn River. The Upper Tongue River subwatershed has the greatest extent (3,172 acres) of the forested riparian ecosystem; however, the North Fork Powder River subwatershed has the highest proportion, approximately 8 percent, of this type. The Upper Tongue River subwatershed has the greatest extent (32,931 acres) of the shrubby riparian ecosystem; however, the Little Bighorn River subwatershed has the highest proportion (approximately 21 percent) of this type. The Dry Fork Cheyenne River subwatershed has the greatest extent (5,198 acres) of the herbaceous riparian ecosystem and the highest proportion (almost 2 percent) of this type. The Upper Tongue River subwatershed has the greatest extent (75,985 acres) and second-highest proportion (approximately 10 percent) of the wet meadow wetland type, but the Little Bighorn River subwatershed has the highest proportion (almost 11 percent) of this type.

Riparian and Wetland Ecosystem Functions

Riparian and wetland ecosystems have various functions that occur at the landscape scale, including: 1) flood storage and flood-peak desynchronization; 2) recharge to the groundwater aquifer; 3) flood-flow attenuation; 4) purification of water via removal of nutrients and toxic compounds; and 5) recreation (Carter 1986; Zinn and Copeland 2001). These functions apply to all riparian zones of the subwatersheds within the PRB study area. Evaporation rates in much of Wyoming, including the PRB study area, greatly exceed precipitation rates, and the gentle slopes or relatively flat valleys of many of the 18 subwatersheds contribute to generally low-flow, highly sinuous rivers and streams spaced widely apart that have very narrow and limited riparian corridors.

The ecological community-scale functions of riparian ecosystems include: 1) the presence of surface water and abundant soil moisture that attracts or facilitates plant and animal occurrence; 2) high productivity within various food chains; 3) disproportionate species richness and abundance

relative to surrounding areas; 4) diversity and interspersion of habitat features that create more niches for plants and animals; and 5) corridors for animal dispersion and migration (Brinson et al. 1981). The functions of riparian and wetland ecosystems at the ecological community scale ultimately depend on the hydrology of the watershed. The rates of sedimentation and nutrient deposition, as well as the energy of water flow and local soil types, affect the vegetation community that establishes itself and thrives in the riparian zone. Other factors that influence the riparian vegetation include elevation and moisture gradients, floodplain width, and shallow groundwater depth. These components also influence the wildlife communities that are attracted to, and use, the riparian zone.

Hunters, anglers, bird watchers, and biologists have long recognized the value of riparian ecosystems to fish and wildlife. Riparian ecosystems are particularly valuable in a dry environment such as Wyoming. It has been estimated that, although only 1 percent or less of the region is classified as riparian land, approximately 80 percent of the native animals depend on riparian zones for food, water, shelter, and migration routes during some time of the year (Olson and Gerhart 1982). Riparian ecosystems are known for high animal species richness relative to other ecosystem types. Individual stands of riparian woodland average 20 to 34 species of breeding birds, and population densities of breeding birds in riparian areas average 1.5 to almost 6 pairs per acre. Riparian woodlands also may contain, on average, 5 to 30 species of mammals with a comparable species richness for amphibians and reptiles (Brinson et al. 1981). Based on the GAP model analysis, it is estimated that 201 to 319 species of terrestrial vertebrates inhabit the wetland and riparian areas in the PRB study area (University of Wyoming 2002).

Existing Wetland and Riparian Impacts

Alteration of hydrologic conditions can affect the physical and chemical properties in a wetland, such as pH, soil salinity, sediment properties, oxygen content, and nutrient availability. These wetland properties affect the biota in terms of establishment, recruitment, maintenance, and spatial arrangement. Small changes in the hydrologic conditions can result in massive responses by wetland biota in terms of species composition, species richness, and ecosystem productivity (Mitsch and Gosselink 1993). Peak flows, periodic flooding, and related stream channel processes, such as meandering, are closely related to the reproduction and growth of riparian plant species (Busch and Scott 1995). The maintenance of cottonwood and willow populations in riparian ecosystems depends on ground availability of water that, in turn, depends on instream flows (Busch et al. 1992). Changes to the interrelationships among surface water dynamics, groundwater level, and river channel processes can lead to changes in the establishment and maintenance of dependent riparian plant communities (Busch and Scott 1995).

The primary existing impacts to the riparian ecosystems of the PRB study area (e.g., livestock grazing and agricultural water withdrawals) are similar to riparian ecosystems throughout the West. Riparian vegetation and the availability of water in an otherwise dry landscape tend to attract livestock. Livestock spend more time grazing in riparian ecosystems than in adjacent uplands. Grazing along primarily low-order streams can cause increased erosion and sedimentation, decreased water quality via introduction of pathogens and excess nutrients, and channel downcutting (Brinson et al. 1981; Kauffman and Kreuger 1984). Grazing removes plants through consumption and trampling, particularly young plants, thereby affecting the age structure and reproduction of the plant population. Species composition of the riparian ecosystem also may be altered (Brinson et al. 1981). As a result of these impacts, the functions of the riparian and wetland

ecosystems may be diminished or disappear altogether. The potential indirect effects that would follow include increased flows, diminished flood storage capacity, increased frequency of flooding, increased upland erosion and sedimentation, decreased water quality, increased water temperature, and decreased aquatic biota species diversity. Details regarding the current condition of riparian ecosystems on specific rivers within the PRB study area are not available.

Agricultural uses have, in many cases, diminished the minimum instream flows necessary to sustain aquatic life and the riparian ecosystem for numerous streams and rivers in the arid Rocky Mountain states (Mitsch and Gosselink 1993). Water withdrawal reduces the availability of water for the maintenance of riparian ecosystems and, in extreme cases, can alter the composition of the plant community to include more upland species or eliminate the riparian or wetland ecosystem. Water diversions and withdrawals also can upset the salt balance by minimizing the flood frequency that usually leaches soil salts within the floodplain (Brinson et al. 1981). Additionally, return flows from irrigated fields in the arid West often contain high levels of inorganic salts, selenium, and other metals that may negatively affect water quality in the rivers or streams. Downstream uses (e.g., municipal and livestock water supply and aquatic habitat) may be adversely affected by excessive amounts of salts and metals that currently are being introduced by the return flows from irrigated fields. The existing water quality parameters (e.g., concentrations of metals such as selenium, sodium adsorption ratio, salinity, and total dissolved solids) are discussed in the Task 1B Report for the PRB Coal Review, Water Resources (ENSR 2005c). Ninety-eight percent of the surface water withdrawals from the rivers and streams in the PRB study area are for irrigation. Approximately one-third of the surface water withdrawals in the PRB study area occur in the Upper Tongue River subwatershed. The other major surface water withdrawals occur in the North Fork Powder River (17 percent) and Clear Creek (13 percent) subwatersheds. Recent data on surface water withdrawal for the Upper Tongue River subwatershed indicate that nearly twice the mean flow and approximately 50 percent of the maximum flow were withdrawn for irrigation. Consequently, little, if any, water flows under these conditions were reaching riparian areas and wetlands that historically had received normal water flows. As a result, many riparian ecosystems and wetlands in the Upper Tongue River subwatershed, and in other subwatersheds with major water withdrawals, may have been eliminated or substantially degraded in recent years.

Based on GIS analysis, as of the end of 2003, the existing development-related disturbance to wetland and riparian areas in the study area was 2,090 acres, of which 317 acres of disturbance was related to coal mining activity (see **Tables 2.3-2** and **2.3-3**, respectively). The primary communities impacted as a result of coal mine development have included shrubby riparian and wet meadows.

Water that is produced by the extraction of CBNG currently is being gathered from individual wells and discharged at the surface. In 2000, almost 4,000 permitted outfalls were discharging water at the surface within the PRB study area (WDEQ 2001). Nearly all (94 percent) of these discharges were related to CBNG wells. Approximately 50 percent of the permitted outfalls are within the Upper Belle Fourche River subwatershed, while 21 percent are in the Upper Powder River subwatershed, and 14 percent are in the Little Powder River subwatershed (BLM 2003a). It is not known how much of the produced water reaches the streams and wetlands of the subwatersheds of the PRB study area. Some stream segments, including ephemeral and often dry segments, received produced water continuously over the course of the year 2000. It can be assumed that existing riparian areas that received continuous input of produced water were affected through abnormal inundation, overly saturated soils, increased flow velocity and subsequent erosion, impediment of seedling

recruitment, and other factors. The water quality of the produced water from existing CBNG wells also is likely to cause adverse effects to riparian ecosystems and wetlands (BLM 2003a). Sodium absorption ratios of 13 or more can cause irreversible changes to soil structure that cause reduced percolation of rainfall and surface water flows, restrict root growth, limit permeability of gases and moisture, and cause difficult tillage (Seelig 2000; U.S. Salinity Laboratory Staff 1954). Such effects from the releases of produced water during recent years may have caused increased erosion of uplands leading to greater sedimentation in riparian areas and wetlands, as well as a reduction in plant seedling recruitment and vigor of established plant communities (BLM 2003a).

2.3.3.3 Invasive and Non-native Species

Once established, invasive and non-native plant species can outcompete and eventually replace native species, thereby reducing forage productivity and the overall vigor of existing native plant communities. The State of Wyoming has designated 25 plant species as noxious weeds. These species are listed in **Table 2.3-4**.

Table 2.3-4
State of Wyoming Designated Noxious Weeds

Common Name	Scientific Name
Russian knapweed	*Acroptilon repens*
Skeletonleaf bursage	*Ambrosia tomentosa*
Common burdock	*Arctium minus*
Hoary cress	*Cardaria draba*
Hairy whitetop	*Cardaria pubescens*
Plumeless thistle	*Carduus acanthoides*
Musk thistle	*Carduus nutans*
Diffuse knapweed	*Centaurea diffusa*
Spotted knapweed	*Centaurea biebersteinii*
Canada thistle	*Cirsium arvense*
Field bindweed	*Convolvulus arvensis*
Houndstongue	*Cynoglossum officinale*
Quackgrass	*Elymus repens*
Leafy spurge	*Euphorbia esula*
Common St. Johnswort	*Hypericum perforatum*
Dyer's woad	*Isatis tinctoria*
Perennial pepperweed	*Lepidium latifolium*
Ox-eye daisy	*Leucanthemum vulgare*
Dalmation toadflax	*Linaria dalmatica*
Yellow toadflax	*Linaria vulgaris*
Purple loosestrife	*Lythrum salicaria*
Scotch thistle	*Onopordum acanthium*
Perennial sowthistle	*Sonchus arvensis*
Saltcedar	*Tamarix chinensis*
Common tansy	*Tanacetum vulgare*

Wyoming is experiencing rapid introduction and spread of noxious weeds on all lands throughout the state, regardless of surface ownership. The potential for noxious weeds to continue spreading to new areas, particularly areas of disturbance, is high. As a collaborative effort, the BLM, South Goshen Cooperative Extension Conservation District, Wyoming Department of Agriculture, NRCS,

and 42 private surface owners joined WGFD and Weed and Pest District officials in efforts to control the spread of noxious weeds. This group agreed to a long-term integrated weed management plan, public awareness and prevention programs, and a common inventory, while monitoring and reporting on their progress.

Noxious weeds occur throughout the PRB study area. Their occurrence, distribution, and density are variable and are influenced by many factors, including disturbance type and frequency, climatic conditions, soil conditions, and local management efforts. Noxious weed lists are maintained by the Wyoming Department of Agriculture and by county weed and pest districts. Data relative to known occurrences of noxious weeds or species of concern are scarce. However, county-specific information obtained from the University of Wyoming Cooperative Agricultural Pest Survey (CAPS) detailing the estimated acres of infestation for four of the state-designated noxious weeds is listed in **Table 2.3-5**.

Table 2.3-5
Known Occurrences of Noxious and Invasive Species of Concern

Species	Campbell County	Converse County	Johnson County	Sheridan County
Broom snakeweed	Yes	Yes	Yes	Yes
Buffalobur	Yes	Yes	Yes	Yes
Bull thistle	No	Yes	Yes	Yes
Cheatgrass	Yes	Yes	Yes	Yes
Common cocklebur	Yes	Yes	Yes	Yes
Common lambsquarters	Yes	Yes	Yes	Yes
Common mullein	Yes	Yes	Yes	Yes
Common sunflower	Yes	Yes	Yes	Yes
Curlycup gumweed	Yes	Yes	Yes	Yes
Dyer's woad	No	No	No	No
Halogeton	Yes	Yes	Yes	No
Kochia	Yes	Yes	Yes	Yes
Milkweed	Yes	Yes	No	No
Ox-eye daisy	No	No	Yes	Yes
Perennial sowthistle	Yes	Yes	No	No
Pigweed	Yes	Yes	Yes	Yes
Plains larkspur	Yes	Yes	No	No
Platte thistle	No	Yes	Yes	No
Plumeless thistle	No	Yes	Yes	No
Pricklypear cactus	Yes	Yes	Yes	Yes
Puncturevine	No	Yes	No	No
Ragweed	Yes	Yes	Yes	Yes
Russian thistle	Yes	Yes	Yes	No
Sandbur	Yes	Yes	N/A	N/A
Sulfur cinquefoil	Yes	No	No	Yes
Sumpweed	N/A	Yes	Yes	Yes
Tarweed	N/A	Yes	N/A	N/A
Wild licorice	Yes	Yes	Yes	Yes
Wild oat	Yes	Yes	Yes	Yes
Yellow bedstraw	No	Yes	No	No

Sources: Dorn 1992; CAPS 1999; Gonzales 2005; Griswold 2002; Lewis 2002; and Litzel 2002.

N/A = Not available.

In addition to the state-designated list of noxious weeds, Campbell, Converse, Johnson, and Sheridan counties declared weeds of concern in the year 2000 under the authority of the Wyoming Weed and Pest Control Act. Noxious weeds tracked by individual counties include: common cocklebur (*Xanthium strumarium*) and wild licorice (*Glycyrrhiza lepidota*) in Campbell county; chicory (*Cichorium intybus*) and Dames rocket (*Hesperis matronalis*) in Converse County; and common mullein (*Verbascum thapsus*), common cocklebur, and wild licorice in Johnson County. No noxious weed species were identified for tracking in Sheridan County.

The distribution and spread of many plant species of concern currently are being monitored by CAPS in association with county weed and pest districts and the Wyoming Department of Agriculture. Some additional species being monitored that occur within the PRB study area include: broom snakeweed (*Gutierrezia sarothrae*), buffalobur (*Solanum rostratum*), bull thistle (*Cirsium vulgare*), cheatgrass (*Bromus tectorum*), common lambsquarters (*Chenopodium album*), common sunflower (*Helianthus annuus*), curlycup gumweed (*Grindelia squarrosa*), halogeton (*Halogeton glomeratus*), kochia (*Kochia scoparia*), milkweed (*Asclepias* spp.), pigweed (*Amaranthus* spp.), plains larkspur (*Delphinium geyeri*), platte thistle (*Cirsium canescens*), pricklypear cactus (*Opuntia polyacantha*), puncturevine (*Tribulus terrestris*), ragweed (*Ambrosia* spp.) Russian thistle (*Salsola australis*), sandbur (*Cenchrus longispinus*), sulfur cinquefoil (*Potentilla recta*), sumpweed (*Iva xanthifolia*), tarweed (*Madia glomerata*), wild oat (*Avena fatua*), and yellow bedstraw (*Galium verum*).

Table 2.3-6 lists the known presence or absence per county of the plant species of concern monitored by the CAPS program and individual weed and pest control districts. Included in **Table 2.3-6** are state-designated noxious weeds where no estimates of the acres of infestation were available.

Although data relative to known occurrences of noxious weeds in the PRB study area is scarce, the actual occurrence potential is assumed to be commensurate with the type and frequency of disturbance and the site-specific reclamation and weed control measures that currently are or would be implemented.

2.3.3.4 Special Status Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species that are protected under the Endangered Species Act (ESA), or are considered candidates for such listing by the U.S. Fish and Wildlife Service (USFWS), as well as BLM, USFS, and WGFD sensitive species.

In accordance with the ESA, as amended, land management agencies in coordination with the USFWS must ensure that any action that they authorize, fund, or carry out would not adversely affect a federally listed threatened or endangered species. In addition, as stated in Special Status Species Management Policy 6840 (6840 Policy) (Rel. 6-151), it also is BLM policy “to conserve listed species and the ecosystems on which they depend, and to ensure that actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status

species and do not contribute to the need to list any special status species, either under the provisions of the ESA or other provisions" identified in the 6840 Policy.

Table 2.3-6
Occurrence of Noxious Weeds and Invasive Species of Concern in Campbell, Converse, Johnson, and Sheridan Counties

Species	Areal Extent of Infestation[1] (acres)						
	<10	11 to 100	101 to 1,000	1,001 to 5,000	5,001 to 10,000	>10,000	Known to Occur
Black henbane	Co	Ca					
Canada thistle					S	Ca, Co, J	
Common burdock		Ca	Co	J, S			
Dalmation toadflax	J, S	Co	Ca				
Diffuse knapweed		Co	Ca, J				
Field bindweed			Co	Ca, J			S
Foxtail barley				C			Ca, J
Hoary cress			Ca, Co, S	J			
Houndstongue		Ca		S	Co, J		
Jointed goatgrass			Ca,				
Leafy spurge		Co		Ca		J, S	
Musk thistle		Ca, S		J		Co	
Perennial pepperweed	Ca	Co					
Purple loosestrife	S						
Quackgrass			Co, S				Ca, J
Rush skeletonweed	Ca			J			
Russian knapweed			S	Ca, J	Co		
Saltcedar	Co	Ca	s				J
Scotch thistle	S	Ca, Co			J		
Skeletonleaf bursage					Ca		Co, J
Spotted knapweed		Co	Ca, J, S				
Yellow toadflax	Co, J, S						

[1]Ca = Campbell County, Co = Converse County, J = Johnson County, S = Sheridan County.

Source: CAPS 1999; Gonzales 2005; Griswold 2002; Lewis 2002; and Litzel 2002.

A total of eight special status plant species were identified as potentially occurring within the PRB study area, including one federally threatened species, six BLM sensitive species, and one USFS sensitive species. No WGFD sensitive species were identified in the PRB study area. The identified species, their associated habitats, and their potential for occurrence within the PRB study area are summarized below. Occurrence potential was evaluated for each species based on their habitat requirements and/or known distribution.

Ute Ladies'-tresses Orchid. Ute ladies'-tresses orchid (*Spiranthes diluvialis*) is listed as federally threatened (USFWS 1992). This species currently is known from western Nebraska, southeastern

Wyoming, north-central Colorado, northeastern and southern Utah, east-central Idaho, southwestern Montana, and central Washington. In Wyoming, the Ute ladies'-tresses orchid is known from the western Great Plains in Converse, Goshen, Laramie, and Niobrara counties. Rangewide, the Ute ladies'-tresses orchid occurs primarily on moist, sub-irrigated or seasonally flooded soils in valley bottoms, gravel bars, old oxbows, or floodplains bordering springs, lakes, rivers, or perennial streams at elevations between 1,780 and 6,800 feet (Fertig 2000a). Suitable soils vary from sandy or coarse, cobbley alluvium to calcareous, histic, or fine-textured clays and loams. Populations have been documented from alkaline sedge meadows, riverine floodplains, flooded alkaline meadows adjacent to ponderosa pine, Douglas fir woodlands, sagebrush steppe, and streamside floodplains. Some occurrences also are found on agricultural lands managed for winter or early season grazing or hay production. Known sites often have low vegetative cover and may be subjected to periodic disturbances such as flooding or grazing. Populations are often dynamic and "move" within a watershed as disturbances create new habitat or succession eliminates old habitat (Fertig and Beauvais 1999).

In Wyoming, this species is known from four occurrences, all discovered between 1993 and 1997 (Fertig 2000b). As reported by Fertig (2000b), the only population known to occur within the PRB study area is located in Converse County, along a tributary of Antelope Creek. The BLM Casper Field Office administers the land at this location. This population is characterized as stable, with the number of observed individual plants varying between 11 and 35 during the period between 1990 and 1994. The three remaining Wyoming populations found outside of the PRB study area are located in Goshen, Niobrara, and Laramie counties on lands owned by the State of Wyoming and private parties. These populations are characterized as stable to increasing.

Laramie Columbine. The Laramie columbine (*Aquilegia laramiensis*) is a BLM sensitive species. This species is endemic to the Laramie Range of southeast Wyoming (Fertig 2000c) where it is known from eight extant populations in extreme southern Converse County and northern Albany County (Fertig and Beauvais 1999). The Laramie columbine is often found in shady crevices of north-facing granite boulders and cliffs with pockets of rich soil at elevations between 6,250 and 8,000 feet amsl (Fertig 2000c). Although no documented occurrences within the PRB study area have been identified, this species may occur in the area within suitable habitats.

Porter's Sagebrush. The Porter's sagebrush (*Artemisia porteri*) is a BLM sensitive species. The species is endemic to Wyoming and is restricted to the Wind River and Powder River basins in Fremont, Johnson, and Natrona counties. Suitable habitat includes sparsely vegetated badlands of ashy or tufaceous mudstones and clay slopes at elevations between 5,300 and 6,500 feet amsl. In the northern Wind River Basin, this species is found in semi-barren, low desert shrub communities dominated by Porter's sagebrush, birdfoot sagebrush, and longleaf wormwood on dry, whitish, ashy-clay hills, gravelly-clay flats, and shaley erosional gullies of the Wagon Bed Formation (Fertig 2000a). Porter's sagebrush is known from eight extant populations in Fremont, Johnson, and Natrona counties (Fertig 2000a). One of the documented populations in southwestern Johnson County is within the PRB study area. This species also may occur in other suitable habitats within the PRB study area.

Nelson's Milkvetch. The Nelson's milkvetch (*Astragalus nelsonianus*) is a BLM sensitive species. The species is regionally endemic to southwestern and central Wyoming, northeastern Utah, and northwestern Colorado. In Wyoming, it is known from the Wind River, Green River, Washakie, southern Powder River, and Great Divide basins; Owl Creek Mountains; and the Rock Springs

Uplift in Fremont, Natrona, and Sweetwater counties. Suitable habitat for this species includes alkaline, often seleniferous, clay flats, shale bluffs and gullies, pebbly slopes, and volcanic cinders. Known occurrences are found primarily in sparsely vegetated sagebrush, juniper, and cushion plant communities at elevations between 5,200 and 7,600 feet amsl (Fertig 2000e). This species is known from 24 extant populations, all located on private lands within central Wyoming (Fertig 2000e). Three populations are known from Johnson County, two of which are located in the eastern portion of the county and within the PRB study area. This species also may occur in other suitable habitats within the PRB study area.

Many-stemmed Spider-flower. The many-stemmed spider-flower (*Cleome multicaulis*) is a BLM sensitive species. Its global distribution includes central Mexico (near Mexico City) to southeastern Arizona, southwestern New Mexico, and southwestern Texas, with disjunct populations in south-central Colorado and central Wyoming. Wyoming populations are restricted to the Sweetwater River Valley in Natrona County. In Wyoming, the many-stemmed spider-flower primarily is found on whitish, alkali-rich, strongly hydrogen-sulfide scented soils that border shallow, spring-fed playa lakes or dried lakebeds. Populations are most abundant on damp, but not flooded, flats with approximately 90 percent cover of alkali-cordgrass, desert saltgrass, Baltic rush, Nuttall's alkali grass, Nevada bulrush, and sea arrowgrass bordering playa lakes. This species also may be present in lower numbers on clayey dunes surrounding alkaline lakes with less than 50 percent cover of cordgrass, arrowgrass, and alkali sacaton or on low hummocks of greasewood. Small patches also may occur in dry alkaline depressions with 20 percent cover of saltgrass, cordgrass, plains sea-blite, smooth hawk's beard, and goldenweed. All Wyoming colonies occur at an elevation of approximately 5,860 feet amsl (Fertig 2000f). This species is known from a single extant site in Natrona County (Fertig 2000f). Based on the species distribution, it is not expected to occur within the PRB study area.

Williams' Wafer-parsnip. The Williams' wafer-parsnip (*Cymopterus williamsii*) is a BLM sensitive species. This species is endemic to, and restricted to, the Big Horn Mountains of north-central Wyoming in Bighorn, Johnson, Natrona, and Washakie counties. Suitable habitat includes open, south, or east-facing ridge tops and upper slopes with exposed limestone outcrops or talus at elevations between 6,000 and 8,300 feet amsl. Suitable soils tend to be thin, sandy, and often restricted to small cracks or pockets in limestone bedrock. Barren rock can provide up to 50 percent of the total cover. This species usually is absent or very uncommon where grass cover is high or where western mountain mahogany and ponderosa pine are dominant. It also tends to be absent from lower slopes or valley bottoms with deeper or better-developed soils. Common associates include timber milkvetch, spatulate milkvetch, alpine bladderpod, whitlow-wort, and stemless hymenoxys (Fertig 2000g). This species is known from 23 extant populations found in the limestone or talus outcrops of the Big Horn Mountains (Fertig 2000g). It may occur in suitable habitats in Johnson County and other suitable habitats within the PRB study area.

Laramie False-sagebrush. The Laramie false-sagebrush (*Sphaeromeria simplex*) is a BLM sensitive species. This species is endemic to southeastern Wyoming in the western foothills of the Laramie Range, Shirley Basin, and Shirley Mountains. The species occupies gentle slopes or rims of dry, rocky limestone-sandstone "pebble plains" in wind-scoured openings. It occurs in cushion plant communities within more densely vegetated stands of juniper, limber pine, big sagebrush, or mountain mahogany at elevations of 7,200 to 8,760 feet amsl (CPC 2004). This species is known from 11 extant populations that occur in Albany, Carbon, Converse, and Natrona counties (Fertig 2000i). All of the known populations in Converse County occur in the southern portion of the county

and south of the southern extent of the PRB study area. Based on the species distribution, it is not expected to occur within the PRB study area.

Barr's Milkvetch. The Barrs' milkvetch (*Astragalus barrii*) is a USFS sensitive species. Its global distribution includes northeastern Wyoming and adjacent southeastern Montana, southwestern South Dakota, and northwestern Nebraska. In Wyoming, this species is known in Campbell, Johnson, Natron, Niobrara, Sheridan, and Weston counties. The Barr's milkvetch occurs primarily on buttes, hilltops, badlands, and gullied knolls and draws at elevations between 2,940 and 4,000 feet amsl. Suitable soil characteristics consist of shallow rocky soils derived from limestone, calcareous sandstone, shale, or siltstone. This species is indicative of a cushion plant community comprised of a more densely vegetated mixed grass prairie (CPC 2000). It is known from 27 extant populations throughout the PRB. Twelve of the populations are within the PRB study area including one in Sheridan County, seven in Johnson County, and four in Campbell County. Based on its distribution, the Barr's milkvetch may occur in suitable habitats within the PRB study area (University of Wyoming 1998).

2.3.4 Comparison to Previous Predictions

Vegetation within the study area has 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 minimizing the overall acreage of remaining vegetation disturbance and the time for vegetation to reestablish.

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 vegetation in 1994 were 73,321 and 21,964, respectively. In comparison, the existing disturbance acreage affecting vegetation at the end of 2003 (based on GIS analysis) was 121,890 (ENSR 2005b). Based on the Task 2 database, as of the end of 2003, a total of approximately 127,495 acres of previously disturbed vegetation had been reclaimed (ENSR 2005a).

The majority of the disturbance in the basin primarily has occurred in sagebrush-dominated vegetation types. Subsequent reclamation, where completed in these disturbance areas, likely has resulted in the reestablishment of immature sagebrush-dominated and grass- and forb-dominated communities.